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NATURALIZED OUTDOOR PLAY AREAS AT SCHOOLS TO SUPPORT PHYSICAL ACTIVITY AND HEALTH – A RAPID EVIDENCE REVIEW

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EXECUTIVE SUMMARY

The health of individuals and communities is significantly influenced by complex interactions between social and economic factors, the physical environment, and individual behaviours and conditions.²⁹ In this context, a comprehensive approach to encourage and support physical activity is more than individuals developing awareness and skills; policy and supportive environments are also needed. As microcosms of the broader community, schools can be viewed in much the same way. School grounds represent an environment worthy of attention in school-based health promotion initiatives.²¹ It is anticipated that the findings from this review will be shared with local schools and school board stakeholders to raise awareness and inform or shape school ground greening plans, policies and related initiatives.

School ground greening, also referred to as naturalization, is a growing international movement. It involves transforming hard, barren expanses of turf and asphalt into places that include a diversity of natural and built elements.⁷ In this context, the authors of this review have defined naturalized school ground areas as forested areas and areas with shade trees, shrubs, gardens, logs, tree stumps, boulders, stepping stones, grassy berms, hilly terrain, rock amphitheaters, wildflower meadows, and loose parts (e.g. twigs, sand, pine cones). The main focus of this review is on health from a physical activity perspective. The research question for this review is: How does schoolyard / ground greening / naturalization affect the health of school-aged children 4 to 12 years?

An evidence search of several databases was conducted; this included Ovid MEDLINE, Ovid EMBASE, PubMed PsycINFO, and Health Evidence. In addition to Google Scholar, a hand-search was completed on the following websites: Evergreen, the Children and Nature Network and Back to Nature. The authors divided and independently screened the titles and abstracts, and full-text documents from the search. Seventeen published studies were determined to be suitable for a full critical appraisal of methodological quality. One study was removed due to a low rating of methodological quality. Studies pertaining to active play, physical literacy, sedentary behaviour and physical activity intensity and duration within the context of naturalized outdoor areas in school settings were included.

Five themes emerged following the authors' critical review and data extraction from the included 16 articles. The themes are: Physical Activity Quality – Intensity and Duration; Diversity and Quality of Play; Age and Gender Variations; Interest, Ability and Inclusiveness; Sedentary Behaviour and Physical Literacy. Additional benefits also reported within these studies that fell outside of the inclusion criteria were captured as well.

The authors of this review agree that there are complex causal pathways between environmental factors and human behaviors such as physical activity which are not yet fully understood.⁸ However, the body of literature associating school environment factors to child and youth physical activity outcomes is growing.⁸ When the scope within the literature is narrowed specifically to naturalized/greened schoolyard features (as with this review) the strength of evidence is further limited as more scientific research is needed. Collectively

however, the evidence in this review is promising as it appears to reveal similar findings in terms of the themes which emerged, suggesting potential associations with schoolyard greening/naturalization. Overall, it is agreed that school grounds are an obvious setting where health, education and environmental design issues overlap, and where inter-sectoral collaboration would be of benefit.²¹ It is in the interest of the design experts, school planners, and public health professions, as well as in the interest of communities and students, to engage in and inform policy and leadership decisions.⁸ A transdisciplinary process can be successful in focusing a particular school design project on a student's physical activity and health outcomes, in conjunction with learning outcomes.⁸ The findings realize the need for assessment of existing schoolyard conditions for potential enhancement with naturalized features that will promote and support the active play interests and abilities of all ages and genders. Traditional/conventional school grounds have their limitations in promoting physical activity in large part because many children are not interested or able to play in vigorous, rule-bound activities.²⁰

- **Green/ naturalized school grounds:**

- represent a promising means of getting more children moving in ways that promote physical, social and cognitive health at the same time;⁷
- encourage children to get moving in ways that nurture all aspects of their health and development;²⁰
- play a significant role in promoting physical activity—especially moderate and light levels of activity;²¹
- support active play for longer periods of time;¹⁷
- can improve motor development¹⁷ which is related to physical literacy;
- provide more affordances for functional play (running, climbing rocks, sliding down slopes) in addition to constructive and symbolic play (playing house, pirates);¹⁶
- provide a diversity of spaces that better accommodate the play interests and abilities of all students;²²
- foster more welcoming settings for a diversity of children to engage in active play;²⁰
- may contribute to maintaining physical activity levels among girls, those less inclined to participate in competitive rule-bound games, and younger children;^{12,20,21,23}
- can heighten student environmental awareness and stewardship;^{14,22}
- can provide shade, create cooler and more comfortable play and learning environments;²² and
- can create opportunities for student leadership.¹⁴

To make the most of the outdoor free time students have throughout the school day, and to potentially support outdoor classroom initiatives, the authors of this review propose and cite the following recommendations pertaining to school ground greening/naturalization as

comprehensive school-based strategies to promote health generally and physical activity specifically.²⁰

Planning and Development:

- Focus school design projects on student physical activity and health outcomes, in conjunction with learning outcomes.⁸
- Develop naturalized play areas that connect children with nature and increase opportunities for physical activity to complement conventional/traditional schoolyard features.
- Balance perceptions of risk and safety on school grounds to provide children with appropriately challenging and enticing natural environments.¹⁶
- Review site plans to allow students the maximum amount of direct interaction with green/naturalized space.²²
- Ensure master plan designs and school-initiated projects incorporate practical, sustainable and engaging design elements as well as long-term maintenance plans.²²

Advocacy:

- Advocate for resources to establish and support research, policies and programs aimed at developing healthy outdoor environments for children.²¹
- Elevate the importance of green/naturalized school grounds in terms of funding priorities.²²

Education and Training:

- Organize professional development workshops and hands on learning for educators.
- Engage parents/caregivers in learning about the importance of active outdoor play.
- Utilize relevant aspects of the curriculum to support student learning about the relationship between the natural environment and health.

Collaboration:

- Engage students, parents, community stakeholders in school ground greening/naturalization initiatives, including plans for maintenance.
- Explore opportunities for support from public health.

Policy:

- Officially recognize at a policy level the broad health benefits of green/naturalized school grounds.²¹
- Ensure school ground design standards and supervision policies foster and support opportunities for physical activity on school grounds.²⁰
- Explore policy development regarding school-community partnerships to promote physical activity.⁸

- Develop a plan to measure policy implementation and ensure school community involvement.²⁰

BACKGROUND

Because societies are complex and interrelated, health cannot be separated from other goals.¹ The inextricable links between people and their environment constitutes the basis for a socio-ecological approach to health.¹ The health of individuals and communities is significantly influenced by complex interactions between social and economic factors, the physical environment, and individual behaviours and conditions.²⁹ In this context, a comprehensive approach to encourage and support physical activity is more than individuals developing awareness and skills; policy and supportive environments are also needed. As microcosms of the broader community, schools can be viewed in much the same way.

The Ontario Ministry of *Education Foundations for a Healthy School* resource is designed to help contribute to a learning environment that promotes and supports child and student well-being – one of the four core goals in Ontario’s renewed vision for education. This goal emphasizes the need to focus not just on academic success, but also on the whole child and student– their cognitive, emotional, social, and physical development. The research is clear: healthy students are better prepared to learn, and education is a key determinant of health. Elevating well-being as a goal for education in Ontario recognizes its fundamental importance to our learners and their futures.²⁸ The Foundations for a Healthy School supports the integration of healthy schools policies, programs and initiatives into school and school board planning and implementation processes. The resource aligns with the *K-12 School Effectiveness Framework* (K-12 SEF) by including five interconnected areas that relate closely with the components of the K-12 SEF: Curriculum, Teaching and Learning; School and Classroom Leadership; Student Engagement; Social and Physical Environments; and Home, School and Community Partnerships.²⁸

School grounds represent an environment worthy of attention in school-based health promotion initiatives.²¹ As children and youth spend a large proportion of their waking hours in school, this environment represents multiple opportunities to promote and facilitate physical activity.² There is evidence that more physical activity offerings at school are associated with more active children and youth.² In addition, studies reveal that people who are more connected to nature tend to be happier.² Positive experiences in nature at a young age are important for fostering nature connectedness.² These experiences can influence one’s tendency to connect with nature and, subsequently, behaviours like time spent outdoors and moderate-to-vigorous physical activity.²

The Canadian Physical Activity Guidelines recommend children and youth participate in a variety of physical activities that support their natural development, and are enjoyable and safe. For health benefits, children aged 5-11 years and youth aged 12-17 years should accumulate at least 60 minutes of moderate-to-vigorous-intensity physical activity daily.⁴ However, the majority of school-aged children and youth are not getting enough physical activity to meet the current

Canadian Physical Activity Guidelines. In school-aged children and youth between the ages of 5 and 17, only 13% of boys and 6% of girls were getting an average of at least 60 minutes of moderate-to-vigorous physical activity daily as recommended in the Guidelines.⁵ Regular physical activity helps build and maintain healthy bones and muscles, reduces the risk of obesity and chronic diseases, reduces feelings of depression and anxiety, and promotes psychological well-being.²⁷

PURPOSE

The Ontario Public Health Standards establish requirements for fundamental public health programs and services, which include assessment and surveillance, health promotion and policy development, disease and injury prevention, and health protection. The Ontario Public Health Standards outline the expectations for boards of health, which are responsible for providing public health programs and services.²⁹ Within the *Standards*, the goal for chronic disease prevention includes a requirement that the board of health shall work with school boards and/or staff of elementary, secondary, and post-secondary educational settings, using a comprehensive health promotion approach, to influence the development and implementation of healthy policies, and the creation or enhancement of supportive environments to address several topics including healthy weights, healthy eating, physical activity, and exposure to ultraviolet radiation.²⁹

As such, it is the interest and mandate of the Simcoe Muskoka District Health Unit's (SMDHU) Unit's Chronic Disease Prevention – Healthy Lifestyle Program to collaborate with schools and school boards on these topics.

The impetus for this review occurred in stages. Initially, during a staff in-service, the SMDHU Healthy Schools Team shared details from the 2013 local school climate surveys in which students had identified the need to address the lack of shade at their schools.

Subsequently in 2015, ParticipACTION released the annual report card on the physical activity levels of Canadian children and youth.⁶ For the first time, the report card took a stand on play in nature and the outdoors—with its risks—and includes a Position Statement on Active Outdoor Play. The Statement was developed by the Healthy Active Living and Obesity Research Group at the Children's Hospital of Eastern Ontario Research Institute, ParticipACTION and a group of 12 other organizations, and was supported by over 1,600 stakeholders from across Canada and around the world.⁶ The following is cited from the Position Statement and the Report Card:

Access to active play in nature and outdoors—with its risks—is essential for healthy child development. We recommend increasing children's opportunities for self-directed play outdoors in all settings—at home, at school, in child care, the community and nature.²⁶

It may be no surprise that outdoor time is good for kids—but in wanting them to be safe outdoors, we sometimes over-supervise their play. Kids are more active when they have some freedom to roam and take risks. For example, 3 to 5 year-old kids are less likely

to be active on playgrounds that are designed to be “safer,” because many kids equate less challenging with boring. What many parents recall from their childhoods as thrilling and exciting play is often called “risky play” these days. These are the active games and independent play that tested boundaries and included things like exploring the woods, rough housing, moving fast or playing at heights. This is not to suggest that children be reckless, but to recognize that some risk is actually good for kids. Adventure playgrounds and loose parts playgrounds, which support some exposure to “risky” elements, lead to an increase in physical activity and decrease in sedentary behaviours. While physical activity injuries to children are common—from all forms of physical activity and not just risky play—the vast majority of these injuries are minor. We need to give kids the freedom to occasionally scrape a knee or twist an ankle. Their long-term health should be valued as much as safety. We need to consider the possibility that rules and regulations designed to prevent injuries and reduce perceived liability consequences have become excessive, to the extent that they actually limit rather than promote children’s physical activity and health. Adults need to get out of the way and let kids play.⁵

As a result, in 2015, staff in the Chronic Disease Prevention-Healthy Lifestyle Team initiated an informal environmental scan in consultation with the health unit’s Healthy Schools Team to assess whether local schools had initiatives underway such as school ground greening projects, outdoor classrooms, or other activities related to schoolyard naturalization. A number of relevant local school and school board initiatives were identified. During this time, staff from the Healthy Lifestyle Team undertook this review with the goal to gather research evidence to inform local decision-making about the relationship between naturalized outdoor elements on school sites and the potential impacts on student health--mainly from the perspective of physical activity.

Physical activity is defined by the World Health Organization as any bodily movement produced by skeletal muscles that require energy expenditure.³ In childhood, active play is a key source of physical activity, also contributing to physical literacy development and reducing sedentary/inactive time. Active play has been defined as unstructured, child-led and often spontaneous physical activity which is perceived as enjoyable by the child, often occurring outdoors.⁹ As such, studies pertaining to active play, physical literacy, sedentary behaviour and physical activity intensity and duration within the context of naturalized outdoor areas in school settings are included for the purpose of this review.

It is anticipated that the findings from this review will be shared with local schools and school board stakeholders to raise awareness and inform or shape school ground greening/naturalization plans, policies and related initiatives such as outdoor classrooms.

DESCRIPTION OF NATURALIZED AREAS

School ground greening, also referred to as naturalization, is a growing international movement. It involves transforming hard, barren expanses of turf and asphalt into places that include a diversity of natural and built elements, such as shelters, rock amphitheatres, trees, shrubs, wildflower meadows, ponds, grassy berms and food gardens.⁷ In the context of this rapid review, the authors have similarly defined naturalized school ground areas as shade trees, forested areas, shrubs, gardens, logs, tree stumps, boulders, stepping stones, grassy berms, hilly terrain, rock amphitheatres, wildflower meadows, and loose parts (e.g. twigs, sand, pine cones). Where appropriate, naturalized areas could also include trails or small spaces like dens and separated areas off limits to open play without adult supervision (e.g. wetlands for educational purposes). Manicured grass/turf sports fields is not the type of greening/naturalization intended as the focus of this review. It is also relevant to indicate that this concept of greened/naturalized areas is referred to as a 'forest school' in some regions.

RESEARCH QUESTION

The following PECO (population, exposure, comparison, outcomes) research question was developed in June 2015 to guide this review:

How does schoolyard / ground greening / naturalization affect the health of school-aged children 4 to 12 years?

P = elementary school-aged children (4-12 years)

E = schoolyard or school ground greening / naturalization

C = the usual / no schoolyard or school ground greening / no naturalization

O = health impacts in relation to physical activity and sun safety

INCLUSION - EXCLUSION CRITERIA

Include: PECO criteria (as above), English language studies, published and unpublished research studies (from 2005 to 2015).

Exclude: Animal research, manicured grass/turf-like playing fields without the naturalized landscape features (as described above).

EVIDENCE SEARCH METHODOLOGY

With the research question and inclusion and exclusion criteria, the authors utilized the SMDHU librarian to begin a search for both published and unpublished studies in July 2015. An initial search of the following databases occurred: Ovid MEDLINE (**Appendix C**), Ovid EMBASE (**Appendix D**), PubMed (**Appendix D**), PsycINFO (**Appendix D**) and CINAHL (**Appendix C**).

A second search was completed by the SMDHU librarian in August 2015 within Google Scholar using the search terms school + ground + greening (**Appendix F**). Then an additional search of Google Scholar was initiated using the term school + playground + shade structures trees (**Appendix F**).

Based on the limited number of results evident in the search to this point, the original date parameters (2010 to 2015) used to guide the initial search strategy were expanded to 10 years so any additional articles could be considered if published from the year 2005 to present.

The third phase, a hand search, was conducted by the authors from October to December 2015. This included a review of references within the published articles and the grey literature collected to date, as well as a search of websites for the following organizations: Evergreen - <http://www.evergreen.ca/get-involved/resources/school-ground-greening/>, the Children and Nature Network - <https://www.childrenandnature.org/research/> and Back to Nature - <http://www.back2nature.ca/resources-research/>. Additional articles were obtained through the Ontario Public Health Association Built Environment Listserv as well as those provided by an individual employed at Evergreen. The authors also became aware of potentially relevant articles from a separate search of Health Evidence (**Appendix G**) and Ovid MEDLINE (**Appendix H**) completed by a SMDHU librarian in November 2015 for a different SMDHU initiative on the topic of the built environment and physical activity. The librarian initiated this preliminary search specifically for review articles and guidelines. The terms used in those searches were: systematic review, built environment, physical activity and obesity. Overall, all potentially relevant hand-searched documents from aforementioned processes were initially screened using the title and abstract. At the conclusion of the evidence search, the authors proceeded with a more detailed relevance assessment.

RELEVANCE ASSESSMENT

As evidence reviewers, the authors of this review divided and independently screened the titles and abstracts, and full-text documents where necessary from the search. Seventeen published studies were determined to be suitable for a full critical appraisal of methodological quality.

Any uncertainties that surfaced throughout this process were discussed between the reviewers and decisions were made by consensus. One key decision was to eliminate the grey literature obtained as it was not apparent the information was based on a specified study. As such, the quality of this particular grey literature could not be assessed as research evidence. The grey literature eliminated included website articles and narrative summary reports or book chapters written from an individual perspective.

Another factor that required reviewer discussion and agreement pertained to the few published studies addressing shade or ultraviolet radiation exposure as key outcome of schoolyard naturalization. Although sun safety was originally included as part of the evidence search for this review, it was decided that physical activity (and subcategories pertaining to physical activity such as active play, physical literacy, sedentary behaviour) would be the key health

related outcome and the focus of studies considered for inclusion. Any other health or child development outcomes, also part of an included study, are considered supplementary information (e.g. sun exposure, safety, social and mental health, cognitive development, environmental consciousness etc.) and are reported in the Other Benefits section of this review. While recognizing that all of these supplementary factors are intrinsically linked to the overall health, wellbeing and child development, it is beyond the scope of this review to have explored the literature from this multifaceted perspective. It is also relevant to have included some sun safety/shade information and potential resources for schools because local students had identified the need for shade, and that sun protection can result from shade trees, and that participation in physical activity is more likely if the outdoor temperature is not too hot.

Figure 1 depicts the numerical results of the literature search and relevance assessment.

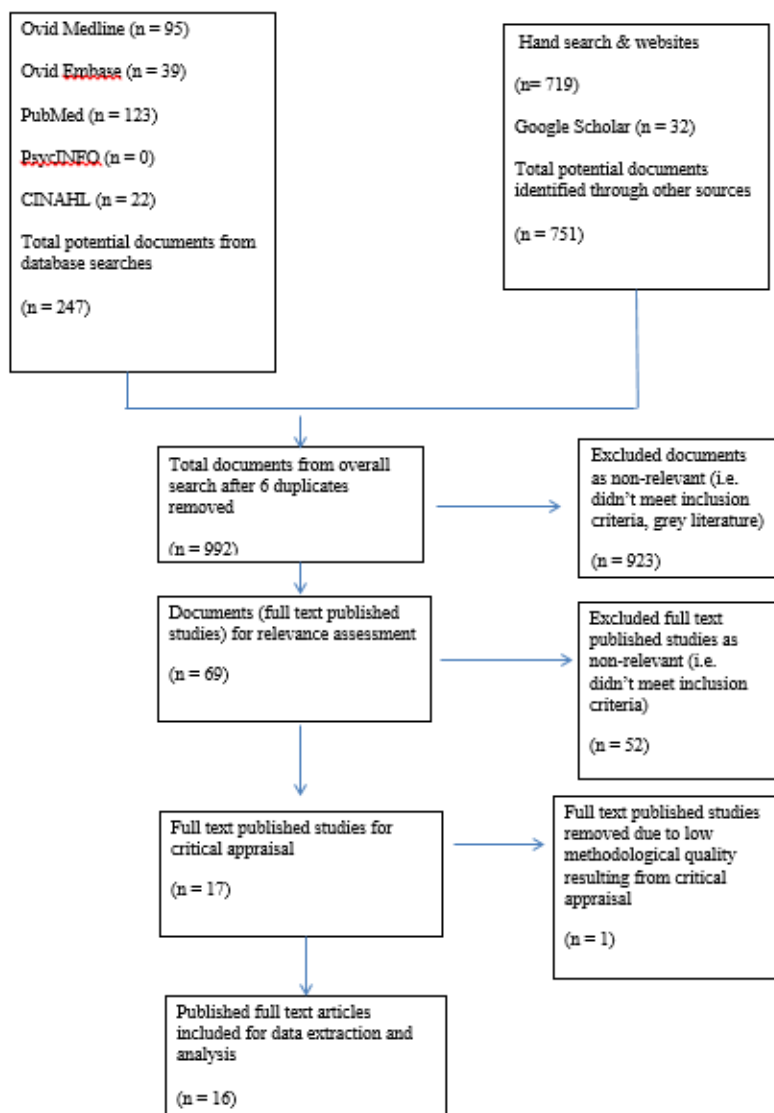


FIGURE 1 – LITERATURE SEARCH & RELEVANCE ASSESSMENT FLOW DIAGRAM

CRITICAL APPRAISAL OF RELEVANT STUDIES

A total of 17 published research studies were assessed for methodological quality according to standardized critical appraisal instruments. These tools included: *AMSTAR* for systematic reviews, *National Collaborating Centre for Environmental Health: A Primer for Evaluating the Quality of Studies on Environmental Health Critical Appraisal of Cross-Sectional Studies* for the cross-sectional studies that were included, *CASP Qualitative Checklist* for the studies with a qualitative component, *AGREE II* tool for the one guideline that was included, and *CASP Cohort Study Checklist* for the cohort studies.

Upon completion of the critical appraisals, 16 published articles were accepted for data extraction and analysis because they were at minimum of moderate methodological quality. For mixed methods research studies, two critical appraisal tools were utilized to enable assessment of each of the quantitative and qualitative aspects of the study. In this situation, the authors of this review decided to include the study if one of the rankings was at minimum of moderate methodological quality even if the other tool used revealed weak methodological quality. Overall, one study was eliminated due to weak methodological quality.

Refer to **Appendix A** - Critical Appraisal Tools used and Criteria for Ranking Methodological Quality

Refer to **Appendix B** – Chart - Description of Included Studies

EVIDENCE REVIEW FINDINGS AS THEMES

Five themes emerged following the authors' critical review and data extraction from the included 16 full text articles: Physical Activity Quality; Diversity and Quality of Play; Age and Gender Variations; Interest, Ability and Inclusiveness; as well as Sedentary Behaviour and Physical Literacy. Other benefits also reported within these studies that fell outside of the inclusion criteria were captured in the Other Benefits section of this review because they offer insight to other important considerations related to child play in naturalized environments.

Physical Activity Quality – Intensity and Duration

Pagels et al. (2014) describe a steep decline in physical activity between the second and eighth grade which corresponds with other research findings. Increasing the amount of time children spend outdoors has been recommended as a promising strategy for increasing children's physical activity levels.¹⁰ Play where children can get lost in risky play supportive environments are positively associated with physical activity.¹⁰ Brussoni et al. (2015) define risky play as thrilling and exciting play that can include the possibility of physical injury. The quality of play spaces, determined by factors such as the presence of natural elements (trees, plants), materials that can be manipulated by the children (e.g. wood, crates) and the freedom to engage in activities of their choosing influenced children's interest in playing there.^{10, 11, 17} These environments also promote increased play time.¹⁰

Conventional school grounds that consist primarily of open expanses of turf and asphalt do offer opportunities for vigorous activities in rule-bound games like basketball, tag and soccer.¹⁷ Dymont et al. (2009) also found that children were engaged in vigorous physical activity on manufactured equipment. However, conventional school grounds have their limitations in promoting physical activity in large part because many children are not interested or able to play in vigorous, rule-bound activities.²⁰ In such cases, these children are relegated to the sidelines.²⁰ The results of the study by Dymont and Bell (2007) indicate that green school grounds can play a significant role in promoting physical activity. A different pattern of activity emerges on greened areas of school grounds; they tend to support more moderate and light activity than vigorous activity.¹⁹ Bell and Dymont (2006) described that approximately half of all study participants reported that green school grounds promote 'more' or 'much more' moderate and light physical activity among individuals who are typically disadvantaged on conventional school grounds.²¹ During a seven hour day, green outdoor environments with high play potential can add 1500 to 2000 steps of movement.¹⁵ Recent studies suggest that even moderate levels of physical activity can reduce the risk of obesity.²⁰

Although the majority of findings from the included studies referred to light to moderate physical activity outcomes in greened/naturalized environments, there were a couple of notable exceptions where girls and younger children were also moving at moderate-to-vigorous intensity levels.^{12, 21} This is further described under the Age and Gender Variations theme within this report.

Overall, twelve articles based on seven separate studies, one set of guidelines and two systematic reviews included in this review identified factors related to the impact of schoolyard greening/naturalization on physical activity quality, intensity (i.e. light, moderate, vigorous) and duration (i.e. time). The evidence reveals that in greened/naturalized environments, children are, in general, actively playing for longer periods of time at mostly light to moderate physical activity levels which is advantageous to their health. This is noted in particular for students who tend to not get involved in competitive games.¹⁷

Diversity and Quality of Play

In addressing overweight and obesity, it is important to provide children with enjoyable, non-competitive play opportunities as well as opportunities to integrate physical activity into their daily lives.⁷ Emerging in the health literature is a call to increase the range of enjoyable, non-competitive physical activities for children.²⁰ Green school grounds encourage more active play, support a wider variety of play activities and promote a better integration of physical activity into school life generally.²⁰ Participants of one study noted that green school grounds positively influenced many aspects of play, reporting an increase in cooperative and collaborative play (73%), and an increase in the diversity of play (76%).²² Whereas barren spaces and manufactured play equipment on conventional school grounds supported repetitious patterns of behaviour, the nooks and crannies created by the rocks, shrubs and trees on green school grounds invited exploration and imaginative play.²² Many participants in this study concurred with this viewpoint, noting that prior to greening, the school ground favoured the play activities of

boys who dominated large open spaces with aggressive, competitive, rule-bound games such as hockey, baseball and soccer.²² Participants described how the transformed school ground provided a diversity of spaces that better accommodated the play interests and abilities of all students.²²

Ridgers et al. (2012) noted as well that activities undertaken in a forest school stimulated this imaginative play within the natural environment outside of school hours, particularly with boys. Greening/naturalization has the ability to temper social dynamics of control and dominance by diversifying play opportunities, providing opportunities for non-competitive, open-ended play and foster more civil and cooperative behaviour.

The diversity of the natural environment can meet children's needs for a stimulating and varied play environment, whereby the type, creativity and inventiveness of play is closely related to environmental features.¹⁴ Sticks, leaves, stones, sand, mud and other natural materials were reported in the study by Dennis et al. (2014) to support longer engagement, more cooperation, and a wider variety of play behaviours compared with more traditional play materials. Brussoni et al (2015) noted that the studies in their systematic review suggest the quality of play spaces is determined by factors such as the presence of natural elements and materials that can be manipulated by children, and the freedom to engage in activities of their choosing.

Overall, nine articles based on six separate studies and one set of guidelines included in this review identified factors related to the importance of naturalized/green school grounds to support a range of diverse play options (e.g. non-competitive, cooperative, inclusive, active, open-ended, unorganized/free, explorative, pretend, social, stimulating, imaginative, creative, inventive, and constructive). In this way, green school grounds can play a significant role in promoting physical activity—especially moderate and light levels of activity.²¹

Age and Gender Variations

Some studies have demonstrated that traditional/conventional school ground elements (fixed play equipment, asphalt and ball fields) reinforce gender-differentiated play.¹⁶ This is supported by the study by Dymont (2005) as participants described how the transformed schoolyard with more naturalized/greened elements provided a diversity of spaces that better accommodated the play interests and abilities of both girls and boys. Obviously, the play patterns of girls and boys are far more complex than such broad generalizations imply as there are girls who want to run and play active games and boys who want to engage in quieter activities, so the authors of this report agree with Dymont that it's important not to reinforce simplistic gender stereotypes.²² However, there are notable and consistent differences related to gender and age which emerged from the collection of studies in this review. As Dymont (2005) points out, identifying these differences simply reinforce the value of offering a diversity of spaces to accommodate a range of active and quiet play activities, irrespective of gender. The authors of this report also include age from this same perspective.

With respect to gender, the majority of conventional school grounds comprised of asphalt and open playing fields cater primarily to boys, older students and those with high physical competence.²¹ However, conventional school grounds do little to promote moderate or vigorous physical activity for many girls.¹⁷ On these spaces girls are often engaged in sedentary behaviour.^{17, 21} Although green landscapes are desired options for play in both genders, boys have shown preference for landscape features like boulders and dens whereas girls have shown preference for wildflowers, trees and shrubs, swings/play equipment and a flower or vegetable garden.^{16, 18} Girls tend to play in those areas not dominated by sport based physical activity and tend to choose social interaction over competition in the school playground.¹⁷ Forested areas seem to invite more physical activity in girls than in boys.^{12, 18} Pagels et al. (2014) showed that girls at a forested school environment spent significantly more outdoor time in moderate-to-vigorous physical activity than girls at other schools who did not have a forest environment.

With respect to age, several researchers have noted the different play behaviours of boys and girls throughout a number of developmental stages--thus requiring play spaces designed for their respective needs.²¹ Younger children show a preference for natural elements (rocks, stumps, wildflowers and gardens) where they can explore and create their own worlds.¹⁶ Bell and Dymont (2006) also revealed the green school grounds promoted the full range of physical activity intensity levels among younger students.

As students grow older, it appears to be the open areas (such as sports fields), which contribute to maintaining moderate-to-vigorous physical activity levels for both genders—although mainly for boys. There is evidence to suggest that even some older girls (e.g. grade 6 and 7) enjoy varied use of the school ground--including involvement in soccer and basketball.¹⁶ This is consistent with boys as they grow older (e.g. intermediate grades or 11 years and older); they also prefer asphalt/paved areas and sport fields for this reason.¹⁶ However, research results are somewhat mixed in terms of the play preferences of older girls. Pagels (2014) reported that it is the forested areas which contributed to maintaining moderate to vigorous physical activity in girls with increasing age.

Overall, ten articles based on eight separate studies and two systematic reviews included in this review addressed aspects of age and gender in relation to outdoor play/physical activity. It is plausible to agree that there are positive effects from risky outdoor play on a variety of health indicators and behaviours in children from age 3 to 12 years.¹⁰ Furthermore, greening/naturalization of school grounds may contribute to maintaining physical activity levels among girls, those less inclined to participate in competitive rule-bound games, and younger children.¹² In addition to gender and age differences, other factors also influence play/physical activity--such as a child's stage of development, interests, and abilities as described below.¹⁸

Interest, Ability and Inclusiveness

There are dramatic and important differences between the play opportunities afforded by conventional and green school grounds.⁷ School grounds without greened/naturalized areas have their limitations in promoting physical activity in large part because many children are not

interested or able to play vigorous, rule-bound activities therefore creating a disadvantage for some students.²⁰ Conventional school grounds cater to only a portion of the student population—primarily boys, older students, students with high physical competence and those from wealthier communities.²¹ Brussoni et al. (2015) discuss the limited appeal and affordances for play that traditional/conventional playgrounds, also known as Kit, Fence, Carpet (KFC) playgrounds have. KFC playgrounds have been rated as having inferior opportunities for promoting children’s emotional, social, physical and cognitive development.¹⁰

Individuals who are typically disadvantaged on conventional school grounds include: girls, less physically competent children, younger children, children with intellectual and physical challenges, and those from lower-income families.²¹ Conversely, inclusiveness is manifested in many ways on green school grounds.²¹ Greened/naturalized areas are an important location for promoting physical activity, adding to the more traditional opportunities provided by turf, asphalt and play structures.²¹ It supports choices with broader appeal, freedom in play, and opens up a world of creative play possibilities.^{11,19,22} Greening also has the potential to temper the social dynamics of control and dominance on the school ground through the diversified play opportunities, and by providing opportunities for non-competitive, open-ended play and fostering more civil and cooperative behaviour.²¹ Samborski’s (2010) study similarly revealed that more natural and diversified areas encourage mixing of sexes, ages, and other human variable such as ethnic background, personality, and disability.

In the study by Ozdemir et al. (2008), when students were asked to describe an ideal schoolyard, over a third defined a perfect yard with lots of trees, lawn areas and greenery. Furthermore, Reed et al. (2013) identified from their research that perceived exertion and enjoyment scores may give some indication that ‘green exercise’ or physical activity in greened/naturalized environments feels easier and is enjoyable. Green exercise could therefore be used as a tool for enabling children to achieve activity recommendations and could improve exercise adherence.¹³

Overall, eight articles based on five separate studies and one systematic review included in this review addressed aspects of physical activity/play interest and ability and/or inclusiveness as it relates to greened/naturalized environments. From this, it can be viewed that green/naturalized school grounds can foster more welcoming settings for a diversity of children to engage in active play and offer opportunities for forms of play that appeal more broadly to children of varying interests and abilities.^{20,23}

Sedentary Behaviour and Physical Literacy

Gray et al. (2015) conclude there is consistent evidence that children from age 3 to 12 years who spend more time outside are more active and less sedentary. Sedentary behaviour is time when children are doing very little physical movement.²⁵ As per the Canadian Sedentary Behaviour Guidelines, it’s important to the health of children and youth that time spent being sedentary is minimized each day.²⁵

By their very design, green school grounds encourage children to get moving in ways that nurture all aspects of their health and development.²⁰ Emerging evidence suggests that in addition to promoting more physical activity, green school grounds can also improve motor development which is related to physical literacy.²⁰ Physical literacy is defined as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life.²⁴ The diversity of natural, child-friendly landscape provides more affordances for functional play (running, climbing rocks, sliding down slopes) in addition to constructive and symbolic play (playing house, pirates, or kings and queens).¹⁶

The study by Dymont et al. (2009) revealed certain patterns of sedentary behaviour that differed between countries. Paved sporting courts/courtyards and asphalt, grassy berms, and shaded concrete steps were the areas on school grounds observed to have the highest percentage of sedentary behaviour.¹⁷ There is likely a variety of reasons that could explain this lack of active play/physical activity under such conditions as found within the scope of this evidence. For example, younger students and many girls less inclined/interested in competitive rule bound games on sporting courts/courtyards may be resigned to the sidelines to become sedentary. Shaded areas may also be attractive for rest and socialization when the outdoor temperature is hot and other areas of the playground are in full sun.

Play where children can disappear/get lost in risky play supportive environments were shown by Brussoni et al. (2015) to be positively associated with physical activity and social health, and negatively associated with sedentary behaviour. Risky play supportive environments generally lead to an increase in physical activity and decrease in acute sedentary behaviours.¹⁰

Overall, five articles based on three separate studies and two systematic reviews included in this review identified aspects pertaining to sedentary behaviour and physical literacy as it relates to naturalized/green school ground features. There appears to be a positive association between opportunities for increased physical literacy development and reduced sedentary behaviour when children can engage in outdoor active play in green/naturalized environments.

Other Benefits

A holistic view of child health and wellness involves many more dimensions than those related to physical health (e.g. cognitive/intellectual, emotional, spiritual and social health). The additional child health and development benefits included in this section of the report are only those which were part of the included studies and are not the focus of this review. To fully understand the full range of factors that impact the health of children and youth, an intentional search and analysis of a broader scope of evidence would be required. Nonetheless, it's important to note that the benefits of nature for positive developmental outcomes in children have been established in multiple studies.¹¹

Dymont et al. (2009) report that green/naturalized school grounds promote social and cognitive well-being. Likewise, from an earlier study by Dymont, play was reported by participants to fulfill an important role in the intellectual, physical and social growth of children and better served by

green/naturalized school grounds than by conventional ones.²² Study participants reported that when students were learning and playing on a green school ground, they were being more civil, communicating more effectively, and were being more cooperative.²² Moreover, it was suspected that improved social and behavioural skills were fostered when students were actively involved in the process of greening and given opportunities to work with other students, teachers, parents and community members on greening projects.²² Active involvement of students in planting and caring for their green school environment is believed to heighten environmental awareness and stewardship and create opportunities to develop leadership skills.^{14, 22} Samborski (2010) postulates that the degree of children's involvement in nature affects their full range of development including areas such as emotional, social, social responsibility, aesthetic, physical and intellectual/language.

Dyment et al. (2008) report on the strengthening link between play and learning, as well as the link between green/naturalized school grounds and learning. They also point to a mounting body of evidence which indicates that greening settings may help to promote increased concentration, attentional functioning and self-discipline.⁷ The relationship between the design of school grounds and student behaviour also seems clear.⁷ Boredom is a factor that can lead to increased aggression on school grounds.⁷ By enhancing the quality of play, green school grounds represent a promising means of getting more children moving—moving in ways that promote physical, social and cognitive health and learning at the same time.⁷

Although general physical activity and structured exercise both have positive effects on children's self-esteem, the findings by Reed et al. (2013) suggest that exposure to nature did not have a significant additive effect on self-esteem compared to physical activity alone. They propose that because the current generation of youth spend less time interacting with nature than previous generations they may have consequently developed a disconnection from lack of understanding of the natural world.¹³

One of the additional health benefits provided by green/naturalized school grounds is the provision of shade, creating cooler and more comfortable play and learning environments.²² Lack of shade is a prevalent factor limiting physical activity.²⁰ In addition to reducing local air and ground temperature, green spaces also have a natural ability to filter pollution from the air.²³ A main finding from the study by Boldemann et al. (2011) was that greener outdoor environments trigger children's physical activity and sun protection.

Although a full account of the holistic benefits of play in naturalized environments is beyond the scope of this review, the authors of this review have cited a publication by McCurdy et al. to highlight the range of potential child health and development benefits that can be achieved through interaction with naturalized environments. McCurdy et al. (2010) corroborates there is a growing body of evidence suggesting that exposure to nature may directly benefit health, and that outdoor activity in natural environments may have the potential to improve children's mental and physical well-being. It is reported that natural environments may improve attention, especially for children with Attention Deficit Hyperactivity Disorder or other attention disorders.²⁷ This is based on the idea that nature can restore the mental fatigue that occurs after prolonged

concentration, which is characterized by having difficulty focusing on tasks, feeling irritable, and being easily distracted.²⁷ Spending time in the natural world may bring about a positive effect on mood, decrease stress, and increase feelings of being connected to nature.²⁷ Furthermore, some studies have proposed that outdoor activity in nature may also benefit children's health by improving asthma, myopia (nearsightedness), chronic pain issues, and child development.²⁷

Overall, twelve articles based on ten separate studies, one set of guidelines and one systematic review included in this review identified various aspects related to other child health and development benefits related to greened/naturalized school environments.

KEY MESSAGES

- **Traditional/conventional school grounds** have their limitations in promoting physical activity in large part because many children are not interested or able to play in vigorous, rule-bound activities.²⁰
- **Green/naturalized school grounds:**
 - represent a promising means of getting more children moving in ways that promote physical, social and cognitive health at the same time;⁷
 - encourage children to get moving in ways that nurture all aspects of their health and development;²⁰
 - play a significant role in promoting physical activity—especially moderate and light levels of activity;²¹
 - support active play for longer periods of time;¹⁷
 - can improve motor development¹⁷ which is related to physical literacy;
 - provide more affordances for functional play (running, climbing rocks, sliding down slopes) in addition to constructive and symbolic play (playing house, pirates);¹⁶
 - provide a diversity of spaces that better accommodate the play interests and abilities of all students;²²
 - foster more welcoming settings for a diversity of children to engage in active play;²⁰
 - may contribute to maintaining physical activity levels among girls, those less inclined to participate in competitive rule-bound games, and younger children;^{12,20,21,23}
 - can heighten student environmental awareness and stewardship;^{12, 14, 22}
 - can provide shade, create cooler and more comfortable play and learning environments;²² and
 - can create opportunities for student leadership.¹⁴

DISCUSSION

Limitations

The authors of this review agree with Britten et al. (2015) that there are complex causal pathways between environmental factors and human behaviors such as physical activity which are not yet fully understood. However, the body of literature associating school environment factors to child and youth physical activity outcomes is growing.⁸ When the scope of the literature is narrowed specifically to naturalized/greened schoolyard features (as with this review) the strength of evidence is further limited because more scientific research is needed.

While a set of guidelines and two systematic reviews representing a broad collection of scrutinized evidence (generally considered more scientifically robust) were included in this review, they did not fully address the research question. As a result, relevant single studies were incorporated. In addition to a cohort, mixed methods and qualitative research designs (which provide a unique contribution) the majority of the included single studies in this review were cross-sectional study designs. Cross-sectional studies are essentially a snapshot in time where data is collected to examine the relationship between health-related states and variables of interest. As such, the main outcome measure is prevalence. Furthermore, associations can be difficult to interpret, and causal relationships are not established. This type of study is also susceptible to certain biases (e.g. selection bias, sampling bias, recall bias). Generalizations can also be difficult if the population sample size is small and not representative of the whole population--as identified in several of the studies included in this review. While some of the researchers of the included studies attempted to address the potential risks of bias, this is considered a limitation and the evidence needs to be interpreted with caution.

However, collectively the evidence in this review is promising as it appears to reveal similar findings in terms of the themes which emerged--suggesting potential associations between schoolyard greening/naturalization and student physical activity quality (including intensity and duration); diversity and quality of play; interest, ability and inclusiveness; age preferences as well as sedentary behaviour and physical literacy.

To fully understand evidence related to naturalized environments and the impact on aspects of child health and development beyond the focus on physical activity for this review, more specific research questions and additional literature searching would be required.

Conclusions

Overall, it is agreed that school grounds are an obvious setting where health, education and environmental design issues overlap, and where inter-sectoral collaboration would be of benefit.²¹ It is in the interest of professionals in school planning and design and public health, as well as in the interest of communities, to engage in and inform policy and leadership decisions.⁸ A transdisciplinary process can be successful in focusing a particular school design project on a student's physical activity and health outcomes, in conjunction with learning outcomes.⁸

The findings from this review realize the need for assessment of existing schoolyard conditions for potential enhancement with naturalized features that will promote and support the active play interests and abilities of all ages and genders. This will result in more student physical activity to positively impact their health and wellbeing. Comprehensive approaches that involve school community stakeholders, including students, in the process of school ground assessment, design, implementation and evaluation is recommended.

Recommendations

To make the most of the outdoor free time students have throughout the school day, and to potentially support outdoor classroom initiatives, the authors of this review propose and cite the following recommendations pertaining to school ground greening/naturalization as comprehensive school-based strategies to promote health generally and physical activity specifically.²⁰

Planning and Development:

- Focus school design projects on student physical activity and health outcomes, in conjunction with learning outcomes.⁸
- Develop naturalized play areas that connect children with nature and increase opportunities for physical activity to complement conventional/traditional schoolyard features.
- Balance perceptions of risk and safety on school grounds to provide children with appropriately challenging and enticing natural environments.¹⁶
- Review site plans to allow students the maximum amount of direct interaction with green/naturalized space.²²
- Ensure master plan designs and school-initiated projects incorporate practical, sustainable and engaging design elements as well as long-term maintenance plans.²²

Advocacy:

- Advocate for resources to establish and support research, policies and programs aimed at developing healthy outdoor environments for children.²¹
- Elevate the importance of green/naturalized school grounds in terms of funding priorities.²²

Education and Training:

- Organize professional development workshops and hands on learning for educators.
- Engage parents/caregivers in learning about the importance of active outdoor play.
- Utilize relevant aspects of the curriculum to support student learning about the relationship between the natural environment and health.

Collaboration:

- Engage students, parents, community stakeholders in school ground greening/naturalization initiatives, including plans for maintenance.
- Explore opportunities for support from public health.

Policy:

- Officially recognize at a policy level the broad health benefits of green/naturalized school grounds.²¹
- Ensure school ground design standards and supervision policies foster and support opportunities for physical activity on school grounds.²⁰
- Explore policy development regarding school-community partnerships to promote physical activity.⁸
- Develop a plan to measure policy implementation and ensure school community involvement.²⁰

POTENTIAL ROLE FOR PUBLIC HEALTH

Collaborate with schools/school boards to:

- Exchange information, identify policy and research priorities, and advocate for support to promote healthy school environments that include green/naturalized school grounds.²¹
- Advocate for resources to establish and support research, policies and programs aimed at developing healthy outdoor environments for children.²¹
- Support policy development that promote healthy outdoor settings for children including green/naturalized school grounds.²¹
- Support school community awareness and engagement.

RESOURCES FOR SCHOOLS

Videos

- Over Protection and Safe Risk Documentary – Youth Voice - <http://www.childhealth2.com/#!activities/c17ov>
- Voices from the International School Grounds Movement - <https://www.youtube.com/watch?v=HOUp0Xho1-I>
- Natural Play in Schools - <https://www.youtube.com/watch?v=pot8EhKUdI>
- The Child in Nature - <https://www.youtube.com/watch?v=wsIYWEodnz0>
- Evergreen Canada – Outdoor Play and Learning – Video Series <https://www.youtube.com/watch?v=t7U-ElN2Y3k&index=1&list=PLDSOKzaT4AFu7mJXhod7gudaCs3UsSgPw>

Posters

- Conservation Ontario – Step into Nature – The Benefits of Nature poster http://healthyhikes.ca/images/CO_Step_Infographic.pdf

- Ecohealth Ontario poster – What’s in a green space that makes us feel so good - http://www.ecohealth-ontario.ca/files/EcoHealth_Handout_1_1.pdf

Policy & Planning

- Position Statement on Active Outdoor Play - https://www.participaction.com/sites/default/files/downloads/Participaction-PositionStatement-ActiveOutdoorPlay_0.pdf
- Back to Nature. Children’s Outdoor Charter - <http://www.childrensoutdoorcharter.ca/>
- Physical Activity Guidelines for School Architecture - <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0132597>
- Sun Safety Policy Guidelines for Schools - <http://www.cancer.ca/~media/cancer.ca/ON/prevention%20and%20screening/live%20well/Sunsense/Sunsense-Policy-Document---FinalVersion.pdf?la=en>
- TDSB Eco Schools Guide - School Ground Greening: Design for Shade and Energy Conservation - <http://www.tdsb.on.ca/Portals/ecoschools/docs/Shade%20Guide%20low-rez.pdf>
- The Outdoor PLAYbook for Schools - <http://outdoorplaybook.ca/>
- Evergreen Canada - School Ground Greening. A Policy and Planning Guidebook - <https://www.evergreen.ca/downloads/pdfs/School-Ground-Greening-Policy-Planning.pdf>
- Design Guidelines for K-12 Outdoor Play and Learning Environments - https://www.wrdsb.ca/wp-content/uploads/WRDSBGuidelines.K_12-Outdoor-Play.pdf

Funding

- Evergreen Funding Opportunities - <http://www.evergreen.ca/get-involved/funding-opportunities/>
- TD Friends of the Environment Foundation – Funding - <https://fef.td.com/about-us/>
- Tree Canada – Greening Canada’s School Grounds – Funding <https://treecanada.ca/en/programs/greening-canadas-school-grounds/>
- WWF Go Wild School Grants - <http://www.wwf.ca/takeaction/gowildschools/>
- Walmart and Evergreen Foundation Green Grants - <https://www.evergreen.ca/about/news-releases/green-grants-program-celebrates-community-greening-across-canada/>
- Tree Canada – Green Schools, Green Futures Award - <https://treecanada.ca/en/green-schools-green-futures-award/application/>
- S’cool Life Fund - <http://www.scoollifefund.ca/>
- Let Them Be Kids – Building Playgrounds, Inspiring Hope - <http://www.activecircle.ca/en/funding/1665-let-them-be-kids-building-playgrounds-inspiring-hope.html>

General

- Houghton, E. - A Breath of Fresh Air: Celebrating Nature and School Gardens - <http://www.torontopubliclibrary.ca/detail.jsp?R=155006>
- Evergreen Resources – School Ground Greening - <http://www.evergreen.ca/get-involved/resources/school-ground-greening/>
- Evergreen Landscape and Child Development - <https://www.evergreen.ca/downloads/pdfs/Landscape-Child-Development.pdf>

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APPENDICES:

Appendix A – Critical Appraisal Tools used and Criteria for Ranking Methodological Quality

Appendix B – Chart - Description of Included Studies

Appendix C – Ovid MEDLINE Database Search

Appendix D – PubMed, PsychInfo and EMBASE Database Search

Appendix E – EBSCO Host Database Search

Appendix F – Google Scholar Search

Appendix G – Health Evidence Database Search (for systematic reviews and guidelines related to the built environment)

Appendix H - Ovid MEDLINE Database Search (for systematic reviews and guidelines related to the built environment)

Appendix A – Critical Appraisal Tools used and Criteria for Ranking Methodological Quality

Critical Appraisal Tool Used	Criteria Developed by Author-Appraisers of this Review for Ranking Methodological Quality
Appraisal of Guidelines for Research & Evaluation II - AGREE II Instrument consists of 23 areas of assessment within 6 domains	<p>Weak – if only 1/3 of the areas of assessment were answered favourably</p> <p>Moderate – if 2/3 of the areas of assessment were answered favourably</p> <p>Strong – if > than 2/3 of the areas of assessment were answered favourably</p>
AMSTAR – Assessing the Methodological Quality of Systematic Reviews - consists of 11 screening questions	<p>Weak – if < than 5 questions were answered favourably</p> <p>Moderate - if between 5 and < than 8 questions were answered favourably</p> <p>Strong – if 8 or more questions were answered favourably</p>
Critical Appraisal of Skills Program (CASP) Cohort Study Checklist – consists of 12 screening questions	<p>Weak - if < than 5 questions were answered favourably</p> <p>Moderate – if between 5 and < than 8 questions were answered favourably</p> <p>Strong – if 8 or more questions were answered favourably</p>
Critical Appraisal Skills Program (CASP) Qualitative Research Checklist – consists of 10 screening questions	<p>Weak - if < than 5 questions were answered favourably</p> <p>Moderate – if between 5 and < than 8 questions were answered favourably</p> <p>Strong – if 8 or more questions were answered favourably</p>
National Collaborating Centre for Environmental Health – A Primer for Evaluating the Quality of Studies – Critical Appraisal of Cross Sectional Studies – consists of 11 overall screening questions	<p>Weak - if < than 5 questions were answered favourably</p> <p>Moderate – if between 5 and < than 8 questions were answered favourably</p> <p>Strong – if 8 or more questions were answered favourably</p>

Appendix B – Chart – Description of included studies

Study (author, year) Country Publication	Aim of Study	Study Design Population/ Sample Size Intervention/ Exposure/ Research Methods	Strengths/ Limitations	Quality Assessment/ Risk of Bias	Relevant Findings/ Recommendations
Physical Activity Design Guidelines for School Architecture Brittin J, et al. (2015) United States PLoS ONE	To provide architects and designers, school planners, educators, and public health professionals, with strategies for making K-12 school environments conducive to healthy physical activity	Guidelines Specific strategies in 10 school design domains. Qualitative review process	Strengths: Guidelines contribute substantively to the literature Scope and purpose and target users specifically described Systematic methods used to search evidence Describes facilitators to application and supporting information Limitations: Evidence base remains limited Further explication of built environmental variables and measures, and their causal, mediating, or modifying roles in relation to PA,	AGREE Tool – (moderate methodological quality) Comprehensive search strategy used.	Provide designers with opportunities to leverage synergies with sustainable practices and universal design. Help inform school administration and designer decisions, in consideration of evidentiary support, from small-scale renovation to an entirely new site and facility Assessment tools have been developed to reveal issues in community and school environments' support of PA Recommend creation of policy on school-community partnerships specifically to promote PA in schools Transdisciplinary collaborations are needed, including government, corporate, community, and non-profit stakeholders to create health-promoting environments To facilitate focus of industry and education standards on building schools with the goal of improving health outcomes

			<p>PA programming, and social environmental variables is needed</p> <p>Measurement consistency</p> <p>External validity - other settings later in life</p>		
<p>What is the Relationship between Risky Outdoor Play and Health in Children? A Systematic Review</p> <p>Brussoni, M., et al. (2015)</p> <p>Canada</p> <p>International Journal of Environmental Research and Public Health</p>	<p>To identify all studies that examined the relationship between risky outdoor play and health related outcomes in children</p>	<p>Systematic Review</p> <p>Children (aged 3.00–12.99 years)</p> <p>Qualitative review process</p>	<p>Strengths:</p> <p>Registered study</p> <p>Two independent data extractors and a consensus procedure</p> <p>Comprehensive search strategy</p> <p>GRADE framework used to evaluate the quality of the studies</p> <p>Limitations:</p> <p>Findings are based on ‘very low’ to ‘moderate’ quality evidence</p>	<p>AMSTAR Tool (strong methodological quality)</p>	<p>Overall positive health effects of increased risky outdoor play provide greater benefit than the health effects associated with avoiding outdoor risky play</p> <p>Overall positive effects of risky outdoor play on a variety of health indicators and behaviours in children aged 3-12 years.</p> <p>Risky play supportive environments positively associated with physical activity and social health, and negatively associated with sedentary behaviour</p> <p>Play at height was not related to fracture frequency and severity</p> <p>Engaging in rough and tumble play did not increase aggression, and was associated with increased social competence</p> <p>Indication that risky play supportive environments promoted increased play time, social interactions, creativity and resilience</p>

<p>What Is the Relationship between Outdoor Time and Physical Activity, Sedentary Behaviour, and Physical Fitness in Children? A Systematic Review</p> <p>Gray, C., et al. (2015)</p> <p>Canada</p> <p>International Journal of Environmental Research and Public Health</p>	<p>To identify all studies that examined the relationship between outdoor time and physical activity, sedentary behaviour, fitness, or motor skill development in children</p>	<p>Systematic Review</p> <p>Apparently healthy children aged 3.00–12.99 years)</p> <p>Qualitative review process</p>	<p>Strengths:</p> <p>Registered study</p> <p>Two independent data extractors and a consensus procedure</p> <p>Comprehensive search strategy</p> <p>Examined risk of bias and quality of included studies</p> <p>Use of objective measures of physical activity and sedentary behaviour</p> <p>Consistency of results re: relationships between outdoor time, physical activity and sedentary behaviour</p> <p>Limitations:</p> <p>Heterogeneity in the measurement of outdoor time and outcome variables</p> <p>Three studies did not assess statistical significance</p> <p>Small sample sizes</p> <p>Predominantly included studies from developed nations</p> <p>Studies were observational and assessed</p>	<p>AMSTAR Tool (moderate methodological quality)</p> <p>Risk of Bias:</p> <p>The observational nature of included studies automatically increases the risk of bias. However, there were few other factors of concern.</p>	<p>Time spent outdoors was consistently associated with improved movement behaviour and fitness outcomes</p> <p>Outdoor time is positively related to physical activity and negatively related to sedentary behaviour in children aged 3–12 years</p> <p>Consistent positive relationship between outdoor time and physical activity held across sexes, age groups and contexts</p> <p>Findings highlight the importance of preserving time in children’s schedules for unstructured outdoor play</p>
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			<p>exposures and outcomes simultaneously</p> <p>Design of included studies prevented high quality of evidence rating according to GRADE</p> <p>Did not assess outcomes in relation to the quality of the outdoor environment</p>		
<p>A Post-Occupancy Study of Nature-Based Outdoor Classrooms in Early Childhood Education</p> <p>Dennis, S., et al. (2014)</p> <p>United States</p> <p>Children, Youth and Environments</p>	<p>To address questions related to the use and effectiveness of nature-based outdoor classrooms in a variety of settings, regions, and institutions, with a focus on their physical, social and cognitive impacts</p>	<p>Qualitative Study</p> <p>11 sample institutions (elementary school – special needs, early childhood centre, shelter, library)</p> <p>Semi-structured telephone interviews</p>	<p>Strengths:</p> <p>Builds on existing evidence</p> <p>Limitations:</p> <p>Small sample size</p> <p>Reported data</p> <p>Lack of trained independent research staff</p> <p>External validity</p>	<p>CASP Qualitative Research Tool (moderate methodological quality)</p> <p>Risk of Bias:</p> <p>Selection bias - Purposeful sampling methods used</p> <p>Sampling bias</p>	<p>Confirmed the crucial role nature-based settings play in supporting positive learning outcomes</p> <p>Children in natural settings reported to be more relaxed, focused, engaged, cooperative, creative, nurturing and happy compared with children in indoor classrooms or on traditional playgrounds</p> <p>Natural outdoor play environments helped decrease separation difficulties during morning drop-off as children found activities to do outside and teachers spent more time interacting with the children and less time policing</p> <p>Sticks, leaves, stones, sand, mud and other natural materials support longer engagement, more cooperation, and a wider variety of play behaviors</p> <p>Important that specific use areas be spread out on site</p> <p>Greater overall size allowed for larger use areas that could accommodate more users and create less competition for space and reduce conflict among children</p>

					<p>Pathways support movement throughout a site and an important visual feature linking all various use areas</p> <p>Nature provided far more play props and open-ended play opportunities than sites with fixed equipment set in large areas of safety surfacing</p> <p>Further research is needed to quantify the outcomes respondents described</p>
<p>A repeated measurement study investigating the impact of school outdoor environment upon physical activity across ages and seasons in Swedish second, fifth and eighth graders</p> <p>Pagels, P., et al. (2014)</p> <p>Sweden</p> <p>BioMed Central Public Health</p>	<p>To further investigate the association between outdoor environment and level of physical activity across seasons and ages</p>	<p>Cross-Sectional Study</p> <p>196 students from available 2nd, 5th and 8th graders (aged 7–14 years) at four municipal schools in mid-southern Sweden</p> <p>Aerial pictures of playgrounds, measurement tool and visual inspection and counts, weather conditions observed and ranked, and temperature recordings obtained. Parent questionnaires, and student diaries completed re: leisure-time PA, and hip-mounted accelerometers with build-in light sensor</p>	<p>Strengths:</p> <p>Multiple data collection methods</p> <p>Schools were selected to reflect the socio-economic composition of the municipalities of the whole country</p> <p>Use of objective monitoring both of outdoor time and of the intensity of PA</p> <p>Limitations:</p> <p>Sample size</p> <p>Drop-out rate among 8th graders</p> <p>Crude categorization of school ground quality and forms for tracking children</p> <p>Non-randomized</p> <p>External validity</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (strong methodological quality)</p> <p>Risk of bias:</p> <p>Selection bias</p> <p>Sampling bias</p>	<p>Results show a steep decline in physical activity between the 2nd and 8th grade.</p> <p>Also revealed was a steep decline between 2nd and 5th grade in moderate to vigorous physical activity which is not clearly explained in other studies, at least during school time.</p> <p>Further studies are warranted to explain the decline in physical activity from childhood to adolescence.</p> <p>Attention needs to be paid considering the location and design of play spaces and equipment at schools that allow pupils to use the whole school ground.</p> <p>Extended ball areas with art grass and green play areas with woodland seem to enhance moderate to vigorous physical activity in 2nd and 5th graders during outdoor stay.</p> <p>Vegetation and woodland have previously been shown to increase physical activity, particularly among girls.</p>

			Potential confounding variables		<p>Observations showed that girls at forest school (in this study) spent significantly more outdoor time in moderate to vigorous physical activity than girls did at the other schools.</p> <p>Open spaces seem to contribute to maintaining moderate to vigorous physical activity among pupils as they grow older.</p> <p>Environmental factors that impact seasonal variations for moderate to vigorous in school children during school outdoor stay seem unclear.</p> <p>In all three grades, boys are more physically active than girls which make it important to reveal what will improve girls' physical activity in the school environment. Woodland may contribute to maintaining levels of physical activity among girls.</p> <p>The school outdoor environment may thus be a potentially health promoting factor.</p>
<p>A repeated measures experiment of green exercise to improve self-esteem in UK school children</p> <p>Reed, K., et al. (2013)</p> <p>United Kingdom</p> <p>PloS ONE</p>	<p>To determine the effects of green exercise on self-esteem when compared with a control (outdoor, non-green urban area) exercise condition</p> <p>Secondary aims to determine if differences in enjoyment and perceived exertion between exercise environments</p>	<p>Cohort Study</p> <p>Counterbalanced randomized cross-over design</p> <p>75 children (11–12 year olds)</p> <p>Intervention:</p> <p>Control condition was a 1.5 mile run of a one lap course around the school campus, on a relatively flat terrain (62 m). The green</p>	<p>Strengths:</p> <p>University ethical review committee approved</p> <p>Use of a control condition</p> <p>Conditions were randomized</p> <p>Robust scientific design and analysis</p>	<p>CASP Tool for Cohort Studies (strong methodological quality)</p> <p>Risk of Bias:</p> <p>Selection bias – Although randomized, convenience sampling used</p> <p>Sampling bias</p>	<p>Despite no evidence for synergy between exercise and nature for increasing self-esteem, some promising trends for both enjoyment and ratings of perceived exertion</p> <p>Increased energy expenditure during the green condition may indicate that natural environments make more intense exercise seem equally as easy and enjoyable as less intense exercise in built environments</p>

	<p>and how affected by children's levels of fitness and physical activity</p>	<p>condition was also a 1.5 mile run of a single lap course through the local country park</p> <p>PA questionnaires to estimate habitual PA levels, 20 m shuttle-run, pacer test, Rosenberg Self-Esteem Scale, perceived exertion ratings, assessment of overall enjoyment using a visual-analogue scale</p>	<p>Addressed a clearly focused issue</p> <p>Use of subjective and objective measurements</p> <p>Researchers identified confounding factors</p> <p>Limitations:</p> <p>Sample size</p> <p>Rosenberg Self-Esteem Scale is typically used as a trait scale and may have reduced the study's sensitivity</p> <p>Lesson contaminated by the presence of external researchers</p> <p>Children contained within an urban environment could occasionally see trees or grassy patches at some points during their run</p> <p>Differences between the two courses in terms of terrain and elevation makes comparing the energy expenditure and 'effort' difficult</p> <p>External validity</p>		<p>Green exercise could be used as a tool for engaging children in more moderate to vigorous physical activity</p> <p>Also promising was the lack of association between physical activity and perceived exertion and the attenuated association between physical activity and enjoyment in the green condition. They tentatively suggest that green exercise may offer an enjoyable and accessible form of physical activity to less active children who may not typically be well-engaged in physical education</p> <p>Future research to obtain a measure of energy expenditure so that exercise conditions can be compared, to also perform a follow-up study incorporating different green exercise modes such as walking and running, in order to determine if role of environment to improve self-esteem varies according to exercise intensity. Perceptions and attitudes and perceived level of engagement would also need to be controlled for to develop further insights into the effects of green exercise in children</p>
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			Potential confounding variables		
<p>Encouraging play in the natural environment: a child-focused case study of Forest School</p> <p>Ridgers et al. (2012)</p> <p>United Kingdom</p> <p>Children's Geographies</p>	<p>To investigate children's perceptions, knowledge and experiences of play in the natural environment both prior to and following their engagement in Forest School</p> <p>A secondary aim was to examine whether it provides an appropriate mechanism for connecting children with the natural environment through exploring changes in their leisure time activities and behaviours</p>	<p>Qualitative Study</p> <p>17 children (6 boys, 11 girls aged 6-7 years)</p> <p>Focus group discussions with the children</p>	<p>Strengths:</p> <p>Clear statement of the aims of the research</p> <p>Approval sought from a university ethics committee</p> <p>Used a consultation process of triangulation (one author who presented verbatim quotations to two other authors who all then critically questions the analysis and interrogated the data independently). Alternative interpretations were discussed and consensus decision-making used.</p> <p>Findings support previous research</p> <p>Limitations:</p> <p>Sample size</p> <p>Self-reported data</p> <p>Short-term project</p> <p>External validity</p>	<p>CASP Tool for Qualitative Studies (moderate methodological quality)</p> <p>Risk of bias:</p> <p>Selection bias – purposeful sampling</p> <p>Sampling bias</p>	<p>Activities undertaken during Forest school stimulated imaginative play within the natural environment outside of school, particularly with boys.</p> <p>Girls talked about their social interactions with others through games and different activities, providing examples of opportunities for social activities through Forest School and to their overall social development</p> <p>Children had developed an awareness of the range of opportunities that the natural environment afforded their creative play</p> <p>Range of activities undertaken during Forest School may have encouraged a variety of new play behaviours</p> <p>Examples of social skill development, confidence when interacting with the natural world, understanding, interest, motor skills and leadership skills – all important components of child development</p> <p>Barriers to play related to parental constraints that were closely related to safety concerns</p> <p>During Forest school, children access the woodland area in all weather, and it appeared their desire to play outdoors had overcome their perceptions of the weather being a barrier</p> <p>More children reported their motivation to find out more about the natural environment</p> <p>Natural environments provide opportunities for</p>

					<p>challenging and diverse play that test children's competencies, enables them to manage their own perceptions of risk, and helps their creativity and observation and motor skills</p> <p>An active engagement with the natural world helps to develop through hands on active involvement</p> <p>Children learned they could achieve a physical task (e.g. climbing trees)</p> <p>Regular contact with the woodland area has encouraged children to challenge their own barriers and to test their feelings and emotions within a safe and increasingly familiar environment</p> <p>The voice of the children and their experiences needs to be a stronger part of any future Forest School evaluation</p> <p>More longitudinal work is needed to explore this issue further</p>
<p>Preschool outdoor play environment may combine promotion of children's physical activity and sun protection. Further evidence from Southern Sweden and North Carolina</p> <p>Boldemann, C., et al. (2011)</p> <p>Sweden and United States</p> <p>Science & Sports</p>	<p>The protective potential of the physical environment was the aim of the study</p>	<p>Cross-Sectional Study</p> <p>169 children (3 – 5.9 years)</p> <p>Outdoor preschool environment scoring using ordinal outdoor play environment categories, children weight and height measurements, parental questionnaire, weather conditions recorded, children carried pedometers, and wore UV-exposure using</p>	<p>Strengths:</p> <p>Approval sought from a Regional Ethics Committee</p> <p>There was convincing rationale and purpose for the study</p> <p>The issue is clearly focused</p> <p>The study tried to detect a beneficial or harmful effect</p> <p>Measurement tools were previously tested and validated</p> <p>Findings support previous research</p> <p>Limitations:</p> <p>The choice of play locations may vary depending on the</p>	<p>NCCEH Tool for Cross Sectional Studies (strong methodological quality)</p> <p>Risk of bias: Selection bias - convenience sampling used</p> <p>Sampling bias</p>	<p>High-OPEC locations (i.e. includes integrated vegetation) trigger children's physical activity and sun protection</p> <p>Findings support the idea that green and varied outdoor environments increase children's physical activity</p> <p>The result of free mobility in green outdoor settings would be increased physical activity and sun protection without the children having to be told to seek shade as they are attracted to using trees and bushes in their play</p> <p>In green and varied outdoor settings children's own</p>

		dosimeter badges	weather, which complicates interpretation of data External validity		<p>choice of place and playful use of the physical surrounding actually seems to result in sun protection</p> <p>Fences segmenting preschool outdoor areas for safety or practical reasons may restrict free mobility and thereby reduce step counts and also children's ability to seek shade if vegetation is not within reach</p> <p>Greenery integrated with play space is attractive to children, and would enable long outdoor stay with decreased sunburn risk</p> <p>The role of climate and varying policies of outdoor stay and play needs to be further explored</p>
<p>Biodiverse or Barren School Grounds: Their Effects on Children</p> <p>Samborski, S. (2010)</p> <p>Canada</p> <p>Children, Youth and Environments</p>	<p>Hypothesis: Exposure to nature influences children to prefer natural elements and enriches their experience, then children who regularly play on a more biodiverse school ground should show a significantly higher preference for natural elements and use landscape elements in a more complex manner.</p> <p>To address this a comparison of children's experiences on two contrasting</p>	<p>Mixed Methods Research</p> <p>349 children (approx. half of students at each school) from all grades (primary ages 6-9 and intermediate ages 10-13 years)</p> <p>Classroom drawings, classroom surveys, classroom brainstorming sessions, walkabout audio-recorded interviews, observations and photographs</p>	<p>Strengths:</p> <p>Clear statement of the aims of the research</p> <p>Multiple data sources – mixed methods</p> <p>Minimized confounding variables by selecting schools similar in population size, socio-demographics and available outdoor area</p> <p>Affirmed previous studies</p> <p>Multidisciplinary study, integrating educational and environmental psychology, ethnobotany and eco restoration principles-bringing together much evidence</p>	<p>CASP Tool for Qualitative Studies (moderate methodological quality)</p> <p>NCCEH Tool Cross-Sectional Studies (weak methodological quality)</p> <p>Risk of bias: Selection bias – convenience sampling used</p>	<p>Biodiverse school ground provided many more affordances for play and discovery than the barren school ground</p> <p>Noted was the vital importance of considering the developmental differences between the younger (primary, ages 6 to 9) and older (intermediate, ages 10 to 13) children</p> <p>Natural areas beckoned the young children for manipulative and sociodramatic play</p> <p>Older children were more drawn to these natural havens for reflective contemplation and conversation, though there was mixing of ages and activities in these areas</p>

	<p>elementary school grounds, one barren and the other biodiverse</p> <p>To capture the children's feelings and insights and as closely as possible—to see school grounds through the children's eyes</p>		<p>regarding the benefits of nature for children</p> <p>Limitations:</p> <p>Respondent validation not apparent</p> <p>External validity</p>		<p>Girls aged 11 to 13 expressed high levels of satisfaction with the biodiverse school ground and dissatisfaction with the barren school ground</p> <p>Areas on the school grounds with the most boy-girl interaction were the naturalized areas</p> <p>The needs of other user groups tended to be ignored on the barren grounds</p> <p>Sports-oriented boys aged 11 to 13 expressed the highest level of satisfaction with the barren school ground</p> <p>Barren asphalt and grass school grounds most closely met the needs of sports-oriented boys aged 11 and older</p> <p>Small features such as dens can provide a disproportionately positive effect, a focal point to distinguish that environment from all others and make it a special place</p> <p>Affirm studies demonstrating traditional school ground elements (fixed play equipment, asphalt and ball fields) reinforce sex-differentiated play, and that more natural and diversified areas encourage mixing of sexes, ages, and other human variables such as ethnic background, personality, and disability</p> <p>Children's involvement in nature affects their full</p>
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					<p>range of development: emotional and social, social responsibility, aesthetic, physical, and intellectual/language</p> <p>The complex ecological context of schoolyard play should be considered in policy decisions affecting recess design and practice</p> <p>Teachers and administrators must work to balance their perceptions of risk and safety on school grounds</p> <p>Children respected the established safety rules</p> <p>Need to strengthen the professional and political voice in support of children's healthy play experience in nature</p>
<p>The relationship between school ground design and intensity of physical activity</p> <p>Dyment, J. E., Bell, A. C., Lucas, A. J., (2009)</p> <p>Canada and Australia</p> <p>Children's Geographies</p>	<p>To examine the effect of school ground design elements on the physical activity levels of children using direct, quantitative measurement of children's physical activity</p>	<p>Cross-Sectional Study</p> <p>The Australian school: Kindergarten to Grade 6 (just over 400 students)</p> <p>The Canadian school: Kindergarten to Grade 8 (just over 700 students)</p> <p>System for Observing Play and Leisure Activity in Youth (SOPLAY) used to track the location and intensity of play behaviours at the school population level</p> <p>Pre-determined target areas coded as sedentary,</p>	<p>Strengths:</p> <p>Ethical approval received by both school boards and the University of Tasmania</p> <p>Quantitative measurements</p> <p>SOPLAY is a standardized instrument - received validity and reliability testing</p> <p>Research team trained to use SOPLAY</p> <p>The study tried to detect a beneficial or harmful effect</p> <p>Limitations:</p> <p>Purposeful sampling</p> <p>Potential confounding variables</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (strong methodological quality)</p> <p>Risk of bias: Selection bias - purposeful sampling</p>	<p>The green area encouraged the highest percentage of children present to be engaged in moderate physical activity</p> <p>At the Australian school, the green area was the most popular area (highest percentage of students)</p> <p>The patterns of sedentary behavior differed slightly between countries. At the Australian school, the Target Area that promoted the highest degree of sedentary play for all children was the paved sporting courts</p> <p>At the Canadian school, the treed grassy berm and the treed concrete steps encouraged the highest percentage of sedentary behavior, followed by the open asphalt</p>

		<p>moderately active or vigorously active</p> <p>Separate scans were conducted for boys and girls</p>			<p>Patterns for vigorous and moderate activity persisted across both countries when the data were examined as a function of gender</p> <p>The manufactured equipment encouraged the highest percentage of girls and boys to be vigorously active at both schools</p> <p>The green area encouraged the highest percentage of moderate activity for girls and boys at both schools</p> <p>At both schools, the manufactured equipment provided opportunities for a large percentage of children to be engaged in vigorous physical activity. One possible reason as to why the manufactured equipment may have promoted higher intensities of physical activity is the wealth of external stimuli present through the equipment, whereas the paved sporting courts, open asphalt, and the canteen courtyard, which were almost entirely barren and unnatural, may have promoted less activity due to the lack of external stimuli</p> <p>One reason for girls' increased activity on the manufactured play equipment is that these areas promote open ended play, not centred on rules or sport based activity as well as the opportunity to engage socially in a non-competitive context</p> <p>Paved sporting courts in Canada did promote a large</p>
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					<p>percentage of boys to engage in vigorous physical activity - also the second most popular area for boys after the open asphalt</p> <p>At both the Australian and Canadian schools, the green area of the school ground promoted the highest percentage of both boys and girls to be engaged in moderate physical activity</p> <p>Observed were Australian and Canadian students in the green area spending recess and lunch breaks exploring areas hidden by trees and bushes, climbing over boulders, playing in the sandpit and crawling through long grass in imaginative play, all of which were deemed as moderate physical activity</p> <p>Findings challenge the belief that flat turf and asphalt provide ideal (and often only) surfaces for burning off excess energy and engaging in team sports, and are therefore best suited to promoting physical activity</p> <p>The green area of the school ground seems to allow children to 'expand their play repertoire' by engaging in less organized play and more unorganized 'free' play</p> <p>Green school grounds appeal to a wider variety of student interests, support a wider variety of play activities and promote moderate physical activity</p> <p>Documented were changes in children's play behaviors as a result of greening, noting in particular an</p>
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					<p>increase in the diversity of play behaviors</p> <p>On green school grounds, trees, shrubs, rocks and logs define a variety of places to jump, climb, run, hide and socialize. Moveable, natural materials such as sticks, branches, leaves and stones provide endless opportunities to engage in imaginative play, such as building shelters and huts</p> <p>Diversity of natural features can also positively influence motor development</p> <p>The green area of the school ground may be an especially important space for children who are less physically competent or socially developed (due to age, gender, ability) to engage in moderate physical activity</p> <p>At schools that only provided opportunities for active and physical play, social hierarchies were established through these means, and children with low physical competence or desires were often socially excluded</p> <p>Conversely, at schools where a diversity of play opportunities were afforded, students who were less physically competent could still engage in types of physical activity that were more in line with their abilities and interests</p> <p>Majority of conventional school grounds that are comprised of asphalt and open playing field do little to promote moderate or vigorous physical activity for many girls</p>
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					<p>Critical need to provide spaces that will engage more girls in moderate physical activities and greened areas stand to make an important contribution in this regard</p> <p>Green design elements stand to make an important contribution and get more children moving in ways that nurture all aspects of their health and development</p>
<p>Children in schoolyards: Tracking movement patterns and physical activity in schoolyards using global position system and heart rate monitoring</p> <p>Fjortoft (2009)</p> <p>Norway</p> <p>Landscape and Urban Planning</p>	<p>To investigate how 6-year-old school children used their schoolyard during recess and how the yard invited physical activity</p> <p>The main objective was to describe movement patterns and physical activity levels in 6-year-old schoolchildren in two different schoolyards in Southern Norway</p>	<p>Cross Sectional Study</p> <p>Primary schools comprising grades 1–7 (71 first graders – age 6 years)</p> <p>At school A, 28 children, 10 girls and 18 boys participated</p> <p>At school B, 42 children, 21 girls and 21 boys participated</p> <p>Geographical positioning system (CPS) and heart rate (HR) monitoring</p> <p>Methods of GPS for mapping movement patterns in the two schoolyards were combined with monitoring heart rate by a Polar Pulse watch</p> <p>Enabled tracking of children's movement in the</p>	<p>Strengths:</p> <p>Convincing rationale for conducting the study</p> <p>Issue is clearly focused</p> <p>Tried to detect a beneficial or harmful effect</p> <p>Limitations:</p> <p>Sample size</p> <p>Convenience sample</p> <p>HR monitors difficult to fit to small body size and would fall off</p> <p>Tall buildings and play equipment interfered with the GPS signals</p> <p>Small playgrounds problematic for precise GPS reading (+/- 4m). Method not widely explored, and more accurate equipment is being developed</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (moderate methodological quality)</p> <p>Risk of bias:</p> <p>Selection bias – convenience sampling used</p> <p>Sampling bias</p>	<p>The schoolyards provided different space and qualities of outdoor environments, but those factors did not seem to affect the physical activity level of the children in general</p> <p>A gender difference in activities was observed. The flat, asphalted schoolyard favoured boys playing soccer, while the forest yard seemed to favour higher intensity of physical activity in girls</p> <p>Open space favoured locomotion and moderate to vigorous physical activity in the asphalt schoolyard, while running around and exploring the forest area were documented by movement patterns that enhanced more moderate levels of physical activity</p> <p>More research is needed to identify environmental indicators for physical activity in children at different gender and age groups</p>

		schoolyards and location of areas that promoted different activity levels	Potential confounding variables		
<p>Grounds for movement: green school grounds as sites for promoting physical activity</p> <p>Dyment, J. & Bell, A.C. (2008)</p> <p>Canada</p> <p>Health Education Research</p>	To gather results from and understand trends across a large number of Canadian schools before and after greening	<p>Cross-Sectional Study</p> <p>59 elementary schools across Canada (27 urban, 21 suburban and 11 rural)</p> <p>28 parents, 48 teachers and 29 administrators completed questionnaires (n = 105) to indicate if and how their greening initiative influenced the physical activity of students in both positive and negative ways</p>	<p>Strengths:</p> <p>Supports previous research findings</p> <p>Tried to detect a beneficial or harmful effect</p> <p>Survey was validated and pilot tested</p> <p>Diversity of schools used in terms of size, age, design elements, urban and rural</p> <p>Respondents represented a variety of roles, education levels, ages and involvement levels</p> <p>Involved schools with small to large staff and student populations</p> <p>Greening projects at the schools were varied—having been in place for between 1 and 26 years</p> <p>Limitations:</p> <p>Purposeful sampling – although the criteria used included a diversity of socio-economic status</p> <p>Potential confounding variables</p> <p>Non-randomized</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (strong methodological quality)</p> <p>Risk of bias:</p> <p>Selection bias – purposeful sampling used</p>	<p>Strong indication that green school grounds were providing more opportunities for physical activity – addition to the traditional opportunities provided by turf, asphalt and play structures</p> <p>Turf and asphalt support more vigorous and moderate levels of activity than light levels of activity. So do play structures, though the emphasis shifts from vigorous to moderate levels of activity</p> <p>Greened areas of school grounds: these tend to support more moderate and light activity than vigorous activity</p> <p>Many children are simply not interested or able to participate in the types of vigorous, competitive activities commonly occurring on turf and asphalt</p> <p>Green school ground appeals to a wider variety of student interests and supports a wider variety of play activities</p> <p>Green school grounds are promoting more active, more imaginative and more constructive play, more civil behaviour and a better integration of physical activity into school life generally</p> <p>Strengthening the link</p>

			Subjective data only		<p>between play and learning</p> <p>Trees, shrubs, rocks and logs define a variety of places to jump, climb, run, hide and socialize</p> <p>Moveable, natural materials such as sticks, branches, leaves and stones provide endless opportunities to engage in imaginative play</p> <p>Participants indicated that safety concerns (about water features, sight lines, climbing, etc.) limited physical activity on their school ground after</p> <p>Greening - safety is an issue that can and needs to be addressed during the design stage</p> <p>Greening can enhance the safety by calming student traffic, by softening play surfaces, by promoting more civil and cooperative behaviour</p> <p>Complements turf and playing fields</p> <p>Encourage moderate and light levels of physical activity by increasing the range of enjoyable, non-competitive, open-ended forms of play</p> <p>Future studies should involve direct observation and measurement</p> <p>Future research should explore the impact of seasonal changes on children's activity patterns, especially as this</p>
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					relates to school ground design
Assessment of outdoor school environments and physical activity in Ankara's primary schools Ozdemir, A. and Yilmaz, O., (2008) Turkey Journal of Environmental Psychology	To explore the associations between the physical characteristics of schoolyards and the physical activity of third and fourth year students (9 and 10 year olds) in five Turkish primary schools	Cross-Sectional Study Five public schools in Ankara, 290 students, teachers of each class (10 classes), administration reps Individual interviews with teachers and administrators, physical activity data gathered by student self-reporting, direct observation of students, Physical activity data were gathered, student BMI measurements obtained by trained assessors, aerial photographs were taken of the school property.	Strengths: Random selection of schools Aimed to represent a cross section of the population Multiple data sources – including objective measures Interview guide developed Test–retest reliability obtained on student questionnaires Reliability scores were 0.68 and 0.71 thus the scale is valid, reliable, and suitable for the study Study tried to detect a beneficial or harmful effect Limitations: Self-reporting Small sample size Potential confounding variables	NCCEH Critical Appraisal of Cross Sectional Studies (moderate methodological quality) Risk of bias: Sampling bias	Found evidence of the relationship between qualities of outdoor environments and physical activity Almost all schoolyards had outdoor environments with limited landscape qualities Most of the students are satisfied with the schoolyard Despite the poor design and maintenance problems, students become accustomed to these spaces, and over time they adapt their behavior and play routines to these environments for better or worse Among students dissatisfied with the schoolyard a significant number cited the lack of trees and greenery in as the cause Over a third of students defined a perfect yard with lots of trees, lawn areas and greenery Interestingly, slightly less than half of the students from schools with low quality schoolyards reported that they were satisfied with those yards. There are more frequent responses of satisfaction from students in schools with low landscape score There is a statistically significant relationship between landscape

					<p>features of the schoolyards and BMI values of students</p> <p>Despite the expectations, students from schools with advanced landscape features have higher BMI values than students from schools with less advanced landscape features. These values, however, are in the normal range of BMI values</p> <p>A major critical factor that emerged from this investigation was the necessity for spacious schoolyards for students' play and learning</p> <p>Future projects and design proposals may offer students, parents and teachers the opportunity to participate in improving schoolyards,</p> <p>Future schools should have more access to spacious outdoor school environments with more landscape features and soft materials, rather than concrete and asphalt.</p>
<p>Active by Design: Promoting Physical Activity through School Ground Greening</p> <p>Dyment, J.E. and Bell, A.C. (2007)</p> <p>Canada</p> <p>Children's Geographies</p>	<p>To explore the potential of 'greening' to enhance school grounds in ways that promote active play</p>	<p>Cross-Sectional Study</p> <p>105 parents, teachers and administrators at 59 elementary schools from across Canada</p> <p>At each school, the questionnaires were to be completed by up to three individuals, including if possible a</p>	<p>Strengths:</p> <p>The ethnicity of the population of these schools varied widely</p> <p>The validity of the questionnaire was judged by a panel of six experts</p> <p>Questionnaires were analyzed using a statistical analysis program.</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (Strong methodological quality)</p> <p>CASP Tool for Qualitative Studies (moderate methodological quality)</p> <p>Risk of Bias: Selection bias - purposeful sampling</p>	<p>Green school grounds can play a significant role in promoting physical activity</p> <p>Green school grounds are encouraging more active play, supporting a wider variety of play activities and promoting a better integration of physical activity into school life generally</p> <p>Suggests a strong association between physical activity and one of the common objectives of school ground greening: heightened student</p>

		<p>parent, a teacher and an administrator in order to provide a variety of perspectives</p> <p>Specifically, they examine responses to two survey questions that directly addressed issues of design and school ground culture and aimed to identify the factors affecting active play</p>	<p>Findings are supported by other studies</p> <p>Limitations:</p> <p>Non-randomized</p> <p>Self-reporting</p> <p>Subjective data only</p> <p>External validity</p>	<p>Sampling bias</p>	<p>involvement and sense of ownership in the school ground</p> <p>Design factors are perceived to be the more important determinant of physical activity on school grounds</p> <p>To diversify the school ground, natural elements are of critical importance.</p> <p>There is a strong synergy between the developmental and health benefits of school ground greening and its more traditional purposes, such as promoting hands-on experiential learning and bringing nature back into children's everyday experiences</p> <p>The top limiting design factor was the lack of adequate space. This finding is open to different interpretations, including the most obvious, which is that some school grounds are simply too small to allow adequate opportunities for physical activity</p> <p>Rather than building on the social dynamics of control and dominance, greening has the potential to temper them, by diversifying play opportunities, providing opportunities for non-competitive, open-ended play and fostering more civil and cooperative behavior</p> <p>School rules and policy are needed to ensure that the culture of the school ground is explicitly targeted as a means of promoting physical activity</p>
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					<p>Green school grounds should figure prominently within comprehensive school-based strategies to promote health generally and physical activity specifically</p> <p>High-level political direction is key to ensuring that local interventions are adequately resourced and integrated into existing programs and structures</p>
<p>Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada</p> <p>Bell, A., and Dymont, J. (2006)</p> <p>Canada</p> <p>Evergreen</p>	<p>To take a critical look at the design of school grounds, the rules that govern them, their role in school and community life and the types of play and social interactions that they invite and support</p> <p>Central Research Question: How do green school grounds affect the quantity and quality of physical activity among elementary school children (kindergarten to grade eight)?</p>	<p>Cross-Sectional Study</p> <p>105 respondents including: parents, teachers and administrators at 59 elementary schools from across Canada</p> <p>Mailed questionnaire</p>	<p>Strengths:</p> <p>Survey results span a diversity of geographic and demographic circumstances, as well as a variety of approaches to greening</p> <p>The ethnicity of the population of these schools varied widely</p> <p>Urban, suburban and rural schools are represented, for example, some with fewer than 200 students, and some with over 1,000</p> <p>Questionnaires were analyzed using a statistical analysis program</p> <p>Content validity of the questionnaire was judged by a panel of six experts</p> <p>Supports findings from previous studies</p> <p>Limitations:</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies (Strong methodological quality)</p> <p>CASP Tool for Qualitative Studies (Moderate methodological quality)</p> <p>Risk of bias: Sampling bias</p>	<p>Participants consistently reported that their green school ground is having a positive influence on physical activity</p> <p>Compared to conventional school grounds, green schools grounds appeal to a wider variety of student interests and support a wider variety of play opportunities that promote more vigorous, moderate and light physical activity</p> <p>On green school grounds, a different pattern of activity emerges: more students are engaged in moderate and light physical activity</p> <p>Green school grounds improve the quality of play by encouraging children to be active in ways that promote their physical, social and cognitive well-being</p> <p>The design and culture of school grounds can limit or enable physical activity</p> <p>Undertake a comparative study to monitor (through direct observation and mapping) and measure</p>

			<p>Purposeful sampling protocol used</p> <p>Non-randomized</p> <p>Subjective data only</p> <p>External validity</p>		<p>(through the use of accelerometers or pedometers) children's physical activity behaviours on school grounds with and without green elements</p> <p>Undertake a longitudinal study, tracking cohorts of children as they move through the school system, to explore the influence of greening initiatives on their physical activity and eating patterns over the long term</p> <p>Generally, participants reported that all parts of the school ground are being used to promote all levels of physical activity. Turf and asphalt support more vigorous and moderate levels of activity than light levels of activity. So do play structures, though the emphasis shifts from vigorous to moderate levels of activity</p> <p>A different pattern of activity emerges on greened areas of school grounds: these tend to support more moderate and light activity than vigorous activity</p> <p>Green school grounds across Canada are enriching the quality of children's play in many ways. They are promoting more active, more imaginative and more constructive play, more civil behaviour and a better integration of physical activity into school life generally</p> <p>They are also strengthening the link between play and learning</p>
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					<p>In enhancing the quality of play, green school grounds represent a promising means of getting more children moving – moving in ways that promote physical, social and cognitive health at one and the same time</p> <p>Green school grounds across Canada are encouraging positive changes in student play behaviour, with the large majority of survey participants reporting that their green school ground promotes more cooperative play and more civil behaviour</p> <p>The positive relationship between physical activity and academic success has been repeatedly demonstrated</p> <p>Half of all study participants reporting that green school grounds promote “more” or “much more” moderate and light physical activity among individuals who are typically disadvantaged on conventional school grounds, such as girls, less physically competent children, younger children, children with intellectual and physical challenges, and children from lower-income families</p> <p>Conventional school grounds cater to only a portion of the student population – primarily boys, older students, students with high physical competence, and students from wealthier communities. These are the students who tend to dominate large open areas and play equipment</p>
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					<p>Green school ground now promotes more active play among both boys and girls. Instead of being faced with the limited choice of soccer, baseball or tag on conventional school grounds, children playing on green school grounds can engage in different kinds of play that draw on their physical strengths and personal interests</p> <p>Comparing their school ground before and after greening, survey participants report that their green school ground promotes more vigorous physical activity and more moderate/light physical activity among less physically competent students</p> <p>Green school ground is providing opportunities for children with a range of intellectual and physical abilities to engage in more vigorous and more moderate/light physical activity</p> <p>Greening can help to create a more welcoming environment, inviting more children to participate in physical activity</p> <p>Teachers also need professional development opportunities to build their confidence and competence in teaching outdoors</p> <p>Education ministries should ensure that curriculum policies explicitly state the value of outdoor, experiential learning and provide concrete examples of how the curriculum can</p>
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					<p>be delivered on school grounds</p> <p>Faculties of education and school boards should train teachers how to teach outside the classroom</p>
<p>GAINING GROUND: The Power and Potential of School Ground Greening in the Toronto District School Board</p> <p>Dyment, J. (2005)</p> <p>Canada</p> <p>Evergreen</p>	<p>To explore the impacts of greening initiatives on curriculum delivery and teaching practices, as well as on student learning, behaviour, play and environmental awareness</p> <p>Three main questions guided the research:</p> <ol style="list-style-type: none"> 1. What are the impacts of green school grounds in the TDSB? 2. Are the impacts emerging across a range of different schools and projects? 3. What are the key challenges and opportunities to fully realizing the positive impacts of green school grounds? 	<p>Cross-Sectional Mixed Methods Study</p> <p>45 elementary, middle and high schools in the TDSB</p> <p>41 principals, 39 involved teachers, 36 uninvolved teachers and 33 parents</p> <p>Questionnaires and follow-up interviews</p>	<p>Strengths:</p> <p>Supports previous research</p> <p>Considers issues of social inclusion, health and safety</p> <p>Identifies major challenges and opportunities</p> <p>Respondents differed in age, Gender, teaching experience, and level of involvement and interest in greening initiatives</p> <p>Results varied little across the board, despite the differences among the schools, projects and research participants involved</p> <p>The 149 questionnaire respondents and 21 interviewees associated with 45 different greening projects consistently reported positive impacts</p> <p>Limitations:</p>	<p>NCCEH Critical Appraisal of Cross-Sectional Studies</p> <p>(Strong methodological quality)</p> <p>CASP Tool for Qualitative Studies</p> <p>(Moderate methodological quality)</p> <p>Risk of Bias:</p> <p>Sampling Bias</p>	<p>The majority participants agreed strongly that their school ground greening projects were having significant positive impacts on many aspects of students' and teachers' experiences at school-green school grounds in the TDSB were having a positive influence on curriculum delivery and teaching practices, on student learning, behaviour, play and environmental awareness, and on issues relating to social inclusion, health and safety</p> <p>Participants reported that when students were learning and playing on a green school ground, they were being more civil, communicating more effectively and were being more cooperative</p> <p>Interactions between students and teachers were also enhanced</p> <p>Green school grounds positively influenced many aspects of play, reporting an increase in cooperative and collaborative play, an increase in the diversity of play, a decrease in boredom and a decrease in negative and aggressive play</p> <p>Where play areas were dominated by turf and asphalt, they promoted only limited types of play, notably active, repetitive, rule-bound play through games</p>

			Small sample size		like tag, soccer and four-square
			Non-randomized		In contrast, green school grounds offered a wide range of play opportunities and students were often less bored
			Subjective data only		
			External validity		The diversity of play spaces allowed students more freedom in their play
					Green school grounds stimulated children's imaginations, whereas the barren spaces and manufactured play equipment on conventional school grounds supported repetitious patterns of behaviour
					The nooks and crannies created by the rocks, shrubs and trees on green school grounds invited exploration and imaginative play
					Offering a diversity of play spaces was especially important for young people who had few other opportunities to play outdoors
					For many students, their only outside playtime happened at school, either because many parents worked after school, because parents were concerned about their children's safety outdoors, because there was a lack of outdoor play spaces nearby, or because children were enrolled in after-school programs
					Green school grounds are more inclusive with respect to gender, class, race and ability

					<p>The play patterns of girls and boys are far more complex than such broad generalizations imply</p> <p>Importance of providing a diversity of spaces to accommodate a range of active and quiet play activities, irrespective of gender</p> <p>Green school grounds were more inclusive of people with intellectual disabilities. Unlike conventional school grounds, green school grounds provided a diversity of play areas so that students with distinct needs were better able to find spaces that were safe and suitably challenging. They could also choose from among a wider variety of activities to find one more in line with their abilities and needs</p> <p>Green school grounds helped to provide an inclusive space for people with other differences as well, noting that they were welcoming of people of all ages, sexual orientations and religions</p> <p>One of the greatest health benefits provided by green school grounds is the provision of shade</p> <p>Noted the important role that trees and shelters assumed in creating healthier, cooler and more comfortable play and learning environments for students</p> <p>Green school grounds</p>
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					<p>contributed to students' physical health and safety, for example through the reduction of "knock and bump" injuries</p> <p>Green school grounds presented new health and safety issues, such as allergic reactions to vegetation or insects, injuries from natural elements such as rocks and logs, reduction in sight lines from trees and bushes, and safety concerns about water features</p> <p>Logistical support and human resources are critical to the success of greening projects</p> <p>Conversely, projects blessed with many helping hands and donors/funders were able to overcome commonly cited barriers</p> <p>Adequate and long-term funding is essential to ensure that the benefits of green school grounds are maximized</p> <p>Providing professional development opportunities to student teachers and practising teachers, and training opportunities to other stakeholders (e.g. custodial and grounds maintenance staff) is important</p> <p>At some schools, design was a key enabling factor in the greening process</p>
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Appendix C – Ovid Medline Database Search

Ovid®

Wolters Kluwer

My Account

Support & Training

Help

Logged in as Crystal Merriott at Simcoe Muskoka District Health Unit

Logoff

Search

All Ovid Journals

My Workspace

Ovid MEDLINE(R) without Revisions 1996 to July Week 1 2015

#	Searches	Results	Search Type
1	physical activity/ or play/ or recreation/ or outdoor play.mp.	60343	Advanced
2	outdoor activit*.mp.	627	Advanced
3	playground facilities.mp. or exercise/	58458	Advanced
4	playground equipment.mp.	90	Advanced
5	free play.mp.	345	Advanced
6	free recess.mp.	1	Advanced
7	social development.mp. or social evolution/	1330	Advanced
8	child development.mp. or child development/	25919	Advanced
9	health/ or child health/	20167	Advanced
10	ground greening.mp.	0	Advanced
11	naturalization.mp.	129	Advanced
12	school/ or school yard.mp.	15180	Advanced
13	school child/	0	Advanced
14	child/	694979	Advanced
15	environmental planning/ or green space.mp.	187	Advanced
16	1 or 2 or 3 or 4 or 5 or 6	116084	Advanced
17	7 or 8 or 9	46508	Advanced
18	10 or 11 or 12 or 15	15492	Advanced
19	school children.mp.	9005	Advanced
20	14 or 19	696458	Advanced
21	16 and 17 and 18 and 20	89	Advanced
22	environment design.mp. or exp Environment Design/	3610	Advanced
23	16 and 22	893	Advanced
24	school.mp. or Schools/	103061	Advanced
25	16 and 22 and 24	175	Advanced
26	(canada or united states).cp.	5303952	Advanced
27	25 and 26	95	Advanced

English

Français

Deutsch

日本語

繁體中文

Español

簡體中文

한국어

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Appendix D – PubMed, PsycInfo and EMBASE Database Search

Search terms for the cross-database search in PubMed, PsycInfo and EMBASE

PubMed

((("schoolyard" OR "play and playthings"[MeSH Terms] OR ("play"[All Fields] AND "playthings"[All Fields]) OR "play and playthings"[All Fields] OR "play"[All Fields]) AND outdoor[All Fields]) OR playground[All Fields]) AND ((("child"[MeSH Terms] OR "child"[All Fields]) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields]) OR ("adolescent"[MeSH Terms] OR "adolescent"[All Fields] OR "youth"[All Fields]))ⁱ

PsycInfo

playgrounds OR outdoor play OR (outdoor and play)ⁱⁱ

EMBASE

(((((outdoor play} OR {outdoor activity} OR {outdoor activities} OR {playground facilities} OR {playground equipment} OR {free play} OR playtime OR {playground facility} OR {outdoor play} OR {free recess} OR {school break} OR { outdoor physical activity} OR { outdoor physical activities} OR { outdoor spaces} OR { schoolyard} OR {active playground})) AND (play OR playing)) AND ({social development} OR exercise OR {child development} OR effects OR importance OR benefits OR impact OR beneficial OR {psychological development} OR health OR lifestyle OR {active lifestyle} OR postive OR value OR values) AND PUBYEAR > 1999) AND KEY(schoolchildren) OR KEY(child, preschool) OR KEY(toddlers) OR KEY(adolescents) OR INDEXTERMS(child, preschool) ORⁱⁱⁱ INDEXTERMS(schoolchildren) OR INDEXTERMS(toddlers) OR INDEXTERMS(adolescents) OR KEY(preschool children) OR INDEXTERMS(preschool children) OR TITLE(schoolchildren) OR TITLE(adolescents) OR TITLE(toddlers))) AND NOT (TITLE-ABS-KEY(exposure) OR TITLE-ABS-KEY(contamination) OR TITLE-ABS-KEY(contaminated) OR { soil contamination} OR { contaminated soil})) AND ({outdoor play} OR outdoor)) OR ({playground characteristics} OR { playground specifications} OR {type playground} OR playground PRE/3 TYPE OR {playground design}) AND (LIMIT-TO(SRCTYPE, "j")) AND (EXCLUDE(EXACTKEYWORD, "Injury") OR EXCLUDE(EXACTKEYWORD, "Wounds and Injuries") OR EXCLUDE(EXACTKEYWORD, "Accidental Falls") OR EXCLUDE(EXACTKEYWORD, "Environmental exposure"))

ⁱ Sdfiakfsjdkf:sifka

ⁱⁱ gafiklafikalfikfia

ⁱⁱⁱ dgdfsgdgfgf

Appendix E – EBSCO Host Database Search



Tuesday, March 01, 2016 2:54:42 PM

#	Query	Limiters/Expanders	Last Run Via	Results
S20	S16 AND S19	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S19	S17 OR S18	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S18	meta-analysis	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection:	Display

Appendix E - Continued

			Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	
S17	systematic review	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S16	S14 AND S15	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S15	health	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences	Display

Appendix E - Continued

			Collection;SPORTDiscus with Full Text	
S14	S12 AND S13	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S13	children	Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20100101-20151231 Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S12	S7 AND S9	Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20100101-20151231 Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display

Appendix E - Continued

S11	S7 AND S9	Limiters - Published Date: 20100101-20151231 Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S10	S7 AND S9	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S9	play	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S8	S1 AND S5 AND S7	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases	Display

Appendix E - Continued

			Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	
S7	school	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S6	S1 AND S5	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S5	S2 OR S4	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search	Display

Appendix E - Continued

			Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	
S4	(MH "Natural Environment") OR "built environment"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S3	(MH "Schools, Middle") OR "school yard"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display
S2	ground greening	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development &	Display

Appendix E - Continued

			Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	
S1	"outdoor play" OR (MH "Play and Playthings")	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - Academic Search Premier;Child Development & Adolescent Studies;Cochrane Database of Systematic Reviews;Nursing & Allied Health Collection: Comprehensive;Psychology and Behavioral Sciences Collection;SPORTDiscus with Full Text	Display

Appendix F – Google Scholar Search

Google Scholar Search for +school+ground+greening

[PDF] from cefpi.org

Five successful strategies for greening your school

AB Metzger - Educational Facility Planner, 2011

No school or school district is too far behind to start improving the school environment they provide their students and teachers. A green school can be a new school or an old school, and any effort to make the school healthier, more efficient and more conducive to...

Cited by 2 Related articles All 2 versions Cite More

[PDF] from ulakbim.gov.tr

Place, sustainability and literacy in environmental education: Frameworks for teaching and learning

M Green - Review of International Geographical Education Online, 2012

Abstract The 'ecologisation' of Australian primary schools brings new opportunities for curriculum expansion and renewal for sustainability education. My contribution to the broader discussion of place, geography, sustainability and literacy stems from an interest...

Cited by 5 Related articles All 6 versions Cite More

[PDF] from academicjournals.org

Participation in the greening of schoolyards in the Ankara public school system

A Özdemir, M Çorakçı - Scientific Research and Essays, 2010

This research seeks to examine how schoolyards promote physical activity among children and how these environments can be improved using input from students. The study is based on a project that involved school children, teachers and principals of five public schools in...

Cited by 4 Related articles All 3 versions Cite More

The role of greenery for physical activity play at school grounds

F Mårtensson, M Jansson, M Johansson, A Raustorp... - Urban Forestry & Urban ..., 2014

Abstract Greenery is assumed to promote physical activity at school grounds by facilitating open and flexible play situations that engage many children. The role of greenery for school ground activity was investigated at two schools, one of which contained a substantial...

Cited by 4 Related articles All 7 versions Cite More

[PDF] from tachedaycare.com

Making the Case for Natural Playgrounds

Appendix F - Continued

[A Bienenstock](#) - Interaction: Canadian Child Care Federation, 2010

We've been designing and building playgrounds across North America for child care centers, schools and public parks and institutions for some time now. Our work began intuitively. We were just making playgrounds out of the stuff we played with when we were ...

Cited by 4 Related articles All 10 versions Cite More

[\[PDF\]](#) from ed.gov

Exploring Primary Children's Views and Experiences of the School Ground: The Case of a Greek School.

[V Christidou](#), [I Tsevreni](#), [M Epitropou](#), [C Kittas](#) - International Journal of ..., 2013

The present study explores the use of a conventional school ground of a primary school and its potential as a space for creative play and environmental learning. Children's play behavior and views of the school ground are explored, as well as their vision for its ...

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[\[PDF\]](#) from naturalearning.org

Greening Montessori School Grounds by Design

[R Moore](#), [N Cosco](#) - NAMTA JOURNAL, 2007

Robin Moor?; it id Niida Cosco vom the Montessori approach lo the prepared envtromaati as overlapping their understanding of the naturalization of school grounds. As they present the possibilities for a naturalized setting to overcome sedentary lifestyle* find maximize ...

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[\[PDF\]](#) from uvic.ca

[Biodiverse](#) or barren school grounds: their effects on children

[S Samborski](#) - Children Youth and Environments, 2010

This child-centered study compares the effects on children of two Canadian public school grounds chosen for maximum variability of vegetation, one (Strawberry Vale Elementary) richly [biodiverse](#), the other ([Glanford Elementary](#)) relatively barren. A total of 349 [students](#) ...

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[\[PDF\]](#) from theptc.org

Do our kids have nature-deficit [disorder](#)

[R Louv](#) - Educational Leadership, 2009

A few years ago, I was deeply moved by a photograph I saw on the back page of a magazine. It showed a small boy at the ocean's edge, his tracks receding in the wet sand toward the water. Beyond the sand, one could see a gray sky, a distant island, and a long,...

Appendix F - Continued

Cited by 21 Related articles [Cite More](#)

[\[PDF\]](#) from utas.edu.au

'There's only so much money hot dog sales can bring in': The intersection of green school grounds and socio-economic status

[JE Dymont](#) - [Children's Geographies](#), 2005

Abstract In the interest of enhancing children's environments, many school grounds around the world are being 'greened' as asphalt and manicured grass are replaced with a diversity of elements and spaces, such as trees, shrubs, gardens, art, and gathering areas. Despite a...

Cited by 11 Related articles [All 7 versions](#) [Cite More](#)

Gaining ground: The power and potential of school ground greening in the Toronto District School Board: Evergreen

[J Dymont](#) - [Evergreen](#), Online,(3), 2005

Gaining ground: The power and potential of school ground greening in the Toronto District School Board: Evergreen. [J Dymont](#) [Evergreen](#), Online,(3), 2005.

Cited by 2 Related articles [Cite More](#)

'Our garden is colour blind, inclusive and warm': reflections on green school grounds and social inclusion

[JE Dymont](#), [AC Bell](#) - [International Journal of Inclusive Education](#), 2008

In the interest of enhancing children's environments, communities around the world are 'greening' school grounds, replacing asphalt and manicured grass with a diversity of design elements such as trees, shrubs, gardens, water features, artwork and gathering areas. ...

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[\[PDF\]](#) from utas.edu.au

Green school grounds as sites for outdoor learning: Barriers and opportunities

[JE Dymont](#) - ... [Research in Geographical & Environmental Education](#), 2005

In their review of evidence-based research entitled A Review of Research on Outdoor Learning, [Rickinson](#) et al.(2004) identify five key constraints that limit the amount of outdoor learning. This paper explores whether green school grounds might be a location where ...

Cited by 61 Related articles [All 8 versions](#) [Cite More](#)

Student Participation in School Ground Greening Initiatives in Canada: [Reflections on Research Design Decisions](#) and Key Findings

Appendix F - Continued

[JE Dymment](#) - 2008

This edited collection brings together voices and experiences from around the world, all charged with a similar task: to address participation in the context of environmental, health and sustainability education and to do so within a critical framework. Participation [viewed ...](#)
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[Grounds for movement: green school grounds as sites for promoting physical activity](#)

[JE Dymment](#), [AC Bell](#) - [Health Education Research](#), 2008

Abstract [An](#) environmental factor of particular importance to children's physical activity levels appears to be the presence of parks and open space. Thus, in promoting children's health, school grounds merit consideration as a potential setting for intervention. This [paper ...](#)
[Cited by 97](#) [Related articles](#) [All 10 versions](#) [Cite More](#)

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[Related articles](#) [Cite More](#)

[\[PDF\]](#) from [uiowa.edu](#)

[Evaluation of Abstinence Only Until Marriage Education in Iowa](#)

[EJ Saunders](#), [MJ Landsman](#), [NM Graf](#) - 2007

This report presents evaluation results from the eighth year of the Abstinence-Only Education Program, Iowa Department of Public Health. Although this represents the eighth year of data collection from abstinence-only programs in Iowa communities, it is the [third ...](#)
[Related articles](#) [All 2 versions](#) [Cite More](#)

Appendix F - Continued

[\[PDF\]](#) from [usc.edu](#)

Entertainment or Exploitation: Reality Television and the Inadequate Protection of Child Participants under the Law

[CC Cianci](#) - [S. Cal. Interdisc. LJ](#), 2008

Reality shows have undoubtedly changed the business of television in America while also having an enormous effect on the American television-viewing experience. Considering the form's immense success as a major-and recently crucial'-part of network programming ...

[Cited by 9 Related articles](#) [All 19 versions](#) [Cite More](#)

Students' attitudes and knowledge about genital herpes

[KEM Bruce, CG Bullins](#) - [Journal of Sex Education and Therapy](#), 1989

Undergraduate students at the University of North Carolina at Wilmington (n= 451) and the University of Georgia (n= 157) completed the Herpes Attitudes Scale (HAS) and Herpes Knowledge Scale (HKS) to provide normative data on students' knowledge and attitudes ...

[Cited by 9 Related articles](#) [All 2 versions](#) [Cite More](#)

[\[PDF\]](#) from [gmu.ac.ir](#)

US Children's Bureau

[HAL HANSEN](#) - [Editorial Board](#)

Progressive reformers Florence Kelley and Lillian Wald are generally credited with coming up with the idea for a federal children's bureau. The NATIONAL CHILD LABOR COMMITTEE endorsed the idea in 1905 and the 1909 White House Conference on the Care of ...

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Appendix F - Continued

Google Scholar results of Search: +school +playground +shade structures trees

[PDF] from unilorin.edu.ng

THE PLAYGROUND: AN INTEGRAL PART OF THE NIGERIAN LEARNING ENVIRONMENT

Y AJAYI-DOPEMU

ABSTRACT NIGERIAN schools have an abundance of outdoor space that can be made into exciting playgrounds where children learn through play. This concept is inherent in the open-classroom concept but rarely is it applied to the playground. The work-play playground...

Related articles All 4 versions Cite More

[PDF] from adrina.ca

Exploring Applications of a Tree Inventory Database as a tool for the Toronto District School Board Grounds Division

B Volz - 2009

The Toronto District School Board consists of 600 school properties making it the second largest land holder in the Greater Toronto Area. For the past six years students from the Masters of Forest Conservation program have participated in collecting data for a tree...

Related articles Cite More

[DOC] from usq.edu.au

Shade provision for UV minimization: a review

AV Parisi, DJ Turnbull - Photochemistry and photobiology, 2014

Abstract Minimizing exposure to ultraviolet (UV) radiation is an essential component of skin cancer prevention. Providing and using natural and built shade is an effective protection measure against harmful UV. This article describes the factors that must be addressed to...

Cited by 1 Related articles All 5 versions Cite More

Grounds for health: the intersection of green school grounds and health-promoting schools

AC Bell, JE Dymont - Environmental Education Research, 2008

Despite the growing body of research on green school grounds, relatively little has been written about their relationship with health promotion, particularly from a holistic health perspective. It is this relationship that we explore in this paper—the power and potential of...

Cited by 50 Related articles All 3 versions Cite More

[PDF] from researchgate.net

School grounds as sites for learning: Making the most of environmental opportunities

Appendix F - Continued

[K Malone, PJ Tranter - Environmental Education Research, 2003](#)

Drawing on the findings of an ARC funded project 'Children's Environments and the Role of School Grounds for Enhancing Environmental Cognition', this paper explores the question: What is the role of school grounds as sites for teaching and learning? Observation and ...

[Cited by 158](#) [Related articles](#) [All 7 versions](#) [Cite More](#)

[\[PDF\] from maine.edu](#)

Natural Playgrounds

[A Loomis - Sustainable Portland: Implementation Series, 2008](#)

ABSTRACT: The City of Portland has an opportunity to create sustainability through parks and school grounds. With the installation of natural playgrounds, the city is enhancing recreational opportunities and promoting active lifestyles through school and park venues. ...

[All 2 versions](#) [Cite More](#)

[\[HTML\] from oapublishinglondon.com](#)

Novel and promising sun safety interventions: UV photography and shade structures

[LN Bovers, C Karimkhani, R Gamble, RP Dellavalle](#)

Discussion UV photography has the potential to affect beliefs, opinions, and, ultimately, behaviours in a diverse range of populations. As the academic community continues to document success stories in the literature, UV photography has a unique potential for ...

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[\[HTML\] from mdpi.com](#)

An Environmental Assessment of School Shade Tree Canopy and Implications for Sun Safety Policies: The Los Angeles Unified School District

[A Moreno, J Tangenberg, BN Hilton, JK Hilton - ISPRS International Journal of Geo- ..., 2015](#)

Abstract: In an effort to reforest school sites with limited resources, communities and non-profits have implemented projects on Los Angeles Unified School District (LAUSD) school sites, often without thought for the best location, long-term maintenance, or ...

[Related articles](#) [All 2 versions](#) [Cite More](#)

[\[PDF\] from researchgate.net](#)

North Queensland sun-safety award: lessons learned from a health promotion pilot in local government

[L Bartlett, S Harrison, M Nowak, C Taylor - Journal of Rural and Tropical Public ..., 2009](#)

ABSTRACT Issue addressed: North Queensland (NQ) has the highest rates of skin cancer in the world. The North Queensland Skin Cancer Network aimed to promote sun-safety to a wider audience than their Townsville base. A pilot award scheme was conceived to ...

[Cited by 1](#) [Related articles](#) [All 5 versions](#) [Cite More](#)

Appendix F - Continued

Measurements of the Solar UVR Protection Provided by Shade Structures in New Zealand Primary Schools¶

P Gies, C Mackay - Photochemistry and photobiology, 2004

ABSTRACT To reduce ultraviolet radiation (UVR) exposure during childhood, shade structures are being erected in primary schools to provide areas where children can more safely undertake outdoor activities. This study to evaluate the effectiveness of existing and...

|

Appendix G – Health Evidence Database Search (for systematic reviews and guidelines related to the built environment)

Your Current Search:

Limit:

Intervention Strategy = Built Environment (e.g., housing, urban planning)

Topic Area = Physical Activity

Returned **30 results**

☐ All

	Article	Authors	Date	Rating
1 <input type="checkbox"/>	Reducing obesity and related chronic disease risk in children and youth: A synthesis of evidence with 'best practice' recommendations Highly Accessed Summarized	Flynn, M.A., et al.	2006	Strong
2 <input type="checkbox"/>	Interventions to promote walking: A systematic review Highly Accessed Summarized	Ogilvie, D., et al.	2007	Strong
3 <input type="checkbox"/>	Physical activity interventions in Latin America: A systematic review Highly Accessed	Hoehner, C.M., et al.	2008	Strong
4 <input type="checkbox"/>	Organisational travel plans for improving health Highly Accessed	Hosking, J., et al.	2010	Strong
5 <input type="checkbox"/>	Interventions to promote cycling: Systematic review Highly Accessed	Yang, L., et al.	2010	Strong
6 <input type="checkbox"/>	Addressing childhood obesity: The evidence for action (Report) Highly Accessed Summarized	Booth, M., et al.	2004	Strong
7 <input type="checkbox"/>	Community wide interventions for increasing physical activity Highly Accessed Summarized	Baker, P.R., et al.	2015	Strong
8 <input type="checkbox"/>	The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review Highly Accessed Summarized	Heath, G.W., et al.	2006	Strong

Appendix G – Continued

9	<input type="checkbox"/>	<u>The effectiveness of interventions to increase physical activity among adolescent girls: A meta-analysis</u> Highly Accessed	Pearson N., et al.	2015	Strong
10	<input type="checkbox"/>	<u>Effect of changes to the school food environment on eating behaviours and/or body weight in children: A systematic review</u> Highly Accessed	Driessen C.E., et al.	2014	Strong
11	<input type="checkbox"/>	<u>Cycling for transport and public health: A systematic review of the effect of the environment on cycling</u> Highly Accessed	Fraser S.D., et al.	2011	Strong
12	<input type="checkbox"/>	<u>What interventions increase commuter cycling? A systematic review</u>	Stewart G, et al.	2015	Moderate
13	<input type="checkbox"/>	<u>Adapting health promotion interventions to meet the needs of ethnic minority groups: Mixed-methods evidence synthesis</u>	Liu JJ, et al.	2012	Moderate
14	<input type="checkbox"/>	<u>Effectiveness of physical activity interventions for preschoolers: A meta-analysis</u>	Gordon ES, et al.	2013	Moderate
15	<input type="checkbox"/>	<u>The impact of interventions to promote physical activity in urban green space: A systematic review and recommendations for future research</u>	Hunter R.F., et al.	2015	Moderate
16	<input type="checkbox"/>	<u>A systematic review of standing and treadmill desks in the workplace</u> Highly Accessed	MacEwen B., et al.	2015	Moderate
17	<input type="checkbox"/>	<u>A place for play? The influence of the home physical environment on children's physical activity and sedentary behaviour</u>	Maitland C, et al.	2013	Moderate
18	<input type="checkbox"/>	<u>Impact of recess interventions on children's physical activity-A meta-Analysis</u>	Erwin H, et al.	2014	Moderate
19	<input type="checkbox"/>	<u>The impact of the natural environment on the promotion of active living: An integrative systematic review</u>	Calogiuri G, et al.	2014	Moderate
20	<input type="checkbox"/>	<u>Population approaches to improve diet, physical activity, and smoking habits: A scientific statement from the American heart association</u>	Mozaffarian D., et al.	2012	Moderate

Appendix G – Continued

<u>from the American heart association</u>				
21	<input type="checkbox"/>	<u>Low-income groups and behaviour change interventions: A review of intervention content, effectiveness and theoretical frameworks</u>	<u>Michie, S.</u> , et al.	2009 Moderate
22	<input type="checkbox"/>	<u>Community-based interventions to reduce overweight and obesity in China: A systematic review of the Chinese and English literature</u>	<u>Gao, Y.</u> , et al.	2008 Moderate
23	<input type="checkbox"/>	<u>Physical activity levels of children during school playtime</u>	<u>Ridgers, N.D.</u> , et al.	2006 Moderate
24	<input type="checkbox"/>	<u>Interventions aiming at balance confidence improvement in older adults: An updated review</u>	<u>Bula, C.J.</u> , et al.	2011 Moderate
25	<input type="checkbox"/>	<u>Meta-analysis of school-based childhood obesity interventions in the U.K. and U.S.</u> Highly Accessed	<u>Kanekar, A.</u> , et al.	2008 Moderate
26	<input type="checkbox"/>	<u>Physical activity interventions in Latin America: Expanding and classifying the evidence</u>	<u>Hoehner CM</u> , et al.	2013 Moderate
27	<input type="checkbox"/>	<u>Playground designs to increase physical activity levels during school recess: A systematic review</u> Highly Accessed	<u>Escalante Y</u> , et al.	2014 Moderate
28	<input type="checkbox"/>	<u>A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: What works?</u> Highly Accessed	<u>Matson-Koffman, D.M.</u> , et al.	2005 Weak
29	<input type="checkbox"/>	<u>Infrastructure, programs, and policies to increase bicycling: An international review</u> Highly Accessed	<u>Pucher, J.</u> , et al.	2010 Weak
30	<input type="checkbox"/>	<u>A systematic review of interventions to promote physical activity in the preschool setting</u>	<u>Temple M.</u> , et al.	2014 Weak

Appendix H – Ovid MEDLINE Database Search (for systematic reviews and guidelines related to the built environment)

Ovid MEDLINE(R) 1946 to November Week 1 2015			
#	Searches	Results	Search Type
1	meta <u>analysis</u> .mp.pt.	89140	Advanced
2	<u>systematic</u> review.tw.	53156	Advanced
3	<u>cochrane</u> database of systematic reviews.jn.	11707	Advanced
4	<u>exp</u> guideline/	27387	Advanced
5	guideline.pt.	15736	Advanced
6	<u>practice</u> guideline.pt.	21007	Advanced
7	<u>guideline</u> .ti.	8259	Advanced
8	meta <u>synthes</u> *.ti.	156	Advanced
9	<u>integrative</u> review.tw.	938	Advanced
10	<u>integrative</u> research review.tw.	38	Advanced
11	<u>rapid</u> review*.tw.	170	Advanced
12	<u>consensus</u> development conference.pt.	9851	Advanced
13	<u>practice</u> guideline.pt.	21007	Advanced
14	<u>acp</u> journal <u>club</u> .jn.	153	Advanced
15	<u>evidence</u> based.ti.	18470	Advanced
16	<u>evidence-based</u> medicine.mp.	63449	Advanced
17	<u>best</u> practice*.ti.	2633	Advanced
18	<u>evidence</u> <u>synthesis</u> .ti.ab.	1534	Advanced
19	(<u>systematic</u> or <u>systematically</u> *) .tw.	225672	Advanced
20	<u>review</u> .ti.	261843	Advanced

Appendix H - Continued

21	handsearch.mp.	117	Advanced
22	medline.tw.	60757	Advanced
23	review.pt.	2031770	Advanced
24	<u>search</u> :tw.	249233	Advanced
25	or/1-24	2502183	Advanced
26	<u>healthy</u> weight*.mp.	1393	Advanced
27	<u>exp</u> Obesity/	159242	Advanced
28	<u>exp</u> Body Weight/	378126	Advanced
29	body mass index/	92843	Advanced
30	(Physical* adj3 <u>activ</u> *) <u>mp</u> .	67546	Advanced
31	Exercise/	73640	Advanced
32	Motor Activity/	85456	Advanced
33	Physical Fitness/	23414	Advanced
34	Walking/	22992	Advanced
35	Bicycling/	8439	Advanced
36	<u>exp</u> Running/	14935	Advanced
37	Recreation/	5473	Advanced
38	Built environment*.mp.	1309	Advanced
39	Architectural Accessibility/	1146	Advanced
40	Environment Design/	4342	Advanced
41	City Planning/	1780	Advanced
42	rural health/ or suburban health/ or urban health/	35541	Advanced
43	Residence Characteristics/	23372	Advanced

Appendix H – Continued

44	(<u>urbanization</u> or <u>urbanisation</u>). <u>mp.</u> [<u>mp</u> =title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	8656	Advanced
45	" <u>smart growth</u> ". <u>mp.</u>	36	Advanced
46	<u>sidewalk*</u> . <u>mp.</u>	404	Advanced
47	((<u>bike</u> or <u>bikes</u> or <u>bicycle</u> or <u>bicycles</u>) adj3 (<u>road*</u> or <u>path*</u> or <u>lane*</u>)). <u>mp.</u>	183	Advanced
48	(<u>trail</u> or <u>trails</u>). <u>mp.</u> [<u>mp</u> =title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	13208	Advanced
49	<u>street connectivit*</u> . <u>mp.</u>	110	Advanced
50	(<u>Physical*</u> adj3 <u>activ*</u>). <u>mp.</u>	67546	Advanced
51	Exercise/	73640	Advanced
52	or/26-37	630259	Advanced
53	or/38-49	84672	Advanced
54	52 and 53	7611	Advanced
55	limit 54 to (<u>english language</u> and <u>yr</u> ="2010 -Current")	3808	Advanced

Appendix H - Continued

56	25 and 55	354	Advanced
57	Built environment*.ti.	432	Advanced
58	25 and 57	75	Advanced
59	55 or 58	3856	Advanced
60	56 or 58	402	Advanced
61	limit 60 to (english language and yr="2010 -Current")	371	Advanced