



Child and Youth Health and Well-Being Indicators Project:
Appendix E—Evidence Review Protocol for Assessing
Concepts and Indicators



Office of the
Provincial Health Officer



Canadian Institute
for Health Information

Institut canadien
d'information sur la santé



Evidence Review Protocol for Assessing Concepts and Indicators

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Prepared For
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Systematic Review Protocol for Assessing Indicators of Child Health and Well-Being

Introduction

Overall Project Goal

The Office of the Provincial Health Officer (PHO), in partnership with the Canadian Institute for Health Information (CIHI), intends to generate a suite of indicators that will inform a future PHO report on the health and well-being of children in British Columbia. The ultimate goal of the initiative will be to identify a limited number of indicators that are both significant to the health and well-being of children and youth and malleable to policy, program, or service interventions.

Preamble: Initial Indicator Selection and Concept Identification

A total of 264 indicators associated with child health and well-being were identified, partly based on sources identified during background work for this project. The first key analytic step in the project was to create a smaller initial working list (the report summarizing this process is reproduced in Annex E-1).

Briefly, the first filter to reduce the number of indicators was applied as follows:

- A. ***Filter 1 (Relevance Assessment) – Ask stakeholders if indicators are relevant to policy, significant to children, easily understood, and whether they lead to action.***

In summary, the 264 indicators were first grouped into 125 **concepts** (for example, cause-specific mortality was used as a concept to represent multiple different causes of mortality, including but not limited to mortality from injuries, from motor vehicle accidents, and from cancer). The resulting concepts all fall within the following 5 dimensions of health and well-being:

1. Physical Health
2. Mental / Emotional Health and Well-Being
3. Social Relationships
4. Cognitive Development
5. Economic and Material Well-Being

Within each of the 5 dimensions, the concepts were further grouped into themes, as follows:

1. Physical Health
 - a. Injury / Safety Theme
 - b. Health Enhancing Behaviour Theme
 - c. Negative Health Outcome Theme
 - d. Health Compromising Behaviour Theme
2. Mental / Emotional Health and Well-Being

- a. Family Functioning Theme
 - b. Positive Mental Health Theme
 - c. Mental Illness Theme
 - d. Life Outlook Theme
3. Social Relationships
 - a. Social Connection Theme
 - b. Safety Theme
 - c. Child Welfare Theme
 - d. Youth Justice Theme
4. Cognitive Development
 - a. Readiness to Learn Theme
 - b. Learning Performance Theme
 - c. School System Theme
 - d. General Cognitive Development Theme
5. Economic and Material Well-Being
 - a. Income Theme
 - b. Housing Theme
 - c. Child Care Theme
 - d. General Socio-Economic Status Theme

A group of experts was then surveyed and asked to rate the concepts using the following four criteria:

- Relevance to policy
- Significance to the health and well-being of children
- Easily understood by multiple stakeholders
- Ability to drive action.

Upon completing ratings for each concept, respondents were then asked to order the 10 most important concepts so identified within each dimension.

The number of candidate concepts was further reduced from 125 to 93 using this **Relevance Assessment Filter**. For instance, this dropped the number of concepts for consideration under the physical health dimension from 37 to 28.

In order to complete the project, these 93 concepts will be subjected to Evidence and Data Assessment Filters, as follows:

- B. Filter 2 (Evidence Assessment) – Is there evidence of a link between the concept and the outcome of interest?***
- C. Filter 3 (Data Assessment) – Are indicator data available for this concept? Are the data suitable for use?***

Purpose of the Present Document and Definition of Terms

The purpose of this document is (1) to provide a protocol for a modified systematic literature review related to each concept, one that will fulfill the intention of the Evidence and Data Assessment Filters noted above; and (2) to provide guidelines for exploring the utility of the potential indicators that were identified as part of the review for each concept.

Reviewers will be asked to comment on what the academic research and grey literature evidence says about a subset of the concepts identified as a result of the relevance review process. Generally, the subset of concepts assigned to each review group is associated with a particular dimension of child health and well-being. Additionally, a commentary will be provided by the reviewer on the utility of the measurements identified in the reviewed studies in terms of potential application as a population-level indicator.

Definitions

It is important to distinguish the terms used in the statement of purpose just laid out.

A **dimension** is an umbrella category that reflects some commonly described aspect of well-being. While there may be overlaps in the understanding of (and what is covered by) two or more dimensions, there has been an attempt to design them as discrete categories. Generally, a dimension can be further divided into themes (or sub-dimensions) under which a list of related concepts (as defined below) may be clustered.

A **concept** represents one component of a particular dimension, one that typically is reflected in some type of measurement(s) that could serve as an indicator (as defined below).

Because a particular concept under the dimension of well-being is typically measured or tracked in different ways, there is a requirement to clarify one additional idea to guide the project, namely, that of an **indicator**. Following the thinking of the World Health Organization, an indicator is a variable with characteristics of quality, quantity, and time used to measure, directly or indirectly, changes in a situation and to appreciate the progress made in addressing it; the indicator typically provides a basis for developing adequate plans for improvement.

In sum, for the remainder of this document, the term indicator will be used to refer to one of the ways to measure or track some aspect of a concept.

Research Objectives

More specifically, the project for each review group may be considered as two sets of research objectives to be addressed for each assigned concept. One set of objectives (related to the concept) will be explored by a modified systematic review. The second set (related to the potential indicators) will be explored in a commentary informed by additional information on the indicators in the literature, the existence of population-level data collection in British Columbia and similar jurisdictions, and other relevant matters known to the review group.

The two sets of research objectives are as follows:

Evidence of a Concept's Impact within the Population of Interest

- For what proportion of children/youth in B.C. is the concept applicable?
- Is there research evidence of an association between the concept and the dimension of interest? What is the strength of any research evidence?

Commentary on Indicator(s) for Each Concept

- What measurements for each concept were found in the reviewed reports? In other words, what are the potential or candidate indicators for use in the province?
- Are data available (e.g., routinely collected) in B.C. for the candidate indicators in question? If so, are the data suitable (reliable, valid, etc.) for use as an indicator for child and/or youth well-being in B.C.?
- What currently are the most useful indicator(s) for measuring the concept in question?

Two additional areas of concern are relevant to concepts of interest: (i) practical modifiability through public policy and (ii) research gaps. These two areas will be useful to the overall project and therefore subject to some final consideration and comment from the review groups. In both cases, the main input is to be derived from the specific expertise of the review group rather than some additional scanning of the literature.

Assessing Modifiability of a Concept

In addition to noting the proportion of the child/youth subpopulation that is affected by a particular concept and the magnitude of the impact on health and well-being that is represented by the concept, there are two policy qualifications related to feasibility of application. First, as introduced in the research objectives above, it is important to know if data are available for a particular concept/indicator. Second, it is valuable to know the degree to which a concept (or a component indicator) may be modified in a positive direction through public policy as expressed through some type of intervention. A reading on modifiability will be provided at a high level as determined by the expertise of the review group. It is acknowledged that a formal assessment of program or services effectiveness (which typically would require its own extensive literature review) lies outside the scope of this project.

Gap Identification

The evidence reviews will also assist in identifying where *further research* evidence and/or indicator data are needed in cases where concepts are otherwise deemed (from an expert perspective) to be important to understanding the health and well-being of children and youth but where good information is currently unavailable. As well, based on the expertise of the review group, there will be an opportunity to note other potential concepts and/or indicators not reflected in the review. These variations on the theme of “gap identification” will form part of the conclusion at the end of all of the systematic reviews and discussion.

Overview of the Literature Review Method for this Project

While a full systematic review will not typically be required in this project, it does represent the basic idea for the work plan, which then will be modified as indicated below.

A systematic review is a type of secondary research project that identifies, summarizes, and analyzes the results that have been published on a specific research question. It is a *study of studies* offering a *digest of* and *commentary on* original research papers that have been located, selected, evaluated, and described according to a rigorous, predefined methodology—in other words, following the “system” that qualifies the process as systematic.

Thus, a systematic review classically may be characterized as:

- **Targeted:** It focuses one or more clear research questions
- **Transparent:** The methods and parameters for each step are explicitly documented, so that (as with any scientific endeavour) the process and results are reproducible
- **Comprehensive:** It identifies all studies for initial consideration to be included
- **Relevant:** Studies of no or low relevance to the research question(s) are excluded
- **Synthetic:** The pertinent characteristic and results of the final list of papers are displayed succinctly
- **Evaluative:** The methodological quality of the studies and the evidentiary power of results are assessed according to a specified method
- **Summative:** The evidence is translated into a brief narrative review, including a comparison with the results in other recent reviews in the literature
- **Conclusive:** The bearing of the current state of the scientific evidence on the research question is offered, alongside a statement of limitations

A systematic review may be distinguished from other primary and secondary studies (see the table below).

Types of Scientific Studies		
Primary or Original	Secondary	Tertiary
Experimental <ul style="list-style-type: none">• Randomized controlled trial (<i>RCT</i>; <i>always prospective</i>)• Controlled clinical trial• Uncontrolled clinical trial	<ul style="list-style-type: none">• Systematic review with meta-analysis• Systematic review• Best-evidence synthesis• Narrative review	<ul style="list-style-type: none">• Review of reviews
Observational <ul style="list-style-type: none">• Cohort• Case-control (<i>usually retrospective</i>)• Cross-sectional		
Other <ul style="list-style-type: none">• Qualitative• Case series• Case report		

Modified Systematic Review

In the Purpose statement given above, the main work of this project has been referred to as a “modified systematic review.” Given the limited resources and time-frame available to complete this work, every effort has been made to simplify or streamline the process while still preserving its transparency and the defensibility of any conclusions.

There are two ways that the systematic review may be modified for the present project, specifically when there are a large number of papers on a concept of interest and/or at least one recent systematic review of reasonable quality. In such cases, one or both of the following modifications may be applied, subject to the judgment of the review group doing the work.

1. If there is one or more systematic reviews on a particular concept that are both recent (i.e., published in 2005 or later) and of reasonable quality, then the reviews may serve as the mainstay of the results summary, *augmented only by those pertinent studies published since (or otherwise not covered) by the most recent reviews* (Level A search). Alternately, if there is no review paper on the topic, then all individual studies from the last decade become the focus of the literature review (Level B search).
2. When there is extensive evidence in the academic literature, the main electronic database search can be allowed to dominate, with only modest recourse to supplementary searches; furthermore, the exclusion criteria related to quality can be more stringently applied to produce a manageable list of studies for final consideration.

Protocol for Systematic Review Components

The following section of the document outlines the various steps to be followed in conducting the modified systematic review (a convenient checklist summarizing the steps may be found in Annex E-2). This information is provided for the sake of quality control and to provide some helpful guidance. There may be compelling reasons for a review group to deviate from the suggestions in one or more of these steps. As long as the rationale is made clear, reviewers should allow the particularities of a topic to inform their final methodology.

Research Questions for the Systematic Review

Every systematic review begins with one or more clear research questions. Stated in the most general terms to cover all aspects of the current project, the research questions are as follows:

For a particular assigned concept, what is the recent scientific evidence that supports the adoption of that concept in British Columbia as a compelling expression or experience of at least one of the five dimensions of child health and well-being?

For each concept, what are the pros and cons of the identified means of measuring that concept, that is, the measures that could serve as an indicator of child health and well-being in British Columbia?

These questions generate the following research specifications:

1. The definition of each concept and dimension will not be predetermined apart from the fact that the topic should for the most part relate directly to the experience of children; the exception will be any concept that has a well-recognized link to adult health and well-being (e.g., smoking in adolescents).¹ Apart from these provisos, definitions will be guided by the literature (in other words, following the lead of how a subset of studies defines it, as long as it has “face validity” as an expression of that particular concept or an experience of that particular dimension—physical health, mental/emotional health and well-being, etc.). For example, for the concept of physical activity, the dimension of physical health maps onto four subcategories: bone health, cardiovascular disease risk, overweight and general health or fitness.²
2. A “child” is defined as an individual less than 20 years old. This requirement can be fulfilled in a PubMed search, for example, by the age filter offered as a utility when searching that database; note that filtering for All Child (defined as age 0-18 years) is equivalent to applying Medical Subject Heading (MeSH) terms for Infant OR Child OR Adolescent.
3. “Recent literature” will be delineated as published in 2005 or later for systematic reviews or 2000 or later if a scan of all studies is required (i.e., in the absence of a suitable systematic review on the topic in the literature).

¹ It is useful to note that, by definition, the several unproven and sometimes controversial proposals concerning a connection between pediatric exposures and adult effects are not part of the agenda for this project.

² This open-ended perspective on how to understand a particular dimension may lead to internal duplication in the search or some overlap with other dimensions; however, it in the end is of little consequence—since the utility of an indicator is the ultimate point of the exercise, no matter how broad or narrow may be its overall connection to the concept of child health and well-being.

Literature Search Related to Each Assigned Concept

Sources

The aim is to locate the most pertinent literature for a given concept. There are two routes to assembling a complete “long list” of potentially pertinent literature (that is, before applying the series of exclusions, as described later): (i) the **main search of electronic databases** for journal articles and systematic reviews; and (ii) if necessary, a **supplementary search** for grey literature in a source such as Google, as well as various kinds of hand-searching. Further details on searching these sources are provided below.

- **Electronic databases** of (mainly) journal articles are meant to be the mainstay of this project, with the databases chosen according to the needs of the particular topic and the expertise of the review group. Search limits should be used whenever possible to begin targeting the pertinent studies, with the specific limits related to “date” and “type of study” depending on the level of search required (refer to example boxes below).

Level A. Searching for Recent Systematic Reviews of Reasonable Quality³ with Updates from Studies Not Covered by the Most Recent Such Review

STEP ONE

Example of Search Limits: Recent Systematic Reviews

If PubMed/Medline is being used, the following search limits would be applied:

Date: 2005-present

Language: English

Subjects: Humans

Age: All Child 0-18 years*

Type of Study: Meta-analysis, Review

*While the protocol defines a child as 0-20 years of age, the search limit available in PubMed for All Child was 0-18 years, so this is what was used.

If no suitable systematic reviews are found, continue to Level B search process below.

³ For the purposes of this project, a quality systematic review will be identified according to the expertise of the review group, following these guidelines: published in 2005 or later; search sources, methods, etc explicitly stated; search appears to be comprehensive; inclusion/exclusion criteria transparently applied; conclusion appears to be supported by data. Adapted from Kelly KD, Travers A, Doran M et al. Evaluating the quality of systematic reviews in the emergency medicine literature. *Annals of Emergency Medicine*. 2001; 38: 518-26.

STEP TWO

This step in a Level A search should be applied unless the most recent suitable review is dated 2009 or 2010 and appears to comprehensively cover literature published at least up to 2007. Again, this becomes a matter for judgment, guided by expertise. If the available reviews are working with a limited set of papers and/or the area appears to be marked by recent research activity, looking for and considering the most recent papers may be advisable.

Example of Search Limits: Update with Individual Studies if Last Year Fully Covered by Most Recent Review was 2006

If PubMed/Medline is being used, the following search limits would be applied:

Date: 2007-present

Language: English

Subjects: Humans

Age: All Child 0-18 years

Type of Study: Clinical trial, Controlled Clinical Trial, Randomized Controlled Trial

Level B. Searching for Individual Studies Where There is No Suitable Systematic Review on the Topic

Example of Search Limits: Scanning for Studies if No Recent Systematic Review Available

Database used was PubMed/Medline, with the following limits:

Date: 2000-present

Language: English

Subjects: Humans

Age: All Child 0-18 years

Type of Study: Clinical trial, Controlled Clinical Trial, Randomized Controlled Trial

Note: If necessary, the electronic search can sometimes be enhanced by finding potentially pertinent articles through any “related citations” utility available through the database, as well as by searching for recent work by the leading authors in the field.

- **Grey literature** (which often is not peer reviewed) identified by a variety of Internet search methods; pertinent materials for this project are any government, academic or advocacy reports describing some validation of the child health and well-being concept of interest—in other words, a source providing true evidence rather than mere commentary or a statement of philosophy.

- **Scanning reference lists** from all of the above sources (this is sometime called “hand searching”) for any studies not otherwise captured.

Electronic Search Terms

Both scientific paper databases and search engines allow selection of potentially pertinent literature according to key words. An important part of the project involves generating the key words that will be used in the automated search process. This requires as much thought as any other step of the process, and should involve collaboration among as many reviewers in the group as possible.

Suggestions for search terms can be generated by a number of means, including:

- Examining terms used by other systematic reviews
- Database utilities (such as medical subject headings in PubMed, and the key MeSH terms attached to seminal articles)
- Background reading on child health and well-being
- Expertise of the review team
- Using English thesauruses

Electronic searching by key terms always entails a balance between being comprehensive and being targeted. It is not helpful to create too extensive a “long list” of potentially pertinent articles that creates a lot of unnecessary labour. Even before applying exclusion criteria (see below), some databases of journal articles allow key terms to be qualified in different ways. PubMed is an example of this resource, where subject headings can be marked as standard (by default) or major, as well as being restricted to certain subheadings. The following example box demonstrates how this was executed for physical activity as related to the dimension of physical health.

Example of Electronic Search Terms

Dimension : Physical Health **Concept** : Physical Activity

Terms Related to Concept

- Motor Activity[Majr]
- Sedentary Lifestyle[Majr]
- Exercise[Majr]
- Exercise Therapy[Majr]
- Physical Education and Training[Majr]

AND

Terms Related to Dimension

- Health/statistics and numerical data[Mesh]
- Physical Fitness[Majr]
- Health Status Indicators[Mesh]
- Health Status/statistics and numerical data[Mesh]
- Risk Factors[Mesh]
- Diseases Category/prevention and control[Majr]
- Diseases Category/statistics and numerical data[Majr]
- Phenomena and Processes Category/prevention and control[Majr]
- Phenomena and Processes Category/statistics and numerical data[Majr]
- Overweight[Mesh]
- Bone density[Mesh]

Applying these terms to PubMed returned 851 articles. A further 55 were identified in a supplementary search, for a total 'long list' of 906.

Mesh = Medical Subject Heading

Majr = Major Subject Heading

Major Decision on Modifying the Literature Search Strategy

If one or more suitable reviews are discovered in the initial search targeting recent systematic reviews on the topic, then the assignment for that particular topic defaults to a **Level A** search. In other words, the conclusions will be drawn from the available review papers, augmented only by newer individual studies when the most recent pertinent review is dated before 2009 and/or does not cover information published up to at least 2007.

In the case where there is no suitable systematic review on a particular topic, then a **Level B** search will be conducted.

It is important to note that both levels of searching require the application of various exclusion criteria before building a volume report and a summary table of results. The aim is to focus in the end on the most pertinent literature. The exclusion criteria and steps applicable to review papers and individual primary studies are described in the next section.

Exclusion Criteria

Only a “short list” of the relevant paper should be included in the ultimate literature review that forms the basis of discussion and conclusions. There are several stages of the review process that involve applying certain exclusion criteria in order to refine the initial long list of studies. These stages comprise *Preliminary Exclusion*, *Primary Exclusion*, and *Secondary Exclusion*, as described below.

Preliminary Exclusion

While one of the main goals of the process is comprehensiveness, there is a form of “preliminary exclusion” that will be applied so that the initial “long list” of review papers or primary studies is limited to certain desired types. After conducting the comprehensive search, the list of paper titles should be examined to find obvious matches with the research topic, excluding those that clearly do not fit.

Primary Exclusion

At this stage, the abstracts/full text of reviews or studies should be tested against the key elements of the research questions to see if an article qualifies as a potential source of evidence. The four primary tests that should be applied are as follows:

- Is the study about children?
- Is the study related to the relevant concept?
- Is the study related to the relevant dimension of child health and well-being?
- Does the study examine the linkage between the concept and the dimension?

If the answer is “no” to any one of these questions, the paper should be excluded. This step can be refined by using two reviewers to execute all abstract assessments independently, comparing results and resolving any disagreements by further discussion.

Secondary Exclusion

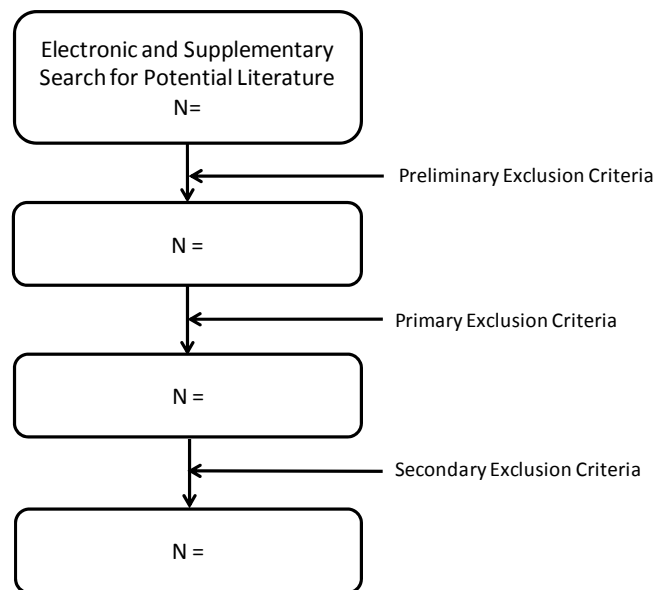
At this point, the aim is to review the papers in more detail and exclude the studies of lesser quality. Applicable quality criteria may include Journal Impact Factor, number of study participants, type of study, etc., while still keeping in mind the preliminary/primary criteria related to topic pertinence. Only primary studies that utilize a scientific methodology and generate quantitative or qualitative results should be included; this means excluding case

reports or other anecdotal work, case series, and the like. This is also the stage where duplicate reports of the same research project should be removed; the most complete, peer-reviewed reference related to a particular research project should always be chosen.

Basic Reporting Requirements

As a rule, the search criteria and results should be clearly elucidated as part of the literature review documentation. As well, in the case of a Level B search, a summary count of items should be provided for the initial long list, as well as after the various types of exclusions have been applied (see example below).

Literature Review Volume Report: Individual Studies



Data Extraction and Reporting

This is the process by which each review group identifies and reports the necessary information about study characteristics and findings from the final review papers and (where applicable) primary studies.

A summary table for pertinent review paper results should be developed, incorporating the following information:

- Citation: Author (Year) – with full citation as an Endnote
- Review Title
- Number of Studies Reviewed
- Conclusions/Comments

Alternately, if the review group is required to conduct a search for newer individual studies (where the last review published is older) or a Level B search for a particular concept (i.e., when no review paper is available), a Summary Table of Primary Study Results should be developed, incorporating the following information:

- Citation: Author (year) – with full citation as an Endnote

- Study Objective
- Study Description
- Setting/Participants
- Design/Data Collection
- Outcomes
- Results
- Conclusions/Comments

Note: References for summary tables should follow a modified Vancouver style (see Annex E-3).

Documentation and Discussion

Following the outline provided in Annex E-2, a succinct but complete report is expected of each review group. There will be one section in the report for each assigned concept, similar to the examples found in Annexes E-4 and E-5. At the end, the various sections/concepts will be drawn together in an overall conclusion.

Background and Context

A brief preamble should be provided about the concept and the typical child health and well-being outcomes related to that concept. Where appropriate and possible, this should include an assessment of the present and potential population exposure to the measured phenomenon in question.

Documentation

Thorough and careful documentation is the cornerstone of producing a literature review that is transparent, reproducible, and reliable in terms of ultimate results. While the expectations are more modest for the modified literature search specified by this project, the items outlined in the various protocol sections point to the minimum information to be communicated. ***The centerpiece of the report is represented by the Summary Tables where the results of the data extraction are provided.*** Finally, the number, names, and professional titles of reviewers involved with the various stages should be included; other vital matters that occur to the review group can also be noted.

Summary and Discussion

As already noted, each concept under investigation generates its own modified systematic review. For each review, the results captured in the summary tables should be summarized in a brief commentary (a type of narrative review). Explanations may be suggested for significant variations between papers identified in the literature.

Conclusion

Concluding statements should be provided in two locations in the report.

- First, at the end of each section (i.e., as related to each concept). This involves synthesizing the body of evidence and its overall strength in a brief statement, anticipating an eventual recommendation about the suitability of the particular indicator for application in British Columbia.

- A second conclusion is in order at the end of the report, once all the sections are complete. This should include a statement of the concepts/indicators that rise to the surface as potentially being most pertinent to tracking child health and well-being in British Columbia. In addition, important gaps should be noted with respect to the evidence related to otherwise promising concepts; this information will help to guide future research priorities.

As a foundation for these concluding statements, the evidence for and expert assessment of each concept's potential contribution to policy around child health and well-being should be summarized in **tabular form** (see sample outline below). This should include information about the proportion of the child/youth subpopulation affected by the concept and the degree of impact on a dimension of health and well-being supported by evidence identified in the literature review. As well, based on the expertise of the review group, it would be useful to identify the potential for modifying a concept through public health or other interventions, and the availability/quality of indicator data.

Concept / Indicator	Magnitude Proportion of B.C. child/youth population to which concept applies (include # and/or %)	Significance / Impact Association between concept and health/well-being dimension	Modifiability Can the concept/indicator(s) be reasonably changed through public policy or other intervention	Data Availability Existence and quality of information for the component indicator(s) for each concept
1.				
2.				
3.				
...				

Each of the four evaluation elements in the table would be labelled simply as **high**, **medium**, or **low** utility with reference to its suitability as a part of a child/youth health and well-being program in British Columbia.

Annex E-1: Child Health & Well-Being Indicators—Relevance Filter

Relevance Filter Summary Findings

Purpose

The goal of the relevance filter, conducted using a modified Delphi online survey approach, was to select indicators based on their relevance, as rated on four separate criteria through expert opinion.

Background

Health economist Hans Krueger was consulted to provide methodological advice on developing the indicator filtering and selection process. Dr Krueger proposed two approaches, as follows:

1. Conduct an evidence filter of a broad range of indicators and then conduct a relevance filter based on the most promising indicators in the literature.
2. Conduct a relevance filter on a broad range of indicators and then, based on these results, conduct an evidence filter on the indicators deemed most relevant.

The second approach was accepted for two reasons. First, on the advice of the project's Technical Advisory Committee (TAC), the project working group decided not to limit indicators for selection only from among those for which evidence is currently available – it may be that there are significant aspects of child health and well-being that there currently aren't good measurements for. Part of the project is to identify a gap analysis of where important indicators are missing. The second concern was that conducting the evidence review on a large number of indicators that were not deemed to be relevant to the health and well-being of children would be more costly.

There were originally over 250 indicators for the relevance filter. However, this was too many indicators to be evaluated, so the working group combined most indicators into concepts. For example, cause specific mortality was used as a concept to represent multiple different causes of mortality, including but not limited to mortality from injuries, from motor vehicle accidents, from cancer, etc. This grouping resulted in 125 concepts/indicators in the survey.

The 125 candidate indicators included in the survey were primarily taken from examples that were identified in the project background paper, The Foundations of Child Health and Well-being in British Columbia. Additions included elements contained in the Early Development Instrument, the Middle Years Development Instrument and indicators identified by youth through a consultation conducted by the McCreary Institute.

Survey Administration

The survey – administered using Survey Monkey between May 18 and June 11, 2010 – was sent out to:

- participants who attended the project's expert workshop in November 2009;
- workshop invitees who were unable to attend the November workshop; and,
- a number of other experts who were identified by the working group.

In total the survey was distributed to 125 people, and responses received from 57, resulting in a 46% response rate. The survey was divided into five sections based on the five dimensions of the framework. Participants had the choice to complete the entire survey or to complete only the section(s) they felt they had the expertise to comment on.

The survey included two sets of evaluation questions. First, each concept/indicator was rated using four criteria – relevance to policy, significance to the health and well-being of children, easily understood by multiple stakeholders and ability to drive action. Second, upon completing ratings for each concept/indicator in that section of the survey, respondents were then asked to rank order the 10 most important indicators within that dimension.

The number of participants rating each dimension varied from a low of 22 in the material well-being and cognitive development sections, to a high of 33 in the physical health section.

Review of Survey Analysis Approach

The TAC recommended the following methodology for reviewing the survey results and reducing the number of candidate indicators put forward for the evidence reviews:

- Within each dimension start the selection process using the rank ordering of the indicators rather than the criteria ratings because the differentiation among criteria ratings was insufficient. The rank ordering represents the comparative importance the survey participants placed on each of the indicators.

After selecting the top ranked indicators apply filters to fill in possible gaps. The filters applied to the analysis were:

- **A cluster filter** – to group indicators within a dimension into sub-themes. This helped identify duplication as well as ensured candidate indicators comprehensively reflected the dimension. Only considering the top ranked indicators may have skewed the representativeness of a given dimension.
- **An age span filter** – to ensure relevance for younger children through to older youth.
- **A First Nations and Aboriginal filter** – to identify indicators that First Nations and Aboriginal peoples would want to compare against the general population.
- **A youth filter** – to identify indicators that young people identified as being significant to their health and well-being.

Results

Overall the number of candidate indicators to be put forward for the evidence review was reduced from 125 to 93 through the relevance review exercise. The specific indicators to be put forward are as follows:

Physical Health

The candidate indicators were reduced from 37 to 28 through the review. Indicators clustered around four general sub themes; Injury/safety, Health enhancing behaviour, Negative health outcomes and Health compromising behaviour.

Each of the clusters (sub themes) contained higher ranked candidate indicators. In addition a number of lower ranked candidate indicators were filtered in for the evidence review on the basis of youth input (teen pregnancy, STIs, sexual behaviour, drug use) and age span representation (Emergency Department use – for injuries, sleep levels and self-rated health) The First Nations and Aboriginal filter did not provide additional candidate indicators for inclusion. Vision and hearing screen were included as they are current government priorities. In conducting the evidence review the project is interested in both the evidence around the candidate indicators as well as what the evidence suggests are the best indicators of the four clusters (sub-themes).

Physical Health candidate indicators for evidence review and survey rankings

Injury/safety Theme		Health Enhancing Behaviour Theme	
	Rank		Rank
• Major Injuries	5	• Physical Activity Levels	1
• Environmental Exposures	14	• Proper Nutrition	2
• Cause Specific Emergency Department Use	31	• Healthy Weights	6
		• Birth Weights	7
		• Sleep Levels	26
		• Self-rated Health	30
		• Sexual Behaviour	28
		• Immunization Rates	3
		• Newborn Screening	10
		• Oral Health	12
		• Vision Screening	18
		• Hearing Screening	22
		• Outreach Services to Pregnant Women and Mothers	15
		• Health Services Accessibility - including sexual health	19
		• Antenatal Care	23
Negative Health Outcome Theme		Health Compromising Behaviour Theme	
	Rank		Rank
• Cause Specific Mortality	8	• Tobacco Use	4
• Major Chronic Diseases	11	• Alcohol Use	9
• Fetal Alcohol Spectrum Disorder in Children	13	• Drug Use	29
• Cause Specific Disabilities	16	• Teenage Pregnancy	25
• Major Childhood Infectious Diseases	17	• Sexually Transmitted Infections	34

Mental/Emotional Health and Well-being.

The candidate indicators were reduced from 18 to 14 through the review. Indicators clustered around four general sub themes; Family functioning, Mental illness, Positive mental health, and Life outlook (although life outlook could also be considered a subset of positive mental health).

Interestingly, few candidate indicators were eliminated from this dimension once the filters were applied. Two items around specific drug utilization were combined looking at the relevance of prescription medications for mental health concerns. Parental criminal record was dropped as it was the lowest ranked candidate indicator and was not filtered back in. Parental depression was filtered out as being a subset of parental mental health status. Spirituality was included as it was identified as being particularly significant to First Nations and Aboriginal People.

In conducting the evidence review the project is interested in both the evidence around the candidate indicators as well as what the evidence suggests are the best indicators of the four clusters (sub-themes).

Mental/Emotional Health candidate indicators for evidence review and survey rankings

Family Functioning Theme		Positive Mental Health Theme	
	Rank		Rank
• Family Functioning	1	• Emotional Health (self rated)	5
• Parenting Style & Practices	3	• Self-esteem	6
• Parental Mental Health Status	4	• Self-rated Mental Health	9
		• Self-efficacy	10
		• Spirituality	17
Mental Illness Theme		Life Outlook Theme	
	Rank		Rank
• Mental Health Disorders	2	• Life Satisfaction	12
• Suicide & Suicidation	7	• Optimism	13
• Mental Health System Utilization	14		
• Prescription Drug Utilization	15		

Social Relationships

The candidate indicators were reduced from 26 to 20 through the review. Indicators clustered around four general sub themes; Social Connections, Safety, Child Welfare and Youth Justice.

The clustering filter in this dimension identified the sub theme of youth justice as being absent from the top ranked candidate indicators which accounts for the inclusion of youth justice indicators. The clustering filter also resulted in the candidate indicators pro-social activities and physical punishment being dropped as sub-set of other candidate indicators (constructive use of time and domestic abuse/child neglect). Both the youth and First Nations filter identified the importance of community/cultural connection and an important social relationship indicator. Although it was absent from the survey it has been added in as a result.

In conducting the evidence review the project is interested in both the evidence around the candidate indicators as well as what the evidence suggests are the best indicators of the four clusters (sub-themes).

Social Relationship candidate indicators for evidence review and survey rankings

Social Connection Theme		Safety Theme	
	Rank		Rank
• Relationships with Parents	1	• Violence in the Home	5
• Relationships with Adults	2	• Bullying	7
• School Connectedness	3	• Parental Alcohol/Substance Use	8
• Relationships with Peers	6	• Neighbourhood Safety	12
• Constructive Use of Time	15		
• Neighbourhood Cohesion	16		
• Community Connection	NR		
Child Welfare Theme		Youth Justice Theme	
	Rank		Rank
• Domestic Abuse/Child Neglect	4	• Youth Who Receive Alternative Sentencing	22
• Students Reporting Physical/Sexual Abuse	10	• Youth Charged & Convicted	24
• Children in Care	11		
• Social Support for Parents	13		
• Children in Non-parental Care	17		
• Child Protection Caseload	18		
• At-risk Children & Youth Supported to Stay at Home	20		

Cognitive Development

The candidate indicators were reduced from 24 to 18 through the review. Indicators clustered around four general sub themes; Readiness to Learn, Learning Performance, School System, and General.

In the cluster filter, school enrolment was ranked lower than school attendance and as school enrolment is mandatory to age 16 it was not included. With respect to youth early school leavers and idle youth (in the economic and material well-being dimension) also capture school enrolment. The highest ranked indicators all focused on early development and readiness to learn. All the indicators in this cluster were included and the project will be looking to the evidence review as to which of them are the best indicators.

In conducting the evidence review the project is interested in both the evidence around the candidate indicators as well as what the evidence suggests are the best indicators of the four clusters (sub-themes).

Cognitive Development candidate indicators for evidence review and survey rankings

Readiness to Learn Theme		Learning Performance Theme	
	Rank		Rank
<ul style="list-style-type: none"> Personal Social Behaviour Skills Readiness to Learn Verbal Skills Early Childhood Education Reading by an Adult Motor Skills Number Knowledge Skills Copying and Writing Skills 	1 2 3 4 5 7 19 21	<ul style="list-style-type: none"> High School Completion English Language Skills (ESL) Children Reading and Writing FSA Children Numeracy FSA Youth English Proficiency Early School Leavers Youth Math Proficiency 	6 8 11 13 14 17 18
School System Theme		General	
	Rank		Rank
<ul style="list-style-type: none"> School Attendance Education Expenditures 	9 10	<ul style="list-style-type: none"> Reading as a Leisure Activity 	12

Economic and Material Well-Being

The candidate indicators were reduced from 20 to 13 through the review. Indicators clustered around four general sub themes; Income, Housing, Child Care and General Socioeconomic Indicators.

The cluster filter showed a number of related income candidate indicators. The fifth ranked candidate indicator families living below the LICO, was duplicating the intention of children in families living below the LICO which is the reason for it being omitted. With respect to the sub-theme of child care adequate child care subsumed the other two candidate child care indicators.

In conducting the evidence review the project is interested in both the evidence around the candidate indicators as well as what the evidence suggests are the best indicators of the four clusters (sub-themes).

Economic & Material Well-being candidate indicators for evidence review & survey rankings

Income Theme		Housing Theme	
	Rank		Rank
• Children in Families Living Below the LICO	1	• Homelessness	3
• Food Security	2	• Housing Availability	7
• Family Income	4	• Housing Conditions	11
• Parental Employment	9		
• Children in Families Receiving So Assistance	15		
Child Care Theme		General SES Theme	
	Rank		Rank
• Adequate Child Care	8	• Children SES Circumstances	6
		• Lone Parent Families	14
		• Recreation Program Registrations	18
		• Idle Youth	13

Injury and Safety

When the child and youth health and well-being framework was revised after the November 2009 workshop the dimension of Safety was removed as it cut across a number of the other dimensions. Given the importance of safety and injury prevention in the lives of children and youth it is imperative that the framework is able to identify to identify indicators in these areas. The following table identifies where injury and safety candidate indicators are identified within 4 of the framework's 5 dimensions.

Injury and safety candidate indicators cutting across dimensions

Physical Health Dimension		Mental/Emotional Health	
	Rank		Rank
• Major Injuries	5	• Suicide & Suicidation	7
• Environmental Exposures	14		
• Cause Specific Emergency Department Use	31		
Social Relationships		Economic and Material Well-being	
	Rank		Rank
• Domestic Abuse/Child Neglect	4	• Housing Conditions	11
• Violence in the Home			
• Bullying	5		
• Students Reporting Physical/Sexual Abuse	7		
• Parental Alcohol/Substance Use	8		
• Neighbourhood Safety	10		
• At-risk Children & Youth Supported to Stay at Home	12		
	20		

Next Steps

The list of candidate indicators in each of the above dimension tables will proceed to the evidence review. The evidence review will consist of modified systematic reviews for each of the dimensions. The reviewers will be asked to comment on what the evidence says about the indicators put forward from this relevance review as well as what the evidence says are the best indicators of the dimensions and sub-themes to ensure the project is not missing any important indicators. In other words, are the proposed candidate indicators the best indicators for measuring each of the dimensions and sub-themes or are there additional indicators that should be considered.

The evidence reviews will also assist in identifying where further evidence is needed in cases where indicators are deemed important to understanding the health and well-being of children and youth but where good measurements are currently unavailable. This will form part of the project's gap analysis. The evidence reviews will be coordinated by health economist Hans Krueger.

Overall Ranking of Concepts/Indicators From the Five Dimensions

Physical Health		Mental/Emotional Health	
	Rank		Rank
Physical Activity Levels	1	Family Functioning	1
Proper Nutrition	2	Mental Health Disorders	2
Immunization Rates	3	Parenting Style & Practices	3
Tobacco Use	4	Parental Mental Health Status	4
Major Injuries	5	Emotional Health	5
Healthy Weights	6	Self-esteem	6
Birth Weights	7	Suicide & Suicidation	7
Cause Specific Mortality	8	Self-rated Emotional Health	8
Alcohol Use	9	Self-rated Mental Health	9
Newborn Screening	10	Self-efficacy	10
Major Chronic Diseases	11	Parental Depression	11
Oral Health	12	Life Satisfaction	12
Fetal Alcohol Spectrum Disorder in Children	13	Optimism	13
Environmental Exposures	14	Mental Health System Utilization	14
Outreach Services to Pregnant Women and Mothers	15	Methylphenidate Utilization	15
Cause Specific Disabilities	16	Anti-psychotic Prescription	16
Major Childhood Infectious Diseases	17	Drug Utilization	17
Vision Screening	18	Spirituality	17
Health Services Accessibility	19	Parental Criminal Records	18
Drug and Alcohol Affected Newborns	20		
Risky Behaviour During Pregnancy	21		
Hearing Screening	22		
Antenatal Care	23		

Safe Environment	24	At-risk Children & Youth Supported to Stay at Home	20
Teenage Pregnancy	25	Children Who Have Moved in the Last Year	21
Sleep Levels	26	Youth Who Receive Alternative Sentencing	22
Maternal Nutrition	27	Youth Who are Repeat Offenders	23
Sexual Behaviour	28	Youth Charged & Convicted	24
Drug Use	29	Children in Care Adopted	25
Self-rated Health	30	Youth Who are Victims of Crime	26
Cause Specific Emergency Department Use	31	Cognitive Development	
Congenital Anomalies	32	Personal Social Behaviour Skills	1
Cause Specific Hospitalizations	33	Readiness to Learn	2
Sexually Transmitted Infections	34	Verbal Skills	3
Children Exposure to Environmental Tobacco Smoke	35	Early Childhood Education	4
Tobacco Sales to Minors	36	Reading by an Adult	5
Infants Exposed to HIV	37	High School Completion	6
Social Relationships		Motor Skills	7
Relationships with Parents	1	English Language Skills	8
Relationships with Adults	2	School Attendance	9
School Connectedness	3	Education Expenditures	10
Domestic Abuse/Child Neglect	4	Children Reading and Writing FSA	11
Violence in the Home	5	Reading as a Leisure Activity	12
Relationships with Peers	6	Children Numeracy FSA	13
Bullying	7	Youth English Proficiency	14
Parental Alcohol/Substance Use	8	School Enrolment	15
Involvement in Prosocial Activities	9	Parental Education Attainment	16
Students Reporting Physical/Sexual Abuse	10	Early School Leavers	17
Children in Care	11	Youth Math Proficiency	18
Neighbourhood Safety	12	Number Knowledge Skills	19
Social Support for Parents	13	Mathematics and Science Performance	20
Physical Punishment	14	Copying and Writing Skills	21
Constructive Use of Time	15	Youth Science Proficiency	22
Neighbourhood Cohesion	16	Direct Transition to Post-Secondary	23
Children in Non-parental Care	17	Academic Course-Taking	24
Child Protection Caseload	18		
Youth Involved in Fighting	19		

Economic and Material Well-Being

Children in Families Living Below the LICO	1
Food Security	2
Homelessness	3
Family Income	4
Families Living Below the LICO	5
Children SES Circumstances	6
Housing Availability	7
Adequate Child Care	8
Parental Employment	9
Child Care Spaces	10
Housing Conditions	11
Children & Youth Not Living at Home and Receiving Social Assistance	12
Idle Youth	13
Lone Parent Families	14
Children in Families Receiving Social Assistance	15
Child Care Subsidies	16
Youth Employment	17
Recreation Program Registrations	18
Children in Subsidized Housing	19
Home Internet Access	20

Annex E-2: Protocol Checklist and Outline of Report Format

For ease of reference, a checklist of requirements for the systematic review and the final report is provided below.

Modified Systematic Review Protocol Checklist

1. Ensure that the concepts (and thus the related research questions) are clear
2. Establish the databases for the electronic search and what kind of automatic limits may be set (as appropriate for a Level A or Level B search)
3. Working collaboratively, establish the search terms for the particular concept and the dimension of interest
4. Run the electronic database search and create the main portion of the “long list” of articles
5. Add literature to the long list by a supplementary search, as appropriate
6. Apply the various exclusions, tracking the numbers of articles “in play” at each step
7. Create a literature review volume report, tracking the effect of exclusions on the original long list of papers.
8. Create table(s) summarizing the data extracted from the final inventory of review papers and/or individual primary studies.
9. Summarize the evidence of an association between the concept and the dimension in a brief narrative review
10. Abstract and discuss information about the candidate indicators that are associated with the concept

Basic Report Format

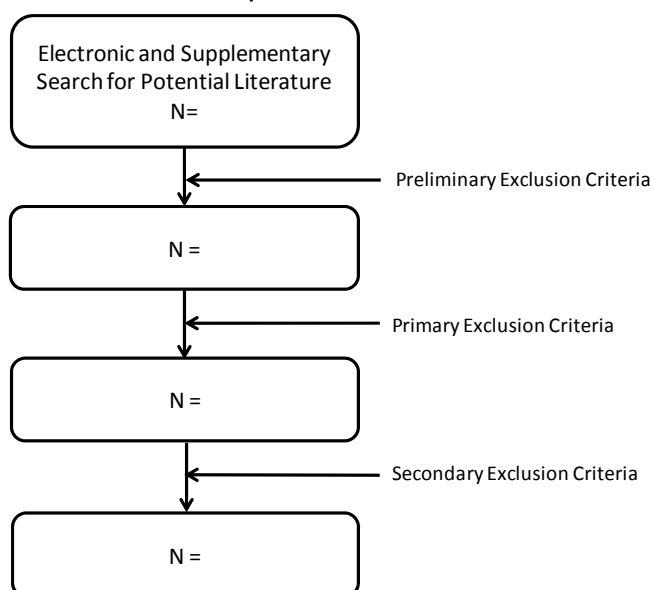
For each concept...

Background and Context

Methodology and Provisional Results, including in particular:

- Electronic databases and search terms used (for Level A and B searches)
- Systematic review volume report, by exclusion stage; see outline sample below

Literature Review Volume Report: Individual Studies



Detailed Results, including:

- Tabular listing of papers after applying secondary exclusion criteria
- Level A search: Summary Table of Review Paper Results since 2005 and, if Step Two is deemed necessary, a Results Table updating primary studies since the most recent review
- Alternately, Level B search: Summary Table of Primary Study Results since 2000
- Summary Table references
- Narrative summary of results, combined with any information about indicator data availability and the proportion of the pediatric population to which the concept applies.

Discussion

Conclusion

After all concept sections completed...

Overall Conclusion, with a summary table covering information/assessment for all concepts.

Annex E-3: Modified “Vancouver Style” for References

It is useful to the final step of integrating results from several review groups to follow the same style guide for references. The following guidelines will cover the main categories. For any question not included here, the review group can follow their own judgment, *as long as consistency is maintained*.

Examples of the suggested approach to the main categories are provided in boxes.

1. Journal Articles

1.1 One to three authors.

Holland R, Harvey I. Population needs assessment and knee replacement surgery. *Rheumatology*. 2003; 42: 503-506.

1.2 Four or more authors.

Hawker GA, Wright JG, Coyte PC et al. Differences between men and women in the rate of use of hip and knee arthroplasty. *New England Journal of Medicine*. 2000; 342(14): 1016-22.

1.3 Supplements

Supplement to a volume. 2002; 42(suppl 2): S93-9.

Supplement to an issue. 2004; 58(12 suppl 2): 67A-73A (Note: use the pagination style adopted by the supplement’s editors.)

2. Reports and Books

2.1 Follow author rules used for journal articles, as provided above.

Getzen TE. *Health Economics: Fundamentals of Funds*. New York: John Wiley & Sons; 1997. p. iv.

Fauci AS, Braunwald E, Isselbacher KJ et al, eds. *Harrison’s Principles of Internal Medicine*. 14th ed. New York: McGraw Hill; 1998. pp. 123-4.

2.2 Organization as author or sponsor.

Note: reports will often provide citation style suggestions in their front matter, but these can be adapted to a more streamlined style.

Health Canada. *Arthritis in Canada. An Ongoing Challenge*. Ottawa: Health Canada; 2003. p. 32.

Note: since reports are usually available on-line, they generally should be reference with a URL included (see the next section).

2.3 Chapter in an (edited) book.

Sweanor D, Kyle K. Legislation and applied economics in the pursuit of public health. In: de Beyer J, Brigden LW, eds. *Tobacco Control Policy: Strategies, Successes, and Setbacks*. Washington: World Bank; 2003. pp. 57-8.

3. Internet Sources

Health Canada. Youth Smoking Survey, 2002. Available at <http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/yss/>. Accessed July 2004.

See the discussion on “denormalization” at http://www.ncth.ca/NCTH_new.nsf/0/BB9C061688D983AA85256E160077E4C8?OpenDocument. Accessed October 2004.

LaPorte RE, Marler E, Akazawa S, Sauer F. The death of biomedical journals. *British Medical Journal* [serial online]. 1995; 310: 1387-90. Available at <http://www.bmj.com/bmj/archive/6991ed2.htm>. Accessed September 1996.

Systematic Review of Physical Activity Related to Physical Health

Background and Context

The purpose of this review is to find research evidence of an association between physical activity in children and youth and their physical health. An additional goal is to determine what the most useful indicators are for tracking physical activity in children and youth. According to the World Health Organization (WHO), school-aged youth should engage in at least 60 minutes of moderate- to vigorous-intensity physical activity daily. Similarly, the Canadian Physical Activity Guides recommend that inactive children and youth increase their moderate/vigorous physical activity by at least 30 minutes per day, and decrease their time in sedentary activities by at least 30 minutes per day.⁴ Despite these recommendations, a global decrease in physical activity levels among young people has been observed; according to the WHO, “it is estimated that less than one-third of young people are sufficiently active to benefit their present and future health and well-being.”⁵ Potential physical health benefits of physical activity include development of healthy bones and muscles, development of a healthy cardiovascular system, and maintenance of a healthy body weight. This review will determine the level of research evidence for such benefits in young people.

If physical activity is confirmed as a concept enjoying at least a reasonable association with pediatric physical health, then it will become all the more important to know how to track the concept at a population level. In a review of methods of assessing physical activity in children and adolescents, de Vries et al. point out that “knowledge of physical activity patterns is needed to serve as a cornerstone in establishing appropriate federal health objectives....it is also desirable to determine what proportion of children and adolescents are meeting physical activity guidelines and to examine what proportion is in need of intervention programmes or whether to adjust physical education curricula for children.”⁶ This highlights the importance of using an appropriate and useful indicator to measure physical activity levels among young people in British Columbia.

Methodology and Provisional Results

Initial Search Process

For the **main electronic search**, the database used was PubMed, with the following limits:

Date: 2005-present *Language:* English *Subjects:* Human *Age:* 0-18 years*

Type of Article: Review, Meta-analysis

*While the protocol defines a child as 0-20 years of age, the search limit available in PubMed for All Child is 0-18 years, so this approximation was used.

Note that the preceding specifications will be standard for all of the evidence searches under the Physical Health dimension, so it will not be repeated for the remaining concepts. Similarly,

⁴ Public Health Agency of Canada Activity Guidelines for children and youth. Available at <http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/pag-gap/cy-ej/children-enfants/guidelines-lignesdir-eng.php>. Accessed August 2010.

⁵ World Health Organization Global Strategy on Diet, Physical Activity and Health. Available at http://www.who.int/dietphysicalactivity/factsheet_young_people/en/index.html. Accessed August 2010.

⁶ de Vries SI, Pronk MG, Hopman-Rock M et al. *Assessing Physical Activity in Children and Adolescents. A Review of Different Methods*. 2004. TNO. Available at http://www.tno.nl/downloads/TNO-KvL_Report_%20Assessment_Physical_Activity_Children1.pdf. Accessed August 2010.

some of the following steps are very similar as those applied to other concepts, so the descriptions will be abbreviated in subsequent sections of the report.

Electronic Search Keywords

"Motor Activity"[Majr] OR "Sedentary Lifestyle"[Majr] OR "Exercise"[Majr] OR "Exercise Therapy"[Majr] OR "Physical Education and Training"[Majr]

AND

"Health/statistics and numerical data"[Mesh] OR "Physical Fitness"[Majr] OR "Health Status Indicators"[Mesh] OR "Health Status/statistics and numerical data"[Mesh] OR "Risk Factors"[Mesh] OR "Diseases Category/prevention and control"[Majr] OR "Diseases Category/statistics and numerical data"[Majr] OR "Phenomena and Processes Category/prevention and control"[Majr] OR "Phenomena and Processes Category/statistics and numerical data"[Majr] OR "Overweight"[Mesh] OR "Bone density"[Mesh]

Note that, in order to provide as targeted a search as possible, Medical Subject Headings (MeSH) were applied, qualified by subheadings and whether or not it was a Major term (Majr) for the article.

The search for review articles ultimately returned a sufficient volume (see below) of papers to qualify for a Level A search process. As well, a selective approach to the supplementary search was deemed to be all that was necessary. This involved a scan in Google for grey literature and for any obvious articles missed, using terms such as: **(physical activity OR physical fitness) AND children AND health**. Finally, as the most recent systematic review of the association of physical activity with health was dated 2010, and included primary studies as recent as 2008, an update of the most recent studies was not pursued.

Taken together, the search processes returned 189 reviews for consideration.

Preliminary Exclusion

The 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 physical activity and physical health outcome(s), or if it was not about children, then it was excluded. When there was disagreement between the reviewers, the article in question was examined in more detail until a consensus was reached.

After completing this first exclusion process, the list of articles was reduced to 32.

Primary Exclusion

The full versions of the 32 reviews were divided between two researchers. Articles not pertinent to the research topic were excluded; specifically, if the article did not link physical activity with physical health outcome(s), or if it was not about children, it was excluded. Also excluded was any review that focused on a specific subgroup of children, such as those who were obese, African-American, etc., where there would be a limitation to the generalizability of results across the whole pediatric population in a jurisdiction such as British Columbia. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

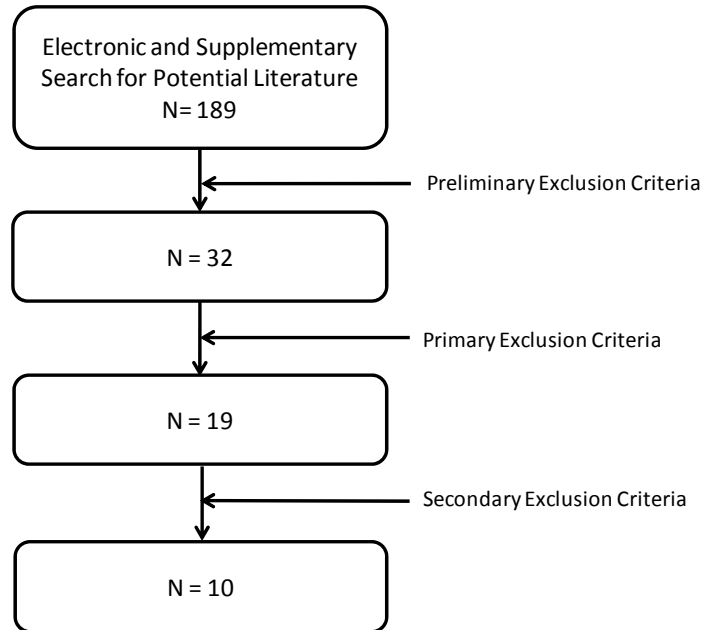
There were 19 reviews remaining in the list following the primary exclusion.

Secondary Exclusion

Studies and systematic reviews that were deemed to be of lesser quality or usefulness were excluded, yielding a final total of 10 reviews, as indicated in the following Volume Report.

Literature Review Volume Report

Dimension: Physical Health Concept: Physical Activity



The list of review papers are then identified in the table that follows.

Summary of Relevant Reviews

Domain: *Physical Health*

Concept: *Physical Activity*

	Title of Review	Lead Author	Year	Journal	Journal Impact Factor (2005)	Year Range of Studies	No. of Studies
Overweight							
1	Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review	Jimenez-Pavon	2010	International Journal of Pediatric Obesity	2.0 (2008)	2004-2008	48
2	Effect of school-based physical activity interventions on body mass index in children: a meta-analysis	Harris	2009	Canadian Medical Association Journal	7.4	1996-2007	15
3	Physical activity and abdominal obesity in youth	Kim	2009	Applied Physiology, Nutrition, and Metabolism	1.97 (2009)	1997-2008	38
4	Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence	Brown	2009	Obesity Reviews	7.82	1993-2007	38
5	Physical activity as a predictor of adolescent body fatness	Reichert	2009	Sports Medicine	3.33	1997-2007	24
Bone mineral density							
6	Weight-bearing exercise and bone mineral accrual in children and adolescents: A review of controlled trials	Hind	2007	Bone	3.94	1996-2005	22
General Health/Fitness							
7	After-School Program Impact on Physical Activity and Fitness A Meta-Analysis	Beets	2009	American Journal of Preventive Medicine	3.17	2003-2008	13
8	Inflammatory factors, physical activity, and physical fitness in young people	Thomas	2008	Scandinavian Journal of Medicine & Science in Sports	2.15	1996-2008	30
9	Adolescent Physical Activity and Health	Hallal	2006	Sports Medicine	3.33	2000-2004	13
10	Evidence based physical activity for school-age youth	Strong	2005	Journal of Pediatrics	3.84	1980-2005	---

Detailed Results

For the 10 reviews identified by the literature search and exclusion process, a summary table of results was developed; this table is provided below.

Summary Table of Review Papers

Lead Author	Review Title	Number of Studies Reviewed	Conclusions/Comments
Jimenez-Pavon (2010)¹	Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review	48	Review supports the hypothesis that higher levels of habitual physical activity are protective against higher levels of child and adolescent adiposity. However, prospective longitudinal studies using more precise methods of measuring body composition are warranted. There is a need for more research on younger children, in a wider variety of settings and populations, and for more dose-response evidence.
Harris (2009)²	Effect of school-based physical activity interventions on body mass index in children: a meta-analysis	18	School-based physical activity interventions did not improve BMI, although they had other beneficial health effects.
Kim (2009)³	Physical activity and abdominal obesity in youth	38	Limited evidence suggests that a high level of physical activity is associated with lower abdominal obesity, and that increased time spent in vigorous physical activities is independently associated with lower waist circumference and visceral fat. Engaging in regular aerobic types of exercise is associated with reductions in total fat and has a protective effect on age-associated increases in visceral fat in growing children and adolescents.
Brown (2009)⁴	Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence	38	School-based interventions to increase physical activity and reduce sedentary behaviour may help children to maintain a healthy weight but the results are inconsistent and short-term. Physical activity interventions may be more successful in younger children and in girls.
Reichert (2009)⁵	Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of the literature	24	Most studies showed protective effects of physical activity against adiposity, mainly in individuals who were obese at baseline. However, few studies are available, with limitations relating to a lack of validity in the measurement of physical activity and body composition. The literature offers only limited support for a causal link between physical activity and adiposity in adolescence.
Beets (2009)⁶	After-school program impact on physical activity and fitness	13	Although there a limited number of studies, results of this review suggest that after-school programs that include a physical activity component can be effective in improving physical activity levels, physical fitness, body composition, and blood lipid profiles of children and young adolescents.
Thomas (2008)⁷	Inflammatory factors, physical activity, and physical fitness in young people	30	The evidence for an inverse association between exercise and inflammatory factors in young people is inconsistent.
Hind (2007)⁸	Weight-bearing exercise and bone mineral accrual in children and adolescents: A review of controlled trials	22	Positive skeletal effects from weight-bearing exercise can be attained in girls and boys. Early puberty potentially represents an opportune maturity stage to augment bone mineral accrual through exercise, although definitive conclusions cannot yet be made. It remains unclear as to what constitutes the optimal exercise programme.

Lead Author	Review Title	Number of Studies Reviewed	Conclusions/Comments
Hallal (2006) ⁹	Adolescent Physical Activity and Health	13	There is consistent evidence that adolescent physical activity is positively associated with adult physical activity levels. Adolescent physical activity provides a long-term protective effect on bone health. Most evidence on the role of adolescent physical activity on breast cancer is positive.
Strong (2005) ¹⁰	Evidence based physical activity for school-age youth	Experts assessed a “long list” of 850 articles	Evidence-based data are strong for beneficial effects of physical activity on musculoskeletal health, several components of cardiovascular health, adiposity in overweight youth, and blood pressure in mildly hypertensive adolescents.

References for Summary Table

- ¹ Jimenez-Pavon D, Kelly J, Reilly JJ. Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *International Journal of Pediatric Obesity*. 2010; 5(1): 3-18.
- ² Harris KC, Kuramoto LK, Schulzer M et al. Effect of school-based physical activity interventions on body mass index in children: a meta-analysis. *Canadian Medical Association Journal*. 2009; 180(7): 719-26.
- ³ Kim Y, Lee S. Physical activity and abdominal obesity in youth. *Applied Physiology, Nutrition, and Metabolism*. 2009; 34(4): 571-81.
- ⁴ Brown T, Summerbell C. Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: an update to the obesity guidance produced by the National Institute for Health and Clinical Excellence. *Obesity Reviews*. 2009; 10(1): 110-41.
- ⁵ Reichert FF, Baptista Menezes AM, Wells JC et al. Physical activity as a predictor of adolescent body fatness: a systematic review. *Sports Medicine*. 2009; 39(4): 279-94.
- ⁶ Beets MW, Beighle A, Erwin HE et al. After-school program impact on physical activity and fitness: a meta-analysis. *American Journal of Preventive Medicine*. 2009; 36(6): 527-37.
- ⁷ Thomas NE, Williams DR. Inflammatory factors, physical activity, and physical fitness in young people. *Scandinavian Journal of Medicine & Science in Sports*. 2008; 18(5): 543-56.
- ⁸ Hind K, Burrows M. Weight-bearing exercise and bone mineral accrual in children and adolescents: a review of controlled trials. *Bone*. 2007; 40(1): 14-27.
- ⁹ Hallal PC, Victora CG, Azevedo MR et al. Adolescent physical activity and health: a systematic review. *Sports Medicine*. 2006; 36(12): 1019-30.
- ¹⁰ Strong WB, Malina RM, Blimkie CJ et al. Evidence based physical activity for school-age youth. *Journal of Pediatrics*. 2005; 146(6): 732-7.

Summary of Results

The reviews under the concept of physical activity (PA) were found to fall under several subcategories related to different aspects of pediatric physical health, including bone health, being overweight (including obesity, elevated adiposity, etc.) as both a disease and a risk, and general health (e.g., physical fitness). It is convenient to summarize the evidence under these three headings.

In the category of bone health, reviews indicated that there is in fact a beneficial effect of PA on skeletal health, as reflected in bone mineral content, bone mineral density, and bone mineral apparent density. Results further suggest that pre-pubertal children, or those in early puberty, are most likely to accrue these benefits, whereas the effect is not as clearly established for adolescents in later stages of puberty. One review, however, did find that there is a consistent long-term protective effect of adolescent PA on bone health.

Regarding the major health concern of overweight and related phenomena, there is limited evidence from review papers that habitual PA is protective against higher levels of adiposity in children and adolescents. One review found that a moderately intense regular exercise program for overweight children and adolescents resulted in a reduction in total body and visceral adiposity; however, such programs did not influence the percentage of body fat in normal weight children and adolescents.

In the general health/fitness category, reviews indicate that PA can be effective in improving physical fitness in children. With regard to cardiovascular risk factors, one review found strong evidence for a beneficial effect of PA on high-density lipoprotein cholesterol and triglyceride levels, as well as an effect of PA in reducing blood pressure in youth with mild hypertension. Another review focusing on the influence of adolescent PA on adult health found that most of the literature does not report a positive long-term impact of PA on risk factors for cardiovascular morbidity. In this same review, it was reported that most studies of PA in adolescence and adult female breast cancer risk find that such risk is reduced with increased PA.

Physical Activity Indicator Sources

There are several surveys that currently collect data on physical activity in children in British Columbia, as described below.

Canadian Community Health Survey

The Canadian Community Health Survey (CCHS) is a cross-sectional survey that collects information related to health status, health care utilization, and health determinants for the Canadian population.⁷ The target population is all Canadians aged 12 and over, with some exclusions.⁸ The CCHS relies upon a large sample of respondents, allowing it to provide reliable estimates at the health region level. The survey was launched in 2000, with data collection occurring every two years; data are available for the 2001, 2003, and 2005 periods.

⁷ Statistics Canada. Canadian Community Health Survey. Available at <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SurvId=3226&SurvVer=1&InstaId=15282&InstaVer=5&SDDS=3226&lang=en&db=imdb&adm=8&dis=2>. Accessed April 2010.

⁸ These include individuals living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions

In 2007, major changes were made to the survey design, and data collection now occurs every year.

The physical activity section of the survey asks questions regarding leisure time physical activity, including the type of activity, frequency, and duration. This allows for the proportion of the population meeting and not meeting recommended physical activity levels to be established. The most recent data for physical inactivity in B.C. adolescents is provided in the following table:

Physical Inactivity in British Columbia		
Aged 12 - 19, by Gender		
2009		
	Number of Individuals	Percent of Population
Males	36,679	17.7%
Females	61,879	30.6%
Total	98,558	24.1%
Source: Statistics Canada. <i>Cansim table 105-0501</i> . 2009.		

British Columbia Adolescent Health Survey

The Adolescent Health Survey (AHS) is designed to provide a comprehensive picture of the physical and emotional health of B.C. youth; it includes questions about perceptions of current physical and emotional health, risky behaviours, health promoting practices, and broader issues such as family connectedness, school safety, and peer relationships. The AHS asks youth to self-report their participation in at least 20 minutes of daily physical activity in the past week, as well as weekly involvement in sports/physical activities with and without a coach.⁹

The AHS was first conducted by the McCreary Centre Society in 1992, followed by three more surveys in 1998, 2003, and 2008. It is completed by B.C. public school students in grades 7-12; in the 2008 survey, 50 of 59 school districts participated, for a total of 29,440 students. Participation in the survey is voluntary, with parental consent procedures being determined by the individual school districts. The AHS is administered by trained public health nurses in classrooms, with funding provided by the Ministry of Children and Family Development and the Ministry of Health, with additional support from other government departments.

Health Assessment of School-Aged Children

Health Assessment of School-Aged Children (HASAC) is a project that aims to gather data on the nutrition, physical activity, smoking behaviour, and self-perception of grade 6 students

⁹ McCreary Centre Society. A Picture of Health: Highlights from the 2008 BC Adolescent Health Survey. Available at <http://www.mcs.bc.ca/pdf/AHS%20IV%20March%2030%20Final.pdf>. Accessed April 2010.

in B.C.¹⁰ The first year of the project was 2008, in which 17 schools participated; most recently, 19 schools took part in the 2009 assessment. The health assessment project is comprised of two parts:

- Student questionnaire, developed in collaboration with the Centre for Behavioural Research and Program Evaluation at the University of Waterloo. Students complete this questionnaire under the supervision of school staff.
- Height and weight measurements. Trained project staff people record each student's height and weight in private, away from the view of other students.

The project is managed by the Provincial Health Services Authority (PHSA) and funded by the Ministry of Healthy Living and Sport, PHSA and Child Health BC.

Discussion

There is strong research evidence that physical activity in children and youth has a positive effect on physical fitness. In other areas of health such as bone strength, cardiovascular disease risk profile, and maintenance of a healthy weight, some reviews indicate that physical activity in children and youth can have a positive effect, though the evidence is limited.

With regard to tracking physical activity levels, self-report of physical activity is most suitable for use at the population level as objective measures based on equipment such as accelerometers are labour-intensive and expensive to manage. Ideally, any inquiry tools would generate information regarding energy expenditure, frequency, intensity, duration, and type of physical activity of children and adolescents in a reliable, valid, and practical manner.¹¹ Unfortunately, most of the assessment tools that do exist have either unknown validity or clear limitations in terms of accuracy. The primary disadvantage with children's self-report of physical activity is poor memory recall; in general, children have difficulty recalling their physical activity behaviour over longer time periods, and this is especially a challenge for children younger than 10 years of age.¹² The reliability of survey results may therefore be limited.

There are several surveys that currently collect self-reported physical activity data among B.C. children, though each of these has limitations. The CCHS and AHS target adolescents, which is only one subset of the children and youth population. The AHS, which aims to survey all members of the cohort, has a high participation rate among B.C. youth. On the other hand, the CCHS also includes all ages over 12 years, but it is a cross-sectional survey building on a sample (rather than attempting to get information from all youth in the province); notably, it also explicitly excludes individuals living on Indian Reserves. HASAC is even more limited in scope, with only 19 schools reporting in the most recent application; as well, only grade 6 students are surveyed.

¹⁰ Health Assessment of School-Aged Children. Backgrounder 2009. Available at <http://www.phsa.ca/NR/rdonlyres/9529AC51-BE69-45D2-B623-04EB82DF5E71/0/HASACFactSheet0809.pdf>. Accessed April 2010.

¹¹ de Vries SI, Pronk MG, Hopman-Rock M et al. *Assessing Physical Activity in Children and Adolescents. A Review of Different Methods*. 2004. TNO. Available at http://www.tno.nl/downloads/TNO-KvL_Report_%20Assessment_Physical_Activity_Children1.pdf. Accessed August 2010.

¹² Kohl HW, Fulton JE, Caspersen CJ. Assessment of Physical Activity among Children and Adolescents: A Review and Synthesis. *Preventive Medicine*. 2000; 31: S54-S76.

Conclusion

While there are gaps in the research results, there appears to be adequate evidence supporting the tracking of physical activity as a useful pointer to pediatric physical health at the population level. The Adolescent Health Survey, with its high participation rate across the province, is a potential physical activity assessment tool for B.C. youth. In order to collect the most pertinent data, however, the physical activity portion of the survey could be modified. Information on the frequency, intensity, type, and duration of physical activity (similar to CCHS questions) would be valuable in terms of calculating overall levels to serve as an indicator among children in British Columbia. Expansion of the surveyed population to include grades 5 and/or 6 could be strategic; rationales for such a change include providing more comprehensive coverage of the pediatric population, and the fact that some authorities believe important lifestyle patterns have been set before children reach grade 7.

Systematic Review of Teenage Pregnancy Related to Physical Health

Background and Context

The purpose of this review is to find research evidence of an association between teenage pregnancy and child physical health. In this case, the “child” may refer to either the teenage mother or the infant. Teenage pregnancy rates in Canada have been declining since the mid-1970s. In 1995, the rate of pregnancies in females under age 20 was 40.2 per 1,000, compared to a rate of 24.6 per 1,000 in 2005. The rates were similar in British Columbia, translating to over 4,000 teenage pregnancies in 2005 in that province. The decline in this ten-year period coincided with a substantial increase in contraceptive use by sexually active teens. According to McKay and Barrett, such a decline may also reflect “greater access to reproductive health services, exposure to higher quality sexual health education, and/or a shifting of social norms in a direction that provides greater support for young women’s capacity to exercise reproductive choice.”¹³

Teenage pregnancy has been associated with a range of adverse health and socioeconomic outcomes; the focus in this report will be on physical health effects on the mother and/or the infant. Maternal risks identified with pregnancy at a young age include obstetric complications, sexually transmitted infections (STIs), urinary tract infections, pregnancy-induced hypertension, and premature death. Infant adverse outcomes potentially include low birthweight, preterm birth, increased risk of birth defects, and increased risk of death. A subject of much controversy in this area is the root cause of these increased health risks for mother or infant: Are they due to young maternal age per se (i.e., biologically caused), or are they an epiphenomenon of one or more variables commonly associated with teenage pregnancy, such as low socioeconomic status?

Methodology and Provisional Results

Review Search Process

For the electronic search for reviews in this area, the database used was PubMed, with the following limits:

Date: 2005-present *Language:* English *Subjects:* Human *Age:* 0-18 years*

Type of Article: Review, Meta-analysis

*While the protocol defines a child as 0-20 years of age, the search limit available in PubMed for All Child is 0-18 years, so this approximation was used.

Search Keywords

("Pregnancy in Adolescence"[Majr]) AND

("Health/statistics and numerical data"[Mesh] OR "Health Status Indicators"[Mesh] OR "Risk Factors"[Mesh] OR "Health Status/statistics and numerical data"[Mesh] OR "Physical

¹³ McKay A, Barrett M. Trends in teen pregnancy rates from 1996-2006: A comparison of Canada, Sweden, U.S.A, and England/Wales. *Canadian Journal of Human Sexuality*. 2010; 19(1-2): 43-52.

Fitness"[Majr] OR "Diseases Category/prevention and control"[Majr] OR "Phenomena and Processes Category/prevention and control"[Majr] OR "Diseases Category/statistics and numerical data"[Majr] OR "Phenomena and Processes Category/statistics and numerical data"[Majr] OR "Overweight"[Mesh])

It was determined from the search results (examining the 47 located papers) that there were no suitable reviews for this concept, so the decision was made to execute a “Level B” search process involving individual studies.

Study Search Process

A second electronic search was conducted for individual studies in this area. The database used was again PubMed, with the following limits:

Date: 2000-present *Language:* English *Subjects:* Human *Age:* 0-18 years*

Type of Article: Clinical Trial, Randomized Controlled Trial, Controlled Clinical trial.

The same search terms were used as in the review search process outlined previously. There were 43 studies identified in this search process.

*While the protocol defines a child as 0-20 years of age, the search limit available in PubMed for All Child is 0-18 years, so this approximation was used.

In addition to the above search method, the following searches were conducted:

- PubMed search using “Related citations” link
- A scan in Google for grey literature and for any obvious articles missed, using terms such as: **(teenage pregnancy) AND children AND health**
- Hand-searching bibliographies of key papers
- Checking for study updates (by author)

Taken together, the various search processes returned 70 articles for consideration.

Preliminary Exclusion

The 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 teenage pregnancy and physical health outcome(s), then it was excluded.

After completing this first exclusion process, the list of articles was reduced to 32.

Primary Exclusion

The full articles were then reviewed, with articles not pertinent to the research topic being excluded; specifically, if the article did not link teenage pregnancy with physical health outcome(s), it was excluded. Also excluded was any study that focused on a specific subgroup, such as African-Americans, or studies that did not take place in Western developed countries, where there would be a limitation to the generalizability of results across the whole pediatric population in a jurisdiction such as British Columbia. If there was uncertainty as to whether an article should be excluded, the reviewers discussed the matter further to reach a consensus.

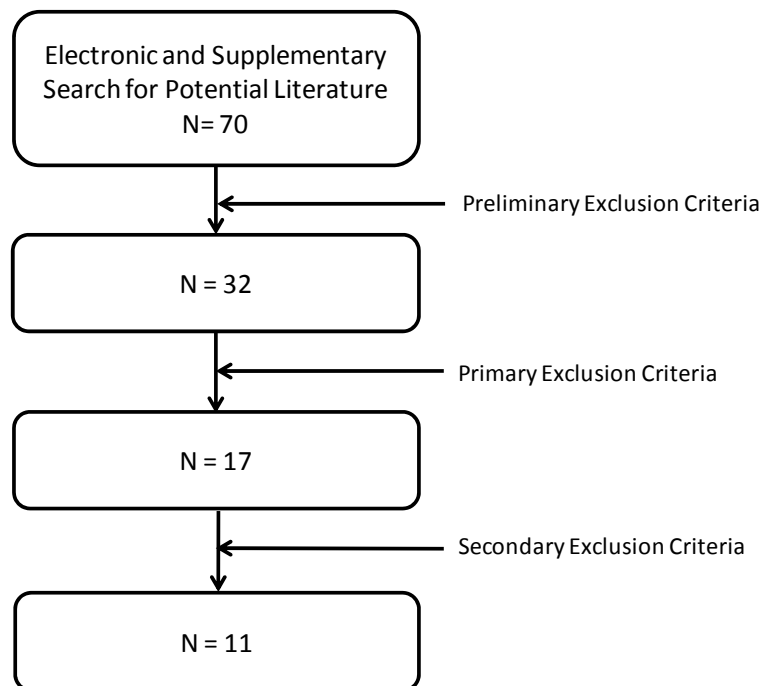
There were 17 articles remaining in the list following the primary exclusion step.

Secondary Exclusion

Studies that were deemed to be of lesser quality or usefulness were excluded. This secondary exclusion step yielded a total of 11 studies, as reflected in the following Volume Report and the subsequent table of results.

Literature Review Volume Report: Individual Studies

Dimension: Physical Health **Concept:** Teenage Pregnancy



Results After Applying Secondary Exclusion: Studies

Dimension: *Physical Health*

Concept: *Teenage Pregnancy*

Title of Study	Author(s)	Year	Journal	Journal Impact Factor (2005)	Type of Study	Sample Size	Sample Population	Location	Conflict of Interest
Maternal Health									
1 Premature death among teenage mothers	Otterblad Olausson et al.	2004	British Journal of Obstetrics and Gynaecology	2.17	Population-based cohort study	460,434	Swedish women born 1950-1964 who had their first infant before age 30	Sweden	Not Available
2 Excessive maternal weight gain patterns in adolescents	Howie et al.	2003	Journal of The American Dietetic Association	2.38	Population-based cohort study	2,796,805	Mothers delivering singletons	USA (excluding California)	Not Available
3 High postpartum rates of sexually transmitted infections among teens: pregnancy as a window of opportunity for prevention	Ickovics et al.	2003	Sexually Transmitted Infections	2.67	Prospective longitudinal study	411	Pregnant and non-pregnant adolescents	Connecticut, USA	Not Available
Infant/child Health									
4 Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study	Chen et al.	2007	International Journal of Epidemiology	4.05	Retrospective cohort study	3,886,364	Live singleton births to primiparae <25 years during 1995-2000	USA	Not Available
5 Teenage children of teenage mothers: Psychological, behavioural and health outcomes from an Australian prospective longitudinal study	Shaw et al.	2006	Social Science & Medicine	2.71 (2009)	Prospective study	5,260 mother-offspring pairs	Mothers with 14-year-old offspring	Australia	Not Available
6 Socioeconomic factors and adolescent pregnancy outcomes: distinctions between neonatal and post-neonatal deaths?	Markovitz et al.	2005	BMC Public Health	1.66	Retrospective cohort study	18,954 adolescent women/28,899 older women	Singleton births to women aged 12-17 years and 20-35 years	Missouri, USA	None Declared
7 Maternal age and non-chromosomal birth defects, Atlanta -- 1968-2000: Teenager or thirty-something, who is at risk?	Reefhuis et al.	2004	Birth Defects Research (Part A): Clinical and Molecular Teratology	1.55	Population-based cohort study	1,050,616	Singleton infants born after 20 weeks gestation, without chromosomal defects, with a mother 14-40 years of age	Atlanta, USA	Not Available
8 Young maternal age associated with increased risk of postneonatal death	Phipps et al.	2002	Obstetrics and Gynecology	4.17	Population-based cohort study	1,830,350	Singleton, first births to mothers 12 to 29 years old	USA	Not Available
Maternal and Infant/child Health									
9 How do pregnancy outcomes differ in teenage mothers? A Western Australian study	Lewis et al.	2009	Medical Journal of Australia	2.13	Cross-sectional descriptive analysis	4,896 singleton births (560 to teenage mothers)	Women with singleton pregnancies who delivered between June 2004 and September 2006	Western Australia	None Declared
10 Comparing pregnancy in adolescents and adults: Obstetric outcomes and prevalence of anemia	Briggs et al.	2007	Journal of Obstetrics and Gynaecology Canada		Retrospective chart review	207 adolescents and 415 adults	Patients of a single obstetrician who had a live singleton birth at ≥24 weeks' gestation	Canada	Not Available
11 Does young maternal age increase the risk of adverse obstetric, fetal and neonatal outcomes: A cohort study	de Vienne et al.	2009	European Journal of Obstetrics & Gynecology and Reproductive Biology	1.14	Retrospective cohort analysis	8,514 singleton births to primiparous women	Singleton births of primiparous women aged 14-30 years	France	Not Available

Detailed Results

For the 11 studies identified through the literature search and exclusion process, a summary table was developed, as provided below.

Summary Table of Primary Studies

Citation	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Maternal Health							
Otterblad Olausson et al. (2004) ¹¹	Investigate the relationship between maternal age at first birth and risks of total, as well as cause-specific, premature mortality	Follow up of all women born in Sweden from 1950 to 1964, registered in the 1985 Swedish Population and Housing Census, who had their first infant between 1964 and 1989, and before the age of 30 years	Sweden N=460,434 women born 1950-1964 who had their first infant before the age of 30 years	Population-based cohort study	-Maternal age at first birth -Socioeconomic status -Mortality rates by cause of death	Independent of socioeconomic background, teenage mothers faced an increased risk of premature death later in life compared with older mothers (rate ratio 1.6, 95% CI 1.4-1.9). After adjustment for pre-childbearing socioeconomic status, teenage mothers (compared with women aged 20-29 at first birth) faced a more than doubled risk of dying from cervical cancer; a doubled risk of dying from lung cancer; 10-fold increase in risk for death due to inflicted violence; and doubled or more than doubled risks for death due to ischemic heart disease, suicide, and alcohol-related causes.	Teenage mothers, independent of socioeconomic background, face an increased risk of premature death. Strategies to reduce teenage childbearing are likely to contribute to improved maternal and infant health.
Howie et al. (2003) ¹²	Examine the correlates of excessive maternal weight gain among adolescent mothers	Data from the Centers for Disease Control & Prevention 2000 natality file were analyzed to examine weight gain among adolescents (≤ 19 years) compared with their older counterparts (≥ 20 years)	United States N=2,796,805 births	Population-based cohort study	-Percentage of mothers with excessive weight gain (>40 lb) by maternal age and other maternal characteristics	Over 27% of adolescent mothers gained excessive weight during pregnancy, compared to 18% of their older counterparts. The association between young maternal age and weight gain was stronger for primiparous women than for multiparous women. Adolescents were more likely to gain excessive weight than their older counterparts in nearly all demographic categories (e.g., race).	Adolescents gain an excessive amount of weight during pregnancy compared with older women. Higher weight gains are associated with subsequent health risks for the mother, such as postpartum obesity, which can lead to serious health effects.
Ickovics et al. (2003) ¹³	Identify incidence and	Subjects were recruited from 10	Connecticut, USA	Prospective longitudinal	-Incidence of <i>C. trachomatis</i> and <i>N.</i>	Among pregnant teens, new infections of <i>C. trachomatis</i> and <i>N.</i>	Postpartum adolescents are particularly vulnerable to STI

Citation	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
	predictors of <i>Chlamydia trachomatis</i> and <i>Neisseria gonorrhoeae</i> infection among postpartum adolescents	community-based health clinics. Structured interviews and STI testing were conducted at baseline (third trimester for pregnant adolescents) and at 6 and 12 month follow-up visits (3 and 9 months postpartum for those pregnant at baseline).	N=411 (203 pregnant and 208 non-pregnant adolescents aged 14-19 years)	study -Structured, face to face interview that took 60-90 minutes to complete; included demographics, sexual history, and sexual risk behaviour -urine sample for testing for <i>C. trachomatis</i> and <i>N. gonorrhoeae</i>	<i>gonorrhoeae</i>	<i>gonorrhoeae</i> increased from 7.1% at the 6-month follow-up interview to 14.3% at the 12-month follow-up interview; among non-pregnant teens, new infections remained relatively stable over this time period. <i>C. trachomatis</i> and <i>N. gonorrhoeae</i> prevalence was 1.94 times higher among teens 9 months postpartum than among the comparison group of non-pregnant teens, controlling for baseline STI.	infection, most probably because of re-initiation of high risk sexual behaviour. Postpartum adolescents are a high risk subgroup needing additional attention to ensure follow-up screening and treatment.
Infant/Child Health							
Chen et al. (2007)¹⁴	Determine whether teenage pregnancy is associated with increased adverse birth outcomes independent of known confounding factors	Study data were derived from the 1995-2000 nationally linked birth-infant death data set of the United States, compiled by National Center for Health Statistics and Centers for Disease Control and Prevention	USA N=3,886,364 nulliparous pregnant women <25 years of age with a live singleton birth during 1995-2000	Retrospective cohort study	-Birth outcomes: Very pre-term delivery (live infant delivered at less than 32 weeks' gestation), pre-term delivery (live infant delivered at <37 weeks' gestation), very low birth weight (very LBW=live infant weighing <1500 g at birth), LBW (live infant weighing <2500 g at birth), birth weight < 10 th percentile for sex and gestational age (SGA), very low Apgar score at 5 min (<4), low Apgar score at 5 min (<7), and neonatal death (death of a live birth within 28 days) -Maternal alcohol use, tobacco use, and weight gain during pregnancy	The rates of all adverse birth outcomes were higher in teenage pregnancies. They consistently increased with decreasing maternal age, being highest among infants born to mothers aged 15 years or younger. Results were similar when the analysis was restricted to white married women with age-appropriate education level, adequate prenatal care, and without smoking and alcohol use during pregnancy, in other words, when controlling for some posited confounding factors.	Teenage pregnancy was associated with increased risks of very pre-term delivery, pre-term delivery, very LBW, LBW, SGA, and neonatal mortality, with a general tendency of poorer outcomes in younger teenagers. Restriction of the analysis to white married women with age-appropriate education level, adequate prenatal care, and without smoking and alcohol use during pregnancy did not change the results, suggesting that the increased risk of adverse birth outcomes for teenage pregnancy was less likely to be secondary to socioeconomic factors and prenatal care, and more likely intrinsic to the phenomenon of maternal youth.

Citation	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
Shaw et al. (2006) ¹⁵	Examine the associations of maternal age with outcomes among their 14-year-old offspring in terms of physical health, psychological, and behavioural characteristics	Subjects were participants in the Mater-University study of pregnancy (MUSP) and its outcomes, a prospective study of women and their offspring receiving antenatal care at a major public hospital in South Brisbane between 1981 and 1984. Mothers were interviewed pre- and post-birth, and the 14-year-old child was interviewed and physically examined.	Australia N=5,260 mother-offspring pairs	Prospective study -interviews with mother at the first antenatal clinic visit, 3-5 days after birth, 6 months after birth, 5 and 14 years after birth -physical examination of and interview with 14-year-old child	-Child psychological and cognitive behaviour -Health outcomes: self-report of poor health by the teen, maternal report of diagnosis of asthma, any fracture, any accidents requiring medical attention, and >2 admissions to hospital since birth	Maternal age was not associated with most physical health outcomes in the offspring at age 14 years; the exception was that dental fillings were more common among children of younger mothers. The evidence for other dimensions of well-being was more compelling; thus, 14-year-old offspring of mothers aged 18 years and younger at birth were more likely to have disturbed psychological behaviour, poorer school performance, poorer reading ability, been in contact with the criminal justice system, and become regular smokers and consumers of alcohol.	The only health outcome found to be associated with teenage motherhood was dental health. Results suggest that interventions aimed at reducing maternal poverty may be more effective ways of improving childhood outcomes (psychological, behavioural, health, cognitive) than those that focus on reducing the teenage birth rate.
Markovitz et al. (2005) ¹⁶	Investigate the relationships between infant mortality, socioeconomic status, and maternal age	Population-based cohort study using linked birth-death certificate data for Missouri residents during 1997-1999. Infant mortality rates for all singleton births to adolescent women were compared to those for older women.	Missouri, USA N=18,954 women 12-17 years; 18,954 women 18-19 years; 28,899 women 20-35 years	Retrospective population-based cohort study	Infant mortality rate: Neonatal (0-27 days) mortality and post-neonatal (28-364 days) mortality	The risk of infant, neonatal, and post-neonatal mortality were significantly higher for younger adolescent (12-17 years) than older (20-34 years) mothers. After adjusting for race, marital status, age-appropriate education level, parity, smoking status, prenatal care utilization, and poverty status, the risk of post-neonatal mortality but not neonatal mortality remained significant for younger adolescent mothers.	Socioeconomic factors likely account for most of the young mothers' increased risk of neonatal mortality, but (given the controls applied) not the increase in post-neonatal mortality risk. Further analysis suggests an increased risk of accidental and infectious deaths in these infants, raising questions of maternal maturity and ability to adequately supervise developing infants.
Reefhuis and Honein (2004) ¹⁷	Explore the association between maternal age and non-chromosomal birth defects to assess any	Birth defect cases were ascertained by the Metropolitan Atlanta Congenital Defects Program (MACDP).	Atlanta, USA N=1,050,616 singleton infants born after > 20 weeks gestation in metropolitan Atlanta from 1968-	Population-based cohort study	Birth defect categories (not involving chromosomal abnormality) associated with maternal age	Young maternal age (14-19 years) was lined to various birth defects, with the strongest association seen in gastroschisis (adjusted for parity, race, sex of the child, and the year of birth).	Women giving birth under 20 years and over 35 years are at increased risk of having a child with a birth defect. There may be some biological reasons why young mothers are at a higher risk for birth defects, but lifestyle factors (e.g., smoking) seem to be the most

Citation	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
	increased risk associated with maternal age (both younger and older)		2000 who did not have a chromosomal abnormality and whose mother was 14 to 40 years old				likely explanation.
Phipps et al. (2002) ¹⁸	Determine whether full-term, healthy infants born to early adolescent mothers (15 years old and younger) are at higher risk of postneonatal death compared with infants of adult mothers	Combined data from the comprehensive 1996 and 1997 United States Linked Birth/Infant Death data sets	United States N=1,830,350 singleton, first births to mothers 12-29 years old. Only “healthy” infants were included, defined by gestational age of 37 weeks or greater, birth weight of 2500 g or greater, and no congenital anomalies.	Population-based cohort study	-Postneonatal mortality rate (deaths more than 28 days after birth but within a year) -Risk of postneonatal death associated with maternal age, adjusting for race and several other factors	The postneonatal mortality rate for infants born to mothers 15 years old and younger was 3.2 per 1000, compared to 0.8 per 1000 for infants born to mothers 23-29 years old. After adjusting for maternal race or ethnicity, prenatal care utilization, and marital status, infants born to early adolescent mothers had a three-fold higher risk of postneonatal death compared with adult mothers.	Infants born to mothers 15 years old and younger are at increased risk of death within the first year after birth compared with infants born to older mothers. The increased risk remaining after adjustments is likely related to unmeasured social factors. Because many of these infant deaths may be preventable, developing and evaluating postnatal support services could have a dramatic effect on the postneonatal mortality rate.
Maternal and Infant/Child Health							
Lewis et al. (2009) ¹⁹	Determine whether teenage pregnancy and indigenous status are associated with increased risk of adverse pregnancy outcomes	Retrospective hospital-based study using computerized perinatal data	Australia N=4896 births (N=560 births to teenage mothers) to nulliparous women with singleton pregnancies who delivered after 22 weeks gestation between June 2004 and September 2006	Retrospective study using cross-sectional descriptive analysis	-Maternal risk factors, pregnancy characteristics, and obstetric and perinatal outcomes for teenage and adult pregnancies	Antenatally, teenagers experienced anemia, urinary tract infection, and pregnancy-induced hypertension more often than adults. They were more likely to smoke and came from more socioeconomically disadvantaged backgrounds. Their babies were at increased risk of having low Apgar scores, low birthweight, lower median birthweight at term, and stillbirth.	Smoking and nutritional status are modifiable factors in pregnancy; teenagers need special attention in terms of innovative, culturally appropriate system-wide services targeted at addressing these health issues in pregnancy.
Briggs et al. (2007) ²⁰	Characterize the obstetric outcome and prevalence of anemia in	Retrospective chart review of patients whose prenatal care was provided by a single	Ontario, Canada N=207 adolescents and 415 adults	Retrospective study	-Obstetric outcomes: mode of delivery, gestational age at delivery, infant birth weight, infant sex	Adolescents delivered babies with significantly lower birth weight than adults; more adolescents delivered preterm than adults. Maternal complication rates were similar	Although adolescents delivered infants with lower birth weight than infants born to adults, when factors such as smoking, BMI, anemia, and age were controlled,

Citation	Study Objective	Study Description	Setting/ Participants	Design/ Data Collection	Outcomes	Results	Conclusions/Comments
	primiparous adolescents, comparing them with older primiparous women.	obstetrician, and who had a live singleton birth at ≥ 24 weeks gestation between 1996 and 2004.			-Maternal complications: hypertensive disorders, UTI during pregnancy, anemia	between the two groups, except that adolescents were more likely to have a urinary tract infection during pregnancy than adults. Based on hemoglobin measurements at three time points during pregnancy, adolescents were more likely than adults to be anemic at entry into prenatal care and throughout pregnancy.	the difference was not significant. Results suggest that behavioural factors such as smoking rates, rather than maternal age per se, have the greatest impact on infant birth weight. Maternal age ≤ 19 years is an independent risk factor for anemia at 26 to 35 weeks gestation and pre-delivery. Future research focusing on strategies to influence potentially modifiable risk factors such as smoking and anemia will help in achieving the best possible outcomes for both adolescents and their older counterparts.
De Vienne et al. (2009) ²¹	Determine whether young maternal age is associated with increased risks of adverse obstetric, fetal and perinatal outcomes	Analysis derived from data of the computerized medical records system of a French University Hospital for the years 1994-2001	France N=8,514 singleton births of primiparous women aged 14-30 years	Retrospective cohort study	Maternal outcomes: anemia during pregnancy, preeclampsia, caesarean section, operative vaginal delivery, and post-partum hemorrhage. Perinatal outcomes: prematurity, LBW, birth weight >4000 g, admission to the neonatal ICU, and fetal death. For each outcome, adjustment was made for the following factors: ethnic origin, marital status, educational level, history of previous miscarriage or previous abortion, tobacco use, prepregnancy BMI, and prenatal care	Adjusted relative risk (RR) of anemia increased significantly with lower maternal age. Young maternal age was associated with decreased risks of adverse obstetric outcomes. Crude relative risks of prematurity, LBW, and fetal death increased with lower maternal age; after adjustment for confounding factors, only the association between fetal death and maternal age remained significant.	Younger maternal age was associated with increased risks of fetal death and anemia during pregnancy and lower risks of adverse obstetric outcomes, even after adjustment for confounding factors. The persistence of the effect after adjustment suggests a direct influence of maternal youth.

References for Summary Table

- ¹¹ Otterblad Olausson P, Haglund B, Ringback Weitof G et al. Premature death among teenage mothers. *British Journal of Obstetrics and Gynaecology*. 2004; 111(8): 793-9.
- ¹² Howie LD, Parker JD, Schoendorf KC. Excessive maternal weight gain patterns in adolescents. *Journal of The American Dietetic Association*. 2003; 103(12): 1653-7.
- ¹³ Ickovics JR, Niccolai LM, Lewis JB et al. High postpartum rates of sexually transmitted infections among teens: pregnancy as a window of opportunity for prevention. *Sexually Transmitted Infections*. 2003; 79(6): 469-73.
- ¹⁴ Chen XK, Wen SW, Fleming N et al. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. *International Journal of Epidemiology*. 2007; 36(2): 368-73.
- ¹⁵ Shaw M, Lawlor DA, Najman JM. Teenage children of teenage mothers: psychological, behavioural and health outcomes from an Australian prospective longitudinal study. *Social Science & Medicine*. 2006; 62(10): 2526-39.
- ¹⁶ Markovitz BP, Cook R, Flick LH et al. Socioeconomic factors and adolescent pregnancy outcomes: distinctions between neonatal and post-neonatal deaths? *BMC Public Health*. 2005; 5: 79.
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- ²¹ de Vienne CM, Creveuil C, Dreyfus M. Does young maternal age increase the risk of adverse obstetric, fetal and neonatal outcomes: a cohort study. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2009; 147(2): 151-6.

Summary of Results

A total of 11 studies were identified under the concept of teenage pregnancy that included pertinent research evidence regarding physical health outcomes. These studies fell under the subcategories of maternal health, infant/child health, and health in relation to both mother and offspring.

In the category of maternal health, certain studies found that: (i) teenage mothers face an increased risk of premature death, independent of socioeconomic background; and (ii) postpartum adolescents are at high risk for STI infection. For these two conclusions in particular, no direct causal link has been identified between the health outcome and teen pregnancy per se. In the Swedish study indicating increased risk of premature death, the authors found it unlikely that this increased risk was due to maternal age at first birth, but rather caused by unmeasured lifestyle-related factors (e.g., teenage mothers in Sweden include a much higher proportion of daily smokers during pregnancy than older mothers).¹⁴ As for increased rates of STI in adolescent mothers, this is likely due to re-initiation of high-risk sexual behaviours rather than some direct effect of the pregnancy.¹⁵ Other studies related to maternal health found that teenagers experienced anemia, urinary tract infection, and pregnancy-induced hypertension during pregnancy more often than older pregnant women. Whereas the study by de Vienne et al. drew a direct link between anemia and young maternal age, Lewis et al. indicated that smoking and poor nutritional status play a significant role in such health outcomes. Finally, the study by Howie et al. determined that adolescents gain an excess amount of weight during pregnancy compared with older women.¹⁶

In the 8 studies relevant to infant/child health, adverse outcomes associated with teenage pregnancy included: increased risks of fetal death, low birth weight, and pre-term delivery; elevated infant mortality; and more frequent birth defects. Only two of the studies concluded that maternal youth had a stronger association with these outcomes than socioeconomic and other factors.^{17,18} The remaining 6 studies all determined that socioeconomic, behavioural, and/or educational factors have the greatest impact on infant health in the cases where the mother is a teenager.

¹⁴ Otterblad Olausson P, Haglund B, Ringback Weitoft G et al. Premature death among teenage mothers. *British Journal of Obstetrics and Gynaecology*. 2004; 111(8): 793-9.

¹⁵ Ickovics JR, Niccolai LM, Lewis JB et al. High postpartum rates of sexually transmitted infections among teens: pregnancy as a window of opportunity for prevention. *Sexually Transmitted Infections*. 2003; 79(6): 469-73.

¹⁶ Howie LD, Parker JD, Schoendorf KC. Excessive maternal weight gain patterns in adolescents. *Journal of The American Dietetic Association*. 2003; 103(12): 1653-7.

¹⁷ de Vienne CM, Creveuil C, Dreyfus M. Does young maternal age increase the risk of adverse obstetric, fetal and neonatal outcomes: a cohort study. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2009; 147(2): 151-6.

¹⁸ Chen XK, Wen SW, Fleming N et al. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. *International Journal of Epidemiology*. 2007; 36(2): 368-73.

Teen Pregnancy Indicator Sources

There are two data sources from which teenage pregnancy rates in British Columbia may be extracted: Statistics Canada and the BC Adolescent Health Survey.

Statistics Canada

Statistics Canada provides annual data on Pregnancy Outcomes in Canada by Province. The data set can be restricted to those under 20 years of age, and be targeted to: *total pregnancies, live births, induced abortions, and fetal loss*. Each of these four outcomes is available as absolute numbers and as a rate per 1,000 females. The most recent data is for the year 2005, which was released in October of 2008. The following table summarizes the most current Statistics Canada data available for British Columbia:

Teenage Pregnancy in British Columbia, 2005		
	Total	Rate per 1,000 females
Pregnancies	4120	25.3
Live births	1338	8.2
Induced abortions	2727	16.8
Fetal loss	55	0.3

Source: Statistics Canada Cat. No. 82-224-XIE

Not allowing for the possibility of multiple pregnancies in one year, the 4,120 births to females under age 20 years in 2005 equates to approximately 1.6% of a modified cohort, specifically females aged 10-19 years in B.C. (on the presumption that no births happened in girls under 10 years of age).

The Statistics Canada website lists the status of the data set as Ongoing/Available despite the fact that it has been close to two years since the last release.¹⁹

BC Adolescent Health Survey

A British Columbia-specific data source for teen pregnancy data is the Adolescent Health Survey (AHS), first conducted by the McCreary Centre Society in 1992; the inaugural work is followed by three more surveys in 1998, 2003, and 2008.²⁰ It is designed to provide a comprehensive picture of the physical and emotional health of B.C. youth. The survey includes questions about perceptions of current physical and emotional health, risky behaviours, health-promoting practices, and broader issues such as family connectedness, school safety, and peer relationships. According to 2008 survey results, less than 2% of teenage males and females had experience; among sexually active students, 7% had been involved in a pregnancy (8% of males and 6% of females).

The AHS is completed by B.C. public school students in grades 7-12; in the 2008 survey, 50 of 59 school districts participated, for a total of 29,440 students. Participation in the survey is voluntary, with parental consent procedures being determined by the individual school districts. The AHS is administered by trained public health nurses in classrooms. Funding is provided by the Ministry of Children and Family Development and the Ministry of Health, with additional support from other government departments.

¹⁹ Available at <http://statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=82-224-XIE&land=eng>. Accessed September 2010.

²⁰ Available at <http://www.mcs.bc.ca/AHS>. Accessed September 2010.

Discussion

A wide range of adverse maternal and infant health outcomes has been identified with teenage pregnancy in the literature; while a few studies suggest that there is a direct link between such outcomes and maternal youth, many reports point more towards mediating social, economic, and behavioural factors to explain effects in both mothers and infants. The complex interaction of all of these factors and their relative importance with regard to teenage pregnancy and health is not well understood. As Cunningham remarks, “interventions aimed at reducing teenage pregnancy rates may have very little effect on the frequency of adverse medical outcomes in this population if the socio-economic and behavioural factors are not addressed.”²¹ Overall, the present review found that there is overall weak evidence for a direct, causal link between teenage pregnancy and maternal or infant adverse physical health outcome.

With regard to its utility as an indicator of child physical health, there are other issues that arise with respect to teenage pregnancy rates. First, not all teenage pregnancies result in a live birth. In fact, according to 2005 Statistics Canada data, over half of all teenage pregnancies in Canada (and in B.C.) ended in abortion.²² The teen pregnancy rate, then, does not provide a comprehensive measure of the number of live infants born to teenage mothers; thus, it is a very qualified representation of that category of potential adverse health outcomes. Furthermore, teenage pregnancy rates in B.C. are only tracked every 5 years in the Adolescent Health Survey, and the data collected is based on self-report and therefore open to question in terms of reliability. Although the Statistics Canada data would also be of use to evaluate teenage pregnancy rates in BC, the information is not current and it is not clear whether it will be consistently updated.

Conclusion

Although there appear to be various adverse health outcomes associated with teenage pregnancy, there is limited and weak evidence that these outcomes are directly linked to teenage pregnancy; confounding socioeconomic factors are more often identified as the causal force. Additionally, there is limited information available concerning teenage pregnancy rates in B.C.; by all accounts, however, the proportion of teenagers involved is small, albeit the absolute numbers of individuals with potential health effects may be 50% higher due to pregnancies brought to term. From a population health perspective, then, there is at best a weak rationale for using teenage pregnancy as a concept/indicator of child physical health. Links to other dimensions, such as mental/emotional health or economic/material well-being may be of more import and worthy of further investigation, but these are outside the scope of this review.

²¹ Cunningham AJ. What's so bad about teenage pregnancy? *Journal of Family Planning and Reproductive Health Care*. 2001; 27(1): 36-41.

²² Available at <http://statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=82-224-XIE&land=eng>. Accessed September 2010.

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