



Child and Youth Health and Well-Being Indicators Project:
Appendix J—



Office of the
Provincial Health Officer



Canadian Institute
for Health Information
Institut canadien
d'information sur la santé



Indicators of Cognitive Development

Öçia^} &^ÄÜ^çã,

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By

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Assessing Concepts and Potential Indicators of Child Health and Well-Being In British Columbia: *Cognitive Development*

Introduction

Background on the Report

The Office of the Provincial Health Officer of British Columbia is considering the design of a suite of core or representative indicators that will inform future “report cards” on the health and well-being of children in British Columbia. The goal of the initiative is to identify a limited number of indicators that are both significant to the health and well-being of children and youth and amenable to modification through policy, program, or service interventions.

A total of 264 indicators associated with child health and well-being were identified by an initial working group, partly based on sources identified during background research for this project. This list has been informed by the extensive Canadian work over the last decade on:

- Population-level health indicators (e.g., the *Health Indicators Project* sponsored by Statistics Canada and the Canadian Institute for Health Information)
- Certain indicator inventories with a specific connection to child health (e.g., the *Perinatal Health Indictors* managed by the Public Health Agency of Canada)
- The well-established research area related to the social determinants of health, especially as they pertain to child health and well-being

The first important analytic step in the project was to create a smaller working list of concepts through an initial relevance filter (the report summarizing this process is reproduced in Annex E-1 of the separate document entitled *Evidence Review Protocol for Assessing Concepts and Indicators*). A major aspect of the further analysis conducted for this project consisted of a refinement of the initial relevance filter; this involved examining in more detail the following four aspects as they apply to each broad concept and/or a specific indicator related to the concept.

- **Magnitude** Proportion of B.C. child/youth population to which the concept/indicator applies (considered in terms of an absolute number)
- **Significance/Impact** The extent of evidence for an association between the concept and health/well-being, with an emphasis on the particular dimension of health and well-being that is under scrutiny at the time

- **Modifiability** Is the concept/indicator(s) amenable to change through public policy or other intervention?
- **Data Availability/Quality** Routine availability and quality of data for the pertinent indicator(s) for each concept

The part of this project represented by the present report involves understanding the association between 17 selected Cognitive Development concepts and the health and well-being of children. In other words, the series of literature reviews conducted were aimed at finding how **important** and **feasible** a particular concept (e.g., verbal skills, high school completion, or youth math proficiency) might be in terms of tracking pediatric health and well-being at a population level. The task of evaluating how **important** a concept might be equates to the first two assessment categories of magnitude and significance/impact; on the other hand, the agenda of determining how **feasible** a concept might be is consistent with the other two assessment categories, namely, modifiability and data availability/validity.

The use of the term “important” here may be problematic: it is meant to convey an assessment of the concept/indicator within the limits of this project and the currently available evidence. An assessment of **Low** on *Significance/Impact*, for example, does not mean that the indicator is unimportant; only that the currently available research evidence indicating a causal linkage between the indicator and child health and well-being is either very weak or has not yet been developed. A distinction must be made between “evidence of limited significance/impact” and “limited evidence of significance/impact”, even though in the present report *both* of these situations would generate a Low rating in terms of *Significance/Impact*. More often than not, however, the Low rating is associated with limited evidence, suggesting areas that could use additional high-quality research which could lead to a higher rating for *Significance/Impact*.

The Meaning of Health and Well-being

It is especially important to be clear about the intention of the significance/impact assessment. While the concepts under the dimension of cognitive development will regularly map onto outcomes related to cognition, the understanding of health and well-being in childhood and later years is much broader. In developing the initial framework for this project, Mitic and Leadbeater¹ highlighted the following comprehensive definition of health offered by the Ottawa Charter 25 years ago:

...the extent to which an individual or group is able to develop aspirations and satisfy needs and to change or cope with the environment. Health is a resource for everyday life, not the objective of living. It is a positive concept emphasizing social and personal resources, as well as physical capacities.

This means that for each of the 17 concepts being reviewed, the potential relationship between the concept and social and personal resources, in addition to the concept’s relationship to physical health, will be considered. These broad outcomes related to health and well-being will be reflected in the literature search terms employed.

¹ Mitic W, Leadbeater B. *The Foundations of Child Health and Well-being in British Columbia*. 2009. Available at http://www.cyhrnet.ca/documents/the_foundations.pdf. Accessed October 2011.

Organization of the Concepts and Chapters

After the initial relevance filter was applied, 18 concepts related to the dimension of Cognitive Development of children and youth were highlighted for further investigation by the assigned review team. The stakeholders and working group initially clustered the concepts into the following four sub-dimensions or themes:

- Readiness to Learn Theme
- Learning Performance Theme
- School System Theme
- General Cognitive Development Theme

The General Cognitive Development Theme included just one concept (reading as a leisure activity) while the School System Theme included two concepts (school attendance and education expenditures). Education expenditures have since been removed from the list by the Child Health Indicators project team.

After the analysis described in this report, it seemed appropriate to refine this clustering into the following two groupings:

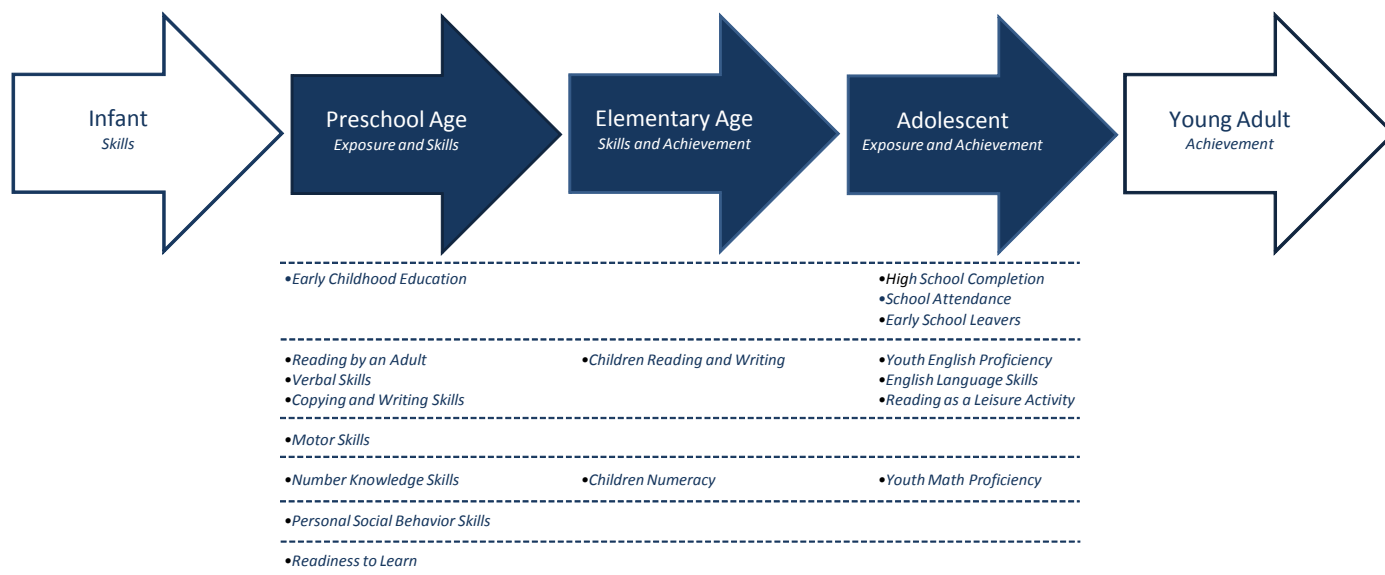
- Concepts Related to Readiness to Learn
- Concepts Related to Learning and Other Outcomes

Reading as a leisure activity and school attendance have been included within the second grouping.

Each concept chapter begins with a brief section on **background and context**, followed by (as appropriate) the **literature search methodology** and **summary and discussion of results**. Potential **data sources** for each indicator, the quality and regularity of the data stream, and the most up-to-date population magnitude related to the indicator are all noted. Finally, a **conclusion is offered as to the utility of the concept or its component indicators** in terms of a measure of child and youth health and well-being and a marker of progress in order to track secular trends or evaluate any future public health interventions. Whether or not a concept and at least one associated indicator is recommended for consideration as part of the initial list of core or representative indicators is clearly stated. In some cases, the concept/indicator received a relatively high rating in the areas of magnitude, significance/impact and modifiability but no source for routinely tracking the indicator was available or the data source was of poor quality. These concepts/indicators were grouped under the heading of **Indicator to Potentially Develop**.

Linkages between Cognitive Development Concepts

There is an aspect to the Cognitive Development dimension that is not as evident in the other dimensions being reviewed for this project. This refers to the direct linkages between concepts across different stages of a child's development. For example, **number knowledge skills** during preschool influence **children numeracy** in Elementary school which in turn influences **youth math proficiency** in high school. The following diagram maps out the 17 Cognitive Development concepts so that these linkages are more transparent.



Two inter-connected issues are associated with these linkages between concepts.

1. What sort of evidence exists of an earlier part of an academic trajectory being associated with a later stage? For example, planners are interested in knowing whether exposure to preschool affects high school attendance, early departure, and/or completion. This topic is part of the ongoing discussion among social scientists about the so-called “education effect.”
2. When is it appropriate to propose that an association along a trajectory is actually causal, so that there is confidence that related policies will lead to the desired change in well-being in the pediatric population? This introduces the complex topic of establishing causation in the social sciences realm.

Each of these issues will be briefly explored below.

Effects of Education

It is critical to understand the definition, evidence stream, and importance of formal education, as the academic realm clearly dominates the dimension of Cognitive Development. Typically, planners looking at comprehensive health and well-being effects want to see how a particular cognitive concept (e.g., verbal skills) produces outcomes *beyond* that concept, and even beyond the cognitive dimension as a whole. The term “education effect” is sometimes applied to the body of evidence suggesting that schooling increases health and well-being. This research reinforces the importance of education as a means to improve factors related to the social determinants of health. Education in this context usually refers to educational *attainment* or *status* (i.e., quantity of years in school) rather than quality of schooling, evidence of learning, achievement scores, etc.

It is important to note that the impact of educational attainment of *parents* on child well-being is part of the discussion on socioeconomic status as a determinant of health in families, found in the report on the *Economic and Material Well-Being* dimension.

When discussing the linkage between health and well-being and education in the *developed world*, it is usually the level of post-secondary education that is being considered. This explains why the influential U.S. study on education effects by Cutler and Lleras-Muney from 2006 somewhat downplayed the high school completion factor and instead concluded that “there may be substantial health returns to education policies that promote college attendance.”²

The causal chain between cognitive development in the early years of a child’s life and subsequent health and well-being is a long one. It follows a trajectory starting with the parent’s educational attainment through to a child’s early childhood education (ECE) exposure to elevated graduation rates to increased college attendance to higher income to better health and well-being. The relationships between adjacent links in this chain are easier to assess in terms of causality. The overall chain from earliest schooling through to later health and well-being, however, is much more difficult to assess and employ in an argument for causality. The challenge of proving causation in this way will be touched upon in the next subsection.

Causation in the Social Sciences

In his philosophical discussion of causation in the social sciences, Reiss notes that there is a “wealth of alternative methods used to establish causal claims throughout the social sciences” and that “the social scientist’s different purposes require different types of causal knowledge.”³ An *interventionist* (as coined by Reiss) approach to causation appears to be critical in the current project. In the interventionist approach, causal relationships are assessed based on the ability of manipulations to X to result in changes to Y. If X is varied in some way, it follows that Y will also be varied in some way. But Reiss also notes that causal relationships in the social world are “fragile” and easily broken. In addition, causation in temporal events is increasingly difficult to determine the farther apart the events are in time.

Identifying when an association or correlation involves some sort of causal mechanism is as important in the social sciences as it is, for example, in the biomedical realm. Without some indication that a linkage is causal, there can be little confidence that applying an intervention to influence a presumed predictor of well-being will actually have the predicted effect on well-being.

In the biomedical literature, randomized controlled trials (RCTs) are considered the gold standard for assessing causality. In the report on the Physical Health dimension, it was common to depend on RCTs, whether as individual studies or summarized in review papers. For ethical and logistical reasons, randomized studies are less common in the social sciences. One exception is the randomization that has sometimes been applied in studies of model ECE programs.⁴

Instead of RCTs, longitudinal studies are a well-established alternate approach in the social sciences. Longitudinal studies collect data about the same group of subjects at multiple time

² Cutler DM, Lleras-Muney A. *Education and Health: Evaluating Theories and Evidence*. 2006. Available at <http://www.nber.org/papers/w12352>. Accessed October 2011.

³ Reiss J. Causation in the social sciences: Evidence, inference, and purpose. *Philosophy of the Social Sciences*. 2009; 39: 20-40.

⁴ Barnett WS. Long-term effects of early childhood programs on cognitive and school outcomes. *The Future of Children*. 1995; 5(3): 25-50.

points. Typically, they have a prospective design, although they can be retrospective, using a “life history” approach where data are collected on a single occasion about multiple points in the past. Prospective designs, following a cohort into the future, are considered more reliable because they reduce recall bias.

Since they (by definition) take the long view, longitudinal studies are popular as a potential window on human development, including child cognitive development. Indeed, just as RCTs function in the biomedical world, prospective longitudinal studies are considered to be the gold standard in observational epidemiology. Such research “provides an understanding of social change, of the trajectories of individual life histories and of the dynamic processes that underlie social and economic life, not possible from research based on cross-sectional data.”⁵

Longitudinal studies can provide clues about causation because of their ability to detect temporal ordering; in other words, if X always happens before Y, then it increases the odds that X actually *causes* Y. A Canadian review of longitudinal research noted that “we need longitudinal data for establishing temporal order, measuring change and making stronger causal interpretations.”⁶

Three main types of longitudinal studies relevant to the present project are:

1. Birth cohort studies, where a cohort of mothers and infants are enrolled at pregnancy / birth, and followed for at least one year (although usually much longer)
2. Studies of early childhood or later school years, where the cohort is constructed some time after birth; such research can have a broad or narrow focus
3. Intervention studies, where a cohort are followed before and after an intervention (e.g. enrolment in an ECE program), ideally including a control group not receiving the intervention

There have been a substantial number of projects in each category, with new ones still being launched.⁷ An inventory of birth cohort studies predominantly based in Europe currently contains over 80 records, with some cohorts numbering over 100,000 mother-child pairs. A similar database managed by the Maternal, Infant, Child & Youth Research Network is tracking around 50 birth cohort studies in Canada alone; these comprise about 40,000 pregnancies and are committed to prospective, longitudinal tracking in order to detect associations between exposures and health and well-being.⁸

As for the second category of longitudinal studies, there are cohorts of preschool-aged and older children being followed in most industrialized countries and their regions.⁹ In the

⁵ See www.ccsr.ac.uk/methods/festival/programme/rta/buck.ppt. Accessed November 2011.

⁶ Rajulton F. The fundamentals of longitudinal research: An overview. *Canadian Studies in Population*. 2001; 28(2): 169-85.

⁷ For example, Vandenhorst S, Bois C, Pirus C et al. Rationales, design and recruitment for the Elfe longitudinal study. *BMC Pediatrics*. 2009; 9: 58.; Siden H, Steele R, Brant R et al. Designing and implementing a longitudinal study of children with neurological, genetic or metabolic conditions: charting the territory. *BMC Pediatrics*. 2010; 10: 67.

⁸ See <http://www.micryn.ca/cores/research-partnership-core.html>. Accessed November 2011.

⁹ See *Inventory on International Surveys of Children and Youth* at <http://dsp-psd.pwgsc.gc.ca/Collection/MP32-28-02-12E.pdf>. Also see *Longitudinal Studies for Education Reports: European and North American Examples*. Available at http://www.bmbf.de/pub/bildungsreform_band_10_eng.pdf. Both accessed November 2011. It should be noted that neither of these inventories are exhaustive.

Canadian context, this includes parts of the National Longitudinal Survey of Children and Youth, which is introduced more fully in the next section of the report.

Studies with long-term results are of key importance in terms of assessing the potential causal relationships between any of the 17 concepts reviewed for this report and subsequent changes in health and well-being. This means that, at times, results from cohorts established well before this project's literature search time limit of the year 2000 will be reflected in the evidence located.

Concept/Indicator Assessment Scale

Each of the 17 concepts will be assessed for magnitude, significance/impact, modifiability and data availability/quality using the rubric of “high”, “medium” or “low” utility, as defined in the following grid:

Key to Summary Assessments - Cognitive Development				
by Evaluation Category				
	Magnitude <i>Estimated prevalence of affected B.C. children</i>	Significance / Impact <i>Health and well-being effects</i>	Modifiability <i>Expert assessment of prevention potential</i>	Data Availability/Quality <i>B.C.-specific information sources</i>
Low	< 19,000 (<2% of total pediatric cohort)	Minimal effects and/or little indication of direct causation	Underlying risk factor not well-identified or not amenable to prevention	Data not routinely collected and reported
Medium	19,000 - 97,000 (2-10% of total pediatric cohort)	Medium Substantial acute effects or moderate chronic effects; moderate/mixed evidence of association	Medium Underlying risk factor theoretically amenable to prevention, but potential interventions not yet proposed in the literature	Medium Data routinely collected but not easily accessible and/or of potentially questionable validity (e.g., mostly self-reported topics with stigma attached)
		Medium-High Substantial acute effects or moderate chronic effects; stronger evidence, but with causation still not well-established	Medium-High Underlying risk factor amenable to prevention, but proposed interventions have not been well-tested and/or have shown mixed evidence of effectiveness	Medium-High Data routinely collected via sources based on self-reported information of high validity (e.g., the Census)
High	>97,000 (>10% of total pediatric cohort)	Substantial chronic effects and /or elevated mortality; strong evidence, with direct causation well-established	Underlying risk factor amenable to prevention, and identified interventions have been shown to be effective	Annual data routinely collected and reported via administrative sources or (objective) physical measurement methods

A number of comments are warranted concerning the rating scale for the various assessment categories.

First, with respect to significance/impact, several considerations entered into deciding on a high, medium-high, medium, or low rating. Generally, a higher rating was dictated by:

- i. Larger effect sizes for outcomes of greater import, that is, marked by substantial and persistent impacts on manifest aspects of health and well-being
- ii. Confidence about causation (because, for instance, potentially confounding factors have been well controlled)
- iii. Strength of evidence at the level of a general pediatric population

On the latter point, the evidence of impact becomes progressively weaker when it focuses on a subgroup (such as an at-risk cohort or children with a specific comorbidity) rather than the whole pediatric population. This caveat does not mean that intervention studies targeting at-risk groups are of limited importance, just that they are less valuable as population-level evidence than effects that are measured within a more general pediatric population.

As noted above, another important clarification relates to the interpretation of the occasional Low rating for significance/impact in this report. It does not mean that the concept/indicator has no impact on well-being, but simply that the scientific evidence of a direct, causal association of that sort has not yet been developed.

Further, it is clear from the table above that extra granularity was also required in the intermediate ratings for both modifiability and data availability/validity. To reiterate, modifiability of a concept/indicator is being assessed mainly by reviewer expertise rather than by a full examination of the literature. As indicated in the rating descriptions, the categories allow for distinguishing a reasonable expectation for modifying a concept (given adequate resources) from the situation where there is low potential for *further* prevention progress simply *because most or all of the clear and effective approaches have already been applied to a substantial degree*. The latter situation was rated as Low modifiability, because of the limited prevention potential in the remaining at-risk subpopulation.

The refined assessments for the data category were required due to the inherent unreliability of self-reported information; this is the class into which all survey data fall. However, all self-reported information is not created equal; in short, there is a difference between the issue of poor recall and outright dissembling. When the factor in question may be considered a high-stigma topic, such as sexual behaviour or alcohol abuse (e.g. binge drinking), then there is a certain rate of “reticence” across a population to report accurately. Similarly, there will be a certain level of inaccuracy when parents or other “second-party” respondents (such as teachers) are asked to report on behalf of the children in their care.

For the sake of this project, data streams based on self-report are generally assessed as having intermediate utility when informing an indicator. The more favourable intermediate category, Medium-High, is reserved for self-reported or second-party reported data related to topics of low or no stigma for the individual providing the information. Making such distinctions can involve a subjective judgment. For instance, it seems unlikely that parents reporting the level of home literacy would go out of their way to exaggerate the amount they read to their young children. In the case of the Early Development Instrument (EDI), a teacher-completed reporting tool that is prominent in this part of the project (see below), it is also unlikely that stigma issues will come into play, though other forms of bias may enter into the equation. This sort of consideration is part of the reliability testing that tools such as the EDI must undergo.

As well as the three main rating levels, sometimes the available information did not allow any clear conclusion; for the purposes of notionally combining the four evaluation categories into an aggregate rating, the weight given to an “Unclear” assessment was equated to that applied to a “Low” rating.

While magnitude is also summarized in terms of the same basic rating scale used for the other three categories, it is the one assessment category where a *quantitative* approach was pursued. The following steps were followed (see Annex J-1 for a summary of the calculations across all the concepts):

1. The best incidence or prevalence information (preferably B.C.-specific) was identified for the most pertinent indicator(s) under each concept
2. In the case of prevalence data, the absolute number of cases was simply calculated by applying that rate to the pertinent 2010 age cohort (see following table).

BC Population by Gender and Age, July 2010			
Age	Male	Female	Total
<1	22,994	21,522	44,516
1	23,403	21,845	45,248
2	23,476	22,010	45,486
3	22,920	21,548	44,468
4	22,788	21,153	43,941
5	22,578	21,093	43,671
6	22,819	21,265	44,084
7	22,931	21,246	44,177
8	22,921	21,184	44,105
9	23,239	21,673	44,912
10	23,687	22,298	45,985
11	24,204	22,915	47,119
12	24,498	23,123	47,621
13	25,677	23,887	49,564
14	26,510	25,022	51,532
15	27,484	25,613	53,097
16	27,888	26,447	54,335
17	28,878	27,472	56,350
18	30,094	28,160	58,254
19	32,214	29,749	61,963
Total	501,203	469,225	970,428
Source: Statistics Canada			

3. The age cohort was ascertained according to when the indicator measurement data were collected. For instance, for the indicators based on the Early Development Instrument, which is applied in kindergarten, the pertinent age cohort started with age 5 and extended to age 19. The argument for tracking the vulnerable group to age 19 is based on the assumption that the effects of any deficit (e.g., weak verbal skills, lower exposure to reading, missing school) would persist to a greater or lesser extent throughout the balance of the pediatric period.

The resulting magnitude figures (and pertinent age range of the cohort generating the underlying prevalence rate) are provided in the summary table in Annex J-1, as well as at the end of each section for the various concepts related to the Cognitive Development dimension.

Five general observations about the assessment process would be useful at this juncture:

- The assessments provided always relate to a *particular* indicator pertinent to a concept. Often, an indicator was selected because magnitude data were in fact available for that indicator, the population totals involved were substantial, and/or it was a high-leverage focus for prevention that was amenable to routine data tracking. In other words, taking the considerations all together, the indicator was positioned to be rated reasonably high in terms of utility.
- It was not realistic to make age-standardization adjustments when the underlying prevalence rates were based on a specific age cohort, or to qualify the analysis when the absolute number of cases identified was for a cohort other than the entire 0-19 year age group; these limitations are likely not very critical, since the goal was in fact to make broad quantitative assessments.

- Indeed, the prevalence estimates are, by definition, not meant to be precise figures but rather a representation of “order of magnitude” information in order to allow comparisons at a high level only.
- The concepts are ordered in Annex J-1 based on the prevalence estimate, in order to highlight the effect of that assessment category; again, this has been done for ease of comparison across this one category, not because it is the most important category. By contrast, the summary table provided in the Summary and Conclusion section at the end of the entire report is ordered according to a sense of aggregate rating across all four assessment categories.
- A final assessment category that could provide useful information would be the recent trend related to each indicator of interest, but assembling this information was beyond the scope of the project.

Key Evidence Sources

Similar to the reports prepared on other dimensions, it is useful to point out the main sources for identifying evidence papers and reports on the Cognitive Development dimension.

Not surprisingly, evidence related to the dimension of Physical Health largely depended on PubMed, the premiere database of biomedical literature. In order to accommodate the complexity of various cognitive, learning, and school achievement concepts and their effects outside of the realm of physical health, it was determined that additional databases should be searched for applicable reviews and/or studies. A preliminary examination of available databases found that, while targeted searches in PubMed would still sometimes be a supplementary strategy for this report, the basic search could be easily and effectively broadened by also including the databases of EBSCO¹⁰ Host.

The entire EBSCO Host collection includes 50 databases, ranging from general academic literature to more topic-specific sources. It clearly represents a powerful and efficient tool to move beyond typical biomedical sources. Through the integrated utility of EBSCO Host, the databases may be searched individually or in any combination. Because EBSCO includes the Medline database, the main biomedical literature would therefore automatically be included in the search. The following four databases— all of which proved useful in the context of the present report— illustrate what is available through EBSCO.

Academic Search Complete

Academic Search Complete is the largest scholarly, multi-disciplinary full-text database in the world. It includes a total of more than 12,600 journals, of which over 11,900 are peer-reviewed journals. Articles from more than 6,800 journals are available in full-text, an important feature given the detailed analysis of any paper identified for the child health and well-being indicator project.

CINAHL

The Cumulative Index to Nursing and Allied Health Literature, or CINAHL, provides full text services for over 600 journals in the fields of nursing and allied health, making it the most comprehensive collection of nursing literature.

¹⁰ A subscription agency founded in 1944 by Elton Bryson Stephens (hence the EBSCO acronym **E**lton **B**Stephens **C**Ompany).

Education Research Complete

Education Research Complete is an authoritative online resource for education research. Topics covered include all levels of education from early childhood to higher education, and all educational specialties, such as multilingual education, health education, and testing. The database also covers areas of curriculum instruction, as well as administration, policy, funding, and related social issues. It provides indexing and abstracts for more than 2,300 journals, as well as full text services for over 1,400 journals.

PsycINFO

Managed by the American Psychological Association, PsycINFO is the largest resource for peer-reviewed literature in behavioural science and mental health. The database includes articles from 2,400 periodicals from around the world.

Key Data Sources

In order to avoid repetition, it is appropriate to introduce two of the dominant B.C. sources of data for potential core indicators examined in this report. There is one source used multiple times for each of two sub-dimensions or themes in this part of the project: the Early Development Instrument (related to Readiness to Learn) and Foundation Skills Assessment (related to Learning Outcomes). In addition, it is useful to describe a national data source, the National Longitudinal Survey of Children and Youth, which has been applied in recent years to populate provincial-level indicators of child health and well-being in Canada.

Early Development Instrument

The Early Development Instrument (EDI) is a tool originally designed in Canada to evaluate school readiness, a theme related to the Cognitive Development dimension that will be introduced more fully in the next major section of the report. While categorized for the sake of this project under the cognitive area, modern views of school readiness extend beyond the cognitive or intellectual to embrace domains such as the physical and the psychosocial; as such, this subdimension will likely demonstrate overlaps with other aspects of this project, including Physical Health and Mental/Emotional Health.

The EDI strongly reflects this contemporary trend towards *comprehensive* child assessment, accounting for its usefulness in a number of areas of the present report. In fact, the EDI questionnaire comprises five subscales, as follows:

- Emotional maturity
- Social competence
- Physical health and well-being
- Communication skills and general knowledge
- Language and cognitive development

As will be seen below, each of the five subscales, with the possible exception of Social Competence, map quite closely to one or more concepts examined in the first part of the report.

In its current format, the EDI is a 120-item questionnaire filled out by kindergarten teachers on all the children in their class. Information collected using the EDI is analyzed at a group

level (e.g., for a school, neighbourhood, school district, or local health area), and “is not used as a diagnostic tool for individual children.”¹¹ The items for the EDI were derived from existing early childhood assessment instruments, key informant interviews, and focus groups. Over 60% of the initial base of questions was modified from the National Longitudinal Study of Children and Youth (NLSCY).¹² The NLSCY is a federally-funded study of a representative sample of Canadian children that was launched in 1994, which has generated its own report on school readiness in Canada.¹³

Since its development at McMaster University in the 1990s, the EDI has undergone limited evaluation in terms of its stability and reliability. In the Canadian setting, the available studies have offered good support for the instrument. For instance, one analysis reported in a poster presentation in 2004—based on data from Saskatchewan (N=72 students) and Ontario (N=151)—generated a number of pertinent conclusions, as follows:¹⁴

- The results from the study showed that the EDI test-retest reliability was strong, with correlations varying from 0.76 for the Emotional Maturity domain to 0.96 for the Communication and General knowledge domain, results which are reasonably consistent with earlier findings in a different Ontario sample.
- Intra-teacher reliability was also high, varying from a mean of 0.70 to 0.95; overall, it indicates that there is little variation among teachers using the instrument.
- Generally, the reliability of the EDI has remained stable over time and for different samples with differing characteristics.

The one deviation in terms of reliability is the inter-rater reliability. The match between school teacher and day care attendant ratings using the EDI has been shown to be reasonable (0.53 to 0.80, depending on the subscale), but the consistency between teacher and parent ratings is at best moderate (0.36 to 0.64). The match with parental assessments is especially weak for three subscales: Emotional Maturity, Physical Health and Well-being, and Communication Skills and General Knowledge. However, the authors and promoters of the EDI suggest that “it is a commonly accepted discrepancy that agreement between parents and teachers [on such assessments] is in the moderate range.”¹⁵

In addition to its Canadian origins and a track record of being utilized in multiple provinces (and several other countries),¹⁶ the EDI has commended itself in the context of the present project because of a number of factors. First, under the auspices of the Human Early Learning Project (HELP), the EDI is being implemented in every school district in B.C., with the

¹¹ Goelman H, Hertzman C. What the EDI is (not) – and Why it is Important for British Columbia. Available at [http://wwwFOUNDERS.net/fn/papers.nsf/79bd30dc8fee05dc85256638007535f0/f5a745e5f1cadd848525721000485e4d5/\\$FILE/What_the_EDI_is_%28not%29.pdf](http://wwwFOUNDERS.net/fn/papers.nsf/79bd30dc8fee05dc85256638007535f0/f5a745e5f1cadd848525721000485e4d5/$FILE/What_the_EDI_is_%28not%29.pdf). Accessed September 2011.

¹² Janus M, Offord D Development and psychometric properties of the Early Development Instrument (EDI): A measure of children’s school readiness. *Canadian Journal of Behavioural Science*. 2007; 39: 1-22.

¹³ Background available at <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=4450&lang=en&db=imdb&adm=8&dis=2>. Accessed September 2011.

¹⁴ Duku E, Janus M. A population-based measure for communities (EDI). Poster presentation. 2004. Available at http://www.offordcentre.com/readiness/files/PUB.2.2004_Duku-Janus.pdf. Accessed September 2011.

¹⁵ Janus M, Brinkman S, Duku E et al. *The Early Development Instrument: A Population-based Measure for Communities. A Handbook on Development, Properties, and Use*. 2007. Available at http://www.offordcentre.com/readiness/pubs/2007_12_FINAL.EDI.HANDBOOK.pdf. Accessed September 2011.

¹⁶ See inventory at http://www.offordcentre.com/readiness/EDI_sites.html. Accessed September 2011.

results incorporated into an Atlas of Child Development. Coloured maps produced by HELP on an annual basis depict information about EDI data; this information has been correlated with a number of potential pediatric environmental factors, including median family income, ethnic diversity, and available child care spaces. Second, as recommended by the originators of the EDI, HELP has begun to pursue validation studies of the EDI subscales that are specific to the B.C. context. Any predictive validation studies will be reported in the pertinent chapters to follow, as they in fact are integral to the literature search for evidence of the significance of certain concepts/indicators.

Foundation Skills Assessment

The Foundation Skills Assessment (FSA) is an annual province-wide assessment of British Columbia students' academic skills launched in 2000. It is intended to provide "a snapshot of how well BC students are learning foundation skills."¹⁷

The FSA is administered annually to Grade 4 and 7 students in public and provincially funded independent schools. Grade 10 was originally included, but this stream of the assessment was discontinued after the 2002/03 school year; secondary school achievement at a population level can now only be tracked through the required end-of-term exams.

The FSA focuses on three domains:

- Reading comprehension
- Writing
- Numeracy

Two of the assigned concepts under the Learning Outcome theme are explicitly related to these domains, namely, Children Reading/Writing and Children Numeracy. Each of these may in fact be considered to comprise two sub-concepts from the perspective of the FSA, as assessment results are available for students from two grade levels.

The main purpose of the assessment is to help the province, school districts, schools, and school planning councils evaluate how well students are achieving basic skills, and make plans to improve student achievement. The skills assessed are linked to the provincial curriculum and provincial performance standards.

It is fair to say that the FSA has been controversial in certain quarters, mostly due to its applications as a public information and policy-building tool.¹⁸ On the technical side, published academic studies of the reliability (or validity) of this instrument are not very extensive. Its predominance as a comprehensive source of data on school achievement for the purposes of informing child indicators in B.C. is predicated on the assumption of its continued utilization in the province.

National Longitudinal Survey of Children and Youth

The National Longitudinal Survey of Children and Youth (NLSCY) represents a long-term study that has been conducted every 2 years by Statistics Canada. The primary objective of

¹⁷ B.C. Ministry of Education webpage. Available at <http://www.bced.gov.bc.ca/assessment/fsa/>. Accessed September 2011.

¹⁸ For example, see <http://bctf.ca/fsa.aspx>. Accessed September 2011.

the NLSCY is to “monitor the development and well-being of Canada’s children from infancy to adulthood.”¹⁹

The study began collecting information in 1994/5 (Cycle 1) on an initial 23,000 children and families in households that were currently or had recently been in the Labour Force Survey, with children aged 0 – 11 years, excluding Aboriginal children living on Reserves and children in institutions.²⁰

In addition to following the original longitudinal panel of children, aged 14 to 25 years in 2008/9 (Cycle 8), the survey has continued to add and follow a new sample at each cycle in order to allow ongoing monitoring of early childhood development. Of course, without this strategy only the original cohort would be accessible, and the youngest child available for interviewing would be 14. In Cycle 8, this added sample was comprised of children aged 0 to 7 years. In total, 2,272 children age 0-19 years were surveyed in B.C. in 2008/9.

Much of the information in the NLSCY is collected from parents on behalf of their children by means of a household interview; children aged 14 to 17 complete a separate written questionnaire in the home. The NLSCY also includes direct measures of achievement, including:

- Tests of receptive vocabulary, early writing, and early number skills (ages 4-5 years)
- A short mathematics/computation assessment (grades 2-10)
- A problem solving exercise (ages 16-17 years)
- A literacy assessment (ages 18-19 years)
- A numeracy assessment (ages 20-21 years)

Cross-sectional data from Cycles 1 to 3 are available on a public use microdata file (PUMF); no PUMF was created for Cycles 4, 5, 6, 7 and 8, but tabulations can be requested from Statistics Canada.

While having the advantages of a longitudinal design and being a national instrument allowing for interprovincial comparisons, the NLSCY suffers against data sources such as the EDI and FSA since the latter are based on annual administrative information rather than biennial survey responses. The sampling size, while generally adequate for national or provincial aggregate reports, does not allow analysis for specific age groups of children or for regions within a province. Nonetheless, for over a decade B.C. and other provinces have been using NLSCY data as the major input to a biennial report on indicators of early childhood health and well-being. It should be acknowledged that, reflecting the limitations suggested above, the information for B.C. related to a particular indicator sometimes is suppressed due to “unacceptable” data quality.

The present project will depend on the NLSCY, specifically for magnitude calculations for certain concepts. However, continuing to base any related indicator on the NLSCY is problematic since the stated plan of the survey program was to follow the original cohort of

¹⁹ *National Longitudinal Survey of Children and Youth - Survey Overview for the 2008/2009 Data Collection, Cycle 8*. Available at http://www.statcan.gc.ca/imdb-bmdi/document/4450_D2_T9_V4-eng.pdf. Accessed September 2011.

²⁰ *Indicators of Early Childhood Health & Well-Being in British Columbia*. Fourth Report, Winter 2008. Available at http://www.mcf.gov.bc.ca/early_childhood/pdf/early_indicators_fourth_report.pdf. Accessed September 2011.

children until “they reach the age of 25.”²¹ This milestone was in fact reached for the leading edge of the group in 2008, and therefore it appears that the NLSCY project has not been renewed; as such, it cannot be proposed as a an ongoing source for indicator tracking.

²¹ Michaud S. The National Longitudinal Survey of Children and Youth – Overview and Changes After Three Cycles. *Special Issue on Longitudinal Methodology, Canadian Studies in Population*. 2001; 28(2): 391-405.

Concepts Related to Readiness to Learn

The emergence of the concept Readiness to Learn as it is applied (generally) in kindergarten is understandable given the value that is placed on learning in modern society, and the general sense that the first 5 years of life are “critical to a child’s lifelong development.”²² It should be noted from the start that the concept is really shorthand for “readiness to *formally* learn,” which accounts for the dominant synonym for the concept, namely, school readiness. One of the leading research groups in this field, the Offord Centre for Child Studies based at McMaster University, puts the two ideas together as “school readiness to learn.” That organization spells out the meaning of the concept as follows:²³

- The child's ability to meet the task demands at school
- The child's ability to benefit from the educational activities provided by the school

As described in the Introduction in the context of the EDI, assessments of school readiness are now trending towards including comprehensive categories that explicitly cover areas beyond the cognitive/learning realm. It is not automatic for the subscales that are included in the contemporary assessment instruments to be summed to create an aggregate score. More often than not, they are treated as separate lines of assessment, not too different from the older pattern of employing multiple tools (motor skills testing, vocabulary testing, etc.) for the same students in order to measure school readiness. Hence, it is appropriate to reflect this dominant usage by starting with classic concepts related to school readiness on an individual basis, before turning to a discussion of an aggregate or omnibus approach to scoring readiness. Finally, two of the dominant influences on school readiness will be examined: early childhood education and home-based child development (as specifically reflected in the concept Reading by an Adult).

Personal Social Behaviour Skills

Background and Context

Growing in the ability to interact positively with others and establish relationships is one of the major developmental tasks in early childhood. Every day, individuals at every age are faced with a wide range of challenging social situations; successfully navigating these challenges requires a sophisticated repertoire of social skills, including the capacity to solve various interpersonal problems.²⁴ Such skills include a range of verbal (e.g., tone of voice; volume, rate, and clarity of speech) and non-verbal (e.g., eye-contact, facial expression, posture, social distance) responses that influence the perception and reaction of other people during social interactions. The ability to use these skills appropriately in social situations is the basis for what is sometimes known as “social competence.” Often this theme is broadened to include the emotional underpinnings of positive and negative social interaction, or narrowed to specific problem expressions in social contexts, including aggression, shyness/withdrawal, and attention deficits. The latter problem will be considered here in general terms, not from the perspective of medically diagnosed attention deficit hyperactivity disorder (which is covered under the Mental/Emotional Health dimension of this project).

²² *Getting Ready: Findings from the National School Readiness Indicators Initiative*. Available at <http://www.gettingready.org/matriarch/d.asp?PageID=303&PageName2=pdfhold&p=&PageName=Getting+Ready+-+Full+Report.pdf>. Accessed September 2011.

²³ See <http://www.offordcentre.com/readiness/index.html>. Accessed September 2011.

²⁴ Spence SH. Social skills training with children and young people: Theory, evidence and practice. *Child and Adolescent Mental Health*. 2003; 8(2): 84-96.

Bierman and Welsh define social competence as “an organizational construct that reflects the child’s capacity to integrate behavioural, cognitive and affective skills to adapt flexibly to diverse social contexts and demands.”²⁵ Spence notes that this sort of broad definition “emphasises the multiple determinants of social competence, with the ability to engage in socially skilled behaviour representing just one factor.”²⁶ This means that the concept entails more than so-called “externalizing behaviours” such as aggression and “internalizing behaviours” such as anxiety and self-harm. Beyond behaviours per se, social competence encompasses behavioural, cognitive, emotional, and environmental determinants such as interpersonal problem solving skills, social perception and perspective taking, accurate processing of social information (also known as social cognition), and so forth.

For the present purpose, the preceding description of social competence will allow for a comprehensive understanding of personal social behaviour skills in relation to child health and well-being, and serve as a guide for the subsequent literature search. Curiously, however, it will ultimately be necessary to adopt an assessment subscale labelled as emotional maturity rather than one called social competence. This merely represents an artefact of the heterogeneous ways that different researches have packaged and identified collections of psychosocial factors.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Major Heading:* Social Behaviour *Age:* All Child (0-18)

Search Keywords

“Social Behavior*” AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 800 papers in total.

²⁵ Bierman KL, Welsh JA. Assessing social dysfunction: the contributions of laboratory and performance-based measures. *Journal of Clinical Child Psychology*. 2000; 29(4): 526-39.

²⁶ Spence SH. Social skills training with children and young people: Theory, evidence and practice. *Child and Adolescent Mental Health*. 2003; 8(2): 84-96.

Preliminary Exclusion

The 800 articles were scanned *by title* by two reviewers working independently, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between personal social behaviour skills and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 67.

Primary Exclusion

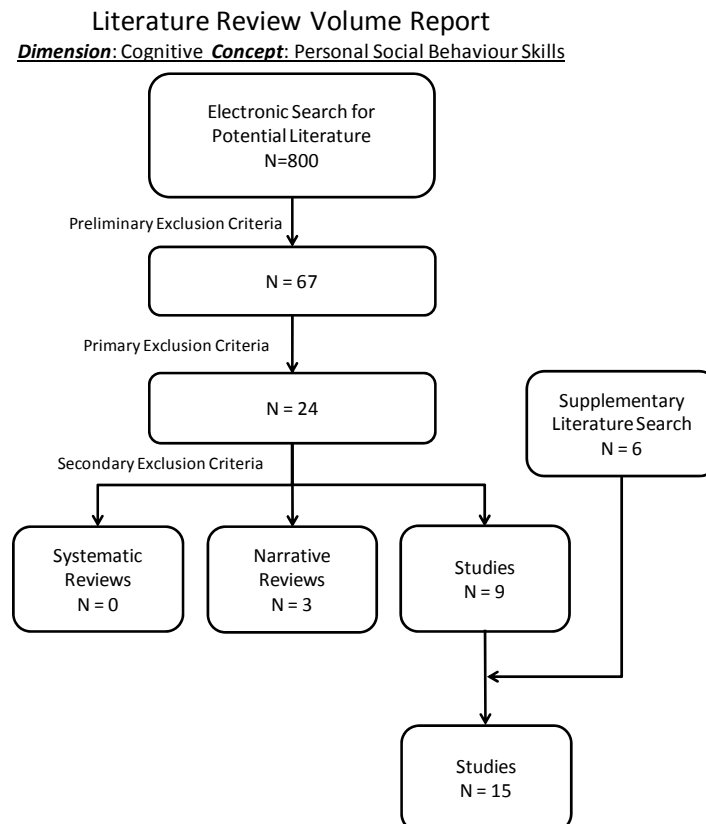
Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link “personal social behaviour” with health or well-being outcome(s) *in children*, it was excluded. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

There were 24 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

These 24 full-text articles were then reviewed in depth. Upon completion, it was determined that 9 were relevant to the current topic and therefore included in the analysis. Six additional studies were found through a supplementary search of the literature, using specific keywords, related article utilities, bibliography scans, etc.

The literature search process is detailed in the chart below, with the 15 final articles identified and summarized in the following tables.



Summary of Relevant Studies										
Dimension: <i>Cognitive Development</i>										
Concept: <i>Personal Social Behaviour Skills</i>										
Title of Study	Author(s)	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest	
				Factor	Type of Study					
<i>Physical Health Outcomes</i>										
1 Predicting adult physical health outcomes from childhood aggression, social withdrawal and likeability: A 30-year prospective, longitudinal study	Temcheff et al.	2011	International Journal of Behavioural Medicine	1.94	Prospective, Longitudinal	4,109	Elementary School Students	Montreal, Quebec, Canada	Not Stated	
2 Longitudinal associations between externalizing behavior and dysfunctional eating attitudes and behaviors: A community-based study	Marmorstein et al.	2007	Journal of Clinical Child and Adolescent Psychology	3.44	Longitudinal	799	Adolescent Girls	Minnesota, USA	Not Stated	
3 Adolescent psychosocial maturity and alcohol use: Quantitative and qualitative analysis of longitudinal data	Adalbjarnardottir	2002	Adolescence	2.43	Longitudinal	1,198	15 year-old students	Iceland	Not Stated	
<i>Academic Outcomes</i>										
4 Reexamining the relationship between academic achievement and social behaviour	Algozzine et al.	2011	Journal of Positive Behavior Interventions	1.94	Longitudinal	350	Students at high risk of academic failure	Southeast, USA	None	
5 School readiness and later achievement: Replication and extension using a nationwide Canadian survey	Romano et al.	2010	Developmental Psychology	3.41	Cross-sectional	1,688	Kindergarten students (follow-up at grade 3)	Canada	Not Stated	
6 School readiness and later achievement: A french Canadian replication and extension	Pagani et al.	2010	Developmental Psychology	3.41	Cross-sectional	2,800	Kindergarten students (follow-up at grade 2)	Canada (Quebec)	Not Stated	
7 Population level associations between preschool vulnerability and grade-four basic skills	D'angiulli et al.	2009	PLoS One	4.35	Cross-sectional	6,805	Kindergarten students (follow-up at grade 4)	British Columbia	None	
8 Disorganized attachment and social skills as indicators of Head Start children's school readiness skills	Stacks and Oshio	2009	Attachment & Human Development	1.43	Cross-sectional	75	36-72 month year-old children	Midwest, USA	Not Stated	
9 The impact of early behaviour disturbances on academic achievement in high school	Breslau et al.	2008	Pediatrics	4.04	Longitudinal	693	Ethnically diverse 6 year-olds	Detroit, USA	None	
10 School readiness and later achievement	Duncan et al.	2007	Development Psychology	3.41	Cross-sectional	45,000	Kindergarten students	USA, Canada, UK	Not Stated	
11 Contemporaneous and longitudinal associations between social behaviour and literacy achievement in a sample of low-income elementary school children	Miles et al.	2006	Child Development	3.77	Longitudinal	400	Low-income children aged 4-6	USA	Not Stated	
12 Prosocial foundations of children's academic achievement	Caprara	2000	Psychological Science	5.09	Longitudinal	294	Grade three students	Rome, Italy	Not Stated	
<i>Psychosocial Outcomes</i>										
13 Promoting positive adult functioning through social development intervention in childhood	Hawkins	2005	Archives of Pediatric and Adolescent Medicine	4.73	Longitudinal	605	Grade 1- 6 students	Seattle, USA	Not Stated	
14 Social anxiety in childhood: the relationship with self and observer rated social skills	Cartwright-Hatton et al.	2003	Journal of Child Psychology and Psychiatry	4.36	Cross-sectional	110	Children aged 8-11	Manchester, UK	Not Stated	
15 The cost of understanding other people: social cognition predicts young children's sensitivity to criticism	Cutting and Dunn	2002	Journal of Child Psychology and Psychiatry	4.36	Longitudinal	141	Children aged 4-6	South London, UK	Not Stated	

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Physical Health Outcomes							
Temcheff (2011)	To examine the long-term (i.e. adult) health sequelae of aggression observed in childhood.	Over 4,000 students selected to participate in this study in 1976-1978; peers scored students against factors of interest, such as aggression, withdrawal, likeability. Scores were then correlated to medical care between 1992 and 2003.	Montreal, Quebec N=4,109 elementary school students (grades 1, 4, 7).	Prospective, Longitudinal Study Peer questionnaires and medical record database.	-total number of medical acts, lifestyle illnesses, and injuries correlated against: -aggression -withdrawal -likeability -education attainment	-Aggression was positively associated with higher total medical acts, lifestyle illnesses, and injuries ($p<0.01$) in both men and women. -Withdrawal was negatively associated with injuries in men ($p<0.05$) and positively in women ($p<0.05$). -Likeability was negatively associated with all three medical dimensions in men and women ($p<0.01$). -Education attainment was negatively associated with all three medical dimensions in men and women ($P<0.01$; except lifestyle illness in women $p<0.05$).	The study showed small, but significant predictive effects of childhood aggression for overall health services usage, lifestyle-related illnesses, and injuries.
Marmorstein (2007)	To investigate the longitudinal associations between externalizing behaviours such as aggression and dysfunctional eating attitudes and behaviours.	Assessment at ages 11, 14, and 17 of eating attitudes and behaviours, with the teachers of students providing an assessment of externalizing behaviours by means of three personality-based questions and 24 behaviour-focused items.	Minnesota, U.S.A. N=799 adolescent girls.	Longitudinal study with cross-sectional correlation between externalizing behaviour and eating attitudes and behaviours.	-externalizing behaviour correlated against: -body dissatisfaction (BD) -weight preoccupation (WP) -binge eating (BE) -compensatory behaviour (CB) (inappropriate behaviours to attempt to control weight).	-At age 11 only CB was significantly (and positively) correlated with externalizing behaviour ($p<0.05$). -At age 14, BP ($p<0.01$) and CB ($p<0.01$) were positively associated with externalizing behaviour. -At age 17, BD ($p<0.01$), WP ($p<0.001$), and CB ($p<0.001$) were positively associated with externalizing behaviour.	Externalizing behaviour is positively correlated with dysfunctional eating attitudes and behaviours in adolescent females.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Adalbjarnardottir (2002)	To investigate the relationship between psychosocial maturity and alcohol use.	Using qualitative and quantitative methods, adolescents completed questionnaires during school hours to track alcohol use over time and correlate it against measures of psychosocial maturity.	Iceland N=1,198 15 year-old students at baseline; about 700 provided useable data at follow-up (two years).	Longitudinal survey	Alcohol use was correlated against four dimensions of psychosocial maturity, including: -interpersonal understanding -hypothetical skills -real-life skills -personal meaning	-Alcohol drinking was negatively associated with all four dimensions of psychosocial maturity at age 15 and 17, and longitudinally (from age 15-17. The correlation was significant in all cases except for real-life skills at age 17.	Both concurrent and longitudinal results indicated that the more psychosocially mature adolescents were less likely to drink heavily than those who showed less maturity.
Academic Outcomes							
Algozzine (2011)	To evaluate the relationship between social behaviour and academic achievement.	Followed three cohorts of students starting in kindergarten or grade 1 over two or three years. Compiled scores for reading and behavioural measures at the end of each school year.	Southeast U.S. N=350 in schools at high risk of academic failure based on minority enrolments, poverty status, and prior behaviour and achievement history.	5- year Longitudinal study	Mean scores were compiled in the following domains: -social skills -problem behaviours -academic competence -reading achievement Correlations between these domains were then determined.	-Problem behaviours were negatively associated with social skills, academic competence, and reading achievement for the 2 nd and 3 rd years ($p<0.05$). -Conversely, pro social skills were positively associated with academic competence in both follow-up years ($p<0.05$).	Students with poor social skills are more likely to exhibit problem behaviours and display poorer academic competence.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Romano (2010)	To examine the influence of kindergarten mother-reported attention and mother-reported socioemotional behaviours on 3 rd grade math and reading outcomes.	The National Longitudinal Survey of Children and Youth was analyzed, with kindergarten attention and socioemotional behaviours (interpersonal skills, externalizing/internalizing problem behaviours, hyperactivity/impulsivity) correlated against 3 rd grade math and reading outcomes	Canada N = 1,688 children in kindergarten (baseline)	Cross-sectional study of longitudinal data	-Reading skills (mother-reported) -Math skills (test score)	-Kindergarten mother-reported attention was positively but weakly associated with third grade reading and math -Kindergarten socioemotional behaviours showed weak associations with third grade achievement outcomes -A separate analysis found that interpersonal skills significantly, positively predicted reading and math skills, internalizing problem behaviours positively predicted math scores, and hyperactivity/impulsivity significantly, negatively predicted reading skills	There is evidence that certain socioemotional behaviours and attention in kindergarten are correlated with later reading and math outcomes, mostly in expected directions.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Pagani (2010)	To examine the influence of kindergarten attention and socioemotional skills on verbal, reading, math, and general academic achievement at the end of second grade	Two sets of Canadian data on children, the Quebec Longitudinal Study of Child Development (QLSCD) and the Montreal Longitudinal-Experimental Preschool Study (MLEPS), were analyzed, with kindergarten attention, socioemotional (externalizing/internalizing) behaviours, and social skills correlated against 2 nd grade academic outcomes.	QLSCD Quebec N = 1,977 children in kindergarten (baseline) MLEPS Montreal N=767 children in kindergarten (baseline)	Cross-sectional study of longitudinal data	QLSCD -Reading, math, and general achievement -Classroom engagement (teacher-rated) MLEPS Verbal and math achievement (teacher-rated)	QLSCD -Attention skills significantly (positively) predicted later math, reading, and general achievement -Attention problems significantly (negatively) predicted later reading, math, and general achievement, as well as classroom engagement -Externalizing problems were inversely related to later math and general achievement, and to classroom engagement -Internalizing problems were negatively related to later reading achievement -Kindergarten attention and social skills positively predicted second grade classroom engagement MLEPS -Attention skills positively predicted later verbal and math achievement -Attention problems negatively predicted later math achievement	There is evidence that kindergarten attention and externalizing characteristics prospectively predicts 2 nd grade math, reading, and verbal achievement; the association with internalizing problems was more limited.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
D'Angiulli (2009)	To determine if emotional maturity in kindergarten, as measured by the Early Development Instrument (EDI), predicts numeracy, reading, and/or writing skills in fourth grade.	Administrative data from four school districts were used to examine linked EDI and Foundation Skill Assessment (FSA) scores and perform a relative risk analysis.	British Columbia N = 6,805 Mean age at EDI = 5.7 y; mean age at FSA = 9.7	Cross-sectional analysis of longitudinal data	Social competence was evaluated against -numeracy -reading -writing Relative risk analysis performed on each domain.	Being vulnerable in terms of emotional maturity significantly results in individuals being: -2.26 times more likely to be below expectations on the numeracy component of the FSA -1.84 times more likely to be below expectations on the reading component of the FSA -2.57 times more likely to be below expectations on the writing component of the FSA	Being vulnerable in terms of emotional maturity results in a significantly greater likelihood of student falling below expectations on the numeracy, reading, and writing components of the FSA 4 years later.
Stacks (2009)	To examine the relationship between social skills, attachment, and school readiness.	Parents of children were surveyed regarding stress, parenting, social support, child behaviour, and demographics; teachers also provided data on behaviour.	Midwest U.S. 29 Head Start classrooms with an average of 2.5 students per classroom enrolled.	Cross-sectional study	Mean scores for school readiness (as tested by the Behaviour Assessment System for Children Teacher Report Scale), social skills, and defensive dysregulation were taken; correlations between outcome and predictor variables were calculated.	-Social skills were positively correlated with school readiness ($p < 0.01$); fear and agitation and controlling behaviour were negatively correlated with school readiness ($p < 0.05$ and $p < 0.01$, respectively).	Children who display social skills scored higher on measures of school readiness.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Breslau (2009)	To determine if attention deficit, internalizing behaviour, and externalizing behaviour can predict later academic achievement.	A diverse cohort of children at age 6 were assessed for behavioural problems, which were then compared against later academic achievement in math and reading.	Detroit, U.S.A. N = 693 (initial assessment and follow-up)	Longitudinal	At age six, initial assessments included the Wechsler Intelligence Scale for Children Revised and the Teacher Rating Form (TRF). The TRF subscales include attention deficit, Internalizing (withdrawn, somatic complaints, anxious/depressed) and externalizing (delinquent/aggressive). Academic achievement at age 17 was measured by the Woodcock-Johnson Psycho-Educational Battery-Revised.	-Each of the three behavioural problem areas was significantly negatively associated with math and reading achievement (the exception was externalizing behaviour with respect to reading achievement, $p=0.06$) -After controlling for attention, externalizing and internalizing behaviour was no longer significant -Attention showed significant negative associations with math and reading achievement even when externalizing and internalizing behaviours were controlled for.	-Attention problems are the primary predictor of diminished academic achievement in children who also manifest other problem behaviours.
Duncan (2007)	To assess the association between skills and behaviours that emerge during the preschool years and later academic achievement.	Using six longitudinal datasets from the US, Canada, and the UK, academic, attention and socio-emotional skills were compared against later school reading and math achievement; the data was combined in a meta-analysis.	USA, Canada, UK N=45,000 Children aged 4-6 (kindergarten at baseline)	Cross-sectional evaluation of longitudinal data	-Reading achievement -Math achievement	-Meta-analysis of the six studies found that attention is the only behaviour skill that significantly predicts subsequent reading and math achievement -Behaviour problems and social skills are not associated with later achievement.	Attention, but not externalizing/internalizing behaviour and social skills, predicted later academic achievement in math and reading.

Dimension: Cognitive Development Concept: Personal Social Behaviour Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Miles (2006)	To investigate the association between aggression and prosocial behaviour on literacy achievement in low-income children.	Children's behaviour was reported by teachers (questionnaires) and compared against literacy achievement through records in the early school years.	U.S. N = 400 Two cohorts of students (C1, C2) sampled in kindergarten (C1), grade 1 (C2) and grades 3 and 5 (C1+C2)	5-year Longitudinal study	Teacher reports of aggressive and prosocial behaviour (3 point scale). Assessment of child's literacy using the Woodcock-Johnson test (word reading, passage comprehension, and letter-word identification).	-Aggression was not associated with literacy achievement in kindergarten or the first grade, but was significantly (negatively) correlated in the third and fifth grades. -In kindergarten and first-grade, children with positive social skills showed higher literacy achievement, but significance was not maintained in grades 3 and 4	Aggression is negatively correlated with literacy achievement in children; this correlation appears to become stronger as children age. The opposite effect is observed for prosocial behaviour, though the effect appears to dissipate by grade three.
Caprara (2000)	To determine how early prosocial behaviour contributes to children's developmental trajectories in academic and social domains.	Prosocial and aggressive behaviours in elementary school were tested as predictors of academic achievement and peer relations in adolescents (five years later)	Rome, Italy N = 294 Four cohorts from third grade; behaviour was tested against eighth grade academic achievement and peer evaluations.	Longitudinal study	Children rated their own prosocial level and aggressive behaviour, while also rating their peers. Teachers also rated children's prosocial and aggressive behaviour. At midyear and the end of academic term, teachers categorized all children according to academic achievement in each of their six courses using five levels of performance.	-Prosociality had a strong positive impact on later academic achievement and peer evaluation, but early aggression does not appear to have a significant effect on either outcome.	Prosociality appears to be a positive predictor of later academic achievement, whereas aggression does not.

Psychosocial/Mental Health Outcomes							
Hawkins (2005)	To examine the long-term effects of the Seattle Development Project Intervention in promoting positive adult functioning and preventing mental health problems, crime, and substance use at 21 years of age.	<p>Participants were divided into three groups; control, full-intervention (intervention at least once in grades 1-4 and once in grades 5-6), and late-intervention (intervention in grades 5 - 6 only).</p> <p>The intervention included teacher training, child social and emotional skill development, and parent training.</p>	<p>Seattle, USA</p> <p>N = 605 elementary school students (grades 1-6), with follow-up at age 21</p>	Longitudinal intervention study	Outcomes were divided into three categories: positive functioning in school or work, emotional and mental health, and crime and substance abuse.	<p>Under the positive functioning in school or work, many significant differences were observed between the full intervention and control groups, as follows:</p> <ul style="list-style-type: none"> -constructive engagement (p=0.01) -high school graduate (p=0.01) -at least 2 y of college (p=0.01) -integrated at school (p<0.001) -employed as of last month (p=0.02) -longer time at present job (p=0.04) -constructive self-efficacy (p=0.05) <p>Other significant differences with full intervention seen in the emotional/mental health domain:</p> <ul style="list-style-type: none"> -social phobia symptom count (p=0.01) -suicide thoughts (p=0.002) <p>As well, the crime and substance use domain showed significant results of full intervention, as follows:</p> <ul style="list-style-type: none"> -lower variety of crime (p=0.04) -reduced court charges in lifetime (p=0.04) 	An early intervention (grades 1 – 6) appears to promote positive outcomes later in life, across the domains of school and work, emotional and mental health, and crime and substance use.

Cartwright-Hatton (2003)	To determine if self-reported social anxiety in children is related to objectively-measured social skills.	Children were asked to give an impromptu speech about themselves that was filmed; before filming, they rated their anxiety (scale of 1 to 10). The children then rated their performance in terms of social skills, with two observers also watching the video and independently rating the students.	Manchester, U.K. N=110 Children aged 8 to 11 (mean age = 9.35 years)	Cross-sectional study	Children's pre-speech anxiety score Children's post-speech social skill ratings and objective observer social skill ratings (micro-behaviour, nervous behaviours, global performance)	-There was very little correlation between social anxiety level and observer ratings of children's social scores	Self-reported social anxiety does not appear to predict observer-rated social skills.
Cutting (2002)	To determine if a child's social cognition is related to sensitivity to criticism.	Tests were administered to determine an individual's social cognition (theory of the mind tasks and emotional understanding) at three time intervals	South London, UK N = 141 children (mean age 5.13 years)	Longitudinal study	Social cognition evaluated, including: -theory of the mind -affective perspective-taking -causes of emotions -vocabulary scale -mixed emotions	There was a negative correlation between children's social cognition and sensitivity to criticism.	It appears that children with heightened social cognition may be more sensitive to criticism.

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Summary of Results

Academic Outcomes

Most of the studies related to this concept focused on social behavioural skills and academic performance; school achievement has an indirect linkage with adult health concerns, as will be examined later in the report. For instance, two reports from 2010 examine important longitudinal studies with relatively large samples in Canada that offer insight on this theme. The National Longitudinal Survey of Children and Youth (first noted in the Introduction to the report) found weak but significant associations between kindergarten socioemotional behaviours and third grade achievement. One possibly surprising results was a positive association between internalizing problems (e.g., anxiety) and math scores in grade three. An analysis by Pagani et al. of parallel projects in Quebec as a whole and in Montreal demonstrated similar results for second grade achievement, distributed in different ways in terms of reading and math scores, depending on the specific behaviour in question. The connection between early elementary academic achievement and multiple types of social behaviours represents a change from an earlier meta-analysis conducted by a study group that included Pagani. In that 2007 research, Duncan et al. integrated results from 6 datasets obtained from across three countries (including the Montreal study noted above), and concluded that attention is the only behaviour skill that predicted later reading and math achievement.

In a smaller U.S. study from 2011, Algozzine et al. also found that problem behaviours (broadly defined) in kindergarten through grade four were negatively associated with social skills and academic success, and that positive social skills were positively associated with markers of academic competence. Similarly, a 2009 study from British Columbia found that kindergarten children who were ‘vulnerable’ (i.e., scoring below 10% cut-off) according to the Early Development Instrument subscale related to emotional maturity were 2 to 2.5 times more likely to underachieve on the Foundation Skill Assessment four years later. As will be explained below, the emotional maturity subscale of the EDI in fact maps more closely to the classic social behaviour topics of aggression, social phobia, etc. than the subscale labelled social competence.

Stacks et al. examined social skills and school readiness, finding that better social skills were correlated with school readiness, and negative behaviours such as fear, agitation, and being controlling were negatively correlated with school readiness. Moving from readiness to actual academic results, Breslau et al. found that attention problems rather than internalizing and externalizing behaviours was the key behaviour that negatively correlated with diminished school achievement; this is consistent with the results of the large meta-analysis conducted by Duncan et al. and reported a year earlier. These studies thus introduce mixed results on the academic impact of certain classic problem behaviours such as aggression.

The heterogeneous results continue in the oldest studies. Miles and Stipek found that, in the third and fifth grades, aggression was negatively correlated with literacy achievement. Conversely, younger children (kindergarten and first grade) that displayed prosocial behaviour had higher literacy achievement, albeit this correlation dissipated by grade 3. Finally, Caprara et al. found that prosociality in third-graders was a predictor of adolescent academic achievement, whereas aggression was not.

Physical Health Outcomes

Based on data collected in the Concordia Longitudinal Risk Project in Quebec, Temcheff et al. offered the best developed evaluation (prospective, longitudinal) of childhood social behaviours (aggression, social withdrawal, and likeability) and their link to adult physical health outcomes. The authors found that, in both men and women, early expression of aggression was positively associated with an increased number of total medical acts, lifestyle illnesses, and injuries. Conversely, individuals who were more likable as children had lower rates of these three adverse physical health outcomes in later years. In a restatement and extension of these results published in November 2011 in the *Canadian Medical Association Journal*, the authors concluded that “childhood aggression has lasting effects on physical health and can have an impact on the level of use of medical services over many years.”²⁷

Marmorstein et al. evaluated the link between externalizing behaviour (covering personality traits such as “aggression” and “manipulation” and behaviour traits such as “starting physical fights”) and dysfunctional eating attitudes and behaviours in girls aged 11, 14, and 17. The eating attitudes and behaviours evaluated were weight preoccupation, body dissatisfaction, binge eating, and compensatory behaviour. Their research found that externalizing behaviours were positively correlated to compensatory behaviour (all ages), body dissatisfaction (ages 14 and 17), and weight preoccupation (age 17).

A 2002 study found that increased psychosocial maturity (interpersonal understanding, hypothetical skills, real-life skills, and personal meaning) were all negatively correlated with alcohol drinking in adolescents at age 15 and 17.

In sum, there appears to be good evidence of negative short- and long-term consequences of antisocial behaviours (such as aggression) in children, with negative health and well-being effects able to be predicted as early as grade 1.

Psychosocial Outcomes

Three studies evaluated social behaviour skills and psychosocial outcomes, which represents another important dimension of health and well-being. Hawkins et al. found that a behavioural skills intervention between grades 1 and 6 resulted in a number of positive outcomes in the realms of functioning in society and at work, emotional and mental health, and crime and substance use at 21 years of age. The functioning in school or work domain demonstrated the most consistent positive outcomes, with seven of eight factors reaching statistical significance. Cartwright-Hatton et al. compared self-reported anxiety among children with observer ratings of social skills; they found that students who report being socially anxious do not necessarily lack social skills, which underlines the complexity of relationships between well-known psychosocial factors. Lastly, Cutting and Dunn found that children who are more socially conscious are more sensitive to criticism, which may predict negative mental health effects at some point.

The arena of psychosocial outcomes offers a weaker strand of evidence concerning a relationship between personal social behaviour skills and health and well-being.

²⁷ Temcheff CE, Serbin LA, Martin-Storey A et al. Predicting Adult Physical Health Outcomes from Childhood Aggression, Social Withdrawal and Likeability: A 30-Year Prospective, Longitudinal Study. *International Journal of Behavioral Medicine*. 2011; 18(1): 5-12.

Data Sources

As discussed in the opening to this section, the analysis has ranged from specific behaviours in social settings to assessments of social competence/skills that help to shape such behaviours. Given the heterogeneity of social/behavioural “inputs” used in the studies and potentially adaptable as indicators, it is reasonable to settle on an instrument that integrates a number of important factors and, pragmatically, is already in operation. A measurement that lends itself to this purpose is the Early Development Instrument (EDI) subscale related to emotional maturity. The competing, and perhaps more obvious EDI subscale, that could inform an indicator related to social behaviour would be the one related to social competence. However, the inputs for that subscale actually evaluate a range of attitudes and skills that *shifts* the focus away from classic social behaviour concerns. Thus, the social competence score in the EDI encompasses a child’s curiosity about the world, eagerness to try new experiences, knowledge of standards of acceptable behaviour, appropriate respect for adult authority, cooperation with others, following rules, and ability to play and work with other children.²⁸ By comparison, the emotional maturity subscale covers:

- Ability to reflect before acting
- Balance between too fearful and too impulsive
- Ability to deal with feelings at the age-appropriate level
- Empathic response to other people's feelings

According to an originator of the EDI, it is this subscale that is meant to be used to track well-known behavioural concerns, namely, aggression, anxiety, and hyperactivity.²⁹ These expressions actually were investigated as species of mental health problems, which again underlines the overlap between this concept and another major dimension, namely Mental/Emotional Health and Well-being, investigated for this project.

The EDI has two additional advantages pertinent to the British Columbia context. First, it has been widely used among kindergarten students in B.C. since 2001.³⁰ Thus, it provides a long-term and ongoing data source that can monitor how emotional maturity in this age group is changing over time. As detailed above in the results section, the second advantage is that the EDI, including the emotional maturity subscale, has been linked to relevant outcomes in B.C., most notably numeracy, reading and writing achievement. While a step removed from predicting broader health outcomes, this is an important start to the task of predictive validation of the instrument, a process that will undoubtedly continue in the years to come.

The Human Early Learning Project website reports that, as of the 2008-09 school year, 12.1% of kindergarten children were “vulnerable” on the EDI Emotional Maturity subscale, that is, scoring below the bottom cut-off as established by school authorities. This offers a good starting point for assessing the magnitude of this factor in the B.C. pediatric population.

As a comparison, the National Longitudinal Survey of Children and Youth (NLSCY) has been used in recent years as the basis of a biennial report in B.C. on indicators of child health

²⁸ D'Angiulli A, Warburton W, Dahinten S et al. Population-level associations between preschool vulnerability and grade-four basic skills. *Plos One*. 2009; 4(11):

²⁹ Raos R, Janus M. Examining spatial variations in the prevalence of mental health problems among 5-year-old children in Canada. *Social Science and Medicine*. 2011; 72(3): 383-8.

³⁰ The Human Early Learning Partnership. *The Early Development Instrument (EDI) in British Columbia*. 2008. Available at <http://www.ccl-cca.ca/pdfs/fundedresearch/Hertzman-FINAL.pdf>. Accessed September 2011.

and well-being. The design and limitations of this instrument were described in the Introduction to the present report. In addition to specific subscales related to anxiety and other emotional problems, hyperactivity-inattention, and physical aggression, the NLSCY has devised an omnibus “Ages and Stages” score that tracks children who do or do not exhibit age-appropriate personal social behaviours. The 2004/5 (Cycle 6) data suggest that 16.9% of B.C. children aged 3 to 47 months did not attain this standard. The possibility that the NLSCY project has been curtailed means that it does not offer an active alternate to EDI for designing an indicator for the present concept.

Discussion

Studies of personal social behaviour skills, and social competence more broadly defined, have shown a correlation with a number of adverse health and well-being outcomes. The most dominant body of evidence is related to academic outcomes, with several researchers focusing on behaviours and social competence at the beginning of formal education (kindergarten and elementary grades) and the impact on reading, writing, and numeracy in later years. While results did vary, adverse social behaviours such as aggression and attention deficits generally were correlated with poor academic outcomes, while positive social skills were correlated with better achievement in school. The association with academic achievement is best supported for attention-related behaviours.

In one study that seemed to extend beyond academic outcomes, Temcheff et al. in fact found that the important connection between adult health and childhood behavioural problems was still most likely mediated through educational attainment; the latter topic will itself be addressed under various conceptual headings later in the report.³¹

As with all results depending partly on correlation studies, determining causality can be problematic. For example, Algozzine et al. noted that an analysis of causality revealed only a “weak causal relationship between behavior and achievement. This suggests that not all students rated positively for behavior were ‘good’ readers and that not all students with problem behaviors demonstrate difficulty reading.”³² This caveat highlights that, while the concept of social behaviour skills may be a useful predictor at a population level (as pertinent to the present project), its ability to diagnose outcomes on an individual basis is more limited.

Different researchers refer to some aspects of emotional maturity under headings such as self-control, self-regulation, executive function, or attentional control. This specific subfield has itself been recognized as potentially an important predictor of health and well-being outcomes later in life.^{33,34} Assuming that suitable population data could be abstracted and tracked, this leaves open the possibility that an indicator more narrowly constructed around self-control could be an alternate to social competence/emotional maturity more broadly conceived.

³¹ Temcheff CE, Serbin LA, Martin-Storey A et al. Predicting Adult Physical Health Outcomes from Childhood Aggression, Social Withdrawal and Likeability: A 30-Year Prospective, Longitudinal Study. *International Journal of Behavioral Medicine*. 2011; 18(1): 5-12.

³² Algozzine B, Wang CA, Violette AS. Reexamining the relationship between academic achievement and social behaviour. *Journal of Positive Behavior Interventions*. 2011; 13(1): 3-16.

³³ Moffitt TE, Arseneault L, Belsky D et al. A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences of the United States of America*. 2011; 108(7): 2693-8.

³⁴ Mischel W, Ayduk O, Berman MG et al. 'Willpower' over the life span: decomposing self-regulation. *Social Cognitive and Affective Neuroscience*. 2011; 6(2): 252-6.

Conclusion

Although there appear to be various adverse health and well-being outcomes in later years associated with poor social behaviour skills at the start of formal education, the available evidence does not always demonstrate direct causality. However, the longitudinal design of a number of studies serves to increase confidence in the main conclusion, namely, that aspects of personal social behaviour and skills, such as aggression, other externalizing behaviours, and social competence properly defined, are correlated with adverse health and well-being outcomes.

Summary Assessment					
Personal Social Behaviour Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
5-19	90,359	Medium	Medium	Medium-High	High

As summarized above, assessments have been applied to the Personal Social Behaviour Skills concept. Specifically, the indicator adopted for consideration is the Emotional Maturity subscale of the Early Development Instrument (EDI).

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. Based on data from the 2008-09 wave of the EDI, 12.1% of children of kindergarten age are deemed vulnerable in the area of Emotional Maturity. This rate was applied to the pediatric cohort aged 5-19, yielding an estimate of 90,359 vulnerable individuals. The entire cohort after age 5 was used, rather than just those of kindergarten age, because children that are vulnerable at this early age are susceptible to adverse health and well-being outcomes the assumption is that, in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability (and its consequences) would persist. The resulting estimate of 90,359 individuals is between 2-10% (19,000-97,000) of the total pediatric cohort, resulting in a Magnitude classification of medium.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. While the evidence does show correlations between adverse personal social behaviours and negative health and well-being outcomes, the bulk of the evidence appears to focus on educational achievement, which is a step removed from health and well-being more broadly understood. Moreover, the intriguing results from one Canadian study that traced social behaviours as early as grade 1 to *adult* physical health effects may also be mostly mediated by academic achievement.

The **Modifiability** of the potential indicator is assessed as **Medium-High**. There are intervention studies that have demonstrated that teaching personal social behaviour skills has the potential to lead to positive outcomes up to a decade later.

Data Availability/Reliability for the potential indicator is assessed as **High**. Data from the EDI are collected annually through teacher observations of kindergarten-aged children across the province.

Based on the indicated assessment, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being. It represents a concept that ranks relatively high for most assessment categories.

Motor Skills

Background and Context

Traditionally, research on infant development has focused on comparing earlier and later cognitive ability.³⁵ Bushnell and Boudreau noted that during the “coming of age” period for infancy research in the 1960’s, 70’s and 80’s, studies focused largely on perception, socio-emotional development, and cognitive development rather than motor development. In studies that did focus on motor behaviour, it was largely observed as a dependent variable to investigate other areas of infant development.³⁶ With observations that cognitive measures in infancy are poor at predicting future cognitive performance, there has been a renewed interest in the role motor development plays in cognitive, social, and emotional development. The proposal that there is a relationship between motor development and cognitive development has existed since at least the time of Piaget in the 1950s.³⁷

Motor skills can be broadly defined as either gross or fine. Gross motor skills refer to larger movements, such as the arms and legs, and are measured through a variety of activities including hand strength, touching finger to nose, distance, jumping, walking in a line, and standing on one foot. Fine motor skills include more delicate movements, such as the fingers and hands; measurements instruments often include tasks such as transferring beads in a box, putting beads on a rod, finger tapping, turning a nut into a bolt and sliding a peg on a rod.

For our current analysis, all motor skills, including gross and fine, will be evaluated to determine their association with children’s health and well-being.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Major Heading:* Motor Skills *Age:* Preschool (2-5)

Search Keywords

(“Motor Skill*” OR “Motor Coordination”) AND

³⁵ Piek JP, Dawson L, Smith LM et al. The role of early fine and gross motor development on later motor and cognitive ability. *Human Movement Science*. 2008; 27(5): 668-81.

³⁶ Bushnell EW, Boudreau JP. Motor development and the mind: the potential role of motor abilities as a determinant of aspects of perceptual development. *Child Development*. 1993; 64(4): 1005-21.

³⁷ Piek JP, Dawson L, Smith LM et al. The role of early fine and gross motor development on later motor and cognitive ability. *Human Movement Science*. 2008; 27(5): 668-81.

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 353 papers in total.

Preliminary Exclusion

The 353 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between motor skills and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 23.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link “motor skills” with health or well-being outcome(s) *in children*, it was excluded. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

There were 13 articles remaining in the list following the primary exclusion step.

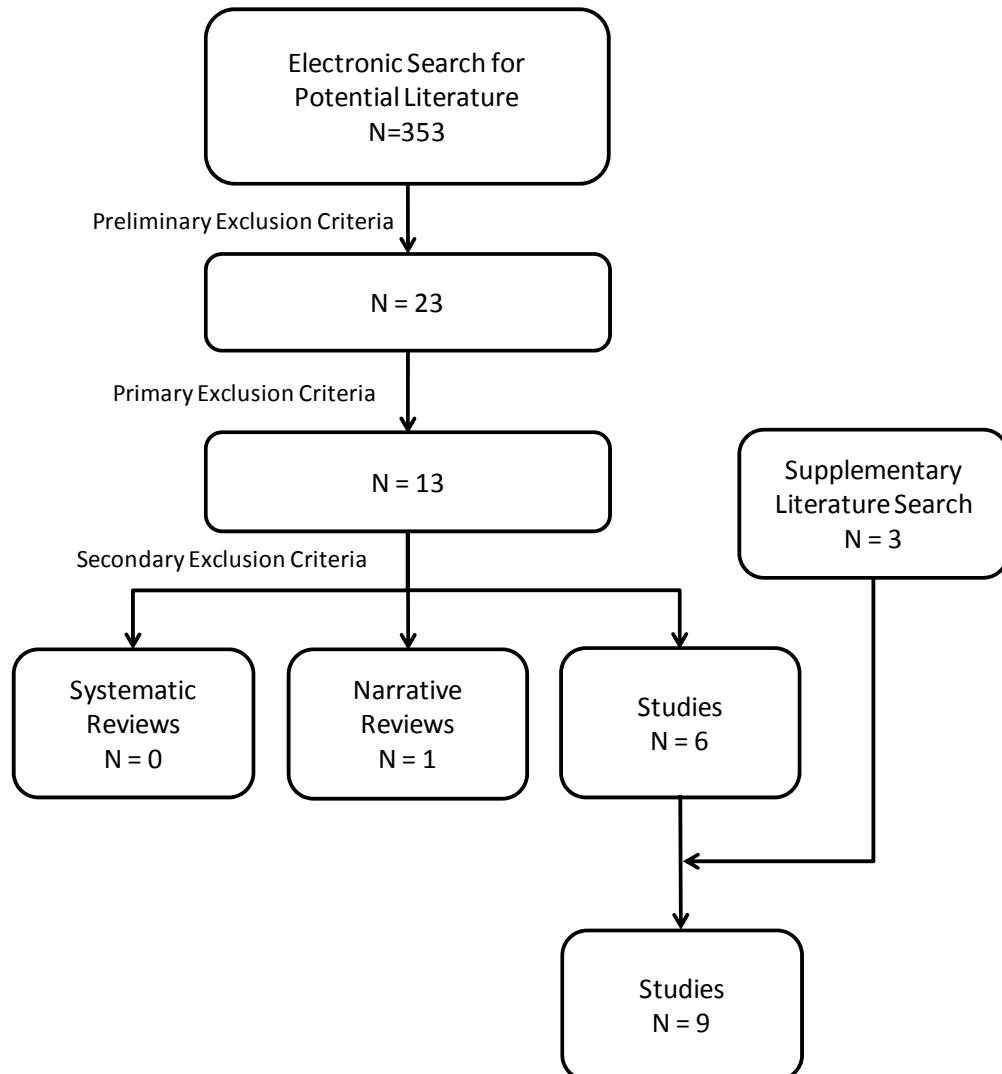
Secondary Exclusion

These 13 full-text articles were then reviewed in depth. Upon completion, it was determined that 6 were relevant to the current topic and therefore included in the analysis. Three additional studies were found through a supplementary search of the literature, using specific keywords, related article utilities, bibliography scans, etc.

The literature search process is detailed in the chart below, with the 9 final articles identified and summarized in the following tables.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Motor Skills



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Motor Skills*

Title of Study	Author(s)	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
Academic, Cognitive, and Psychosocial Outcomes									
1 Do motor skills in infancy and early childhood predict anxious and depressive symptomatology at school age?	Piek et al.	2010	Human Movement Science	2.53	Longitudinal	50	Children aged 4 months (baseline)	Perth, Australia	Not Stated
2 School readiness and later achievement: A French Canadian replication and extension	Pagani et al.	2010	Developmental Psychology	3.41	Cross-sectional	1,997	Kindergarten children (follow-up at 2nd Grade)	Quebec, Canada	Not Stated
3 Population level associations between preschool vulnerability and grade-four basic skills	D'Angiulli et al.	2009	PLoS One	4.35	Cross-sectional	6,805	Kindergarten studies (follow-up at grade 4)	British Columbia	None
4 The role of early fine and gross motor development on later motor and cognitive ability.	Piek et al.	2008	Human Movement Science	2.53	Longitudinal	30	Children aged 4 months (baseline)	Perth, Australia	Not Stated
5 Predicting school adjustment from motor abilities in kindergarten.	Bart et al.	2007	Infant and Child Development	1.25	Longitudinal	88	Kindergarten children (baseline)	Israel	Not Stated
6 Fine motor skills and mathematics achievement in east Asian American and European American kindergartners and first graders	Luo et al.	2007	British Journal of Developmental Psychology	1.39	Longitudinal	10,060	Kindergarten children (baseline)	USA	Not Stated
Physical Activity and Fitness Outcomes									
7 Changes in motor skill and fitness measures among children with high and low motor competence: A five- year longitudinal study	Hands et al.	2008	Journal of Science and Medicine in Sport	2.69	Longitudinal	38	Children aged 5-7 (baseline)	Australia	Not Stated
8 Does childhood motor skill proficiency predict adolescent fitness?	Barnett et al.	2008	Medicine and Science in Sports and Exercise	4.10	Longitudinal	1,045	Primary school children	Australia	Not Stated
9 Childhood movement skills: Predictors of physical activity in Anglo American and Mexican American adolescents?	McKenzie et al.	2002	Research Quarterly for Exercise and Sport	1.10	Longitudinal	351	Children aged 4 (baseline)	San Diego, USA	Not Stated

Dimension: Cognitive Development Concept: Motor Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Academic, Cognitive, and Psychosocial Outcomes							
Piek (2010)	To determine how motor performance (gross and fine) in infancy and early childhood is related to anxious and depressive symptomatology at 6 – 12 years of age.	Parents completed a measure of fine and gross motor abilities at 11 points between ages 4 months and 4 years. These scores were correlated to anxiety, and depression problems between the ages of 6 and 12	Perth, Australia N= 50 Children aged 4 months at baseline	Longitudinal	-Fine and gross motor score as measured by the Ages and Stages Questionnaires (ASQ). -Anxiety and anxiety/depression subscales of the Child Behaviour Checklist (CBCL) -Wechsler Intelligence Scale for Children (WISC-IV) -The Movement Assessment Battery for Children (MABC) to determine motor performance (gross motor skills)	-Based on hierarchical regression analyses, stability of the gross motor skills predicted both the anxiety/depression measure and the anxiety score from the CBCL. That is, the more stable the motor skill development between ages 4 months and 4 years, the less likely a child was to report anxiety/depressive symptoms at school age.	These findings suggest that variability in a young child's gross motor development may predict levels of anxious/depressive symptoms at school age.
Pagani (2010)	To examine the influence of kindergarten gross and fine motor skills on academic achievement, as well as classroom engagement at the end of second grade	The Quebec Longitudinal Study of Child Development was analyzed, with kindergarten motor skill inputs correlated against second grade academic outcomes.	Quebec N = 1,977 children in kindergarten (baseline)	Cross-sectional study of longitudinal data	-Reading, math, and general achievement -Classroom engagement (teacher-rated)	-Fine motor skills predicted second grade reading, math, and general academic achievement, in addition to classroom engagement -No significant correlations were observed with gross motor skills	There is evidence that fine motor skills play a role in influencing later academic achievement and classroom engagement
D'Angiulli (2009)	To determine if physical health and well-being in kindergarten, as measured by the Early Development Instrument (EDI), predicts numeracy, reading, and/or writing skills in fourth grade.	Administrative data from four school districts were used to examine linked EDI and Foundation Skill Assessment (FSA) scores and perform a relative risk analysis.	British Columbia N = 6,805 Mean age at EDI = 5.7 y; mean age at FSA = 9.7	Cross-sectional analysis of longitudinal data	Physical health and well-being (motor development, energy level, daily preparedness for school, washroom independence and established handedness) was evaluated against -numeracy -reading -writing Relative risk analysis performed on each domain.	Being vulnerable in terms of physical health and well-being results in individuals being: -2.56 times more likely to be below expectations on the numeracy component of the FSA -2.16 times more likely to be below expectations on the reading component of the FSA -2.90 times more likely to be below expectations on the writing component of the FSA	Being vulnerable in terms of physical health and well-being results in a 2-3 times greater likelihood of students falling below expectations on the numeracy, reading, and writing components of the FSA 4 years later.

Dimension: Cognitive Development Concept: Motor Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Piek (2008)	To determine whether motor performance taken between birth and 4 years of age predict motor and cognitive performance when children reach school age.	Parents completed a measure of fine and gross motor abilities at 11 points between ages 4 months and 4 years. These scores were correlated to neuromuscular development at aged 6 – 12 and intelligence.	Perth, Australia N = 30 Children aged 4 months at baseline	Longitudinal	-Fine and gross motor score as measured by the Ages and Stages Questionnaires (ASQ). -Neuromuscular development was measured by the McCarron assessment of Neuromuscular Development (MAND) -Intelligence measured by the WISC-IV	-Based on hierarchical regression analyses, gross motor trajectory information (i.e., the trajectory of development between 4 months and 4 years) significantly predicted cognitive performance at school age (working memory and processing speed.)	There appears to be a strong relationship between early gross motor skills and school aged cognitive development.
Bart (2007)	To assess the relationship between basic motor abilities in kindergarten and scholastic, social, and emotional adaptation a year later.	Kindergarten children were assessed with a number of motor (gross and fine) skill measures in kindergarten. One year later measures of emotional, behavioural, and academic adaptation to school were employed and correlations between the two were analyzed.	Israel N = 88 Kindergarten children with follow-up in grade 1.	Longitudinal (1 year follow-up)	Outcomes include various aspects of motor skills (fine motor and gross motor) and teacher and children ratings of emotional, scholastic, and social performance.	-All seven measures of motor abilities (visual-motor index, visual-spatial perceptions, fine motor accuracy, muscle tone, imitation of postures, kinaesthesia, and general motor function) were significantly correlated to scholastic adaptation. -Of the emotional and behavioural outcomes (disruptive behaviour, anxious-withdrawn, pro-social behaviour, child subjective adaptation), disruptive behaviour had the most significant correlations (five of seven)	Fine and gross motor function appears to be a positive predictor of scholastic adaptation.
Luo (2007)	To examine whether fine motor skills (FMS) are related to mathematics achievement at baseline or over time.	Children were assessed at the beginning and end of kindergarten, and during the first grade to determine if motor skills were correlated with achievement in mathematics.	United States N=10,060 Kindergarten children (East Asian and European American descent)	Longitudinal (1.5 years between first and final follow-up)	Some of the outcomes include: -Socioeconomic status -Parental education levels -Parental expectation levels -Children's mathematics knowledge and skills -Children's fine motor skills	-The results showed that FMS significantly predicted initial mathematics achievement as well as achievement over time.	-Fine motor skills may be implicated in the developmental trajectory of mathematics achievement.

Dimension: Cognitive Development Concept: Motor Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Physical Activity and Fitness Outcomes							
Hands (2008)	To determine if differences in gross motor skills at baseline are correlated to changes in fitness measures and gross motor skills over time.	Children were categorized at either having low- or high- motor competence (LMC, HMC). Measures of motor skill and fitness were taken over five years.	Australia N=38 Children ages 5-7 at baseline	Longitudinal	Outcomes include measures of motor skill (balance on one foot, volleyball bounce and catch, single hop for distance, 50-m run) and fitness (body composition, multi-stage fitness test)	-the LMC group performed poorer than the HMC on all fitness items except BMI - Over time, both groups performance on fitness measures and motor skills increased, maintaining the same relative differences.	Overall, the results suggest that children who perform poorly on motor skills or have low fitness components when they are young are unlikely to catch up to their peers as they age.
Barnett (2008)	To determine whether childhood fundamental motor skill proficiency predicts subsequent adolescent cardiorespiratory fitness and physical activity.	In 2000, motor skills were assessed as part of an elementary-school intervention, participants were followed up in 2006/07 (adolescence) where cardiorespiratory fitness and physical activity were measured.	NSW, Australia N=1,045 Primary school children	Longitudinal	-Eight motor skills were measured at baseline (kick, catch, overhand throw, hop, side gallop, vertical jump, sprint run, and static balance) -At follow up, the multistage fitness test was used to determine aerobic fitness.	-It was determined that object control proficiency (kicking, throwing, catching) in childhood was associated with adolescent cardiorespiratory fitness ($p = 0.012$) whereas advanced performance of the sprint run in childhood was not ($p = 0.102$)	Children with strong object control skills are more likely to become fit adolescents.
McKenzie (2002)	To determine if there is a relationship between young children's movement skills and their physical activity in early adolescence	Motor skills were assessed at the child's home beginning at four years of age, with a physical activity assessment (twice) and skin fold thickness to determine physical activity.	San Diego, USA N=351 children aged 4 years with follow-up at 5,6,11, and 12 years of age.	Longitudinal	-Movement proficiency skills tested included: later jumping, eye-hand coordination or manipulation, and stability. -Physical activity measures were estimated by the Physical Activity Recall (PAR) at the child's home on two occasions at 11 and 12 years. -Skin fold measurements of the triceps and subscapular were also taken.	-Movement skill performances at 4-6 years of age did not predict physical activity levels at 12 years.	Motor skills do not appear to predict long-term physical activity.

Bibliography for Table of Studies

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Pagani LS, Fitzpatrick C, Archambault I et al. School readiness and later achievement: a French Canadian replication and extension. *Developmental Psychology*. 2010; 46: 984-94.

D'Angiulli A, Warburton W, Dahinten S et al. Population-level associations between preschool vulnerability and grade-four basic skills. *Plos One*. 2009; 4: .

Piek JP, Dawson L, Smith LM et al. The role of early fine and gross motor development on later motor and cognitive ability. *Human Movement Science*. 2008; 27: 668-81.

Bart O, Hajami D, Bar-Haim Y. Predicting school adjustment from motor abilities in Kindergarten. *Infant and Child Development*. 2007; 16: 597-615.

Luo Z, Huntsinger CS, Pigott TD. Fine motor skills and mathematics achievement in east asian american and european american kindergartners and first graders. *British Journal of Developmental Psychology*. 2007; 25: 595-614.

Hands B. Changes in motor skill and fitness measures among children with high and low motor competence: a five-year longitudinal study. *Journal of Science and Medicine in Sport*. 2008; 11: 155-62.

Barnett LM, Van Beurden E, Morgan PJ et al. Does childhood motor skill proficiency predict adolescent fitness? *Medicine and Science in Sports and Exercise*. 2008; 40: 2137-44.

McKenzie TL, Sallis JF, Broyles SL et al. Childhood movement skills: predictors of physical activity in Anglo American and Mexican American adolescents? *Research Quarterly for Exercise and Sport*. 2002; 73: 238-44.

Summary of Results

Academic, Cognitive, and Psychosocial Outcomes

In all, six papers evaluated motor skills and academic, cognitive, and psychosocial outcomes. Piek et al., in two published studies, tracked a cohort of children from age 4 months, to between 6 and 12 years, evaluating anxiety, depressive symptoms, and cognitive outcomes such as working memory and processing speed. They found that greater variability in gross motor development predicts higher levels of anxious/depressive symptoms at school age. Additionally, the trajectory of gross motor development (measured between 4 months and 4 years) significantly predicted working memory and processing speed at school age.

D'Angiulli et al., in a B.C. based study, found that vulnerable individuals on the EDI subscale of 'physical health and well-being', which contains motor development, were between 2 and 3 times more likely to fall below expectations on the numeracy, reading, and writing components of the FSA test four years later. This is consistent with results found in a Quebec-based study for gross and fine motor skills evaluated as predictors of academic achievement in second grade. Similarly, Bart et al. found that fine and gross motor function in Israeli kindergarten students positively predicted scholastic adaptation a year later; some negative correlations were observed between good motor skills and problem behaviours such as disruptive behaviour and being anxious/withdrawn. Lastly, Luo et al found that fine motor skills predicted mathematics achievement at baseline as well as achievement over time.

Physical Activity and Fitness Outcomes

Hands et al. found that children performing poorly on gross motor skills or having poor fitness are likely to continue being below average in these two measures when compared to their peers over time, though the skills of the two groups improve at approximately the same rate. Barnett et al found that object control skills (kicking, throwing, catching) in childhood, and not performance on a 'sprint run', predicted later cardiorespiratory fitness. Finally, McKenzie et al found no correlation between young children's movement skills and physical activity in early adolescence.

Data Sources

This review has covered a variety of gross and fine motor skills and their relationship with child health and well-being. As with personal *social behaviour skills*, it is reasonable to settle on an instrument that integrates a number of such motor skills and is already in use in British Columbia. A measurement that lends itself to this purpose is the Early Development Instrument (EDI) component scale related to *physical health and well-being*. This scale evaluates fine and gross motor skills, energy level, daily preparedness for school, washroom independence, and established handedness.³⁸

The EDI has two additional advantages pertinent to the British Columbia context. First, it has been widely used among kindergarten students in B.C. since 2001.³⁹ Thus, it provides a long-term and ongoing data source that can monitor how physical health and well-being in this age group is changing over time. As detailed above in the results section, the second advantage is that the EDI, including the physical health and well-being subscale, has been linked to

³⁸ Pan-Canadian EDI Mapping Package, Available at

http://www.councilecd.ca/files/PanCanadianEDI_EDI_Mapping_Information.pdf. Accessed September 2011.

³⁹ The Human Early Learning Partnership. *The Early Development Instrument (EDI) in British Columbia*. 2008. Available at <http://www.ccl-cca.ca/pdfs/fundedresearch/Hertzman-FINAL.pdf>. Accessed September 2011.

relevant outcomes in B.C., most notably numeracy, reading and writing achievement. The physical health and well-being subscale of the EDI does not directly map to motor development (four questions of thirteen are related to motor development)⁴⁰ so it is unclear how sensitive this EDI subscale is when the focus is on motor development. Nevertheless, this subscale represents the best current measure with which to track motor development in B.C. children.

Based on a 2008/09 analysis of the EDI subscales by the Human Early Learning Partnership (HELP), 11.5% of kindergarten children are “vulnerable” on the Physical Health and Well-being subscale of the EDI, that is, scoring below the bottom cut-off as established by school authorities.

The NLSCY also contains a component section relevant to motor skills, entitled *motor and social development*. The objective of this section is to measure the motor, social, and cognitive development of children aged 0-3. The scale contains 48 questions in total, with 15 questions asked of each child; the questions asked are specific to each child’s age.⁴¹ Of the 48 questions, approximately 27 (56%) are primarily relevant to motor development.⁴² As mentioned in the introduction, the NLSCY does have drawbacks, including the fact that the survey is completed by parents, who can bias results, is biennial rather than annual, and a relative small sample size (just over 2,000 children ages 0-19 in British Columbia) that can limit regional comparisons. For these reasons, the EDI is considered the superior data source for the current concept.

Discussion

Studies evaluating motor skills have shown a correlation with a number of adverse health and well-being outcomes. The most dominant body of evidence is related to academic, cognitive, and psychosocial outcomes, with all five studies focusing on children at the beginning of (or just prior to) formal education. Generally speaking, strong motor skills were positively correlated with desirable academic, cognitive and psychosocial outcomes while poor motor skills were correlated with less desirable outcomes. The evidence seems particularly strong for fine motor skills, as evidenced by the results of Pagani et al. It has been noted that fine motor skills might predict positive academic outcomes because “...most activities that build or display cognitive skills also involve the use of fine motor skills. Writing requires fine motor skills with the hands as well as hand-eye coordination. Speaking requires fine motor skills that control the production of sound. Reading requires the use of fine motor skills controlling eye movement for word tracking.”⁴³

Studies focusing on physical activity and fitness evaluated a variety of outcomes. Our findings are in line with that of a 2010 review of fundamental movement skills (FMS, also referred to as gross motor skills) in children, which found that strong FMS were positively

⁴⁰ Early Development Instrument, Available at http://www.offordcentre.com/readiness/SRL_project.html. Accessed September, 2011.

⁴¹ Statistics Canada. *Microdata User Guide: National Longitudinal Survey of Children and Youth, Cycle 8*. 2010. Available at <http://www.statcan.gc.ca/imdb-bmdi/4450-eng.htm>. Accessed September 2011.

⁴² Statistics Canada. *National Longitudinal Survey of Children and Youth: Cycle 8 Survey Instruments, 2008/09 Book 1*. 2010. Available at <http://www.statcan.gc.ca/imdb-bmdi/4450-eng.htm>. Accessed September 2011.

⁴³ Grissmer D, Grimm KJ, Aiyer SM et al. Fine motor skills and early comprehension of the world: two new school readiness indicators. *Developmental Psychology*. 2010; 46(5): 1008-17.

associated with physical activity and cardiorespiratory fitness.⁴⁴ Perhaps the most surprising finding was that object control skills, such as kicking and throwing, were a better indicator of later cardiorespiratory fitness than sprinting skills. The authors reason that this may be a result of such skills being associated with recreational or organized sports, and children proficient at performing these skills may participate more in such activities.⁴⁵

One line of evidence that did not turn up in our search was the relationship between FMS and overweight/ obesity as an outcome. This is because the literature in this area often focuses on overweight/ obesity impacting motor skills which runs counter to our current search. The available evidence suggests that “children who were overweight had significant fundamental movement skill difficulties, as well as having poorer physical abilities self-concept perceptions compared to non-overweight children.”⁴⁶ What is not clear, however, is whether these factors are predisposing factors for overweight children. Some researchers have suggested that interventions aimed at preventing unhealthy weight gain could benefit from including FMS training as a component.⁴⁷

A 2011 meta-analysis concluded that “[m]otor skill interventions are effective in improving FMS in children. Early childhood education centres should implement ‘planned’ movement programmes as a strategy to promote motor skills development in children.”⁴⁸

The EDI component scale of *physical health and well-being* offers the best data source for the current concept. However, as mentioned above, the component scale does not map directly to motor skills, although perhaps more than its name would indicate. The *physical health and well-being component* of the EDI is comprised of 13 questions, of which four are directly related to motor skills. Teachers answer each question with one of the following options: very good/good, average, poor/very poor, or don’t know. The four EDI questions relevant to motor skills are:

- is well coordinated (i.e., moves without running into or tripping over things)
- proficiency at holding a pen, crayons, or a brush
- ability to manipulate objects
- ability to climb stairs

Thus while this component scale does offer some insight into gross and fine motor skills which can then be compared with academic achievement in later years, another alternative would be to evaluate these four questions independently (rather than as part of the 13 question component). At this point it is not clear if the EDI data could be manipulated in this manner, and this would also require further validation studies. Other alternatives would be to use an alternate data source, such as the motor and social development scale from the

⁴⁴ Lubans DR, Morgan PJ, Cliff DP et al. Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Medicine*. 2010; 40(12): 1019-35.

⁴⁵ Barnett LM, Van Beurden E, Morgan PJ et al. Does childhood motor skill proficiency predict adolescent fitness? *Medicine and Science in Sports and Exercise*. 2008; 40(12): 2137-44.

⁴⁶ Poulsen AA, Desha L, Ziviani J et al. Fundamental movement skills and self-concept of children who are overweight. *International Journal of Pediatric Obesity*. 2011; 6(2-2): e464-71.

⁴⁷ Okely AD, Booth ML, Chey T. Relationships between body composition and fundamental movement skills among children and adolescents. *Research Quarterly for Exercise and Sport*. 2004; 75(3): 238-47.

⁴⁸ Logan SW, Robinson LE, Wilson AE et al. Getting the fundamentals of movement: a meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development*. 2011: E-published ahead of print.

NLSCY, or implement a new motor skills measurement instrument across the province. There are a number of measures that could be used to assess motor skills in the preschool age group.⁴⁹

Conclusion

Although there appear to be various adverse physical and non-physical health outcomes in later years associated with poor gross and fine motor at the start of formal education, the evidence does not always demonstrate direct causality. However, the longitudinal design of a number of studies does increase confidence in the main conclusion, namely, that aspects of poor motor skills are correlated with adverse health and well-being outcomes.

Summary Assessment					
Motor Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
5-19	85,878	Medium	Medium	Med-High	Medium

As summarized above, assessments have been applied to Motor Skills concept. Specifically, the indicator adopted for consideration is the *Physical Health and Well-being* component scale of the Early Development Instrument (EDI).

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. Based on data from the EDI, 11.5% of children of kindergarten age are deemed vulnerable in the area of Physical Health and Well-being. This rate was applied to the entire pediatric cohort aged 5 -19, yielding an estimate of 85,878 vulnerable individuals. This rate was applied to the entire cohort aged 5-19, rather than just those of kindergarten age, because those that are vulnerable at this early age are susceptible to adverse health and well-being outcomes; the assumption is that, in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability would persist. The resulting estimate of 85,878 individuals is between 2-10% (19,000-97,000) of the total pediatric cohort, resulting in a Magnitude classification of medium.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. While the evidence does show correlations between adverse motor skills and negative health and well-being outcomes, the most convincing evidence focuses on educational achievement, which is a step removed from health more broadly understood.

The **Modifiability** of the potential indicator is assessed as **Medium-High**. A recent meta-analysis has shown that motor skill interventions are effective in improving fundamental movement skills in children.

Data Availability/Reliability for the potential indicator is assessed as **Medium**. Data from the EDI are collected annually through teacher observations of kindergarten-aged children across the province. The concern is that the component scale of physical health and well-

⁴⁹ Tieman BL, Palisano RJ, Sutlive AC. Assessment of motor development and function in preschool children. *Mental Retardation and Developmental Disabilities Research Reviews*. 2005; 11(3): 189-96.

being does not directly map to motor skills (four of thirteen questions), thereby calling into question the suitability of the indicator to appropriately identify those at-risk specifically in the area of motor skills in the population.

Based on the consistent and reasonably high assessment rankings, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being.

Verbal Skills

*The development of oral language is one of children's most impressive accomplishments that occur during the first 5 years of life.*⁵⁰

This section will examine the assigned concept Verbal Skills. For the purpose of this project, this will be defined as *oral* communication or speech, since early *written* language as an aspect of school readiness will be the topic of a later section of this report. Separating the treatment of language development in this way is convenient, but it must be recognized that there are important linkages between all forms of communication (oral, written, and even gesture) as they emerge and are nurtured in children. In general, there is little debate that development of language skills of all types, inasmuch as they provide a vital foundation for relationships, work, and other interactions with society, are a substantial component of well-being in both the short- and long-term. This section will elaborate on this theme in the specific context of oral communication.

Background and Context

Oral language development is a vast tree of topics. There are two main branches that can be identified for potential discussion: (i) language delays or disorders that are recognized as having some specific cognitive and/or organic cause and that may be amenable to professional treatment, and (ii) the range of language development that may be promoted among children with “normal” abilities using routine educational approaches. In short, this classification is an attempt to distinguish speech problems that are inherent in the child (e.g., genetically-based) from those with an environmental cause.

The first category was introduced under the Physical Health dimension of this project, in the context of both Cause-Specific Disability and Hearing Screening. There is of course a subset of physical or cognitive disability where weak verbal skills is a major characteristic. In fact, the classic tools used to inventory disability in Canada, including the *Participation and Activity Limitation Survey* and the *Health Utility Index*, specify Speech as a major category of concern to be tracked.^{51, 52}

Disabilities themselves demonstrate complex interactions. For example, there is a species of motor disability that can affect oral movements in particular and thus speech development.^{53, 54} Most notably, hearing impairment can have a substantial impact on language development and oral communication, including both comprehension issues and specific speech impediments. As recognized in the Cause-Specific Disability chapter under Physical Health, all forms of hearing-related developmental delay have the potential to affect

⁵⁰ Isbell R, Sobol J, Lindauer L et al. The effects of storytelling and story reading on the oral language complexity and story comprehension of young children. *Early Childhood Education Journal*. 2004; 32(3): 157-63.

⁵¹ MacKenzie A, Hurst M, Crompton S. Statistics Canada. Living with disability series. Available at <http://www.statcan.gc.ca/pub/11-008-x/2009002/article/11024-eng.htm>. Accessed October 2010.

⁵² Kopec JA, Williams JI, To T et al. Measuring population health: correlates of the Health Utilities Index among English and French Canadians. *Canadian Journal of Public Health*. 2000; 91(6): 465-70.

⁵³ Alcock K. The development of oral motor control and language. *Down Syndrome Research and Practice*. 2006; 11(1): 1-8.

⁵⁴ Smith A, Zelaznik HN. Development of functional synergies for speech motor coordination in childhood and adolescence. *Speech Motor Development*. 2004; 45: 22-33.

academic achievement, social functioning, and emotional well-being.^{55,56,57} This concern can be extended to any form of physical or mental disability where speech is implicated.

The second category, the range of language development among children with no diagnosed impairment, will be the main focus of this section. This is mainly because the stated context for the discussion is school readiness, that is, the learning environment as found at home, in preschool settings, etc.—in other words, the context representing the *typical* development of oral language skills. To be sure, there is responsibility for adult mentors at home (parents and other care-givers), child care workers, and preschool staff to be cognizant of the signs and symptoms of speech impediments; these conditions, sometimes referred to as specific language impairments, require referral to a professional for examination, diagnosis and potential treatment. However, it is not clear that the *main* responsibility for this type of intervention (especially the important area of early detection) rests with formal and informal educators; rather, the burden for evaluating sometimes quite subtle developmental problems must fall mostly on health professionals, that is, it represents a type of pediatric health care.^{58,59} Furthermore, wherever it may be located, medical diagnosis/therapeutic intervention certainly does not represent the beginning or the end of the attention that must be paid to encouraging verbal skill development in *all* young children. So, while recognizing the importance of early diagnosis and intervention with respect to developmental delays with some sort of biological root, typical educational opportunities to enhance oral language development will ultimately be the focus of this section.

A final scoping consideration is the decision to limit the age focus of the literature to the preschool years (age 2 to 5). The assumption is that the bulk of the opportunity to improve health and well-being related to “normal” oral language development in *infants* or *toddlers* will overlap substantially with another concept to be examined later in this report, namely, Reading by an Adult.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

⁵⁵ Effects of hearing loss on development. *American Speech-Language-Hearing Association*. Available at <http://www.asha.org/public/hearing/disorders/effects.htm>. Accessed March 2011.

⁵⁶ Meinen-Derr J, Wiley S, Choo DI. Impact of early intervention on expressive and receptive language development among young children with permanent hearing loss. *American Annals of the Deaf*. 2011; 155(5): 580-91.

⁵⁷ Thagard EK, Hilsmier AS, Easterbrooks SR. Pragmatic language in deaf and hard of hearing students: correlation with success in general education. *American Annals of the Deaf*. 2011; 155(5): 526-34.

⁵⁸ Williams J, Holmes CA. Improving the early detection of children with subtle developmental problems. *Journal of Child Health Care*. 2004; 8(1): 34-46.

⁵⁹ Vitkovitch J. Speech and language skills: their importance in development. *The Journal of Family Health Care*. 2008; 18(3): 93-5.

Date: 2000-Present Major Heading: Language Development Age: Preschool (2-5 yrs)

Search Keywords

(“Verbal Skill*” OR “Verbal Behavior*” OR “Language Development”) AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 1,523 papers in total.

Preliminary Exclusion

The 1,523 articles were scanned *by title*, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between verbal skills and some *alternate* measure of physical, psychosocial, or academic well-being, then it was excluded. This means, for instance, that papers simply investigating any link between preschool and subsequent verbal skills were deemed to be of lesser interest and therefore not pursued. Finally, because of the relatively large volume of research on the link between early verbal skills and later reading, the pertinent studies chosen were restricted to sample sizes of at least 100 children drawn from the general population.⁶⁰

After completing this first exclusion process, the list of articles was reduced to 21.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not examine verbal skill at an early age as a predictor of health or well-being outcome(s), it was excluded.

There were 18 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

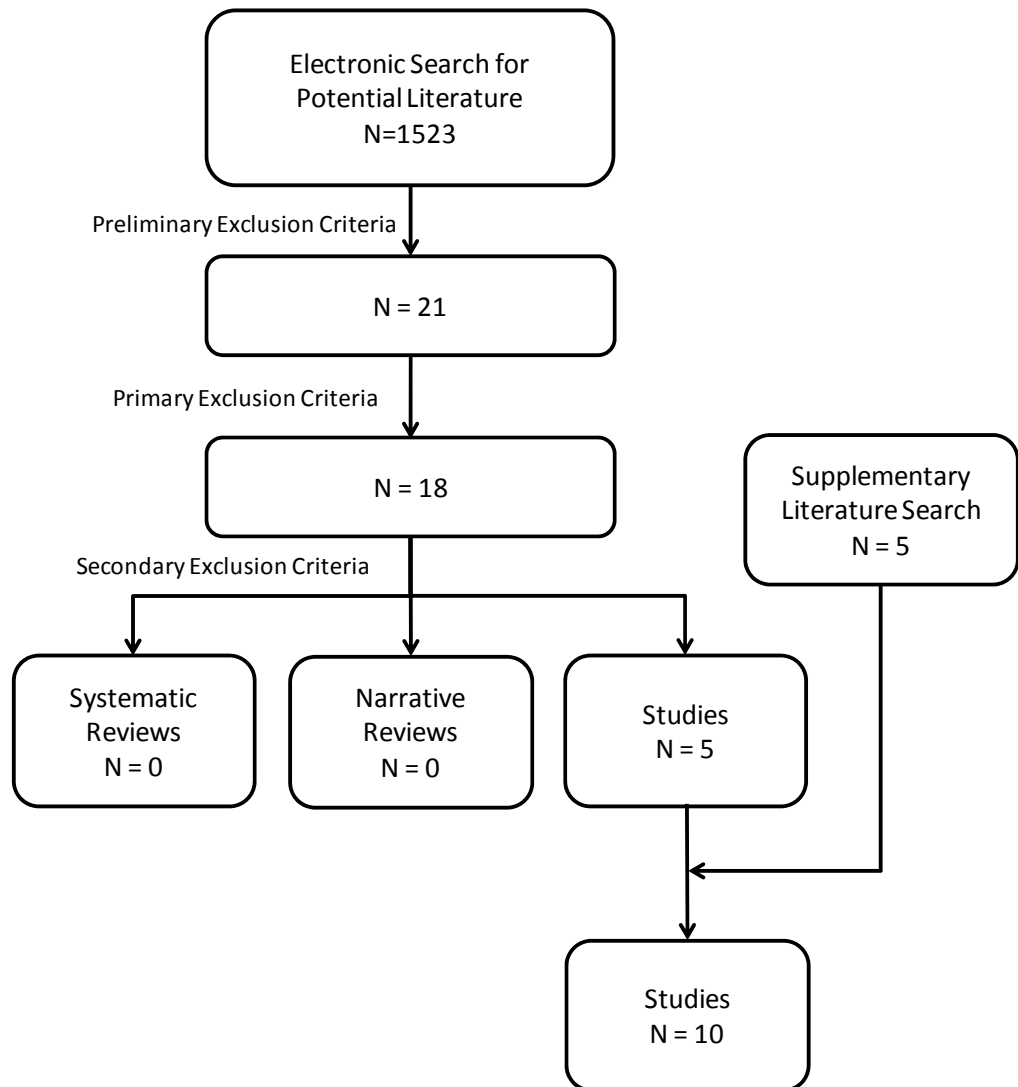
These 18 full-text articles were then reviewed in depth. Upon completion, it was determined that only 5 were relevant to the current topic and therefore included in the analysis. Five additional studies were found through a supplementary search of the literature, using specific keywords, related article utilities, bibliography scans, etc.

The literature search process is detailed in the chart below, with the 10 final articles identified and summarized in the following tables.

⁶⁰ For example, Dollaghan CA, Campbell TF. How well do poor language scores at ages 3 and 4 predict poor language scores at age 6? *International Journal of Speech-Language Pathology*. 2009; 11(5): 358-65.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Verbal Skills



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Verbal Skills*

Title of Study	Author(s)	Year	Journal	Journal Impact Factor	Type of Study	Sample Size	Sample Population	Location	Conflict of Interest
<i>Cognitive/Academic Outcomes</i>									
1 Preschool speech, language skills, and reading at 7,9, and 10 years: Etiology of the relationship	Hayiou-Thomas et al.	2010	Journal of Speech, Language, and Hearing Research	2.69	Longitudinal	1,672	Children aged 7, 8, and 10 years	U.K.	Not Stated
2 Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills	Kendeou et al.	2009	Journal of Educational Psychology	3.58	Cross-sequential	220	Children aged 4 and 6	U.S.	Not Stated
3 Population level associations between preschool vulnerability and grade-four basic skills	D'Angiulli et al.	2009	PLoS One	4.35	Cross-sectional	6,805	Kindergarten students (follow-up at grade 4)	British Columbia	None
4 Preschool cognitive and language skills predicting Kindergarten and grade 1 reading and spelling: a cross-linguistic comparison	Furnes et al.	2009	Journal of Research in Reading	0.93	Longitudinal	906	Preschool students	U.S./ Australia/ Scandinavia	Not Stated
5 Precursors of language ability and academic performance: An inter-generational, longitudinal study of at-risk children	Campisi et al.	2009	Infant and Child Development	1.25	Longitudinal	131	Children age 2 - 5 at baseline	Montreal	Not Stated
6 Literacy, numeracy, and learning in school-aged children identified as having speech, language impairment in early childhood	Harrison et al.	2009	International Journal of Speech-Language Pathology		Longitudinal	3,632	Children in early childhood	Australia	Not Stated
7 Reading trajectories of children with language difficulties from preschool through fifth grade	Skibbe et al.	2008	Language, Speech, and Hearing Services in School	1.24	Longitudinal	800	Children with language difficulties	U.S.	Not Stated
8 A longitudinal investigation of reading outcomes in children with language impairments	Catts et al.	2002	Journal of Speech, Language, and Hearing Research	2.69	Longitudinal	570	Children with language impairments	U.S.	Not Stated
<i>Sociobehavioural Outcomes</i>									
9 A longitudinal study of behavioral, emotional, and social difficulties in individuals with a history of specific language impairment (SLI)	St. Clair et al.	2011	Journal of Communication Disorders	1.94	Longitudinal	242	Children with SLI	U.K.	Not Stated
10 Psychosocial outcomes at 15 years of children with a preschool history of speech-language impairment	Snowling et al.	2006	Journal of Child Psychology and Psychiatry	4.36	Cross-sectional	71	Children age 15-16 with history of preschool language impairment	U.K.	None

Dimension: *Cognitive Development* Concept: *Verbal Skills*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
<i>Cognitive/Academic Outcomes</i>							
Hayiou-Thomas (2010)	To examine the relationship between preschool language and later reading skills	Children from the Twins Early Development Study were given a comprehensive speech and language assessment at 4½ yrs, and then retested for reading in elementary school	United Kingdom N=1672	Longitudinal Reading tested at 7, 9, and 10 years; twin analysis applied to assess the contributions of genetic and environmental factors to the reading effect	Word recognition ability comprising 2 subtests: Sight-Word Efficiency, which assesses fluency and accuracy, and Phonemic Decoding Efficiency, which assesses non-word reading	Speech and broad oral language skills at 4½ yrs showed a moderate and very stable association with reading measures at 7, 9, and 10 years.	Both genetic and environmental factors contribute to the relationship between early language skills and reading
Kendeou (2009)	To examine the development of oral language and decoding skills from preschool to early elementary school and their relation to beginning reading comprehension	Four- and 6-year-old children were tested on oral language and decoding skills and were retested 2 years later	Midwest U.S. N=113 aged 4 yrs N=108 aged 6 yrs	Cross-sequential design	Oral language skills (e.g., <i>Peabody Picture Vocabulary Test - Third Edition</i>), decoding skills (e.g., <i>Dynamic Indicators of Basic Early Literacy Skills</i>), and a reading comprehension measure	- Oral language skills at one age uniquely predicted oral language skills 2 years later for both cohorts of children (i.e., from age 4 to age 6, and from age 6 to age 8) and, likewise, decoding skills at an early age uniquely predicted decoding skills 2 years later - Oral language and decoding skills each independently predicted a child's reading comprehension in second grade	Two clusters of language skills develop early in a child's life and contribute to reading comprehension ability in early elementary school, suggesting the potential value for preschool enhancement of such basic skills to improve later literacy skills

Dimension: Cognitive Development Concept: Verbal Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
D'Angiulli (2009)	To determine if a Communication subscale in kindergarten, as measured by the Early Development Instrument (EDI), predicts numeracy, reading, and/or writing skills in fourth grade	Administrative data from four school districts were used to examine linked EDI and Foundation Skill Assessment (FSA) scores and perform a relative risk analysis.	British Columbia N = 6,805 Mean age at EDI = 5.7 yrs; mean age at FSA = 9.7 yrs	Cross-sectional analysis of longitudinal data	Preschool communication skills evaluated against -numeracy -reading -writing as measured by FSA scores Relative risk analysis performed on each domain.	Being vulnerable in terms of verbal communication results in individuals being: -2.20 times more likely to be below expectations on the numeracy component of the FSA -2.38 times more likely to be below expectations on the reading component of the FSA -2.29 times more likely to be below expectations on the writing component of the FSA	Being vulnerable in terms of verbal skills results in about 2 times greater likelihood of the student falling below expectations on the numeracy, reading, and writing components of the FSA four years later.
Furnes (2009)	To investigate the importance of various cognitive and language skills on reading and spelling development	Children assessed in preschool, kindergarten, and grade one	U.S./Australia/Scandinavia N=906	Longitudinal study	Preschool assessment of verbal memory, vocabulary, print knowledge etc. was compared against reading and spelling tests in grades K and one	Pre-reading scales such as print knowledge and phonological awareness exceeded general verbal language markers in predicting later reading and spelling ability	Consistent with some older results, verbal skills may not always be the strongest predictor of later reading competence
Campisi (2009)	To examine whether low preschool language skills persisted in the form of language-related academic achievement in early elementary school	A sample of children drawn from a larger study was assessed at an early time point (from ages 2 to 5) and later (from grades 1 to 3).	Montreal N=131	Longitudinal	- Preschool child language (French) skills were evaluated during free-play interactions between child and mother. - This predictor was correlated with language arts grades from report cards and scores from a special reading test	Children's language-related academic abilities were predicted by their expressive language at preschool age.	Underscores the potential importance of early intervention programs aimed at improving young children's language skills prior to school entry, including mechanisms focusing on parental behaviours.

Dimension: Cognitive Development Concept: Verbal Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Harrison (2009)	To examine the predictive effects of different aspects of communicative ability, and of early vs. sustained identification of speech and language impairment, on achievement and adjustment at school	Progress of a nationally representative sample followed from early childhood through to primary school, using data from the Longitudinal Study of Australian Children	Australia N=3632	Longitudinal	Teachers' ratings of language/literacy ability, numeracy/mathematical thinking and approaches to learning	Children identified as having speech and language impairment in their early childhood (age 4–5 years) did not perform as well in the key learning areas of literacy and numeracy, or in their more general approach to learning at school 2 years later	The variance explained by language differences was modest (9-12%), but “a substantial amount of unexplained variance is not unusual in this type of naturalistic, non-experimental, correlational study.”
Skibbe (2008)	To compare children with language difficulties against those with typical language in terms of trajectory of reading development	Children with language difficulties at 54 months identified via National Institute of Child Health and Human Development data. Reading skills measured at 4 time points from preschool through fifth grade.	United States N=145 N= 653 with typical language	Longitudinal Latent shape growth curve model applied	Three subtests of the WJ–R were used to characterize children's reading development: Letter-Word Identification, Word Attack, and Passage Comprehension	Children with oral language difficulties continued to exhibit reading skills that were substantially lower than those of children with typical language during fifth grade.	Evidence-based practices for teachers and/or speech pathologists ought to be employed in order to proactively target improving reading outcomes for children with language difficulties identified in preschool or at school entry.

Dimension: Cognitive Development Concept: Verbal Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Catts (2002)	To examined the reading outcomes of children with language impairments	A large subsample of children who participated in an epidemiologic study of language impairments in kindergarten was followed into second and fourth grades.	United States N=208 with language impairment N=362 without language impairment	Longitudinal	Participants' language, reading, and nonverbal cognitive abilities were assessed through a wide range of instruments, including the Peabody Picture Vocabulary Test–Revised and the Woodcock Reading Mastery Tests–Revised.	<ul style="list-style-type: none"> - Children with language impairment in kindergarten were at a high risk for reading disabilities in second and fourth grades. - The risk was higher for children with non-specific language impairment. 	The results ought to prompt appropriate program responses, especially in light of the fact that children with non-specific language impairment often do not qualify for language intervention.
Sociobehavioural Outcomes							
St. Clair (2011)	To examine the relation between specific language impairment (SLI) and behavioural, emotional and social difficulties	Behavioural and other problems were tracked in a sample of individuals with a history of SLI at four time points from childhood (age 7) to adolescence (age 16)	Manchester, UK N=242	Longitudinal	Strengths and Difficulties Questionnaire was used to measure behavioural (hyperactivity and conduct), emotional, and social (peer) problems	<ul style="list-style-type: none"> - Expressive language (and early reading) skills were related specifically to behavioural problems. - Behavioral difficulties appear to decrease to normative levels by adolescence. 	Different aspects of early language abilities (and reading skills) exert different types, degrees and durations of influence on behavioral, emotional and social difficulties.
Snowling (2006)	To assess the psychosocial adjustment in adolescence of children with history of speech-language impairment	A cohort aged 15–16 years with a preschool history of speech-language impairment were assessed for psycho-social outcomes, and compared against age-matched controls	United Kingdom N=71	Cross-sectional control group	Psychiatric interview supplemented by questionnaires probing social encounters and parental reports of behaviour and attention	<ul style="list-style-type: none"> - An elevated incidence of attention and social difficulties in the study group compared to the control group 	Amongst children with speech-language delays at 5.5 years, those with more severe and persistent language difficulties and low nonverbal IQ are at higher risk of psychiatric morbidity in adolescence.

Bibliography for Table of Studies

Hayiou-Thomas ME, Harlaar N, Dale PS et al. Preschool speech, language skills, and reading at 7, 9, and 10 years: etiology of the relationship. *Journal of Speech, Language, and Hearing Research*. 2010; 53: 311-32.

Kendeou P, White MJ, van den Broek P et al. Predicting reading comprehension in early elementary school: the independent contributions of oral language and decoding skills. *Journal of Educational Psychology*. 2009; 101: 765-78.

D'Angiulli A, Warburton W, Dahinten S et al. Population-level associations between preschool vulnerability and grade-four basic skills. *PloS one*. 2009; 4: e7692.

Furnes B, Samuelsson S. Preschool cognitive and language skills predicting Kindergarten and Grade 1 reading and spelling: a cross-linguistic comparison. *Journal of Research in Reading*. 2009; 32: 275-92.

Campisi L, Serbin LA, Stack DM et al. Precursors of language ability and academic performance: An inter-generational, longitudinal study of at-risk children. *Infant and Child Development*. 2009; 18: 377-403.

Harrison LJ, Mcleod S, Berthelsen D et al. Literacy, numeracy, and learning in school-aged children identified as having speech and language impairment in early childhood. *International Journal of Speech-Language Pathology*. 2009; 11: 392-403.

Skibbe LE, Grimm KJ, Stanton-Chapman TL et al. Reading trajectories of children with language difficulties from preschool through fifth grade. *Language, Speech, and Hearing Services in Schools*. 2008; 39: 475-86.

Catts HW, Fey ME, Tomblin JB et al. A longitudinal investigation of reading outcomes in children with language impairments. *Journal of Speech, Language, and Hearing Research*. 2002; 45: 1142-57.

St Clair MC, Pickles A, Durkin K et al. A longitudinal study of behavioral, emotional and social difficulties in individuals with a history of specific language impairment (SLI). *Journal of Communication Disorders*. 2011; 44: 186-99.

Snowling MJ, Bishop DV, Stothard SE et al. Psychosocial outcomes at 15 years of children with a preschool history of speech-language impairment. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*. 2006; 47: 759-65.

Summary of Results

The most natural division of the literature on the health effects of verbal or oral language skills involved two sets of outcomes: cognitive/academic and social behaviours.

Cognitive/Academic Outcomes

Within academic outcomes (the dominant domain across the available studies), the particular sub-domain that stands out is elementary school reading. Reading is the focal outcome of interest in about half the studies in this category; reading *combined* with other literacy and numeracy concerns occupies the balance of the research. In all but one study, general speech ability was a predictor of reading skills in early elementary school. In contrast, Furnes et al. report that the more important driver of reading ability is the level of pre-reading skills attained before kindergarten.

The research by D'Angiulli et al. based on British Columbia's Early Development Instrument (EDI) is a good example of a study linking oral language to more than reading outcomes. In fact, being vulnerable on the Communication Skills subscale of the EDI more than doubled the risk of falling below expectations in reading, writing, *and* numeracy.

Social Behaviour Outcomes

The literature with respect to preschool language abilities as a predictor of later behavioural problems is quite limited. It appears to be more common to track this relationship starting with somewhat older children.⁶¹ To augment the information, one 2011 study of 7 year-olds was included as a rare example of a longitudinal assessment starting at a relatively early age. St. Clair et al. found a relationship between language difficulties at the beginning of school and behaviour problems in later grades, but the effect appears to attenuate by the time the children reach high school. This contrasts with an earlier study that showed preschool language impairment potentially causing problems with attention and social behaviours that persist into adolescence.

Data Sources

Given the heterogeneity of the concerns and markers that fall under the heading of language, it is reasonable to settle on an instrument that clearly focuses on verbal or oral communication and, pragmatically, is already in operation in the province. As noted for the two preceding concepts in this report, a measurement that lends itself to this purpose is the Early Development Instrument (EDI) subscale that is related to Communication Skills (as well as general knowledge).

The EDI has two additional advantages pertinent to the British Columbia context. First, it has been widely used among kindergarten students in B.C. since 2001.⁶² Thus, it provides a long-term and ongoing data source that can monitor how verbal skills in this age group are changing over time. As detailed above in the results section, the second advantage is that the EDI, including the Communication Skills subscale, has been linked to relevant outcomes in B.C., specifically with respect to reading, writing, and numeracy achievement in elementary school.

⁶¹ For example, Hart KI, Fujiki M, Brinton B et al. The relationship between social behavior and severity of language impairment. *Journal of Speech, Language, and Hearing Research*. 2004:

⁶² The Human Early Learning Partnership. *The Early Development Instrument (EDI) in British Columbia*. 2008. Available at <http://www.ccl-cca.ca/pdfs/fundedresearch/Hertzman-FINAL.pdf>. Accessed September 2011.

The Human Early Learning Project website reports that, as of the 2008-09 school year, 13.2% of kindergarten children were “vulnerable” on that subscale, that is, they scored below the bottom cut-off established by school authorities.⁶³ This offers a good starting point for assessing the magnitude of this factor in the B.C. pediatric population.

Discussion

As outlined in the opening to this section, it has been important to be clear about the concept that was to be examined. The topic of verbal skills has been deemed for the present purpose to be a synonym for oral language competence, specifically to distinguish it from writing and other literacy concerns that are considered elsewhere. Not surprisingly, verbal or speech skills represent a concept that has generated a great deal of interest among researchers, as demonstrated in the good number of recent studies identified. In fact, the search terms for this concept returned among the largest provisional volume of papers for consideration of any concept in this report. The attention paid by social scientists reflects the central importance of communication to all ages and aspects of the human experience.

Technically, researchers are usually interested in one or more components of oral language, in other words, in one or more of the many skills involved with talking; this reality has led to a wide array of assessment measures being developed and applied to characterize language in preschoolers.⁶⁴ Parsing the complex elements that make up oral language ability⁶⁵ and the tests and interventions pertinent to each type of skill development (or deficit mitigation) lies outside of the main purpose of this section.

An argument was made to further scope the concept in the direction of language skills or problems in the *general population* that are created mostly by *environmental influences* in the home, in early childhood educational settings, etc., and therefore that are amenable to interventions carried out in those contexts.⁶⁶ This does not mean that specific, diagnosable language impairments of an organic nature are unimportant, or that lessons cannot be learned from that field that are applicable to “normal” children who are experiencing atypical language development. Whatever their origin, it is clear that persistent communication deficits are a substantial concern for the individual involved and for society as a whole. As noted by one reviewer,

*Difficulties affecting the development of speech and language in children are considered to be the most common of paediatric disabilities and may have long-lasting effects on social skills, behaviour, education and employment.*⁶⁷

The actual evidence developed in this section concerning the impact on child/youth well-being of verbal skills acquired by the point of school entry centred on two domains tracked

⁶³ D'Angiulli A, Warburton W, Dahinten S et al. Population-level associations between preschool vulnerability and grade-four basic skills. *Plos One*. 2009; 4(11):

⁶⁴ Dockrell JE. Assessing language skills in preschool children. *Child Psychology and Psychiatry Review*. 2001; 6(2): 74-85.

⁶⁵ Aguilar-Mediavilla EM, Sanz-Torrent M, Serra-Raventos M. A comparative study of the phonology of pre-school children with specific language impairment (SLI), language delay(LD) and normal acquisition. *Clinical Linguistics and Phonetics*. 2002; 16(8): 573-96.

⁶⁶ On this distinction, see Dyck M, Pick J. How to distinguish normal from disordered children with poor language or motor skills. *International Journal of Language and Communication Disorders*. 2010; 45(3): 336-44.

⁶⁷ Vitkovitch J. Speech and language skills: their importance in development. *The Journal of Family Health Care*. 2008; 18(3): 93-5.

into the early elementary school years, as follows: (i) cognitive/academic outcomes and (ii) social behaviours. This dual focus was in fact confirmed in a brief 2006 review published in the grey literature on behalf of the Canadian Language & Literacy Research Network, which concluded that “the prominent research questions have been concerned with the extent to which aspects of early language status are predictive of later reading and behaviour problems and what the possible bases might be for these relationships.”⁶⁸

Support for an effect in the reading area is reasonably strong. However, it must be acknowledged that it represents at best a limited, moderately persuasive picture. For instance, there is little surprise in the fact that weak oral language development at school entry translates into weaker academic achievement in the realm of reading and writing; in a similar vein, it is not unexpected to find a strong overlap between specific language impairment and specific reading disability.⁶⁹ There is high plausibility attached to the assertion (even before being explicitly demonstrated) that “oral language ability facilitates both word recognition and reading comprehension.”⁷⁰ Despite support for such a case, there is not a uniform voice in the literature about the exact connection between oral language and reading. A competing conclusion about etiology is certainly plausible, namely, that pre-reading skills such as phonological awareness and decoding are more important than skills related to oral language per se.⁷¹ Pre-reading is the one basic component of school readiness that was not assigned as a concept for this project. Another proposal is that varied language skills interact with early literacy knowledge to influence later reading achievement.⁷² A third argument looks for a common developmental delay that would simultaneously explain gaps in oral language and reading skills. Hayiou-Thomas et al. sum up this position, noting that finding a genetic or other type of association

...does not in itself elucidate the causal mechanisms by which speech or language skills are linked to reading. It is possible that genetic factors affect speech and language skills, which themselves directly support reading; however, it is also possible that genetic influences work on a general shared resource that both speech or language and reading draw upon, without a direct causal link between the two.

The motivation to investigate causal mechanisms in this way is to improve the odds that an intervention targeting a factor such as oral language impairment will generate the intended collateral benefits in terms of, say, later reading achievement.

The jury is even more firmly “out” in the ongoing debate about the (quite limited) evidence of a link between oral language and social behaviours. While according to Hartras “there are strong theoretical and empirical grounds for the association between language and behavioural, social, and emotional difficulties,” the evidence to date does not consistently

⁶⁸ Tomblin B. Literacy as an outcome of language development and its impact on children's psychosocial and emotional development. 2006. Available at <http://literacyencyclopedia.ca/index.php?fa=items.show&topicId=7>. Accessed September 2011.

⁶⁹ McArthur GM, Hogben JH, Edwards VT et al. On the “specifics” of specific reading disability and specific language impairment. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*. 2000; 41(7): 869-74.

⁷⁰ Skibbe LE, Grimm KJ, Stanton-Chapman TL et al. Reading trajectories of children with language difficulties from preschool through fifth grade. *Language, Speech, and Hearing Services in Schools*. 2008; 39(4): 475-86.

⁷¹ In this regard, see also Storch SA, Whitehurst GJ. Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental psychology*. 2002; 38(6): 934-47.

⁷² Dickinson DK, McCabe A, Anastasopoulos L et al. The comprehensive language approach to early literacy: The interrelationships among vocabulary, phonological sensitivity, and print knowledge among preschool-aged children. *Journal of Educational Psychology*. 2003; 95(3): 465-81.

support such a connection.⁷³ Hartas actually studied a younger cohort not eligible for inclusion in this section, but the conclusion of her study is still salient. She notes that there can be a big gap between parental assessments of behaviour in their children and those of a teacher, with a bias in an institutional setting towards interpreting, for example, good oral vocabulary as an expression of positive social behaviour. In her view, parents are less “fooled” by precocious speech when assessing their child’s social cognition and competence!

Understanding the potential causal connection between language development and current or future social behaviour also represents a complex task. Hartas follows other authorities⁷⁴ in locating the mechanism for both oral language and sociobehavioural skills in another factor mentioned earlier in this report, namely, emotion-related self-regulation. She concludes her study with this observation: “Young children who lack self-regulatory skills and social competence find it difficult to learn and relate socially to others in early years settings and after their transition to school.”⁷⁵

Conclusion

With respect to oral language skills as a driver, it is only the outcomes in the cognitive/academic realm, and particularly early reading ability, that are supportable with any degree of confidence. Is this enough to propel verbal skills to a high level of consideration as an indicator of child health and well-being? In sum, while elementary school achievement is certainly important as an outcome, it is unfortunate that the phenomenon of weak or strong verbal skills in preschool has not been tracked over a longer time period and/or into manifestly different domains such as physical or mental health.

The best that can be said is that the outcomes measured in early elementary school, such as academic achievement (and perhaps social behaviours), may in turn drive other health and well-being impacts in later years. However, even this indirect argument represents a sort of “closed loop.” As shown in a previous section of the report, the most studied subsequent effect of current social behaviours has in fact been in the realm of academic achievement. This leaves the cognitive/academic domain as the main focus for further consideration. If a health and well-being effect attributable to reading in elementary grades could be demonstrated, then additional (albeit indirect) traction would be added to maintaining preschool verbal language skills as a key concept/indicator of well-being. In fact, this very evidence will be pursued in a later section of the report focusing on the concept Children Reading and Writing.

⁷³ Hartas D. Children's language and behavioural, social and emotional difficulties and prosocial behaviour during the toddler years and at school entry. *British Journal of Special Education*. 2011; 38(2): 83-91.

⁷⁴ For example, Eisenberg N, Sadovsky A, Spinrad TL. Associations of emotion-related regulation with language skills, emotion knowledge, and academic outcomes. *New Directions for Child and Adolescent Development*. 2005; (109): 109-18.

⁷⁵ Hartas D. Children's language and behavioural, social and emotional difficulties and prosocial behaviour during the toddler years and at school entry. *British Journal of Special Education*. 2011; 38(2): 83-91.

Summary Assessment					
Verbal Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
5-19	98,574	High	Medium	High	High

As summarized in the above table, assessments have been applied to the Verbal Skills concept. Specifically, the indicator adopted for consideration is the Communication Skills subscale of the Early Development Instrument (EDI).

The pediatric population **Magnitude** of the potential indicator is assessed as **High**. Based on data from the EDI, 13.2% of children of kindergarten age are deemed vulnerable in the area of Communication Skills. This rate was applied to the entire pediatric cohort aged 5-19 years, yielding an estimate of 98,574 vulnerable individuals. This rate was applied to the entire cohort aged 5-19, rather than just those of kindergarten age, because those that are vulnerable at this early age are susceptible to adverse health and well-being outcomes the assumption is that, in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability would persist. The resulting estimate of 98,574 individuals is greater than 10% (97,000) of the total pediatric cohort, resulting in a Magnitude classification of high.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. While the evidence does show correlations between lower Verbal Skills and negative health and well-being outcomes, the bulk of the evidence appears to focus on elementary school educational achievement, which is a step removed from health and well-being more broadly understood. Moreover, as outlined in the Discussion, the causal connections between oral language and later reading ability are not well-established.

The **Modifiability** of the potential indicator is assessed as **High**. There are many interventions and a large volume of research related to improving verbal skills in preschool, whether the gaps to be addressed are in otherwise typically developing children or in those with some specific disorder. For instance, as reported in another part of this project, there is evidence to suggest that some skills that are normally acquired within the earliest developmental window, but that are delayed by hearing impairment, can be learned in the preschool years or later. This means that early detection has the potential to help children catch up with their peers, even after a late start.

Data Availability/Reliability for the potential indicator is assessed as **High**. Data from the EDI are collected annually through teacher observations of kindergarten-aged children across the province.

Based on the indicated assessment suggesting a mostly high ranking, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being. Notwithstanding the limited domain of the evidence and complications concerning causality, the fundamental importance of language for human development suggests that, of all potential preschool indicators of future well-being, this concept represents a good one on which to focus.

Copying and Writing Skills

*Failure to attain handwriting competency during the school-age years often has far-reaching negative effects on both academic success and self-esteem.*⁷⁶

This section will examine the assigned concept of Copying and Writing Skills. Since it is situated under the dimension Readiness to Learn, the assumption will be that the age focus is preschool. In other words, the concept refers to the earliest development of handwriting abilities, as opposed to the more general category of communication via written expression.

Background and Context

Handwriting is a complex occupational task that develops “along a continuum from scribbling to conventional spelling.”⁷⁷ Montreal researchers Feder and Majnemer have identified the many underlying component skills that may influence handwriting performance, as follows: fine motor control, bilateral and visual-motor integration, motor planning, in-hand manipulation, proprioception, visual perception, sustained attention, and sensory awareness of the fingers.⁷⁸ According to a number of studies, visual-motor integration (a species of the motor skills domain) is especially important as a predictor of handwriting skill levels in young children.^{79,80,81} Similar conclusions have been drawn for languages beyond English.⁸² This phenomenon once again points to the importance of considering the various aspects of readiness to learn (e.g., from motor skills to writing skills) in an integrated manner, and the potential value of a global measure for that concept (see further in the section below on Readiness to Learn).

Similar to the concept Verbal Skills covered in the previous section of the report, it is useful to distinguish intrinsic factors (such as genetically-based biomechanical problems) from environmental influences in terms of handwriting development. The latter category is more related to a general population perspective, which is the focus of the present project. The ultimate purpose is to guide the choice and implementation of interventions in a routine preschool context that will improve handwriting across the whole population at that age level. As with all the concepts in this project, it is important to understand how important such a program might be in terms of eventual effects on health and well-being. In the event that the significance of the concept in this sense turns out to be deemed to be reasonably high, then it becomes more critical to establish the availability and/or feasibility of a pertinent population-level indicator of handwriting skills. Pursuing each of these items will occupy the balance of this section of the report.

⁷⁶ Feder KP, Majnemer A. Handwriting development, competency, and intervention. *Developmental Medicine and Child Neurology*. 2007; 49: 312-7.

⁷⁷ Puranik CS, Lonigan CJ. From scribbles to scrabble: preschool children's developing knowledge of written language. *Reading and Writing*. 2011; 24: 567-89.

⁷⁸ Feder KP, Majnemer A. Handwriting development, competency, and intervention. *Developmental Medicine and Child Neurology*. 2007; 49: 312-7.

⁷⁹ Volman MJ, van Schendel BM, Jongmans MJ. Handwriting difficulties in primary school children: a search for underlying mechanisms. *The American Journal of Occupational Therapy*. 2006; 60(4): 451-60.

⁸⁰ Daly CJ, Kelley GT, Krauss A. Relationship between visual-motor integration and handwriting skills of children in kindergarten: a modified replication study. *The American Journal of Occupational Therapy*. 2003; 57(4): 459-62.

⁸¹ Marr D, Cermak S. Predicting handwriting performance of early elementary students with the developmental test of visual-motor integration. *Perceptual and Motor Skills*. 2002; 95(2): 661-9.

⁸² Maki HS, Voeten MJM, Vauras MMS et al. Predicting writing skill development with word recognition and preschool readiness skills. *Reading and Writing*. 2001; 14(7-8): 643-72.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Writing Skills *Age:* Preschool (age 2-5 yrs)

Search Keywords

(Writing OR Copying OR Handwriting) **AND**

(Skill* OR Ability OR Abilities OR Competence OR Letter*) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 117 papers in total.

Preliminary Exclusion

The 117 articles were scanned *by title* by two reviewers working independently, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between handwriting skills and a physical health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 3.

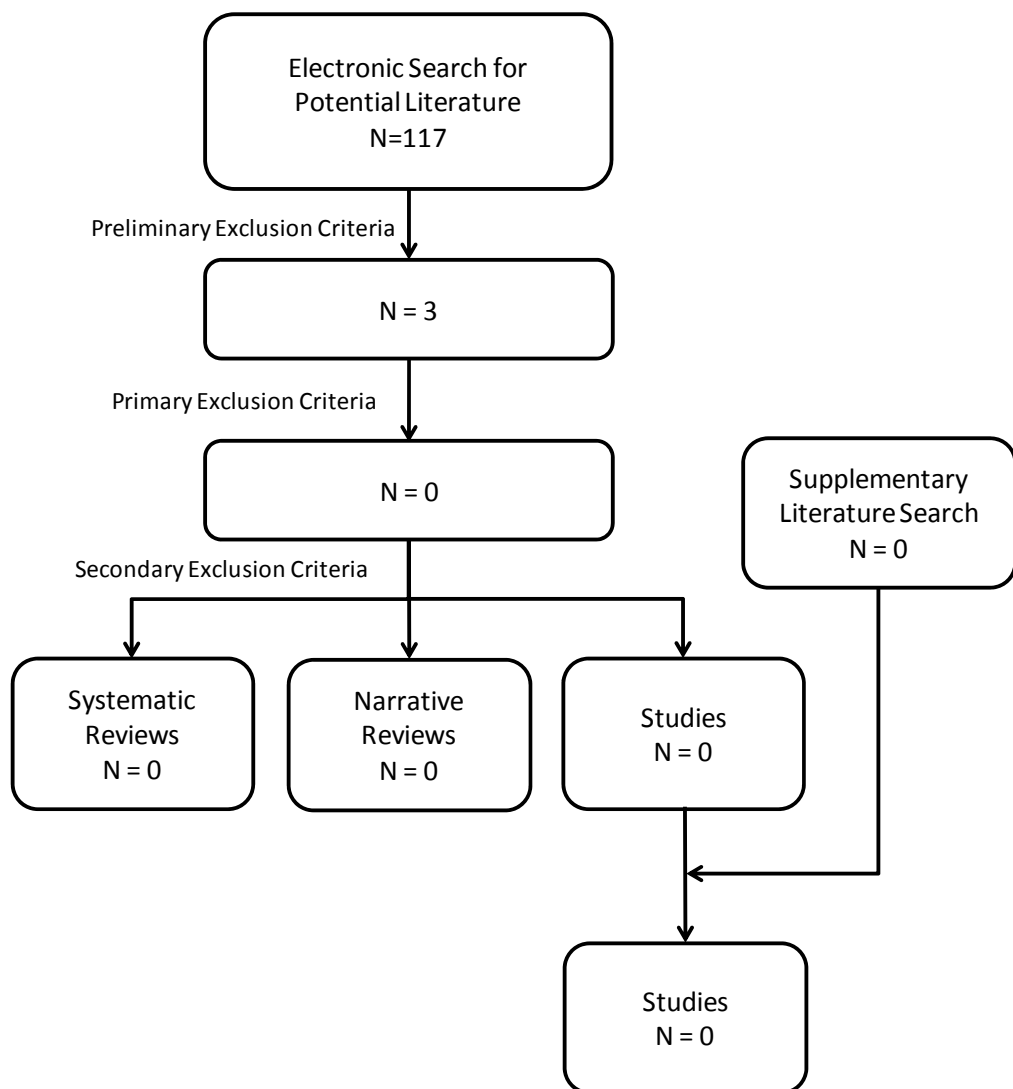
Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link handwriting skills in the preschool years with later health and well-being outcome(s), it was excluded. To be of interest, the outcome had to extend beyond the world of writing and written language *per se*; any reports involving later academic achievements in fields other than writing were deemed to be of interest, and therefore would have been included. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

There were no articles remaining in the list following the primary exclusion step, thus a secondary exclusion step was not required. Upon completion of the unproductive systematic review (summarized below), a supplemental search via Google, in the grey literature, etc. was pursued. Again, pertinent materials were not located.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Copying/Writing Skills



Data Sources

The Early Development Instrument (EDI) that has been deemed useful for tracking prior concepts in this project is not as helpful for Copying and Writing Skills. The Language and Cognitive Development scale of the EDI does not include any questions directly related to copying abilities; there are only 4 questions (out of 40 in this part of the instrument) pertinent to handwriting skills, as follows:

1. The child is aware of writing directions in English (left to right, top to bottom)
2. The child is able to write own name in English
3. The child is able to write simple words
4. The child is able to write simple sentences

However, these items do not appear to be reflected in any writing- or literacy-specific subscale in the Canadian context, unlike the system developed for EDI in Australia.⁸³ In short, the Language and Cognitive Development domain of the EDI as an aggregate score is not specific enough for a concept related to Copying and Writing.

A number of copying and/or early writing measurement instruments have been developed by researchers, such as the Scale of Children's Readiness in Printing (SCRIPT) and the Minnesota Handwriting Assessment; the latter has been adapted to a computer-based scoring application and recently tested in a Canadian setting.⁸⁴

A copying and emergent writing assessment tool that has been widely used in Canada is the *Who Am I?* instrument. Originally developed in Australia, the format consists of a booklet in which the child is asked to:

- Write their name
- Copy a series of simple shapes (a circle, a cross, a square, a triangle, and a diamond)
- Write some numbers, letters, words, and a sentence
- Draw a picture of themselves

Responses to the various tasks are used to construct three scales, a Copying Scale, a Symbols Scale, and a Drawing Scale. The scores on all three scales can be summed to provide an overall total; alternately, scores on the Copying Scale and the Symbols Scale can be combined to provide an overall score for these two scales only, as in the case of the Canadian adaptation of this instrument.⁸⁵

A key application of *Who Am I?* is in the National Longitudinal Survey of Children and Youth (NLSCY), a long-term Canadian project outlined in the Introduction to the report. Based on the NLSCY, an indicator has been developed that is defined as the proportion of

⁸³ Brinkman S, Sayers M, Goldfeld S et al. Population monitoring of language and cognitive development in Australia: The Australia Early Development Index. *International Journal of Speech-Language Pathology*. 2009; 11(5): 419-30.

⁸⁴ Falk TH, Tam C, Schellnus H et al. On the development of a computer-based handwriting assessment tool to objectively quantify handwriting proficiency in children. *Computer Methods and Programs in Biomedicine*. 2011: E-published ahead of print.

⁸⁵ See Patterns of Young Children's Development: An International Comparison of Development as Assessed by *Who Am I?* Available at <http://www.hrsdc.gc.ca/eng/cs/sp/sdc/pkrf/publications/research/2002-002358/page12.shtml>. Accessed October 2011.

children 4-5 years of age who display advanced, average, or delayed levels of copying and writing skills. In this case, “delayed” means scoring from 0-84 on the scale combining copying and writing skill levels; the threshold of 84 represents one standard deviation below the mean.

The latest information for this indicator readily available for children in B.C. is for the NLSCY Cycle 5 (2002/03). According to the data gathered that year, 10.9% of B.C. children aged 4-5 years displayed delayed levels of copying and writing skills. Presumably, the information from more recent cycles of the NLSCY would be obtainable on request. In the meantime, the 2002/03 data do allow for a magnitude estimate for the present purpose, but the apparent curtailment of the NLSCY project means that it cannot be a source for future indicator development and tracking.

Discussion

As might be expected, difficulties with writing in preschool and kindergarten have been shown to have an impact on later writing abilities, at least into the earliest years of elementary school.⁸⁶ The explanation for the dearth of literature demonstrating a more comprehensive and/or durable effect on well-being related to this concept is not immediately clear. The most obvious potential reason for limited research is that early copying and writing delays (and their short-term consequences) are presumed to be reversible for the majority of children involved.

When a broader impact of writing problems has been detected, it appears to be restricted to the realm of academic achievement. Moreover, the preponderance of the literature on the link between handwriting skills and general academic performance is relatively old, dating back 20 years or more.⁸⁷ The one exception appears to be the specific skill of writing one’s name, which has often been tested as a milestone of emergent writing. Even here the evidence of an effect related to a delay in learning how to write one’s name appears to be restricted to concurrent rather than future language abilities.^{88,89,90} One recent study suggested that, if employed at all as a preschool assessment indicator, name writing “should be used as a measure of mechanical skill only and should not be used as a means to assess children’s conceptual knowledge (of letter names, letter sounds, or the alphabetic principle).”⁹¹

The general datedness of the research in this field is a reflection of either the fact that it is a topic with completely established conclusions or that the area is in fact becoming somewhat passé. Perhaps more than for any other concept in this report, the importance of handwriting

⁸⁶ For example, Marr D, Cermak S. Consistency of handwriting in early elementary students. *The American Journal of Occupational Therapy*. 2003; 57(2): 161-7.

⁸⁷ For example, Simner ML. Estimating a child’s learning potential from form errors in a child’s printing. In: Wann J, Wing A, Sovik N, eds. *Development of Graphic Skills: Research Perspectives, and Educational Implications*. London: Academic Press; 1991.

⁸⁸ Puranik CS, Lonigan CJ. Name-writing proficiency, not length of name, is associated with preschool children’s emergent literacy skills. *Early Childhood Research Quarterly*. 2011: E-published ahead of print.

⁸⁹ Cabell SQ, Justice LM, Zucker TA et al. Emergent name-writing abilities of preschool-age children with language impairment. *Language, Speech, and Hearing Services in Schools*. 2009; 40(1): 53-66.

⁹⁰ Haney MR, Bissonnette V, Behnken KL. The relationship among name writing and early literacy skills in kindergarten children. *Child Study Journal*. 2003; 33(2): 99-115.

⁹¹ Drouin M, Harmon J. Name writing and letter knowledge in preschoolers: Incongruities in skills and the usefulness of name writing as a developmental indicator. *Early childhood research quarterly*. 2009; 24(3): 263-70.

(whether printing or cursive) appears to be increasingly a “moving target” because of the pressure from technological change.⁹² Here of course the issue is the encroachment on traditional handwriting by word processing—either via keystroke entries on a keyboard or via touching a screen. And technology itself is not static; if anything, the pace of change is accelerating. Fifty years ago, the debate among educators was whether using typewriters would replace handwriting.⁹³ Today, voice recognition/transcription software, combined with either traditional or computer-aided editing, is threatening to eventually make composition by manual keyboarding an old-fashioned mode of writing.

A recent on-line report noted that over 40 states in the U.S. have adopted the Common Core State Standards for English, which in fact omit cursive handwriting from required curriculum. Now that it is not mandatory, there are schools and school systems around the country that are “are debating whether or not to spend valuable teaching resources on classic penmanship.”⁹⁴ Although cursive writing or penmanship skills are a step beyond manual printing, it is likely that the “writing is on the wall” for handprinting as well, at least in terms of the degree of emphasis put on all forms of copying and writing skills in preschool and early elementary school.

Conclusion

Whatever the future of handwriting as a focus in the preschool and elementary school curriculum, some recognition of its importance will persist in specialized instances of elementary language learning, such as reinforcing the pattern of reading from left to right, entrenching letter shapes (especially in English-as-a-second-language students), and overcoming the deficits related to certain language disabilities.⁹⁵ Generally, however, the literature does not suggest a great deal of support for this concept as a marker of later pediatric health and well-being.

Summary Assessment Copying and Writing Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
4-19	86,187	Medium	Low	High	Low

As summarized above, assessments have been applied to the Copying and Writing Skills concept. Specifically, the indicator adopted for consideration is the Copying Skills and Writing Tasks component of the National Longitudinal Survey of Children and Youth.

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. Based on data from the NLSCY, 10.9% of children of preschool age in B.C. are deemed to be delayed in copying and writing skills. This rate was applied to the entire pediatric cohort aged

⁹² Should Cursive Handwriting Still Be Taught In Schools? Available at <http://drs.dadeschools.net/InformationCapsules/IC0916.pdf>. Accessed October 2011.

⁹³ Templin EM. How important is handwriting today? *The Elementary School Journal*. 1960; 61(3): 158-64.

⁹⁴ See Association of American Educators webpage at <http://www.aaeteachers.org/index.php/blog/395-the-great-cursive-debate>, Accessed October 2011.

⁹⁵ Longcamp M, Boucard C, Gilhodes JC et al. Remembering the orientation of newly learned characters depends on the associated writing knowledge: a comparison between handwriting and typing. *Human Movement Science*. 2006; 25(4-5): 646-56.

4 - 19, yielding an estimate of 86,187 vulnerable individuals. This rate was applied to the entire cohort aged 4 -19, rather than just those aged 4-5 years, on the presumption that anyone with vulnerability at this early age, and not helped through early intervention, may be susceptible to some adverse health and well-being outcomes that persist throughout life. The resulting estimate of 86,187 individuals is between 2-10% (19,000-97,000) of the total pediatric cohort, resulting in a Magnitude classification of Medium.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Low**. There is very little indication in the literature that the adverse effects of copying and writing problems for the affected children extend very far beyond academic achievement levels in early elementary school. It is useful to recall that a Low rating on significance/impact does not rule out a broad and persistent well-being effect for this concept, but only shows that evidence for such an effect has not yet been developed.

The **Modifiability** of the potential indicator is assessed as **High**. Interventions that address writing difficulties are long-established in the educational and therapeutic settings; most of these appear to focus on motor skills related to writing.^{96,97}

Data Availability/Quality for the potential indicator is assessed as **Low**. The NLSCY, which offered information for a magnitude calculation, is likely not continuing and therefore cannot be the basis for indicator development and tracking.

Based on the indicated assessment, and especially the Low rating for significance/impact and data reliability/quality, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

⁹⁶ Ratzon NZ, Efraim D, Bart O. A short-term graphomotor program for improving writing readiness skills of first-grade students. *The American Journal of Occupational Therapy*. 2007; 61(4): 399-405.

⁹⁷ Asher AV. Handwriting instruction in elementary schools. *The American Journal of Occupational Therapy*. 2006; 60(4): 461-71.

Number Knowledge Skills

Background and Context

This section will evaluate the assigned concept of number knowledge skills. Number knowledge skills (also referred to as “number competence,” “number sense,” or simply, “numeracy”) refer to the “... ability to apprehend the value of small quantities immediately, make judgments about numbers and their magnitudes, grasp counting principles, and join and separate sets.”⁹⁸ Ultimately, number skills allowed children to make connections among mathematical relationships, principles, and procedures; indeed, many mathematical difficulties in elementary school have been traced back to weaknesses in understanding the meaning of numbers and number relationships.

The development of number skills begins long before the start of formal education; at an early age, children develop in an environment rich in numerical experiences. They hear adults using numbers to count and measure, to tell the time and, eventually, they begin to count and complete basic calculations on their own.⁹⁹ These differential developmental experiences can result in wide variances in mathematical knowledge between children at the beginning of formal education.^{100,101} Specific environmental factors such as socioeconomic status, culture, language, in addition to genetics factors and developmental and learning disabilities have often been cited as specific causes of variation in mathematics achievement^{102,103,104}

In the current section, numeracy and mathematics skills at the beginning of formal education (pre-school/kindergarten) will be evaluated against health and well-being outcomes. In anticipation of two concepts that will be evaluated later in this report, *children numeracy* and *youth math proficiency*, outcomes that pertain to mathematics will be included in the analysis. There is evidence that math difficulties are cumulative, with difficulties in whole numbers serving as an obstacle to learning fractions, and difficulties with fractions leading to failure in algebra.¹⁰⁵ Including this line of evidence will allow us to track numeracy and mathematics throughout the developmental trajectory of childhood and adolescence, alongside the associated health and well-being outcomes.

In addition to investigating the associations between *number knowledge skills* and health and well-being outcomes, targeted interventions to improve numeracy and mathematics will be evaluated. We will also aim to answer the following questions; Are the persistence of deficits

⁹⁸ Jordan NC, Kaplan D, Ramineni C et al. Early math matters: kindergarten number competence and later mathematics outcomes. *Developmental Psychology*. 2009; 45(3): 850-67.

⁹⁹ Rousselle L, Noel MP. Basic numerical skills in children with mathematics learning disabilities: a comparison of symbolic vs non-symbolic number magnitude processing. *Cognition*. 2007; 102(3): 361-95.

¹⁰⁰ Klibanoff RS, Levine SC, Huttenlocher J et al. Preschool children's mathematical knowledge: The effect of teacher "math talk." *Developmental Psychology*. 2006; 42(1): 59-69.

¹⁰¹ Dowker A. Individual differences in numerical abilities in preschoolers. *Developmental Science*. 2008; 11(5): 650-4.

¹⁰² Rousselle L, Noel MP. Basic numerical skills in children with mathematics learning disabilities: a comparison of symbolic vs non-symbolic number magnitude processing. *Cognition*. 2007; 102(3): 361-95.

¹⁰³ Jordan NC, Levine SC. Socioeconomic variation, number competence, and mathematics learning difficulties in young children. *Developmental Disabilities Research Reviews*. 2009; 15(1): 60-8.

¹⁰⁴ Jordan NC, Glutting J, Ramineni C. The Importance of Number Sense to Mathematics Achievement in First and Third Grades. *Learning and Individual Differences*. 2010; 20(2): 82-8.

¹⁰⁵ National Mathematics Advisory Panel. *Foundations for success*. 2008. Available at <http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf>. Accessed September 2011.

inevitable barring targeted interventions? Or are those behind their peers at the entrance to formal education able to catch-up?

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Numeracy

Search Keywords

("Number Knowledge" OR "Number Skill" OR Numeracy OR Counting OR Arithmetic)
AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR
"Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare"
OR Outcome*) **AND**

(Child or Youth OR Adolescent OR Teen)

This search returned 517 unique papers in total.

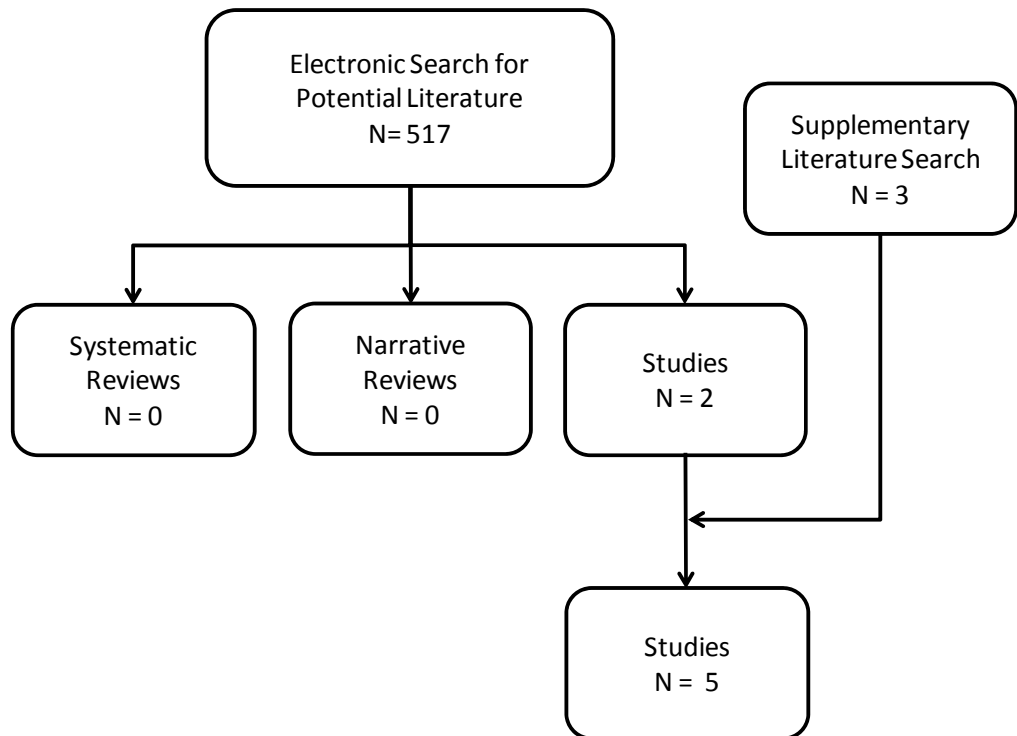
Preliminary Exclusion

The 517 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between number knowledge skills and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, there were only 2 pertinent studies identified. These studies were reviewed in full-text format and deemed appropriate for the current analysis. At this point, a naive search of the grey literature and academic literature was undertaken. This supplementary search identified three additional studies.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Number Knowledge Skills



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Number Knowledge Skills*

Title of Study	Author(s)	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
1 School readiness and later achievement: Replication and extension using a nationwide Canadian survey	Romano et al.	2010	Developmental Psychology	3.41	Cross-sectional	1,688	Kindergarten students (follow-up at grade 3)	Canada	Not Stated
2 School readiness and later achievement: A french Canadian replication and extension	Pagani et al.	2010	Developmental Psychology	3.41	Cross-sectional	2,800	Kindergarten students (follow-up at grade 2)	Canada (Quebec)	Not Stated
3 The importance of number sense to mathematics achievement in first and third grades	Jordan et al.	2010	Learning and Individual Differences	2.01	Longitudinal	1,279	Grade 1 students (follow-up grades 1 and 3)	Delaware, USA	Not Stated
4 Early math matters: Kindergarten number competence and later mathematics outcomes	Jordan et al.	2009	Developmental Psychology	3.41	Longitudinal	378	Kindergarten students (follow-up through grade 3)	Delaware, USA	Not Stated
5 School readiness and later achievement	Duncan et al.	2007	Development Pyschology	3.41	Cross-sectional	45,000	Kindergarten students	USA, Canada, UK	Not Stated

Dimension: *Cognitive Development* Concept: *Number Knowledge Skills*

Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Romano (2010)	To examine the influence of kindergarten literacy and math skills, mother-reported attention, and mother-reported socioemotional behaviours on 3 rd -grade math and reading outcomes.	Two sets of Canadian data on youth, the National Longitudinal Survey of Children and Youth (NLSCY) and the Montreal Longitudinal-Experimental Preschool Study (MLEPS), were analyzed, with kindergarten academic, behavioural, and socioemotional inputs correlated against 3 rd -grade math and reading outcomes	NLSCY Canada N = 1,688 children in Kindergarten (baseline) MLEPS Montreal, Canada N=767 children in Kindergarten (baseline)	Cross-sectional study of longitudinal data	NLSCY -Reading skills (mother-reported) -Math skills (test score) -Behavioural/social skills (attentive behaviour, interpersonal skills, externalizing/internalizing problems, hyperactivity/impulsivity (mother-reported scores) MLEPS -Behavioural/social skills (attentive behaviour, interpersonal skills, externalizing/internalizing problems, hyperactivity/impulsivity (mother-reported scores)	NLSCY -Kindergarten math skills significantly predicted better third-grade math and reading achievement. -Math skills were the strongest predictor of later reading -Math skills were positively and significantly associated with attentive behaviour, and negatively significantly associated with externalizing and internalizing problems, and hyperactivity/impulsivity. MLEPS -Kindergarten math skills were positively and significantly predictive of third-grade math achievement -Kindergarten math skills were negatively and significantly associated with externalizing problems at the end of third-grade.	Both datasets suggest that kindergarten math is a significant predictor of grade-3 academic achievement in math and reading; strong math skills are also positively associated with desirable socioemotional and behavioural outcomes.

Dimension: Cognitive Development Concept: Number Knowledge Skills
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Pagani (2010)	To examine the influence of kindergarten math skills (number knowledge test) on reading, math, verbal, and general academic achievement at the end of second grade.	Two sets of Canadian data on children, the Quebec Longitudinal Study of Child Development (QLSCD) and the Montreal Longitudinal-Experimental Preschool Study (MLEPS), were analyzed, with kindergarten attention, socioemotional (externalizing/ internalizing behaviours, and social skills) inputs correlated against 2nd-grade academic outcomes.	QLSCD Quebec N = 1,977 children in Kindergarten (baseline) MLEPS Montreal N=767 children in Kindergarten (baseline)	Cross-sectional study of longitudinal data	QLSCD -Reading, Math and General (teacher-rated achievement) -Classroom engagement MLEPS Verbal and Math (teacher-rated achievement)	QLSCD -Math skills significantly, positively predicted later math, reading and general academic achievement, in addition to classroom engagement. MLEPS - Math skills positively predicted later math, but not verbal, achievement	-Kindergarten math skills are a significant predictor of math, reading and academic achievement in grade 2.
Jordan (2010)	To determine the predictive validity of a number sense screening tool on mathematics achievement at the first and third grades.	Children were screened with the Number Sense Brief (NSB) at the beginning of first grade; mathematics outcomes were obtained at the end of first and third grades.	Delaware, USA N=1,279 (baseline)	Longitudinal	-Mathematics Achievement (Woodcock-Johnson III)	-All correlations between NSB scores at the beginning of first grade and the end of first grade and third grade were significant (p<0.01)	-Number sense at the beginning of grade 1 predicts mathematics achievement at the end of grade 1 and grade 3.
Jordan (2009)	To examine the predictive relationship between early number competence and later mathematics achievement.	Children were assessed 11 times between kindergarten and the 3 rd grade; six number measures (K + grade 1), five math measures (grades 1, 2, and 3).	Delaware, USA N=378 (baseline)	Longitudinal	-Number Competence (Number Competence Core Battery) -Mathematics Achievement (Woodcock-Johnson III)	-Number competence in kindergarten is significantly correlated with later math achievement across all time points (grade 1 spring, grade 2 fall, spring, grade 3 fall spring).	-Kindergarten number competence significantly, positively predicts later math achievement between grades 1 and 3.

Dimension: *Cognitive Development* Concept: *Number Knowledge Skills*

Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Duncan (2007)	To assess the association between skills and behaviours that emerge during the preschool years and later academic achievement.	Six longitudinal datasets from the US, Canada, and the UK Academic, attention, and socioemotional skills were compared against later school reading and math achievement. This data was combined in a meta-analysis.	USA, Canada, UK N=45,000 Children aged 4-6 (kindergarten) at baseline	Cross-sectional evaluation of longitudinal data	-Math achievement -Reading achievement	-Meta-analysis of the six studies found that early math concepts were the most powerful predictors of later learning. -Early math is as powerful a predictor of later reading achievement as early reading achievement. -These significant correlations between early math and later math and reading achievement are maintained until 13-14 years of age.	Math skills are a powerful predictor of later academic achievement in math and reading.

Bibliography for Table of Studies

Romano E, Babchishin L, Pagani LS et al. School readiness and later achievement: replication and extension using a nationwide Canadian survey. *Developmental Psychology*. 2010; 46: 995-1007.

Pagani LS, Fitzpatrick C, Archambault I et al. School readiness and later achievement: a French Canadian replication and extension. *Developmental Psychology*. 2010; 46: 984-94.

Jordan NC, Glutting J, Ramineni C. The Importance of Number Sense to Mathematics Achievement in First and Third Grades. *Learning and Individual Differences*. 2010; 20: 82-8.

Jordan NC, Kaplan D, Ramineni C et al. Early math matters: kindergarten number competence and later mathematics outcomes. *Developmental Psychology*. 2009; 45: 850-67.

Duncan GJ, Dowsett CJ, Claessens A et al. School readiness and later achievement. *Developmental Psychology*. 2007; 43: 1428-46.

Summary of Results

Based on the results of the five included studies, it can be stated with reasonable certainty that early math skills strongly predict later math-related academic achievement. Each study performed this analysis in one form or another. Jordan et al., in two separate studies, evaluated early mathematics (and numeracy) against later math achievement, and found significant correlations up until the end of grade three (the final follow-up). Duncan et al. evaluated six studies, analyzing the results together, and found early math to be the strongest predictor of later academic achievement; this finding was echoed in related studies by Romano et al. and Pagani et al. This effect appears to be maintained over time; Duncan et al. found significant correlations between early math and later academic achievement (math and reading) with a follow-up at 13-14 years of age. Interestingly, early math skills were found to be as strong a predictor of later reading achievement as early reading skills.

Other outcomes were also evaluated, Romano et al found that math skills were positively and significantly associated with attentive behaviour, and negatively associated with internalizing and externalizing behaviours, and hyperactivity/impulsivity problems. Pagani et al found that in addition to math and reading achievement, early math also predicted general academic achievement and classroom engagement. One of the outcomes that was not predicted by early math skills was later verbal achievement.

Data Sources

In comparison with a number of concepts leading up to this point, such as *personal social behaviour skills* and *verbal skills*, *number knowledge skills* is a relatively focused concept, with only numeracy and measures of early mathematics serving as the “inputs” that lead to outcomes related to health and well-being. Up to this point, the Early Development Instrument (EDI) has served as the primary data source due to its high degree of overlap between individual component scales and our concepts of interest, and because it is already in operation in the province.

The EDI component scale of Language and Cognitive Development touches on numeracy and mathematics, however the overlap between the two is not large enough to justify its use as an indicator of this concept. Of the 40 questions in this component scale, only 4 relate to numeracy and mathematics in a manner that is consistent with the concept being investigated. This represents only 10% of the total questions. By comparison, the concept of motor skills, which used the physical health and well-being scale of the EDI, contained 4 relevant questions out of a total of 13 (30%).

The National Longitudinal Survey of Children and Youth (NLSCY) includes a component on number knowledge in children aged 4-5. The test “assesses children’s intuitive knowledge of numbers by assessing their understanding of the system of whole numbers.” Children who score one standard deviation or more below the mean are classified as “delayed.” Conversely, those scoring one standard deviation above the mean and higher are classified as “advanced.”¹⁰⁶

Data are compiled on a biennial basis, with the most recent data available on request from Statistics Canada for 2008/09. These data has been used to inform prior reports on early

¹⁰⁶ Government of Canada. *The Well-being of Canada's Young Children*. 2008. Available at http://www.socialunion.gc.ca/well_being/2008/en/pdf/well-being-2008-en.pdf. Accessed September 2011.

childhood health and well-being in B.C., with the 2002/03 report noting that 14.3% of B.C. children aged 4-5 display “delayed levels” of number knowledge.¹⁰⁷ Presumably, the information from more recent cycles of the NLSCY would be obtainable on request. In the meantime, the 2002/03 data do allow for a magnitude estimate for the present purpose, but the apparent curtailment of the NLSCY project means that it cannot be a source for future indicator development and tracking.

Discussion

As discussed in the background section, our analysis of number knowledge skills was allowed to include outcomes that related to numbers and/or mathematics outcomes. This was done in anticipation of the sections on *children numeracy* and *youth math proficiency*, so that any pertinent future health and well-being outcomes tied to numeracy or mathematics could be linked to *number knowledge skills*. It is clear from the studies evaluated that numeracy and mathematics skills are a strong predictor of later numeracy related outcomes. However, one question remains, how deep into the developmental course of childhood would these significant correlations be seen? The majority of studies evaluated kindergarten/grade 1 numeracy or mathematics against grade 3 outcomes. However Duncan et al. included one paper that found significant associations in children as old as 14 (i.e., 9 years later). This supports tracking numeracy and mathematics from childhood and tying it to health and well-being outcomes observed in the later concepts, albeit with the appropriate caveats attached.

This would be particularly useful if later concepts showed connections between numeracy or mathematics and more direct measures of childhood health or well-being. The outcomes observed in the current analysis are relatively weak since they pertain to academic and behavioural outcomes, which are themselves one step removed from actual impacts on child health and well-being.

In terms of modifiability, Dowker acknowledges that intervention techniques targeting the remediation of mathematical difficulties have been in existence since the 1920s.¹⁰⁸ Dowker goes on to identify two individualized intervention programs, the *Mathematics Recovery Program* and the *Numeracy Recovery Program* that are currently undergoing research and development. Both are targeted at 6-7 year old children and target numbers and arithmetic rather than other aspects of mathematics; to date the *Mathematics Recovery Program* has reported students often reaching age-appropriate levels in these topics, and the Numeracy Recovery Program has seen the intervention group display “very significant improvements on standardized tests.” In younger children, such as those ages 3-5, interventions have also shown some evidence of effectiveness.¹⁰⁹

Sometimes planners have questioned whether children trailing in number knowledge skills at the entrance to formal education are able to “catch-up” without a targeted intervention. However, the evidence does show that differences in number skills at kindergarten are able to predict academic outcomes up to 9 years later. Thus, it would seem that, at least at a

¹⁰⁷ Government of British Columbia. *Indicators of Early Childhood Health and Well-being in British Columbia*. 2005. Available at http://www.mcf.gov.bc.ca/early_childhood/pdf/early_indicators_third_report.pdf. Accessed September 2011.

¹⁰⁸ Dowker A. Early identification and intervention for students with mathematics difficulties. *Journal of Learning Disabilities*. 2005; 38(4): 324-32.

¹⁰⁹ Clements DH, Sarama J. Early childhood mathematics intervention. *Science*. 2011; 333(6045): 968-70.

population level, children are not able catch-up without a targeted intervention during this follow-up period.

Conclusion

Although there appear to be various adverse academic and sociobehavioural outcomes associated with poor number knowledge skills at the start of formal education, the most convincing evidence appears to be the not unexpected connection with later mathematics skills.

Summary Assessment					
Number Knowledge Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
4-19	113,072	High	Medium	Med-High	Low

As summarized above, assessments have been applied to the Number Knowledge Skills concept, specifically, the Number Knowledge component of the NLSCY.

The pediatric population **Magnitude** of the potential indicator is assessed as **High**. Based on data from the National Longitudinal Survey of Youth and Children, 14.3% of children aged 4-5 are deemed to have “delayed levels” of number knowledge. This rate was applied to the entire pediatric cohort aged 4 - 19, yielding an estimate of 113,072 vulnerable individuals. This rate was applied to the entire cohort aged 4 -19, rather than just those of kindergarten age, because those that are vulnerable at this early age are susceptible to adverse health and well-being outcomes, and in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability would persist. The resulting estimate of 113,072 individuals is greater than 10% (97,000) of the total pediatric cohort, resulting in a Magnitude classification of high.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual’s health and well-being is assessed as **Medium**. The available literature does suggest a strong correlation between early numeracy skills and later math-related academic achievement, as well as the possibility of a positive correlation with later reading ability. One study found that strong math skills are positively associated with desirable socio-emotional and behavioural outcomes, but a causal connection would be difficult to establish. In other words, it is possible that prosocial behaviours lead to better number skill development.

The **Modifiability** of the potential indicator is assessed as **Medium-High**. The underlying risk factor of Number Knowledge Skills is theoretically amenable to intervention, with some preliminary studies showing that interventions are effective. With more conclusive and well-established trials, the rating could be raised to High.

Data Availability/Quality for the potential indicator is assessed as **Low**. The NLSCY, which offered information for a magnitude calculation, is likely not continuing and therefore cannot be the basis for indicator development and tracking.

Based on the reasonably strong assessment, but in light of the Low rating for data availability/quality, the potential indicator is **Recommended for Development** as a core indicator of child health and well-being.

Readiness to Learn

*One of the persisting perennial problems that beset school administrators is that of initiating and properly orienting the hordes of 6-year-olds who present themselves each year for entrance into the regular elementary schools. One obvious need is some sort of foreknowledge of each child's degree of readiness for the public-school experience. There are, of course, a number of reading-readiness tests in wide use, but relatively little is being done in the way of a comprehensive assessment of total readiness for school experience.*¹¹⁰

—Stott & Ball, 1965

Readiness to Learn is unique within this project as it appears as both a sub-dimension heading over a number of concepts and as an assigned concept itself. Implicit in all of the preceding sections, from Personal Social Behaviour Skills to Number Knowledge Skills, is the fact that there are various components that can make up a *comprehensive* assessment of readiness to learn; this was reinforced by the fact that an established “readiness to learn” assessment tool, the Early Development Instrument, was the data source of choice for a number of the concepts being examined in this part of the project.

This perspective means that Readiness to Learn may be best considered as a meta-concept rather than a discrete measure that is tracked in its own right; in other words, it may or may not be eligible as an operational concept to consider for this project. The issue will be decided on the grounds of whether or not there is an *aggregate* measure related to Readiness to Learn, or whether the concepts such as Personal Social Behaviour Skills, Motor Skills, etc. are consistently dealt with as *separate* measures. In other words; Is there truly an idea of readiness to learn attached to a global metric, with that measure then evaluated in some way as an integrated or aggregate predictor of present and/or future health and well-being? This question will be answered explicitly in the subsection on *Measurement of Readiness*, after a fuller introduction to the concept is provided below.

Background and Context

While the term/concept of school readiness has been used for many decades,¹¹¹ it gained new momentum in the U.S. context in the early 1990s. At that time, the President and 50 state governors established National Education Goals, with the first one stating that “by the year 2000 all children in America will start school ready to learn.”¹¹² This goal generated substantial debate at the federal, state, and local levels, in both the public sector (e.g., schools) and the private sphere (e.g., media, business, family). The complexity and ensuing controversy was presented succinctly in a 1995 commentary:¹¹³

Even though the goal of having children start school ready to learn is praiseworthy, as a guide to policy implementation, this statement is proving problematic. In general, to be an effective guide for policy, a goal statement should use well-defined terms, be clearly stated, and be measurable. However, the concept of “readiness” is poorly defined and is

¹¹⁰ Stott LH, Ball RS. Infant and preschool mental tests: Review and evaluation. *Monographs of the Society for Research in Child Development*. 1965; 30(3): 1-151.

¹¹¹ For example, Brenner A, Morse N. Measurement of children's readiness for school. *Papers of the Michigan Academy of Science, Arts and Letters*. 1956; 41: 333-40.

¹¹² See *Reconsidering Children's Early Development and Learning: Toward Common Views and Vocabulary*. Available at <http://govinfo.library.unt.edu/negp/reports/child-ea.htm>. Accessed September 2011.

¹¹³ Lewitt EM, Baker LS. *School Readiness*. Available at www.jstor.org/stable/pdfplus/1602361.pdf. Accessed September 2011.

interpreted differently in different contexts. Even the basic assumptions of the goal statement have been contested: is it the children who should be ready for school or the schools that should be ready for the children, or the society that should provide appropriate support for the children and the schools? Regardless of who or what is to be ready, there is no system in place to measure how ready to learn our nation's children are as they begin school or how well equipped schools are to receive children at different levels of development. This is due, at least in part, to the lack of consensus on what constitutes readiness and how to measure it.

The confusion multiplied along with the objectives that were initially attached to the goal of school readiness. The objectives tended to depart from the concept as a *status* indicator (i.e., how many or what proportion of children are ready to learn by, say, age 5), and instead focused on the mechanisms or interventions to actually get children ready. The three objectives established by U.S. policy leaders were as follows:

- All children will have access to high quality and developmentally appropriate preschool programs that help prepare children for school.
- Every parent in the United States will be a child's first teacher and devote time each day helping his or her preschool child learn, and parents will have access to the training and support parents need.
- Children will receive the nutrition, physical activity experiences, and health care needed to arrive at school with healthy minds and bodies, and to maintain the mental alertness necessary to be prepared to learn, and the number of low birth weight babies will be significantly reduced through enhanced prenatal health systems.

Shifting the focus from readiness to learn as a predictor (or outcome) towards the various interventions aimed at increasing such readiness did not advance the cause of clarity. In short, it did not add to the understanding of what being a learning- or school-ready child actually entails, how to measure and track the concept across a population, etc.

Despite the conceptual challenges persisting after the introduction of intervention goals, researchers inspired by the U.S. school readiness initiative have been very active in developing readiness assessment instruments. Similar work has been pursued in other countries, including the Early Development Instrument that was originally designed in Ontario. The various elaborations of the concept of school or learning readiness over the last two decades have only increased its power and popularity. But the question still remains: Is there such a thing as a single measure or indicator of such readiness?

Selected instruments will be reviewed in the next section, with the ultimate aim to decide whether or not an *aggregate* measure of readiness to learn is currently available.

Measurement of Readiness

Dozens of instruments have been proposed over the years for the purposes of assessing school readiness. A 2000 review paper examined about 70 such tools that had been tested in the U.S. context alone, with results published in papers from 1985 to 1997.¹¹⁴ For example, a

¹¹⁴ LaParo KM, Pianta RC. Predicting children's competence in the early school years: A meta-analytic review. *Review of Educational Research*. 2000; 70(4): 443-84.

long-standing tool is commonly known as the Lollipop test, named after the simple, child-friendly pictograms used in the questions. It focuses on four subscales:¹¹⁵

- Identification of colours and shapes, copying of shapes (14 questions)
- Spatial recognition (10 questions)
- Identification of numbers and counting (14 questions)
- Identification of letters and writing (14 questions)

A total school readiness score may in fact be calculated by adding the scores of the four subtests. It is important to note that the Lollipop test can be mapped onto a *subset* of the conceptual domains as conceived by other, more recently developed instruments. Thus, the various Lollipop subscales may be equated with Language and Cognitive Development (counted as one or two domains, depending on the particular instrument being compared). Other more contemporary domains, such as Social Competence, are not an explicit part of the Lollipop text. This gap underlines the fact that there has been a trend towards expanding the domains qualitatively and quantitatively in the readiness assessment tools developed more recently.

Almost 80% of the studies in the review noted above focused on preschool/grade K cognitive assessment (and especially early language skills) tracked forward into grade 1/2 academic achievement (showing reasonably strong correlations, as might be expected); the balance of the tools dealt with social/behavioural predictors of social/behavioural outcomes (in fact showing relatively small effect sizes). In other words, the scales of interest were more limited than recent developments in the field, and there was no attempt to move beyond the most obvious predictor pathways (i.e., cognitive to academic, or early social behaviour to later social competence). Importantly, the cognitive and social scales were also not integrated in any way to produce a comprehensive picture of readiness to learn. Most challenging of all, the various readiness assessments are quite heterogeneous in content, so that “their predictive validity regarding future school achievement tends to vary greatly.”¹¹⁶

One reason for multiple domains being included in more recent school readiness assessments is the commitment to seeing children and their development in a holistic manner; in this sense, the cognitive dimension is simply one of a number of important aspects of a human being, even when the sphere of interest is restricted to public school and learning. This perspective was already recognized over 50 years ago, as reflected in a school readiness assessment approach from the 1950s: “The program was based on the idea that a child must have reached a minimum stage of maturity—mentally, socially, physically, and emotionally—if he [or she] is to meet school expectations in the first grade.”¹¹⁷ Five decades later, the value of the comprehensive approach is still being recognized, as summed up by Hair et al.: “Research has made it increasingly clear that children’s school and later life success depends not only on children’s cognitive skills, but also on their physical and mental health, emotional well-being, and ability to relate to others.”¹¹⁸ From this standpoint, it is not

¹¹⁵ Chew A L, Morris JD. Validation of the Lollipop Test. A diagnostic screening test of school readiness. *Educational and Psychological Measurement* 1984; 44(4): 987-91.

¹¹⁶ Forget-Dubois N, Dionne G, Lemelin JP et al. Early child language mediates the relation between home environment and school readiness. *Child Development*. 2009; 80(3): 736-49.

¹¹⁷ Stott LH, Ball RS. Infant and preschool mental tests: Review and evaluation. *Monographs of the Society for Research in Child Development*. 1965; 30(3): 1-151.

¹¹⁸ Hair E, Halle T, Terry-Humen E et al. Children’s school readiness in the ECLS-K: Predictions to academic, health, and social outcomes in first grade. *Early Childhood Research Quarterly*. 2006; 21: 431-54.

surprising that multiple domains are now regularly considered when constructing an assessment tool related to school readiness.

The heterogeneity of domains/scales considered under the rubric of school readiness appears to be increasing, which is only adding complexity to the conceptual discussion. This is illustrated in the following table, where several North American assessment inventories are placed side by side.

Domains Used in Multi-Domain School Readiness Assessments				
Selected Examples				
Organization/Instrument	Association of Principals	Early Development Instrument	Nat'l Long'l Survey of Children & Youth	National School Readiness Indicators
Jurisdiction	Canada	Canada	Canada	USA
Date of Compilation	<2000	2000	2002	2005
Domains	<ul style="list-style-type: none"> Physical well-being and motor development Emotional health and a positive approach to new experiences Social knowledge and competence Language skills General knowledge and cognitive skills 	<ul style="list-style-type: none"> Physical health and well-being Emotional maturity Social competence Language and cognitive development Communication skills and general knowledge 	<ul style="list-style-type: none"> Academic skill Self-control of behaviour Social competence and independence Language and communication skill Self-regulation of learning 	<ul style="list-style-type: none"> Physical well-being and motor development Social and emotional development Approaches to learning Language development Cognition and general knowledge

While some of the domains map easily onto one another, others appear to occupy a unique position. Not only do the scales vary by heading, but the components within each domain show great differences from instrument to instrument, making comparisons challenging. For instance, one of the most widely implemented contemporary approaches to assessing school readiness, the Early Development Instrument (EDI) created by the Offord Centre of McMaster University, is based on 104 teacher-administered questions across five domains, as follows:

- Physical health and well-being**
Includes: gross and fine motor skills, holding a pencil, running on the playground, motor coordination, adequate energy levels for classroom activities, independence in looking after own needs, daily living skills
- Social competence**
Includes: curiosity about the world, eagerness to try new experiences, knowledge of standards of acceptable behaviour in a public place, ability to control own behaviour, appropriate respect for adult authority, cooperation with others, following rules, ability to play and work with other children
- Emotional maturity**
Includes: ability to reflect before acting, a balance between too fearful and too impulsive, ability to deal with feelings at the age-appropriate level, empathic response to other people's feelings
- Language and cognitive development**
Includes: reading awareness, age-appropriate reading and writing skills, age-appropriate numeracy skills, board games, ability to understand similarities and differences, ability to recite back specific pieces of information from memory

- **Communication skills and general knowledge**

Includes: skills to communicate needs and wants in socially appropriate ways, symbolic use of language, story-telling, age-appropriate knowledge about the life and world around

From a policy development perspective, it would be very useful if the individual scores generated by readiness instruments were compiled into an aggregate score. “Aggregate” here simply refers to the fact that readiness to learn assessment tools typically consist of multiple questions stratified over more than one scale or domain; whereas the scores for the set of questions related to a particular scale are usually summed (as was the case with past cognitive-focused instruments such as the Lollipop test), the separate scales found in contemporary instruments do not appear to be routinely compiled into a single index. This is why, for instance, the EDI stands for Early Development *Instrument* rather than using the term *Index*, as is the (inaccurate) practice in Australia after it adopted the EDI. As declared by the originators of the EDI, there was no intention of creating an aggregate score (or index) across the 5 domains; they simply state: “There is no total score on the EDI.”¹¹⁹ In fact, reviewers of various modern assessment instruments have acknowledged that there has not been a great deal of focus on integrating a single measure of readiness across multiple domains. In 2006, Hair et al. observed that:¹²⁰

...there has been little exploration of how children’s cognitive, language, social, emotional, and health status interact with one another and collectively affect children’s outcomes. Additionally, little empirical evidence has documented the ways in which these elements function in combination at the earliest stages of children’s schooling, and how these interactions might affect later outcomes.

So, adding to the complexity of having no agreement in the literature on the key components of school readiness, there has been little progress on “theoretical models to connect them.”¹²¹ However, as introduced above, the operational focus of this section is precisely on an *aggregate* or integrated index of readiness to learn. If an aggregate approach is not employed, so that only a single domain of school readiness is represented and tested at a time, then there is really no advance over simply considering the various domains/scales on an individual basis—that is, on their own merits as separate indicators or predictors of future academic achievement or some other aspect of child well-being. This was already accomplished in the preceding sections of this report. The conclusion just noted is not meant to suggest there is no practical advantage in gathering the data for such scales simultaneously in one convenient process—but this does not turn the instrument involved into a unique index with its own global predictive power under the heading Readiness to Learn.

It is important to note that there have been attempts to *qualitatively* reflect the information available across multiple domains of readiness that fall short of an aggregate score per se. For instance, Hair et al. describe an approach that identified clusters in the distribution of vulnerability wherein one or more of the best known U.S. readiness domains (see the earlier table) was manifested as a strength or weakness in a child. The following four clusters were

¹¹⁹ Janus M, Offord DR. Development and psychometric properties of the Early Development Instrument (EDI): A measure of children's school readiness. *Canadian Journal of Behavioural Sciences*. 2007; 39(1): 1-22.

¹²⁰ Hair E, Halle T, Terry-Humen E et al. Children's school readiness in the ECLS-K: Predictions to academic, health, and social outcomes in first grade. *Early Childhood Research Quarterly*. 2006; 21: 431-54.

¹²¹ Snow KL. Measuring school readiness: Conceptual and practical considerations. *Early Education and Development*. 2006; 17(1): 7-41.

noted: 1) where the child scored positively on all domains; 2) where both physical well-being and social/emotional development were positive; 3) where social/emotional development was weak; and 4) where physical well-being was weak.¹²²

Similarly, in the B.C. context a predictor variable based on the EDI has sometimes been used that involves identifying preschool children that are experiencing *at least one* domain-specific form of vulnerability and then tracking related outcome differences in later school grades. However, this approach inevitably generates questions about weighting (i.e., whether some vulnerabilities are more important than others), and whether being vulnerable on more than one scale is of greater concern than demonstrating precisely one vulnerability. Exploring answers to these questions would move the EDI more in the direction of a global readiness to learn index.

Discussion

The main aim of this section has been to underline three realities with respect to Readiness to Learn as a concept and measurable indicator:

1. The contemporary movement away from a strictly cognitive focus towards a more comprehensive set of domains to be assessed as markers of readiness
2. The heterogeneity of the domains and their components employed by various readiness assessment tools, with each instrument ultimately requiring its own validation process
3. The gap represented by the general lack of an aggregate score calculated across a multidimensional instrument

Given the complexity of developing, implementing, and testing a readiness instrument, the main practical criterion for proposing an indicator is whether the constituent data are already being collected. As has been true in earlier sections, there really is only one candidate source for such an indicator in British Columbia: the EDI. But the EDI has not been constructed as a global index that may be subsequently tested in its own right, although the component scales have undergone some validity testing. In sum, while the EDI does offer good information for domains that are of interest in preschool assessment of child development, it does not generate a comprehensive index of readiness to learn.

Conclusion

The result of this overview can only be that there is no operational indicator of readiness to learn matching current definitions for the concept, and thus no independent literature search possible for such a concept. If consensus were to be reached on what readiness to learn means and a validated aggregate score were to be devised, the comprehensive list of domains involved would in fact approximate a global view of child health and well-being at the younger ages. In other words, as it is typically conceptualized, an index of readiness to learn would be a virtual *synonym* for preschool health and well-being. If developed and adopted, a new global index could encompass and therefore replace many of the other health and well-being status indicators up to age 5.

¹²² Hair E, Halle T, Terry-Humen E et al. Children's school readiness in the ECLS-K: Predictions to academic, health, and social outcomes in first grade. *Early Childhood Research Quarterly*. 2006; 21: 431-54.

While its importance as a meta-concept or sub-dimension of child health and well-being is secure, a potential indicator related to Readiness to Learn **cannot be Recommended** for consideration as a core indicator of child health and well-being.

Early Childhood Education

*The extent to which early childhood programs produce long-term benefits in children's cognitive development, socialization, and school success is a matter of some controversy.*¹²³

—W. S. Barnett, 1995

*A broad range of early educational interventions are found to produce meaningful, lasting effects on cognitive, social, and schooling outcomes.*¹²⁴

—W. S. Barnett, 2011

This section of the report marks a departure from what has been covered so far under the Readiness to Learn subdimension. The focus now shifts from predictor variables that are components of school readiness to interventions aimed at actually achieving such conditions in young children. Two of the assigned concepts can be considered under the heading of intervention: Early Childhood Education and Reading by an Adult. The first topic will focus on settings involving public or private facilities—also known as centre-based learning—and the second on the home or family front.

The term Early Childhood Education (ECE) can cover a broad range of interventions, differing widely in their goals, delivery strategies, and the ages of children served.

As a first distinction, the aim may be to directly serve children or to indirectly serve them by training/ supporting their family caregivers. Thus, ECE programs may be classified as child-focused or family-focused.¹²⁵ As suggested above, this section will be concerned mostly with the first category.

Further, the intention of an early childhood program may be educational per se or it may be more focused on child *care* with learning as a collateral benefit. This is why the field as a whole is sometimes called Early Childhood Care and Education.¹²⁶ Regardless of the language used, it is clear that substantial overlap exists between the present conceptual area and another concept in the overall project, namely, Adequate Child Care.¹²⁷ Based on the low ratings generated on its assessment grid, designing an indicator for Adequate Child Care was in fact *not* recommended. It will be important to delineate the topic of this present section to ensure it adds a unique contribution to the discussion.

As an additional point of distinction, the age of the child being served by an ECE program varies from the youngest group (infants/toddlers) through various levels of preschool. When the entire age range is included, then ECE may be deemed one aspect of the broader agenda known as “early childhood development.”¹²⁸ Compulsory education generally begins at age 6 in Canada, so sometimes even kindergarten (which normally begins at age 5) is included

¹²³ Barnett WS. Long-term effects of early childhood programs on cognitive and school outcomes. *Long-term Outcomes of Early Childhood Programs*. 1995; 5(3): 25-50.

¹²⁴ Barnett WS. Effectiveness of early educational intervention. *Science*. 2011; 333(6045): 975-8.

¹²⁵ See further at <http://www.sharingsuccess.org/code/bv/ec1.html>. Accessed October 2011. Accessed October 2011.

¹²⁶ For example, see <http://www2.capilanou.ca/programs/ecce.html>. Accessed October 2011.

¹²⁷ See H. Krueger & Associates Inc. Assessing Concepts and Potential Indicators of Child Health and Well-being in British Columbia; *Dimension: Economic & Material Well-being*, July 8, 2011.

¹²⁸ In the B.C. context, the inventory of early childhood development services is helpfully summarized in an annual report published by the government. See http://www.mcf.gov.bc.ca/early_childhood/pdf/EarlyYearsAnnualReport2010.pdf. Accessed October 2011.

under the heading of ECE. In B.C., kindergarten is clearly grouped with grades 1-3 as part of primary schooling, so that technically it is not considered part of the ECE world.¹²⁹

For the purposes of this project, the discussion will focus on preschool programs for the general population of children, where preschool is defined as offering prekindergarten learning resources mostly in the context of centre-based classes; based on this definition, the age group of interest runs from 3 to 5 years. This narrow definition of ECE is consistent with leading authorities in the field.¹³⁰ One rationale to adopt this approach is to distinguish the discussion from the alternate section of this project that looked at services more concerned with custodial child care.

Background and Context

The quotations that opened this section suggest that past controversy about the utility of ECE has given way to general acceptance of the value of this approach in encouraging child development and future well-being. But the question still pertains: What exactly are the early *educational* programs or interventions in view?

Some child care programs lean more towards the custodial mode, where the main goal is offering a safe care environment while parents are otherwise engaged (at work, at school, etc.). Hence, the traditional distinctions made between “group child care” and “preschools” when tracking statistics on available spaces. Although the language sometimes varied (e.g., day care or playschool on one side *versus* nursery school or pre-K on the other), parents seemed to understand that there were differences between programs in terms of educational values. Thus, the system allowed parents to choose a program that fit their preferences, whether a “free play” style or an emphasis on educational pursuits as a preparation for kindergarten.

The situation with respect to ECE in British Columbia and other jurisdictions has become more complex in recent years. Three aspects of the evolution are important for the present discussion:

- New educational models and staff training standards have made it increasingly difficult for parents (or policy-makers) to distinguish centres that focus mainly on custodial care from those with a strong commitment to ECE. As noted in an Ontario report on ECE, “parents may not be able to judge the differences among types of care or appreciate the importance of additional resources in the child care centre.”¹³¹
- There is no help in this regard in official government records providing an inventory of ECE spaces. For instance, it seems that the only distinction made in B.C. between “group child care” (for preschool age) and “preschool” is that the former can keep a child for up to 13 hours a day, whereas the latter can only enroll a child for up to 4

¹²⁹ See *The Primary Program: A Framework for Teaching* at http://www.bced.gov.bc.ca/primary_program/primary_prog.pdf. Accessed October 2011.

¹³⁰ Pianta RC, Barnett WS, Burchinal M et al. The effects of preschool education: What we know, how public policy is or is not aligned with the evidence base, and what we need to know. *Psychological Science in the Public Interest*. 2009; 10(2): 49-88.

¹³¹ Cleveland G, Krashinsky M. *The Benefits and Costs for Good Child Care*. 1998. Available at <http://childcarecanada.org/publications/other-publications/98/11/benefits-and-costs-good-child-care-economic-rationale-public>. Accessed October 2011.

hours.¹³² The implication supposedly is that 4 hours runs closer to normal expectations for a school day, and therefore represents an environment with a greater likelihood of delivering true ECE resources. The accuracy of this sort of assumption is not clear.

- The government of B.C. may be moving into the universal preschool education business, as noted in a commitment in the 2008 Throne speech to “undertake a feasibility study of providing parents with the choice of day-long kindergarten for **four-year-olds** by 2010, and for **three-year-olds** by 2012.”¹³³ This type of initiative would radically change the quality and comprehensiveness of information on available ECE spaces/enrollment. Were the enrollment ever to approach 100%, the usefulness of a related indicator may be reduced.

Prior to the advent of universal ECE, it could continue to be useful to enumerate available preschool spaces or, better, the proportion of the preschool population covered by the currently available spaces.¹³⁴ This approach would be more robust if a more reliable distinction between custodial child care and ECE could be derived and the capacity related to each mode ascertained. As always in this project, the utility of any such an indicator depends on the impact of the underlying concept in terms of child health and well-being. This theme was pursued through a literature search described in the next subsection.

Methodology and Provisional Results

An initial scan determined a high likelihood that the volume of studies would generate one or more systematic reviews upon which to base the evidence assessment. As such, reviews were specifically targeted (e.g., setting the publishing time limits starting at 2005). Following the systematic search, a supplementary search was conducted in Medline and Google that generated three more reviews, including one from 2003 that was of high enough quality to include. In addition, useful narrative reviews were located; they were folded into the Discussion section.

Review Search Process

A search of the EBSCO database was performed to identify review papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

¹³² Beach J, Friendly M, Ferns C et al. *Early Childhood Education and Care in Canada*. 2008. Available at <http://childcarecanada.org/publications/ecec-canada/09/11/early-childhood-education-and-care-canada-2008>. Accessed October 2011.

¹³³ Early Childhood Learning Agency. *Expanding Early Learning in British Columbia for Children Aged 3-5*. 2008. Available at http://www.bced.gov.bc.ca/early_learning/pdfs/ecla_report.pdf. Accessed October 2011.

¹³⁴ Child Care Advocacy Association of Canada. *Making the Connections: Using Public Report to Track the Progress of Child Care Services in Canada*. 2007. Available at http://www.ccaac.ca/mtc/en/pdf/mtc_finalreport_en.pdf. Accessed October 2011.

The following limits were selected:

Date: 2005-Present *Subjects:* Preschool Education, Cognitive Development

Search Keywords

("Early Childhood Education" OR "Early Education" OR Preschool OR "Early Intervention") **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR "Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare" OR Outcome*)

This search returned 174 papers in total, including several potential items from the supplementary search.

Preliminary Exclusion

The 174 items were scanned *by title*, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be a review article summarizing studies of ECE outcomes related to physical, psychosocial, or academic well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 13.

Primary Exclusion

Abstracts of the selected articles were then examined, with manifestly non-review papers being excluded.

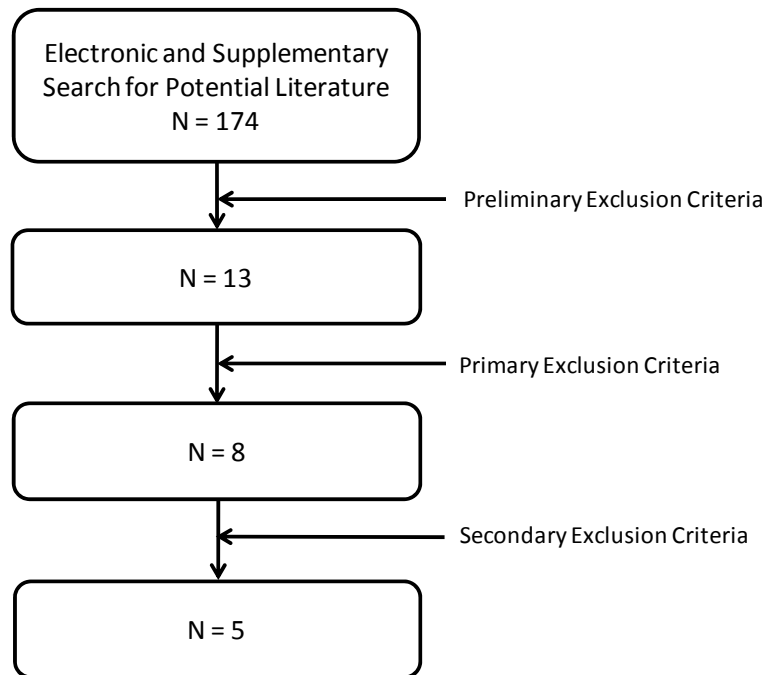
There were 8 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

The 8 full-text versions were retrieved and reviewed in depth. Upon completion, it was determined that only 5 satisfied the full inclusion criteria.

The literature search process is detailed in the chart below, with the 5 final articles identified and summarized in the following two tables.

Literature Review Volume Report: Reviews
Dimension: Cognitive Development **Concept:** Early Childhood Education



Summary of Relevant Reviews

Dimension: *Cognitive Development*

Concept: *Early Childhood Education*

Title of Review	Lead Author	Year	Journal	Journal Impact Factor	Year Range of Studies	No. of Studies
1 Meta-analysis of the effects of early education interventions on cognitive and social development	Camilli	2010	Teachers College Record	0.429	1960-2003	123
2 How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds	Burger	2010	Early Childhood Research Quarterly	2.192	1970-2008	22
3 Does attendance at preschool affect adult health? A systematic review	D'Onise	2010	Public Health	1.493	1974-2008	13
4 Can preschool improve child health outcomes? A systematic review	D'Onise	2010	Social Science & Medicine	3.484	1978-2008	20
5 The effectiveness of early childhood development programs	Anderson	2003	American Journal of Preventive Medicine	4.987	1967-1995	51

Dimension: Cognitive Development Concept: Early Childhood Education
Summary Table of Reviews

Lead Author	Review Title	Number of Studies Reviewed	Conclusions/Comments
Camilli (2010)	Meta-analysis of the effects of early education interventions on cognitive and social development.	123	The authors found that preschool programs have statistically significant impacts, especially in the cognitive domain in grade school; positive results were also observed for children's social skills and school progress.
Burger (2010)	How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds.	22	The majority of studies that evaluate cognitive achievement found that exposure to preschool was positively correlated with later educational attainment. In terms of special education rates, two of six studies found a reduced proportion of children required such services, two studies found mixed results, and two were not able to draw conclusions due to a lack of a control group. Five studies evaluated grade retention, with two showing that the proportion of children retained in a current grade for an extra year was lower in children who had attended preschool; one study provided mixed results, and the balance could not be evaluated due to a lack of control group. Four studies evaluated school graduation as an outcome, with one not finding any significant correlation and the remaining three showing a clear advantage for preschool children.
D'Onise (2010)	Does attendance at preschool affect adult health? A systematic review.	13	Preschool interventions appear to improve health behaviours, but not chronic disease outcomes, in young adults. The authors note that, due to the long latent period for many chronic diseases, another 10-20 years of follow-up is needed to adequately assess risk mitigation that may be achieved by ECE.
D'Onise (2010)	Can preschool improve child health outcomes? A systematic review.	20	There is some evidence for preschool leading to favourable outcomes in terms of child well-being, including obesity reduction, greater social competence, improved mental health, and crime prevention. However, the authors conclude that "the great potential for early childhood interventions to improve population health across a range of health outcomes, as anticipated by policy makers worldwide, currently rests on a rather flimsy evidence base."
Anderson (2003)	The effectiveness of early childhood development programs: A systematic review	51	The majority of outcomes evaluated fell under the cognitive domain. Early childhood development programs were found to improve intellectual ability, overall school readiness, standardized academic test scores, chance of promotion to the next grade, and the rate of placement in special education classes.

Bibliography for Table of Studies

Camilli G, Vargas S, Ryan S et al. Meta-analysis of the effects of early education interventions on cognitive and social development. *Teachers College Record*. 2010; 112: 579-620.

Burger K. How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds. *Early Childhood Research Quarterly*. 2010; 25: 140-65.

D'Onise K, McDermott RA, Lynch JW. Does attendance at preschool affect adult health? A systematic review. *Public Health*. 2010; 124: 500-11.

D'Onise K, Lynch JW, Sawyer MG et al. Can preschool improve child health outcomes? A systematic review. *Social Science & Medicine*. 2010; 70: 1423-40.

Anderson LM, Shinn C, Fullilove MT et al. The effectiveness of early childhood development programs: A systematic review. *American Journal of Preventive Medicine*. 2003; 24: 32-46.

Summary of Results

The sizeable number of studies covered by reviewers and the fact that almost all of the located systematic reviews were published in 2010 suggests that ECE is a subject of substantial interest among researchers and policy-makers. The one earlier paper from the authoritative Task Force on Community Preventive Services anticipated the pattern seen in more recent reviews that points to cognitive outcomes being a predominant focus.¹³⁵ This is not unexpected; as highlighted in narrative reviews of this area, there has been a strong orientation among ECE proponents from the start (in both program design and related research) towards school preparation, that is, explicitly getting young children ready for kindergarten and the balance of primary school.¹³⁶ A preponderance of the research has focused on various U.S. initiatives, and especially the massive Head Start preschool program that is geared to low-income families whose children are known to be at a disadvantage in terms of developed skills at kindergarten entry. There is a general agreement across studies in this area that, compared with control groups, children exposed to ECE fare significantly better in kindergarten and early grade school in terms of cognitive and (to a lesser extent) social behavioural outcomes. As well, the intervention group required fewer special education services and progressed through school with less frequent need to repeat a grade.

In domains of health and well-being beyond the cognitive and social, and especially with respect to outcomes tracked into later years, the evidence has been less convincing. One challenge observed by D’Onise et al. is that the impact of large public programs such as Head Start in the U.S. on chronic disease rates probably will require another couple of decades to fully evaluate. The research data have not yet emerged that would prove a long-term physical health effect of ECE.

Data Sources

There are two main types of programs operating for preschool ages in the B.C. context: centre-based child care or pre-K programs in the community (non-profit or for-profit, and either stand-alone or attached to a private school) and the relatively recent government program called Strong Start. Since Strong Start is a drop-in model (see below), traditional “drop off” daycare/preschool programs (featuring more consistent exposure for the child during the week) probably represents the best place to turn for statistics on the absolute number or proportion of children covered by ECE in the province. As was true in the Adequate Child Care concept in another dimension of this project, capacity (i.e., available spaces) will serve as a proxy for coverage, based on the assumption that such a high-demand resource will be almost fully utilized.

Unfortunately, the reported B.C. data does not allow one to reliably distinguish between centres where educational values and approaches are explicitly incorporated from centres that are mainly custodial in nature. In short, there is no accurate data source for the proportion of the population with ECE exposure (appropriately defined). A proxy for ECE could be *quality* child care, as there is in fact substantial overlap between high standards for child care and the typical characterization of ECE-related aims and values. For example, good quality child care programs have been summed up in the U.S. context as those supporting “cognitive, social,

¹³⁵ Anderson LM, Shinn C, Fullilove MT et al. The effectiveness of early childhood development programs: A systematic review. *American Journal of Preventive Medicine*. 2003; 24(3S): 32-46.

¹³⁶ For example, Barnett WS. Effectiveness of early educational intervention. *Science*. 2011; 333(6045): 975-8.

and emotional development, school readiness, and academic achievement.”¹³⁷ However, determining the proportion of B.C. children in quality child care (=centres offering ECE?) is also outside the current reporting protocols. This suggests that Strong Start be explored as another possible avenue of tracking ECE exposure in B.C.

In the 2006/07 school year, the British Columbia Ministry of Education funded 12 school districts to pilot 12 Strong Start centres for families/caregivers and preschool-aged children. Strong Start BC expanded to 85 sites in 2007/08, and a total of 400 were planned for 2009/10.¹³⁸ The centres are located in schools and may be co-located with other early childhood programs, such as child care or parent resource centres, as part of emerging school-based hubs. They are intended to support early learning, i.e., the knowledge and skills that young children require in language/communication, as well as in social, emotional, and physical domains. A key feature of Strong Start BC is that it is not a drop-off program but rather a *family drop-in* model, requiring the attendance of at least one caregiver (although that person can be a paid nanny). The main aim of this approach is to encourage parents to participate in their children’s early learning and development and to indirectly enhance the home environment as a support for such processes.

In terms of ages covered, Strong Start appears to overlap with the long-established Head Start and Early Head Start programs in the U.S. The terms of reference require Strong Start facilitators to provide (at no cost) “developmentally appropriate activities” for infants, toddlers, and preschoolers functioning in small and larger groups.¹³⁹ During the pilot year, the Ministry of Education anticipated that the program would mainly serve families with 3- and 4-year olds; however, approximately half of the children involved were in fact from birth to age 3.

The main access difference compared to Head Start is that the U.S. program is set up specifically for low-income families. In B.C. there is no economic “means test” in order to register. However, there may be an implied economic gradient for participation that is attached to the requirement to have a caregiver present. Thus, according to an evaluation of the pilot project from 2006/07, the most common reasons given for dropping out of Strong Start (other than the child being newly enrolled in regular preschool) were related to the parent’s schedule, and especially return to (or changes to) their work.¹⁴⁰ By comparison, the low-income Head Start parents are not typically part of the labour force, a pattern that may by default characterize any regular user of Strong Start as well.

What is not clear from available statistics on the ongoing Strong Start program is the proportion of B.C. children aged 3 or 4 years registered and the actual population-level of exposure to ECE resources (since some families drop in as little as one or two times per month).

Given the limitations described above related to data sources, the best estimate of ECE capacity currently available is the number of preschool/nursery school spaces, as tracked by the Child Resource and Research Unit (CRRU), a policy- and research-oriented team that

¹³⁷ See the description of the book *The Tragedy of Child Care in America* at <http://yalepress.yale.edu/book.asp?isbn=9780300172119>. Accessed October 2011.

¹³⁸ Strong Start BC: Evaluation. Available at http://www.bced.gov.bc.ca/early_learning/pdfs/strongstart_evaluation_report.pdf. Accessed October 2011.

¹³⁹ Ibid.

¹⁴⁰ Ibid.

focuses on early childhood education, child care, and other family policy in Canada and internationally. The CRRU periodically assembles pan-Canadian data on child care spaces, with the most recent report being published in 2009. That publication indicated that there were 19,910 preschool spaces in British Columbia in 2007/08.¹⁴¹

Discussion

The intense focus on ECE programs and research is not unexpected given that “the prekindergarten years (approximately 3 to 4 years of age) are thought to be a critical window for children’s intellectual and socio-emotional development.”¹⁴² As has been described above, there is a good evidence trail of positive effects in these domains following ECE, at least when the cognitive and socio-emotional effects are tracked into kindergarten/primary school. One of the disconcerting notes about the research into cognitive/academic outcomes, especially in large, public rather than small, experimental programs, is a so-called fade-out effect, where control groups seem to eventually catch up to the children exposed to ECE.¹⁴³ A variety of explanations are given for this phenomenon, including the idea that, “if early educational interventions have only small initial impacts, the compensatory efforts of public schools for children who enter school behind may succeed in offsetting the entire advantage. Such efforts gradually equate achievement over time so that what is observed is ‘catch-up’ rather than ‘fade-out.’”¹⁴⁴

The school-related effects apart from academic performance may be longer lasting. One narrative review summed up the potential persistent benefits of ECE in terms of “gains in outcomes such as special education placement and grade retention, high school graduation rates, labor market outcomes, social welfare program use, and crime.”¹⁴⁵ The latter three markers especially prove the case for well-being effects originating in the preschool years that reach beyond the cognitive development domain—an important finding. The positive labour market outcomes have been of special interest, for they are known to be mediators of physical health and other well-being effects. Longer term results will be required, due to long disease latency periods, of effects on physical health.

The same sort of phenomenon seems to apply to smaller, experimental and pilot programs. For example, one well-known intensive model, the High/Scope Perry Preschool system, was in fact tested in a randomized controlled trial with 37 years follow-up, i.e., when subjects had reached 40 years of age. The Perry Preschool Project, carried out from 1962 to 1967, provided high-quality preschool education to 3- and 4-year-old African-American children living in poverty and assessed to be at high risk of school failure and other serious social consequences. The program was provided in 2.5-hour morning sessions taught by certified public school teachers with at least a bachelor’s degree. The average child-teacher ratio was 6:1. The curriculum emphasized active learning, in which the children engaged in activities

¹⁴¹ Beach J, Friendly M, Ferns C et al. *Early childhood education and care in Canada 2008*. 2009. Childcare Resource and Research Unit. Available at <http://www.childcarecanada.org/ECEC2008/index.html#toc>. Accessed December 2010.

¹⁴² Muennig P, Schweinhart L, Montie J et al. Effects of a prekindergarten educational intervention on adult health: 37-year follow-up results of a randomized controlled trial. *American Journal of Public Health*. 2009; 99(8): 1431-7.

¹⁴³ RAND. *Proven Benefits of Early Childhood Interventions*. 2005. Available at http://www.rand.org/pubs/research_briefs/RB9145/index1.html. Accessed October 2011.

¹⁴⁴ Barnett WS. Effectiveness of early educational intervention. *Science*. 2011; 333(6045): 975-8.

¹⁴⁵ RAND. *Proven Benefits of Early Childhood Interventions*. 2005. Available at http://www.rand.org/pubs/research_briefs/RB9145/index1.html. Accessed October 2011.

that focused on problem-solving; the activities were planned and reviewed by the children themselves, with support from adults. The teachers also provided a weekly 1.5-hour home visit, “designed to involve the mother in the educational process and help implement the preschool curriculum at home.”¹⁴⁶

The long-term study of the Perry Preschool program, albeit based on a small sample (N=112 at follow-up), did find significant differences between the intervention and control groups. Adults at age 40 who had been in the preschool program had higher earnings, were more likely to hold a job, had committed fewer crimes, and were more likely to have graduated from high school than adults who did not have preschool. As noted earlier in the general discussion of evidence, several of these items represent strong markers of well-being.

The researchers’ initial theory had been that these positive factors would also represent mediators of improved physical health.¹⁴⁷ They hypothesized that the

...social benefits would translate into improvements in health-promoting behaviors, which should in turn translate into lower rates of such health conditions as diabetes, hypertension, obesity, and arthritis. This reduced frequency of health conditions should then translate into improved overall health status and reduced mortality. As the participants age, we would expect such differences to become more pronounced.

While recognizing that physical health results at age 40 are still at a relatively early life stage, the researchers were surprised that a noticeable reduction in risky health behaviours did not begin to translate into a lower level of self-reported medical conditions. It will still be important to track the results of reduced adult risk behaviours observed in different studies¹⁴⁸ following ECE exposure for a longer period of time before a final judgment on disease effects may be drawn.

By most definitions, the Perry Preschool model represents a high-quality program. One of the major challenges in this conceptual area involves understanding how to characterize minimal quality standards; this is important because it is reasonable to assume that a *quality* ECE program will be the best driver of desired outcomes. Unfortunately, neither distribution across the quality spectrum nor the more basic category of quantity (i.e., the gap in ECE delivery) are known in the B.C. context, though a rough estimate of the latter may be derived (see below).

Conclusion

In the absence of a more robust indicator such as capacity/enrollment related to a high-quality ECE program, all pertinent programs will be deemed to be equivalent in terms of quality; this provides a foundation for the selected indicator, namely, the proportion of children age 4 years not being served by ECE.

¹⁴⁶ See the program summary at http://evidencebasedprograms.org/wordpress/?page_id=65. Accessed October 2011.

¹⁴⁷ Muennig P, Schweinhart L, Montie J et al. Effects of a prekindergarten educational intervention on adult health: 37-year follow-up results of a randomized controlled trial. *American Journal of Public Health*. 2009; 99(8): 1431-7.

¹⁴⁸ For example, D’Onise K, Lynch JW, McDermott RA et al. The beneficial effects of preschool attendance on adult cardiovascular disease risk. *Australian and New Zealand Journal of Public Health*. 2011; 35(3): 278-83.

Summary Assessment					
Early Childhood Education					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
4-19	384,496	High	High	High	Low

As summarized in the above table, assessments have been applied to the Early Childhood Education concept, specifically the indicator just noted..

The pediatric population **Magnitude** of the potential indicator is assessed as **High**. Based on data assembled by the CRRU, there were 19,910 preschool/nursery school spaces in the province in 2007/08; this is adopted as the best marker currently available of ECE capacity. The number was subtracted from the age 4 cohort to establish an annualized snapshot of the capacity gap; the resulting total was multiplied by a factor of 16, representing the affected years from age 4 to age 19 and thus an estimate of the pediatric population prevalence with respect to being underexposed to ECE resources. The number of potentially vulnerable children is thus calculated as 384,496, which is greater than 10% (97,000) of the total pediatric cohort, resulting in a Magnitude classification of High.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **High**. The available evidence indicates a correlation between exposure to ECE and benefits in terms of cognitive development and academic achievement, with possibly more persistent effects on later mediators of well-being such as graduation rates and income levels. While there has not yet been a strong demonstration of the expected physical health effects over the long-term, such evidence is beginning to emerge, at least in terms of adult risk behaviours.

The **Modifiability** of the potential indicator is assessed as **High**. Although the public resources involved are substantial, jurisdictions such as certain U.S. states and Quebec¹⁴⁹ have demonstrated that expanding pre-K services is within reach, whether provided via a no- or low-fee model.

Data Availability/Reliability for the potential indicator is assessed as **Low**. Data reported by CRRU provide at best a rough approximation of the population exposure to ECE, given that the type of programs actually being delivered by day cares and preschools is not tracked in the statistics.

Based on the above assessment, the potential indicator is presently **Recommended for Development** as a core indicator of child health and well-being. The ratings of High for magnitude, significance/impact and modifiability, together with the existence of a system of ECE delivery in B.C. that is undergoing a rapid evolution, suggest the strong need to establish an appropriate data collection process that is both reliable and valid.

¹⁴⁹ Japel C. What a difference a decade makes: Counting the benefits of investment in early childhood development in Quebec. *Pediatric Child Health*. 2009; 140(10): 662-3.

Reading by an Adult

*A child who lacks the experience of snuggling up to a carer with a book, or talking about books they have read, may not only become disadvantaged in terms of educational opportunity but may also be deprived of a key opportunity for relationship, fun, social, personal and emotional development across a range of dimensions.*¹⁵⁰

In this section, the intervention focus related to preschoolers shifts from facility-based, group settings to the more informal, intimate context of a home. The specific topic in view is Reading by an Adult. To identify this activity specifically with the child's normal caregiver(s) represents a choice, partly designed to mark off a distinct concept for the purposes of this project.

Background and Context

One circumstantial reason for strongly equating reading to a child with the home environment is that fact that the literature, appearing under headings such as shared or joint reading, leans predominantly in that direction. Researchers and preschool leaders have been very motivated to study the impact of (and possibly ways to improve upon) parents functioning as allies in the early childhood education (ECE) process—and especially in the domain related to language and literacy.

It is important to note that, technically, the adults reading to a child can include a range of people beyond parents and other caregivers, and can occur in settings that include libraries, museums, parks, and community centres. The adults involved certainly will include ECE staff working in preschools, a context that was addressed in the previous section of this report. But, as noted, ECE professionals and advocates have been impressed with the particular power of “home literacy” environments to help launch the reading career of children and foster the development of language more broadly. So, while it may be worthwhile to investigate whether “other story-reading experiences are equally effective,”¹⁵¹ in this section the focus will be on the traditional category of parents reading with their children.

Using the phrase “reading with” rather than “reading to” is important, a fact reflected in common terms such as “shared reading” and “joint reading.” Book-related activities can involve reading to, but generally will also entail some kind of interaction or, if their development level allows, listening to children reading. The range of possible approaches demonstrates that reading styles are not all created equal; in fact, they may not be equally valuable in terms of literacy outcomes.^{152,153,154} This is why many studies of parental reading examine quality indicators, including strategies for engagement and interaction, the emotional tone of questions and comments, the appropriateness of “teaching” talk, and even the type of books chosen. Despite the volume of research on these topics, the number and variety of

¹⁵⁰ Seden J. Enhancing outcomes through children's literature. *Vulnerable Children and Youth Studies*. 2009; 4(2): 142-7.

¹⁵¹ Saracho ON, Spodek B. Parents and children engaging in storybook reading. *Early Child Development and Care*. 2010; 180(10): 1379-89.

¹⁵² Duursma E, Augustyn M, Zuckerman B. Reading aloud to children: the evidence. *Archives of Disease in Childhood*. 2008; 93(7): 554-7.

¹⁵³ Mol SE, Bus AG, de Jong MT et al. Added value of dialogic parent-child book readings: A meta-analysis. *Early Education and Development*. 2008; 19(1): 7-26.

¹⁵⁴ Lane HB, Wright TL. Maximizing the effectiveness of reading aloud. *The Reading Teacher*. 2007; 60(7): 668-75.

items studied actually creates a challenge for tracking a consistent evidence stream. This explains why quantity seems to trump quality when developing public statistics around parental reading. In short, the *frequency* of reading experiences tends to dominate the discussion. As a result, the literature review in this section will be scoped towards identifying the evidence of differential impacts on preschoolers when reading at home is *routine* rather than rare.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Major Heading:* Reading *Age:* Childhood (birth-12 yrs)

Search Keywords

Reading **AND** (Family OR Home OR Parent* OR Mother OR Father OR Care) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 269 papers in total.

Preliminary Exclusion

The 269 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between parental reading with a child and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 43.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

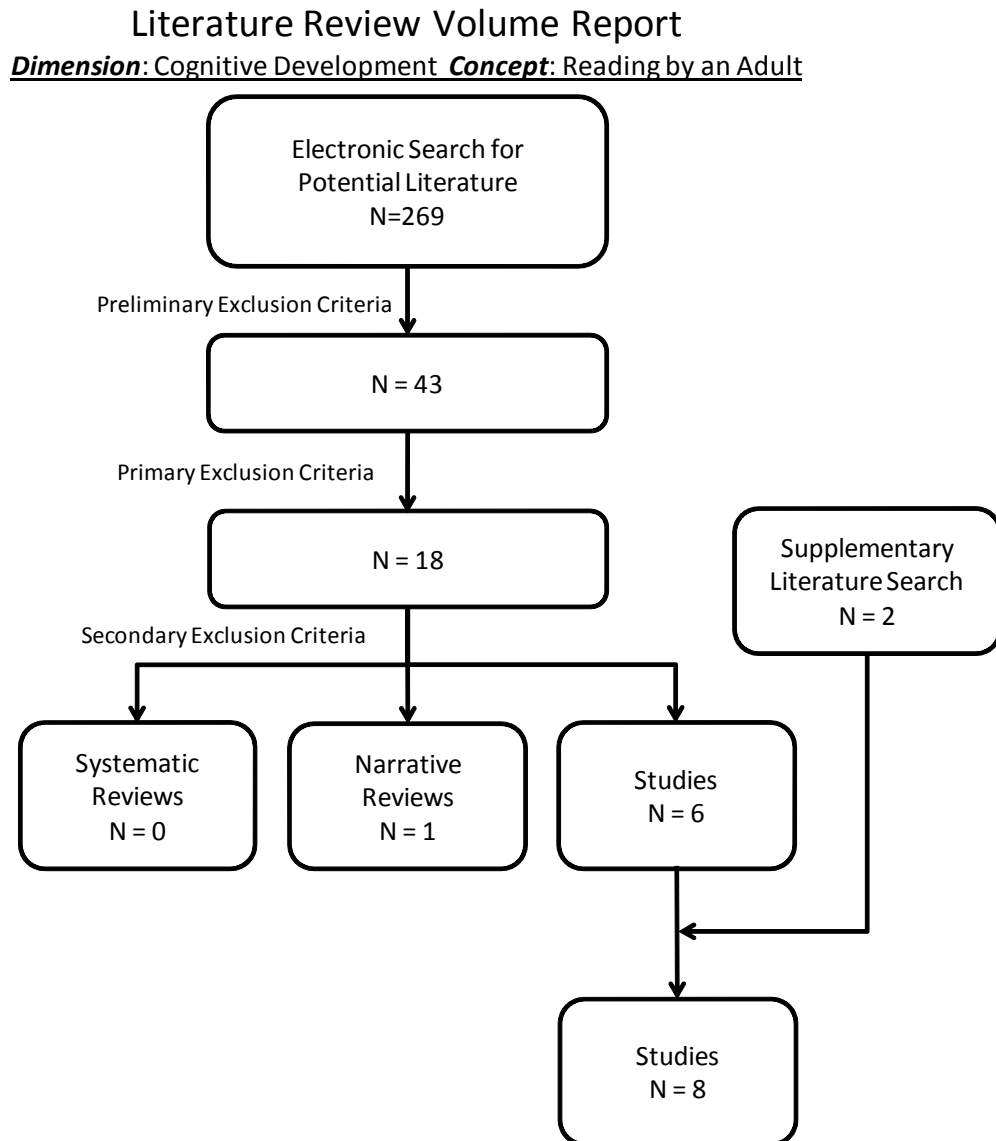
There were 18 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

The 18 full-text articles were then retrieved and examined in depth. Upon completion, it was determined that 6 were relevant to the specific topic of reading frequency and therefore

included in the analysis. Two additional studies were found through a supplementary search of the literature, using specific keywords, related article utilities, bibliography scans, etc.

The literature search process is detailed in the chart below, with the final 8 articles identified and summarized in the following tables.



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Reading by an Adult*

Selected Reading by Author									
Title of Study	Author(s)	Year	Journal	Journal Impact Factor	Type of Study	Sample Size	Sample Population	Location	Conflict of Interest
Language-Related Outcomes									
1 Relations among the frequency of shared reading and 4-year-old children's vocabulary, morphological and syntax comprehension, and narrative skills	Senéchal	2008	Early Education and Development	0.81	Cross-sectional	106	Children (mean age 4.6 years)	Canada	Not stated
2 Predicting language development in children at risk: the effects of quality and frequency of caregiver reading	Fletcher	2008	Early Education and Development	0.81	Cross-sectional	87	Children (24 months)	U.S.	Not stated
3 Early attention and literacy experiences predict adaptive communication	Arterberry	2007	First Language		Cross-sectional	229	Children (aged 2-4 years)	U.S.	Not stated
4 The role of home literacy practices in preschool children's language and emergent literacy skills	Roberts	2005	Journal of Speech, Language, and Hearing Research	2.15	Longitudinal	72	Children (mean age 8 months at baseline)	U.S.	Not stated
5 Effects of shared parent-infant book reading on early language acquisition	Karrass	2005	Applied Developmental Psychology	2.08	Longitudinal	87	Children (age 4 months at baseline)	U.S.	Not stated
6 The influence of home-based reading interactions on 5-year-olds' reading motivations and early literacy development	Sonnenschein	2002	Early Childhood Research Quarterly	2.19	Longitudinal	30	Children (aged 5.2 years at baseline)	U.S.	Not stated
Outcomes that Include the Social Domain									
7 Shared-reading versus oral storytelling: associations with preschoolers' prosocial skills and problem behaviours	Curenton	2011	Early Child Development and Care		Cross-sectional	33	Children (mean age 53 months)	U.S.	Not stated
8 Mothers' storybook reading and kindergartners' socioemotional and literacy development	Aram	2009	Reading Psychology		Cross-sectional	40	Children(mean age 5 yr 9 mo)	Israel	Not Stated

Dimension: Cognitive Development Concept: Reading by an Adult
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Language-Related Outcomes							
Senechal (2008)	To test the contribution of shared reading and parent literacy to a variety of child outcomes	- Parent questionnaire and direct child assessment generated the data - "Shared reading" was defined as an aggregate factor that included frequency of reading, visits to a library, and recognition of children's literature by the parent	Canada N=106 dyads (parent-child, mean age 4 yr 8 mo)	Parent who read most to the child completed questionnaire Hierarchical regression analysis was applied to the data	Measures of expressive vocabulary, morphological and syntax comprehension, and narrative ability (story grammar, cohesion, and language complexity)	- Shared reading as defined in this study was significantly positively correlated with expressive vocabulary and comprehension measures - After entering controls, the effect was modest, accounting for only 10 to 11% of the variance in the expressive language measure	Since "shared reading" was defined as an aggregate factor, a practice that is common in this field of research, it is not possible to abstract the specific impact of frequency of reading
Fletcher (2008)	To test a model of the relations among toddler language, caregivers' reported frequency of reading with children, and reading strategies on children's language and attention	The participants were from a program for children at-risk due to prenatal exposures that caused mild to moderate developmental delays	Indiana N=87 dyads (primary caregiver-child, 24 mo)	Caregivers read to their children for 2 min, an interaction that was filmed and later coded, and then they reported on the frequency of reading to their children by means of a survey	Caregivers completed the MacArthur Communicative Development Inventories to measure children's receptive and expressive language at 24 and 30 mo.	Children's language skills at 24 months were positively associated with the reported frequency of caregiver reading in the home	The observed interactions underlined the potential importance of caregiver question asking during shared reading
Arterberry (2007)	To investigate the contributions of sociodemographic factors, literacy experiences, and child attention in predicting adaptive communication	Children's information-processing abilities were assessed in a laboratory task using visual stimuli in one visit between the ages of 3 and 9 months; families were contacted again when the children were aged 2 to 5 years, and information was collected on each child's literacy environment and adaptive communication	United States N=229 children	Path analyses used to identify direct and indirect influences of variables of interest on measures of adaptive communication	Communication was assessed using the Communication Domain of the Vineland Adaptive Behavior Scales	Path analyses revealed direct effects for reading times per week and number of trips to the library for Adaptive Communication and the sub-domain of Expressive Communication, as well as for Receptive Communication	Encouraging reading in children, along with trips to the library, likely foster both expressive and receptive communication

Dimension: Cognitive Development Concept: Reading by an Adult
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Roberts (2005)	To examine how 4 specific measures of home literacy practices (i.e., shared book reading frequency, maternal book reading strategies, child's enjoyment of reading, and maternal sensitivity) and a global measure of the quality and responsiveness of the home environment during the preschool years predicted children's language and emergent literacy skills	Children were recruited from child care centres in several small cities; when they were between 18 months and 5 years of age, the children's mothers were interviewed on an annual basis about the variables of interest, including the frequency they read to their child	Southern states, U.S.A. N=72 children, mean age 8 months at baseline	Longitudinal study	Language skills measured via the Peabody Picture Vocabulary Test - Revised, the Clinical Evaluation of Language Fundamentals - Preschool, and the Test of Early Reading Ability	Significant correlation with language and literacy skills not found for frequency of reading	A <i>global</i> measure of overall responsiveness and support of the home environment was the strongest predictor of children's language and early literacy skills
Karrass (2005)	To investigate whether shared parent-infant book reading at 4 and 8 months would be associated with subsequent language abilities at 12 and 16 months	Typically developing infants and their parents visited the lab at 4, 8, 12 and 16 months of age	Midwest U.S.A. N=87 children	Longitudinal study Six analyses of covariance (ANCOVAs) were conducted to assess the relation of shared reading at an early age to total language composite scores in later toddler months	Language measure based on pertinent items from the Bayley Mental Scale and parent-report items from the Sequenced Inventory of Communicative Development-Revised (expressive and receptive scales)	Shared reading at 8 months was related to 12- and 16-month language abilities (particularly for girls and for expressive language); reading at 4 months was not significantly related to later language.	Findings support the efficacy of reading to children as young as 8 months, a result that adds to the relatively scarce information on reading to infants; the study would be improved by examining effect of frequency and duration of reading (i.e., dosage of exposure)

Dimension: Cognitive Development Concept: Reading by an Adult
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Sonnenschein (2002)	To investigate what literacy-related components are fostered by the affective and other qualities of reading interactions, in addition to tracing the impact of frequency of reading	Storybook reading interactions were observed in children's homes during the summer before children started kindergarten; children were individually assessed in school with a battery of emergent literacy measures in the spring of kindergarten.	Baltimore N=30 families, mean age of children was 5.2 years	Longitudinal study	Phonological awareness, orientation toward print, story comprehension, and children's motivations for reading	Reported reading frequency was the only significant correlate of children's early literacy-related skills.	In contrast, the affective quality of the reading interaction was the most powerful predictor of children's motivations for reading, which points to the importance of affective characteristics for fostering children's interest in literacy.
Outcomes that Include the Social Domain							
Curenton (2011)	To investigate how shared reading and oral story telling were associated with children's social skills	Information was gathered from mothers, children's receptive language skills were assessed, and transcripts of narrative interaction analyzed	Virginia/Florida N=33 dyads (mother-preschooler)	Repeated measures analysis of variance	Receptive language skills measured via Test of Early Language Development	<ul style="list-style-type: none"> - Reported frequency of shared reading was a predictor of prosocial skills but not of problem behaviours - Younger age at first shared reading showed similar correlations - Significance actually lost when controlling for mother's literacy and children's language skills 	Certain styles of oral story-telling may be superior to shared reading as an influence on problem behaviours
Aram (2009)	To assess storybook reading at home with reference to kindergartners' empathy, socioemotional adjustment, language, and alphabetic skills	Frequency of reading (via a proxy measure of the mother's recognition of children's literature) and expertise in choosing books were tested against socioemotional and language outcomes	Israel N=40 dyads (mother-child, mean age 5 yr 9 mo)	Regression analysis	<ul style="list-style-type: none"> - Teachers rated empathy and socioemotional adjustment according to a study-specific and established instrument, respectively. - Children completed tasks to rate language and alphabetic skills; the language instrument used has tested well against other language measures, including receptive vocabulary. 	Frequency of storybook reading correlated significantly with socioemotional adjustment and language but not alphabetic skills	Promoting alphabetic skills by means of joint reading may be limited because it rarely focuses on letter knowledge or on the reading process itself; instead (as might be expected), it dwells on the plot and the meaning of the story

Bibliography for Table of Studies

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Fletcher KL, Cross JR, Tanney AL et al. Predicting language development in children at risk: The effects of quality and frequency of caregiver reading. *Early Education and Development*. 2008; 19: 89-111.

Arterberry ME, Bornstein MH, Midgett C et al. Early attention and literacy experiences predict adaptive communication. *First Language*. 2007; 27: 175-89.

Roberts J, Jurgens J, Burchinal M. The role of home literacy practices in preschool children's language and emergent literacy skills. *Journal of Speech, Language, and Hearing Research*. 2005; 48: 345-59.

Karrass J, Braungart-Rieker JM. Effects of shared parent-infant book reading on early language acquisition. *Applied Developmental Psychology*. 2005; 26: 133-48.

Sonnenschein S, Munsterman K. The influence of home-based reading interactions on 5-year-olds' reading motivations and early literacy development. *Early Childhood Research Quarterly*. 2002; 17: 318-37.

Curenton SM, Craig MJ. Shared-reading versus oral storytelling: associations with preschoolers' prosocial skills and problem behaviours. *Early Child Development and Care*. 2009; 181: 123-46.

Aram D, Aviram S. Mothers' storybook reading and kindergartners' socioemotional and literacy development. *Reading Psychology*. 2009; 30: 175-94.

Summary of Results

The outcomes linked to reading by an adult are dominated by language-related themes, which is not unexpected. Only two of the identified studies moved beyond this realm to encompass one or more aspects under the social/psychosocial heading. The evidence was categorized accordingly for the purpose of this section.

Language-Related Outcomes

In all, 6 papers evaluated the concept Reading by an Adult, as experienced by children before formal schooling, in terms of immediate or later language outcomes. A wide range of effect assessment tools were applied, including the well-known Peabody Picture Vocabulary Test and the Clinical Evaluation of Language Fundamentals. The sub-domains of interest comprised both verbal and early literacy skills. As explained earlier, the predictor variable targeted in this literature search was frequency of reading. Two-thirds of the studies explicitly tracked the impact of the number of reading episode over a particular time period; for one other study the notion of frequency was implicit, and for the remaining paper the frequency of reading was incorporated in an aggregate factor termed “shared reading.”

The frequency of shared reading in the home emerged as a clear predictor of the development of various language skills in at least four of the studies.

Outcomes that Include the Social Domain

The modest evidence stream relating shared reading with socioemotional development suggested that frequency again was positively correlated with social skills/adjustment. Any socioemotional effect may be mostly mediated by the enhanced language skills now available to the child and/or the skills of the parent involved in the shared reading.

Data Sources

There are other aspects of the home literacy environment that have been studied and sometimes tracked, such as regularity of using the library and episodes of parents tutoring their preschool child in phonology and other language skills; there is also a large literature on supporting or even training parents for these sorts of activities. However, the proportion of homes offering a minimal frequency of shared reading is the statistic most often collected for policy-making purposes. For instance, in Canada, the National Longitudinal Survey of Children and Youth (NLSCY) has for many years been monitoring the proportion of children aged 0-5 years exposed to reading with an adult at least daily. The last information reported in B.C. based on the NLSCY was for 2004/05, where 71.9% of preschool children experienced at least daily reading.¹⁵⁵

Discussion

Routine reading with a child by a parent or other caregiver at home appears to confer an excess benefit compared with less frequent episodes of this type of activity. There is, unsurprisingly, a language development and literacy advantage that emerges either concurrently or at an early stage of formal schooling. The positive effect of higher exposure dose appears to apply to socioemotional development as well. This seems plausible, given the possible involvement of a mediator such as increased emotional and even physical connection between caregiver and child. The picture of parent and child “snuggling up” together with a

¹⁵⁵ Indicators of Early Childhood Health & Well-Being in British Columbia. 2008. Available at http://www.mcf.gov.bc.ca/early_childhood/pdf/early_indicators_fourth_report.pdf. Accessed October 2011.

book was introduced in the quotation that opened this section of the report. However, it is also possible that increased language skill is the main mediator of improved social functioning, so that some improvement in child social skills may be achievable even when the adult reader is a professional that does not have the same strong emotional bond with the child.

While the focus in this section has been on frequency of reading by an adult, it should be acknowledged that conclusions on this specific topic are reinforced by the broader home literacy evidence. Later reading achievement in primary school consistently stands out as a critical impact of early reading experiences. For example, a 5-year longitudinal study showed that children's exposure to books developed their vocabulary and listening comprehension skills, which in turn had an impact on their reading skills in the third grade.¹⁵⁶ These sorts of results have been confirmed by reviews and meta-analyses covering many decades of research. For instance, Bus et al. synthesized studies between 1950 and 1994 that supported the conclusion that the positive effects of being read to "affected the young children's literacy development and their reading performance later in school when they learned to read conventionally."¹⁵⁷ It is important to stress that reading by an adult can have salutary effects even when begun in infancy/toddlerhood, that is, well before the child can read on their own.^{158,159}

The exact mechanism that leads to shared reading contributing to later language abilities is not completely understood. The review by Bus et al. noted above suggested that children experiencing shared reading may develop a greater interest in language-related activities; consequently, children with a stronger predisposition for language and higher cognitive capacities may have a desire to be read to more often at a later age.¹⁶⁰ Alternately, Karrass et al. have pointed to the following possibilities:¹⁶¹

- Joint attention providing the infant with consistent opportunities for learning
- Parents using more sophisticated language with their infants during book reading, because of the greater complexity of written versus oral language
- Employing shared reading time to consciously teach vocabulary through labeling, having the infant point, and various questioning activities

Conclusion

Whatever the mediators and mechanisms, research clearly supports the implication that exposure to reading in young children helps to develop their early literacy skills as a key

¹⁵⁶ Saracho ON, Spodek B. Parents and children engaging in storybook reading. *Early Child Development and Care*. 2010; 180(10): 1379-89.

¹⁵⁷ Senechal M, LeFevre JA. Parental involvement in the development of children's reading skill: a five-year longitudinal study. *Child Development*. 2002; 73(2): 445-60.

¹⁵⁸ Westerlund M, Lagerberg D. Expressive vocabulary in 18-month -old children in relation to demographic factors, mother and child characteristics, communication style and shared reading. *Child: Care, Health, and Development*. 2008; 34(5): 257-66.

¹⁵⁹ Burgess SR. Home literacy environments (HLEs) provided to very young children. *Early Child Development and Care*. 2011; 181(4): 445-62.

¹⁶⁰ Bus AG, de Jong MT, Van Ijzendoorn MH. Social Aspects in Language and Literacy Learning: Progress, Problems, and Interventions. In: Saracho ON, Spodek B, eds. *Contemporary Perspectives on Social Learning in Early Childhood Education*. Greenwich, CT: Information Age; 2007.

¹⁶¹ Karrass J, Braungart-Rieker JM. Effects of shared parent-infant book reading on early language acquisition. *Applied Developmental Psychology*. 2005; 26: 133-48.

component of school readiness; moreover, the differential effect of more frequent exposure to reading by an adult is traceable at least as far as primary school reading achievement, and possibly reflected in social development at that stage as well.

As summarized below, assessments have been applied to the Reading by an Adult concept, specifically related to an indicator tracking at least daily reading experiences.

Summary Assessment					
Reading by an Adult					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
0-19	271,720	High	Medium	High	Low

The pediatric population **Magnitude** of the potential indicator is assessed as **High**. Based on the latest available data from the National Longitudinal Survey of Children and Youth (NLSCY), 28.1% of children aged 0 - 5 are not exposed to at least daily reading. This rate was applied to the entire pediatric cohort aged 0 -19, yielding an estimate of 271,720 individuals that have not experienced daily reading in the home. For the sake of this project, the assumption is that some expression of vulnerability, even if modest, persists into later years; this justifies the application of the vulnerable rate to the entire pediatric population aged 0 -19 in the province. The resulting total is greater than 10% (97,000) of the total pediatric cohort, resulting in a Magnitude classification of high.

The **Significance** of the potential indicator as demonstrated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. While the evidence does show positive correlations between reduced exposure to reading at home and poorer outcomes, the evidence is restricted almost exclusively to the realm of language development and literacy, and in fact those effects have been mostly traced only into the primary school years. As well, it is important to carefully account for confounders in past and future research in this area, including the effect of different maternal education levels and "teaching" abilities^{162,163} and the connection between socioeconomic status and the ability to provide home literacy resources (books, parental time, etc.).¹⁶⁴ In general, it is important to keep in mind that "it is not only the frequency with which a parent reads to a child that affects the child's success; what that parent does during shared reading and how he or she mediates the shared text is also important."¹⁶⁵

The **Modifiability** of the potential indicator is assessed as **High**. The predictors of infrequent reading with a child at home are numerous and variable; at least some of them are amenable

¹⁶² Korat O. The effect of maternal teaching talk on children's emergent literacy as a function of type of activity and maternal education level. *Journal of Applied Developmental Psychology*. 2009; 30: 34-42.

¹⁶³ Hammer CS, Farkas G, Maczuga S. The language and literacy development of Head Start children: a study using the Family and Child Experiences Survey database. *Language, Speech, and Hearing Services in Schools*. 2010; 41(1): 70-83.

¹⁶⁴ Centre for Community Child Health, The Smith Family. *Let's Read: Literature Review*. 2004. Available at <http://www.letsread.com.au/pages/litreview.php>. Accessed October 2011.

¹⁶⁵ DeBruin-Parecki A. Establishing a family literacy program with a focus on interactive reading: The role of research and accountability. *Early Childhood Education*. 2009; 36: 385-92.

to modification.¹⁶⁶ There is an extensive literature examining interventions to enhance parental involvement in reading and other literacy activities.^{167,168,169} In one meta-analysis of home literacy interventions, the “mean effect size for the combined studies was moderately large (effect size = .68).”¹⁷⁰

Data Availability/Reliability for the potential indicator is assessed as **Low**. While data from the NLSCY are useful to establish a magnitude for this report and possibly a benchmark for future tracking, the commitment to continue the NLSCY in its present form is not clear.

The indicator is presently **Recommended for Development** as a core indicator of child health and well-being. The ratings of High to Medium for magnitude, significance/impact, and modifiability are already compelling; clearly, the issue of a sustained and regular data trail is the key area requiring attention from policy makers.

¹⁶⁶ Kuo AA, Franke TM, Regalado M et al. Parent report of reading to young children. *Pediatrics*. 2004; 113(6 Suppl): 1944-51.

¹⁶⁷ Swick K. Promoting school and life success through early childhood family literacy. *Early Childhood Education*. 2009; 36(5): 403.

¹⁶⁸ Zeece P, Wallace B. Books and good stuff: A strategy for bulding school to home literacy connections. *Early Childhood Education*. 2009; 37(1): 35.

¹⁶⁹ Zuckerman B, Khandekar A. Reach Out and Read: evidence based approach to promoting early child development. *Current Opinion in Pediatrics*. 2010; 22(4): 539-44.

¹⁷⁰ Senechal M. The Effect of Family Literacy Interventions On Children’s Acquisition of Reading. 2006. Available at http://lincs.ed.gov/publications/pdf/lit_interventions.pdf. Accessed October 2011.

Concepts Related to Learning and Other Outcomes

Having dealt with concepts/indicators related to readiness to learn in the first part of the report, a sub-dimension mainly associated with cognitive development in the preschool age, it is time to move on to the results experienced after entering and engaging in formal schooling. In many cases, the concepts/indicators in this part of the report were already introduced as outcomes against which the various readiness to learn predictors and interventions were tested. Now the outcomes, which by definition relate to children of elementary or secondary school age, become predictors in their own right, to be tested against concurrent or future health and well-being effects.

The concepts to be examined fall into three subsets. First, there are academic achievement results covering the classic “three Rs” of reading, writing, and arithmetic. Helpfully, British Columbia actually has tracked these indicators for several years through standardized testing in both elementary and secondary school. One concept in this category is unusual in that it focuses by definition on a subpopulation of the total pediatric cohort, namely, those who do not have English as their primary language. Second, there are two concepts covering the consistency and duration of exposure to formal school, School Attendance (tracking intermittent interruptions of exposure) and Early School Leavers (extended and sometimes permanent interruption). Finally, there are concepts that can involve activities outside of school per se, including High School Completion (which sometimes is accomplished through alternate routes that extend into the young adult years) and Reading as a Leisure Activity. The beneficial and enjoyable habit of reading is the one concept that could be usefully tracked at almost any age, though such patterns likely extend all the way back to the commitment of parents and early childhood education staff to expose the youngest children to experiences fostering literacy. Thus, it is an apt topic to end a report on the indicators of child health and well-being related to Cognitive Development.

A Note on Educational Proficiency

Five chapters on performance in formal school settings follow below, two related to elementary grades and three to secondary. Two of the chapters involve numbers and mathematics, and the others focus on language. “Proficiency” in a subject area is an ambiguous idea. Broadly speaking, there are two approaches to measuring proficiency in a subject area: specialized testing of skills that can be applied one or more times during the school year, and standardized exams that are usually administered at the end of a term.

By definition, standardized exam scores represent a better data source for population-level indicator tracking. As noted above, exam scores are available in elementary and secondary schools in B.C., and therefore are the natural place to land for constructing an indicator. By contrast, evidence in the literature tends to be based on specialized tests for assessing language or mathematics skills and these tests can be quite variable with respect to content, validity, etc. In other words, there is a mismatch between the available literature on academic skills as a predictor of well-being and the ready access to academic achievement scores across the pediatric population. For this project it will be necessary to accept this gap with the assumption that measuring proficiency using various psychometric tests of language and mathematics skills approximates results observed based on standardized exams.

Children Reading and Writing

Background and Context

This section will evaluate the assigned concept of children reading and writing, foundational skills for a future concept of youth English proficiency. Strickland and Morrow note that “even during the first few months of life, children come in contact with written language as parents place soft alphabet blocks in their environments or read them books. These early contacts with print can be thought of as the beginning of a lifelong process of learning to read and write.”¹⁷¹ Indeed, the foundations of reading and writing are built in early childhood; with the development of these two domains occurring in a concurrent and interrelated fashion. In fact, reading and writing are so interdependent that they, along with oral language development, are often collectively referred to as literacy.

Literacy can impact health and well-being both directly (e.g., incorrect use of medications, failure to comply with medical directions, errors in administration of infant formula, safety risks in the home) and indirectly (e.g., healthy lifestyle practices, income as a result of employment and education).¹⁷² The latter example has been cited elsewhere in this report; generally speaking the better educated are healthier, and researchers believe that cognitive factors, such as verbal, reading, and writing abilities, play a role in mediating this relationship.¹⁷³ While educational attainment (e.g., college graduation) has been traditionally correlated with health outcomes, recent evidence suggests that academic performance is also strongly linked to health later in life.

With respect to literacy specifically, the relationship between adult literacy and health outcomes has been well documented, with lower literacy being linked to problems with the use of preventive services, delayed diagnoses, understanding of one’s medical condition, adherences to medical instructions, self-management skills, physical and mental health, increased mortality risk, and higher health care costs.¹⁷⁴

Beginning in the 1990’s, *health literacy* has been a focus for attention in North America.¹⁷⁵ It is an emergent concept, defined by the National Institutes of Health as the “...degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.”¹⁷⁶ It is broader than functional literacy, incorporating literacy, numeracy, and at times, social skills. While this definition does stray from reading and writing, there is a strong correlation between health literacy skills and functional literacy. Limited health literacy is more common among adults with less than a high-school education, poverty-level income, limited English language

¹⁷¹ Strickland DS, Morrow LM. *Emerging Literacy: Young Children Learn to Read and Write*. Newark, Delaware: International Reading Association; 1989.

¹⁷² See, *How Does Literacy Affect the Health of Canadians?* Available at <http://www.nald.ca/library/research/howdoes/howdoes.pdf>. Accessed October 2011.

¹⁷³ Herd P. Education and health in late-life among high school graduates: Cognitive versus psychological aspects of human capital. *Journal of Health and Social Behavior*. 2010; 51(4): 478-96.

¹⁷⁴ Dewalt DA, Berkman ND, Sheridan S et al. Literacy and health outcomes: a systematic review of the literature. *Journal of General Internal Medicine*. 2004; 19(12): 1228-39.

¹⁷⁵ Clement S, Ibrahim S, Crichton N et al. Complex interventions to improve the health of people with limited literacy: A systematic review. *Patient Education and Counseling*. 2009; 75(3): 340-51.

¹⁷⁶ Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *American Journal of Health Behavior*. 2007; 31 Suppl 1: S19-26.

proficiency, a learning disability, or a physical disability.¹⁷⁷ For these purposes, health literacy will be included in the current search.

Often the health literacy literature investigates the relationship between adult health literacy, and the potential impacts on their children's health. This is beyond the scope of the current concept. This analysis will focus on the literacy skills of children, and the relevant health outcomes in childhood and adulthood. As was the case with the three numeracy concepts, any evidence trail that ties childhood literacy to adolescent literacy will be included, in anticipation of the future concept of youth English proficiency. Another similarity between the two concepts is that they are defined by age cut-offs; the current concept will evaluate children in the elementary school age, while English language proficiency will evaluate high-school aged children.

As alluded to above, there is a substantive literature on adult literacy and health literacy and the associated health effects. Thus, any studies investigating the connection between childhood literacy or health literacy and adulthood correlates will also be included.

Methodology and Provisional Results

Article Search Process

A literature search for reviews relevant to the current concept was undertaken, with a number of reviews found relevant to health literacy. There was substantive overlap between the reviews, so two of the most recent (2009) were chosen. The majority of studies included focused on the relationship between adult literacy (i.e., parent/caregiver literacy) and the parent/caregiver child's health. The current concept is in fact concerned with *children* reading and writing and the potential health and well-being effects, whether in children or later as adults. Thus, it was decided that the studies with a focus on children's language skills as an input would be extracted from the review and evaluated independently. In total, there were five such studies for the group of interest (i.e., children's reading and writing skills in elementary/middle school evaluated against health and well-being outcomes). Additional literature searches were undertaken to look for other relevant studies.

In addition, a targeted literature search was performed, looking for additional studies published since the 2009 reviews. The search was performed as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2009-Present *Subject: Major Heading:* Academic Achievement

¹⁷⁷ Sanders LM, Federico S, Klass P et al. Literacy and child health: a systematic review. *Archives of Pediatrics & Adolescent Medicine*. 2009; 163(2): 131-40.

Search Keywords

(Literacy OR Language) AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 233 unique papers in total.

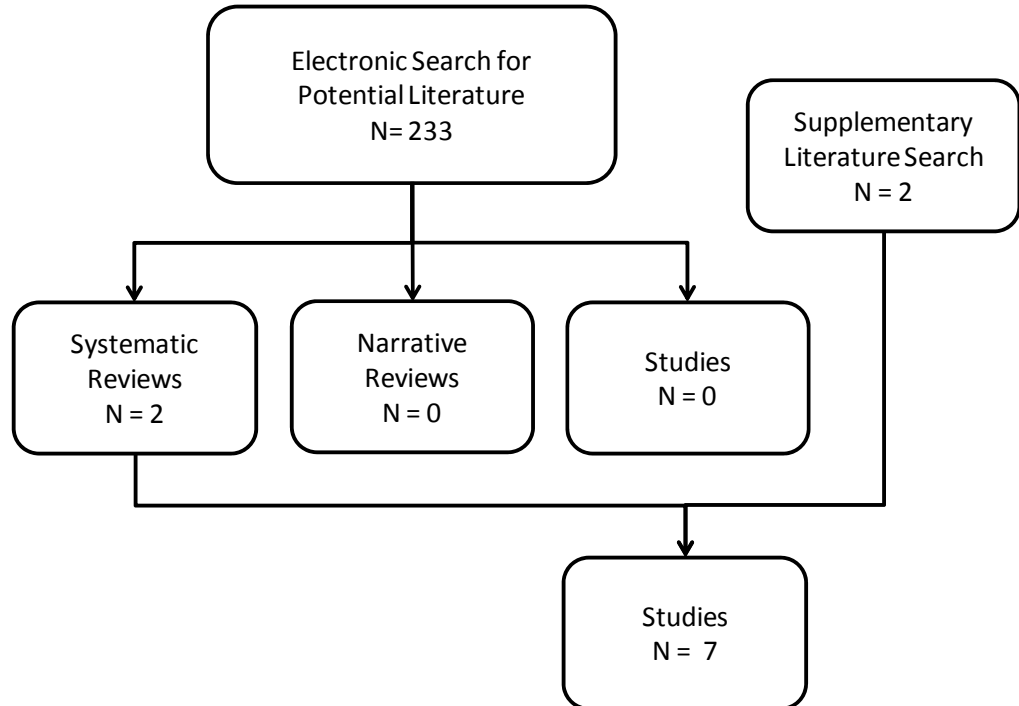
Preliminary Exclusion

The 233 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between children reading and writing, and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, there were no pertinent studies identified. A supplementary literature search found 2 additional studies of interest, bringing the total to 7.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Children Reading and Writing



Summary of Relevant Studies
Dimension: Cognitive Development
Concept: Children Reading and Writing

Title of Study	Lead Author	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
1 The impact of early school behavior and educational achievement on adult drug use disorders	Forthergill	2008	Drug and Alcohol Dependence	4.05	Longitudinal	1,242	African American children	Chicago	None
2 The long-term significance of teacher-rated hyperactivity and reading ability in childhood: findings from two longitudinal studies	McGee	2002	Journal of Child Psychology and Psychiatry	4.36	Longitudinal	3,639	Children age 7-8 at baseline	New Zealand	Not Stated
3 Child and parental mental ability and glycaemic control in children with Type 1 diabetes	Ross	2001	Diabetic Medicine	2.97	Cross-sectional	150	Children aged 5-17	U.K.	Not Stated
4 Health outcomes of elementary school students in New Brunswick	Ma	2000	Evaluation Review	0.84	Cross-sectional	6,883	Children (Grade 6)	New Brunswick	Not Stated
5 Preteenage drug use in Australia: The key predictors and school-based drug education	Hawthorne	1996	Journal of Adolescent Health	3.33	Cross-sectional	3,019	Children aged 11-12	Australia	Not Stated
6 The relative value of reading ability and IQ as predictors of teacher-reported behavior problems	Stanton	1990	Journal of Learning Disabilities	2.24	Cross-sectional	991	Children (aged 5 years at baseline)	New Zealand	Not Stated
7 Psychological functioning of children who have recurrent migraine	Andrasik	1988	Pain	5.35	Cross-sectional	62	Children aged 8-17	N/A	Not Stated

Dimension: *Cognitive Development* Concept: *Children Reading and Writing*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Fothergill (2008)	To explore the impact of multiple early education indicators (including reading and writing) on later problem drug use.	Children were followed from 1966 – 2002/03 (over 35 years), with educational indicators, including grade 7/8 reading achievement, assessed against later adult drug use.	Chicago, U.S. N=1,242 (1,053 at follow-up in 2002/03) African American children in grade 1 at baseline	Prospective, longitudinal	-Classification of 'drug use disorder' at age 32-33 and 42-43 (abuse and dependence) based on DSM-III-R criteria and DSM-IV criteria.	-Standardized reading scores were not significantly correlated with adult drug use disorders (OR = 0.98 [0.97,1.01]).	There appears to be no correlation between grade 7/8 reading achievement and adulthood drug use.
McGee (2002)	To examine behavioural and academic outcomes of children with hyperactivity and to examine comparable psychosocial outcomes for children with early reading difficulties.	Measures of teacher-rated persistent hyperactivity from two longitudinal data sets were used to assess behavioural and academic outcomes during adolescence and adulthood.	Australia, New Zealand N=3,639 (reading assessed at 7-8 years of age.	Retrospective, longitudinal	- Hyperactivity: Rutter, Tizard and Whitmore Child Scale B. - Antisocial behaviour: Teacher reports - Reading: Word Knowledge test - Behavioural and academic outcomes in adolescence: Socialized Aggression subscale of the Quay and Peterson Revised Behaviour Problem Checklist, DISC-C, administrative data	-Poor reading in childhood (7-8 years of age) significantly predicted lower levels of reading at age 15. -Children with the poorest reading predicted later delinquent behaviour (OR = 2.24 [1.07-4.73]). -Odds ratios for early reading predicting adolescent school difficulties were about 1.50, though no significant correlations were seen across percentile groups.	-Early reading problems appear to be maintained through to adolescence; those in the bottom 10% of reading achievement at 7-8 years of age are 2.24 times more likely to engage in later delinquent behaviour.
Ross (2001)	To examine the influence of child's and mothers intelligence (WRAT for children – reading ability) on glycaemic control in children with type 1 diabetes.	Glycemic measurements were compared against reading ability and general mental ability in children and adults.	Edinburgh, UK N=150 children aged 5-17	Cross-sectional	- HbA1c score: measure of glycaemic control (average of 4 tests) - Reading ability: WRAT (children), National Adult Reading Test (NART)	-No significant correlation between the WRAT scores and mean annual HbA1c scores was observed. -A significant correlation was observed between the mean annual HbA1c of the child and NART scores of their mothers.	Parental literacy, but not child literacy is correlated with glycaemic control in children with type 1 diabetes.

Dimension: *Cognitive Development* Concept: *Children Reading and Writing*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Ma (2000)	To examine the health effects of individual, family, and school characteristics on students' health outcomes.	Grade 6 academic achievement (reading/writing) was correlated against physical health and mental health outcomes using administrative data from the New Brunswick school system.	New Brunswick N = 6,883 (reading/writing assessed in Grade 6)	Cross-sectional	-Physical and Mental Health: Adopted from WHO scale that measures the general health of young children.	-Students with higher achievement in reading/writing reported significantly fewer physical health and mental health problems than did students with lower achievement.	The evidence suggests a correlation between reading/writing achievement and mental and physical health.
Hawthorne (1996)	To explore social, personal, and school (including literacy) factors as predictors of pre-teenage drug use.	A cross-sectional survey of students gathered data on social, personal, and educational predictors to identify significant predictors of drug experimentation and use.	Australia N=3,019 (students aged 11-12)	Cross-sectional survey	-Ever having used tobacco, having used tobacco in the past month (self-reported survey.)	Low literacy predicted ever have used tobacco for boys (OR = 1.7 [1.1-2.7]) but not girls (OR=1.1 [0.6-2.0]) Low literacy predicted having used tobacco in the past month in boys (OR = 4.2 [2.0-8.9]) and girls (OR = 4.4 [1.8-10.7])	Low literacy is correlated with increased probability of ever having used tobacco in boys, and having used tobacco in the past month for both boys and girls.
Stanton (1990)	To examine the role of reading ability in the relationship between intellectual performance and teacher-reported behaviour problems.	Children's reading ability was assessed at age 7 and 9, and correlated to problem behaviour.	New Zealand N=991 at 5 years of age.	Cross-sectional analysis of longitudinal data	-Behavioural Problems: Administered at ages 5, 7, 9, and 11; using the Rutter Scale.	-Reading ability predicted the change in behavioural problems during school years; children with lower reading ability were more likely to display disruptive behaviour at school.	Poor literacy is associated with behavioural problems at school.
Andraski (1988)	To analyze the relationship between psychological measures in children who have recurrent migraines.	Children with recurrent migraines and a control group without were compared on a variety of psychometric tests (including reading achievement) to determine if any correlations exist.	N=62 (32 with migraines, 32 control) Aged 8-17	Cross-sectional	-Reading Achievement: WRAT-R -Vocabulary: Peabody Picture Vocabulary Test	-There were no significant differences observed between the migraine and control groups on the WRAT-R or the Peabody tests.	-Migraines are not correlated with poorer reading achievement.

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Fothergill KE, Ensminger ME, Green KM et al. The impact of early school behavior and educational achievement on adult drug use disorders: a prospective study. *Drug and Alcohol Dependence*. 2008; 92(1-3): 191-9.

McGee R, Prior M, Williams S et al. The long-term significance of teacher-rated hyperactivity and reading ability in childhood: findings from two longitudinal studies. *Journal of Child Psychology and Psychiatry*. 2002; 43(8): 1004-17.

Ross LA, Frier BM, Kelnar CJ et al. Child and parental mental ability and glycaemic control in children with Type 1 diabetes. *Diabetic Medicine*. 2001; 18(5): 364-9.

Ma X. Health outcomes of elementary school students in New Brunswick. The education perspective. *Evaluation Review*. 2000; 24(5): 435-56.

Hawthorne G. Preteenage drug use in Australia: The key predictors and school-based drug education. *Journal of Adolescent Health*. 1996; 20: 384-95.

Stanton RS, Feehan M, McGee R, et al. The relative value of reading ability and IQ as predictors of teacher-reported behaviour problems. *Journal of Learning Disabilities*. 1990; 8(23): 514-7.

Andrasik F, Kabela E, Quinn S et al. Psychological functioning of children who have recurrent migraine. *Pain*. 1988; 34(1): 43-52.

Summary of Results

The seven studies that met the inclusion criteria for this section evaluated heterogeneous health and well-being outcomes. The strongest study found that standardized reading scores in grade 7/8 were not correlated with later drug use disorders, while a retrospective analysis by McGee et al. found that poor reading in childhood significantly predicted lower levels of reading at age 15, and was correlated with later delinquent behaviour.

Other health risk behaviours were evaluated; poor reading was significantly correlated with behavioural problems and increased odds of having used tobacco in the past month. A large study from New Brunswick found that there was a significant correlation between reading/writing achievement and mental and physical health problems. Two of the seven studies evaluated specific health outcomes, with neither finding a significant correlation between children's literacy and migraine headaches or glycemic control for children with type 1 diabetes.

Data Sources

The included reviews shed some light on the types of data sources used to evaluate children's literacy. Broadly speaking, there are two types of measures. The first is an assessment of a sample of the population, often using a validated measure; examples pertinent to the current concept include the Burt Word Reading Test and the Wide Range Achievement Test (WRAT). Such measures have the advantage of being validated for use in the relevant context, but often rely on a smaller sample size and are costly to implement at the population level.

The second type of measure, standardized tests, are less likely to be validated than specific assessment tools, but offer population-based data, and, given that most jurisdictions currently have such measures in place, are an attractive option. Throughout this report, one of the foremost criteria in picking an indicator is that the measure is already in place in B.C. For the current concept, the indicator best suited is the foundational skills assessment (FSA) which is completed by all grades 4 and 7 students throughout the province. There is a domain for each of reading and writing; individuals are classified as either "not yet meeting," "meeting," or "exceeding" expectations. Results from the 2011 FSA are presented below:

British Columbia FSA Test		
Children "Not Meeting" Expectations		
2011, Grades 4 and 7		
	Grade 4	Grade 7
Reading	16%	18%
Writing	11%	10%
Source: B.C. Ministry of Education, 2011.		

Given that there is likely to be substantial overlap between individuals that are not meeting expectations in reading and writing, there is no clear way to combine these two into a single "literacy" indicator. The majority of studies evaluated by the two relevant reviews focus on reading over writing, therefore children not meeting expectations on the grade 4 reading component of the FSA is the best indicator based on the evidence trail. Grade 4 was chosen over grade 7 test scores because it allows for interventions earlier in the life course.

Based on 2011 data from the B.C. Ministry of Education, 16% of B.C. children are not meeting expectations on the grade 4 reading component of the FSA.

Discussion

The dominant body of evidence for children's reading and writing skills having an impact on health and well-being is in the area of behavioural outcomes. Recall that in the earlier concepts of Personal Social Behaviour Skills and Motor Skills, correlation studies in the preschool age group found that these skills were often correlated to later reading achievement. Causality concerns were raised and are equally applicable here. For instance, does poorer literacy result in a higher likelihood of violent, aggressive or antisocial behaviour? Or does such behaviour put one at risk for poorer literacy? Are other factors, such as socioeconomic status, better able to explain such phenomenon? These questions are not easily answered, and will require a more robust investigation by researchers.

In elementary school children, the current evidence base, especially when causality is considered, is modest. Literature in this area has primarily focused on the health literacy of adults and its relationship to either child health (adults in the role of caregiver) or adult health outcomes. This is apparent from the two reviews included in the analysis; only about a quarter of the studies included in these reviews focus on reading and informed decision-making by children. The reason for this disparity in the research literature likely stems from the fact that parents make many of the behaviour and other health and well-being choices for their children, particularly at younger ages. As noted by Abrams et al., "all children begin life lacking literacy, with their parents' or caregivers' health literacy acting as their complete surrogate interface with the health system. As children mature, their understanding and participation assume increasing importance in their health and health care."¹⁷⁸

While outside the scope of this current section, the evidence for the impact of *adult literacy* on child health and well-being appears to be strong. This is supported in both the socioemotional and physical realms. The review by DeWalt et al. found that lower literacy was associated with lower rates of health insurance, more severe asthma attacks, medication use, and higher rates of depressive or withdrawal symptoms (in their children). As mentioned in the Introduction, the adult health outcomes associated with poor adult literacy are well-noted. A 2011 systematic review suggests that poorer health literacy is associated with more hospitalizations, greater use of emergency care, lower receipt of mammography screening and influenza vaccine, poorer ability to demonstrate taking medications appropriately, poorer ability to interpret labels and health messages, and, among elderly persons, poorer overall health status and higher mortality rates.¹⁷⁹

Elementary school literacy is not well tracked into adulthood; such a connection is essential to generating an indirect argument for further introducing adult literacy and health outcomes into the current discussion. One study found that poor literacy at 7-8 years of age predicted lower reading levels at age 15. Other data from the National Longitudinal Survey of Children and Youth show that children aged 8 and 9 whose reading ability in school was better than their peers had significantly higher test scores in literacy a decade later.¹⁸⁰ Data in this area

¹⁷⁸ Abrams MA, Klass P, Dreyer BP. Health literacy and children: introduction. *Pediatrics*. 2009; 124 Suppl 3: S262-4.

¹⁷⁹ Berkman ND, Sheridan SL, Donahue KE et al. Low health literacy and health outcomes: an updated systematic review. *Annals of Internal Medicine*. 2011; 155(2): 97-107.

¹⁸⁰ See <http://www.statcan.gc.ca/daily-quotidien/061205/dq061205a-eng.htm>

appear to be sparse; the reasons for this gap related to child reading as an influence on adult reading are not immediately clear. Interestingly, there is evidence for allied concepts, such as early language skills, correlating with adult literacy.¹⁸¹

While the relationship between literacy and health outcomes are well documented for adults, specific causal pathways are not entirely clear.¹⁸² Three distinct points along the continuum of health care that are believed to link literacy and health are: access and utilization of health care, patient-provider relationship, and self care.¹⁸³ Despite an incomplete understanding of the actual causal mechanisms, numerous interventions targeted at literacy have been implemented in adult populations with variable success on health outcomes.^{184,185} There has been a limited focus on interventions targeted at improving the health outcomes of children through literacy; some researchers have argued that there are too few interventions with demonstrated efficacy, as well as too many interpretations of health literacy.^{186,187}

Conclusion

As summarized below, assessments have been applied to Children Reading and Writing concept, specifically to the indicator related to not meeting expectations on the grade 4 FSA for reading.

Summary Assessment Children Reading and Writing					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
9-19	91,317	Medium	Medium	Medium	High

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. Based on data from the B.C. Ministry of Education, 16% of grade 4 children are not achieving expected reading levels. This rate was applied to the entire pediatric cohort aged 9-19, yielding an estimate of 91,317 individuals. This rate was applied to the entire cohort aged 9-19, rather than just those of kindergarten age, because those that are vulnerable at this early age are susceptible to adverse health and well-being outcomes the assumption is that, in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability would persist. The resulting estimate of 91,317 individuals is between 2-10% (19,000-97,000) of the total pediatric cohort, resulting in a Magnitude classification of medium.

¹⁸¹ Schoon I, Parsons S, Rush R et al. Childhood language skills and adult literacy: a 29-year follow-up study. *Pediatrics*. 2010; 125(3): e459-66.

¹⁸² Wolf MS, Wilson EA, Rapp DN et al. Literacy and learning in health care. *Pediatrics*. 2009; 124 Suppl 3: S275-81.

¹⁸³ Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *American Journal of Health Behavior*. 2007; 31 Suppl 1: S19-26.

¹⁸⁴ Wolf MS, Wilson EA, Rapp DN et al. Literacy and learning in health care. *Pediatrics*. 2009; 124 Suppl 3: S275-81.

¹⁸⁵ Clement S, Ibrahim S, Crichton N et al. Complex interventions to improve the health of people with limited literacy: A systematic review. *Patient Education and Counseling*. 2009; 75(3): 340-51.

¹⁸⁶ Abrams MA, Klass P, Dreyer BP. Health literacy and children: introduction. *Pediatrics*. 2009; 124 Suppl 3: S262-4.

¹⁸⁷ Wolf MS, Wilson EA, Rapp DN et al. Literacy and learning in health care. *Pediatrics*. 2009; 124 Suppl 3: S275-81.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. While the evidence does show correlations between poor child literacy and negative health and well-being outcomes, causality is more difficult to determine. If one assumes that poor literacy in children leads to poor literacy in adults, then the evidence supporting a relationship between poor literacy and negative health and well-being outcomes is strengthened.

The **Modifiability** of the potential indicator is assessed as **Medium**. The underlying risk factor of reading achievement as measured by the grade 4 FSA is theoretically amenable to intervention; some studies have shown that interventions focused on literacy have mixed results on health outcomes.

Data Availability/Reliability for the potential indicator is assessed as **High**. The FSA is a standardized test that reports annually on an objective measure of reading achievement among grade 4 and 7 students.

Based on the indicated assessment, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being.

Children Numeracy

Background and Context

This concept is an extension of the earlier section on *number knowledge skills*, which evaluated numeracy and mathematics in the entrance to formal education (preschool/kindergarten). *Children numeracy* focuses on children during elementary and middle school. As with *number knowledge skills*, studies focusing on academic outcomes (including mathematics) will be evaluated in this section with the anticipation of the future concept of youth math proficiency.

Methodology and Provisional Results

Article Search Process

All papers found in an earlier search for Number Knowledge Skills were evaluated for the current concept. The search was as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Numeracy

Search Keywords

("Number Knowledge" OR "Number Skill" OR Numeracy OR Counting OR Arithmetic)
AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR
"Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare"
OR Outcome*) **AND**

(Child or Youth OR Adolescent OR Teen)

This search returned 517 unique papers in total.

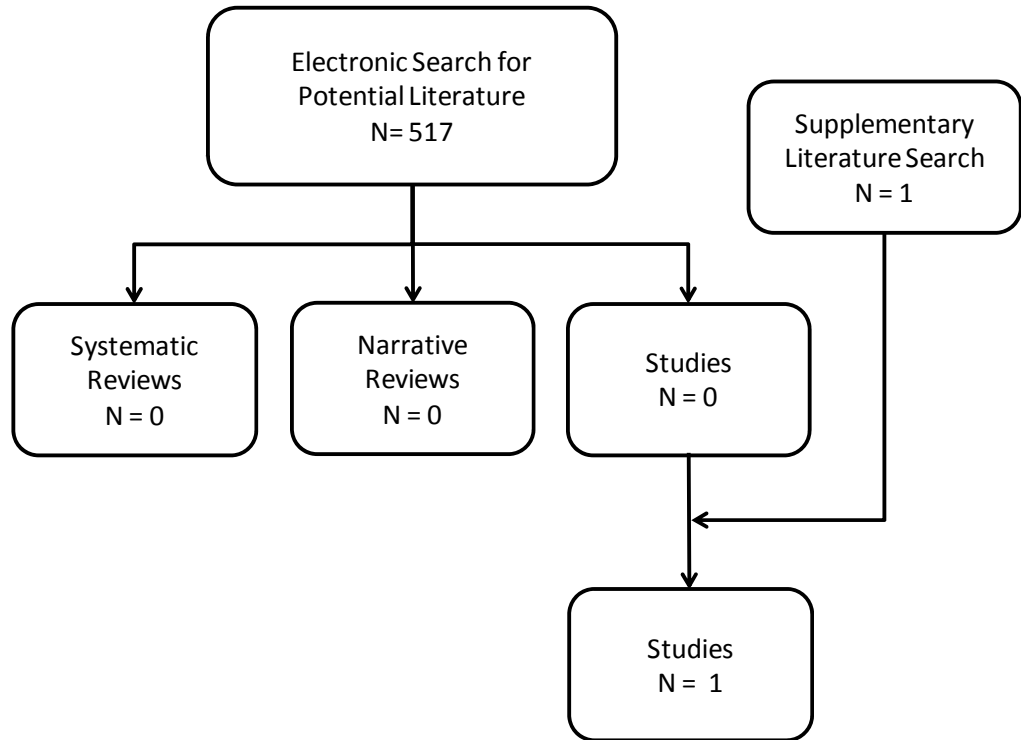
Preliminary Exclusion

The 517 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between children numeracy and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process there were no pertinent studies found. A supplementary search of the literature revealed one study of interest.

Literature Review Volume Report

Dimension: Cognitive Development ***Concept:*** Children Numeracy



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Children Numeracy*

Title of Study	Lead Author	Year	Journal	Journal Impact		Type of Study	Sample Size	Sample Population	Location	Conflict of Interest
				Factor						
1 The impact of early school behavior and educational achievement on adult drug use disorders: A prospective study	Fothergill	2008	Drug and Alcohol Dependence	4.05		Prospective, Longitudinal	1,242	African American Children	Chicago, U.S.	None

Dimension: *Cognitive Development* Concept: *Children Numeracy*

Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Adult Drug Use							
Fothergill (2008)	To explore the impact of multiple early education indicators (including standardized math scores) on later problem drug use	Children were followed from 1966 – 2002/03 (over 35 years), with educational indicators, including mean standardized math scores in the 7 th /8 th grades, assessed against later adult drug use.	Chicago, U.S. N=1,242 (1,053 at follow-up in 2002/03) African American children in grade 1 at baseline	Prospective, longitudinal	-Classification of 'drug use disorder' at age 32-33 and 42-43 (abuse and dependence) based on DSM-III-R criteria and DSM-IV criteria.	-Individuals who did well on standardized math tests were less likely to report drug use disorders in adulthood (Odds Ratio of 0.98 [0.96 – 0.99]).	Students' who score higher on standardized tests in middle school are significantly less likely to develop a drug use disorder in adulthood.

Bibliography for Table of Studies

Fothergill KE, Ensminger ME, Green KM et al. The impact of early school behavior and educational achievement on adult drug use disorders: a prospective study. *Drug and Alcohol Dependence*. 2008; 92(1-3): 191-9.

Summary of Results and Discussion

A literature search found only one study that investigated the relationship between children numeracy in the elementary and middle school grades, and future health and well-being outcomes. Fothergill et al. found that children who performed poorer on standardized math scores in the 7th and 8th grades were significantly more likely to develop a drug use disorder in adulthood. While this evidence is not overly compelling from a quantity perspective (only one study), the study is high quality. It is both prospective, and longitudinal, with the outcome of adult drug use disorders tracked more than 35 years after the study began.

It is important to note that, in this study, higher math scores in adolescence are associated with just a 2% reduction (an OR of 0.98) in the likelihood of developing adult drug use disorders. Much more important factors in determining the likelihood of developing adult drug use disorders include suspension from school (OR of 1.28 [1.07-1.52]), report of skipping school (OR of 1.31 [1.14-1.52]), and being a high school dropout (OR of 3.50 [1.71-7.17]).

Despite the small evidence base supporting numeracy and mathematics in elementary and middle school as mediating factors in later health and well-being, there is some evidence that at least children at the start of the present age cohort are amenable to interventions in this area. As noted under Number Knowledge Skills, Dowker et al. report that interventions have shown effectiveness in improving math and numeracy skills among 6 and 7 year olds.¹⁸⁸ Generally speaking, the research evidence in terms of modifiability is at best mixed; a 2009 report noted that “few interventions have been demonstrated to be effective in raising math achievement... [and] two recent syntheses by the What Works Clearinghouse illustrate the paucity of high-quality research on effective math programs.”¹⁸⁹ Various grey literature publications geared to teachers offer an inventory of techniques for improving math outcomes in their students, but the evidence base for these is generally not provided.¹⁹⁰

Data Sources

The foundational skills assessment (FSA) tests all B.C. students in grades 4 and 7 on reading, writing, and numeracy skills. In 2011, the numeracy component for both grade 4 and 7 was delivered in two parts, one 60 minute section of 40 multiple choice questions and one 30 minute section consisting of two-written response questions. The two grades differ slightly in their test components as specified in the following table:

¹⁸⁸ Dowker A. Early identification and intervention for students with mathematics difficulties. *Journal of Learning Disabilities*. 2005; 38(4): 324-32.

¹⁸⁹ Center for Technology in Learning. *Some Economic Consequences of Improving Mathematics Performance*. 2009. Available at http://ctl.sri.com/publications/downloads/CTL_economic_consequences_math_report_092009.pdf. Accessed October 2011.

¹⁹⁰ For example, Grouws DA, Cebulla KJ. *Improving Student Achievement in Mathematics*. 2000. International Academy of Education. Available at <http://www.iaed.org/files/prac04e.pdf>. Accessed December 2011.

FSA Specifications - Numeracy		
	Grade 4	Grade 7
Number	35-45%	35-45%
Patterns and Relationships	20-30%	15-25%
Shape and Space	20-30%	20-30%
Statistics and Probability	5-15%	10-20%
Total	100%	100%

Data from 2011 suggests that 18% of all grade 4 children are ‘not yet meeting’ expectations in numeracy; in grade 7 students this proportion increases to 21%.¹⁹¹ Given the findings of the lone study in our literature search, which evaluated grade 7 and 8 standardized math scores against adulthood drug use disorders, the grade 7 score on the numeracy component of the FSA will serve as our indicator.

Conclusion

As summarized below, assessments have been applied to the Children Numeracy concept. Specifically, the indicator of choice is the proportion of children ‘not yet meeting’ expectations on the grade 7 FSA for numeracy.

Summary Assessment					
Children Numeracy					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
9-19	119,854	High	Low	Medium	High

The pediatric population **Magnitude** of the potential indicator is assessed as **High**. Based on data from the B.C. Ministry of Education, 21% of B.C. children are not meeting expectations on the numeracy component of the FSA. When applied to the entire pediatric cohort aged 9-19 years, this translates into a magnitude estimate of 119,854 individuals. This is greater than 10% (19,000) of the total pediatric cohort, resulting in a magnitude classification of High.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual’s health and well-being is assessed as **Low**. The evidence of effects on aspects of well-being appears to be scarce. The one available high quality study found a statistically significant but very modest relationship between grades 7/8 standardized math scores and the likelihood of developing adult drug use disorders.

The **Modifiability** of the potential indicator is assessed as **Medium**. The underlying risk factor of Children’s Numeracy is theoretically amenable to intervention, with a few studies showing that interventions may be effective, at least at the younger end of the age spectrum.

¹⁹¹ See B.C. Ministry of Education reports at <http://www.bced.gov.bc.ca/reporting/>

Data Availability/Reliability for the potential indicator is assessed as **High**. The FSA is a standardized test that reports annually on an objective measure of mathematics/numeracy among grade 7 students.

Based on the indicated assessment, and especially the Low rating for significance/impact, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

Youth English Proficiency

Background and Context

This section is an extension of the earlier concept of *children reading and writing*. Whereas the previous concept was focused on children in elementary school, youth English proficiency is aimed at high school students. As stated in the English Language Arts Curriculum document from the Ministry of Education, the aim of language arts throughout high school is “...to provide students with opportunities for personal and intellectual growth through speaking, listening, reading, viewing, writing, and representing to make meaning of the world and to prepare them to participate effectively in all aspects of society.”¹⁹²

The foundational skills of reading, writing and oral language (collectively referred to as literacy), which were introduced under the *children reading and writing* concept, will continue to be a focal point in this section. Moving beyond foundational skill development, English language proficiency will place a greater priority on advanced concepts, such as critical thinking, articulating thoughts, feelings and ideas, while encouraging students to increase their understanding of themselves and others.

As was the case with *children reading and writing*, the current section will evaluate both literacy in the conventional sense as well as health literacy, which has been defined as the “...degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.”¹⁹³

Evidence of connections between high school literacy and adult literacy will also be sought, in light of the strong connection between adult literacy and health outcomes.¹⁹⁴

Methodology and Provisional Results

Article Search Process

During the search for Children Reading and Writing concept, a simultaneous literature search for reviews relevant to the current concept was undertaken, with two relevant reviews found. Each had material unique to adolescent reading inputs which will be included here. Despite a number of studies relevant to child health outcomes, the majority of studies included in these reviews focused on the effects of adult literacy (i.e., parent/caregiver) on their child’s health. However, this present concept is concerned with youth English proficiency and its potential effect on health and well-being, whether in childhood or adulthood. Thus it was decided that the studies with youth literacy (reading/writing/oral language) skills as an input would be extracted from the reviews and evaluated independently. In total, there were four such studies for the group of interest (i.e., youth reading/writing/oral language skills in high school evaluated against health and well-being outcomes).

¹⁹² Ministry of Education. *English Language Arts Grade 10: Integrated Resource Package 2007*. 2007. Available at http://www.bced.gov.bc.ca/irp/pdfs/english_language_arts/2007ela_812.pdf. Accessed October 2011.

¹⁹³ Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *American Journal of Health Behavior*. 2007; 31 Suppl 1: S19-26.

¹⁹⁴ Dewalt DA, Berkman ND, Sheridan S et al. Literacy and health outcomes: a systematic review of the literature. *Journal of General Internal Medicine*. 2004; 19(12): 1228-39.

The two identified reviews were published in 2009 so a targeted literature search was performed, looking for additional reviews or relevant studies from 2009 or later. The search was performed as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2009-Present *Subject: Major Heading:* Academic Achievement

Search Keywords

(Literacy OR Language) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 233 unique papers in total.

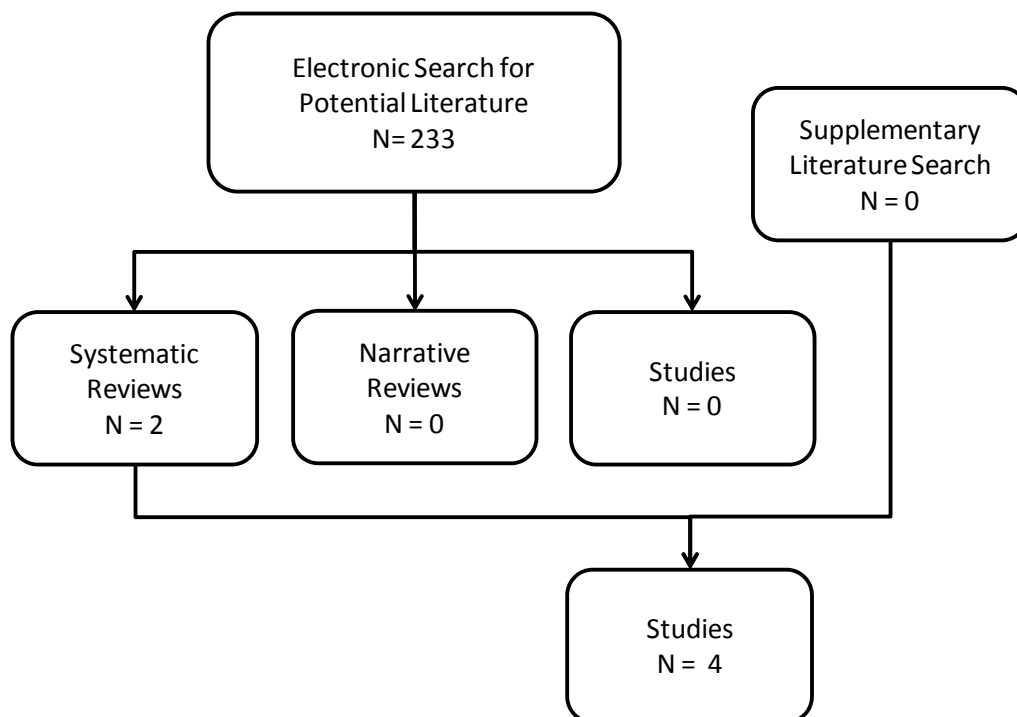
Preliminary Exclusion

The 233 articles were scanned *by title* by two reviewers working independently, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between number knowledge skills and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, there were no pertinent studies identified.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Youth English Proficiency



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Youth English Proficiency*

Title of Study	Lead Author	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
1 Early adolescent smoking and a web of personal and social disadvantage	Conwell	2003	Journal of Pediatric and Child Health	1.12	Cross-sectional	5,247	Children aged 14	Australia	Not Stated
2 Child and parental mental ability and glycaemic control in children with Type 1 diabetes	Ross	2001	Diabetic Medicine	2.97	Cross-sectional	150	Children aged 5-17	U.K.	Not Stated
3 Low literacy and violence among adolescents in a summer sports program	Davis	1999	Journal of Adolescent Health	3.93	Cross-sectional	386	Children aged 11-17	U.S.	Not Stated
4 Psychological functioning of children who have recurrent migraine	Andrasik	1988	Pain	5.35	Cross-sectional	62	Children aged 8-17	N/A	Not Stated

Dimension: *Cognitive Development* Concept: *Youth English Proficiency*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Conwell (2003)	To examine concurrent physical, educational, behavioural, social and family factors associated with cigarette smoking in adolescents at 14 years.	Cross-section data on 14-year-old adolescents and their mothers was analyzed to determine how academic and school performance correlated with cigarette smoking.	Australia N=5,247 (14 year old children)	Cross-sectional	-Cigarettes smoked per week -Reading: WRAT	-Cigarette smoking was significantly, positively correlated with poorer scores on the WRAT ($p<0.001$) in boys, but not girls	-Boys who score poorer on the WRAT are more likely to be smokers; there appears to be no effect for girls
Ross (2001)	To examine the influence of child's and mothers intelligence (WRAT for children – reading ability) on glycaemic control in children with type 1 diabetes.	Glycemic measurements were compared against reading ability and general mental ability in children and adults.	Edinburgh, UK N=150 children aged 5-17	Cross-sectional	-HbA1c score: measure of glycaemic control (average of 4 tests) -Reading ability: WRAT (children), National Adult Reading Test (NART)	-No significant correlation between the WRAT scores and mean annual HbA1c scores was observed. -A significant correlation was observed between the mean annual HbA1c of the child and NART scores of their mothers.	Parental literacy, but not child literacy is correlated with glycaemic control in children with type 1 diabetes.
Davis (1999)	To investigate the relationship between inadequate literacy and violent behaviour among adolescents	Youth from a low-income neighbourhood who participated in a summer track and field and literacy program were tested on their oral reading skills and this was correlated against violent behaviours.	Louisiana, U.S. N=386 (Youth aged 11-18; 86% African-American)	Cross-sectional	-Literacy: Slosson Oral Reading Test-Revised (SORT-R) -Risk behaviours: Youth Risk Behavior Survey (YRBS)	-Youth categorized as having a low reading level (at or below 2 grades below grade level) were at increased risk in engaging in violence-related risk behaviours such as weapon carrying, gun-carrying, missing days or school because of safety concerns, threatened with weapon at school, in a physical fight, in a fight that needed treatment, and in a physical fight at school.	-Youth with lower reading levels are at increased risk engaging in a host of violent behaviours.

Dimension: *Cognitive Development* Concept: *Youth English Proficiency*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Andraski (1988)	To analyze the relationship between psychological measures in children who have recurrent migraines.	Children with recurrent migraines and a control group without were compared on a variety of psychometric tests (including reading achievement) to determine if any correlations exist.	N=62 (32 with migraines, 32 control) Aged 8-17	Cross-sectional	-Reading Achievement: WRAT-R -Vocabulary: Peabody Picture Vocabulary Test	-There were no significant differences observed between the migraine and control groups on the WRAT-R or the Peabody tests.	-Migraines are not correlated with poorer reading achievement.

Bibliography for Table of Studies

Conwell LS, O'Callaghan MJ, Andersen MJ et al. Early adolescent smoking and a web of personal and social disadvantage. *Journal of Paediatrics and Child Health*. 2003; 39(8): 580-5.

Ross LA, Frier BM, Kelnar CJ et al. Child and parental mental ability and glycaemic control in children with Type 1 diabetes. *Diabetic Medicine*. 2001; 18(5): 364-9.

Davis TC, Byrd RS, Arnold CL et al. Low literacy and violence among adolescents in a summer sports program. *The Journal of Adolescent Health*. 1999; 24(6): 403-11.

Andrasik F, Kabela E, Quinn S et al. Psychological functioning of children who have recurrent migraine. *Pain*. 1988; 34(1): 43-52.

Summary of Results

Of the four available studies, two found a relationship between youth literacy and health and well-being while the other two did not. The study by Davis and co-authors found that “compared to youths reading at grade level, those with low literacy were 1.5 times more likely to experience violence as the perpetrator, victim, or both.” They note, however, that “it is difficult to disentangle the complex factors that covary with both low literacy and violence, such as poverty, parenting, low school attainment, and perhaps learning disabilities.” The study by Conwell et al. found a positive relationship between cigarette smoking in boys and poor literacy. As with the Davis study, however, poor literacy was just one of the variables associated with cigarette smoking in boys. Others include “internalizing and externalizing behaviour problems, educational difficulties, alcohol/illicit substance use... parental smoking, marital conflict, maternal depression and social disadvantage.”

The studies by Ross et al. and Andrasik et al. found no relationship between youth literacy and glycemic control or recurring migraine headaches.

Data Sources

The most relevant indicators of youth English proficiency in the province of B.C. are the required provincial exams. Each student is required to complete one language art in each of grade 10, 11 and 12. Those that require examination include English 10, and French as a first language 10, English 12, English 12: First Peoples, Communications 12, and French as a first language 12. The most useful single indicator of English language proficiency should capture as much of the population of interest as possible (ideally 100%); given the higher number of courses offered in grade 12, English 10 serves as a better indicator. In 2009/10, nearly 87% of the total grade 10 cohort took English 10, compared with only 66% of grade 12 students completing English 12.

All provincial courses report on exam marks and blended course marks (a combination of exam and class marks). Course grades are more likely to differ teacher to teacher whereas the same exams are completed by all students in the province, providing a more objective measure of student performance. For this reason, the proportion of students failing the grade 10 English exam will serve as the indicator of youth English proficiency in B.C.

The most recent data from 2009/10 indicates that 9% of students fail the English 10 exam.¹⁹⁵

Discussion

The weak evidence trail relating well-being to final exam marks per se has already been noted in the preamble to this part of the report. As well, there is limited *direct* evidence available supporting a relationship between the allied topic of poor literacy skills and health and well-being, though an indirect argument can certainly be made that better proficiency and scores in this key subject area will increase post-secondary attendance, a factor that has been associated with positive well-being. When a direct relationship has been found between language skills in adolescence and concurrent or later health and well-being, a large number of other variables come into play and the independent effect of poor literacy is difficult to ascertain.

¹⁹⁵ See <http://www.bced.gov.bc.ca/reports/pdfs/exams/req/prov.pdf>

One additional source of information on this topic is the Programme for International Student Assessment (PISA) study completed by the Organization for Economic Co-operation and Development (OECD). The PISA measures various components of education, including reading skills. In 2000, the Youth in Transition Survey (YITS) was launched as a longitudinal component of the PISA. In total, 20,000 Canadian students have participated in this survey since 2000, tracking PISA test scores against later educational attainment. Researchers have found a strong association between reading skills and educational attainment: “Higher achievement made a substantial contribution to the completion of secondary school and participation in at least some post-secondary education.”¹⁹⁶

Conclusion

As summarized below, assessments have been applied to the Youth English Proficiency concept, specifically to the indicator based on failing the grade 10 English exam.

Summary Assessment Youth English Proficiency					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
15-19	25,560	Medium	Low	Medium	High

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. According to data from the B.C. Ministry of Education, 9% of grade 10 students who take the English 10 exam (87% of the total grade 10 cohort) fail. This rate was applied to the entire pediatric cohort aged 15-19, yielding an estimate of 25,560 individuals. This rate was applied to the entire cohort aged 15-19, rather than just those of kindergarten age, because those that are vulnerable at this early age are susceptible to adverse health and well-being outcomes; the assumption is that, in the worst case (i.e., with no spontaneous improvement or intervention), this vulnerability would persist throughout the balance of the pediatric period. The resulting estimate of 25,560 individuals is between 2 and 10% (19,000 and 97,000) of the total pediatric cohort, resulting in a Magnitude classification of medium.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual’s health and well-being is assessed as **Low**. There is limited *direct* evidence available supporting a relationship between poor literacy skills and health and well-being.

The **Modifiability** of the potential indicator is assessed as **Medium**. The underlying risk factor of individuals failing the grade 10 English exam is theoretically amenable to intervention, though it must be admitted that the evidence supporting interventions at the secondary schooling level is modest.¹⁹⁷

¹⁹⁶ Organization for Economic Co-operation and Development. *Pathways to Success: How Knowledge and Skills at Age 15 Shape Future Lives in Canada*. 2010. Available at http://www.oecd.org/document/20/0,3746,en_32252351_32236191_44571668_1_1_1_1,00.html. Accessed October 2011.

¹⁹⁷ Allen JP, Pianta RC, Gregory A et al. An interaction-based approach to enhancing secondary school instruction and student achievement. *Science*. 2011; 333(6045): 1034-7.

Data Availability/Reliability for the potential indicator is assessed as **High**. The grade 10 English exam is completed annually, and is standardized province-wide. Additionally, in 2009/10 the vast majority of grade 10 students in the province wrote the exam (87%).

Based on the indicated assessment, and especially the Low rating for significance/impact, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

Youth Math Proficiency

Background and Context

Youth math proficiency is the last of three topics concerning numeracy and mathematics in the cognitive development dimension. *Number knowledge skills* offered weak evidence against health and well-being outcomes, mostly centered on academic outcomes; a search for *children numeracy* found one relevant study which found a statistically significant but very modest relationship between grades 7/8 standardized math scores and the likelihood of developing adult drug use disorders.

Carl Gauss, one of the greatest mathematicians of all time, referred to mathematics as the queen of the Sciences. Indeed, math has played, and continues to play, an increasingly important role in disciplines such as physics, engineering, biology and medicine, and computer science. Raghunathan notes that while biology and medicine seemed to have practically no use for advanced mathematics just a century ago, they “are now benefiting immensely from the intervention of sophisticated mathematical tools.”¹⁹⁸

Data from the U.S. suggests that greater proportions of students are now taking advanced mathematics courses, such as algebra, pre-calculus, and calculus. The National Assessment of Education Progress (NAEP) long-term trend study found that between 1978 and 2008, the proportion of 17 year-olds having taken a pre-calculus or calculus course increased from 6% to 19% ($p < 0.05$).¹⁹⁹ As jobs are increasingly becoming more dependent on mathematical concepts it is not surprising to find that success in high school mathematics correlates powerfully with access to college, graduation from college, and earning in the top quartile of income from employment.

From a societal perspective, much is made about the collective importance of mathematics in maintaining national economic competitiveness on the international stage, in addition to the economic well-being of individual citizens and enterprises. The current analysis will focus on the impacts of high school mathematics proficiency on later health and well-being outcomes. Of particular interest will be later educational attendance (college, university), employment and income outcomes.

In 2010, the B.C. high school math system was restructured to include two streams.²⁰⁰ The first is *Apprenticeship and Workplace Math*, which has components in grades 10, 11, and 12. The second is *Foundations of Mathematics and Pre-Calculus 10*, which branches off into *Foundations of Mathematics 11* and *12*, and *Pre-Calculus 11* and *12*. Graduation in British Columbia requires two credits of mathematics, including one grade 10 course, and one grade 11 or 12 course.

In the current analysis, studies that evaluate differences in mathematics achievement (i.e., school marks) and differential participation in math courses (i.e., taking advanced vs. introductory mathematics) will be evaluated against health and well-being outcomes. The assumption in the latter case is that simply taking more advanced coursework indicates a greater level of proficiency.

¹⁹⁸ Raghunathan MS. Mathematics- Its place and role in our society. *Current Science*. 2003; 84(3): 285-90.

¹⁹⁹ Statistics NCIE. *NAEP 2008 Trends in Academic Progress*. 2008. Available at <http://nces.ed.gov/nationsreportcard/pdf/main2008/2009479.pdf>. Accessed October 2011.

²⁰⁰ See http://www.bced.gov.bc.ca/irp/pdfs/mathematics/support_materials/math1012impl.pdf

Methodology and Provisional Results

Article Search Process

All papers found in an earlier search for number knowledge skills and children numeracy were evaluated for the current concept. The search was as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Numeracy

Search Keywords

("Number Knowledge" OR "Number Skill" OR Numeracy OR Counting OR Arithmetic)

AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR "Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare" OR Outcome*) **AND**

(Child or Youth OR Adolescent OR Teen)

This search returned 517 unique papers in total.

Preliminary Exclusion

The 517 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between youth math proficiency and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process there were no pertinent studies found. A supplementary search of the literature did not reveal any studies of interest.

Secondary Search

An additional search was performed targeted at adolescents specifically, as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Mathematics Achievement *Age:* Adolescence (13-17 years)

Search Keywords

(Arithmetic OR Math*)

AND (Youth OR Teen OR Adolescent) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR
“Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare”
OR Outcome*)

This search returned 78 unique papers in total.

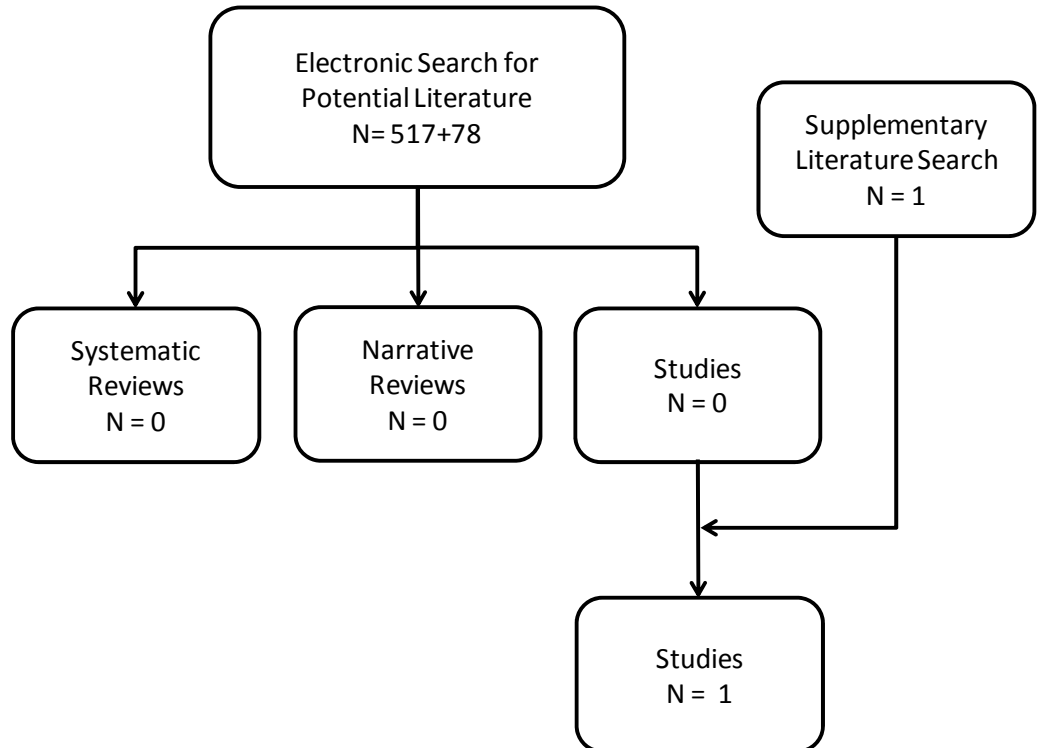
Preliminary Exclusion

The 78 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between youth math proficiency and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

A total of three studies were identified. Further analysis (abstract level) revealed that none of the three studies were relevant to the research topic at hand. A supplemental search including grey literature revealed one relevant study.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** Youth Math Proficiency



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *Youth Math Proficiency*

Title of Study	Author(s)	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
1 Math matters: The links between high school curriculum, college graduation, and earnings	Rose and Betts	2001	N/A	N/A	Cross-sectional analysis of longitudinal data	5,919	High School Students	U.S.	Not Stated

Dimension: *Cognitive Development* Concept: *Youth Math Proficiency*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Education Attainment and Employment Earnings							
Rose (2001)	To examine the influence high school math curriculum on college graduation and employment earnings.	<p>The High School and Beyond (HSB) 1980-92 longitudinal data used to determine how math courses in high school were correlated with:</p> <ul style="list-style-type: none"> -later college graduation -employment income <p>Lastly, the authors also aimed to determine what proportion of the “math effect” operates through education attainment and choice of college major, and what proportion is attributable to student’s ability, motivation, and curriculum.</p>	<p>United States</p> <p>N=5,919 individuals were included in the earning regression analysis (down from 14,825 for the total sample).</p> <p>Loss was attributable to missing variables.</p>	Cross-sectional analysis of longitudinal data	<p>-Probability of college graduation (predicted by high school math course)</p> <p>-Predicted percentage change in earnings resulting from additional high school math credit</p>	<p>-A positive relationship between student’s high school math curriculum and their probability of graduating from college was observed. This effect applied to both men and women, and individuals of different ethnicities. Controlling for demographic, family, school characteristics, math GPA, and math test scores still resulted in a “math effect” that was not simply a result of the above confounding factors.</p> <p>-Predicted percentage change in earnings based on an additional high school math credits (after controlling for demographic, family, school, highest degree earned and student ability variables):</p> <p><i>Vocational math (-3.2%*)</i> <i>Pre-algebra (-0.2%)</i> <i>Algebra/geometry (2.5%*)</i> <i>Intermediate algebra (1.2%)</i> <i>Advanced algebra (1.3%)</i> <i>Calculus (4.6%)</i></p> <p>*P < 0.05</p>	<p>-High school math curriculum, even when controlling for a host of confounding factors, is positively associated with a student’s probability of graduating from college.</p> <p>-Math curriculum seems to have a substantial effect on earnings well after high school graduation.</p>

Bibliography for Table of Studies

Rose H, Betts JR. *Math Matters: The Links Between High School Curriculum, College Graduation, and Earnings*. 2001. Available at www.ppic.org/content/pubs/report/R_701JBR.pdf. Accessed October 2011.

Summary of Results

Only one study relevant to youth math proficiency and health and well-being outcomes was found following an extensive literature search. Rose and Betts evaluated how taking different math courses in high school impacts later educational and earnings outcomes. The authors found the following:

- High school math curriculum, even when controlling for a host of confounding factors, is positively associated with a student's probability of graduating from college. This relationship was "dose dependent", that is, the more advanced the math course, the higher the probability of graduating from high school.
- Math curriculum seems to have a substantial effect on earning well after high school graduation. Students who took more advanced mathematics in high-school earned significantly more in their future careers.

The authors conclude that "one-half to three-quarters of the math effect operates through the channels of educational attainment and choice of college major" (see adjusted model 1 in the table below). Even after further adjustments in the model for student abilities and attitudes, an additional year of algebra/geometry was associated with a 2.5% increase in earnings (see adjusted model 2 in the table below). The authors note that "math effects do diminish but are still important".

Predicted Percentage Change in Earnings Resulting from an Additional Math Credit			
Math Credit	Basic Linear Model	Adjusted Model 1 †	Adjusted Model 2 ‡
Vocational math	0.1	-2.9 *	-3.2 *
Pre-algebra	6.9 *	0.6	-0.2
Algebra/geometry	8.4 *	2.7 *	2.5 *
Intermediate algebra	11.6 *	2.2	1.2
Advanced algebra	14.3 *	3.4 *	1.3
Calculus	21.5 *	5.8 **	4.6
† Controls for demographic, family, school traits, highest degree earned and college major variables			
‡ In addition to controlling for the variables included in Model 1, Model 2 controls for student abilities based on math GPA, math test scores, and student attitude.			
*Significant at the 0.05 level			
** Significant at the 0.10 level.			
Source: Rose and Betts, <i>Math Matters</i> , 2001.			

Data Sources

As mentioned in the introduction, graduation in B.C. requires the successful completion of one grade 10 mathematics course, in addition to a grade 11 or 12 math course. Unfortunately, students at the grade 10 level have two course options, making it challenging to compare all

students. The most recent data for grade 10 provincial examinations is for the previous, three-course system; it is presented in the following table:

B.C Provincial Math Examinations 2009/10			
Course	# of Individuals	Students Failing	
		Final Exam	Course
Applications of Mathematics 10	4,570	21.0%	7%
Essentials of Mathematics 10	10,151	23.0%	7%
Principles of Mathematics 10	39,797	13.0%	7%
Total	54,518	15.5%	
Source: B.C. Ministry of Education, <i>Provincial Required Examinations</i> , 2010.			

Presumably, similar data will be available for the newly implemented two course system in the coming months. For now, it is sufficient (and conservative) to assume that all individuals failing grade 10 mathematics are at risk of adverse health and well-being outcomes. The number of students failing grade 10 math exams will serve as our indicator; the exam mark is chosen over the course mark because exams are equivalent for all students throughout the province, whereas course marks may vary between teachers. In 2009/10 in British Columbia, approximately 15.5% of students taking a math 10 course in the province failed the required provincial exam (8,466 students failing out of a total of 54,518).

Discussion

*"The common claim that taking more math classes in high school leads to better college opportunities and higher future wages echoes in the ears of students nationwide. However...there is little academic research to support this claim."*²⁰¹

It is clear that little has changed in the academic literature since Rose and Betts made this claim a decade ago. They go on to suggest that the force behind this claim may stem from the fact that individuals with higher degrees of education, of which math is a prerequisite for entrance, often have higher earnings (a concept known as the college earning premium).²⁰²

Perhaps the most unique aspect of the Rose and Betts analysis was the ability to determine what proportion of the 'math effect' was mediated through educational attainment, choice of college major, and other factors such as student academic ability. While educational attainment and college major are a dominant factor in determining future earnings, other factors, including student's knowledge and the high school mathematics curriculum, also play a role. As stated in their paper, "merely increasing the number of courses required of students may not achieve the desired effect. It will be important to focus on the type of courses

²⁰¹ Rose H, Betts JR. *Math Matters: The Links Between High School Curriculum, College Graduation, and Earnings*. 2001. Available at http://www.ppic.org/content/pubs/report/R_701JBR.pdf. Accessed October 2011.

²⁰² Berger J, Parkin A. *The Value of a Degree: Education, Employment and Earnings in Canada*. 2009. Available at <http://qspace.library.queensu.ca/handle/1974/5899>. Accessed October 2011.

students are required and motivated to take as well. In particular, our results suggest that algebra/geometry courses should be a fundamental part of any curriculum reform.”²⁰³

Ultimately, the current study highlights the importance of high-school mathematics not only as a “gatekeeper” of future educational opportunities, but also as an independent mediator of future earnings potential. This earnings potential can be significant; 2006 Census data suggests that in B.C., a bachelor’s degree confers \$536,760 in additional earnings, on average, relative to a high school graduate over 40 years.²⁰⁴

The research evidence regarding interventions that focus on improving high school math scores is lacking. As noted in a 2009 Harvard report on improving academic achievement at the high school level, “some high schools have been improving quite impressively, but their stories are not well known. Most of the literature on school change has focused on elementary and middle schools, where changes are more common and, dare we say, easier to achieve.”²⁰⁵ The report goes on to chronicle 15 public high schools that have focused on improving instruction; math achievement between grades 8 and 10 was significantly higher in these schools than the state average, offering circumstantial evidence that modifiability is a real possibility.

Conclusion

This area suffers from the same weak evidence trail directly associating examination scores and well-being effects seen in previous chapters. Only one unpublished study was found that investigated the relationship between a proxy for Youth Math Proficiency and health and well-being outcomes. This study provides a thorough statistical analysis in attempting to abstract the various components associated with the ‘math effect’, i.e., the oft-observed relationship between proficiency in math and higher incomes later in life. Actually, in this study, enrolment in higher mathematics courses is used as a proxy for proficiency in math in the adolescent years. As well, the outcomes of interest are only indirectly related to health and well-being, namely, college attendance and higher earnings. Of course, as noted in other parts of this project, these two factors are strong predictors of subsequent positive health and well-being effects. Taken together, it is legitimate to adopt these lines of reasoning as a moderate level of support for high school mathematics proficiency as a driver of later well-being in individuals. This has the advantage of positioning Youth Math Proficiency as a potential indicator between grade school and high school graduation; this fills a gap, at least until another candidate, the School Attendance indicator, can be better developed (see pertinent chapter below).

As summarized below, assessments have been applied to the Youth Math Proficiency concept, specifically to the indicator based on failing the grade 10 mathematics exam.

²⁰³ Rose H, Betts JR. *Math Matters: The Links Between High School Curriculum, College Graduation, and Earnings*. 2001. Available at http://www.ppic.org/content/pubs/report/R_701JBR.pdf. Accessed October 2011.

²⁰⁴ Berger J, Parkin A. *The Value of a Degree: Education, Employment and Earnings in Canada*. 2009. Available at <http://qspace.library.queensu.ca/handle/1974/5899>. Accessed October 2011.

²⁰⁵ Achievement Gap Initiative (AGI). *How High Schools Become Exemplary*. 2009. Available at <http://www.agi.harvard.edu/events/2009Conference/2009AGIConferenceReport6-30-2010web.pdf>. Accessed December 2011.

Summary Assessment

Youth Math Proficiency

Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
15-19	44,020	Medium	Medium	Medium	High

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. Based on data from the B.C. Ministry of Education, 15.5% of youth fail grade 10 final math exam. This rate was applied to the entire pediatric cohort aged 15-19, yielding an estimate of 44,020 individuals. This rate was applied to all B.C. children aged 15-19 on the assumption that those displaying poor mathematical proficiency at this age are at risk of adverse well-being outcomes later in life. The resulting estimate of 44,020 individuals is between 2 -10% (19,000 - 97,000) of the total pediatric cohort, resulting in a Magnitude classification of medium.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. The limited evidence does show correlations between youth math proficiency and positive health and well-being drivers. High quality studies are needed to replicate and confirm these results with more direct evidence in a variety of settings.

The **Modifiability** of the potential indicator is assessed as **Medium**. Based on this limited evidence of institutional approaches to making improvements that were highlighted in the Discussion, the modifiability of high school math proficiency appears to have a moderate level of evidence.

Data Availability/Reliability for the potential indicator is assessed as **Medium-High**. Grade 10 math scores are reported annually by the B.C. Ministry of Education. However, students are provided with 2 choices of course program and related examination, making it difficult to simultaneously evaluate all individuals.

Based on the indicated assessment, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being.

English Language Skills

Background and Context

English language skills is a concept that focuses on individuals that have English as a Second Language (ESL), a group that is also referred to as English Language Learners (ELL). The B.C. Ministry of Education guide for ESL specialists defines ESL students as “those whose primary language(s) or languages(s) of the home, is other than English and who may therefore require additional services in order to develop their individual potential within British Columbia’s school system. Some students speak variation of English that differ significantly from the English used in the broader Canadian society and in school; they may require ESL support.”²⁰⁶

As noted in the same guide, “there are no typical ESL students. They come from many linguistic and cultural backgrounds and have had a wide variety of life experiences.” ESL speakers are a significant group in British Columbia; census data indicates that between 1996 and 2001 more than three quarters of the population increase in B.C. was attributable to immigration.²⁰⁷ This translates into an increasing number of children entering the school system with little or no English language experience; Statistics Canada reports that school children aged 5 – 16 comprised 17% of the 1.8 million immigrants to Canada during the 1990’s. Over this time period in British Columbia, the number of ESL students is believed to have more than tripled.²⁰⁸

The *English language skills* concept is unique in that the population of interest is a subset of the total pediatric population. Based on the B.C. Ministry of Education definition, the goal of intervention will not be to change an individuals’ English language status, as an ESL student will always be an ESL student, but rather to improve English language deficits to the same level as (or above) native English speakers (assuming that such deficits do exist). This current analysis will evaluate studies that compare ESL students against native English speakers across the entire trajectory of childhood; doing so will allow for a greater understanding of the challenges faced by ESL students, potential benefits of being bilingual, and how these outcomes change throughout childhood development.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

²⁰⁶ B.C. Ministry of Education. *English as a Second Language Learners: A Guide for ESL Specialists*. 1999. Available at English as a Second Language Learners: A Guide for ESL Specialists. Accessed October 2011.

²⁰⁷ Low PB, Siegel LS. A comparison of the cognitive processes underlying reading comprehension in native English and ESL speakers. *Written Language & Literacy*. 2005: 207-31.

²⁰⁸ B.C. Ministry of Education. *English as a Second Language Learners: A Guide for ESL Specialists*. 1999. Available at English as a Second Language Learners: A Guide for ESL Specialists. Accessed October 2011.

The following limits were selected:

Date: 2000-Present *Major Heading:* English as a Second Language
Age: Preschool (2-5); School Age (6-12); Adolescence (13-17)

Search Keywords

“English” **AND** (“Second Language” OR “Foreign Language” OR “Additional Language”
OR “Other Languages” OR learner*) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR
“Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare”
OR Outcome*)

This search returned 591 papers in total.

Preliminary Exclusion

The 591 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between English language skills (in the context of English as a second language) and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 21.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link “English language skills” with health or well-being outcome(s) *in children*, it was excluded. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

There were 9 articles remaining in the list following the primary exclusion step.

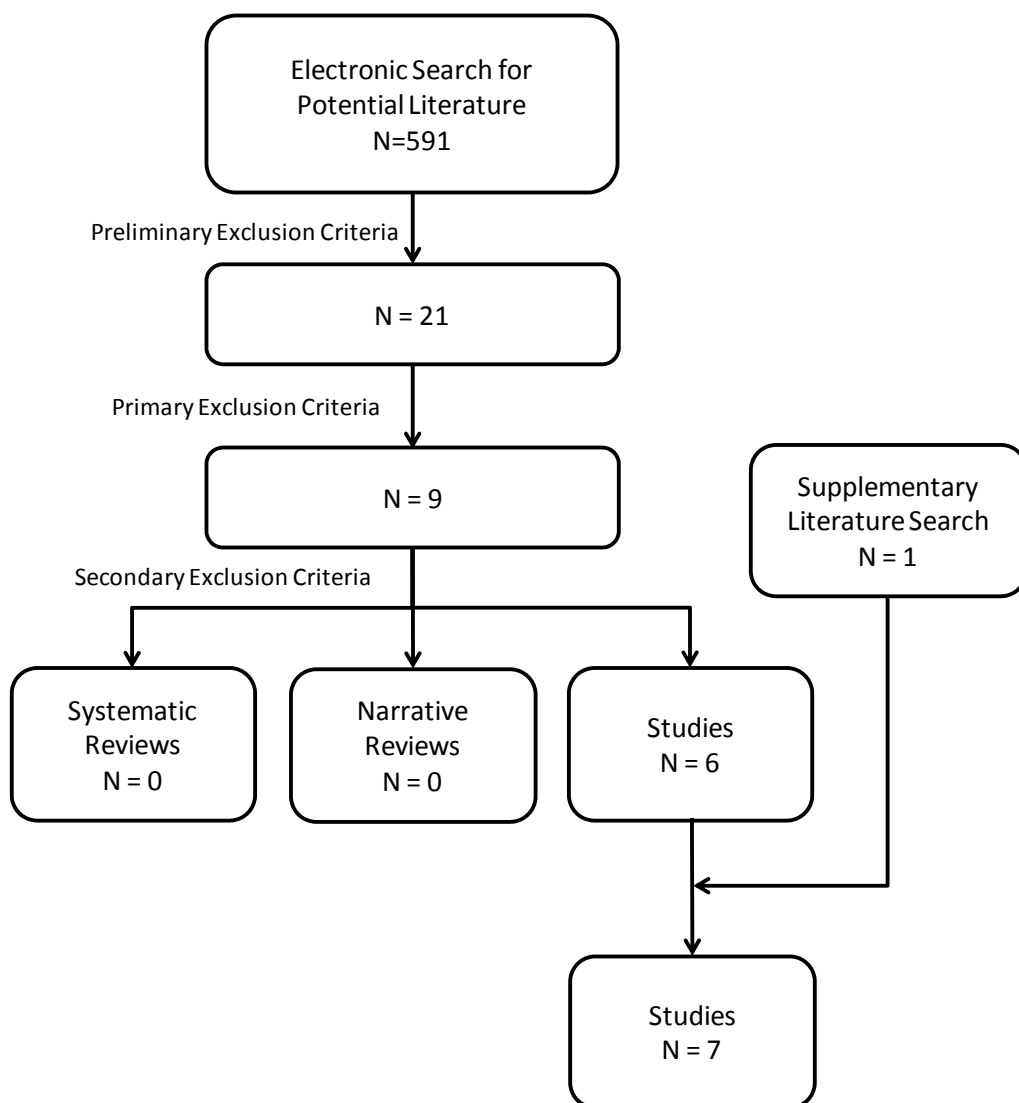
Secondary Exclusion

These 9 full-text articles were then reviewed in depth. Upon completion, it was determined that 6 were relevant to the current topic and therefore included in the analysis. One additional study was found through a supplementary search of the literature, using specific keywords, related article utilities, bibliography scans, etc.

The literature search process is detailed in the chart below, with the 7 final articles identified and summarized in the following tables.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** English Language Skills



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *English Language Skills*

	Journal Impact									Conflict of Interest
	Title of Study	Author	Year	Journal	Factor	Type of Study	Sample Size	Sample Population	Location	
Reading and Oral Language Outcomes										
1	Reading achievement across three language groups: Growth estimates for overall reading and reading subskills obtained with the early childhood longitudinal survey	Roberts	2010	Journal of Educational Psychology	3.58	Cross-sectional	21,000	Children (kindergarten at baseline)	U.S.	Not Stated
2	The relationship between academic oral proficiency and reading performance: A comparative study between English learners and English-only students	Butler	2009	Reading Psychology		Cross-sectional	61	Children (grade 4)	U.S.	Not Stated
3	Population monitoring of language and cognitive development in Australia: The Australian Early Development Index	Brinkman	2009	International Journal of Speech-Language Pathology	1.12	Cross-sectional	35,530	Children (kindergarten)	Australia	Not Stated
4	How do linguistically diverse students fare in full- and half-day kindergarten? Examining academic achievement, instructional quality, and attendance	Hall-Kenyon	2009	Early Education and Development	0.81	Longitudinal	192	Children (kindergarten)	U.S.	Not Stated
5	Behavioral and academic competencies associated with English language learner status	Garefino	2009	PhD Dissertation		Cross-sectional	743	Children (mean age 8 years at baseline)	U.S.	Not Stated
6	Growth in reading skills of children from diverse linguistic backgrounds: Findings from a 5-year longitudinal study	Lesaux	2007	Journal of Educational Psychology	3.58	Cross-sectional	1,238	Children (kindergarten at baseline)	Canada	Not Stated
7	A comparison of the cognitive processes underlying reading comprehension in native English and ESL speakers	Low	2005	Written Language & Literacy		Cross-sectional	1,168	Children (grade 6)	Canada	Not Stated

Dimension: *Cognitive Development* Concept: *English Language Skills*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Roberts (2010)	To estimate reading achievement of ELL compared with native English speakers', while controlling for socioeconomic status (SES)	Reading and language development growth models for English language speakers and ELL (Spanish and Asian) were compared to understand how reading achievement differs between these subgroups, and what potential role SES plays.	United States N= 21,000 kindergarten students (at entry) Follow-up through 2003-4 (5 th yr of cohort)	Cross sectional analysis of longitudinal data	-Early Childhood Longitudinal Survey (ECLS) measure of reading -ECLS measure of SES -Oral Language Development Scale (OLDS)	-Spanish ELLs begin school with lower literacy levels than do native English language speakers and Asian ELLs; they continue to lag behind in general reading ability through the elementary school years. -Language-group differences in achievement relate more to low SES than to the effects of primary language, controlling for proficiency status.	Asian ELL do not lag behind native English speakers in reading achievement; Spanish ELL do, however SES is the more significant factor in explaining the lower achievement rates.
Butler (2009)	To investigate the oral language and reading proficiency of ELL and native English speaking children.	Oral activities measuring students' academic oral skills in science classes was developed and administered, ELL were compared to native English speakers on each of the measures.	United States N=61 students (grade 4)	Cross-sectional	-Oral Language: Meaning accuracy, use of academic vocabulary, accuracy of academic vocabulary use, syntactic complexity, well-formedness.	-For meaning accuracy, use of academic vocabulary, and accuracy of academic vocabulary use, no significant differences were observed between native English speakers and ELL. -For syntactic complexity and well-formedness, ELL had significantly lower scores than native English speakers.	-ELL have significantly lower scores than native English speakers in some aspects of oral language.
Brinkman (2009)	To determine the number of native English speaking children and ELL who are vulnerable on EDI language and cognitive development component scale.	Data from the Australia Early Development Instrument (AEDI) (2004-2007) were used to determine how individuals with different English language status compared on the EDI.	Australia N = 35,530 kindergarten students (average age 5.96 years)	Cross-sectional	-Language and cognitive development component scale of the AEDI	-10.5% of children with English as their first language are vulnerable on the EDI language and cognitive domain, compared with 23.9% of individuals ELL.	-ELL are more likely to be vulnerable on the EDI language and cognitive domain.

Dimension: *Cognitive Development* Concept: *English Language Skills*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Hall-Kenyon (2009)	To determine how linguistically diverse students (ELL and native English speakers) fare in half- and full-day kindergarten.	Data from two schools was collected, with one offering half-day, and the other full-day, kindergarten. Measures of instructional quality, academic achievement, and teacher and administrator perceptions were also collected to compare gains over the course of the school year between ELL and non-ELL students	United States N= 192 kindergarten students	Longitudinal (one year)	-Academic Achievement: Peabody Picture Vocabulary Test –III, Phonological Awareness Literacy Screening (PALS-K), Roswell-Chall Auditory Blending Test, Applied Problems subtest of the Woodcock-Johnson III.	-Language status did not significantly impact score gains on measure of letter sounds, spelling, or work recognition. -ELL students had significantly higher score gains on alphabet knowledge than non-ELL students, but not on measures of rhyming. -ELL students had significantly greater score gains on the PPVT-III test than non-ELL students, but not on the Roswell-Chall Auditory Blending test or the Applied problems subtest.	ELL in kindergarten have significantly higher score gains in some measures of academic achievement.
Garefino (2009)	To examine whether there are differences in externalizing behaviour problems as a function of ELL status, and to examine whether there are differences in the perception of academic achievement as a function of student language status.	Data from a larger longitudinal study was used, with three consecutive years of follow-up for each student. Teachers rated students' academic achievement and behavioural problems, with students classified as either ELL or native English speakers.	United States N= 743 students (mean age of 8.0 years at baseline)	Cross-sectional analysis of longitudinal data	-Academic competency: teacher report) -Behavioural outcomes: IOWA Conners Inattentive/Overactive, Behavioural Assessment System for Children (BASC) – Aggression, Conduct, Involvement.	-ELL status was positively correlated to higher teacher ratings of externalizing behaviour problems, such as oppositional/defiant behaviour, inattention, impulse control problems, aggression, and non compliance. -ELL status was also significantly positively correlated to greater student-teacher conflict in grade 5 compared with native English speakers. -ELL status was not significantly associated with teacher rated academic competency.	ELL may be at increased risk of behavioural problems than their native English speaking counterparts.

Dimension: *Cognitive Development* Concept: *English Language Skills*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Lesaux (2007)	To investigate the reading development of ELL and native English speakers from kindergarten through fourth grade	Children were assessed late in fall semester of kindergarten and early in the spring of all subsequent grades (until grade 4).	West Coast, Canada N=1,238 kindergarten students (824 at grade 4 follow-up)	Cross sectional analysis of longitudinal data	Kindergarten: Letter identification, Stanford-Binet working memory for sentences, sound mimicry, rhyme detection, syllable identification, phoneme identification, phoneme deletion, oral cloze, simple spelling Grade 4: Stanford diagnostic reading test, word identification, word attack, 1-min work reading, 1-min pseudoword reading, WRAT-3: spelling, pseudoword spelling, working memory for words, working memory for numbers, Rosner auditory analysis test, oral cloze	-In kindergarten, ELLs performed more poorly than native English speakers on working memory, sound mimicry, rhyme detection, and oral cloze -by fourth grade, the groups differed only in WRAT-3 (spelling) and pseudoword spelling.	-ELL perform lower on specific reading skills in kindergarten, but by fourth grade the differences are negligible.
Low (2005)	To examine the mean scores of various aspects of reading comprehension in native English speakers and ELL.	Participants were assessed using various measures of reading comprehension, an analysis between native English speakers and ELL was performed.	British Columbia, Canada N= 1,168 sixth grade students (mean age 11.43 years)	Cross-sectional	- Word reading: Woodcock-Johnson Psycho-Educational Battery-Revised: Word Identification - Reading comprehension: Stanford Diagnostic Reading Test (SDRT), Planet Filk and Greb. - Phonological Processing: Pseudoword deletion task - Verbal working memory: Working memory for words task - Syntactic awareness: Oral Cloze task	-ELL scored significantly lower than native English speakers lower on SDRT reading comprehension and Oral Cloze syntactic awareness.	ELL appear to perform worse on some aspects of reading comprehension and syntactic awareness.

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Brinkman S, Sayers M, Goldfeld S et al. Population monitoring of language and cognitive development in Australia: The Australian Early Development Index. *International Journal of Speech-Language Pathology*. 2009; 11: 419-30.

Hall-Kenyon KM, Bingham GE, Korth BB. How do linguistically diverse students fare in full- and half-day kindergarten? Examining academic achievement, instructional quality, and attendance. *Early Education and Development*. 2009; 20: 25-52.

Garefino AC. *Behavioral and academic competencies associated with English language learner status*. 2009. Available at <http://gradworks.umi.com/33/56/3356028.html>. Accessed October 2011.

Lesaux NK, Rupp AA, Siegel LS. Growth in reading skills of children from diverse linguistic backgrounds: Findings from a 5-year longitudinal study. *Journal of Educational Psychology*. 2007; 99: 821-34.

Low PB, Siegel LS. A comparison of the cognitive processes underlying reading comprehension in native English and ESL speakers. *Written Language & Literacy*. 2005; 207-31.

Summary of Results

Roberts et al. report that Spanish ELL begin school with lower literacy levels than both Asian ELL and native English speakers and continue to lag behind in general reading ability through the elementary school years. This difference, however, was found to be largely explained by socioeconomic factors. Butler et al., Lesaux et al., and Low et al. found that ELL performed more poorly on selected measures of reading and oral language; generally speaking, this effect was greater in younger children and had largely disappeared by the time students reached grade 4. Of note, two separate studies found that ELL performed significantly worse on the Oral Cloze task (an assessment of syntactic awareness) than native English speakers.

A large Australian study of over 35,000 students by Brinkman et al. found that ELL were more than twice as likely to be found vulnerable on the EDI component scale of language and cognitive development (23.9% vs. 10.5%). Hall-Kenyon et al. found that one-year gains on most measures of academic achievement did not differ significantly between ELL and native English speakers. There were a few notable exceptions, namely alphabet knowledge, and the PPVT-III test where ELL students significantly out-gained their native English speaking counterparts. Lastly, Garefino et al. found that ELL may be at increased risk of behavioural problems compared to their native English speaking counterparts.

Data Sources

As discussed in the opening to this section, this concept is unique in a number of aspects. In terms of data, ESL students are the focus, rather than the entire cohort of children aged 0-19. The B.C. Ministry of Education reports on the number and proportion of ESL students in kindergarten through grade 12. This is representative of the fact that ELL are generally identified during school years. For the 2010/11 school year, 9.9% of all students in kindergarten through grade 12 were classified as having English as a second language.²⁰⁹

As discussed elsewhere in this report, it is reasonable to settle on an indicator that is already in operation in the province. There are a number of such indicators in the province, such as the Early Development Instrument (EDI), the Foundational Skills Assessment (FSA), and required high school provincial exams.

The EDI has been widely used among kindergarten students in B.C. since 2001, thus providing a long-term and ongoing data source.²¹⁰ One relevant study evaluated the EDI from Australia, and found that ESL students were more than twice as likely to be found vulnerable on the component scale of language and cognitive development than native English speakers. While this one study has evaluated EDI in the context of ESL students, it is unclear if the B.C. data can be manipulated in this manner; there are no questions on the EDI that specify the language status of children. Additionally, some have questioned whether being found “vulnerable” on the language/cognitive development scale of the EDI actually predicts poor development of literacy skills and subsequent academic achievement.²¹¹

²⁰⁹ See http://www.bced.gov.bc.ca/reports/pdfs/student_stats/prov.pdf

²¹⁰ The Human Early Learning Partnership. *The Early Development Instrument (EDI) in British Columbia*. 2008. Available at <http://www.ccl-cca.ca/pdfs/fundedresearch/Hertzman-FINAL.pdf>. Accessed September 2011.

²¹¹ Li J, D'Angiulli A, Kendall GE. The early development index and children from culturally and linguistically diverse backgrounds. *Early Years*. 2007; 27(3): 221-35.

The FSA is another potential data source on the reading, writing, and numeracy achievement of grades 4 and 7 B.C. students. Data from 2011 finds that ESL students are less likely to meet expectations in reading and numeracy categories compared with their native English speaking counterparts.

Finally, provincial examinations serve as the last indicator prior to leaving formal education. In B.C., all students must complete a language arts 10 course; in 2009/10, nearly 87% of the total grade 10 cohort took English 10. As mentioned under the Youth English Proficiency concept, one component of the English 10 curriculum is a standardized, province-wide provincial exam. Evidence from our literature search revealed that over time ESL students may be able to “catch-up” to native English speakers with respect to English language skills. With this in mind, the logical step would be to choose any indicator as far “downstream” as possible; the last indicator available during formal education is the English 10 provincial exam. While there are certainly some ESL students who opt for alternative courses, such as *French as a Primary Language*, it is unlikely that omitting such a small cohort (approximately 0.3% of the total grade 10 cohort) would have any appreciable difference on the indicator.

Annual data on standardized provincial exams is reported by the B.C. Ministry of Education, with both exam grades and final class grades reported for males, females, aboriginal, ESL, French immersion, and non-resident students. Given that class room instruction and grades vary from teacher to teacher, the exam grades are more useful for the current analysis as it ensures a fair comparison among all students in the province.

As mentioned in the introduction, the goal of any intervention in this area is to erase any disparities in English language skills between native English speakers and ESL students. With respect to the English 10 exam marks, those failing the exam are assumed to be at risk; this is equally applicable to ESL students as it is to native English speakers. Thus for the concept of *English language skills*, those individuals failing due to their English language status (i.e., the differential failing rate of ESL students compared with native English speakers), will serve as the indicator.

In 2009/10, 20% of ESL students in B.C. failed the provincial English 10 exam, compared with 9% of native English speakers.²¹² The differential failing rate of 11% will be applied to all ESL students in the province aged 15-19. As noted earlier, 9.9% of children in the province are ESL.

Discussion

The evidence for English Language Skills and health and well-being outcomes is modest. There are clear differences in English language skills between native English speakers and ESL students but much of this difference disappears after a number of years in the school system. This suggests that ESL students may be able to “catch-up” on these measures of reading and language over time; Hall-Kenyon et al. found evidence to this effect, with ESL students increasing their mean scores on a number of such measures significantly more than native English speakers over one year. It is unclear whether this ability to catch-up is due to innate language abilities in children, the enriched language environment that most ESL students experience in school or a combination of these two.

²¹² See <http://www.bced.gov.bc.ca/reports/pdfs/exams/req/prov.pdf>. Accessed October 2011.

When this catch-up does not happen, the research by Roberts et al. suggests that this may be largely explained by socioeconomic factors.

Overall, there appear to be no differences in academic outcomes between ESL students and native English speakers by grade 3. A 2005 narrative review by Genesee et al. found that by the end of elementary school and through high school, educational outcomes of ESL students were comparable or higher compared to their non-bilingual peers. In fact, there may even be an inverse effect as the longer children participate in bilingual education opportunities, the better their outcomes in reading or mathematics achievement, GPA, attendance, high school completion, or attitudes towards school or self.²¹³

As noted earlier, data from B.C. does suggest a much higher failure rate for ESL students on the grade 10 provincial exam compared to native English speakers. One curious observation is that blended marks for English 10, those that combined final exams and course grades, show that 4% of native English speakers fail the course, compared with 7% of ESL students, a difference of only 3%.²¹⁴ This could be explained by a number of factors; ESL students may receive more help on coursework or perform better on assignments that are not as time dependent.

One of the included studies (Garefino, 2009) suggests that ESL may be at increased risk of behavioural problems compared to their native English speaking counterparts. This study is an unpublished PhD dissertation and the results should ideally be replicated.

In terms of modifiability, ESL students are a focal point within the B.C. education system. Early intervention strategies tend to produce the most fruitful results, and while it is unclear how much progress is due to programs that are already in place, the relatively high failure rate of ESL students on the grade 10 provincial English exams suggests that there is still room for improvement.

Conclusion

Not surprisingly, the vast majority of outcomes examined by studies in this area were in areas closely related to language, such as oral language skills, writing skills, and comprehension. While many ESL students catch-up to their native English speaking peers over time, a significantly higher proportion of B.C. ESL students fail the grade 10 provincial English exams compared to native English speaking students.

Summary Assessment					
English Language Skills					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
15-19	10,568	Low	Medium	Low	High

As summarized above, assessments have been applied to the English Language Skills concept. The indicator adopted for consideration is the grade 10 English provincial exam

²¹³ Genesee F, Lindholm-Leary K, Saunders W et al. English language learners in U.S. schools: An overview of research findings. *Journal of Education for Students Placed at Risk*. 2005; 10(4): 363-85.

²¹⁴ See <http://www.bced.gov.bc.ca/reports/pdfs/exams/req/prov.pdf>

mark from the B.C. Ministry of Education, specifically the proportion of ESL students not passing that exam.

The pediatric population **Magnitude** of the potential indicator is assessed as **Low**. Based on data from the B.C. Ministry of Education, 9.9% of all students' grades kindergarten to 12 are classified as ELL. When this proportion is applied to entire pediatric cohort aged 15-19, this corresponds to 28,116 individuals. Of these individuals, approximately 11% fail the English 10 exam as a result of their ESL status, corresponding to 3,093 children. This is less than 2% of the total pediatric cohort (19,000), resulting in a magnitude classification of low.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Medium**. There are clear differences in English language skills between native English speakers and ESL students but much of this difference disappears after a number of years in the school system. It is unclear whether this ability to catch-up is due to innate language abilities in children, the enriched language environment that most ESL students experience in school or a combination of these two.

The **Modifiability** of the potential indicator is assessed as **Low**. It has been acknowledged that the research base on interventions for ELL is "not as well developed as the research base on native English speakers, so it is not yet possible to draw directly on robust evidence in all areas of language and literacy instruction to inform practice."²¹⁵ While some interventions have shown effectiveness, there are many interventions in place in B.C. for ELL in the education system. Disparities in English language skills exist between native English speakers and ELL, however it is unclear how much of the gains have been made by interventions that are already in place, and how easily additional gains could be made. For these reasons, the modifiability of the indicator has been assessed as low.

Data Availability/Reliability for the potential indicator is assessed as **High**. Grade 10 English exam scores are reported annually by the B.C. Ministry of Education and ESL students represent a clear sub-category.

Based on the indicated assessment, in particular the two Low ratings, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

²¹⁵ Rivera MO, Moughamian AC, Lesaux NK et al. *Language and Reading Interventions for English Language Learners and English Language Learners with Disabilities*. 2008. Available at <http://www.centeroninstruction.org/files/Lang%20and%20Rdng%20Interventions%20for%20ELLs%20and%20ELLs%20with%20Disabilities.pdf>. Accessed October 2011.

School Attendance

Background and Context

*School is one of the main social agencies contributing to the creation of the 'citizen'. It plays a paramount role in instilling the values of a society and culture in children, as well as teaching them essential skills to enable them to function in their environment. It is therefore not surprising that school non-attendance is considered detrimental for children and society, and while occasional truancy may be construed as, "somewhat common, perhaps even normal, behaviour", extended non-attendance, without extenuating circumstances, is perceived as aberrant.*²¹⁶

—D.W. Pellegrini, 2007

This section is dedicated to the concept of school attendance in children, covering formal school from kindergarten through to high school graduation. Absenteeism from school is a complex problem with a variety of causes, and is considered a serious public health issue by mental health professionals, physicians, and educators.^{217,218} Risk factors for school absenteeism come from a number of different domains, including personal or psychological, parental and familial, school, and the environment.²¹⁹ The current analysis is not concerned with the factors causing school absenteeism, but rather the outcomes of missing school. As stated in the Fort Nelson Secondary School attendance policy, "[a]n absence is an absence, regardless of the reason. Each absence results in a lost learning opportunity in the classroom, which may not be regained."²²⁰

Given the seriousness and prevalence of school absenteeism, researchers in disciplines ranging from psychology to social and criminal justice have begun to study and address this problem. Broadly speaking, school absenteeism can be broken out into two categories: problematic school absenteeism and non-problematic school absenteeism. Problematic school absenteeism refers to school absences as a result of environmental, social, psychiatric and other factors, whereas non-problematic school absenteeism refers to school absences as a result of medical illness or injury.²²¹ Not surprisingly, problematic school absenteeism is more widely studied in the literature; a number of specific subcategories have been developed, as defined in the following table.

²¹⁶ Pellegrini DW. School non-attendance: Definitions, meanings, responses, interventions. *Educational Psychology in Practice*. 2007; 23(1): 63-77.

²¹⁷ Magne Ingul J, Klockner CA, Silverman WK et al. Adolescent school absenteeism: modelling social and individual risk factors. *Child and Adolescent Mental Health*. 2011: E-published ahead of print.

²¹⁸ Kearney CA. School absenteeism and school refusal behavior in youth: A contemporary review. *Clinical Psychology Review*. 2008; 28: 451-71.

²¹⁹ Magne Ingul J, Klockner CA, Silverman WK et al. Adolescent school absenteeism: modelling social and individual risk factors. *Child and Adolescent Mental Health*. 2011: E-published ahead of print.

²²⁰ See <http://www.sd81.bc.ca/fnss/pdf/attendancepolicy.pdf>

²²¹ Kearney CA. School absenteeism and school refusal behavior in youth: A contemporary review. *Clinical Psychology Review*. 2008; 28: 451-71.

Key Definitions of Problematic School Absenteeism	
School phobia	Fear based absenteeism, as when a child refuses school due to fear of some specific stimulus such as a classroom animal or fire alarm
Separation anxiety	Excessive worry about detachment from primary caregivers and reluctance to attend school
School refusal	A broader term referring to anxiety-based absenteeism, including panic and social anxiety, and general emotional distress or worry while in school
School refusal behavior	An even broader term referring to any child-motivated refusal to attend school or difficulty remaining in classes for an entire day, whether anxiety-related or not
Delinquency	Akin to conduct disorder, refers to rule-breaking behaviors and status offenses such as stealing, physical and verbal aggression, property destruction, underage alcohol or tobacco use, and violations or curfew and expectations for school attendance
Truancy	Illegal, unexcused absence from school: the term may also be applied to youth absenteeism marked by surreptitiousness, lack of parental knowledge or child anxiety, criminal behavior and academic problems, intense family conflict or disorganization, or social conditions such as poverty.

Source: Kearney, *Educational Psychology Reviews*, 2008.

Of the above, truancy and school refusal are the most commonly investigated in regards to school absenteeism. School refusal is most often related to internalizing problems, while truancy is related to externalizing problems, however there is overlap between the two "...and the diagnostic heterogeneity is great."²²² This is a byproduct of the divergent academic disciplines investigating this area. Some have noted that this phenomenon has resulted in varied usage of key terminology which ultimately makes comparisons across publications problematic.²²³

As hinted at in the opening passage by Pellegrini, school absenteeism significant enough to cause adverse health and well-being effects is not an occasional phenomenon. Indeed, this concept refers to the percentage of the school-age population who do not attend school for prolonged periods, or are repeatedly absent. Theoretically this could also include individuals who drop out of school as a form of 'extended absenteeism'. In the literature, however, school dropout is often evaluated as an outcome of school absenteeism, and will be treated as such in this section. The adverse health and well-being outcomes of individuals who drop out of school will be evaluated under the *early school leavers* concept which appears later in this report.

Methodology and Provisional Results

Article Search Process

The search was performed as follows:

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

²²² Magne Ingul J, Klockner CA, Silverman WK et al. Adolescent school absenteeism: modelling social and individual risk factors. *Child and Adolescent Mental Health*. 2011: E-published ahead of print.

²²³ Kearney CA. School absenteeism and school refusal behavior in youth: A contemporary review. *Clinical Psychology Review*. 2008; 28: 451-71.

The following limits were selected:

Date: 2000-2012 *Subject: Major Heading:* Absenteeism *Age:* All Child (0-18)

Search Keywords

(Absenteeism OR Attendance OR Truancy) **AND** (School OR Education)

AND

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 63 unique papers in total.

Preliminary Exclusion

The 63 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between school absenteeism and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, there were 4 pertinent studies identified.

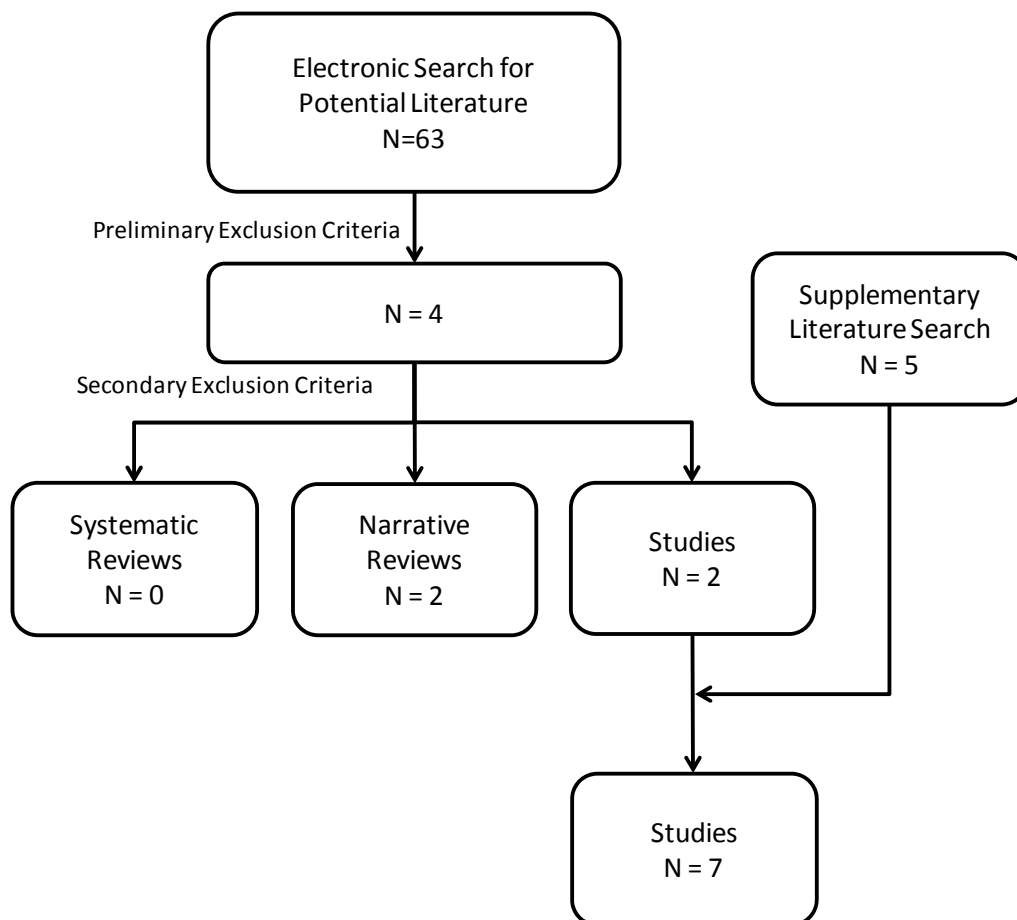
Secondary Exclusion

The 4 pertinent articles were scanned *in full-text* by two reviewers working individually, with articles not pertinent to the research topic being excluded.

After completing this secondary exclusion process, there were 2 pertinent studies identified. A supplementary literature search found an additional 5 studies of interest.

Literature Review Volume Report

Dimension: Cognitive Development **Concept:** School Attendance



Summary of Relevant Studies

Dimension: *Cognitive Development*

Concept: *School Attendance*

Title of Study	Lead Author	Year	Journal	Journal Impact		Sample Size	Sample Population	Location	Conflict of Interest
				Factor	Type of Study				
Substance Abuse									
1 The impact of early school behavior and educational achievement on adult drug use disorders: A prospective study	Fothergill	2008	Drug and Alcohol Dependence	4.05	Prospective, Longitudinal	1,242	African American Children	Chicago, U.S.	None
2 Truancy's effect on the onset of drug use among urban adolescents placed at risk	Henry	2007	Journal of Adolescent Health	3.93	Cross-sectional	1,528	Youth aged 11-15	Denver, U.S.	Not Stated
3 Truancy and illicit drug use among adolescents surveyed via street outreach	Chou	2006	Addictive Behaviors	2.59	Cross-sectional	2,126	Youth aged 12-18	Taipei, Taiwan	Not Stated
4 Truancy, grade point average, and sexual activity: a meta-analysis of risk indicators for youth substance use	Hallfors	2002	Journal of School Health	1.22	Cross-sectional	N/A	Youth, grades 7-12	U.S.	Not Stated
Academic									
5 The relationship of school absenteeism with body mass index, academic achievement, and socioeconomic status among fourth-grade children	Baxter	2011	Journal of School Health	1.22	Cross-sectional	920	Fourth-grade students	South Carolina, U.S.	Not Stated
6 The relationship between school absence, academic performance, and asthma status	Moonie	2008	Journal of School Health	1.22	Cross-sectional	3,812	Children aged 8-17	Missouri, U.S.	Not Stated
Psychiatric									
7 School refusal and psychiatric disorders: A community study	Egger	2003	Journal of the American Academy of Child and Adolescent Psychiatry	5.15	Cross-sectional	1,422	Children aged 9-16	North Carolina, U.S.	Not Stated

Dimension: Cognitive Development Concept: School Attendance
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Substance Abuse							
Fothergill (2008)	To explore the impact of multiple early education indicators (including skipping school) on later problem drug use	Children were followed from 1966 – 2002/03 (over 35 years), with educational indicators, including mother's report of school skipping and the self-report of study participants skipping behaviour assessed against later adult drug use.	Chicago, U.S. N=1,242 (1,053 at follow-up in 2002/03) African American children in grade 1 at baseline	Prospective, longitudinal	-Classification of 'drug use disorder' at age 32-33 and 42-43 (abuse and dependence) based on DSM-III-R criteria and DSM-IV criteria.	-Individuals who reported skipping school often were more likely to report drug use disorders in adulthood (OR 1.31 [1.14-1.52]); similar results were found for individuals who were often suspended from school (student report) (OR 1.28 [1.07-1.52]).	Students' who self reported skipping school or being suspended often are at a significantly higher risk of drug use disorders in adulthood.
Henry (2007)	To examine the relationship between truancy and the onset of drug use.	Data was analyzed to determine if truancy, after controlling for potential confounding factors, predicts initiation of drug use in youth aged 11 – 15 years.	Denver, U.S. N=1,528 Only high-risk neighbourhoods were included in this sample.	Cross-sectional analysis of longitudinal data	-Onset of drug use (alcohol, tobacco, marijuana), with students reporting on the number of times in the past year that they had used each of these drugs.	-Truancy significantly increased the odds of initiating drug use after adjusting for gender, race, and other potential confounders.	Increased truancy between 11 and 15 years of age appears to be significantly associated with earlier onset of drug use.
Chou (2006)	To investigate the association between truancy and drug-related experiences among adolescents in an outreach program.	Participants completed a self-administered anonymous questionnaire on truancy and illicit drug use.	Taipei, Taiwan N=2,126 Youth aged 12-18 involved in a youth outreach program.	Cross-sectional survey	- <i>Readily available</i> drug use, including: Alcohol, tobacco, betel nut -Illicit drug use including: Ecstasy, ketamine, marijuana, barbiturates, amphetamines, heroin.	-Adolescents classified as truant reported five-time higher use of illicit drugs than non-truants. -For specific drugs, the lifetime prevalence of ecstasy, ketamine, and marijuana use was significantly higher in the truancy group than the non-truancy group. -A dose-response relationship between truancy and drug use was also observed.	There appears to be a reciprocal relationship between illicit drug use and truancy in street involved youth in Taiwan.

Dimension: Cognitive Development Concept: School Attendance
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Hallfors (2002)	To determine to what extent truancy is linked with adolescent substance use. How generalizable are the indicators across time, student grade level, community, and type of drug use?	School survey data from 1980 -2000 was collected for grades 7 through 12; truancy, GPA, and sexual activity were compared against recent alcohol marijuana, cigarette, and other drug use.	U.S. Students in grades 7 through 12 from 58 communities	Cross-sectional analysis of longitudinal data	-Recent alcohol, marijuana, cigarette, and other drug use (dichotomized to 1 [any use] and 0 [no use].)	-Truancy, low GPA, and recent sexual activity were all strong predictors of student drug use. -Further analysis revealed that truancy and sexual activity were better predictors of drug use than low GPA. -Truancy is a particularly good indicator of drug use (higher odds ratio in almost all ages and drug categories compared with sexual activity and low GPA)	Truancy is strongly correlated with youth substance use
Academic							
Baxter (2011)	To investigate the relationships of children's school absenteeism with body mass index (BMI) academic achievement, and socioeconomic status (SES)	Data during 2 school years (2005/06, 2006/07) was gathered, with the number of school days absent for each child and an SES measure provided for each child. Measured BMI was also taken, along with academic achievement scores for the school district. These variables were compared with each other to determine correlations.	South Carolina, U.S. N = 920 fourth-grade children.	Cross-sectional	- Absenteeism: School--reported - BMI: Percentile category (calculated) - Socioeconomic status: Eligibility for free/reduced-price school meals - Academic achievement: Palmetto Achievement Challenge Test	-The only significant relationship observed was an inverse relationship between absenteeism and achievement on the PACT composite score (p<0.0001)	School absenteeism is significantly correlated with lower academic achievement on standardized tests.
Moonie (2008)	To investigate the relationships between absenteeism, presence of asthma and asthma severity level against academic achievement.	Absenteeism, demographics, and academic achievement measures were obtained, along with asthma status and severity, from a selected sample who completed a National Asthma Education and Prevention Program	Missouri, U.S. N= 3,812 (aged 8-17; predominantly African American)	Cross-sectional	- Asthma status: Nurse report - Academic Achievement: Missouri Assessment Program	-A significant inverse relationship was found between absenteeism and test performance (p < 0.001). -There was no overall difference between those with or without asthma.	-A negative impact of absenteeism on standardize test scores was observed.

Dimension: *Cognitive Development* Concept: *School Attendance*
Summary Table of Studies

Lead Author	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Psychiatric							
Egger (2003)	To examine the association between anxious school refusal and truancy and psychiatric disorders in a community sample of children and adolescents.	Data from eight annual waves of a study were analyzed, with truancy and school refusal correlated against various psychiatric diagnoses.	North Carolina, U.S. N=1,422 children aged 9-16	Cross-sectional analysis of longitudinal data	-Psychiatric: Child and Adolescent Psychiatric Assessment (CAPA) with DSM-IV diagnosis. -School attendance/truancy: This was assessed from two sections of the CAPA	-Anxious school refusal was associated with depression and separation anxiety disorder -Truancy was associated with oppositional defiant disorder, conduct disorder, and depression. -88.2% of individuals displaying both anxious school refusal and truancy had a psychiatric disorder.	Anxious school refusal and truancy are distinct but not mutually exclusive and are significantly associated with psychopathology

Bibliography for Table of Studies

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Henry KL, Huizinga DH. Truancy's effect on the onset of drug use among urban adolescents placed at risk. *Journal of Adolescent Health*. 2007; 358: 9-17.

Chou LC, Ho CY, Chen CY et al. Truancy and illicit drug use among adolescents surveyed via street outreach. *Addictive Behaviors*. 2006; 31: 149-54.

Hallfors D, Vevea JL, Iritani B et al. Truancy, grade point average, and sexual activity: a meta-analysis of risk indicators for youth substance use. *The Journal of School Health*. 2002; 72: 205-11.

Baxter SD, Royer JA, Hardin JW et al. The relationship of school absenteeism with body mass index, academic achievement, and socioeconomic status among fourth-grade children. *The Journal of School Health*. 2011; 81: 417-23.

Moonie S, Sterling DA, Figgs LW et al. The relationship between school absence, academic performance, and asthma status. *Journal of School Health*. 2008; 78: 140-8.

Egger HL, Costello EJ, Angold A. School refusal and psychiatric disorders: a community study. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2003; 42: 797-807.

Summary of Results

In total, there were four studies that evaluated the relationship between truancy in adolescence and later problem drug use. The majority measured truancy in youth and adolescence against drug use in a cross-sectional manner; however the study by Fothergill et al. tracked truancy in high school against adult drug use disorders. Regardless of the follow-up time frame, the general finding was that truancy was correlated with an increased risk of substance use later in life.

Two studies evaluated academic outcomes, finding that increased absenteeism was correlated with lower achievement on tests. Finally, one study evaluated two separate types of problematic school absenteeism, school refusal and truancy. Both of these behaviours were correlated with adverse psychiatric diagnoses; in total, over 88% of individuals displaying both truancy and school refusal had a psychiatric disorder.

Data Sources

In British Columbia, there is no provincial reporting system for school absences. Presumably this is tracked by each school individually but not pulled together at the provincial level as is the case in Nova Scotia.²²⁴ Data from the 2006/07 youth smoking survey does provide information on truancy in B.C. high schools. This survey is completed annually, with more descriptive data, such as the number of classes skipped in the past 4 weeks, only available at the Canadian level. According to an analysis of the survey, 64.6% of children in grades 9 to 12 reported not-skipping a class in the past 4 weeks.²²⁵ Conversely, this suggests that 35.4% of students in this group did skip at least one class in the past month.

This statistic casts a relatively wide net in terms of magnitude; a more desirable measure would include information on the number of times absenteeism occurs as well as whether that absenteeism is considered to be problematic or non-problematic.

Discussion

The available evidence suggests a consistent relationship between truancy and drug use, including drug use disorders as middle-aged adults. Truancy is also associated with poorer academic achievement.

The best evidence for adverse health and well-being outcomes as a result of poor school attendance was related to substance use. There are, however, some limitations of these studies with the most notable related to the populations studied. Fothergill et al. evaluated African American youth living in an inner city neighborhood. Similarly, Henry et al. and Chou evaluated at-risk youth in Colorado and Taiwan. All three noted that it is unclear how the findings of these studies could be generalized to different groups of youth.

School absenteeism has been a concern to schools, courts, communities, and social and behavioral scientists for some time. A 2011 meta-analysis by Maynard et al. that evaluated interventions targeted at increasing school attendance found that overall, interventions were found to demonstrate

²²⁴ Department of Education - Nova Scotia. *Minister's Response to Promoting Student Engagement: Report of the Minister's Working Committee on Absenteeism and Classroom Climate*. 2010. Available at <http://www.ednet.ns.ca/pdfdocs/reports/Climate%20Committee%20Report%20Response.pdf>. Accessed October 2011.

²²⁵ Pathammavong R, Leatherdale ST, Ahmed R et al. Examining the link between education related outcomes and student health risk behaviours among Canadian youth: Data from the 2006 National Youth Smoking Survey. *Canadian Journal of Education*. 2011; 34(1): 215-47.

a moderate, positively effect on attendance outcomes, though they do cite the relatively few high quality studies as a limitation. The authors note that “[b]ehavioral strategies, parent training and school-based attendance groups appear to be more effective than other interventions, such as mentoring and family therapy.”²²⁶

Conclusion

As summarized below, assessments have been applied to the School Attendance concept; the indicator chosen is the proportion of youth skipping at least one class in the past month.

Summary Assessment					
School Attendance					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
14-19	Less than 119,000	Medium	High	Medium	Low

The pediatric population **Magnitude** of the potential indicator is assessed as **Medium**. According to data from the Canadian Youth Smoking Survey, 35.4% of students in grades 9-12 have skipped at least one class in the past month. This rate was applied to the pediatric cohort aged 14-19, yielding an estimate of 118,775 individuals. This rate was applied to this age range rather than the entire pediatric cohort because it is unclear how truancy differs between this older age group and younger adolescents/children. The resulting estimate of 118,778 individuals is greater than 10% (97,000) of the total pediatric cohort. However, skipping class once a month is unlikely to be a good measure of problematic absenteeism. While rates of problem absenteeism in BC are unknown, they will likely be considerably lower than 119,000. Therefore, the rating of Medium has been applied to the magnitude assessment category.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual’s health and well-being is assessed as **High**. The available research clearly suggests a relationship between truancy and drug use / poor academic performance. The one concern is the generalizability of results observed in specific youth cohorts to the general youth population.

The **Modifiability** of the potential indicator is assessed as **Medium**. A recent meta-analysis describes a number of strategies that have shown varying levels of effectiveness in improving school attendance.

Data Availability/Reliability for the potential indicator is assessed as **Low**. Information on the number of times absenteeism occurs as well as whether that absenteeism is considered to be problematic or non-problematic is not tracked for B.C.

Based on the above reasonably high assessment, the potential indicator is presently **Recommended for Development** as a core indicator of child health and well-being. There is a strong relationship between problematic school absenteeism and drug use / poor academic performance. In addition, interventions can have a positive effect on school attendance. Yet information on school

²²⁶ Maynard BR, Tyson-McCrea K, Pigott T et al. *A systematic review and meta-analysis of indicated interventions to increase school attendance*. 2011. Society for Research on Educational Effectiveness. Available at http://www.eric.ed.gov/ERICWebPortal/search/detailmini.jsp?_nfpb=true&_&ERICExtSearch_SearchValue_0=ED519156&ERICExtSearch_SearchType_0=no&accno=ED519156. Accessed October 2011.

absenteeism (either problematic or non-problematic) does not appear to be tracked in B.C. There is a need to establish an appropriate data collection process that is both reliable and valid.

Early School Leavers

Background and Context

*One of the most robust predictions about any teenager's future is that dropping out of high school will increase the probability of a life marred by lengthy bouts of unemployment and poverty.*²²⁷

This section will examine the assigned concept of Early School Leavers. To avoid overlap, it is necessary to distinguish it from the next concept to be covered in the report, High School Completion. For the purpose of this project, Early School Leavers will be defined as people age 16 to 17 who are not currently in school, and have not graduated from high school. In other words, the focus is on how the reduced exposure to the final years of public school is a predictor of concurrent or future health and well-being. High School Completion, on the other hand, will be defined as obtaining a high school credential by any means by age 24. In short, the focus for that concept is educational attainment rather than a particular educational experience.

Obviously there is considerable overlap between the at-risk populations of these two concepts; individuals who drop out of school are at increased risk of not obtaining their high school diploma. However, there are important differences as well. For many students, dropping out is "...not a permanent condition; they drop out of school but later return with the intention of completing their studies."²²⁸ Individuals who drop out of high school but graduate before age 24 are still included under the current concept, but are excluded from the high school completion concept. Conversely, individuals who do not drop out of school but fail to graduate are not included under the current concept, but will be covered later.

Over the past decades, researchers have identified a multitude of individual, familial, social, and academic predictors of disengagement in school. Some of the most notable include being male, socioeconomically disadvantaged, having a personal and family history of underachievement, conduct problems, and antisocial peer associations.²²⁹ One reason for this intense research interest is the strong evidence base linking education attainment and achievement to health outcomes. Throughout this report, the importance of causation has been mentioned time and time again. Silles notes that there is still controversy in this area, with three possible explanations for the positive correlation observed between school and health. "The first argues there is a causal relationship that runs from increases in schooling to increases in health. The second holds that the direction of causality is reversed and runs from better health to more schooling. The third suggests that there is no causal relationship implied by the observed correlation between education and health."²³⁰

In order for high school leavers to be considered as a concept, a strong positive correlation between leaving high school and adverse health and well-being outcomes, preferably with a causal relationship from education to health, must be established. Three possible mediators of this relationship have been elucidated, as follows:²³¹

²²⁷ Richards J. *School Dropouts: Who Are They and What Can be Done?* 2011. Available at School Dropouts: Who Are They and What Can be Done? Accessed October 2011.

²²⁸ Raymond M. *High School Dropouts Returning to School*. 2008. Available at <http://www.statcan.gc.ca/daily-quotidien/080409/dq080409c-eng.htm>. Accessed October 2011.

²²⁹ Archambault I, Janosz M, Morizot J et al. Adolescent behavioral, affective, and cognitive engagement in school: relationship to dropout. *The Journal of School Health*. 2009; 79(9): 408-15.

²³⁰ Silles MA. The causal effect of education on health: Evidence from the United Kingdom. *Economics of Education Review*. 2009; 28: 122-8.

²³¹ Freudenberg N, Ruglis J. Reframing school dropout as a public health issue. *Preventing Chronic Disease*. 2007; 4(4): A107.

1. The more schooling people have the more money they earn, enabling them to purchase better housing in safer neighbourhoods, healthier food, better medical care and health insurance, and more education
2. Education facilitates healthier behaviour choices by offering learners access to health information and tools to acquire help and resources such as smoking cessation programs
3. Education helps people acquire social support, strengthen social networks and mitigate social stressors.

The current concept will first determine whether there is a correlation between leaving high school early and adverse health and well-being outcomes. If the evidence allows, comments regarding causality and mediating factors will also be made.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject: Major Heading:* Student Dropouts

Search Keywords

("Student Dropouts" OR "School Leavers")

AND (Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR "Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare" OR Outcome*)

This search returned 141 unique papers in total.

Preliminary Exclusion

The 141 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between leaving school early and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 16.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link "high school leavers" with health or well-being outcome(s), it was excluded. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

After completing this second exclusion process, there were no relevant articles identified.

Summary of Results

As mentioned in the background to this concept, the investigation of health and well-being outcomes associated with education has been extensive.^{232,233} However, this concept is interested in only one component of this relationship; the most desirable evidence for our current purposes is a comparison between individuals who leave school during the final high school years and those that do not, regardless of whether or not they graduate. As evidenced by an extensive literature search, such studies are rare.

One narrative review investigated the relationship between high school dropout and substance use, including tobacco, alcohol, marijuana, and other illicit drugs. This review was not included because the majority of studies evaluated the effect of substance use on later high school dropout.²³⁴ However, a number of older studies did evaluate high school dropout and drug use, either cross-sectionally or longitudinally. For instance, dropouts were more likely to report current cigarette smoking, marijuana use, or other illicit drug use than non-dropouts. One study found that dropping out of school was significantly associated with an increased risk of later alcohol abuse. Evidence for dropping out of school and subsequent marijuana use is mixed. Three longitudinal studies found that dropping out of school led to an increase in marijuana use in adulthood (ages 32-33); one study that followed up at 17-20 years of age found no significant correlation.

Another line of evidence that has garnered attention is natural experiments from the United Kingdom and United States. In 1947, UK policy reform increased the compulsory schooling age from 14 – 15. While “dramatic” differences in age at school exit were observed, no observable differences in mortality risk, self-reported health, and smoking and drinking behaviors were observed.²³⁵ In evaluating similar laws in the United States, Lleras-Muney found contrasting results, stating that “...there is a large causal effect of education on mortality.”²³⁶ The UK authors explain these discrepancies through cultural differences between the two jurisdictions, in addition to the variability of health insurance coverage in the United States.

Data Sources

The Labour Force Survey (LFS) provides timely estimates of employment and unemployment as important measures of performance of the Canadian economy. Additionally, information on the educational attainment and attendance of individuals is also tracked.

Information derived for 2009/10 by the LFS suggests that 4.1% of 16-17 year olds in B.C. are not high school graduates, nor are they attending high school. As noted at the start of this section, this is the definition of early school leavers adopted for the purposes of this project.

²³² Freudenberg N, Ruglis J. Reframing school dropout as a public health issue. *Preventing Chronic Disease*. 2007; 4(4): A107.

²³³ Arendt JN. Does education cause better health? A panel data analysis using school reforms for identification. *Economics of Education Review*. 2005; 24: 149-60.

²³⁴ Townsend L, Flisher AJ, King G. A systematic review of the relationship between high school dropout and substance use. *Clinical Child and Family Psychology Review*. 2007; 10(4): 295-317.

²³⁵ Clark D, Royer H. *The Effect of Education on Adult Mortality and Health: Evidence from the United Kingdom*. 2008. Available at <http://www.frbsf.org/economics/conferences/0806/royer.pdf>. Accessed October 2011.

²³⁶ Lleras-Muney A. The relationship between education and adult mortality in the United States. *Review of Economic Studies*. 2005; 72: 189-221.

Discussion

It is surprising to find that the literature directly relating early school leavers and health and well-being outcomes is sparse. Some older studies on substance abuse found cross-sectional correlations between substance use and increased risk of leaving school; longitudinal studies displayed mixed results with respect to dropping out and subsequent marijuana use. No such effects were seen with a follow-up at 17-20 years of age, but they did appear over 10 years later in two studies.

While little evidence of direct correlations relevant to the current concept were uncovered (i.e., leaving high school early and associated health effects); there is no ignoring the larger body of literature relating education attainment and subsequent health and well-being (see the note in the Introduction to the report). Causality in this arena has been investigated in the U.K., with researchers finding “evidence of a causal relation running from more schooling to better health.”²³⁷ Ross and Mirowsky found similar results; when investigating three aspects of education on health, years of schooling had a larger effect than credentials obtained.²³⁸

Interventions in this area have been used for decades; perhaps the best known are the mandatory school laws introduced in the U.K. and U.S.; these laws “...generated dramatic differences in completed education levels among students...”²³⁹ Some evidence suggests that such laws have a larger effect on dropouts rates than on high school graduation.²⁴⁰ Other approaches have been tried as well. A 2009 review of projects designed to keep students in school found a number of successful strategies and programs.²⁴¹

Conclusion

As summarized below, assessments have been applied to the Early School Leavers concept. Specifically, the indicator adopted for consideration is the proportion of children aged 16-17 years who are not currently in school and have not graduated.

Summary Assessment					
Early School Leavers					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
16-19	9,467	Low	Low	Medium	High

The pediatric population **Magnitude** of the potential indicator is assessed as **Low**. Based on data from the labour force survey, 4.1% of youth aged 16-17 are not attending school and have not graduated. This rate was applied to the pediatric cohort aged 16-19, yielding an estimate of 9,467 vulnerable individuals. The resulting estimate of 9,467 individuals is less than 2% (19,000) of the total pediatric cohort, resulting in a magnitude classification of Low.

²³⁷ Silles MA. The causal effect of education on health: Evidence from the United Kingdom. *Economics of Education Review*. 2009; 28: 122-8.

²³⁸ Ross CE, Mirowsky J. Refining the association between education and health: the effects of quantity, credential, and selectivity. *Demography*. 1999; 36(4): 445-60.

²³⁹ Clark D, Royer H. *The Effect of Education on Adult Mortality and Health: Evidence from the United Kingdom*. 2008. Available at <http://www.frbsf.org/economics/conferences/0806/royer.pdf>. Accessed October 2011.

²⁴⁰ Landis RN, Reschly AL. An examination of compulsory school attendance ages and high school dropout and completion. *Educational Policy*. 2011; 25(5): 719-61.

²⁴¹ Gunn TM, Chorney DW, Poulsen JC. High school completion: A comprehensive review of projects directed toward keeping students in school. *Journal of At-Risk Studies*. 2009; 15(1): 17-24.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Low**. There are few studies that directly investigate the relationship between leaving school early and the impact on health and well-being outcomes.

The **Modifiability** of the potential indicator is assessed as **Medium**. Interventions have shown promise in comparative jurisdictions such as Alberta, but it unclear how much more progress can be made given the relatively low high school dropout rate.

Data Availability/Reliability for the potential indicator is assessed as **High**. Data in the well-established LFS are routinely collected and reported.

Based on the indicated assessment, and especially the Low rating for significance/impact, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

High School Completion

*The association between educational attainment and a range of health outcomes is well documented in the economic literature.*²⁴²

As noted in the previous section on Early School Leavers, it is important to distinguish the concept of High School Completion so that the related evidence and conclusions will have distinct utility. “Completion” is a somewhat ambiguous term; as one possibility, it easily could be identified as the flipside of early departure from school, or “dropping out.” However, the most reasonable approach for the present purpose is to equate it with graduation. It is understood that young people may leave high school for a time but subsequently return to take classes and ultimately graduate. It is also possible to graduate by some alternate route. Statistics Canada actually tracks a variety of markers of education status at the end of a secondary school career, as follows:²⁴³

1. Percentage of the population that is a high school graduate, by age group (in the U.S., this is referred to as the “status completion rate”)
2. Percentage of the population that is not a graduate and is attending school, by age group
3. Percentage of the population that is not a graduate and is not attending school, by age group (in the U.S., referred to as the “status dropout rate”)

In any particular age group (e.g., 16-17 years, 18-19 years, 20-24 years), these three measure sum to 100%.

For the purpose of this report, Early School Leavers were defined as category 3 for the **age group 16-17 years**; as noted in that section, this is a departure from the definition sometimes used for a high school “drop out.” The definition adopted here as the basis of a High School Completion indicator is the “status completion rate” for the **20-24 year old age group**, that is, the percentage of that group that has achieved the status of a high school graduate. One rationale for this approach is that achieving a high school diploma or its equivalent by this still (relatively) young age will still generate the majority of the benefits that are attached to graduating “on time” (i.e., by age 18). This is why it is not necessary to move the concept in the direction of another common indicator that is based on a more restrictive definition, namely, the percentage of grade 9 enrolment graduating within four years. The main practical problem with the latter statistic is the substantial overlap between Early School Leavers and the group of young people not graduating on time; this leads to two concepts that are not very distinct. Finally, it is important to note that the same argument concerning anticipated full health effects applied to the 20-24 year age group does not apply as well to individuals gaining their high school equivalency after a longer delay; this is why another common indicator in this area, comprising the percentage of age 25-64 year olds with the status of high school graduate, is not being adopted for this report.

Background and Context

The rate of high school graduation as a focus of measurement and modification has occupied planners to a substantial degree across Canada, the United States, and many other developed countries. This is notwithstanding the fact that graduation rates are actually quite high in these settings, for example, sitting at about 90% for 18-24 year olds in both Canada and the U.S.²⁴⁴ High

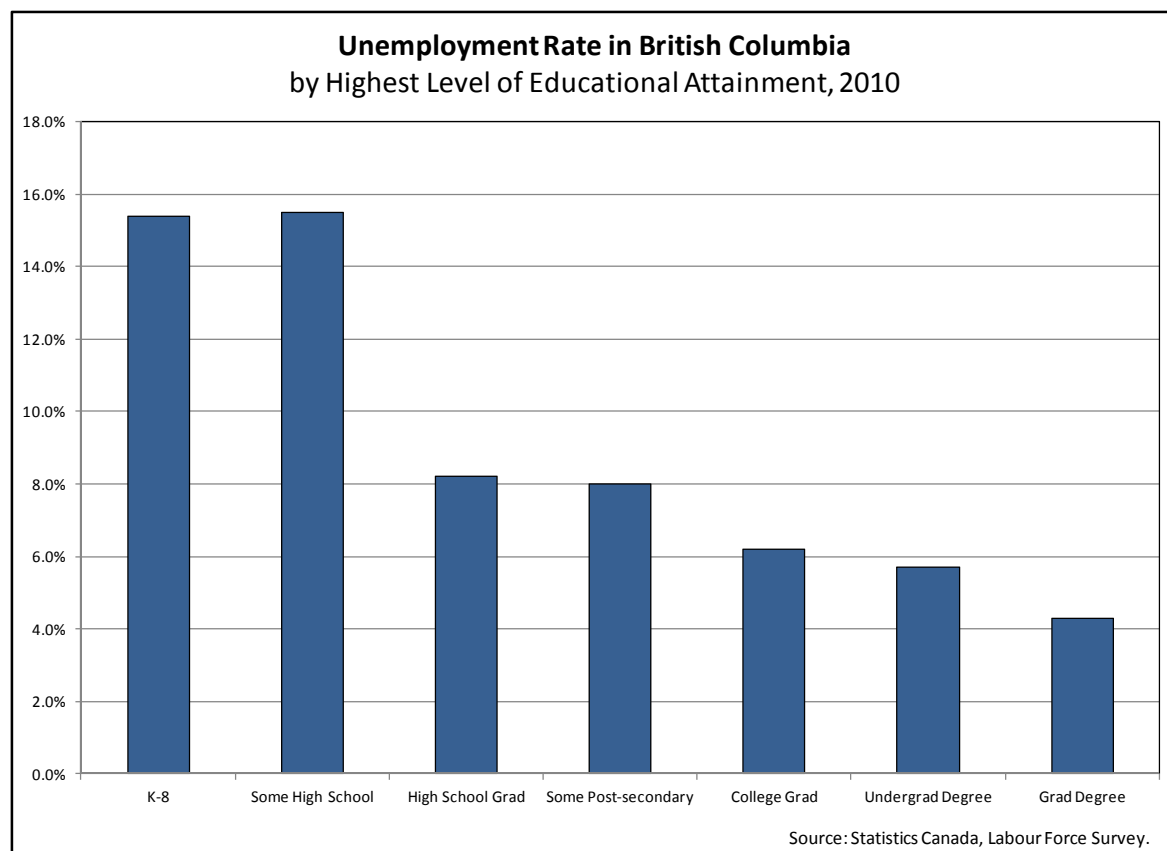
²⁴² Jones AM, Rice N, Rosa Dias P. *Long-term effects of cognitive skills, social adjustment and schooling on health and lifestyle: Evidence from a reform of selective schooling*. 2010. Available at http://econpapers.repec.org/paper/yorhctdg/10_2f11.htm. Accessed October 2011.

²⁴³ See <http://www.statcan.gc.ca/pub/81-004-x/2010004/article/11360-eng.htm>. Accessed October 2011.

²⁴⁴ See <http://nces.ed.gov/pubs2011/dropout08/findings4.asp>. Accessed October 2011.

school graduation (regardless of the age at which it is achieved) is a species of **educational attainment** level, a broader category that generates tremendous interest among researchers of human capital, employment, and productivity within society. Indeed, specifically with respect to high school, the issue has been framed in terms of educational justice and the benefits to society due to “higher tax revenues and reduced costs of criminal justice, public health, and public assistance.”²⁴⁵

One of the phenomena often noted is the association between unemployment and the level of schooling successfully completed. The following figure (based on Labour Force Survey statistics for 2010) illustrates this in the British Columbia context.²⁴⁶



The figure shows that the largest absolute and relative decrease in unemployment is in fact related to moving from a status of an incomplete high school career to being a high school graduate. This is consistent with other Canadian and international jurisdictions.²⁴⁷ Other effects of graduation will be pursued through a literature search described in the next subsection. Given the pervasive well-being consequences that flow from being employed, it may be argued that the case for the importance of high school completion or graduation has already been “proved.” But it will be shown that the health and well-being effects of reaching the high school level of educational attainment are potentially broader.

²⁴⁵ Levin HM. The economic payoff to investing in educational justice. *Educational Researcher*. 2009; 38(1): 5-20.

²⁴⁶ Adapted from Murray A, Sharpe A. *Human Capital and Productivity in British Columbia*. 2011. Available at <http://www.csls.ca/reports/csls2011-10.pdf>. Accessed October 2011.

²⁴⁷ For example, Ontario. See <http://www.law-lib.utoronto.ca/investing/reports/rp25.pdf>. Accessed October 2011.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, Medline, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Graduation Rate, High School

Search Keywords

("High School" OR "Secondary School" OR Education*) **AND** (Graduation OR Completion OR Status OR Attainment) **AND**

(Health OR Well-being OR Satisfaction OR Relationship* OR Family OR School OR "Growth and Development" OR "Cognitive Development" OR Safety OR "Child Welfare" OR Outcome*)

This search returned 67 papers in total.

Preliminary Exclusion

The 67 articles were scanned *by title* by two reviewers working individually, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between high school completion and a health, psychosocial, academic, or other pertinent measure of well-being, then it was excluded.

Surprisingly, after completing this first exclusion process, no articles of pertinence had been located. Thus, the other exclusions steps were not required.

While systematic review focusing on high school graduation and its consequences was not productive, ultimately widening the lens to educational attainment as a whole proved to be more useful. Level of educational attainment (also known as educational level, educational status, or simply "education") appears frequently in the literature as a predictor of health and well-being; in addition to high school, post-secondary education is typically part of the agenda of these studies. The narrative reviews identified in a supplemental search of Medline (using Educational Status as a major subject heading) and of the grey literature (via Google) will form the basis of the discussion of health effects below.

Summary of Results

The investigation of the health outcomes of education has been extensive; this has involved both physical and, to a lesser extent, mental health domains.²⁴⁸ The wide literature on this topic has

²⁴⁸ Arendt JN. Does education cause better health? A panel data analysis using school reforms for identification. *Economics of Education Review*. 2005; 24: 149-60.

generated important narrative reviews.²⁴⁹ The effect of greatest interest for the present purpose would be a difference between only *grade school completion* (possibly with some high school exposure) and actual *high school graduation*. However, this precise comparison is rare in the literature. It is much more common to compare grade or elementary school completion with being exposed to and/or completing post-secondary schooling. For example, U.S. data from 1999 have been used to demonstrate that the age-adjusted mortality rate of high school dropouts aged 25 to 64 years was more than twice that of individuals with some college.²⁵⁰ Cutler and Lleras-Muney have further summed up this particular differential that focuses on mortality as a key general marker for population-level physical health, as follows:²⁵¹

In 1990, a 25 year-old male college graduate could expect to live another 54 years. A high school dropout of the same age could expect to live 8 years fewer.... This enormous difference in life expectancy by education is true for every demographic group, is persistent— if not increasing—over time.

The same emphasis on health differentials for those educated at the *post-secondary level* may be observed in the most recent studies.^{252,253,254,255,256,257,258,259,260} However, there are a few recent studies that have in fact demonstrated a health advantage of being a high school graduate, ranging from the effect on biological risk behaviours to self-rated health to quality of life.^{261, 262,263,264} This

²⁴⁹ For example, Grossman M. *Education and Nonmarket Outcomes*. 2005. Available at <http://www.nber.org/papers/w11582>. Accessed October 2011.

²⁵⁰ Cutler DM, Lleras-Muney A. *Education and Health: Evaluating Theories and Evidence*. 2006. Available at <http://www.nber.org/papers/w12352>. Accessed October 2011.

²⁵¹ Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. *Journal of Health Economics*. 2010; 29(1): 1-28.

²⁵² Ernsten L, Bjerkeset O, Krokstad S. Educational inequalities in ischaemic heart disease mortality in 44,000 Norwegian women and men: the influence of psychosocial and behavioural factors. The HUNT Study. *Scandinavian Journal of Public Health*. 2010; 38(7): 678-85.

²⁵³ Dasgupta K, Khan S, Ross NA. Type 2 diabetes in Canada: concentration of risk among most disadvantaged men but inverse social gradient across groups in women. *Diabetic Medicine*. 2010; 27(5): 522-31.

²⁵⁴ Gall SL, Abbott-Chapman J, Patton GC et al. Intergenerational educational mobility is associated with cardiovascular disease risk behaviours in a cohort of young Australian adults: The Childhood Determinants of Adult Health (CDAH) Study. *BMC Public Health* 2010; 10: 55.

²⁵⁵ Kelly MJ, Weitzen S. The association of lifetime education with the prevalence of myocardial infarction: an analysis of the 2006 Behavioral Risk Factor Surveillance System. *Journal of Community Health*. 2010; 35(1): 76-80.

²⁵⁶ Nadas J, Putz Z, Fovenyi J et al. Cardiometabolic risk and educational level in adult patients with type 1 diabetes. *Acta Diabetologica*. 2009; 46(2): 159-62.

²⁵⁷ Mouw T, Koster A, Wright ME et al. Education and risk of cancer in a large cohort of men and women in the United States. *PloS one*. 2008; 3(11): e3639.

²⁵⁸ Mezuk B, Eaton WW, Golden SH et al. The influence of educational attainment on depression and risk of type 2 diabetes. *American Journal of Public Health*. 2008; 98(8): 1480-5.

²⁵⁹ Fothergill KE, Ensminger ME, Green KM et al. The impact of early school behavior and educational achievement on adult drug use disorders: a prospective study. *Drug and Alcohol Dependence*. 2008; 92(1-3): 191-9.

²⁶⁰ Reither EN, Peppard PE, Remington PL et al. Increasing educational disparities in premature adult mortality, Wisconsin, 1990-2000. *Wisconsin Medical Journal*. 2006; 105(7): 38-41.

²⁶¹ Yan LL, Liu K, Daviglus ML et al. Education, 15-year risk factor progression, and coronary artery calcium in young adulthood and early middle age: the Coronary Artery Risk Development in Young Adults study. *Journal of the American Medical Association*. 2006; 295(15): 1793-800.

²⁶² Albert C, Davia MA. Education is a key determinant of health in Europe: a comparative analysis of 11 countries. *Health Promotion International*. 2010; 26(2): 163-70.

²⁶³ Laaksonen M, Rahkonen O, Martikainen P et al. Socioeconomic position and self-rated health: the contribution of childhood socioeconomic circumstances, adult socioeconomic status, and material resources. *American Journal of Public Health*. 2005; 95(8): 1403-9.

suggests the potential for further insight if this type of research were to be intensified and moved towards “harder” markers of physical health. Only one such paper could be located, specifically examining differential mortality as a result of high school graduation.²⁶⁵

Data Sources

The Labour Force Survey (LFS) provides timely estimates of employment and unemployment as important measures of performance of the Canadian economy. The main aim of the LFS is to divide the working-age population into three classifications (employed, unemployed, and not in the labour force) and “to provide descriptive and explanatory data on each of these.”²⁶⁶ Accordingly, information on the educational attainment of individuals is tracked. The LFS produces estimates for these and other explanatory variables for Canada, the provinces, the territories and a large number of sub-provincial regions.

Information derived for 2009/10 by the LFS suggests that 92.7% of 20-24 year olds in B.C. have acquired a high school diploma or equivalent. As noted at the start of this section, this is the definition of high school completion adopted for the purposes of this project.

Discussion

The literature focusing on the health and well-being outcomes of high school graduation/completion per se is unexpectedly scarce. However, when seen as part of the broader picture of educational attainment, useful information about high school graduation does emerge, specifically with respect to health outcomes. It should first be noted that the factor of educational attainment is generally incorporated in indexes of socioeconomic status (SES), so that it has already been encountered in passing under the Economic and Material Well-Being dimension of this project. In the present context, of course, the issue is the educational status of the child themselves rather than of their parental/family context. Some of the same complexities pertain, however, including the challenge of distinguishing educational attainment as an indirect marker of cognition and learning from the well-being effects mediated through income inequality.²⁶⁷

There is a positive association between educational attainment and health, possibly generated by reduced health risk behaviours seen in the more highly educated (and therefore better employed and more highly paid). However, the evidence is strongest when comparing the levels that are more at the extremes (e.g., completing just grade school versus being a college graduate). For reasons that are not entirely clear, the differential health effects appear to attenuate when high school completers are compared with high school non-completers. One explanation is the fact that, counterintuitively, the employment income of high school non-completers is sometimes not that different than for those with a high school diploma and even some years of college-level education. For example, based on the Survey of Labour and Income Dynamics, the ratio of these two income categories in B.C. is actually 97%.²⁶⁸

²⁶⁴ Skevington SM. Qualities of life, educational level and human development: an international investigation of health. *Social Psychiatry and Psychiatric Epidemiology*. 2010; 45(10): 999-1009.

²⁶⁵ Trumbetta SL, Seltzer BK, Gottesman, II et al. Mortality predictors in a 60-year follow-up of adolescent males: exploring delinquency, socioeconomic status, IQ, high-school drop-out status, and personality. *Psychosomatic Medicine*. 2010; 72(1): 46-52.

²⁶⁶ See <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3701&lang=en&db=imdb&adm=8&dis=2>. Accessed October 2011.

²⁶⁷ See, for example, Muller A. Education, income inequality, and mortality: a multiple regression analysis. *British Medical Journal*. 2002; 324(7328): 23-5.

²⁶⁸ Statistics Canada. *Education Indicators in Canada: An International Perspective*. 2010. Available at <http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=81-604-X&lang=eng>. Accessed October 2011.

A general caveat pertinent to this section has in fact come up many times in this report, namely, the issue of causality and plausible mechanisms of influence.^{269,270} As discussed in the Introduction to this report, the crux of the debate may be summed up as follows: Is there a *causal* link between educational attainment and any physical and/or other health effects, even if they are mainly mediated by employment/earning levels?²⁷¹ Alternately, are there other “upstream” drivers of both education *and* health levels, for example: childhood SES circumstances, quality of grade school, innate intelligence, future-oriented cognitions and expectations of children, or even parental aspirations for and involvement in a child’s education and career?^{272,273,274,275,276} This is a very complex and sometimes controversial issue, one that continues to be investigated by researchers.

While educational attainment may be considered to be a robust predictor of socioeconomic outcomes and possibly positive health effects, it is important to note that educational *achievement* is another strand of the story. In other words, as demonstrated in other sections of this report, the impact of simply passing a course or grade, and even acquiring a credential, can be intensified by actually being successful academically in terms of grades and/or exam scores achieved.²⁷⁷ As mentioned in the Introduction to this report, some policy-makers are depending on measurement of skill development and/or academic achievement as a proxy for educational quality. The critical theme of quality in education delivery was already explored under the Early Childhood Education concept.

The mechanism of an educational effect on health and well-being is an important theme.²⁷⁸ If it has less to do with degree attainment and more to do with years spent in school, then the concept of leaving school early is probably a more useful place to turn for an indicator than acquiring a high school diploma. This and the previous section of the report have been intentional about distinguishing the concepts of Early School Leavers (in terms of reduced exposure to the normal school trajectory) and High School Completion (in terms of timely acquisition of a secondary diploma). This is not to ignore the fact that, across most of the youth population, the related measurements do mirror one another. That is to say, many of the interventions designed to improve graduation rates are precisely school interventions aimed at retaining students (or, helping them to

²⁶⁹ Cutler DM, Lleras-Muney A. *Education and Health: Evaluating Theories and Evidence*. 2006. Available at <http://www.nber.org/papers/w12352>. Accessed October 2011.

²⁷⁰ Kawachi I, Adler NE, Dow WH. Money, schooling, and health: Mechanisms and causal evidence. *Annals of the New York Academy of Sciences*. 2010; 1186: 56-68.

²⁷¹ As suggested by Lynch SM. Explaining life course and cohort variation in the relationship between education and health: the role of income. *Journal of Health and Social Behavior*. 2006; 47(4): 324-38.

²⁷² Lleras-Muney A. The relationship between education and adult mortality in the United States. *Thre REview of Economic Studies Ltd*. 2005; 72(1): 189-221.

²⁷³ Kestila L, Martelin T, Rahkonen O et al. The contribution of childhood circumstances, current circumstances and health behaviour to educational health differences in early adulthood. *BMC Public Health*. 2009; 9: 164.

²⁷⁴ Galobardes B, Lynch JW, Davey Smith G. Childhood socioeconomic circumstances and cause-specific mortality in adulthood: systematic review and interpretation. *Epidemiologic Reviews*. 2004; 26: 7-21.

²⁷⁵ Beal SJ, Crockett LJ. Adolescents' occupational and educational aspirations and expectations: links to high school activities and adult educational attainment. *Developmental Psychology*. 2010; 46(1): 258-65.

²⁷⁶ Spera C, Wentzel KR, Matto HC. Parental aspirations for their children's educational attainment: relations to ethnicity, parental education, children's academic performance, and parental perceptions of school climate. *Journal of Youth and Adolescence*. 2009; 38(8): 1140-52.

²⁷⁷ Herd P. Education and health in late-life among high school graduates: Cognitive versus psychological aspects of human capital. *Journal of Health and Social Behavior*. 2010; 51(4): 478-96.

²⁷⁸ See, for example, Liu SY, Buka SL, Linkletter CD et al. The association between blood pressure and years of schooling versus educational credentials: test of the sheepskin effect. *Annals of Epidemiology*. 2011; 21(2): 128-38.

persist) to the end of their high school career.²⁷⁹ However, the issues and strategies related to promoting high school completion are ultimately much broader.^{280,281}

Conclusion

As summarized below, assessments have been applied to the High School Completion concept. Specifically, the indicator adopted for consideration is the percentage of 20-24 year olds that have not acquired a high school diploma. Arguments for focusing on this age group were provided earlier in the section.

Summary Assessment High School Completion					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
18-19	8,776	Low	High	High	High

The pediatric population **Magnitude** of the potential indicator is assessed as **Low**. Based on data from the Labour Force Survey (LFS), 7.3% of the age 20-24 age group have not achieved high school completion in B.C. This rate was applied to those old enough to be graduates (i.e., age 18 and 19 years), to provide an estimate of the magnitude of non-graduates in the pediatric cohort at any one period. Strictly speaking, this represents a conservative estimate in terms “status non-completion” for age 18-19 years, as it corrects for individuals gaining their high school diploma by an alternate route with relatively little delay (i.e., within 5 or 6 years). The calculation in this way yielded 8,776 vulnerable children, which is less than 2% (19,000) of the total pediatric cohort, resulting in a Magnitude classification of Low.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual’s health and well-being is assessed as **High**. The positive employment effect related to high school graduation, which by itself could be deemed to be a strong marker of well-being, is augmented by emerging evidence of a differential for outcomes related to physical and other forms of health. Although it is true that the health benefits (possibly driven by higher incomes) seen in educational attainment appear to be more evident with *post-secondary* education, *the eventual value attached to achieving the necessary college/university prerequisite of a high school diploma should not be discounted*.

The **Modifiability** of the potential indicator is assessed as **High**. As has been shown by legislative and school-based strategies especially related to retaining children till the end of secondary education, graduation rates appear to be amenable to interventions.

Data Availability/Reliability for the potential indicator is assessed as **High**. Data in the well-established LFS are routinely collected and reported.

²⁷⁹ MacIver MA. The challenge of improving urban high school graduation outcomes: Findings from a randomized study of dropout prevention efforts. *Journal of Education for Students Placed at Risk*. 2011; 16(3): 167-84.

²⁸⁰ Tsoi-A-Fatt R, Harris L. Community-wide systemst that promote high school completion. *Prevention Researcher*. 2009; 16(3): 13-6.

²⁸¹ Owens A. Neighbourhoods and schools as competing reinforcing context for educational attainment. *Sociology of Education*. 2010; 83(4): 287-311.

Based on the assessment provided, the potential indicator is **Recommended** for consideration as a core indicator of child health and well-being. This is notwithstanding the fact that only a small number of children may be potentially affected by improved approaches; the health and well-being outcomes at stake still suggest a reasonably strong population-level impact of higher secondary school graduation rates.

Reading as a Leisure Activity

*[Free reading] is a voluntary, internally motivated, and often times joyful endeavor.*²⁸²

Reading as a leisure activity or hobby, sometimes known as free, voluntary, or independent reading, or reading for pleasure or enjoyment, remains a popular pastime in Canada and other societies. It represents a species of so-called “cognitive leisure” where the focus includes hobbies, games, and other mentally stimulating activities. Whether involving fiction or non-fiction, there is a connection between reading at all ages and informal, life-long learning. A recent survey of adult public library patrons suggested the following benefits of reading:²⁸³

- Understanding one’s world
- Solving problems
- Exploring other cultures
- Providing context for the news

To this list could be added more intangible aspects, such as personal pleasure and enjoyment, as well as satisfaction and sociality involved with discussing books, all of which contribute to quality of life. Finally, a modest literature has suggested physical health effects of adult leisure reading, perhaps extending as far as reduced mortality in the elderly.²⁸⁴

Such considerations may in fact apply to all ages. In keeping with the purpose of this project, the focus of this section will be on extracurricular reading in children.

Background and Context

The main source of information on reading among school-age children at home or some other non-institutional setting appears to be international surveys conducted periodically within cooperating countries. For example, there is the Progress in International Reading Literacy Study (PIRLS) directed at grade 4 students and the Programme for International Student Assessment (PISA) questionnaire and testing completed by a sample of children age 15 years (i.e., in grade 10).

PISA is sponsored by the Organization for Economic Cooperation and Development (OECD). According to the latest results from 2009, the following conclusions could be drawn across OECD countries:²⁸⁵

- About two-thirds of students reported that they read for enjoyment on a daily basis, a percentage that generally has dropped over the last decade
- Girls and socioeconomically-advantaged students read more for enjoyment, with the gap widening in the last decade for boys and the disadvantaged, respectively
- Reading for enjoyment every day is associated with better *concurrent* academic achievement (as measured by the PISA testing component)

The gender gap noted above has been demonstrated by many researchers; it has sparked attempts to identify the moderators of reading in males and female students, and possible interventions to

²⁸² Davey Zeece P. Free reading and reading freely. *Early Childhood Education Journal*. 2002; 29(3): 185-90.

²⁸³ Moyer JE. Learning from leisure reading: A study of adult public library patrons. *Reference & User Services Quarterly*. 2007; 46(4): 66-79.

²⁸⁴ Jacobs JM, Hammerman-Rozenberg R, Cohen A et al. Reading daily predicts reduced mortality among men from a cohort of community-dwelling 70-year-olds. *Journals of Gerontology*. 2008; 63B(2): S73-S80.

²⁸⁵ See *PISA in Focus #8*. Available at <http://www.oecd.org/dataoecd/34/50/48624701.pdf>. Accessed October 2011.

change the pattern of weaker reading interest among boys.²⁸⁶ Other studies have suggested that there is a decline in extracurricular reading activity between grade school and secondary school years.²⁸⁷ If the pertinent data could be abstracted, this phenomenon could be confirmed by comparing PIRLS and PISA results in a jurisdiction such as B.C.

Anecdotally, “children who learn to read for pleasure incorporate literature-based activities into and throughout their lives.”²⁸⁸ The balance of this section will examine whether there is any evidence of *future* health and well-being effects of children reading for pleasure, with an aim to move *beyond* the not unexpected emergence of a pattern of lifelong reading and its relationship with concurrent school achievement.

Methodology and Provisional Results

Article Search Process

A search of the EBSCO database was performed to identify papers of relevance.

The following databases were selected for inclusion:

Academic Search Complete, Biomedical Reference Collection: Comprehensive, CINAHL with Full Text, Education Research Complete, ERIC, PsycARTICLES, PsycBOOKS, PsycEXTRA, PsycINFO.

The following limits were selected:

Date: 2000-Present *Subject:* Reading

Search Keywords

(Reading) AND (Leisure OR Hobby OR Pleasure)

AND (Health OR Well-being OR Satisfaction OR Relationship* OR Family OR “Growth and Development” OR “Cognitive Development” OR Safety OR “Child Welfare” OR Outcome*)

This search returned 67 papers in total.

Preliminary Exclusion

The 67 articles were scanned *by title*, with articles not pertinent to the research topic being excluded; specifically, if the article did not appear to be investigating the association between reading as a leisure activity and some measure of physical, psychosocial, or academic well-being, then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 9.

²⁸⁶ Love K, Hamston J. Committed and reluctant male teenage readers: Beyond bedtime stories. *Journal of Literacy Research*. 2004; 36(3): 335-400.

²⁸⁷ Nippold MA, Duthie JK, Larsen J. Literacy as a leisure activity: Free-time preferences of older children and young adolescents. *Language, Speech, and Hearing Services in Schools*. 2005; 36: 93-102.

²⁸⁸ Davey Zeece P. Free reading and reading freely. *Early Childhood Education Journal*. 2002; 29(3): 185-90.

Primary Exclusion

Abstracts of the selected articles were then reviewed, with articles not pertinent to the research topic being excluded; there were 5 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

These 5 full-text articles were then reviewed in depth. Upon completion, it was determined that only 2 were relevant to the current investigation. Because one of the articles was a very recent meta-analysis (that in fact covered the other located article), it provided the basis of the presentation below.

Summary of Results

The meta-analysis identified in the literature search synthesized 99 studies, roughly balanced between preschool/kindergarten, elementary/secondary school, and post-secondary age groups.²⁸⁹ Of course, there is a substantial overlap between print exposure in preschool/ kindergarten age groups and the concept of Reading by an Adult covered in an earlier section of this report. It is important to note that over 80% of the studies in the elementary/secondary school category (i.e., the focus of this section) actually examined the elementary school age level.

The expected impact of reading exposure on *concurrent* language skills (as measured by achievement) was confirmed by the meta-analysis. The “bottom line” is that frequent readers have better language skills. The more intriguing result found across all ages was the indication of an “upward spiral of causality.” This refers to the gradually increasing impact of reading on various language skills in older samples, driven by enhancements in proficiency that inspire more reading, that then spark more improvement in language, and so on. Thus, while 13% of the variance in oral language skills in primary school ages could be attributable to reading exposure, the same measure rose to 30% by high school. An international study has suggested that the growing synergy between reading experience and skills/achievement may be mainly mediated by an affective component, that is, the *enjoyment* of reading.²⁹⁰ The conclusion is that “shared book reading to preconventional readers may be part of a continuum of out-of-school reading experiences that facilitate children's language, reading, and spelling achievement throughout their development.”²⁹¹

Data Sources

As noted at the start of this section, the source of information is international surveys of students in which Canada participates. While offering less power (and data collection regularity) than larger, national instruments could achieve, many countries have begun to depend on PIRLS and PISA to gain some insight about reading environments and behaviours among their school- age populations.

PIRLS collects data to provide information on trends in reading literacy achievement of fourth-grade students, while providing baseline data for countries newly joining the survey. The third cycle of data collection was conducted in 2011, following an every-five year pattern begun in 2001.

²⁸⁹ Mol SE, Bus AG. To read or not to read: a meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*. 2011; 137(2): 267-96.

²⁹⁰ Chiu MM, McBride-Chang C. Gender, context, and reading: A comparison of students in 43 countries. *Scientific Studies of Reading*. 2006; 10(4): 331-62.

²⁹¹ Mol SE, Bus AG. To read or not to read: a meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin*. 2011; 137(2): 267-96.

PIRLS includes a full complement of questions to investigate the experiences young children have at home and school in learning to read and actually reading.²⁹²

Unlike the singular language focus of PIRLS, every three years PISA measures three domains: reading, mathematical, and scientific literacy. However, the study is conducted on a rotational cycle, where each domain is emphasized only every third time (i.e., every 9 years).

Approximately 470,000 15-year old students in 65 countries/economies participated in the 2009 PISA study. This included 23,000 students from over 900 schools across Canada, a large enough sample to generate information at the provincial level and to allow for estimates for both official language groups.²⁹³ It is not clear, however, whether other sub-provincial results may be abstracted, unlike (for instance) the Canadian Community Health Survey.

Like in 2000, reading was the major focus of the 2009 PISA assessment, allowing an in-depth examination of student achievements across a wider range of reading content areas and skills than had been possible in either 2003 (with a mathematics focus) or 2006 (science). As usual, a 30-minute self-completed contextual questionnaire was administered to students to collect background information to help understand the factors contributing to student achievement. This tool generated the 2009 data related to reading as a leisure activity—a theme that will not be covered again until 2015.

While PISA offers an assessment of reading every 9 years, PIRLS offers an advantage in terms of more frequent data collection (every 5 years) related to reading contexts and habits. According to the 2006 PIRLS results for British Columbia, 57% of grade 4 students read for enjoyment every day or almost every day.²⁹⁴

Discussion

Studies of reading for enjoyment tend to focus on quantity, specifically the frequency of the activity (e.g., little to no reading, once or twice a week, daily or almost every day). This will be the focus for this part of the project as well, partly driven by the type of indicator that is regularly tracked among Canadian children. However, it is important to recognize that a literature exists that also examines *qualitative* aspects of the concept, including the type of literature consumed across ages and genders and the level of enjoyment experienced when doing so.²⁹⁵

The multinational student surveys known as PIRLS and PISA employ different questions related to reading as a leisure activity, which in turn generate results with different utility when interpreting the outcome evidence. Thus, PISA data allow for the development of an indicator based on the percentage of children aged 15 years reporting that “reading is one of their favourite hobbies.” The country of Ireland has in fact adopted this approach to the concept as part of their State of the Nation’s Children report card. Other data gathered in the PISA student questionnaire allow for a stratification of the amount of time spent reading for enjoyment each day. As noted in the Background and Context subsection, at least some reading each day among 15-year olds is better

²⁹² See <http://timssandpirls.bc.edu/pirls2011/index.html>. Accessed October 2011.

²⁹³ See <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5060&lang=en&db=imdb&adm=8&dis=2>. Accessed October 2011

²⁹⁴ See *Progress in International Reading Literacy Study in Primary School in 40 Countries*. 2007. Available at http://timss.bc.edu/PDF/P06_IR_Ch4.pdf. Accessed October 011.

²⁹⁵ Coles M, Hall C. Gendered readings: Learning from children's reading choices. *Journal of Research in Reading*. 2002; 25(1): 96-108.

than no reading in terms of correlations with concurrent academic achievement. However, PISA does go further, suggesting that a longer duration of reading each day may enhance the beneficial effect (see the table below for the B.C. data).²⁹⁶

Reading for Enjoyment Average PISA Reading Scores by Time Spent Reading British Columbia, 2009		
Daily Reading Amount (min)	Average PISA Reading Score	Standard Error
0	497	4.3
≤30	545	3.3
31-60	567	4.1
60-120	582	5.5
≥120	551	9

Source: PISA, 2009.

Intriguingly, the effect of increasing achievement appears to attenuate after 2 hours per day of leisure-time reading. One suggestion is that young people in the latter category actually read more slowly and therefore take longer with the same volume of print, a characteristic that would not be very conducive to academic achievement.

Ultimately, the PIRLS assessment of grade 4 students may be deemed to be most useful for this section of the report. It allows for a simple comparison of reading every day or almost every day with only reading once or twice a week. Similar to the PISA results for high school students, these two reading categories do generate what appears to be a significant difference in average literacy achievement according to PIRLS testing. And, data for the selected indicator of vulnerability (i.e., reading as leisure activity at most two times a week) is generated almost twice as often as equivalent PISA information. Finally, as noted earlier, the inventory of other studies tracking language achievement outcomes related to reading for enjoyment is heavily weighted towards elementary school age, the segment of the educational system where PIRLS is applied.

Regardless of the adopted indicator, it must be acknowledged that the evidence of health and well-being outcomes associated with reading as a leisure activity is quite limited. As summed up in one report concerning adults, both patterns and outcomes of reading as a leisure activity have generally received little research attention.²⁹⁷ While the volume of research is greater for children and young people, the results do tend to coalesce around language skills and scores measured at the same time the reading pattern is evaluated. This sort of evidence naturally raises the question of causality, one that is only partly answered by the suggestion that a cycle of reciprocal effects from year to year may occur in children, that is, where language proficiency spurs on reading, with that activity then increasing proficiency, and so on.

The main support for the potential broader impact of this concept appears to depend upon an *indirect* argument, that is, the plausible case that reading improves language proficiency in a

²⁹⁶ Adapted from *Measuring Up; Canadian Results of the OECD PISA Study*. Available at <http://www.statcan.gc.ca/pub/81-590-x/81-590-x2007001-eng.htm>. Accessed October 2011.

²⁹⁷ Bergadaa M, Faure C. *A Books Reading Pattern Based on Economic and Psycho-Sociological Factors*. 2000. Available at http://www.hec.unige.ch/recherches_publications/cahiers/2000/2000.06.pdf. Accessed October 2011.

manner that persists and even grows, combined with a *separate* line of evidence that literacy in turn generates multiple benefits of health and well-being.²⁹⁸ This chain of connections is not an ideal basis on which to build a robust conclusion concerning present leisure-time reading as a predictor of future well-being.

Conclusion

As summarized in the table below, assessments have been applied to the Reading as a Leisure Activity concept. Specifically, the indicator adopted for consideration is the percentage of grade 4 children not reading every day or almost every day.

Summary Assessment Reading as a Leisure Activity					
Age group (Years)	Estimated Prevalence Among B.C. Children	Magnitude	Significance/Impact	Modifiability	Data Availability/Quality
9-19	245,415	High	Low	High	Medium

The pediatric population **Magnitude** of the proposed indicator is assessed as **High**. Based on data from the 2006 PIRLS study, 43% of B.C. children in grade 4 do not read every day or almost every day. This rate was applied to the pediatric cohort from age 9 to age 19, yielding an estimate of 245,415 vulnerable individuals. The entire cohort following grade 4 was included on the assumption that the reading pattern established by that point, and any related health and well-being effects, would persist. The resulting estimate of 245,415 potentially affected individuals is greater than 10% (97,000) of the total pediatric cohort, resulting in a Magnitude classification of High.

The **Significance** of the potential indicator as indicated by the evidence of impact on an individual's health and well-being is assessed as **Low**. While the evidence does show correlations between reading for pleasure and a range of language-related outcomes, there are few signs that the concept acts as a good *direct* predictor of broader health effects over a longer period.

The **Modifiability** of the potential indicator is assessed as **High**. There appears to be a variety of programs that have been advanced to improve the rates of leisure-time reading.²⁹⁹

Data Availability/Reliability for the potential indicator is assessed as **Medium**. Data from PIRLS are collected and reported infrequently compared to most of the data sources suggested for this project. As well, it is not clear if valid sub-provincial information can be generated.

Based on the indicated mixed assessments, and especially the Low rating for significance/impact, the potential indicator is **Not Recommended** for consideration as a core indicator of child health and well-being.

²⁹⁸ This approach is used in a 2007 National Endowment for the Arts report. Available at <http://www.nea.gov/research/toread.pdf>. Accessed October 2011.

²⁹⁹ Geier DB. Involving a whole school community in reading for pleasure. *Library Talk*. 2002; 15(5): 12.

Summary and Conclusion

This final section of the report is intended to efficiently pull together the substantial volume of information gleaned for the dimension of Cognitive Development. The ultimate purpose of this report and the others in this series is to recommend a set of core, high-leverage indicators of child health and well-being. “High-leverage” reflects a combination of: (i) the population magnitude or prevalence of the risk-generating condition(s) of chief interest for each candidate concept; and (ii) the level of health effects caused in individuals by such conditions. *Feasibility* of application in the real world is another important consideration; it comprises both prevention potential and the ability to populate the indicator with valid data and thereby track prevention progress.

It is useful to emphasize provisos concerning the feasibility of application at this point:

- Prevention potential here refers to the proportion of an indicator’s underlying factor that can conceivably be prevented (e.g., where it is not genetically driven or related to an unknown cause) and/or refers to the existence of interventions of proven effectiveness; while it was not possible in the scope of the present report to conduct a literature review on the latter, reviewer expertise was applied to achieve at least a high-level assessment of the availability of interventions with real-world application.
- Effective interventions need to be considered in the real world context; in particular, the assessment of effectiveness needs to take into consideration the nature of the *remaining* unreached subpopulation, which may in fact be resistant to standard maneuvers because the “low hanging fruit” of the most preventable cases has already been “picked” (as a possible example, early school leavers).
- On the other hand, it is important to note that prevention *potential* as qualified above is *not* the same thing as prevention *capacity*—in other words, assessing whether there is any theoretical “room for improvement” related to a particular concept or indicator, or whether it is already being addressed by planners at a “saturation” level (as a possible example, high school completion); the fact is that prevention capacity is already fully captured under the Magnitude category of assessment.
- Rating a concept as infeasible in terms of prevention potential and/or indicator data availability/quality is not necessarily a final assessment; where the area is deemed to be high-leverage in terms of population burden, the conclusion may be that research into effective interventions and/or establishing pertinent data ought to be made high priorities—in other words, the indicator is a candidate for potential development.

As noted in the Introduction to the report, the four assessment categories applied to each potential indicator are summed up under the following headings: magnitude; significance/impact; modifiability; and data availability/quality. The category of magnitude can be ascertained objectively, as shown by the calculations summarized in Annex J-1 (for interest, the concepts are organized by descending magnitude in the table found there). The other three categories were assessed qualitatively in terms of a rating of Low, Medium, or High; for convenience, the meaning of these ratings is reiterated in the following table (first seen in the Introduction).

Key to Summary Assessments - Cognitive Development
by Evaluation Category

	Magnitude <i>Estimated prevalence of affected B.C. children</i>	Significance / Impact <i>Health and well-being effects</i>	Modifiability <i>Expert assessment of prevention potential</i>	Data Availability/Quality <i>B.C.-specific information sources</i>
Low	< 19,000 (<2% of total pediatric cohort)	Minimal effects and/or little indication of direct causation	Underlying risk factor not well-identified or not amenable to prevention	Data not routinely collected and reported
Medium	19,000 - 97,000 (2-10% of total pediatric cohort)	Medium Substantial acute effects or moderate chronic effects; moderate/mixed evidence of association	Medium Underlying risk factor theoretically amenable to prevention, but potential interventions not yet proposed in the literature	Medium Data routinely collected but not easily accessible and/or of potentially questionable validity (e.g., mostly self-reported topics with stigma attached)
		Medium-High Substantial acute effects or moderate chronic effects; stronger evidence, but with causation still not well-established	Medium-High Underlying risk factor amenable to prevention, but proposed interventions have not been well-tested and/or have shown mixed evidence of effectiveness	Medium-High Data routinely collected via sources based on self-reported information of high validity (e.g., the Census)
High	>97,000 (>10% of total pediatric cohort)	Substantial chronic effects and /or elevated mortality; strong evidence, with direct causation well-established	Underlying risk factor amenable to prevention, and identified interventions have been shown to be effective	Annual data routinely collected and reported via administrative sources or (objective) physical measurement methods

Combining the information in the assessment categories to create a form of aggregate ranking would allow certain concepts/indicators to rise to the top of the priority list to be considered for a progress report related to child health and well-being. Thus, it would be surprising if a concept/indicator rated High in all four assessment categories was *not* considered a very strong candidate for a suite of core indicators; likewise, a Low rating in all or most categories should automatically propel the indicator to the bottom of the list.

Some “exceptions to the rule” have already been suggested above.

1. A Low rating for data availability/quality but higher ratings for the other categories; in such instances, the indicator could be seen as part of a list for future exploration and development.
2. If the modifiability category is rated Low because effective interventions are not yet identified, then the indicator again could be placed on the development list, subject to the pursuit of further scientific evidence. On the other hand, if the Low rating for modifiability is due to the fact that the easily preventable subsets of the relevant target population have already been successfully covered by existing interventions, then the concept typically should be excluded even from the list to “potentially develop.”

Based on the considerations described above, a total of six indicators rose to the top for priority consideration in a suite of core indicators of child health and well-being. The indicators were evenly split between the two sub-dimensions adopted for this report: Readiness to Learn (essentially covering the preschool age group) and Learning and Other Outcomes (covering school-aged children up to age 19).

In addition to the Not Recommended classification, four indicators were deemed to belong to the intermediate category *Indicator to Potentially Develop*. Early Childhood Education, Reading by an Adult, School Attendance, and Number Knowledge Skills could all be considered for a core indicator inventory if pertinent measurements and data sources were designed in the future.

Gathering together the information provided at the end of each section of the report, the following table summarizes the assessments made across all of the concepts/indicators.

Child Health and Well-being

Summary Assessment of Concepts/Indicators for Cognitive Development Dimension

				Magnitude	Significance / Impact	Modifiability	Data Availability/Quality	
			Age Group (Years)	Est. Prevalence Among B.C. Children (2010)	Proportion of B.C. child/youth population to which concept/indicator applies	Association between concept and health/well-being dimension	Degree the concept/indicator(s) be reasonably changed through public policy or other intervention	Existence and reliability of information for the component indicator(s) for each concept
Subdim.	Concept	Indicator						
Recommended as Core Indicator								
RL	Verbal Skills	Vulnerable on Communication Skills scale (EDI)	5-19	98,574	High	Medium	High	High
LO	High School Completion	Young people aged 20-24 who have not graduated from high school	18-19	8,776	Low	High	High	High
RL	Personal Social Behavior Skills	Vulnerable on Emotional Maturity scale (EDI)	5-19	90,359	Medium	Medium	Med-High	High
LO	Children Reading and Writing	Students not meeting expectations on Grade 4 Reading (FSA)	9-19	91,317	Medium	Medium	Medium	High
RL	Motor skills	Vulnerable on Physical Health and Well-being scale (EDI)	5-19	85,878	Medium	Medium	Med-High	Medium
LO	Youth Math Proficiency	Failing grade 10 Math exam	15-19	44,020	Medium	Medium	Medium	Med-High
Indicator to Potentially Develop								
RL	Early Childhood Education	Cumulative lack of preschool spaces	4-19	384,496	High	High	High	Low
RL	Reading by an Adult	Not reading with an adult at least daily (NLSCY)	4-19	271,720	High	Medium	High	Low
LO	School Attendance	Gr. 9- 12 students skipping at least 1 class in last month	14-19	< 118,778	Medium	High	Medium	Low
RL	Number Knowledge Skills	"Delayed" on Number Knowledge component (NLSCY)	4-19	138,771	High	Medium	Med-High	Low
Not Recommended as Core Indicator								
LO	Reading as a Leisure Activity	Not reading for enjoyment "every day or almost every day" (PIRLS)	9-19	245,415	High	Low	High	Medium
LO	Children Numeracy	Students not meeting expectations on Grade 4 Numeracy (FSA)	9-19	119,854	High	Low	Medium	High
LO	Youth English Proficiency	Failing grade 10 English exam	15-19	25,560	Medium	Low	Medium	High
RL	Copying and Writing Skills	"Delayed" on Copying Skills and Writing Tasks component (NLSCY)	4-19	105,777	Medium	Low	High	Low
LO	Early School Leavers	Youth aged 16-17 who have not graduated and are not attending school	16-19	9,467	Low	Low	Medium	High
LO	English Language Skills	ESL students failing grade 10 English exam	5-19	3,093	Low	Medium	Low	High
RL	Readiness to Learn	N/A						

RL = Readiness to Learn; LO = Learning Outcomes; EDI = Early Development Instrument; FSA = Foundational Skills Assessment; NLSCY = National Longitudinal Survey of Children and Youth; PIRLS = Progress in International Reading Literacy Survey

Inevitably, there will be discussion and even debate about the final selections on the Recommended list; certain ratings incorporate a subjective element, and others are based in part on reviewer expertise. Some planners may find it difficult to leave certain concepts/indicators (e.g., Early Childhood Education) off of the initial core list. As an ultimate reassurance in the face of the recommendations made herein, it is important to recall that the final list of core indicators is supposed to be a highly selective monitoring tool, that is, acting as a *representative* list rather than a *complete* inventory of the prevention targets and maneuvers that ought to be pursued among children in the province of British Columbia.

The strong focus on preschool and grade school contexts under the present dimension of Cognitive Development is reflective of the synergy between quality educational interventions and health outcomes, a dynamic that is increasingly being recognized by researchers and planners.^{300,301,302} In sum, the six immediate and four provisional concepts/indicators suggested here offer a good picture of the cognitive development, education, and health nexus across different child/youth age categories.

³⁰⁰ Allensworth D, Lewallen TC, Stevenson B et al. Addressing the needs of the whole child: what public health can do to answer the education sector's call for a stronger partnership. *Preventing Chronic Disease*. 2011; 8(2): A44.

³⁰¹ Castro DC. *Education Inequities and Health Disparities: Child Development and the School Readiness Gap*. 2009. Available at www.minority.unc.edu/institute/2009/.../2009sphrimh-castro-dis.ppt. Accessed October 2011.

³⁰² Fiscella K, Kitzman H. Disparities in academic achievement and health: the intersection of child education and health policy. *Pediatrics*. 2009; 123(3): 1073-80.

Annex J-1: Details of Magnitude Estimates

Magnitude Summary for Selected Child/Youth Indicators						
Concepts / Indicator	Age Group	Prevalence	Source Year	Source	2010 B.C. Population*	Absolute Number
Concepts Related to Readiness to Learn						
Early Childhood Education						
<i>Cumulative lack of preschool spaces ^Ω</i>	4-19	N/A	2007/08	Child Resouce and Research Unit		384,496
Reading by an Adult						
<i>Not reading with an adult at least daily (NLSCY)</i>	0-19	28.0%	2004/05	National Longitudinal Survey of Children and Youth, 2004/05.	970,428	271,720
Number Knowledge Skills						
<i>"Delayed" on Number Knowledge component (NLSCY)</i>	4-19	14.3%	2002/03	National Longitudinal Survey of Children and Youth, 2002/03.	970,428	138,771
Copying and Writing Skills						
<i>"Delayed" on Copying Skills and Writing Tasks component (NLSCY)</i>	4-19	10.9%	2002/03	National Longitudinal Survey of Children and Youth.	970,428	105,777
Verbal Skills						
<i>Vulnerable on Communication Skills scale (EDI)</i>	5-19	13.2%	2008/09	Human Early Learning Partnership, <i>EDI Mapping Package</i> , 2008/09.	746,769	98,574
Personal Social Behaviour Skills						
<i>Vulnerable on Emotional Maturity scale (EDI)</i>	5-19	12.1%	2008/09	Human Early Learning Partnership, <i>EDI Mapping Package</i> , 2008/09.	746,769	90,359
Motor Skills						
<i>Vulnerable on Physical Health and Well-being scale (EDI)</i>	5-19	11.5%	2008/09	Human Early Learning Partnership, <i>EDI Mapping Package</i> , 2008/09.	746,769	85,878
Readiness to Learn						
<i>N/A</i>						
Concepts Related to Learning and Other Outcomes						
Reading as a Leisure Activity						
<i>Not reading for enjoyment "every day or almost every day" (PIRLS)</i>	9-19	43.0%	2006	PIRLS, 2006	570,732	245,415
Children Numeracy						
<i>Students not meeting expectations on Grade 4 Numeracy (FSA)</i>	9-19	21.0%	2011	Foundational Skills Assessment, 2011.	570,732	119,854
School Attendance						
<i>Gr. 9-12 students skipping at least 1 class in last month</i>	14-19	35.4%	2006/07	Youth Smoking Survey, 2006/07.	335,531	118,778
Children Reading and Writing						
<i>Students not meeting expectations on Grade 4 Reading (FSA)</i>	9-19	16.0%	2011	Foundational Skills Assessment, 2011.	570,732	91,317
Youth Math Proficiency						
<i>Failing grade 10 Math exam</i>	15-19	15.5%	2010	BC Ministry of Education, Provincial Required Examinations, 2009/10.	283,999	44,020
Youth English Proficiency						
<i>Failing grade 10 English exam</i>	15-19	9.0%	2009/10	BC Ministry of Education, Provincial Required Examinations, 2009/10.	283,999	25,560
Early School Leavers						
<i>Youth aged 16-17 who have not graduated and are not attending school</i>	16-19	4.1%	2009/10	Canadian Labour Force Survey, 2009/10	230,902	9,467
High School Completion						
<i>Young people aged 20-24 who have not graduated from high school</i>	18-19	7.3%	2009/10	Canadian Labour Force Survey, 2009/10	120,217	8,776
English Language Skills						
<i>ESL students failing grade 10 English exam</i>	15-19	11.0%	2009/10	BC Ministry of Education, Provincial Required Examinations, 2009/10.	28,116	3,093
<small>*Generally, population estimates are taken from BC Stats (available at: http://www.bccstats.gov.bc.ca). ^Ω Based on data assembled by the CRRU, there were 19,910 preschool/nursery school spaces in the province in 2007/08; this is adopted as the best marker currently available of ECE capacity. The number was subtracted from the age 4 cohort to establish an annualized snapshot of the capacity gap; the resulting total was multiplied by a factor of 16, representing the affected years from age 4 to age 19 and thus an estimate of the pediatric population prevalence with respect to being underexposed to ECE resources. The number of potentially vulnerable children is thus calculated as 384,496</small>						

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