

# Are neighborhood characteristics associated with physical activity levels among school children?

Gulin KAYA<sup>1</sup> , Pinar AY<sup>2</sup> , Seyhan HIDIROGLU<sup>2</sup> 

<sup>1</sup> Public Health, Maltepe District Health Directorate, Istanbul, Turkey.

<sup>2</sup> Department of Public Health, School of Medicine, Marmara University, Maltepe, Istanbul, Turkey.

**Corresponding Author:** Pinar AY

**E-mail:** npay@marmara.edu.tr

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## ABSTRACT

**Objective:** The objective of this study was to determine the prevalence of insufficient physical activity (IPA) and neighborhood characteristics associated with it, among school children. The impact of sociodemographic characteristics and ownership of electronic devices on physical activity (PA) were also evaluated.

**Materials and Methods:** This was a cross-sectional study carried out among 5-7<sup>th</sup> grade students attending schools and their parents. IPA was defined as having moderate-vigorous activity for <60 minutes per week. Sociodemographic factors, ownership of electronic devices and characteristics of the neighborhoods were also evaluated.

**Results:** A total of 334 students participated in the study. The prevalence of IPA was 79.3% (95%CI:75.0-83.7%). IPA was associated with ownership of mobile phones (OR:1.96, 95%CI:1.01-3.78), not being a member of a sports team (OR:2.83, 95%CI:1.21-6.58) and having ≤1 day of physical education classes at school (OR:2.10, 95%CI:1.08-4.09). Neighborhood characteristics were not associated with IPA (p>0.05).

**Conclusion:** The prevalence of IPA is alarmingly high among school children. The impact of neighborhood characteristics on PA might be obscured since both variables were measured subjectively. Devices related information/communication technologies increase IPA; we need to find novel ways to use these devices for PA promotion. There is also a need to increase structured PA opportunities.

**Keywords:** Physical activity, Inactivity, Students, Neighborhood characteristics

## 1. INTRODUCTION

Adequate physical activity (PA) is essential for physical, psychosocial and cognitive well-being of children and adolescents [1,2]. For this reason, World Health Organization (WHO) recommends at least an average of 60 minutes of moderate-to-vigorous intensity PA (MVPA) daily for children aged 5-17 years [2,3]. However studies indicate the majority of children cannot achieve the recommended activity levels [4,5]. Worldwide 81% of 11-17 year old school children are physically inactive, e.g. they are not able to perform at least 60 minutes of MVPA daily [5]. Research indicates that PA levels are also very low among Turkish children. In Turkey, the inactivity rate is reported as 82% among the 11-17 year olds [5].

Physical activity can be performed both in structured and unstructured contexts. While structured activity is a planned and

a repetitive activity led often by an adult in physical education classes or sports teams, unstructured PA is a form of spontaneous activity (e.g. playing in parks, yards, streets or walking to school and back) which is not supervised by a trainer. Studies indicate that both physical and social characteristics of the neighborhood are among the determinants of PA levels, particularly for unstructured contexts [6-17]. A systematic review determined that the walkability level of the neighborhood, traffic density, proximity to recreation facilities, land-use mix, and residential density were associated with activity levels among children [6]. Social characteristics of the neighborhood also influence activity; the structure of social networks, trust and solidarity among neighbors/friends, cohesion of neighborhood residents and their sense of belonging, social norms in the neighborhood and

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safety are associated with PA levels in children [15-17]. Hence, both the physical and social attributes of the neighborhood shape the activity levels of children.

Studies evaluating the impact of environmental attributes on PA have been increasing throughout the recent years, yet most of this research comes from North America and Western Europe [6-17]. To our knowledge, there is only limited number of studies in Turkey assessing the impact of environmental factors on the activity level of children [18-20]. These studies highlight the importance of street network connectivity, parents' perceptions of condition of sidewalks and shade-casting street trees and also the green areas around the home as correlates of activity [18,19].

Every community is unique in terms of its neighborhood characteristics, so local studies are essential in identifying the environmental factors enabling PA. Hence, the main objective of this study was to determine the prevalence of insufficient PA (IPA) and neighborhood characteristics associated with it among children aged 9-13 years living in a district of Istanbul. The impact of sociodemographic characteristics and ownership of electronic devices on PA were also evaluated.

## 2. MATERIALS and METHODS

This was a cross-sectional study carried out among 5-7<sup>th</sup> grade students attending public schools and their parents in a district of Istanbul. We wanted to capture neighborhoods with diverse physical and social characteristics, so we used land values in determining the study area. In Turkey, land values are published yearly by the Revenue Administration Office [21]. Based on the median value of the district, neighborhoods with high and low land value were stratified. A total of four schools; two from neighborhoods with low and two from high land values were selected randomly. From each school one branch from the 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> grades were determined through simple random sampling.

Sample size was calculated as 344 assuming a difference of IPA prevalence of 15% (IPA of 55% and 70% in positive vs. negative neighborhood characteristics), an alpha error of 0.05 and a power of 80%.

### Measures

**IPA:** The PA level was determined by the child's self-report through a question as the number of days in the previous week that the child performed MVPA for at least 60 minutes. The question was adapted from the Youth Risk Behavior Surveillance System (YRBSS) [22]. IPA was defined as less than 60 minutes of daily MVPA in accordance with the WHO recommendations [3].

**Sociodemographic factors, ownership of electronic devices and neighborhood characteristics:** Sociodemographic factors, ownership of electronic devices and characteristics of the neighborhood were evaluated by questionnaires applied to both the parents and children. The parental questionnaire assessed; age; gender; educational status of parents; ownership of a mobile phone, tablet of the child, presence of computer at home,

electronic equipment in the child's room. The physical and social characteristics of the neighborhood were evaluated with the parental questionnaire through some selected questions adapted from the Built Environment and Active Play (BEAP) study [23]. Questions regarding the presence of a yard, living at a dead-end street, perceived safety of yards/streets were also included in the parental questionnaire. The child's questionnaire evaluated the number of days the child had participated in physical education classes during an average week and the number of sports teams that the child had played during the last 12 months.

The questionnaire was applied to the students in the classrooms under the supervision of the teachers. The students were asked to take home the parental questionnaire. Thus, the student-parent matching was achieved.

### Statistical Analysis

Descriptive data were presented as mean, standard deviation, median, percentile and percentages. Categorical data were analyzed by the Chi-square and Fisher's tests. Binary logistic regression (backward LR method) was used to control for the confounders. Variables having a p-value less than 0.10 in the univariate analyzes, were evaluated for multicollinearity and added to the binary logistic regression models. Prevalence and ORs were reported with 95% Confidence Intervals (CIs). A p value of less than 0.05 was considered as statistically significant.

## 3. RESULTS

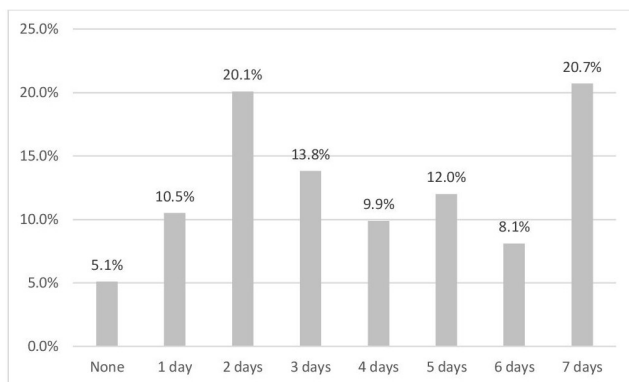
A total of 334 students from four schools participated in the study. The response rate was 96%. The median age was 11 years and 52.9% were girls. Among the respondents 70.4% were mothers, 25.5% were fathers and 4.0% were other family members. The characteristics of the children are presented on Table I.

Only 20.7% of the children (95% CI: 16.4-25.0%) reported sufficient PA; participating in daily MVPA for at least 60 minutes within the previous week (Figure 1). IPA prevalence was 79.3% (95%CI: 75.0-83.7%).

In the univariate analyzes; grade, having a mobile phone, presence of computer at home, participation in organized and unorganized sports activities, the number of days the child had participated in physical education classes in an average week, the number of sports teams the child had played during the last 12 months and presence of convenient yards for playing had a significant association with IPA ( $p < 0.05$  for all) (Tables II and III). The children who had parents with low level of acquaintance of neighbors had higher inactivity compared to the ones with better social ties ( $p = 0.054$ ).

**Table I.** Sociodemographic characteristics and ownership of electronic devices

|   |                         | n   | %    |
|---|-------------------------|-----|------|
| Gender  | Girl                    | 176 | 52.9 |
|   | Boy                     | 157 | 47.1 |
| Grade   | 5 <sup>th</sup>         | 107 | 32.0 |
|   | 6 <sup>th</sup>         | 112 | 33.5 |
|   | 7 <sup>th</sup>         | 115 | 34.4 |
| Mother's educational level                      | University              | 49  | 14.8 |
|   | High school             | 132 | 39.8 |
|   | Secondary school        | 43  | 13.0 |
|   | Primary school or lower | 108 | 32.5 |
| Father's educational level                      | University              | 71  | 21.5 |
|   | High school             | 132 | 40.0 |
|   | Secondary school        | 51  | 15.5 |
|   | Primary school or lower | 76  | 23.0 |
| Mobile phone                                    | Yes                     | 162 | 49.4 |
|   | No                      | 166 | 50.6 |
| Tablet  | Yes                     | 179 | 54.2 |
|   | No                      | 151 | 45.8 |
| Presence of a computer at home                  | Yes                     | 255 | 77.5 |
|   | No                      | 74  | 22.5 |
| Presence of a television in the child's bedroom | Yes                     | 46  | 14.0 |
|   | No                      | 282 | 86.0 |
| Presence of a computer in the child's bedroom   | Yes                     | 158 | 47.9 |
|   | No                      | 172 | 52.1 |



**Figure 1.** Number of days in engaging MVPA for at least 60 Minutes within the previous week

**Table II.** The association of IPA with sociodemographic characteristics, ownership of electronic devices and participation in sports activities, univariable analysis

|  |                           | IPA |      | p value          |
|--|---------------------------|-----|------|------------------|
|  |                           | n   | %    |                  |
| Gender   | Girl                      | 144 | 81.8 | 0.283            |
|  | Boy                       | 121 | 77.1 |                  |
| Grade  | 5 <sup>th</sup>           | 80  | 74.8 | <b>0.044</b>     |
|  | 6 <sup>th</sup>           | 85  | 75.9 |                  |
|  | 7 <sup>th</sup>           | 100 | 87.0 |                  |
| Mother's educational level   | High school or higher     | 145 | 80.1 | 0.660            |
|  | Secondary school or lower | 118 | 78.1 |                  |
| Father's educational level   | High school or higher     | 167 | 82.3 | 0.073            |
|  | Middle school or lower    | 94  | 74.0 |                  |
| Mobile phone   | Yes                       | 138 | 85.2 | <b>0.009</b>     |
|  | No                        | 122 | 73.5 |                  |
| Tablet   | Yes                       | 142 | 79.3 | 0.975            |
|  | No                        | 120 | 79.5 |                  |
| Presence of a computer at home   | Yes                       | 209 | 82.0 | <b>0.029</b>     |
|  | No                        | 52  | 70.3 |                  |
| Presence of a television in the child's bedroom                              | Yes                       | 35  | 76.1 | 0.566            |
|  | No                        | 225 | 79.8 |                  |
| Presence of a computer in the child's bedroom                                | Yes                       | 128 | 81.0 | 0.411            |
|  | No                        | 133 | 77.3 |                  |
| Participation in organized sports activities                                 | Yes                       | 84  | 73.0 | <b>0.037</b>     |
|  | No                        | 178 | 82.8 |                  |
| Participation in unorganized sports activities                               | Yes                       | 118 | 73.8 | <b>0.022</b>     |
|  | No                        | 138 | 84.1 |                  |
| Number of sports teams that the child had participated in the last 12 months | None                      | 129 | 86.0 | <b>&lt;0.001</b> |
|  | 1                         | 66  | 84.6 |                  |
|  | 2                         | 44  | 72.1 |                  |
|  | ≥3                        | 26  | 57.8 |                  |
| Number of days with physical education classes in a week                     | ≤1 day                    | 132 | 87.4 | <b>0.001</b>     |
|  | ≥2 days                   | 133 | 72.7 |                  |

IPA: insufficient physical activity

**Table III.** The association of IPA with physical and social neighborhood characteristics, univariable analysis

|  |             | IPA |      | p value      |
|--|-------------|-----|------|--------------|
|  |             | n   | %    |              |
| <b>PHYSICAL CHARACTERISTICS</b>                    |             |     |      |              |
| Presence of a yard convenient for playing          | Agree       | 127 | 74.7 | <b>0.046</b> |
|  | Disagree    | 133 | 83.6 |              |
| Living on a dead-end street                        | Agree       | 17  | 73.9 | 0.429        |
|  | Disagree    | 244 | 80.3 |              |
| Presence of hilly areas                            | Agree       | 82  | 78.1 | 0.751        |
|  | Disagree    | 172 | 79.6 |              |
| Presence of heavy traffic                          | Agree       | 169 | 80.5 | 0.486        |
|  | Disagree    | 88  | 77.2 |              |
| Presence of traffic signs and pedestrian crossings | Agree       | 86  | 76.8 | 0.413        |
|  | Disagree    | 171 | 80.7 |              |
| Presence of high street connectivity               | Agree       | 200 | 79.7 | 0.882        |
|  | Disagree    | 56  | 78.9 |              |
| Presence of convenient sidewalks                   | Agree       | 170 | 78.3 | 0.616        |
|  | Disagree    | 84  | 80.8 |              |
| Presence of bikeways                               | Agree       | 28  | 73.7 | 0.367        |
|  | Disagree    | 228 | 80.0 |              |
| Presence of sufficient lighting                    | Agree       | 190 | 78.5 | 0.601        |
|  | Disagree    | 65  | 81.3 |              |
| Presence of playgrounds and fields                 | Agree       | 147 | 77.8 | 0.477        |
|  | Disagree    | 111 | 81.0 |              |
| Presence of free sports halls                      | Agree       | 116 | 80.0 | 0.733        |
|  | Disagree    | 142 | 78.5 |              |
| <b>SOCIAL CHARACTERISTICS</b>                      |             |     |      |              |
| There are knit neighborhood relationships          | Agree       | 135 | 79.9 | 0.652        |
|  | Disagree    | 123 | 77.8 |              |
| Neighbors get along well                           | Agree       | 165 | 77.1 | 0.290        |
|  | Disagree    | 92  | 82.1 |              |
| Neighbors are willing to help each other           | Agree       | 135 | 77.6 | 0.555        |
|  | Disagree    | 122 | 80.3 |              |
| Neighbors share similar social norms               | Agree       | 117 | 82.4 | 0.159        |
|  | Disagree    | 139 | 76.0 |              |
| Neighbors can be trusted                           | Agree       | 135 | 81.8 | 0.182        |
|  | Disagree    | 122 | 75.8 |              |
| Parents' level of acquaintance of neighbors        | None at all | 17  | 89.5 | <b>0.054</b> |
|  | Slightly    | 64  | 88.9 |              |
|  | Moderately  | 102 | 74.5 |              |
|  | Well        | 78  | 76.5 |              |

IPA: insufficient physical activity

All variables with a p-value less than 0.10 were evaluated by multivariate analysis. In the multivariable analysis, six predictors remained in the model and the model explained 18.8% of the variance. IPA was lower among children who were participating in unorganized sports activities (OR:0.54, 95% CI: 0.26-1.00). IPA was associated with ownership of mobile phones (OR: 1.96, 95% CI: 1.01-3.78), not being a member of a sports team (OR: 2.83, 95% CI: 1.21-6.58) and having  $\leq 1$  day of physical education classes at school (OR: 2.10, 95% CI: 1.08-4.09). The

other variables which remained in the last step of the model were grade and presence of a computer at home, but they were not statistically significant ( $p > 0.05$  for both).

**Table IV.** Factors associated with IPA, multivariable analysis

|  |                 | p value      | IPA OR    | 95% CI |      |
|--|-----------------|--------------|-----------|--------|------|
|  |                 |              |           | Min    | Max  |
| Grade  | 7 <sup>th</sup> | 0.112        | 1.93      | 0.86   | 4.34 |
|  | 6 <sup>th</sup> | 0.700        | 0.86      | 0.41   | 1.81 |
|  | 5 <sup>th</sup> |              | reference |        |      |
| Mobile phone   | Yes             | <b>0.046</b> | 1.96      | 1.01   | 3.78 |
|  | No              |              | reference |        |      |
| Presence of computer at home   | Yes             | <b>0.055</b> | 1.95      | 0.99   | 3.85 |
|  | No              |              | reference |        |      |
| Participation in unorganized sports activities                               | Yes             | <b>0.051</b> | 0.54      | 0.26   | 1.00 |
|  | No              |              | reference |        |      |
| Number of sports teams that the child had participated in the last 12 months | None            | <b>0.016</b> | 2.83      | 1.21   | 6.58 |
|  | 1               | <b>0.037</b> | 2.79      | 1.06   | 7.33 |
|  | 2               | 0.640        | 1.26      | 0.477  | 3.34 |
|  | $\geq 3$        |              | reference |        |      |
| Number of days with physical education classes in a week                     | $\leq 1$ day    | <b>0.029</b> | 2.10      | 1.08   | 4.09 |
|  | $\geq 2$ days   |              | reference |        |      |

*Variables included in the model: Gender, grade, father's educational level, mobile phone, presence of computer at home, participation in unorganized sports activities, participation in organized sports activities, number of sports teams that the child had participated in the last 12 months, number of days with physical education classes in a week, presence of a yard convenient for play and parents' level of acquaintance of neighbors.*

IPA: insufficient physical activity, OR: odds ratio, CI: confidence interval

#### 4. DISCUSSION

Our survey revealed that four fifths of the children had IPA, which is very similar to the rates reported by WHO and other studies [4,5,24]. These are alarmingly high rates given that inactivity is an important determinant for the development of coronary heart disease, type 2 diabetes, breast and colon cancer and premature death during adulthood [25]. There is an urgent need to develop policies and programs to address inactivity among schoolchildren in Turkey.

Studies show that gender is associated with activity among children and girls are less physically active [4,5,24,26]. We also observed that IPA prevalence was higher among girls compared to the boys (81.8% vs 77.1%), yet multivariable analyses did not show a statistically significant association ( $p > 0.05$ ). This might be related to the limited sample size and thus to type 2 error in our study.

Research indicates that youth become more inactive with increasing age [26,27]. WHO reported the highest prevalence of PA among children aged 11-13-15 was in the 15-year-old group in the European Region [26]. Similarly our study revealed that the prevalence of IPA increased with grade in the univariate analyses. However, this association lost its significance in the



multivariate model. We suggest that this finding was related to the mobile phone ownership; mobile phone ownership increased with grade (data not shown) and having a mobile phone was an independent predictor of inactivity. So when the mobile phone ownership was controlled in the multivariate model, age lost its significance.

The factors associated with IPA were mainly related to the presence of electronic devices. In the multivariable analysis; having a mobile phone and presence of a computer at home each increased the OR of inactivity almost two folds. This finding is in line with other studies [28-33]. Use of electronic devices is very prevalent and their problematic use serves as a critical barrier for achieving PA among schoolchildren. We suggest that children use mobilephones and computers for mostly sedentary activities (e.g. watching movies, playing games and listening to music) [28]. We cannot eliminate the use of these devices totally, so we need to find novel methods to promote PA through using electronic devices.

Structured programs carried out both in the community and in schools are a good opportunity for increasing PA levels among children. In a systematic review, PA was shown as being positively associated with community sports participation in the 13-18 age group [27]. A cross-sectional study of 1223 children aged 8-9 years in 47 schools in the UK found that children who had participated in school sports teams 3-4 days a week and those who had participated in out-of-school sports teams 5 days a week had more MVPA than those who did not [34]. Similarly physical education classes held at schools had an impact on activity. In a study conducted with 17 776 adolescents, it was found that attending physical education classes 1-4 times a week increased MVPA by 1.21 times and attending five times a week increased by 2.21 times [35]. Another study conducted with adolescents in Brazil revealed that not attending physical education classes was a risk factor for physical inactivity [36]. Our analysis also revealed that both the number of sports teams that the child had participated in the last 12 months and the number of physical education classes that the child had attended in a week were associated with PA. While the number of physical education classes per academic year in Denmark, Portugal, Germany and France were reported to be 60, 90, 85 and 108 hours respectively, it was 24 hours in Turkey [37]. School-based interventions as motivating children to participate in sports teams and increasing physical education classes seem as practical and achievable strategies to combat IPA.

Previous research indicates an association of activity levels with both physical and social characteristics of the neighborhood. A systematic review of 103 studies examining the relationship between PA and environmental factors in children and adolescents reported that PA was associated with objective measures of walkability, traffic speed/volume, access/proximity to recreation facilities, land-use mix, and residential density [6]. In a study conducted with children aged 6-11 years and their parents in the United States; the parent reported proximity to the play areas was associated with both accelerometry MVPA and the parent reported PA. In the same study, the lower street connectivity and higher neighborhood aesthetics, safety from

crime and walk and cycle facilities were positively correlated with reported PA [13]. In the BEAP study conducted in the United States, the parents of physical active children reported higher aesthetics, active play areas, walkability and safety of the neighborhood than parents of non-active children [23]. Studies in Turkey indicated that some neighborhood characteristics as street network connectivity, condition of sidewalks, shade-casting street trees and also the green areas were important correlates of activity [18,19]. In our survey, we did not find any statistically significant association between the physical and social characteristics of the neighborhood and the PA levels of children. Although, the prevalence of IPA was lower in the families who had reported presence of available yards for playing in the univariable comparisons, this association lost its significance in the multivariate analysis. However our findings should be interpreted with caution; some associations might be obscured because we measured both the neighborhood characteristics and PA levels only subjectively, and also we did not determine PA as specific domains of walking, transportation-related PA and leisure-related PA.

Our study is one of the few studies conducted in our country that examine the PA of school children according to the WHO recommendations. Still we have some limitations; the PA levels have been evaluated based on self report, which is a subjective measurement. There might also be recall bias in reporting the PA levels of the previous week. Another limitation is that our data were collected in February-April, we are aware that PA levels might be different in warmer months. We assessed the perceived physical and social characteristics of the neighborhoods by the parental reports, which is also a subjective measure. In addition some variables that might be predictors of IPA as parents' PA levels, parental support or peer support for PA, children's self-efficacy and psychological, cognitive conditions were not evaluated in our study [38,39].

The prevalence of IPA was considerably high among schoolchildren. Devices related to information and communication technologies as mobile phones and computers increased the IPA. Since it seems unrealistic to keep children totally away from mobile phones and computers, we need to find innovative ways to use these devices for PA promotion. We also showed that organized activities were more important in determining PA behavior compared to the unstructured ones. So the effectiveness of increasing structured physical activity levels at schools by utilizing sports teams and physical education classes should be evaluated in future studies for Turkey.

### Compliance with Ethical Standards

**Ethical Approval:** The study was approved by the Marmara University, School of Medicine Ethics Committee (Number: 09.2016.569) and the Provincial Directorate of Ministry of Education This study was conducted in accordance with the Declaration of Helsinki. Informed consents were obtained from both the students and their parents.

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**Conflict of interest:** The authors declare that they have no conflict of interest to declare

**Authors' Contribution:** GK, PA and SH: Study conception and design, GK and SH: Data collection, GK and PA: Analysis and interpretation of results, GK and PA: Draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

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