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The Role of Physical Features of the Schoolyard in Increasing Children's Physical Activity, Viewpoints of 8–12-year-old Students in Tehran City, Iran*

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ABSTRACT

Children spend long hours in the school's interior space and do various physical activities; therefore, a considerable part of physical activities and playing is done in the schoolyard. Children's play and physical activities will decrease if the schoolyard does not provide a suitable space for physical activities. Such a decline in physical activity is harmful to children's health. The extant study aims to investigate the effect of the schoolyard's physical features on children's physical activity. This is a quantitative-qualitative study that assesses children's viewpoints about schoolyard features by using a questionnaire. The studied statistical society comprised 8-12-year-old children in Tehran City, Iran. Sampling was done through multistage cluster sampling, and 120 children from selected areas participated in the survey voluntarily. The data of the considered age group of children were collected through a children-specific researcher-made questionnaire. After the data were gathered, the importance of each criterion was determined based on the t-test, and then the components were ranked. According to the results of ranking environmental subfactors affecting physical activity, "light" was the most prior criterion with the highest mean value rather than other criteria. This criterion was followed by legibility, flooring safety, shape diversity, and playground safety with the highest effect on children's physical activity in the schoolyard. Collective space obtained the next rank and group activity was at the last rank. Three factors were derived using factor analysis after determining the role and importance of the environment in children's activities. The environmental and spatial factors affecting physical activity included "attractiveness," "sociability," and "playability" of the environment. One can improve the children's activity and health by considering of mentioned factors in the design process of outdoors in schools.

Keywords: Schoolyard, Physical Activity, Child, Elementary School, Playing.

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1. INTRODUCTION

Now, children spend less time playing outdoors compared with the previous generation (Carver, Timperio, and Crawford 2008) because urban children spent a long time of their lives indoors, such as in kindergarten and school (Mardumi, Karim and Ebrahimi 2013). Rural children are considerably more active than children living in cities and spend more time playing outside of the house (Sandercock, Angus, and Barton 2010). Although children prefer outdoor activities, they spend more time in indoor spaces (Lupu, Norel, and Laurenţiu 2013). Education is mainly realized in indoor spaces in Iran (Mozaffar, Mahdizadeh Seraj, and Mirmoradi 2009), and even residential buildings or apartments are used as educational spaces for children (Shafaee et al. 2009). In most Iranian schools, indoors have received great attention without considering a suitable design, space, and certain functional indicators for the schoolyard (Shayan and Khoramifard 2013). Those schools with no yard or small yard limit the physical activities of children. improper conditions of the schoolyard for playing and lack of green space make students use schoolyard space only during sports hours or for commuting (Tabaian 2021). In this regard, children are encouraged to be outdoors if conditions provide a space where they can freely do activities, play, and communicate with each other. Therefore, educational spaces are structurally defined as a place for child growth and nurture (Khalilikhah et al. 2022). Generally, it can be stated that the schoolyard has no identity in current conditions since it does not fully meet the educational, playing, and rest needs of students. The indoor yards with asphalt pavement with few facilities for playing and physical activities are usually seen more or less in all schools located in Iran (Ahmadpour Samani and Farsi Mohammadipour 2018, 3). In mentioned spaces, children have less opportunity to experience their surrounding physical environment and do activities there (Oloumi, Mahdavinejad, and Namvarrad 2012).

Inactivity is the main cause of many diseases, such as obesity, and cardiovascular diseases, and one of the major concerns for the general health of physically inactive children (Jerrett et al. 2013; Melekoglu 2015). Physical activity includes all movements done by the skeletal organs of the body (Bouchard, Blair, and Haskell 2012). Research indicates that regular physical activity during childhood keeps physical-mental health of individuals (Žaltauskė and Petrauskienė 2016), and is necessary for the physical, mental, and psychological health of children (Smith et al. 2022). Those children and adolescents that have had regular physical activities have mental and physical health, including heart health, muscular power, suitable metabolism, and high self-confidence (Boonzajer Flaes et al. 2016). On the other hand, a consistency exists between the physical activity of children and their learning abilities. The higher the physical activity level of the body, the higher the learning will be. Hence, it is essential for the education system to support such activities, especially for those children that have learning problems (Butcher and Eaton 1989; Demirci, Engin, and Özmen 2012). The increased activity level leads to a dramatic rise in learning. Therefore, supportive teachings are required to increase the physical activity of children that are mental disable (Demirci, Engin, and Özmen 2012).

Children aged 5-12 become aware of physical activities and are willing to gather together to achieve joint goals. In the age range of 5-12, children increase the mastery and concentration of their sport by doing physical exercises more than before (Ebrahimi, Saeidi Rezvani, and Maani Manjil 2012). In this age group, communication between children and their peers and relationships appeared in these communications shape a specific context of their daily activities (Rukavishnikova 2016). Children tend to do physical activities in open spaces; therefore, outdoors must be designed suitable for children's physical activities and exercises (Pellegrini and Smith 1998). Physical environment, especially outdoor space is a variable that can affect the physical activity level of children (Žaltauskė and Petrauskienė 2016). On the other hand, the leading purpose of education in elementary schools is to foster children in different physical, mental, and emotional scopes (Azemati, Norouzian Maleki, and Khan Vali 2015, 92). Therefore, many educational goals are achieved if the school environment can meet the children's needs for communication, playing, and activity (Seneh, Salman, and Aghazadeh 2008, 87). It seems that active behaviors of children are seen in open spaces when communicating with other children. Therefore, the schoolyard must be a suitable space for children to play and do physical activities there. Previous studies have addressed the role of the different outdoors (including outdoors in residential complexes, playgrounds, and urban open spaces) in improving the physical activity of children. However, no study has examined the effect of schoolyards on the physical activity of Iranian children. the literature review indicated the minor role of non-medical scopes in developing physical activity in elementary schools outdoors. Hence, further study must be done on this subject (Ebrahimzadeh et al. 2021, 225-226). This study, in particular, emphasizes the role of the physical features of the schoolyard in increasing the physical activity of children aged 8-12. The present study aims to identify those physical variables of the schoolyard that affects the improvement of children's physical activity. In this case, it is assumed that the physical features of the schoolyard play a vital role in improving the physical activity of children. This paper tends to answer the following questions:

1. Which one of the physical features of the schoolyard plays a more significant role in improving children's physical activity?

2. How we can increase children's physical activity by changing the outdoor (schoolyard) characteristics of the school?

2. THEORETICAL FOUNDATIONS

A relationship exists between physical activity and the built environment. The environment can improve health status if it replaces sedentary time with physical activities (Roemmich, Beeler, and Johnson 2014). Access to outdoors and entertainment in elementary schools anticipate a considerable share of daily physical activities of children (Žaltauskė and Petrauskienė 2016). A study was conducted on 427 children aged 10-11 in the UK and indicated that children had 17-min severe physical activity per hour playing with friends outdoors, while they spent 6-min time for physical activity per hour playing with friends (Pearce et al. 2014). In this regard, empirical evidence indicates that educational classes in schoolyards increase children's physical activity (Bentsen et al. 2022). Those schools with large yards and playgrounds with many pieces of equipment considerably allow children to show physically active behaviors (Delidou, Matsouka, and Nikolaidis 2015). Schoolyard playability is a solution used to improve the physical activity of children. Some factors play an effective role in children's activity improvement: paying attention to the color used in open spaces, providing playing facilities and equipment, creating the potential for outdoor use at different times, and improving space attendance. The presence of children outdoors after formal education hours can create a sense of security, which positively affects the presence and activity of children in the environment (Anthamatten et al. 2011).

The green design of the schoolyard is one of the popular accroaches and orientations in the school's outdoor landscape design (Faizi and Razzaghi Asl 2009). It means green space in schoolyard has a positive impact on children's physical activity (Floyd et al. 2011; Ward et al. 2016; Akoumianaki-Ioannidou, Paraskevopoulou, and Tachou 2016) so that children's playing rate is doubled in planted places (Azemati and Feridonzadeh 2012, 108). School outdoors designed based on natural elements (e.g., trees, flowers, sand, grass, bushes, and hills) will increase children's physical activity level and improve their physical health. Compare with asphalt-base playgrounds, greened schoolyards play a more vital role in improving children's playing (Bikomeye, Balza, and Beyer 2021). Natural elements such as grass grounds, sand grounds, and vegetation or planted yards of a kindergarten and access to all spaces and equipment provide a suitable field for group plays of children encouraging them to do more physical activities and playing (Azlina and S. 2012). The large area and diversity of outdoors, green, and natural spaces also have positive impacts on the physical activities of children (Kjønniksen, Wiium, and Fjørtoft 2022). Play environments must be designed by considering natural landscape combinations, creating play equipment, and fencing to create a sense of security and space for free exploration in the environment. those children that participate in organized plays do fewer activities rather than in free plays. However, teacher monitoring can improve children's physical activity in some cases (Floyd et al. 2011). Available playgrounds improve physical activity (Holt et al. 2008), and schoolyard playability increases children's activity time (Hamer et al. 2017). In general, flexibility, good landscape, nature orientation, and diverse and independent spaces make the schoolyard architecture an appropriate resort with a multifunctional perspective (Malek 2012). Children see the outdoors as a desired space that its design has observed some characteristics, including scale, safety, amenity, accessibility, sociability, and variety (Oloumi, Mahdavinejad, and Namvarrad 2012).

3. METHOD

The present study aims to identify physical variables of schoolyards affecting the improvement of children's physical activity. This was a descriptive-analytical study conducted within three bibliographic methods, field observations, and survey frameworks. The components affecting children's physical activity in the schoolyard were derived from the relevant literature and children's behavior in outdoor spaces of some governmental elementary schools in Tehran, Iran. The collected components formed the structure of a questionnaire that was used in the survey stage. The studied statistical society comprised 8-12-year-old students of government schools in Tehran City. although children aged 5-7 are also influenced by the environment, the age group of 8-12 was selected to obtain more reliable data. The selected age group read the items of questionnaires and had a better perception of images. Sampling was done through the multistage cluster method, and 120 children from selected areas voluntarily participated in the survey. Accordingly, 2.5-5 members were suggested as the sample size for each item; hence, the sample size equaled around five times greater than the items (n=23) (Kline 2011). A children-specific 23-item researcher-made questionnaire was used to collect data from considered age groups of children. The addressed factors included outdoor features seem to have significant nexus with physical activity and play of children. The mentioned features were derived from previous studies and children's physical activity in the available schoolyard. Each considered component was surveyed in form of a question with an image associated with that question. The image helps to achieve a better perception and visualization of space. It should be noted that observation is an appropriate component to conduct studies in the age

group of children. However, the lack of desired and diverse open spaces in the schoolyard and children's control during leisure time led to results that cannot be generalized easily. The reason is that children showed similar behaviors in schoolyards, so they were not classifiable clearly; hence, a researcher-made questionnaire was used to achieve more reliable results.

Data analysis was done through SPSS software. The reliability of the questionnaire was measured by using Cronbach's alpha, which equaled 0.936, and was greater than 0.70 indicating good reliability of the questionnaire. The validity of the questionnaire was also confirmed by child psychologists. Kolmogorov-Smirnov test determined data parametric status. Kolmogorov-Smirnov test's values equaled p=0.000 or p=0.001 for all variables, which were not significant. Therefore, items had normal distribution, so authors could use parametric analysis for this purpose. One-sample t-test was used to examine the effect of each component then the Friedman index was used to rank the effect of each indicator. Finally, exploratory factor analysis was used to derive effective factors.

4. FINDINGS

Girls were 30% more willing to participate in the survey rather than boys (Table 1). This gender difference in the participation rate of children is a debatable issue.

Table 1. The Participation Rate of Children based on Gender

	Frequency	Frequency (%)
Girls	75	63%
Boys	45	37%
Sum	120	100

All environmental factors were considered with an equal score through the questionnaire. The research hypothesis was tested by using a one-sample t-test (Table 2). If the significance level of the test for each variable is less than 0.05, H0 is rejected at an error level of 5%. This rejection indicates confirmation of the main hypothesis of the study. In addition to the significance level, the t-value and mean difference have also been considered.

Table 2. Results of One-Sample t-Test for Effective Environmental Variables

	Physical and Behavioral Variables	t-Test Value	Mean Difference	Lower Bound	Upper Bound
1	Shading	25.500	2.714	2.50	2.93
2	Sand Grounds	29.782	2.946	2.75	3.14
3	Plantation	26.151	2.955	2.73	3.18
4	Greenness	23.764	2.857	2.62	3.10
5	Water Presence	25.289	2.786	2.57	3.00
6	Color	26.006	2.866	2.65	3.08
7	Shape	28.059	2.929	2.72	3.14
8	Activity	27.597	2.848	2.64	3.05
9	Furniture	23.666	2.634	2.41	2.85
10	Volume Composition	26.738	2.661	2.46	2.86
11	Space Division	27.304	2.74	2.52	2.91
12	Group Activities	25.881	2.500	2.31	2.69
13	Sport Ground	24.660	2.830	2.60	3.06
14	Public Space	27.394	2.643	2.45	2.83
15	Locations	25.683	2.714	2.50	2.92

	Physical and Behavioral Variables	t-Test Value	Mean Difference	Lower Bound	Upper Bound
16	Services	25.811	2.696	2.49	2.90
17	Routes	25.676	2.643	2.44	2.85
18	Equipment	25.338	2.741	2.53	2.96
19	Flooring	25.964	2.991	2.76	3.22
20	Playground	30.352	3.062	2.86	3.26
21	Light	31.255	3.152	2.95	3.35
22	Legibility	30.445	2.964	2.77	3.16
23	Monitorability	24.911	2.670	2.46	2.88

According to data (significance level of test) reported in Table 2, all micro-factors affected children's physical activity in the schoolyard with a significance level of 0.000. this test confirmed the research hypothesis indicating the effectiveness of the physical features of the schoolyard in increasing children's physical activity. However, the results could not find the mote effective factor in increasing physical activity.

Friedman test was used to answer the first question of the study (which one of the physical features of a schoolyard plays a more significant role in improving children's physical activity?) and rank the factors. The obtained chi-squared value (95.478) was at an error level<0.05; therefore, the ranking of the factors was significant (Table 3).

Table 3. Results of Friedman' Ranking Test- Test Content

N	112
Chi-squared Value	95.478
df	22
Sig.	0.000

Table 4 reports the order of indicators' importance based on the results of Friedman's test on the answers given to the first question. According to this table, the factor "light" is one of the criteria defined for the sense of security in the environment, which was the most prior variable with the highest mean value compared to other variables. This questionnaire asked some questions about the light and shadow of space; hence, the light was considered a subset of security because children felt insecure in dark and dim spaces. This variable is followed by legibility, flooring safety, shape diversity, and playground safety at the next ranks of variables influencing the children's physical activity in the schoolyard. In general, these values indicated the importance of safety and other factors creating a sense of safety from the view of children. Group activity was at the last rank of importance followed by public spaces with a minor difference in the last rank (Table 4).

Table 4. Results of Friedman's Ranking Test- Ranking the Variables

Environmental Factors	Light	Playground Safety	Shape Diversity	Flooring Safety	Legibility	Plantation	Sand Grounds	Color Diversity	Greenness	Playground	Activity Diversity	Water Presence
Average Rank	14.10	13.95	13.18	13.27	13.02	12.94	12.89	12.61	12.49	12.26	12.19	12.10
Environmental Factors	Equipment Safety	Volume Composition	Access to Services	Shading	Access to Locations	Monitorability	Flexible Furniture	Space Division	Routes	Public Space	Group Activity	
Average Rank	11.57	11.42	11.33	11.21	11.20	11.09	11.04	11	10.98	10.67	9.59	

Factor analysis was used to answer the second question (how we can increase children's physical activity by changing the outdoor (schoolyard) characteristics of the school?). To do this, sample adequacy must be determined in the first stage. For this purpose, the Kaiser test (KMO) was used, and

its value of 0.912 was acceptable. The significance of Bartlett's test at the level of 0.05 indicated data adequacy in exploratory factor analysis (Table 5).

Table 5. Results of Bartlett's Test and KMO Index

KMO Value	0.912
Chi-squared Value	1595.275
df	253
Bartlett's Test Significance	0.000

Table 6 reports the variance value that the tool can discuss it. Accordingly, 67.195% of respondents had five joint thinking contexts. It means that five identified factors were reliable in the opinion of around 67% of respondents; 34.608% of this variance was related to the first scope. The second-fifth category constituted 32.587% (almost half of the total variance) of variance.

Table 6. Explained Variance of Tool

Factors	Initial Values			Sum of Squares of Factor Loads			Sum of Squares of Factor Loads after Varimax		
	Sum	Variance (%)	Cumulative Percentage	Sum	Variance (%)	Cumulative Percentage	Sum	Variance (%)	Cumulative Percentage
1	10.167	44.202	44.202	10.167	44.202	44.202	7.960	34.608	34.608
2	1.605	6.979	51.181	1.605	6.979	51.181	2.237	9.724	44.332
3	1.310	5.696	56.877	1.310	5.696	56.877	2.191	9.526	53.858
4	1.271	5.526	62.403	1.271	5.526	62.403	1.636	7.115	60.973
5	1.102	4.792	67.195	1.102	4.792	67.195	1.431	6.222	67.195
6	0.939	4.071	71.267						
7	0.855	3.716	74.983						
8	0.709	3.082	78.065						
9	0.652	2.835	80.900						
10	0.639	2.779	83.679						
11	0.504	2.192	85.871						
12	0.496	2.158	88.029						
13	0.437	1.901	89.930						
14	0.362	1.575	91.505						
15	0.349	1.517	93.022						
16	0.317	1.376	94.398						
17	0.255	1.107	95.506						
18	0.230	1.002	96.507						
19	0.213	0.927	97.434						
20	0.178	0.774	98.208						
21	0.164	0.714	98.922						
22	0.126	0.549	99.472						
23	0.122	0.528	100.000						

Table 7 reports the contribution of variables in each category after varimax. According to variance values, 23 variables can be classified into five categories. The first category includes color diversity, access to spaces, greenness, flooring safety, playground, shape and form diversity, sports ground, water presence in space, activity diversity, access to services, shading on elements, the safe floor in routes and pause space,

space legibility, shading on the routes, equipment safety, flexible furniture. The variables of space division, group activity in nature, and communication between age groups created the next category. The third category comprised flexible volume composition, sand grounds, and monitorability (Table 7).

Table 7. Matrix od Data after Varimax

	Factors	1	2	3	4	5
Environment Attraction	6. Color Diversity	0.835	0.178	0.171	0.057	0.163
	15. Access to Locations	0.834	0.131	0.240	0.013	0.193
	4. Greenness	0.832	0.057	0.273	0.027	0.236
	20. Playground	0.816	0.236	0.283	-0.520	0.490
	7. Shape Diversity	0.806	0.205	-0.012	-0.047	0.306
	13. Sports Ground	0.786	0.009	0.164	0.020	-0.093
	5. Water Presence	0.778	-0.018	0.220	0.213	-0.035
	8. Activity Diversity	0.764	0.175	0.197	0.052	-0.148
	16. Access to Services	0.668	0.104	0.128	0.357	0.049
	1. Shading	0.662	0.556	0.420	0.209	0.288
	19. Flooring	0.651	0.333	0.190	0.145	0.139
	22. Legibility	0.579	0.278	0.112	0.324	-0.061
	17. Routes	0.572	0.275	0.064	0.261	-0.054
	18. Equipment Safety	0.556	0.070	0.063	0.451	-0.072
Environment Sociability	9. Flexible Furniture	0.386	0.334	0.290	0.173	0.164
	11. Space Division	0.242	0.787	0.039	-0.172	0.072
	3. Plantation	0.154	0.718	0.164	0.114	0.281
	12. Group Activity	0.048	0.599	0.124	0.263	0.420
Environment Playability	10. Volume Composition	0.347	0.022	0.744	0.292	-0.171
	2. Sand Grounds	0.206	0.064	0.689	0.174	0.115
	23. Minitorability	0.224	0.374	0.652	0.190	0.065
	21. Light	0.100	0.029	0.057	0.842	0.151
	14. Public Space	0.130	-0.021	0.040	0.080	0.843

According to Table 7, light (variable 21) forms the fourth category, and public space (variable 14) creates the fifth category. The fourth and fifth categories are univariate, so they cannot determine effective factors. Therefore, these categories are removed. The three first groups comprise 21 variables and explain three major factors of the study. Five architects examined these three factors and defined them based on their constituent criteria: "environment attractiveness," "environment sociability," and "environment playability". The mentioned three factors could explain 53.858% of the total variance of the study (Table 6).

5. DISCUSSION AND CONCLUSION

The results indicated that the physical features of the schoolyard could affect the children's physical activity. These features affected the children's physical activity in the schoolyard under the title of three factors: "environment attractiveness," "environment sociability," and "environment playability". These factors have been defined herein:

- Environment attractiveness: an attractive environment encourages children to be preset in the space.
- Sociable spaces: sociable spaces provide places for children to gather together encouraging them to do group physical activities and plays, which does not necessarily means teamwork or task division in the group.
- Environment playability: playability provides a field for safe activity and plays for children.

Relationships with nature, diversity, space flexibility, accessibility, equipment safety, and a sense of security in the schoolyard provide more physical

activity experiences for children. Grass ground, sand grounds, shading, public space, activity diversity and frolic, space division and territory creation, and environment monitorability were the share concepts between this study and findings obtained by others (Azlin and S. 2012). Moreover, the results of this study regarding the nature orientation, and diverse and independent spaces were matched with research results of schoolyard architecture in an elementary school conducted by Malek (2012). Some studies have examined the correlation between environment and physical activity to consider the effect of the outdoors on physical activity at the urban scale. The mentioned studies have found similar results to the present paper about the effect of green space on children's activity. For example, the results of this study about the effect of green space and natural elements on children's physical activity were in line with the study conducted by Ward et al. (2016). Another study conducted by Hakimian (2014) found a positive effect of environmental attractiveness and natural elements on physical activity.

According to the results of the Friedman ranking test, space light quality had the highest effect on children's physical activity. This finding was matched with results obtained by Ward et al. (2016). This factor, however, could not define the extracted factors because it was the single variable in a category, while a univariate category cannot define a variable. Group activity with the lowest score had a lower effect on children's physical activity in the studied society. This unwillingness for group activity may stem from the age range of studied children or cultural-social factors that can be examined in further studies. Some studies (Malek 2012) reviewed the available data about schoolyards and education outside the classroom to find solutions for schoolyard design, while the present study addressed the effect of physical features of schoolyards on children's physical activity from the viewpoint of students. Direct observation was not an efficient method due to the lack of desired outdoors, schoolyard diversity, and children's control during leisure time; hence, this method was used just for extracting some criteria of the questionnaire. Assessment of children's viewpoints was considered the most proper data collecting method under the research conditions. Hence, a researcher-made questionnaire was used to achieve reliable results. Girls participated in the survey 30% more than boys. This gender-based participation difference may affect the research results, which may be a constraint if is not controlled. Children's physical needs may be affected by gender; therefore, further studies can consider the gender factor in the study regarding the culture of the studied society. In general, the results of this study emphasize that attractiveness, sociability, and playability of schools outdoors can improve the physical activity and health level of children. Principals, educational space designers, and school playability organizations can consider the mentioned factors and their constituent components to create a desired space for children's activity and play in the schoolyard.

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