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The Environmental Factors Determining the Physical Activity of Children: A Narrative Review

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ABSTRACT

The levels of physical activity (PA) is an important for the health of children and environmental factors play a vital role in shaping children's attitudes, behavior and physical-mental development. Hence the identification of the environmental factors that may contribute to children`s health is important. The relevant literature between 2015-2020 was reviewed, and the factors classified according to three principal environments of home, neighborhood and school. Findings highlight the need for more studies, especially into contextual factors and design-related characteristics of the environments. Increasing child`s PA opportunities including active play and commute vs. sedentary behavior (SB) in all of the three environments were suggested through: 1) proper presence and availability of PA supportive places (either indoors or outdoors), routes (sidewalks, cycling routes) and equipment, 2) consideration of practical threshold for walking/cycling time and distance to schools and neighborhood destinations, 3) provision of neighborhood with more traffic/social safety, 4) limitation of child`s sedentary time (ST), SB supportive devices number and accessibility, 5) emphasizing the importance of teachers, child care providers and family role (role modeling, support, attitude, rules, socioeconomic status (SES), perceptions, concerns, priorities and physical-mental health). Implementation of policies and measures targeted at enhancement of the environments PA supportive qualities simultaneous with promotion of knowledge of planners, designers, teachers, child care providers and families about children`s PA importance is needed.

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Introduction

Importance of Physical Activity for Children

PA is considered to be an important determinant of children`s physical and mental health. The PA of children can affect their health and development including cognitive function, scholastic achievement, movement skills or executive function (1-4); measures of adiposity; musculoskeletal health, psychological and cardiometabolic health (5). In spite of some disparities in such PA associations with physical-mental health or academic achievement revealed by some studies (6, 7), higher levels of total physical activity (TPA) including both light physical activity (LPA) and moderate-to-vigorous (MVPA) integrated with lower levels of SB is considered to be crucial to children`s development and health promotion.

Importance of environment

The environment and its components including all involved objects, people and events, shape and affect child`s health and development conditions such as their developing brain structure and function (8), early childhood value structure (9, 10), long-term attitudes and behavior (11). Hence, some researchers are of the opinion that family should be considered as child`s educational setting (12), and cultivation of suitable and healthy environments is absolutely essential whether at home or school as well as in the community (8).

Environmental Factors of Child`s Physical Activity

Understanding the environmental factors that affect children`s PA within the three mentioned environments appears to be important to developing a strategy to increasing children`s

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physical activity level (PAL) and consequently providing them with better physical and mental health and development as one of their certain rights. Accordingly, many researchers in different areas have focused their efforts on the identification of these factors in different locations and environments of home, neighborhood and school. It makes it possible to compare the environments and their relevant factors role in relation to child`s TPA through a clearer overview or identify and assess advantages and disadvantages of every factor and environment at the end. Literature on the subject published in the years 2015-2017 in different mentioned areas (including art and humanities, psychology especially environmental phycology and behavioral psychology, environmental science, social science and medicine) have been sought. The evidence pieces were reviewed considering both preschoolers and school-age children categories while mentioned separately in the context.

According to the relevant evidence published before 2015, some built environment characteristics such as the availability of recreational places (playgrounds, parks or sidewalk), local streets connectivity, diverse land-use integrated with walkable destinations, public transportation access have positive associations with child`s daily PA and active commute. Whereas some other features including commute distance, traffic volume, crime rate and parental safety-related concerns resulting in higher transportation, less outdoor play and neighborhood independent mobility decrease have negative relationships with it (13-28).

The current review aimed to identify the environmental factors affecting child`s PA classified according to their environments of home, neighborhood and school among the more recent pieces of evidence. These environmental factors are categorized into two groups of physical and socioeconomic.

Home, Neighborhood and School Environmental Factors of Child`s Physical Activity

It is widely reported that children`s TPA and outdoor time/activities are decreasing, whether due to interesting activities within the home (29, 30) or as a result of other causes such as parental concerns and priorities (31-38). Researchers findings indicate that children`s total time engaged in MVPA is continuing to decline over time in different environments indoors and outdoors as their indoor proportion of daily time is increasing year after year vs. the outdoor (39). It has also been demonstrated that children`s play are changing from unstructured free kinds outdoors to structured supervised indoors with less frequency and shorter duration (31, 32, 40, 41). Meanwhile, according to some evidence, children`s lowest proportion of overall MVPA occurs at home, while their highest MVPA proportion is provided out of home, either at school (42) or in the neighborhood environment; so that it seems that the most percentile of total time in the environments that is designated to MVPA belongs to the neighborhood environment in compare to home and school environments (39, 42, 43). On the other hand, in some researchers` opinion, household/family and school environments have more significant influences on child`s PA participation rather than community environments (44).

According to some investigations, a low proportion of children population adhere to the PA and dietary guidelines (29, 45, 46). It has been shown that racial/ethnic minorities, rural areas residents and Latinos have less PA levels in comparison with main groups, residents of suburban and urban areas and non-Latinos (13).

Home Environmental Factors of Child`s PA

Home-related child`s PA predictors found consist mainly of home physical and socioeconomic factors from availability of PA healthy/non-healthy equipment and resources to family members role through theirs socioeconomic status (SES), role modeling, supportive attitude and behavior, perceptions and physical-mental well-being conditions.

Home Physical Factors

Some investigators take the view that being of high-risk or low-risk kind, environment of child`s home plays a vital role in providing their different levels of health factors. As shown by some research, preschool children living at home with higher-risk food or activity environment not only have a higher level consumption of energy-dense snacks and sweetened drinks than those in lower-risk home environments, but also are less active, spend more time watching TV and eat less fruit and vegetables in compare to their peers (47). Associations between home physical environment and boys` after-school PA and ST

have been also reported by a study. Actually, availability of home PA resources seems to have positive association with boys` afterschool TPA and negative relation with their afterschool ST. Home physical environment elements had been assessed through some relevant items:

a) Home PA resources (e.g. play space indoors, cardio equipment, jumping ropes, balls) availability whether at home or in the yard

b) The number of TVs, video game consoles and computers at home (48)

There is also some evidence indicating that specific PA behavior at home has associations with child`s PA, and home availability of PA areas and equipment has mediational role for parents-child PA (49). Additionally, bedroom electronic presence and absence of parental supervision are considered as significant predictors of child`s SB (50) and screen time (SCT) (51). Based on another study findings, electronic devices (except to music devices) ownership has an inverse relationship with socioeconomic status (SES) (parents` education) and fewer devices of such kind especially in child`s bedroom leads to their less SCT. The study showed that both children's MVPA and active play equipment (except to bicycle) possession had positive association with SES (household income) while no relationship with each other (52).

Table 1. Domestic Factors determing Children`s PA

	Home Physical Factors of Child`s PA	Affected Item	References Title	Authors	Date	Participants	Location
1	Home environment activity risk level	Child`s Activity/SCT	(47)	Schrempft S et al	2015	1096 preschoolers Aged 4	Gemini
2	Home physical environment: PA/SB resources accessibility at home (Play space, cardio equipment, jumping role, balls, number of TVs, video game consoles)	Boys` Afterschool TPA/ST	(48)	Lau EY et al	2015	671 schoolchildren 6th grade	South Carolina
3	Electronic devices presence	Child`s SB	(50)	Roberts JD et al	2017	144 schoolchildren aged 9-10	Washington DC
4	Electronic devices presence	Child`s SCT	(52)	Dumuid D et al	2016	427 schoolchildren aged 9-11	Australia

Abbreviations: PA: physical activity; SB: sedentary behavior; SCT: screen time.

Home Socioeconomic Factors

Parental attitude, behavior, perception, support, age, SES (education, income) and physical-mental health have been shown that may affect differently children`s PAL and SB including their recommended PA and ST achievement or non-achievement. Even child`s perceived family environment is said to be positively associated with their leisure time physical activity (LTPA) (53).

Family SES

Family members SES including their income, age and education is believed to be responsible for children`s PA partly, even though, there are some disparities demonstrated in evaluated relationships between the mentioned factors and child`s PA/SB. For example, while according to some findings medium or high levels of it can strongly lead to lower screen-based SB in school-age children (54), some inverse relationships between higher SES of child`s family and their PA have been also declared. An experiment in Southern Brazil on 2604 children aged 6 showed a negative association between SES of family and maternal schooling with children`s PALs, without any associations between early life biological factors and children`s PA behavior after a 6-years follow up visit (55). Again, children who belong to lower-income families within rural setting are reported to be engaged in more PA weekly. Actually, parents of lower-income families encourage activity among their children by utilizing immediate environment and using it for play. They are also more likely to be directly involved in PA with their children, whereas, parents of more affluent families focus on organized opportunities more often than their peers who belong to lower-income families (56). Further, a study has indicated that preschoolers with middle-aged parents were more likely to have PA less than needed (57).

On the other hand, as children`s increasing SCT is being reported even among 1-3-years-old toddlers, in some researchers` view, there is a

positive relation between parents` education and less increase in SCT of children under three (58).

Parents` Behavior: Support and Role Modeling

In evaluating factors related to toddlers` SCT change conducted on 1827 children in Finland, they found that higher SCT of mothers has an effect on children`s larger SCT increase (58). Again, assessing parents SCT as the strongest predictor of child SCT in another study supports the idea of the influence of parental role modeling and behavior on children`s ST. Parents attitude is another factor which affects child`s ST (51). Additionally, children`s TV time being partially mediated by parental TV time had also been observed in an ENERGY-project done in seven European countries on 5729 children and their parents (59). Moreover, children from physically inactive families have been showed that are 3.5 times more inactive compared with their peers with physically active both parents (22). Again, parental PA role modeling at age of 11-12 observed by some researchers as one of the three strongest predictors of lower levels of children`s screen-based SB at age 13-14 also emphasizes the vital importance of parental role modeling in shaping children`s PA/SB behavior (54). Petersen et al., assessed 39 studies in a systematic review and reported that there was a weak positive association between child and parent PA regardless of child age, parent-child dyad gender, and type of PA (60).

In spite of such clear effects of parental behavior and role modeling for their children`s PA, they are disparately assessed yet. For example, even though, there appear to be some evidence of significant positive relationships between fathers-children weekday and weekend vigorous physical activity (VPA) (61), fathers influence on children`s PA has been evaluated modest while positive in some other documents (62).

Parental support of children`s PA may occur through their participation, supervision, transportation or encouragement. It has been shown that parents` supportive role for school-age children aged 11-13 can strongly predict children`s PA, MVPA and screen-based SB at age 13-14 (54). Furthermore, associations between home social environment and girls` after-school PA and ST have been observed in a study due to parental support effects on girl`s afterschool TPA, MVPA and ST. Home social environment elements had been assessed by 3 subscales:

a) Parental LTPA and sports participation (evaluated through items about two sports most frequently-played, leisure time TV watching, walking, and biking)

b) Parental support for children`s PA (either tangible support such as transportation, PA participation with children or supervision or intangible support such as encouragement)

c) Family rules to monitor the time children spent on watching TV and playing video/computer games (48).

Seeking more parents-related factors of children`s PA, some researchers` view is that lack of parental cooperation and negative interactions between child and parents might act as barriers to PA of children. In fact, family interplay can serve as a barrier to moderating child`s PA (63). Again, based on the study done on more than five thousand children in several countries in Europe, children`s TV time can be partially mediated by modeling effect of parents` sport participation (59).

Parental Physical and Mental Well-being

The physical and mental well-being of parents not only has associations with their own PA and obesity (64, 65), but also influences children`s PA and SB. As a study shown, parents` perceived work-life stress negatively affects family interplay which is considered as a notable link between child`s PA habits at home and parental stress (63). Data on 56 women who had Roux-en-Y Gastric Bypass (RYGB) surgery at 5 Swedish hospitals and objective PA measurements of their 75 children aged 7 to 14 between 3months before and 9 months after maternal RYGB showed an increase in children`s SB and a significant decrease in their MVPA without any observed difference for women or their spouses (66). Consequently, maternal depressive symptoms association with higher risk for preschoolers` obesity and even scarcely measured link between mother anxiety and dissatisfaction with it are samples supporting the idea (67). Findings of this kind can alarm us that how much vulnerable our children could be.

Neighborhood Environmental Factors of Child`s PA

It has been proposed that spending time outdoors can result in many positive outcomes for children`s physical and mental health from decrease in their anxiety, stress or asthma to increase in well-being feeling of them (68-70). Consequently, a limited daily time spent

outdoors among children is a global concern. According to some investigations, it is only 4 to 7 minutes for average children (71, 72). Anyway, identification of neighborhood child`s PA factors seems to be helpful for decision makers, practitioners, designers, families and all of those who seek procedures [to provide children with higher daily PAL.

Table 2. Socioeconomic Factors determining Children`s PA

Home Socioeconomic Factors of Child`s PA			Affected Item	reference studies				
				Title	Authors	Date	Participants	Location
Family SES	1	Parent`s SES (Household income)	Child`s MVPA	(52)	Dumuid D et al	2016	427 schoolchildren aged 9-11	Australia
	2	Parents` SES, Maternal Schooling	Child`s PA	(55)	Knuth AG et al	2017	2604 preschoolers Aged 6	Brazil
	3	SES (family income)	Child`s PA	(56)	Cottrell L et al	2015	566 schoolchildren and preschoolers aged 5-15	Rural West Virginia
	4	Parental Age	Child`s PAL	(57)	Botey AP et al	2016,	631 schoolchildren and preschoolers aged 2-13	Canada
	5	Parents` Education	Toddlers` SCT	(58)	Matarma T et al	2016	1827 preschoolers Aged 1-3	Finland
Parents` Role Modeling and Supportive Behavior	6	Maternal SCT	Toddlers` SCT	(58)	Matarma T et al	2016	1827 preschoolers Aged 1-3	Finland
	7	Family active/inactive mode	Child`s activity	(22)	Zaltauskee V et al	2016	3802 schoolchildren aged 7-8	Lithuania
	8	Home social environment: family rules, Parents` LTPA and supportive behavior (participation, supervision, transportation, encouragement)	Girls` afterschool PA/ST	(48)	Lau EY et al	2015,	671 schoolchildren 6th grade	South Carolina
	9	Family rules	Child`s SB	(50)	Roberts JD et al	2017	144 schoolchildren aged 9-10	Washington DC

Abbreviations: PA: physical activity; SES: socioeconomic status; MVPA: moderate-to-vigorous; SCT: screen time; LTPA: leisure time physical activity; ST: sedentary time; SB: sedentary behavior.

Presence, accessibility, usage frequency and different characteristics of neighborhood built environment features (such as recreational facilities and public green/open spaces, sports/play grounds, sidewalks, cycling paths and local streets) and their PA supportive equipment, neighborhood commute mode, parent/child concerns, perceptions and priorities, family SES, and neighborhood social disparities are involved in neighborhood-related environmental factors of child`s PA and SB.

Neighborhood Physical Factors of Child`s PA

Neighborhood PA Supportive Destinations Presence and Accessibility

It has been proposed that the presence of and access to neighborhood destinations and local services related to child development have positive association with early childhood physical health and well-being (73). There are reports indicating that close proximity to recreation places influences on preschoolers` PA (74). As shown by a case study, shorter experienced or perceived walking distance (equal to or less than 10 minutes) to neighborhood destinations e.g. outdoor swimming pool, skiing or other kinds of winter recreation areas, relative`s or friend`s home, biking/hiking/walking trails or paths and public open spaces had been significantly reported by more parents of active children who had fulfilled American daily PA recommendations (60min/day). Similarly, statistics have showed

lower relative odds of those children when their parents perceived more walking distance to nearest bus or metro train stations from their home (75).

Additionally, according to some other examinations, distance and use of unstructured public open spaces/parks are correlated with girls` LTPA, and greater distance to them leads in decreasing their use for LTPA by children (53). Moreover, higher frequency of PA among both preschoolers and school-age children aged 1-12 and longer duration of PA as well as less SCT for school-age children aged 7-12 have been observed in the case of closeness of urban green spaces (76). Some researchers hold an opinion of other neighborhood built environment factors like play equipment access as notable predictors of child`s recommended daily PA (60min/day) fulfilling. Actually, greater existence of active play supportive facilities and amenities in their neighborhood built environment are reported by parents of more active children (75). Researchers take the view that neighborhood open/green spaces distance from child home affect their mental health too. Data from a study on 3586 children aged 5.9 from Scotland has showed that children whose home is more than 20 minutes (walking distance) far from open/green spaces, not only display over 2 hours more weekly TV time than their peers with less than 5 minutes walking distance from neighborhood green/open spaces, but also have worse mental health (77).

In spite of the fact that public open spaces serve as key elements of built environment of neighborhoods supporting wide ranges of PA, some inconsistent and mixed associations between their various features and PA have been reported (78). For instance, the association between girl`s playgrounds availability and their BMI appear to become moderated in some cases by family SES and race or ethnicity status. For example, it has been demonstrated that higher availability of playgrounds is associated with White and high-SES girls` lower BMI percentile but higher BMI percentile among girls from African-American and low-SES families. While, for boys, SES is reported to moderate the association between their availability of parks and BMI (79). Meantime, a NET-Works study on 534 low-income parents of preschoolers revealed surprisingly no significant association between frequency of park use and children`s LPA or MVPA while showed that it is inversely related to children`s less ST and positively associated with parental more MPA and less ST. Moreover, according to this study, park use frequency was significantly positively associated with parent-reported supportive behaviors for children`s PA (80).

Neighborhood Features Characteristics

Both ways (sidewalks, cycling paths, local and main streets) and relevant destinations of neighborhood such as recreational public places are involved in this part of child`s PA factors study.

Neighborhood features and characteristics, in some researchers` view, can influence child`s PA/SB and other factors of their physical-mental health. Associations between some neighborhood attributes like it`s walkability and more incivilities in the home-surrounding immediate block with more park use frequency have been observed (80). So are neighborhood environment safety-related issues (e.g. traffic safety, social safety) effects mentioned through different researches results as child`s PAL predictors, whether perceived by parents (73-75) or children (81). Some researchers have conducted investigations into clusters of neighborhood attributes that influence child`s PA/SB. For example, a longitudinal cross-sectional study on children aged 5-6 and 10-12 showed that a distinct cluster with characteristics of mixed land use, many playgrounds and sport places had contributed to children`s less TV viewing on weekends 3 years later (82). Further, results from a national cross-sectional study on more than 3800 Lithuanian children aged 7.3 years indicated that family urban living area and recreational facilities and playgrounds availability were significantly associated with more likelihood of children sufficient daily PA (22).

As a result of a successful intervention in relation to neighborhood PA, Richard Krajicek Foundation seeking provision of safe public playgrounds stimulating daily PA of children living in deprived neighborhoods has reached to some satisfying results. Fortunately, the idea implementation has been showed statistically to lead in more usage and PA intensity among children in Netherlands. In fact, data revealed that children in addition to their higher energy-expenditure (EE) were involved in MVPA on tailored Krajicek playgrounds 3% more than on

the ten control playgrounds (13% vs. 10%). Moreover, Krajicek playgrounds were found significantly less often empty (83).

Streets are also involved in neighborhood built environment factors related to child`s PA. For example, results of a built environment and play study in Washington DC area showed that streets without cul-de-sac had been related to children`s higher SB (50). Further, a study in Indonesia explored influence of streets aspects on children`s activities and eventually classified them according to their scores (from the highest-score to the lowest-score determinant aspects that respectively had encouraged children to engage in more active to more passive activities in different local or main streets of their neighborhood): Traffic calming, size, layout, green space, play space, accessibility, quality of equipment and materials (81).

Table 3. Neighborhood Physical Factors of Child`s PA (Neighborhood PA Supportive Destinations Presence and Accessibility)

	Neighborhood PA Supportive Destinations Presence and Accessibility	Affected/Non-affected* Item	References				
			Title	Authors	Date	Participants	Location
1	unstructured parks/open spaces distance unstructured parks distance and use	their use by children for LTPA girls` LTPA	(53)	Fueyo JL et al	2016	1777 schoolchildren aged 9-11	Cordoba city
2	play equipment access, greater existence of active play supportive facilities and amenities, shorter walking distance to neighborhood destinations (up to 10 minutes)	child`s daily recommended PA achievement	(75)	Robert J D et al	2016	144 school-age children aged 7-12	Washington DC
3	closeness of urban green spaces	frequency of children`s PA (aged 1-12), PA duration and ST of children (aged 7-12), girl`s ST duration	(76)	Akpinar A	2017	422 parents of children aged 1-18	Turkey
4	longer open/green spaces distances	weekly TV time and mental health	(77)	Aggio D et al	2015	3586 preschoolers aged 5.9	Scotland
5	park use frequency park use frequency	children ST , parents ST/MPA child`s LPA/MVPA *	(78)	French SA et al	2017	534 low-income parents of preschoolers	USA

Abbreviations: PA: physical activity; MVPA: moderate-to-vigorous physical activity; LTPA: leisure time physical activity; ST: sedentary time; LPA: light physical activity; MPA: moderate physical activity.

Since many today-parents prefer to transport their children to relative neighborhood destinations, some suggest that turning child`s school or other destinations commute into an active transport can help to graft children`s PA onto their daily life (84). Hence, some studies have focused on children`s school commute mode. For instance, based on an study findings, children and their parents had preferred streets with three common characteristics including low traffic speed (30km/h vs. 50 or 70 km/h), separation of cycling path with a hedge (rather than a curb or nothing) and path evenness (vs. very uneven or moderately even) (84).

Again, another study conducted on 988 9-12-years-old children in Toronto revealed that about 40% of children including around half of those transported by motorized vehicle had shown preference to bike home-to-school distance. In addition, children`s lower BMI (among those participated in the spring, for the morning school trip) and higher PA (among those participated for the afternoon trip) were associated with their preference to cycle the home-to-school way (85). Additionally, an exploration into multi-level factors of school travel mode shift (from sedentary to active) led to identifying some required school commute environments changes encouraging such a kind of travel mode switch: shorter home-to-school distance, better safety, less cycle paths/lanes availability, and greater programs related to both safety and walking promotion. Moreover, the research showed that children with more outdoor places use after school transfer were more likely to change their school commute

mode to an active type (86). However, perceived walking time to school (PWTS) appears to act as the most important negative predictor of children`s active school commute when biking to or from school is considered unusual. Meanwhile, public transport accessibility, public school attendance, school service access and walking preconditions of designs and context have been shown in association with PWTS as well as public transport accessibility and school service access have been declared to be related to children`s active school commute (87).

Anyway, some intervention kinds seem to have worked at least partly. Some societies have already experienced different kinds of interventions in neighborhood built environments aiming at stimulating children`s more PA duration or frequency. For example, what has been implemented as Play Streets in San Francisco as is the case in seven other sites by closing neighborhood streets to be used by children for recreational activities in order to increase their PA, not only has strengthened the residents community, but also has led to children`s and youth`s increased engagement in vigorous PA (VPA) (88).

Table 4. Neighborhood Physical Factors of Child`s PA (Neighborhood Features Characteristics: Destinations and Routes)

Neighborhood Features Characteristic`s (Destinations and Routes)			Affected/Non-Affected* Item	References				
				No.	Author	Date	Participants	Location
Destinations Characteristics	1	walkability, safety, active play areas and esthetics importance to parents	Child`s Daily recommended PA Achievement	(75)	Robert J D et al	2016	144 school-age children aged 7-12,	Washington DC
	2	family urban living area and recreational facilities availability and playgrounds	children daily PA	(22)	Žaltauskė V et al	2016	3802 schoolchildren 7-8 years old	Lithuania
Streets, Sidewalks and Cycling Roads Characteristics	3	streets without cul-de-sac	Children`s SB	(50)	Roberts JD et al	2017	144 schoolchildren aged 9.7	Washington DC
	4	PWTS threshold, public transport accessibility and school service access public transport accessibility, public school attendance, school service access and walking preconditions of designs and context	child`s school active commute PWTS	(87)	Mehdizadeh M et al	2017	735 schoolchildren aged 7-9	Iran
	5	home-to-school distance reduction, walking-promotion programs provision and improved safety	school commute mode shift (sedentary-to-active)	(86)	Lee C et al	2017	165 primary-school-age children	Texas
	6	streets with cycle path separated with a hedge plus the path evenness and street low traffic speed	route preferences for child`s cycling alone	(84)	Ghekiere A et al	2015	305 schoolchildren from 5th and 6th grade	Belgium

Abbreviations: PA: physical activity; PWTS: perceived walking time to school.

Neighborhood Socioeconomic Factors

Parents` Perceptions, Concerns, Priorities and SES

Undoubtedly, parents play a vital role in children`s PA-related behavior in different environments. Nevertheless, parental perceived neighborhood built environment are discussed diversely as a considerable PA factor of children. For example, while some researches demonstrate that parents perceived neighborhood environment is not associated with child`s LTPA and BMI (53), there is evidence indicating importance of parental perception of neighborhood as children`s PA predictor. Exploring relationship between parents perception of built environment and children`s active play, a diverse population of 144 children aged 7-12 and their parents were observed in Washington DC. Findings revealed that walkability and safety, active play areas and esthetics of its built environment were 4

neighborhood-related factors considered important by parents of active children (75).
Some researchers have declared that parents` perception of neighborhood safety is positively related to early childhood general health and both social and emotional development (73). Moreover, it has been shown that among different races, parental perceived barriers can act as negative predictors decreasing the number of days children engage in 60min/day of PA or more in a week. Among white parents, concern over derivers excess of neighborhood speed limits, and among minority-race parents, perceived neighborhood crime rate had acted as positive predictors of children`s SB in a study (89).
Furthermore, it has been stated that parental preferences for and perceptions about home-to-school commute environment which are probably different from children`s can affect child`s school travel active or inactive mode. Apparently, children had considered cycle path evenness plus local speed limit while degree of cycle path separation from vehicle road and speed limit seemed to be associated significantly with the street parents had chosen and preferred for their children cycling along (84).
In addition, parental SES has its own effects on child`s PA in neighborhood environment. A study showed that their income and higher age had been in association with PWTS as well as more cars in family possessions, mothers` higher education and driving license had been related to children`s active school commute (87). Again, children`s greater independent mobility and at least one parent with part-time job (among those participated for the afternoon trip) have been reported to be associated with their preference to cycle the home-to-school way (85).

Neighborhood Social Disparities

Some scientists share the view that child`s psychological stress caused by multi-level environments with social disparities and injustice can have influences on their PA/weight status. Actually, interaction of these two recently mentioned may be affected by child`s psychological stress (44).

Table 5. Neighborhood Socioeconomic Factors of Child`s PA (Parents and Neighborhood Community)

	Neighborhood Community and Parents` Perceptions, Priorities and Concerns	Affected/Non-Affected* Item	References				
			Title	Authors	Date	Participants	Location
1	Parental Perceived Neighborhood	Child`s LTPA/BMI *	(53)	Fueyo JL et al	2016	1777 school-age children aged 9-11	Cordoba city
2	-parental perception of neighborhood walkability, safety, active play areas and esthetics importance -parental shorter perceived walking distance(up to 10 minutes) to neighborhood destinations	Child`s Daily Recommended PA Achievement	(75)	Robert J D et al	2016	144 school-age children aged 7-12	Washington DC
3	psychological stress caused by neighborhood social disparities	interactions of child`s PA and multi-level environments	(44)	Li Y et al	2016	65 schoolchildren aged 8-13	Eastern Alabama
4	SES and race/ethnicity status SES	association between girls` park/playground availability and BMI association between boys` park/playground availability and BMI	(79)	Hughey SM et al	2017	13469 school-age children 3rd-5th grade	US

Abbreviations: PA: physical activity; LTPA: leisure time physical activity; SES: socioeconomic status; BMI: body mass index.

School Environmental Factors of Child`s PA

Places out of home where children are taught or cared for in their parents` absence such as childcare center, family child care home (FCCH), preschool and school included in this part of the review. Totally, curriculum, equipment, material, staff`s knowledge, behavior, and role modeling in these different facilities can influence child`s PA whether directly or indirectly. Undoubtedly, due to great proportion of children`s early years

spent in such environments while their basic health habits are being shaped gradually as physical-mental growth and development are in process, it is necessary to focus on their relative environmental factors affecting on children`s PA.

School Physical Factors of Child`s PA

Based on young children`s PA recommendations (90), childcare PA of preschoolers should consist of at least 60 min structured PA engagement, at least 60 min unstructured activity involvement and less than 60 min SB per day unless they are sleeping. Nevertheless, according to some evidence, children`s PA in preschool seems to contribute poorly to their daily recommended PA fulfilment (91). On the other hand, there are reports indicating that procedures like children`s full-day kindergarten (FDK) enrolment may help them make up this disappointing situation partly. As shown by a study, FDK enrolled preschoolers` outdoor play time probability and PA participation likelihood are more than those of part-day kindergarten (PDK) enrolled children. In addition, it has been shown that the first group had less likelihood of TV watching on the weekdays compared to their PDK enrolled peers (92). Moreover, some researchers are of the opinion that children`s day care attendance results in smaller increase in children`s SCT (58). Totally, environmental factors associated with children`s PA in preschools have been explored through studies conducted in different countries. Some researchers in the U.S have declared children`s outdoor play time, indoor play space suitability and indoor play teacher encouragement but not participation as the strongest 3-5-years-old preschoolers` MVPA environmental predictors (93). On the other hand, researchers in Brazil have described indoor recreation room and parks/playgrounds as 4-years-olds` protective factors against their highly SB (allowing consistent motor activities and games which stimulate children not to remain still). They have also stated indoor recreation room as a factor inversely associated by 5-years-olds` PA and demonstrated indoor recreation room, playground/park and recess as predictors which increase the likelihood of 6-years-olds` more activity (91).

Meanwhile, investigators in the U.K. found no significant association between childcare environmental factors (fixed/portable equipment, active/sedentary opportunities, time allowed outside, time children seated, time reported spent in gross motor play) with preschoolers` LPA/MVPA. Nevertheless, they found that both active opportunities and play in snow outside had been positively associated with children`s SB. Consequently, they have suggested that childcare policies encouraging child-driven plays letting children have freedom of movement indoors and outdoors in childcare environment might be more effective in stimulating preschoolers` childcare PA. They also came to the conclusion that childcare environment had a limited effect upon preschoolers` in-care PA so that other environments or communities like parent-child groups might be more helpful in preschoolers` PA facilitating or stimulating (94). Again, in Australia, results from a cross-sectional study on 68 toddlers aged 1.0-2.9 and 233 preschoolers aged 3.0-5.9 revealed differences in interactions with their childcare environment between these two groups. Actually, children`s less SB was in relationship with sedentary places for toddlers vs. portable play equipment for preschoolers (95).

Surprisingly, explorations in Ohio resulted in no association between indoor play environment, outdoor playground, fixed/portable play equipment and weather/clothes policies of childcare environments with children`s PA there. Researchers found that children with at least 60 min/day outdoor time spent in childcare centers had more MVPA in both childcare time and during the rest of their day(96).

A systematic review article published in 2015 supports the just mentioned idea by evaluating overall influence of outdoor time on 3-12-years-olds` more PA and less SB positively. In fact, they have provided evidence indicating that children had 2.2 to 3.3 times higher PA outdoors compared with indoors (29).

For older children, school environment may provide poor or satisfying PA opportunities. It is said that nearly half, in Strong`s opinion (97) or up to 40% (98) of the time needed for children`s daily PA (60min) can be provided through their school recess. As shown by a study, schoolyard characteristics and recess are affective considerably on school-age children`s PA. An 8-week intervention on elementary school children during 2013 showed that procedures such as pavement painting or providing proper playground equipment could raise the school-age children`s PA during the recess (99). Further, results of a behavior examination on 316

students in 5 schoolyard types suggested that the highest children`s MVPA had occurred in grass areas and playgrounds while solid surface areas had been related to their highest ST proportion. In addition, the examination revealed that girls had spent more ST in comparison with boys in all types of schoolyard areas (98). Again, through a playground environment assessment aiming at identifying areas promoting schoolchildren`s MVPA in two different urban schools one of which had offered a Jog and Walk Stars (JAWS) program, researchers observed that the most populated area of schoolyard differed from the general blacktop areas on non-JAWS days with approximately 50% of children sedentary there to the JAWS track with 99% of children participating in MVPA (100). Seeking procedures effective in promoting children`s PA at school environment, other interventions have been also examined. Guided plays implementation aiming at taking advantages of both child`s natural abilities to learn through play experience expressing their autonomy and prepared environments in addition to adult scaffolding simultaneously has been suggested as a rather successful pedagogical approach (101).

Child`s PA increasing school-based opportunities such as short breaks designated to PA indoors/outdoors may be effective given their complete reach and low costs per child. After-school programs, in spite of their apparently lower reach, could lead in some socioeconomic benefits such as parental participation that could partly make up their higher costs.

Table 6. School Physical Factors of Child`s PA

School Physical Factors of Child`s PA		Affected/Non-Affected* Item	References				
			No.	Author	Date	Participants	Location
1	outdoor time	children`s PA and SB	(29)	Gray C et al	2015	children aged 3-12	Different
2	painting on schoolyard pavement and providing proper playground equipment	children`s school PA during recess	(99)	Grant V et al	2015	approximately 150 school-age children: 3rd-6th grade	American Indian reservation
3	child`s day care attendance	SCT	(58)	Matarma T et al	2016	1827 preschoolers Aged 1-3	Finland
4	indoor recreation room and playground indoor recreation room indoor recreation room, recess, playground	4-years-olds` SB 5-years-olds` PA 6-years-olds` activity likelihood	(91)	Barbosa SC et al	2016	370 preschoolers aged 4-6	Brazil
5	outdoor play time, indoor play space suitability	Children`s MVPA	(93)	Henderson KE et al	2015	389 preschoolers aged 3-5	U.S
6	childcare environmental factors active opportunities and outside play in snow	preschoolers` LPA/MVPA * Children`s SB	(94)	Hesketh KR et al	2016	201 preschoolers aged 3-4	U.K
7	sedentary places for toddlers portable play equipment for preschoolers	children`s SB behavior	(95)	Peden ME et al	2017	68 toddlers aged 1.0-2.9, 233 preschoolers aged 3.0-5.9	Australia
8	indoor play environment, outdoor playground, foxed/portable play equipment, weather/clothes policies outdoor time in childcare centers	children`s PA * MVPA	(96)	Copeland KA et al	2016	388 preschoolers	Ohio

Abbreviations: PA: physical activity; MVPA: moderate-to-vigorous; SCT: screen time; SB: sedentary behavior; LPA:light physical activity.

School Socioeconomic Factors of Child`s PA

Teachers, child care providers and staff in addition to parents can play a crucial role in shaping school PA behavior and levels of both preschoolers and school age children. Actually, they are reported to have both positive and negative effects on children`s PA. Although, some disparities are also reported. For example, child care providers are said to influence on child`s health behavior through their role modeling for

both children and parents (102, 103). Accordingly, it can be a matter of concern in view of the fact that an exploration on 166 family child care home (FCCH) providers in North Carolina revealed that nearly 90% of them were obese while about half of them fulfilled neither PA nor fruit and vegetable guidelines. Additionally, more than half of the providers had reported high stress (103). Further, FCCHs weaker PA and nutrition regulations related to children in comparison with preschools (104, 105) are another problem.

It is necessary to mention that the accuracy of participants` PA levels classification could be questioned in the case of studies based on self-reported data, and so are the objectively measured cases in accelerometer-based studies due to the device limitations and bias (106).

On the other hand, U.S researchers have demonstrated children`s indoor play teacher encouragement but not participation as the strongest 3-5-years-old preschoolers` MVPA environmental predictors (93).

Meanwhile, U.K. investigators studies have not found any significant associations between interpersonal factors such as class composition, children per staff member, government funded places, staff behavior/mean age in years/mean years in childcare/mean years at setting with preschoolers` LPA/MVPA (94). Similarly, explorations in Ohio resulted in no association between PA training of staff and with children`s PA there (96).

Table 7. School Socioeconomic Factors of Child`s PA

	School Physical Factors of Child`s PA	Affected/Non-Affected* Item	References No.	Author	Date	Participants	Location
1	U.K childcare interpersonal factors	preschoolers` LPA/MVPA*	(94)	Hesketh KR et al	2016	201 preschoolers aged 3-4	U.K
2	indoor play teacher encouragement but not participation	preschoolers` MVPA	(93)	Henderson KE et al	2015	389 preschoolers aged 3-5	U.S
3	FCCH providers` role modeling for children and parents	preschoolers` PA habits and outcomes	(103)	Tovar A et al	2017	166 FCCH providers	North Carolina
4	PA training of staff	children`s PA	(96)	Copeland KA et al	2016	389 preschoolers	Ohio

Abbreviations: PA: physical activity; MVPA: moderate-to-vigorous; LPA: light physical activity; FCCH: family child care home.

Study limitations

Despite a major strength of the present study was its wide range of studied locations, the explored literature was limited to those published in English.

Conclusion

The review emphasizes the importance of the parental role and proper presence, availability and safety of PA supportive spaces, routes and equipment as the most frequently considered physical predictors of child`s PA. Family-based education policies addressing promotion of parents` knowledge about relevant topics should be enforced. Consideration of the mentioned characteristics by planners and designers may stimulate more active commute and active plays among children in all of the three environments. More attention to parents` involvement in school PA supportive programs may be effective as well. After all, play opportunities (eitherer structured and supervised or free and unstructured), proper material, active play fixed/portable equipment and interventions should be applied based on settings, locations climatic conditions, context and design characteristics, children`s age, gender and requirements.

Moreover, the season's effects on children's PA and environments have not been properly considered in previous studies due to their largely short duration Explored factors in the reviewed studies rarely or limitedly involved cultural and economic factors or some of those related to the environment architecture or context (such as climate, light, color, dimensions, form, natural/artificial ventilation or the environments spaces view). In addition, there were some disparities in evaluated associations between child`s PA factors and outcomes that might have been caused by some neglected items such as cultural, racial or ethnic differences, child`s age, gender or family conditions. Physical factors were explored in a wider range in the case of neighborhood environment. Socioeconomic factors were more discussed than physical factors in the case of home environment while they were rarely studied in relation to school environment. Therefore, additional studies considering these items are warranted.

Conflict of Interests

The authors confirm no conflict of interests.

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