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Original Article

Effectiveness of School Built Environment on Physical Activity in Children: a Systematic Review

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Abstract: Physical inactivity in children has become a major public health issue today. School is an important and preferred environment for promoting physical activity (PA). The aim of the study was to review the effectiveness of various schools built environment on the level of PA in children and identified efficacious intervention components. The review covered publications between July 2007 and August 2012. Through a systematic search, 28 articles were retrieved for the review. Study design, methodology, built-environment variables, and effectiveness of the intervention on the levels of PA in children were analyzed. Most studies examined motor performance and physical environment pertaining to PA; while 3 studies included body-mass-index (BMI) as a variable. Interventions effect were influenced by the intervention type. Children who attended schools with larger yards, more facilities and recreational space, sports policies, and active setting were physically more active than children in traditional schools. There is an evidence for the long-term effectiveness intervention to increase PA in children by active setting in school built environment. Future research should use appropriate and higher methodologies quality and clarify the extent to which school-built environment intervention can positively influence children's PA levels. It is recommended that specific schools policies should be implemented in order to enhance and improve the built environment for physical activity that is likely to be beneficial for health and well-being.

Key words: **built environment, school, physical activity**

Introduction

Physical inactivity (PA) has become a major health concern today. Physical inactivity is strongly associated with increased obesity, adolescent metabolic syndrome, and risk of cardiovascular diseases.[1,2] Children who engage in regular physical activity have a better mental and physical well-being,[3,4] including reduced risk of cardiovascular diseases, preventing childhood obesity, improved bone density, social development, decreased feelings of depression, and improved cognitive performance.[5-7]

Despite the positive effects associated with physical activity observed in the last 20 years, PA has declined significantly among children.[8-10] Current data from the World Health Organization (WHO) indicates that many children do not meet the current rec-

ommendations of 60 minutes of moderate-to-vigorous-intensity physical activity (MVPA) daily.[11] The National Statistical Office of Thailand in 2011 found that less than 30% of Thai children aged above 11 years regularly engaged in physical activity, while only 7.6% of children are physically active in school compounds.[12] According to the Thai Health Promotion Foundation, the common excuses for inactivity for instance include lack of time, sport facilities and equipment.[12]

Since children spend significant amounts of their time in school, the setting is important for promoting PA.[13-14] Although physical education (PE) programs could make an important contribution to physical activity, there are considerable barriers to curriculum implementations.[15] Several studies place emphasis on activity beyond PE and focus on other non-curricular approaches such as school environment and/or polices. These approaches align well with ecologic models used in active living and health promotion.[16]

In recent years, there has been a growing understanding on the role the school-built environment plays in physical activity, and numerous interventions have been carried out.[17] Many studies demonstrated that availability of facilities significantly predicted the level of physical activity and this is effective in increasing PA.[18-20] However, studies related to children's PA in school, particularly on the built environment, are still limited and results are inconclusive. Furthermore, little is known on the influence of the school built environment and what characteristics of the built physical environment support PA in children. Hence, it is beneficial to systematically review the outcomes of school-built environments on the level of PA in children to make evidence-based recommendations for policy implementations.

The present systematic review aims to examine the effectiveness of various schools built environment on the level of PA in children and to identify critical characteristics of interventions. The effects of the interventions were examined on the level of PA and health and fitness outcome variables. Furthermore, this review evaluated the challenges face among school built environments and modeled the changes in children's physical activity. Finally, findings from the selected intervention studies were lead to policy recommendations.

Methods

In this systemic review, "school built environment" was defined as anything made or modified by humans which is external to the individual but within the school boundaries. Variable elements of the built environment which are more likely to influence individuals rather than populations were excluded.

This review focused on available current literature. A literature search was carried out covering publications between July 2007 and August 2012. Relevant publications were identified through a structured search on the following databases: ScienceDirect, PubMed, and Journal of Physical Activity and Health.

The database search retrieved 1,565 articles. First, the list of titles and abstracts were screened using the different keywords combinations (Table 1). Then, all titles and abstracts of identified publications were reviewed for relevance by a single researcher. After review of titles and abstracts, 158 articles were retrieved. A more detailed review of the full text of retrieved articles was undertaken. Studies were eligible if they met the following criteria.

Inclusion criteria:

- participants were students in primary or secondary school.
- primary studies investigated the role of built

Table 1 Categories and keywords for the literature search

Category	Scope
Population	students; children; youth; adolescents; boys; girls
Setting	school; school-built; built-environment
Outcome	intervention increase physical activity; level of physical activity; effectiveness of built-environment on physical activity

environment.

- intervention(s) were any changes to the school built environment including policies specific to the school built environment.
- outcomes measured by the level of physical activity

Exclusion criteria:

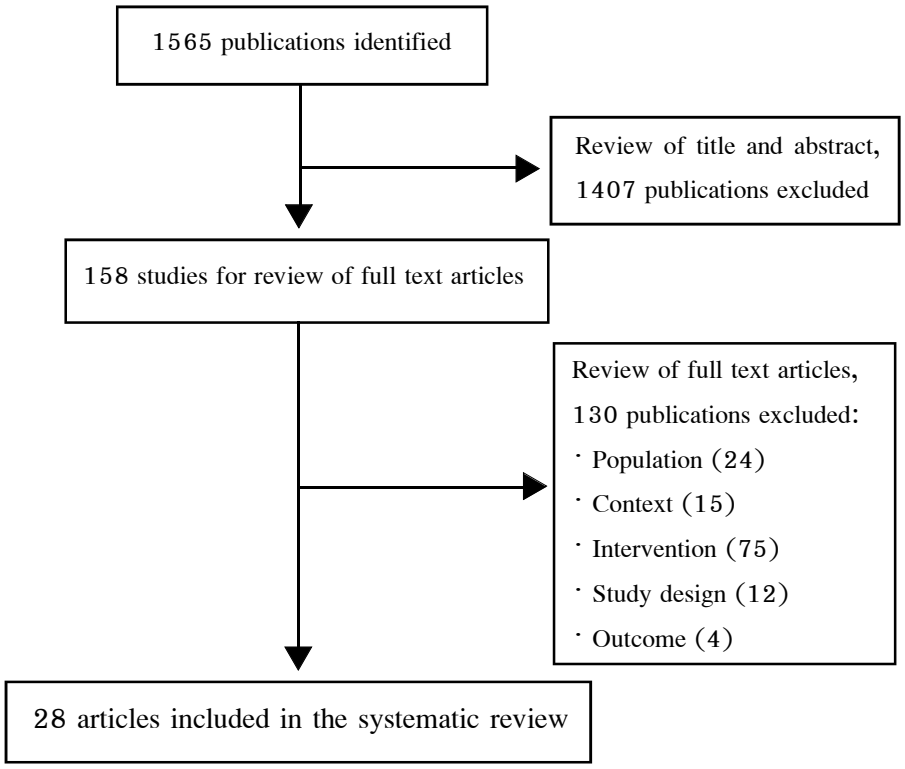
- non-English articles.
- studies not specifying results of the effects of built-environment on children's PA levels.
- specific population targeting overweight individuals, person with physical or mental disability.

The researchers independently assessed full-texts of included studies with regard to relevance and methodological quality. All selected studies were examined to ensure the independence of study participants and that samples did not overlap resulting in a total number of 28 reviews that met the criteria.

Results

Figure 1 illustrates the identification process of the study. The bibliographic databases identified that most of the studies were carried out in North America

Figure 1 Flow-diagram of identification of included studies



and Europe (187 studies), with majority in the United States of America, our literature searched identified 1,565 references and we assessed the full-text of 158 documents. Twenty-eight studies met all the selection criteria and were included in this review. Detailed description of the included studies is presented in Table 2.

The majority of the studies were conducted in USA. There were 15 studies conducted in the USA, 4 in the United Kingdom, 2 in New Zealand, 2 in Turkey, while there was one study each in Canada, Denmark, Belgium, Australia, and Malaysia. In total, there were over 139,595 children, with 3 studies with unspecified number of children participants. Three studies examined only girls, and 25 studies included both boys and girls. Children in the review included preschoolers, primary, and secondary level students.

The studies examined variety of outcome variables. Most studies examined motor performance and physical environment pertaining to PA. Though, few studies included body-mass-index (BMI) as a variable. Five studies examined school policy and recreational spaces utilizations towards children physical activity. One study used pedometer to calculate amount of physical activity, while few studies relied on the use of accelerometer. However, majority of the studies based their results of PA on self-reported questionnaires.

The findings were further grouped into 3 categories: (1) studies that showed highly significant increase in PA levels, (2) studies that were significant but there were variations among the investigated variables, and (3) studies that did not show significant increase in the children's level of physical activity. Seven studies (# 2, 4, 5, 12, 19, 20, 21) were of high significance, 14 studies (#3, 5, 7, 8, 11 13, 14 ,16, 17, 18, 23, 24, 27, 28) were of significance with variations, and 6 studies (#1, 9, 10, 22, 25, 26) that were not significant in the increase in PA levels. One study (#15) did not report test for significance, but reported an increase in the levels of PA.

Three studies (#1, 13, 16) further investigated effects of built environment on children's BMI. One study reported no significant difference in the levels of BMI compared to physical activity, while 2 studies reported children in schools with larger yards and/or more built facilities had higher PA levels and lower BMI.

Overall, majority of the studies concluded there were direct effects of school playground facilities on the levels of children's PA. Children who attended schools with larger yards, more facilities and recreational space, sports policies, and active setting were physically more active than children in other schools.

Table 2 Summary characteristics of the included studies

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
1.	School physical activity environment related to student obesity and activity: a national study of schools and students	O' Malley et al. (2009)/ Journal of Adolescent Health	48 states in USA/cross sectional study	8th, 10th, and 12th grade students in 410 public and private schools (N=70,000)	Availability of field, indoor and outdoor PE facilities on PA	No significant association differences in children's BMI. Significantly higher PA in 8th graders only.	Existing variation in PA polices may not be sufficient to produce discernible school-wide differences in PA. PA is an important part to reduce child obesity.
2.							

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
2.	Do physical facilities near schools affect physical activity in high school girls?	Trilk et al. (2011)/Health & Place	South Carolina, USA/cross sectional study	Girls (N=1394) in 9th grade and followed up during the 12th grade in 22 high schools	Number of PA facilities, total MET weighted blocked per day, 2 + blocks MVPA, 1 + block VPA per day.	Schools with ≥ 5 facilities have higher PA in all three physical variables than schools with < 5 facilities.	Built environment in and surrounding the school encourage PA among students.
3.	School sport policy and school-based physical activity environments and their association with observed physical activity in middle school children.	Bocarro et al. (2011)/Health & Place	North Carolina, USA/cross sectional study	4 middle schools (N=6735)	School physical environment, school's sport policy (intramural and varsity), social environment (adults supervision). School sport policies (intramural and varsity), PA settings in schools, and supervision.	Active setting (uses of gyms and tracts) increases the level of children PA. Significant variations between genders. Boy attending intramural schools had higher PA than boys attending varsity schools. No significant association in supervision within girls, but significant associations for boys.	Policy change within schools relating to sports polices in middle school will affect the levels of PA among children.
4.	School design and physical activity among middle school girls	Cohen et al. (2008)/ Journal of Physical Activity and Health	California, Louisana, Maryland, Minnesota, and South Carolina/ cross-sectional study	6th grade students (n=1566)	School physical environment (building design and size of ground).	Significant increase of PA levels among children when there are more number of active facilities in school. School design was associated with levels of PA.	Number of amenities and facilities can influences the levels of MVPA of children.
5.	The childcare environment and children's physical activity	Bower et al. (2008)/ American Journal of Preventive Medicine	North Carolina, USA/cross sectional study	20 childcare centers	Physical activity environment (areas), staff behavior, PA policies.	Centers with supportive environments have higher moderate-to-vigorous physical activity. Positive interaction between staff and children promote PA among children. PA policies related weakly to PA.	Specific aspects in child care environment influence PA behavior.More active play time is one of the cheapest and simple way to improve children's PA levels.

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
6.	Changing the school environment to increase physical activity in children	Lanningham-Foster et al. (2008)/ Obesity	Minnesota, USA/cross-sectional study	Grade 4-5 elementary school children (n=40)	School environments (Traditional school with chairs and desks, activity-permissive, and standing classroom).	Children on summer vacation are physical more active. Significance higher level of PA in children attending activity permissive schools compared to other schools. Activity-permissive school had PA level identical to PA level of children on summer vacation.	Activity-promoting classrooms can help children move more and possibly a way to increase PA levels in school.
7.	Characteristics of school campuses and physical activity among youth	Cradoc et al. (2007)/ American Journal of Preventive Medicine	Boston, USA/cross-sectional study	10 middle schools (n=248)	School physical environment and play areas on the levels of PA in children.	Larger school campus, building, and play areas were associated with increase levels of PA.	School campus areas and youth PA are directly associated.
8.	The school effect on children's school time physical activity: The PEACH Project	Griew et al. (2010)/ Preventive Medicine	Bristol, UK/cross-sectional study	23 primary schools, (n=1307) aged 10-11 years	Sporting facilities, campus size.	Significant school effect on variances of the levels of PA among students.Greater variability in school-time-physical activity among boys than girls.	Schools should be accounted to an extend for children's physical activity.
9.	Promoting physical activity at the pre-school playground: The effects of providing markings and play equipment	Cardon et al. (2009)/ Preventive Medicine	Flanders, Belgium/ cross-sectional study	40 public pre-schools, (n=583)	Play equip-ments and markings on school playground.	Play equipments and markings on playgrounds were not effective in increasing the activity levels of children.	Providing playground markings is not sufficient to increase activity levels.
10.	Fifth-, sixth-, and seventh- grade students' use of non-classroom spaces during recess: The case of three private schools in Izmir, Turkey	Kasah & Dogan (2010)/ Journal of Environmental Psychology	Izmir, Turkey/ cross-sectional study	5^{th}, 6^{th}, 7^{th} grade students (n=173)	School free space, physical facilities.	None significant associations of spatial features and students' activity level.	Non-classroom spaces and proper school designs may have major impact on children PA.

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
11.	The role of recreational spaces in meeting physical activity recommendations among middle school students	Chomitz et al. (2011)/ Journal of Physical Activity and Health	Massachusetts, USA/ cross-sectional study	6-8th grade students (n=926)	Recreational spaces on children PA.	Significant associations with recreational spaces on PA recommendations, though there are variations among gender, race/ethnicity, and language.	Recreational space utilization is a predictor for PA levels.
12.	School playground facilities as a determinant of children's daily activity: A cross-sectional study of Danish primary school children.	Nielsen et al. (2012)/ Journal of Physical Activity and Health	Copenhagen, Denmark/ cross-sectional study	18 preschools and elementary schools (n=1,112)	Number of play facilities were positively associated with children's level of PA. Every 10 additional play facilities was associated with 14% increase count in accelerometer.	Number of facilities positively association with children's PA levels.Higher levels of association among facilities and PA in 3rd grade students than preschool students.	Environment factors have strong influence on children's PA.
13.	Contribution of the school environment to physical fitness in children and youth	Kelly et al. (2010)/ Journal of Physical Activity and Health	Georgia, USA/cross-sectional study	5th and 7th graders in 93 schools (N=5248)	Physical environment, social environment, and PE classes on PA levels.	Significant increase when combined school level variables and PA levels. Variation shifts in levels of BMI	Physical education, physical environment, and school policies influence PA levels in children.
14.	Associations between the school environment and adolescents girls' physical activity	Kirby et al. (2011)/Health Education Research	Scotland, UK/cross-sectional study	School physical environment (sports facilities), physical education allocation and levels of MVPA.	Significant difference among schools. Girls attending schools with more facilities had higher MVPA.	Significant difference among schools. Girls attending schools with more facilities had higher MVPA.	School environment should be maximize in order to increase PA.

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
15.	Relationship between the outdoor physical environment and students' social behavior in urban secondary school	Shamsudiin et al (2012)/ Social and Behavioral Sciences	Selangor, Malaysia/ cross-sectional study	All students in 2 secondary schools (N=not specified)	School physical environment (buildings, facilities, and outdoor environment).	The school built environment enhances PA in children (no test for significant). Use of more materials and facilities will create excitement for user, while school landscape plays important role in promoting PA (no statistics use to test).	Design of a school should be consider in creating a more conduction learning and physical environment.
16.	Assessment of outdoor school environments and physical activity in Ankara's primary school	Ozeemir & Yilmaz (2008)/ Journal of Environmental Psychology	Ankara, Turkey/ cross-sectional study	3rd and 4th grade students in 5 public schools (n=290)	School yards, dietary habits, BMI.	Children in schools with larger yards had higher PA levels and lower BMI. Outdoor environment in schools is correlated to health outcomes.	Improving physical and landscapes in school will increase the health of children.
17.	Long term effects of physical intervention in high school girls	Pate et al. (2007)/ American Journal of Preventive Medicine	Carolina, USA/cross-sectional study	Adolescent girls in 22 high schools (n=1594)	Intervention was a combined physical education and increase of school facilities.	Girls in intervention schools had significantly higher vigorous physical per day.	A multicomponent school base intervention has positive influence on students' PA.
18.	Long-term effects of a playground markings and physical structures on children's recess physical activity levels	Ridgers et al. (2007)/ Preventive Medicine	North West England UK/cross-sectional study	26 elementary schools, 15 intervention schools and 11 control schools. 232 boys and 238 girls (n=470)	Playground design (basketball loops, goal posts, fencing) with multicol-ored zonal designs for intervention.	Significant higher levels of moderate-to-vigorous and vigorous physical activity levels in intervention schools.	Playground markings and physical structures are effective in increasing in children's PA.
19.	Permanent play facilities in school playgrounds as a determinant of children's activity	Nielsen et al. (2010)/ Journal of Physical Activity and Health	Otago, New Zealand/ cross-sectional study	Primary school children from 7 schools (n=417)	Number of playground facilities and surface area of the grounds on levels of children's PA.	Additional playground facility was significant associated with 4 minutes more MVPA. School area did not affect physical activity.	Increasing play facilities in school may have a direct impact on children's PA.

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
20.	The physical activity climate in Minnesota Middle and High Schools	Samuelson et al.(2010)/ Journal of Physical Activity and Health	Minnesota, USA/3-years cohort study	115 middle and high schools	School environment and PA policies.	High schools students were more physically active with significant higher number of facilities in school.	School policies and environment effects both short and long-term PA in schools.
21.	Environmental correlates of objectively measured physical activity and sedentary behavior in after-school recreation sessions	Rosenkranz et al.(2011)/ Journal of Physical Activity and Health	Kansas, USA/cross-sectional study	7^{th} and 8^{th} grade students (n=240)	Environment characteristics, equipments.	School characteristics and organization of the environment was significant correlated with higher MVPA in children.	School characteristic appear to affect PA of children in both genders.
22.	Twelve-month effects of a playground intervention on children's morning and lunchtime recess physical activity levels.	Ridgers et al.(2010)/ Journal of Physical Activity and Health	City in North West England, UK./cross-sectional study	26 primary schools (N=470)	Interventions on sport playground design.	Not significant increase in the levels of MVPA in children, but significant increase in children's VPA during recess sessions.	Playground marking and physical structure may contribute to children's MVPA and VPA levels.
23.	A multilevel examination of gender differences in the association between features of the school environment and physical activity among a sample of grades 9 to 12 students in Ontario, Canada	Hobin et al.(2012)/ BMC Public Health	Ontario, Canada/ cross-sectional study	9 – 12 grade students in 76 secondary schools (N=21754)	School built environment and children's physical activity.	Significant differences in children's PA in schools with better equipped facilities and PA rooms.	Environmental factors within schools plays significant roles in luring children to be physically active.
24.	What neighborhood area captures built environment features related to adolescent physical activity?	Boone-Heinonen et al.(2010)/ Health & Place	USA/cross-sectional study	11-22 years of age children (n=20,745)	School built environment and physical environment on physical activity.	Significant variations among school built environment and physical characteristics with MVPA.	Neighborhood and school environment could lead to potential differences on the levels of PA in children.
25.	Adolescent physical activity and built environment: A latent class analysis approach	McDonald et al.(2012)/ Health & Place	Minnesota, USA/ longitudinal study	10-16 years old children (n=344)	Physical and built characteristics.	No significant differences in types of built characteristics and adolescents physical activity.	There are potential effects of built environment on adolescents physical activity, but require additional research.

Table 2 Summary characteristics of the included studies (continue)

	Title	Author (Year)/Journal	Location/ study design	Sample size	BE intervention or variable	Results/ Level of PA	Significance of study
26.	A cross-sectional study of the individual, social, and built environmental correlates of pedometer based physical activity among elementary school	McCormack et al.(2011)/ Journal of Behavioral Nutrition and Physical Activity	Perth, Australia/ cross-sectional study	10-12 years old children (n=1480)	School physical environment, sedentary and active leisure-time behavior, active transportation and physical activity.	No significant differences for physical environment and physical activity using pedometers.	Physically active environment and encouragement of active travel might encourage more PA in children.
27.	Changing the School Environment to Increase Physical Activity in Children	Lanningham-Foster et al.(2008)/ Obesity	Rochester, Minnesota, USA/cross-sectional study	Grade 4-5 children (n=40)	School physical environment and children physical activity.	Children in more activity-permissive environment are more PA compared to traditional school environment.	School environment plays a significant role in children's physical activity. Schools may have to be re-designed to promote physical activity.
28.	School playgrounds and physical activity policies as predictors of school and home time activity	Taylor et al.(2011)/ Journal of Behavioral Nutrition and Physical Activity	Dunedin, New Zealand/ cross-sectional study	16 primary schools (n=441)	School facilities and policies with children MVPA.	Number of school facilities was associated with higher totally physical activity.	Increasing number of permanent play facilities may offer a cost-effects long term approach to increase PA levels in children.

Discussion

In recent years, there has been an increase in the number of studies examining the effectiveness of school-based physical activity intervention. The aim of this review was to examine the current evidence on the effectiveness of school built environment on the children's PA level. Unlike many other reviews, this review incorporated a wide variety of bibliographic databases including studies outside the medical field and restricted to studies within the last 5 years.

Certain methodologies points were highlighted in this study. Physical activity was not defined or measured consistently among the studies, which might affect the comparability of outcomes. Most evidence on built environment and PA studies used a cross-sectional design which cannot provide strong support for causality. Hence, more longitudinal studies were recommended. Little was mentioned about intervention exposure and drop-out rate. Various statistical analyses were used to determine the differences in physical activity. Most studies emphasized on but not subjected to only moderate-to-vigorous physical activity levels.

Another observation in this review was the different assessments used for the PA levels. In this review, the level of children's PA was mostly based on self-reported PA questionnaires. The participants' subjective reports for their PA level could possibly be

bias. Many studies had pointed out that subjective reports might be overestimate.[21-23] Therefore, the accurate measurement of PA is critical to determine the levels of PA and assess the effectiveness of interventions to improve physical activity.

Hence, the reliability of the measurement may be questionable. Furthermore, many authors did not provide information on the validity of the research tool. It is understandable that the validity of PA questionnaire is challenging as one "golden rule" does not exist. However, surprisingly, no studies mentioned or used Global Physical Activity Questionnaire (GPAQ), a WHO validated physical activity questionnaire.[24]

Though, the review showed that there were significant variations among PA in genders, both boy and girls were more likely to be more physically active when there were improvements to the physical environment. While physical activities of children vary with gender, age, type of activity, and numerous factors, the setting of the school was shown to be an important place which can directly influence the children's PA level. This correlates well with many other studies that demonstrated that school is an appropriate environment intervention for PA in children.[25-28]

There are few limitations to this review. One limitation is that almost all of the studies are cross sectional and are not follow-up studies that measure the outcome over a period of time as opposed to the immediate PA outcome in cross sectional design. Only one study had a 3 years follow up period. Another limitation is that the review includes studies from only 2 databases and 1 journal while excluding other bibliographic databases and grey literature. The review may have yielded few articles perhaps partially due to only articles in English were retrieved.

Based on the consistent positive associations between the school facilities and activity levels of children, it is fair to say interventions that target school built environment are expected to be effective in stimulating student physical activity. Increasing the number of play facilities in school could be a lasting way to increase children's daily physical activity. It is recommended that interventions should seek to incorporate individual behavior change strategies with policy and environmental changes in order to make a substantial and sustainable impact on children's physical activity.

Data suggested that designing activity promoting buildings, facilities, and areas would enable children to be more active. Hence, schools build in the future should consider the design to enhance children's PA levels. In future studies, a stronger focus should be placed on the investigation on the extent on which built environment can positively influence the children's PA and ways in which it can be meditated to effect students' levels of physical activity. Furthermore, a much larger-scale studies with high methodological quality are recommended to generate the much needed evidence.

Based on the results of the review, there is an evidence for the long-term effectiveness intervention to increase PA in children by active setting in school built environment. Future research should use appropriate and higher methodologies quality and clarify the extent to which school-built environment intervention can positively influence children's PA levels. It is recommended that specific schools policies should be implemented in order to enhance and improve the built environment for physical activity that is likely to be beneficial for health and well-being.

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บทคัดย่อ: ประสิทธิผลของการจัดการสิ่งแวดล้อมทางกายภาพในโรงเรียนต่อการมีกิจกรรมทางกายของนักเรียน: การทบทวนวรรณกรรมอย่างเป็นระบบ

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การมีกิจกรรมทางกายไม่เพียงพอกลายเป็นปัญหาสุขภาพที่สำคัญประการหนึ่งในประชากรเด็ก และเนื่องจากประชากรกลุ่มนี้ ใช้เวลาอยู่ในโรงเรียนเป็นระยะเวลานาน โรงเรียนจึงเป็นสถานที่ที่สามารถมีผลต่อระดับการมีกิจกรรมทางกายของเด็ก การศึกษานี้มีวัตถุประสงค์เพื่อทบทวนวรรณกรรมเกี่ยวกับประสิทธิผลของการจัดสิ่งแวดล้อมทางกายภาพ (Built environment) ในโรงเรียนที่มีต่อระดับการมีกิจกรรมทางกายของนักเรียน รวมทั้งสังเคราะห์ปัจจัยสำหรับประสิทธิผลของมาตรการต่อการส่งเสริมการมีกิจกรรมทางกาย การศึกษานี้เป็นการทบทวนวรรณกรรมอย่างเป็นระบบ โดยทบทวนวรรณกรรมภาษาอังกฤษซึ่งตีพิมพ์ ในวารสารวิชาการระหว่างเดือนกรกฎาคม 2550 ถึง สิงหาคม 2555 ซึ่งได้คัดเลือกแล้วจำนวน 28 บทความ โดยให้ความสนใจกับ ระเบียบวิธีวิจัย ตัวแปรทางสิ่งแวดล้อมทางกายภาพและประสิทธิผลของมาตรการต่อระดับการมีกิจกรรมทางกายของนักเรียน การทบทวนครั้งนี้พบว่างานวิจัยส่วนใหญ่วัดผลลัพธ์ที่ระดับกิจกรรมทางกายในส่วนที่ต้องอาศัยการเคลื่อนไหวของกล้ามเนื้อ เช่น ระยะเวลาและระดับของการออกกำลังกาย โดยมีเพียง 3 ชิ้น ที่ใช้ดัชนีมวลกาย (Body mass index: BMI) เป็นตัวแปรด้วยและยังพบว่า ประสิทธิผลของมาตรการขึ้นอยู่กับประเภทของมาตรการที่ได้ดำเนินการเป็นสำคัญ ทั้งนี้พบว่าปัจจัยสำคัญของโรงเรียนที่มีผลบวกต่อระดับกิจกรรมทางกายของนักเรียน ได้แก่ พื้นที่ของโรงเรียนขนาดใหญ่ การมีสิ่งอำนวยความสะดวกเกี่ยวกับการมีกิจกรรมทางกาย การมีพื้นที่ในการทำกิจกรรมสันทนาการ การมีนโยบายด้านการกีฬาชัดเจน และการจัดกิจกรรมเพื่อส่งเสริมการมีกิจกรรมทางกายเป็นประจำ ซึ่งแสดงให้เห็นว่าการจัดการสิ่งแวดล้อมทางกายภาพของโรงเรียนสามารถเป็นมาตรการส่งเสริมการมีกิจกรรมทางกายของนักเรียนที่มีประสิทธิผลในระยะยาว และผู้มีส่วนเกี่ยวข้องควรพัฒนามาตรการการจัดการสิ่งแวดล้อมทางกายภาพของโรงเรียนและบูรณาการเข้ากับนโยบายส่งเสริมสุขภาพของโรงเรียน การศึกษาวิจัยในอนาคตควรใช้ระเบียบวิธีวิจัยที่เหมาะสมและมีคุณภาพมากขึ้น และควรกำหนดขอบเขตของประสิทธิผลของสิ่งแวดล้อมทางกายภาพของโรงเรียนให้ชัดเจน

คำสำคัญ: **สิ่งแวดล้อมทางกายภาพ, โรงเรียน, การมีกิจกรรมทางกาย**