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Designing Landscapes for Child Health

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1. Introduction

Childhood obesity has reached epidemic proportions and is a major public health problem globally (Ebbeling et al., 2002; Pate et al., 2008), which causes many serious health-related problems (van Emmerik et al., 2012; Daniels et al., 2005; Din-Dzietham et al., 2007; Lorch and Sharkey, 2007) such as coronary heart disease, diabetes, osteoporosis (Sallis and Owen 1999; Pate et al. 1995; Hume et al. 2005; Raitakari et al., 1997; Teixeira et al., 2001; Bailey, 1995; Berenson, 1986; Van Mechelen et al., 2000), sleep apnea syndrome (Wabitsch, 2000) and psychological problems (Dietz, 1998; Daniels, 2006). Obesity is caused by a higher energy intake than energy expenditure, resulting in excessive weight gain (Koezuka et al., 2006). Theory implies that energy balance is maintained by energy expenditure, and physical activity helps to improve energy expenditure resulting weight loss (Weinsier et al., 1998; Lambert and Goedecke, 2004; Chaput et al., 2011). Physical activity helps to improve metabolic profile, muscular and bone health (Anderson and Butcher, 2006; Ekelund et al., 2008; Hind and Burrows, 2007; Biddle et al., 1998), mental health and academic performance (Singh et al., 2012; Strong et al., 2005). For a healthy living, it is recommended that children should participate to at least 60 min/day of physical activity and include vigorous physical activity at least 3 days/week (Strong et al., 2008). Daily walking is a useful activity for healthy living (Shultz et al., 2011) and children should accumulate at least 12.000 steps per day to maintain a healthy weight (Tudor-Locke et al., 2011).

Environmental factors, which discourage energy expenditure and thus limit the availability of facilities for physical activity, have potential to influence body weight and healthy behavior (Lachowycz and Jones, 2011; Feng et al., 2010; Papas et al., 2007; Sallis et al., 2000). Studies reported a positive relationship between access to greenspaces and physical activity (Lachowycz and Jones, 2011; Kaczynski and Henderson, 2007; Kaczynski et al., 2008). Increased vegetation was associated with reduced weight among children (Liu et al., 2007) and neighborhood greenness influenced less weight gain in children (Bell et al., 2008). Promoting physical activity among children, therefore, should be a public health priority,

and studies should focus on the determinants of the environmental variables of physical activity.

Previous reviews found associations between aesthetic attributes of the physical environment with physical activity (Sallis and Owen, 1999; Sallis et al., 1998; Owen et al., 2000; Humpel et al., 2002). Models developed from such research help to explain environment-behavior relationships that can play a key role in linking research, policy and practice. In this context, there is a need for high-quality empirical evidence supporting environmental influences on health (Humpel et al., 2002) and an understanding of how these environmental attributes are related to promoting more physical activity.

Within the extant literature there are many models and theories which help to conceptualize a potential way of mapping ecological, social and biological frameworks. Ecological model implies that behavior is influenced by the environmental factors, and changes in the environment—positive or negative—will have effects on health (McLeroy et al., 1988). The evidence shows that the built environment—the office environments (Chao et al., 2003), healing environments such as hospitals and day care centers (Whitehouse et al., 2001; Cooper-Marcus and Barnes, 1999), school buildings (Cradock, et al., 2007; Everett Jones et al., 2003), outdoor school environments (Rivkin, 1997; Dymont et al., 2009; Dymont and Bell, 2007; Tranter and Malone, 2004; Brink et al., 2010; Özdemir and Yılmaz, 2008), housing and home environments (Shaw, 2004; Wigle, 2003; Evans et al., 2003; Saegert, 1982), recreation facilities and access to green spaces (Wells and Evans, 2003; Maller et al., 2006; Stigsdotter et al., 2010; Sugiyama et al., 2008), greening vacant urban space (Branas et al., 2011), the design of neighborhoods (Wells and Yang, 2008) and store locations (Holsten, 2009)—will affect health and well-being of users.

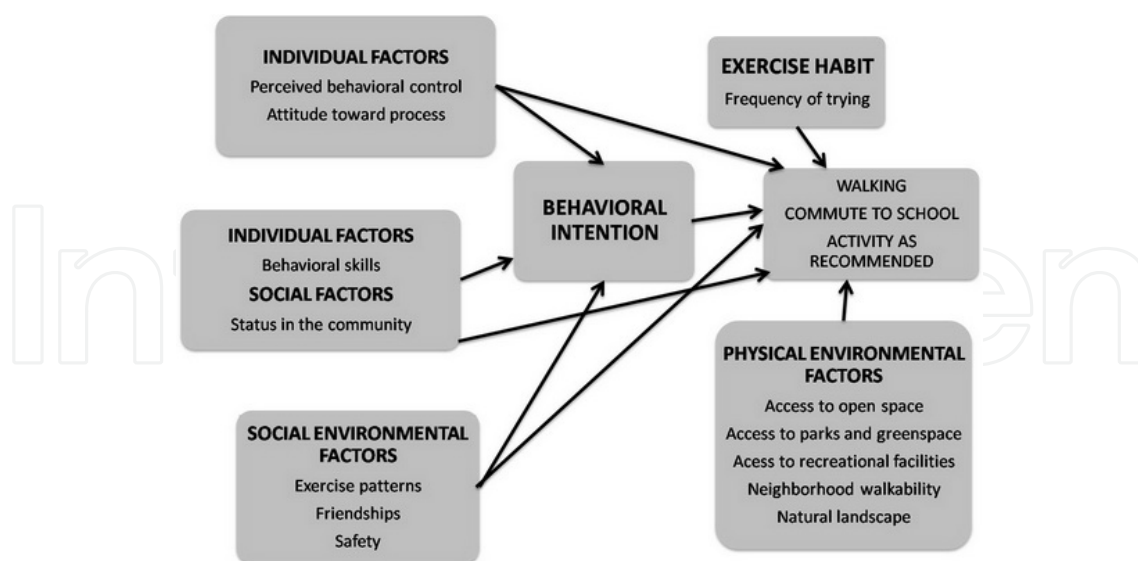


Figure 1. Model of environment health relation (Adapted from Pikora et al., 2003).

Established links between health and environment suggest that individual, social and physical environmental factors are related to behavioral intention, thus, shape our way of activities (Figure 1). As a result, improvements in the physical environment might lead to a number of

long-term health outcomes: decrease in obesity, increase in physical activity, and decrease in serious health problems. Several studies have linked urban green space to fewer health complaints (Maas et al., 2009; Takano et al., 2002; Mitchell and Popham, 2008; Richardson and Mitchell, 2010; Mitchell et al., 2011). Based on these numerous health outcomes, planning and design decisions should take into consideration these public health impacts.

1.1. Environmental characteristics and health outcomes

Research on the determinants of potential environmental variables of physical activity is a growing trend (Carnegie et al., 2002; Sallis et al., 1990; Brug et al., 2005; Humpel et al., 2002; Owen et al., 2004; Trost et al., 2002; Saelens et al., 2003; Cunningham and Michael 2004; Wendel-Vos et al., 2007). Despite extensive research, the determinants of physical activity are not fully understood (Dishman and Sallis, 1994; Sallis and Owen, 1997; Vita and Owen, 1995). In order to promote planned and systematic physical activity among children, the key issue should be to gain insight into environmental factors that facilitate or obstruct physical activity among children (Baranowski and Jago, 2005; Wendel-Vos et al., 2004).

The social model of health conceptualizes health in environmental and social rather than just physical or individual terms (Figure 2). Research on the determinants of healthy child development showed that studies should include a mix of social and environmental factors—income, education, health and everyday environments—and all levels of society (Bonney, et al., 2007). Healthy children will be those who are enabled to satisfy their needs and change, and cope with the urban environment (Davis and Jones, 1996; Black and Krishnakumar, 1998). However there is no systematic analysis of health effects of environments (Davis and Jones, 1996). Physical activity researchers, on the other hand, have not seriously addressed how the wider social and physical environment influences children's play and mobility.

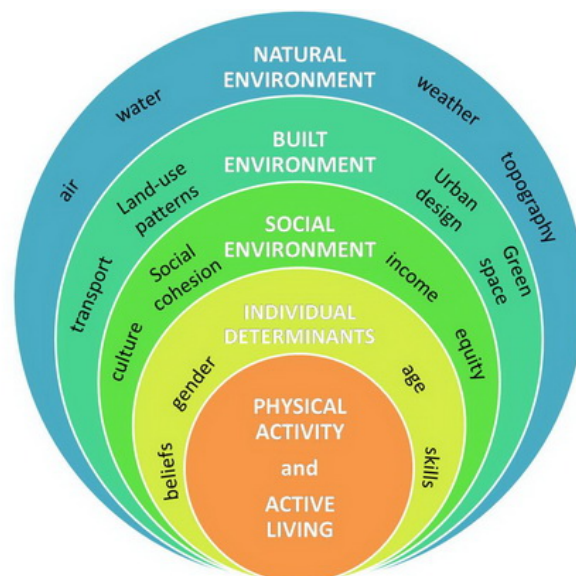


Figure 2. Factors influencing physical activity in communities (Adapted from Dahlgren and Whitehead, 1991).

1.2. Outdoor school environments and health outcomes

Despite the fact that most physical activity by children is undertaken outside of the school building (Sallis et al., 1993; Vicent and Pangrazi, 2002), schools have not been recognized as key settings both to promote and to contribute to physical activity guidelines (Zimring et al., 2005; Zask et al., 2001; Iverson et al., 1985; Biddle et al., 1998) because children spend a large proportion of their time there (Biddle et al., 1998; Iverson et al., 1985).

School environments and policies have been studied for their effects on healthy behavior and obesity prevention (Trudeau and Shepherd, 2005; Story et al., 2006; Wechsler et al., 2000). Additionally, school building and campus characteristics have been associated with objective measures of physical activity (Cradock et al., 2007). Effects of school recess time (Ridgers et al., 2006), type and size of space and fixed outdoor equipments (Sallis et al., 2001), school size and available number of balls (Zask et al., 2001), size of schoolyards (Özdemir and Yilmaz, 2008), the provision of extra equipment (Sallis et al., 2003; Verstraete et al., 2006), school ground paintings (Stratton and Mullan, 2005; Ridgers et al., 2007) and school environment improvements (Haug et al., 2010) have been found to be associated with physical activity. Past studies concentrated on environmental influences on health outcomes, however, found limited and ambiguous results (Ferreira et al., 2007; Davison and Lawson, 2006). Children were found to be healthier in large schoolyards (Özdemir and Yilmaz, 2008); however, children were more active in small schoolyards (Özdemir and Çorakçı, 2010). Additionally, limited outdoor play time and short recess were associated with a higher body mass index levels in young children (Ernst and Pangrazi, 1999; Alhassan et al., 2007; Ridgers et al., 2006).

Access to urban parks and recreational facilities, schoolyard renovations, type and quality of play spaces have been studied for their effects on increased physical activity in children (Sallis et al., 2009; Stucky-Ropp and DiLorenzo, 1993; Sallis et al., 1993). Some studies reported a significant association between active commuting to school and weight status (Faulkner et al., 2009; Lee et al., 2008; Lee and Tudor-Locke, 2005; Heelan et al., 2005; Pabayo et al., 2011; Rosenberg, et al., 2006; Mendoza et al., 2011), and children who actively commute to school are healthier than passive commuters (Heelan et al., 2005; Özdemir and Yilmaz, 2008; Lee and Tudor-Locke, 2005). In a comparison between cycling and non-cycling children, after 6 years of observations, children who cycle to school were found healthier (Cooper et al., 2008).

In order to develop school-based interventions, it is crucial to better understand the ways by which the school environment may promote or inhibit children's physical activity (van Sluijs et al., 2012). For a sustainable and a successful transition of school grounds from a conventional asphalt surface to a natural educational setting, outdoor school environments need to be conducive to health promotion with an integrated and a participatory approach.

1.3. Neighborhood characteristics and health outcomes

Active behaviors should be promoted with city planning and infrastructure by creating safe and accessible urban environments (Lopez and Hynes, 2006; Frank et al., 2005; Badland and

Schofield, 2005; Handy et al., 2002), which in turn enhance energy expenditure. Environmental factors are influential in type and frequency of activity, such as climate of the region, terrains, neighborhood and traffic safety, and parents' perceptions of their children's activities outdoors (Saelens et al., 2003; Leslie et al., 2005). Sociocultural background (Flavia et al., 2010; Fredriks, 2005) and neighborhood characteristics are effective in obesity prevention; children in deprived neighborhoods are more likely to be overweight (deJong et al., 2011; Janssen et al., 2006; Lackshman et al., 2010; Veugelers and Fitzgerald, 2005). Several reviews indicate that people with low income are more likely to live in poor quality built environments, and this contributes to poor health (Lavin et al., 2006; Sallis et al., 2009). Parents in lower income neighborhoods reported the highest rates of unpleasant walking environments (van Lenthe et al., 2005). Neighborhood violent crime may be a significant environmental barrier to outdoor physical activity for urban dwelling (Bennett et al., 2007; Gomez, 2004).

Studies reported a positive relationship between access to greenspaces and physical activity (Kaczynski and Henderson, 2007; Lachowycz and Jones, 2011; Lee and Maheswaran, 2010). Children living in neighborhoods with playgrounds, parks and other recreational facilities engage in more physical activities and are less likely to be obese (Veugelers et al., 2008; Gordon-Larsen et al., 2006). Increased vegetation was associated with reduced weight among children (Liu et al., 2007) and neighborhood greenness influenced less weight gain in children (Kaczynski and Henderson, 2007; Roemmich et al., 2006; Bell et al., 2008). Park playgrounds were influential in reduced BMI values in children (Potwarka et al., 2008). A cross-sectional survey of adults in 8 European cities found that people in the greenest areas are less likely to be obese (Ellaway et al., 2005). Parents complained about the heavy traffic streets and the absence of a park nearby, which limited their children's play outside. Additionally, some parents indicated that their children never play outside of their home, even during the weekend due to the lack of nearby park (Aarts et al., 2012).

1.4. Measurement techniques of physical activity

The assessment techniques of physical activity can be grouped into two categories: subjective and objective. Subjective techniques include observations, questionnaires, interviews, physical activity logs and activity diaries. Objective techniques include physiological indices such as heart rate monitoring and electronic motion sensors (accelerometry, pedometer measurements), and tracking movement with Global Positioning Systems (GPS).

1.4.1. Subjective assessments

Assessment of children's physical activity levels is a research-priority (Trost et al., 2000) and several tools have been developed for this assessment (Welk, 2002; Ekelund et al., 2001). The most common technique is the subjectively measurement of child physical activity by survey techniques with self-reports (Loprinzi and Cardinal, 2011). Sallis et al. (2002) discussed self-report techniques that are defined as inexpensive and easy to administer.

However, accuracy and reliability of self-report data are discussed, since young children may have difficulties in recalling their activity behaviors (Pate et al., 1995; Welk et al., 2000; Affuso et al., 2011), which calls for a response bias that affect the quality of data (Klesges et al., 2004).

Some studies included parental reports of their children's height and weight (Hinkley et al., 2008; Oliver et al., 2007; Eiser and Morse, 2001), which are often inaccurate (Rowland, 1990). Indirect subjective measures such as parent and teacher questionnaires were also administered to assess child physical activity (Oliver et al., 2007) and health related quality of life (Eiser et al., 2000).

The evaluation of the children's perception of the environment and its effect on behavior should be provided by multi-method approach. Focus groups are useful techniques in research with children (Hoppe et al., 1995; Morgan et al., 2002; O'Dea, 2003; Vaughn et al., 1996), and discussing topics in groups in schools is an appropriate method to gain insight into child views on several topics. Focus group method has been used for providing data which are deeper, more qualified and appropriate to the purpose of the research. Focus group is one of the rapid scanning methods which provide qualitative information in a short time. It is generally realized with 10-12 participants. The moderator provides the different/same opinion, comment or information to occur via questions which help to discuss. It is one of the most frequently used information gathering methods, because it provides convenience to reach different information in a short time, enables the flexible, unexpected and unknown findings to occur, catches extreme points and is cost-effective (Babbie, 2006; Debus, 1990; Engelbrektsson, 2002; Krueger and King, 1998; Krueger and Casey, 2000).

1.4.2. Objective measurements

Direct measures with objective tools such as accelerometers, pedometers, heart-rate monitoring (Oliver et al., 2007; Sirard and Pate, 2001; Trost et al., 2000) and GPS techniques can be used to monitor, measure and assess childhood physical activity. The use of these tools reduces the bias commonly associated with self-report measures. The objective assessment with measurement tools has high practical utility, high reliability and high validity relative to subjective measurements (King et al., 2011; Corder et al., 2008).

Pedometers and accelerometers

Accelerometer-based devices provide valid and objective information on physical activity with several outputs such as calories and fat burnt during a period of time, time spent in moderate and vigorous activity, distance walked and total step counts (Bassett and John, 2010). They are battery-operated devices that are attached to the wrists or ankles of the subjects to measure the number of steps during activities. Pedometers enable translating physical activity recommendations into pedometer-based step goals and commonly used in research with children (Pate et al., 2010; Mitre et al., 2009; Marshall et al., 2009; Tudor-Locke et al., 2011; Tudor-Locke and Bassett, 2004). They are widely used in medical research to

compare descriptive data (steps per day) for specific age groups, cultures and environmental contexts (Whitt et al., 2004). However, they fail to capture data of seated activity (Berlin et al., 2006) and they only measure horizontal activities such as walking and running.

Accelerometers are also useful, reliable and valid tools with motion sensors to assess the intensity, frequency, pattern and duration of activity, which is an advantage over the pedometers (Berlin et al., 2006). Data collected by these devices should be processed on a computer. Research that included pedometer measurements found that obese children have lower pedometer counts than non-obese children (Tudor-Locke and Bassett, 2004; Eisenmann et al., 2007; Al-Hazzaa, 2007). Tudor-Locke and Bassett (2004) proposed a system used to classify healthy adults based on their activity levels: <5,000 steps a day for sedentary lifestyle, 5,000 to 7,499 steps a day for low activity, 7,500 to 9,999 steps a day for somewhat active, 10,000 to 12,499 steps a day for active, and >12,500 steps a day for highly active.

Heart rate monitoring

Heart rate (HR) monitoring is an objective, inexpensive and unobtrusive assessment tool providing indirect, intensity and duration data of physical activity among children (Loprinzi and Cardinal, 2011). HR monitoring provides information about total energy expenditure and about the amount of time spent in high-intensity activity (Ainslie et al., 2003). This tool has provided a valid and reliable objective estimate of physical activity (Rowlands and Eston, 2007) however, the link between heart rate measurements and energy expenditure is not as strong as other objective techniques (Troost et al., 2001). Heart rate can be measured easily with monitors attached to the wrists and the beltline. The resting and maximal heart rate is compared to gauge exercise and activity intensity. According to the American College of Sports Medicine Position Stand (1998), physical activity intensity according to frequency of heart rate is calculated for practical purposes as shown in Table 1 below:

| Intensity descriptor | Relative Intensity | |
|----------------------|----------------------|------------------------------|
| | % Heart rate reserve | Rating of perceived exertion |
| Very light | < 20 | < 10 |
| Light | 20-39 | 10-11 |
| Moderate | 40-59 | 12-13 |
| Vigorous | 60-84 | 14-16 |
| Very vigorous | > 85 | 17-19 |

*Adapted from American College of Sports Medicine Position Stand (1998).

Table 1. Physical activity intensity according to frequency of heart rate

Heart rate also has a significant relationship with energy expenditure and has been widely used in studies of physical activity in children (Eston et al., 1998; Spurr et al., 1988; Ceesay et al., 1989; Livingstone et al., 1992). HR monitoring reports much lower levels of physical activity and is based on small sample groups (Livingstone et al., 2003). However there are a

number of limitations to the use of this technique (Armstrong and Welsman, 2006; Rowlands et al., 1997). Since HR is influenced not only by physical activity, reliability of this measurement is questionable. A child with low levels of physical activity may have high heart rates due to the influence of other parameters such as emotional stress, anxiety, hydration and environment (Armstrong and Welsman, 2006; Rowlands et al., 1997). In this respect, heart rate monitoring should be considered to measure moderate to vigorous physical activity, and heart rates below 120bpm would be considered to be valid measures of physical activity.

GIS/GPS Tools

Transportation, urban design and planning studies include Geographic Information Systems (GIS) to support the hypothesis that neighborhood environment is associated with physical activity in the form of walking and biking for transport (Frumkin, 2002; Saelens et al., 2003). GIS tools have been used to describe the associations between objective measures of the built environment and walking and transportation activity (McGinn et al., 2007). In the public health literature, the relationship between the built environment and physical activity was assessed by measuring the frequency, intensity and duration of activity. In such studies, objective measures of the environment were collected and mapped using GIS tools (McGinn et al., 2007). Global positioning system (GPS) is also used to track areas in a settlement or a space in a district where physical activity is promoted (Wheeler et al., 2010; Fjörtoft et al., 2009; Fjörtoft et al., 2010). GPS system was used to record children's movement patterns, which was transferred to GIS systems for further analysis (Fjörtoft et al., 2009; Fjörtoft et al., 2010). The purpose of the studies using GPS tools is to describe the interaction between environment and physical activity; based on the GPS data, designers explore and determine how space may interact with physical activity in children. However, GPS devices fail to record position indoors, under heavy tree canopy and in dense urban areas (Maddison and Ni Mhurchu, 2009) and they have limited accuracy in sensing stationary device location (Chen et al., 2012).

Photography

Studies of children's geography and social behavior concluded that children's physical activity and use of public spaces have been constricted and controlled (Blades et al., 1998; Matthews et al., 1998). In order to include views of children as key informants of research for their health and well-being, qualitative approaches have been employed (Darbyshire et al., 2005). It is important to offer children the opportunity to portray their own environments and one of the methods used for this purpose is photography, which is commonly accepted and validated by many researchers (Booth and Booth, 2003; Sharples et al., 2003; Wang and Burris, 1997) aiming to generate different and complementary visual information (Darbyshire et al., 2005). In a current study, children were asked to take pictures with disposable cameras (Özdemir, 2010). This visual data production strategy enabled children to relate their everyday life with their activities and environmental perceptions. There is extensive research with children using photography (Aitken and Wingate, 1993; Dodman, 2003; Morrow, 2001; Young and Barrett, 2001). However, there limits of this

technique; the method of photography did not include children’s talk about their taken pictures and the reasons of taking those pictures. Children took pictures and we defined and discussed them as adults.

2. Schoolyard design to promote physical activity: An exploratory study

2.1. Methodology

This study aims to assess outdoor school environments for their possible association with healthy behavior of children. For this purpose, children’s total step counts were associated with the schoolyard size and 1115 students in 4 primary schools were surveyed. The aim of the project is to examine whether size and design of the outdoor school environments affect child physical activity. In addition, gender and age were selected to be variables to determine their relation to physical activity.

A random stratified sampling of primary schools from various districts of the city was used to represent a cross-section of the population. The schools, which have the adequate open space for the renewal projects, are located in different districts in terms of socio-culture and economy, have different numbers of students and need their schoolyards to be renewed, have been selected from a list of elementary schools provided from the Provincial Directorate for National Education (Table 2).

| District | School |
|----------|-------------------------------|
| Çankaya | Kavaklıdere Primary School |
| Mamak | Çocuk Sevenler Primary School |
| Keçiören | Kamil Ocak Primary School |
| Akyurt | TOKİ Primary School |

Table 2. The primary schools subject to the research and their districts

2.1.1. Defining landscape characteristics of schoolyards

For each schoolyard, ordinal categories were used as being applied for the classification of landscape quality. Aerial images and photo surveys were used to assess outdoor school environments; total area, usable area, landscaped-vegetated areas and hard surfaces were measured. The reliability tests of these measurements showed that both measurements on aerial images and hand measurements of a selected schoolyard gave specific and similar results. The photographs describe a variety of outdoor settings suggesting the need for a more spacious space per student after the calculation of the open space standards for school population for each case. Outdoor environments and the adjacent areas were assessed with respect to physical and landscape qualities (i.e. vegetation, material, size). A group of reviewers, which includes landscape architects and architects, reviewed the photographs and scored the schoolyards based on the features such as size, material, vegetation cover, vegetation quality, maintenance and spaciousness. Environments with low physical qualities scored 1. Environments with advanced features scored 2.

2.1.2. Focus groups

The study also included 30 minutes meetings that were held with the students in each school. These focus groups, targeting children, included discussions on the current problems and future developments of the schoolyards; children’s attitudes towards the school settings and the parents’ views on their children’s use of the schoolyards were discussed. Teachers did not attend the meetings; students had the chance to express their opinions freely.

2.1.3. Pedometer measurements and BMI value assessments

Intensity of children’s school time activities was measured with electronic pedometers (Omron HJ-12). Pedometers were attached to randomly selected students. Average step counts of 10 children in each school were determined. Measurements also included distance covered, the amount of calorie (kcal) and body oil (gram) burnt during activities. It was assumed that the measurements would be distributed according to age groups, gender and schoolyard size.

Students were asked to indicate their weight and height on the questionnaire sheets to assess their nutritional status. In order to ensure reliability of self-reports, we weighed a group of students using a standard electronic scale, and their heights were measured with a wooden measuring board. Self-reported and objectively measured height and weight status were compared and it was found that self-reports were reliable. The height and weight information obtained in the surveys were used to calculate the BMI, which was computed as weight in kilograms divided by height in meters squared (kg/m²).

BMI values according to age groups are shown below (Table 3) (Uluocak et al., 2006; Şimşek et al., 2005; Öner et al., 2004; Altunkaynak and Özbek, 2007; Uğuz ve Bodur, 2007).

| | Grade | Age | Underweight | Normal | Overweight |
|----------------|---------|-------|-------------|-----------|------------|
| Primary School | 3 and 4 | 9-10 | <14.0 | 14.0-20.0 | >20 |
| | 5 and 6 | 11-12 | <14.6 | 14.6-23.1 | >23.1 |

Table 3. BMI values according to age groups

2.1.4. Photography

Children’s perception of environment was evaluated with photography technique. In this scope, students, selected randomly from each school, were given disposable cameras and were asked to take pictures of places they visit during weekend. It was assumed that children would take pictures of a number of scenes such as greenery, plants, open views, pets, buildings and structures, traffic, indoors and their daily activities. Children’s environmental perception would differ according to places they visit such as an urban park or an indoor environment. Based on the picture characteristics, potential perceptual variables were listed after expert ratings of scenes; experts included landscape architects and graduate students.

2.1.5. Workshops

Researchers offered a variety of workshops for school-aged children, teachers and parents. These workshops were oriented towards the respective target audience and based on participatory methods, providing insight into the design process. The aim was to increase environmental awareness among children and to inspire creative thinking. In these workshops, children were introduced to landscape design through presentation, design drawings, sketches and 3D models.

In this case study, after the presentations to the school community, workshops were organized with the voluntary students. Firstly, borders of the schoolyards on the layout plans and draft drawings, entrances, current uses (parking, playfield, etc.) and green fields were shown to the students and they became familiar with the plan. Alternative uses, requested by the students in the schoolyard, were listed. Group of students prepared their own designs. In this process, the researchers assisted the children regarding the drawing techniques. Each project was developed in line with different concepts such as “adventure” or “blossom.” First group made an adventure road strolling along the schoolyard. Each member of the second group named her/himself after a flower name and requested these flowers to be planted to the different parts of the schoolyard. The authentic design examples provided at the end of nearly half-hour study were displayed and presented by the group representatives (Figure 3).

Each group prepared a draft plan with sketches and colored markings. The final version of these projects, including before and after images, was displayed on the school boards in order to get feedback from students and teachers (Figure 4 and 5).



Figure 3. Views from the workshops

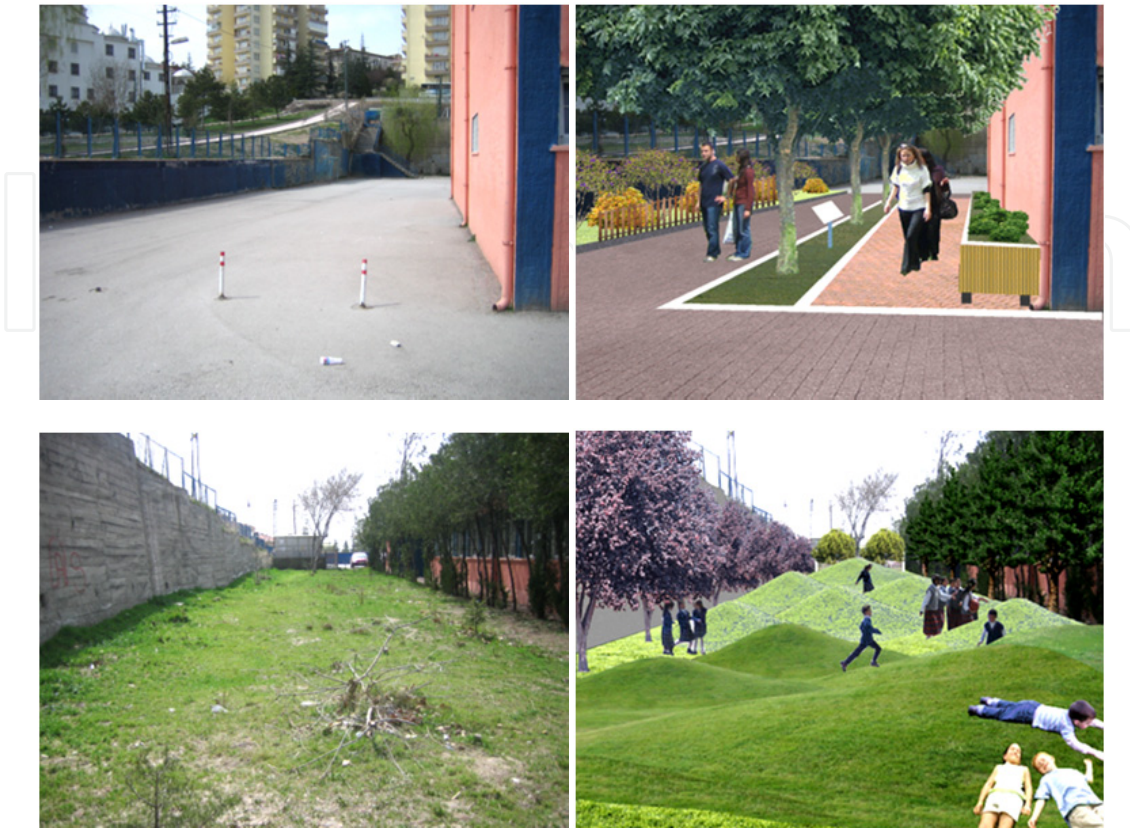


Figure 4. Current status of the schoolyards and the views after the arrangement

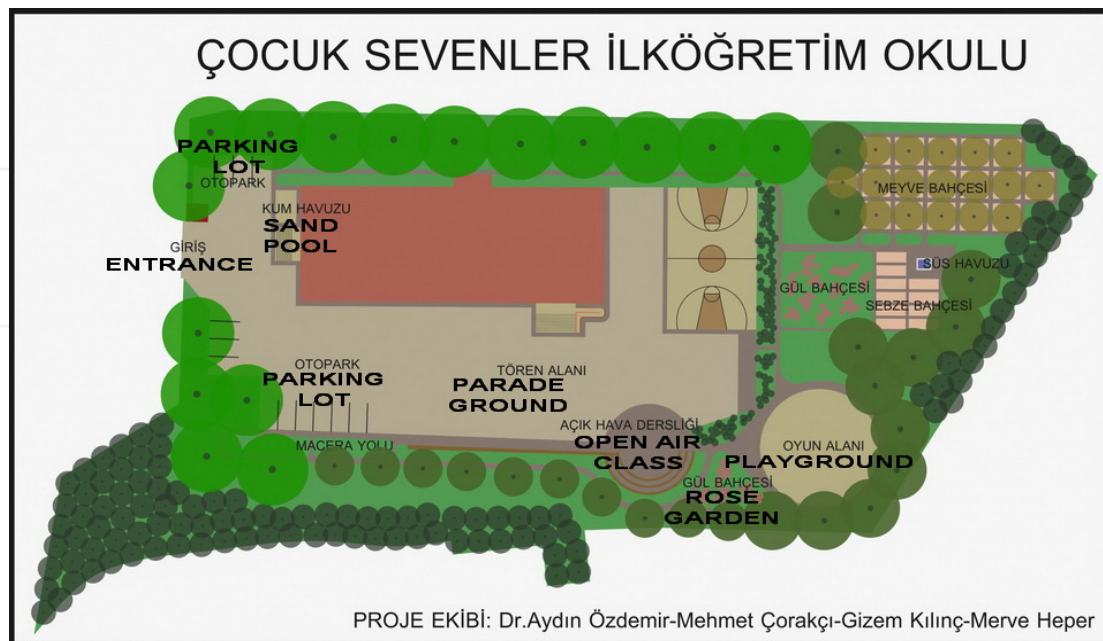


Figure 5. One of the alternative projects include sport facilities, fruit and vegetable gardens, rose garden, parking lot, open-air class, play field and walking trail, as proposed by the children

2.2. Results

Physical and landscape characteristics of schoolyards were defined according to total yard size, total school size, and available space per students as shown in Table 4.

| District | School | Number of students | Total school area | Total yard area | Usable yard space per student |
|----------|-------------------|--------------------|---------------------|---------------------|-------------------------------|
| Çankaya | Kavaklıdere PS | 650* | 2050 m ² | 1350 m ² | 2.08 m ² |
| Mamak | Çocuk Sevenler PS | 580* | 5500 m ² | 4750 m ² | 8.19 m ² |
| Keçiören | Kamil Ocak PS | 1300* | 9300 m ² | 6800 m ² | 5.23 m ² |
| Akyurt | TOKİ PS | 720 | 6100 m ² | 4525 m ² | 6.28 m ² |

*The number shows only the morning shift students

Table 4. Physical assessment of schoolyards

Kamil Ocak Primary School has the largest yard; however, the available area per student is not adequate. According to zoning standards in Turkey, child play spaces should have at least 10m² usable area per child. This standard is also applicable to schoolyards; however, none of the schools provide sufficient space for child activities in this study (Table 4). Çocuk Sevenler Primary School, which has the largest usable space per student, received the best expert rating score. On the other hand, Kavaklıdere Primary School, which has the smallest and inadequate space per student, received the lowest expert rating score. It is assumed that spatial conditions such as spaciousness influence expert ratings. Kamil Ocak Primary School yard received one of the lowest scores due to the confined feeling and the existence of a high retaining wall that divides the yard into separate lots. This wall was defined as dangerous and useless. Green spaces that have the potential for recreational purposes are out of reach of children and they are not accessible. There is the scarcity of shaded seating spaces and most of the ground is covered with hard material such as asphalt.

2.2.1. Questionnaires

Almost half of the respondents were boys (49,4%) and 4th and 5th graders (55,6%). Most of the students have spent at least two years in their school. We may conclude that these students are familiar with the school settings. More than half of the students (54,8%) reside in the same neighborhood where the school is located, and most of the students prefer to walk to their schools. Only 22,3% of respondents commute to school with a vehicle.

There is variability in type of activities during recess. A considerable amount of children spend their recess time inside the school (13,5%). More than half of students spend their recess time both indoors and outdoors (59%). Most of the students prefer to walk in the schoolyard (43,5%) and 21,2% of them behave active during recess. On the other hand, only 13,3% of children in these four schools prefer passive behaviors such as eating and sitting during recess (Figure 6).

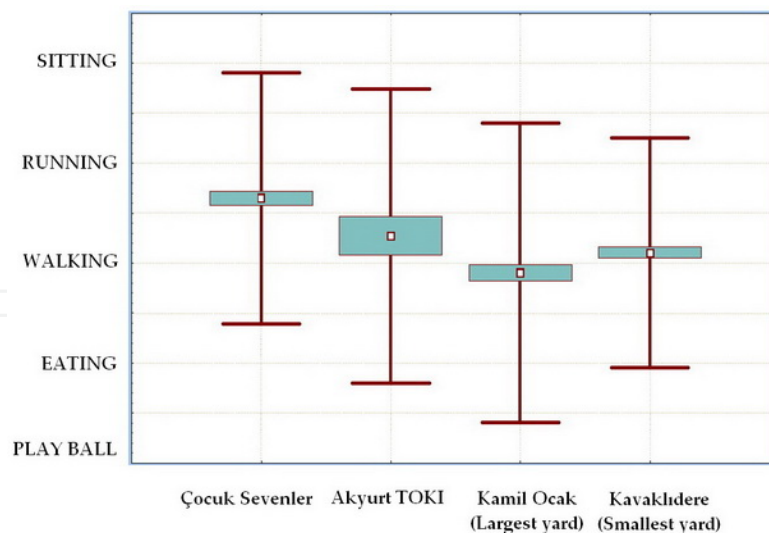


Figure 6. Scatter-plot diagram showing the distribution of type of activities across schools

More than half of respondents define their schoolyards as inadequate for any of the activities (59%). Regardless of the size of schoolyards, this relationship was found statistically significant ($F=113.05$, $df=3$, $p<0.005$, $R=0.48$) (Figure 7).

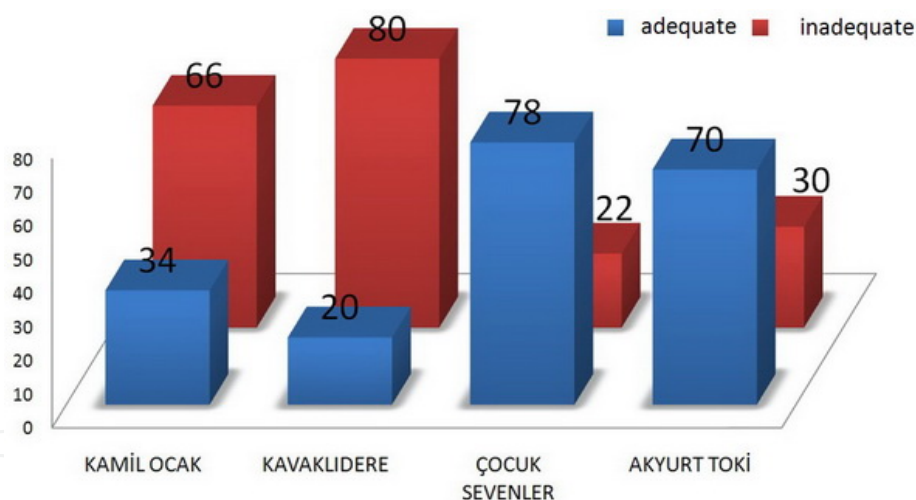


Figure 7. Adequacy of schoolyards

There is a statistical significance among number of students who liked yards; most of the students preferred the larger yards ($F=226.6$, $df=3$, $p<0.005$, $R=0.60$). Similar results were identified between the expert ratings and students' responses; children liked the yards which were also highly rated by the experts ($F=226.6$, $df=3$, $p<0.005$, $R=0.60$) (Figure 8).

Most of the students (65%) were not satisfied with the yards. Responses indicated that the size of the yards was a major contributor of this result; most of the children (34,2%) did not enjoy the small yards ($F=16.1$, $p<0.05$). Other reasons included inadequacy of sport facilities and limited green spaces.

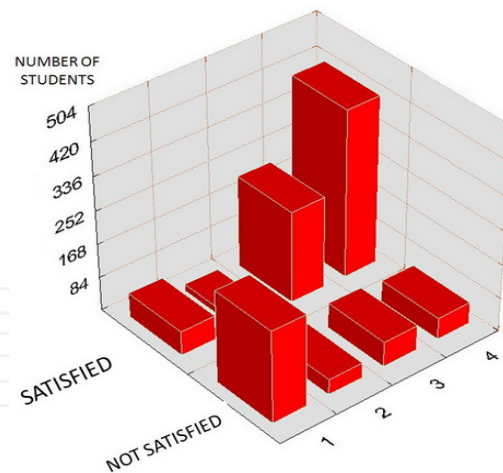


Figure 8. Students' satisfaction of schoolyards among scored yards (Quality scores - 1: High quality; 4: Low quality)

2.2.2. BMI distribution among schools

As a result of BMI distribution among schools, 16,2% of children were defined as overweight (N=181). Most of the students were in the normal range of BMI values (78,6%, N=876). Boys had higher BMI values than girls, and as expected, BMI values raised according to age groups, except 3rd grade students, which had lower BMI values than 2nd grade students (Table 5).

| Domain | | N | Percentage | Mean | sd |
|-----------------|-----------------------------|-----|------------|-------|------|
| Gender | Female | 564 | 50.6 | 17.89 | 2.88 |
| | Male | 551 | 49.4 | 18.64 | 2.96 |
| Grade | 2 | 70 | 6.3 | 17.86 | 2.71 |
| | 3 | 215 | 19.2 | 17.30 | 2.79 |
| | 4 | 303 | 27.2 | 18.15 | 2.86 |
| | 5 | 317 | 28.4 | 18.62 | 2.98 |
| | 6 | 210 | 18.8 | 18.99 | 2.93 |
| BMI | Underweight | 58 | 5.2 | | |
| | Normal | 876 | 78.6 | | |
| | Overweight | 181 | 16.2 | | |
| Type of commute | Walk | 866 | 77.7 | 18.20 | 2.95 |
| | Vehicle | 249 | 22.3 | 18.47 | 2.87 |
| Yard size | Kamil Ocak (Largest yard) | 293 | | 18.17 | 2.75 |
| | Çocuk Sevenler | 293 | | 17.58 | 2.88 |
| | TOKİ Akyurt | 55 | | 18.13 | 2.73 |
| | Kavaklıdere (Smallest yard) | 474 | | 18.75 | 3.02 |

Table 5. Subject characteristics and BMI values

Results showed that there is a statistical significance between type of activities and BMI values ($F=2.67$, $P=0.032$). Students who were active during recess had lower BMI values than passive students. This was similar with the active school commuters; children who actively commute to school have lower BMI values, and this result is statistically significant ($F=3.78$, $df=1$, $p=0.013$). Interestingly, large schoolyards have limited influence on decreased BMI values. Children in smaller schoolyards were more active and had lower BMI values. This finding is assessed by the relationship between total step counts and yard sizes, which is presented in the next section.

2.2.3. Pedometer measurements

A total of 120 measurements were made to indicate the variations in daily step counts, distance covered, burnt calories and fat among children at ages between 9 and 11 (Table 6).

| | | N | % | Step count | sd | Distance (km) | sd | Burnt calorie (Kcal) | sd | Burnt fat (gr) | sd |
|-----------|--------------------------------|----|----|---------------|--------|------------------|------|-------------------------|------|-------------------|------|
| Gender | Female | 65 | 55 | 4201.7 | 1971 | 2.43 | 1.19 | 66.6 | 33.9 | 3.75 | 2.01 |
| | Male | 55 | 45 | 4609.5 | 2068 | 2.75 | 1.25 | 84.1 | 41.8 | 4.71 | 2.48 |
| Grade | 3 | 10 | 8 | 5605 | 2970.8 | 3.32 | 1.91 | 82.5 | 51.1 | 4.85 | 3.2 |
| | 4 | 40 | 34 | 4839 | 2041.7 | 2.81 | 1.32 | 74.6 | 34.3 | 4.17 | 1.95 |
| | 5 | 70 | 58 | 3957 | 1734.4 | 2.34 | 0.96 | 73.4 | 39.3 | 4.1 | 2.32 |
| Yard size | Kamil Ocak (Largest yard) | 40 | 33 | 3645.8 | 2171.6 | 2.23 | 1.34 | 61.18 | 36.9 | 3.46 | 2.24 |
| | Çocuk Sevenler | 40 | 33 | 4173.7 | 1585.7 | 2.49 | 1.02 | 61.1 | 27.3 | 3.6 | 1.54 |
| | Kavaklıdere (Smallest yard) | 40 | 33 | 5346.4 | 1914.7 | 3.01 | 1.76 | 97.5 | 40.1 | 5.5 | 2.4 |

Table 6. Step counts, distance, burnt fat and calorie across gender, grades, and yard sizes

Average step counts were 5346 in Kavaklıdere, 4174 in Çocuk sevenler, 3646 in Kamil Ocak primary schools. Boys were more active than girls, and small children were more active than older ones. Similar results were found for values of energy expenditure; boys and small children burnt more calorie and fat than girls and older students. The most interesting outcome of the study was the statistical significant and inverse relationship between schoolyard size and pedometer counts. Children in small schoolyards walked more ($F=4.47$, $df=2$, $p=0.013$), and burnt more calories ($F=12.83$, $df=2$, $p<0.05$) and fat ($F=11.78$, $df=2$, $p<0.05$).

2.2.4. Assessment of student pictures

Total of 472 pictures taken by students were assessed as shown in Table 7. Experts defined type of images and visible elements in the pictures. As a control group, researcher took pictures with a disposable camera and included these images within other groups of images for a random presentation. Both control group images and student images were similarly assessed, which conclude that assessments are reliable and valid.

| School | Gender | Total | Built | Planting | Enclosed | Open scene | Scene-plants | Animals |
|-------------------|--------|-------|-------|----------|----------|------------|--------------|---------|
| Kamil Ocak | F | 19 | 4 | | 5 | 2 | 8 | |
| | F | 15 | 2 | 7 | 1 | 2 | 3 | |
| | F | 20 | 3 | 8 | 1 | | 8 | |
| | F | 27 | 5 | 3 | | 1 | 13 | 5 |
| | F | 20 | 3 | 8 | 1 | | 8 | |
| | M | 22 | 1 | 7 | 1 | | 8 | 5 |
| | M | 25 | 1 | 16 | | 3 | 4 | 1 |
| Kavaklıdere | F | 25 | 2 | 19 | | | | 4 |
| | F | 22 | 1 | 6 | 5 | | 5 | 5 |
| | F | 25 | 1 | 3 | 1 | | 20 | |
| | F | 23 | | 7 | 4 | | 9 | 3 |
| | F | 18 | 3 | 8 | 4 | | 3 | |
| | F | 25 | 1 | 14 | 2 | 1 | 4 | 3 |
| | F | 15 | 4 | 4 | 5 | 1 | 1 | |
| | M | 20 | | 10 | 1 | 3 | | 6 |
| | M | 21 | 1 | 6 | 2 | | 7 | 5 |
| Çocuk Sevenler | F | 23 | 2 | 11 | 2 | | 8 | |
| | F | 16 | 1 | 8 | 4 | 1 | 2 | |
| | F | 20 | | 3 | 6 | 7 | 4 | |
| | F | 17 | | | 1 | 5 | 8 | 3 |
| | F | 27 | 1 | 10 | 9 | 4 | 3 | |
| | M | 27 | 2 | 8 | 5 | 12 | | |

Table 7. Number of pictures according to the picture character across schools

Most of the students took pictures of plants and plant groups (35%). A considerable number of students took landscape images (27%). Only 12% of children captured interior spaces such as their home environments and school interiors. The most frequent type of images was captured from a vantage point—balcony or a terrace—looking toward the green spaces and plant groups. Although most of the images were captured during weekend, most of the pictures included home environments and local parks. We may conclude that children spend their weekend time at home and in the neighborhood.

Distribution of image properties are associated with regional locations (Figure 9). Kavaklıdere Primary School is located in a highly dense region with dense traffic and limited green spaces. Local parks in the district are scarce and limited front yards of apartments are used for parking cars. Kamil Ocak Primary School, on the other hand, is located in a district with lower dense housing distribution. This neighborhood with lower income families has more open spaces and green lots. Students' perceptions of environment, therefore, may vary according to the neighborhood characteristics. Most of the students in Kavaklıdere Primary School took pictures of plants in their homes. On the other hand, Kamil Ocak and Çocuk Sevenler students took pictures of open spaces and open vistas. These results can be associated with neighborhood characteristics. However, these assumptions should be based on valid and systematic research that should include significant comparisons of children's environmental perceptions and spatial characteristics of neighborhoods.

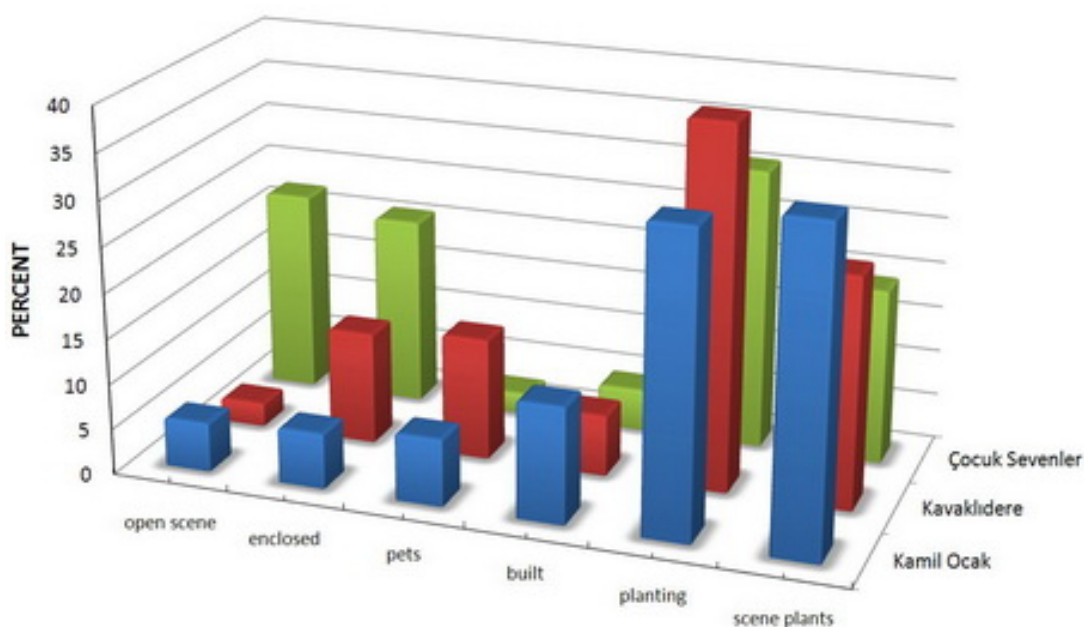


Figure 9. Distribution of picture properties across schools

2.3. Discussion

The results of this study contribute to both health and design professionals; environmental variables are effective in health promotion. In terms of design outcomes, this study provides evidence indicating the spatial effects of school environments on child health. Although most schools lack spacious schoolyards that were defined as mostly crowded and congested during recess, children were more active in small yards. Students generally complain about limited outdoor space for both play and physical activities; most students requested more spacious and green space for attraction and comfort. On the contrary of the expectations, pedometer measurements provided support that space distribution rather than the size is effective in health promotion. As many children attend to public schools, improvement the quality of the schoolyards to promote more physical activities is recommended.

It was expected that larger yards would improve health of students with lower BMI values, which was found in the study of Özdemir and Yılmaz (2008). However, this study found a statistical significant and inverse relationship between schoolyard size and pedometer counts. Children in smaller schoolyards were more active with more step counts. The findings from the questionnaires, which included assessment of BMI values showed similar results; children in schools with smaller yards are more active and have lower BMI values.

The schools are considered for the purpose of this study in the small to medium size bracket. The current study questionnaire sample would appear to be representative in terms of school size and regional distribution. Data in the present study indicate that small schools reported more positive physical activity promoting practices than larger schools. Small schools experienced fewer barriers than larger schools specifically with respect to restricted areas, accessibility, supervision, security and availability of play equipments. Small schoolyards may provide more opportunities for mixed and group plays and the limited availability of space may promote children to be more active. Children in small schoolyards all play together, rather than being in separate groups in larger yards. However, these factors were not included in this study, which requires further investigation.

On the other hand, larger schoolyards were more likely to permit children to play on the green areas, which are generally allocated for cars. These schools also permit the free-play of children during recess for security and health reasons; teachers are generally worried about the possible injury of children on vast and vacant yards. Meanwhile in larger schoolyards, children were more likely to engage in group activities. Since these schools lack fixed equipments and playground markings, children stroll around during recess. Barriers in the large yards such as walls, fences and parked cars limit the active behavior of children.

The findings of this study are relevant to Zask et al. (2001)'s results that as schools got larger children became less active. On the other hand, the pedometer measurements of Cardon et al. (2008) and Louie and Chan (2003) indicated that more space per child was found to be associated with more PA during recess; children in schools with large outdoor space were significantly more active than children at schools with smaller outdoor space. The present study would indicate that the comparison of yard sizes exhibit different challenges in relation to play habits, yard organization, and availability of play equipments, crowding, landscaping, maintenance and most importantly effects on physical activity and child health. More research is needed to investigate possible relations between these factors in order to overcome these challenges and to decide whether yard size is influential on child health.

Children who were active during recess had lower BMI values than passive students. This finding is similar with the active school commuters; children who actively commute to school have lower BMI values. The study also found gender and age differences; boys have higher BMI values than girls, and as expected, BMI values rise according to age groups, except 3rd grade students, which have lower BMI values than 2nd grade students. Boys and small children burnt more calorie and fat than girls and older students. More boys were engaged in active behavior than girls and similar findings were consistently reported in

other studies (Myers et al., 1996; Sallis et al., 2000; Mota et al., 2005; Tudor-Locke et al., 2006; Özdemir and Yılmaz, 2008).

2.4. Conclusions

Given the increasing rates of childhood obesity, energy expenditure is a research priority to improve settings promoting more activity. The effect of the built environment on health is a current research agenda and research has found associations between environmental features and physical activity and body mass. However, the examination of physical environments to explain and promote physical activity is an important yet under-investigated area of research inquiry, and research on health outcomes of the physical environment has been limited by insufficient data regarding the role of the environment.

Many factors contribute to obesity, and the physical environment in particular can have a strong influence on children's opportunities for regular physical activity. Decisions made at the local level regarding planning and design of school environments can have a significant impact on child health. By recognizing these links, communities can help reverse obesity trends and build healthy environments. Young children appear to engage in low levels of physical activity at school. With more than 25 millions of children attending schools in Turkey, it is important to better understand factors inherent in school environment that influence physical activity behaviors of young children.

Major critical factor emerged from this investigation was the spaciousness is not a critical measure for an active behavior as well as for play and learning. Almost all students had complaints about the lack of adequate space for play due to the crowded schoolyard in all recess time. However small spaces may promote more active behavior and public schools with limited space inside the city centers can better develop design guidelines to improve the physical qualities of these yards.

Previous studies have shown the impact of outdoor environments on physical activity and prevention from obesity in various nations, and the recognition of such approach may lead to the advancement of the outdoor school environments. Encouraging students to be active in safe and attractive outdoor environments may be accomplished by careful and systematic landscape designs, but the major concerns are the finance and the maintenance.

The urban environment is not built to suit child needs and to accommodate child play behaviors in a safe environment. The most natural way to be active and to develop healthy attitudes in PA among children is to play outside in a safe and open environment (Caroli et al., 2011), and the school environment is one of the settings to provide safe and healthy environment for children. School setting is a valuable resource contributing improved PA and this type of environment should be studied to find ways of reducing obesity by improving active behavior. Research should include identification of environmental variables of schools contributing to high levels of obesity in children. Schools in neighborhoods with high risks of obesity should be the focus of future studies; those school settings should be re-developed and re-designed to encourage PA in children.

It is assumed that findings would reinforce the need to provide and support school physical environments related to physical activity. The results of exploratory studies indicate support for the contention that child spaces should be thought of as a part of a viable strategy for health promotion. The hypothesis is that outdoor environments with more natural landscape characteristics are a viable context for health promotion activities such as physical activity.

A conceptual framework should be outlined that addresses the complexity of the relationship between spatial characteristics of outdoor environments and students' physical activity behavior, which should be structured to guide future policy and research.

Active behaviors should be promoted with city planning and infrastructure by creating safe and accessible urban environments. Changes in neighborhood characteristics, adding more parks, safe walking routes and playgrounds and recreational facilities will have positive effects on health of children and adults.

2.5. Future directions

Research is needed to develop effective interventions to increase daily physical activity via active commute to school, monitoring daily physical activity behaviors, promoting school activity programs and promoting healthy curriculum and dietary habits. Studies should include more objective measurements of physical activity among different age groups and the specific roles of environmental factors should be defined that are related to preventing childhood obesity (Lobstein et al., 2004). School environment represents a fundamental opportunity for children to gain active lifestyle through the use of spaces that promote active behavior (Pate et al., 2006; Wagner and Kirch, 2006). Schools are ideal places for health promotion by including healthy school programs, curriculums and making availability of daily exercise (Stice et al., 2006; Doak et al., 2006; Brown et al., 2009). Research should include identification of environmental variables of schools contributing to high levels of obesity in children. Schools in neighborhoods with high risks of obesity should be the focus of future studies; those school settings should be re-developed and re-designed to encourage physical activity focusing on minority and disadvantaged groups and communities.

Research should include longitudinal approach to track changes in children's activities, and include sample from rural and remote areas with disadvantaged neighborhoods. Changes in neighborhood characteristics, adding more parks, safe walking routes and playgrounds and recreational facilities will have positive effects on health of children. Promoting physical activity in urban neighborhoods, especially lower income ones, must address concerns about the physical and social environment.

2.6. Strengths and limitations

The key strengths of this study are the use of measured height and weight for the calculation of BMI, the objective measurement of the PA by pedometers and the adoption of

BMI cut-off points for children. This use of objective measurement of PA reduces the bias commonly associated with self-report measures. The sample selected is a good representative of the population; schools were randomly selected according to regions and a considerable number of students were included in the study in each school.

This study was conducted during spring season only, and children were more likely to be outside with active behaviors which resulted with limited variability in the outcomes. Another limitation of our study is the presentation of results from a single time point, which limits the casual directions in the relationships between overweight and well-being. In our study, there may be too many other external factors in the setting—the schoolyards—which are difficult to measure and available to include as independent factors affecting health of children.

As with all questionnaire-based surveys, social desirability bias in the responses is a problem; children may have difficulties in recalling types of behavior they participated in the last two weeks.

Studies that define the casual relationships between environmental interventions and health behaviors with empirical associations usually lack definitions on how and why these variables influence health behaviors, which is one of the limitations of this study.

Based on these limitations, more systematic research is needed on developing strategies to prevent childhood obesity, to find ways in promoting more active behavior and to better design environments for improving child health.

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