Original Article

Using Oaxaca Decomposition to Study Socioeconomic Inequity of Physical Activity among Children Aged 10–12 Years: A Study in West of Iran

Abstract

Background: Low physical activity (PA) is increasing public health problem. The present study aimed to determine socioeconomic inequality in PA among children aged 10–12 years old in Kurdistan, west of Iran in 2015. **Methods:** The present cross-sectional study was conducted on 2506 children aged 10–12 in Sanandaj, Iran, in 2015. Data on the children's level of PA were collected using the Modifiable Activity Questionnaire. The concentration index was used to measure inequality and the Oaxaca decomposition to examine the different determinants of the inequality. The data were analyzed in Stata 13 and SPSS 20. **Results:** Of the 2506 participants, 40.90% (38.97–42.82) had insufficient PA. Girls had a lower level of PA than boys (odds ratio [OR] = 0.34; 95% confidence intervals [CI]: 0.28–0.41) and it is directly related to maternal education (OR = 1.71; 95% CI: 1.18–2.47), the family's Socioeconomic status (SES) (OR = 2.18; 95% CI: 1.56–3.05), and the place of residence (OR = 1.68; 95% CI: 1.16–2.44). The concentration index for insufficient PA was −0.25 (95 CI: −0.30 to −0.21), revealing an insufficient PA in the group with a low SES. The prevalence of insufficient PA is 51.38% (95% CI: 48.45–54.31) in poor group and 28.40% (95% CI: 22.80–33.99) in the wealthier group. The Oaxaca decomposition showed maternal education and the place of residence was the most important determinants of inequality. **Conclusions:** According to the findings, most of the children especially in the poor groups didn't have sufficient PA and socioeconomic factors could have the important role.

Keywords: *Children, concentration index, Oaxaca decomposition, physical activity, socioeconomic inequality*

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Introduction

The low physical activity (PA) is a major risk factor for mortality across the world and leads to an annual of 3.2 million deaths and 32.1 million disability-adjusted life years.[1] Recent public health strategies are focusing on moderate or severe regular PA for preventing chronic diseases. PA is effective at all the stages of disease prevention and leads to an increase in quality of life and a reduction in health-care costs.[2] Regular PA is essential for muscle function, metabolic homeostasis, and immunological and endocrinological health. Regular exercise also reduces and prevents heart disease, hypertension, type 2 diabetes, obesity, colon and breast cancer, mental diseases, and stress. PA is inversely related to insulin resistance, lipid increase, high blood pressure, and the risk of metabolic disorders, even among children. This relationship is relatively independent of weight and is also observed in healthy children within a normal weight range.[3] The PA guidelines for children recommend 60 min or more of regular moderate or severe daily activity for 6–18-year-old children. Research suggests that 40–80% of children do not have sufficient PA in line with the recommended guidelines. According to the ENERGY project, 83.2% of boys and 95.4% of girls aged 10–12 in seven European countries do not have sufficient PA.[4,5] Research suggests an inverse socioeconomic gradient in physical inactivity behaviors.[6] Children with a low SES have a lower level of PA than children with a high SES.[7] The review of literature yielded no studies on the effect of socioeconomic inequality on children's PA in Iran and in EMRO countries or Asia. This study aimed to determine the effect of socioeconomic inequality on children's PA

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using Oaxaca decomposition to reveal how far inequality in PA can be explained by inequalities in the different determinants of the inequality.

Methods

The present cross-sectional study was conducted in Sanandaj in western Iran in 2015**.** Based on the previous studies, social inequality of students is at least 20% ($P = 0.20$). By accepting a 5% error rate, $Z_{1-\alpha/2}$ is 1.96. To determine the value of d, considering interval $0.5p \leq d \leq 0.2p$, we assume $d = 0.02$ (10% p). We consider the design effect to be 1.5, which would result in a final sample size of 2550 boys' and girls' students studying in the fifth and sixth grades of primary school aged 10–12-year old. Respond rate was 98.27%.

The samples were selected from two regions of Sanandaj Education and Training Office, using multistage sampling. The first region consisted of 84 schools and the second of 42. Accordingly, first, the two regions were selected as the two main strata, and the schools in each stratum were selected as clusters. Second, within each school, again, the educational grades (fifth and sixth grade) were selected as the main strata and the classes at each grade were considered as clusters of that stratum. Finally, of the samples allocated to each stratum, the required number of the subjects was selected via random convenience sampling method. In all stages, the sample size was proportion to size. Six trained researchers in two groups of three collected the data through interviews with students whose parents filled out the questionnaire while one in each group supervised the questioning procedure. This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Written informed consent was obtained from all participants and their parents in the study.

The questionnaires were first completed by the students during their examination and through interviews held at the school. The parents then completed the questionnaires at home or via phone with the students' cooperation.

The level of PA was measured using the Modifiable Activity Questionnaire (MAQ) for adolescents.[8,9] The reliability and validity of this questionnaire was evaluated in previous studies on the subject. The test–retest intraclass correlation coefficients and Spearman correlation coefficients were 0.97 and 0.47, respectively ($P = 0.01$).[10,11] Data on the frequency and duration of PA were collected by trained interviewers. The MAQ calculates the total hours of PA per week in the past year, the mean intensity of PA, and the average hours of PA per week.

The intensity of PA is expressed by the metabolic equivalent (MET). One MET is defined as 1 kcal/kg/h or as oxygen uptake in ml/kg/min, equal to the oxygen cost of sitting quietly, or 3.5 ml/kg/min.[12] The hours per week of all activities were weighted by its estimated metabolic cost and expressed as MET h/week by multiplying hours per week for each specific activity by the estimated MET value, then summed to determine total past-year hours per week. A binary variable was created to represent whether the respondent achieved level of PA more than three MET per week. Those with missing data were excluded.[13,14] Values were categorized as "insufficient PA" and "sufficient PA."

To determine residential area, Sanandaj was divided to five regions, considering their socioeconomic status, population density, and marginal area by panel of experts. Area was classified into five regions, including very poor, poor, moderate, rich, and very rich.

To determine the SES, we used a method proposed by O'Donnell *et al*. in 2006.[15] Accordingly, we used a questionnaire which included a number of questions about household assets including separate bathroom, separate kitchen, vacuum cleaners, computers, separate refrigerators, washing machine, color TV, LCD TV, mobile phone, dishwasher, stove, internet access, personal car, landline telephone, personal home, number of rooms, heating appliances, oven, microwave, and furniture. Using principal composition analysis method, which ranks people from the poorest to the richest, 51.19% of variation was explained by the component. On the basis of this index, the studied population was classified into five quintiles, including very poor, poor, moderate, rich, and very rich. Of these, the two groups of very poor and very rich were selected as the limits and socioeconomic inequality were compared between these two groups.[16,17]

The concentration curve and index were used to measure the inequality. Concentration index varies from –1 to +1. A negative concentration index above the equality line indicates a concentration of the outcome among those who are poorer and positive values of it indicate the reverse. If the concentration index is zero, the concentration curve is tangent to the equality line and no inequality exists.[18,19] The Kakwani method was used to calculate the concentration index. The formula for the Kakwani method is as follows:

$$C = \frac{2}{\mu}\mathrm{cov}\left(\gamma_i, R_i\right) \quad (1)$$

where C is the concentration index, cov is the covariance, y_i is the health variable, R_i is the ith individual's fractional rank in the socioeconomic distribution, and μ is the health variable mean.

Due to binary variables, Wagstaff correction was used:[18,20]

$$W_c = \frac{C}{\left(1 - \mu\right)} \quad (2)$$

C is the standard concentration index which is presented in previous formula (Equation 1) and μ is the mean of the health variable.

The Blinder–Oaxaca decomposition method has been used extensively to assess mean outcome differences in

the discrimination and labor economics literature. This method has been employed to study racial/ethnic disparities in health insurance coverage, health-care access, and utilization; we are interested in estimating the magnitude of mean outcome differences for observed and unobserved parts of the decomposition model. The first part of the outcome differential is explained by group differences in levels of observed explanatory variables across the two categories. The second part represents differences that can be interpreted as unobserved heterogeneity.

The Oaxaca decomposition method was used to assess mean outcome differences in the inequality between the rich and poor groups. It determines the level of changes in Y caused by variations in the X inequality variable. The Oaxaca decomposition formula is as follows:[21,22]

$$\begin{aligned} y^{\text{nonpoor}} - y^{\text{poor}} &= \left(\beta_0^{\text{nonpoor}} - \beta_0^{\text{poor}}\right) + \\ &\left(\beta_1^{\text{nonpoor}} \chi_1^{\text{nonpoor}} - \beta_1^{\text{poor}} \chi_1^{\text{poor}}\right) + \\ &\left(\beta_2^{\text{nonpoor}} \chi_2^{\text{nonpoor}} - \beta_2^{\text{poor}} \chi_2^{\text{poor}}\right) \\ &= G_0 + G_1 + G_2 \end{aligned} \quad (3)$$

where y is the mean outcome, that is, insufficient PA in poor and nonpoor groups, x_1 and x_2, are determinants of inequality; β_1 and β_2 are the effects of determinants; G_0 is the difference in the intercept; G_1 is the difference in x_1, β_1, for example, differences in the maternal education (x_1) and the effects of the maternal education (β_1); and G_2 is the difference in the x_2, β_2, for example, differences in the residential area attainment (x_2) and the effects of the residential area attainment (β_2).[18]

The assumptions for Oaxaca were similar to regression (like normality, variance homogeneity, etc.). To carry out decomposition, first, we evaluated the relationship between insufficient PA and different determinants such as age, gender, parental level of education, parental age, the residential area, and economic groups and to control for confounding and examine subgroups, using multiple logistic regressions. Then, the effective variables with a significant relationship were entered into Oaxaca model. For all the models, the significance level was set at 0.05. Stata 13 and SPSS Version 20.0. (IBM Corp, Armonk, NY) softwares were used for the analysis of data.

Results

Among the 2506 participants, 59.09% had sufficient PA (95% CI: 57.17–61.02) while 40.90% did not (95% CI: 38.97–42.82). The number of people in each quintile was as follows: 1120 people (44%) in the first quintile, 465 people (18.55%) in the second quintile, 356 people (14.2%) in the third quintile, 315 people (12.56%) in the fourth quintile, and 250 people (10%) in the fifth quintile. The prevalence of insufficient PA were 51.25%, 37.20%, 32.30%, 28.57%, and 28.40% in the first, second, third, fourth, and fifth quintile. Of all, 1284 people were fifth grade students and 1224 people were sixth grade students. Table 1 shows variables characteristics.

Table 2 shows the odds ratio for each of the independent variables of a multiple regression model, including age, gender, parents' level of education, parents' age, and SES. According to the findings, the students in the richest SES group were more likely to have sufficient PA compared to poor groups (OR = 2.186; 95% CI: 1.565–3.054). There is direct relationship between the place of residence and PA (OR = 1.694; 95% CI: 1.166–2.461), as those living in areas with a higher SES have more PA. The girls examined in this study were found to have a lower level of PA

Table 1: Variables characteristics

Variables	*n* (%)
Sex	
Male	929 (37.07)
Female	1577 (62.93)
Mother education	
Uneducated	473 (18.89)
Elementary	640 (25.56)
Guidance	405 (16.17)
High school	548 (21.88)
Academic	438 (17.49)
Father education	
Uneducated	218 (8.27)
Elementary	501 (20.05)
Guidance	420 (16.81)
High school	565 (22.61)
Academic	795 (31.81)
Residential area	
The poorest	355 (14.17)
Poor	604 (24.10)
Moderate	883 (35.24)
Rich	373 (14.88)
The richest	291 (11.61)
Mother age (years)	
<30	175 (6.99)
30-39	1574 (62.86)
≥40	755 (30.15)
Father age (years)	
<30	970 (38.86)
30-39	1282 (51.36)
≥40	244 (9.78)
SES	
1st (the poorest)	1120 (44.69)
2nd	465 (18.56)
3rd	356 (14.21)
4th	315 (12.57)
5th (the richest)	250 (9.98)
Age (years)	
10	374 (14.92)
11	1044 (41.66)
12	1088 (43.42)

SES=Socioeconomic status

Table 2: Physical activity according to different independent variable

	n (%)	Crude OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Sex					
Male	679 (73.08)	1		1	
Female	802 (50.85)	0.381 (0.319-0.454)	<0.001	(OR = 0.347; 95% CI: 0.280–0.412)	<0.001
Mother education					
Uneducated	225 (47.56)	1		1	
Elementary	344 (53.75)	1.280 (1.009-1.625)	0.042	1.185 (0.906-1.549)	0.214
Guidance	248 (61.23)	1.741 (1.330-2.279)	<0.001	1.474 (1.080-2.012)	0.014
High school	355 (64.78)	2.027 (1.576-2.607)	<0.001	1.580 (1.153-2.167)	0.004
Academic	308 (70.31)	2.611 (1.987-3.431)	<0.001	1.709 (1.186-2.463)	0.004
Father education					
Uneducated	102 (46.78)	1		1	
Elementary	263 (52.49)	1.256 (0.913-1.728)	0.160	1.170 (0.823-1.663)	0.381
Guidance	228 (54.28)	1.350 (0.972-1.874)	0.073	1.076 (0.741-1.562)	0.699
High school	348 (61.59)	1.823 (1.330-2.500)	<0.001	1.165 (0.797-1.701)	0.429
Academic	536 (67.42)	2.353 (1.735-3.191)	<0.001	1.173 (0.790-1.741)	0.428
SES*					
1st (the poorest)	544 (48.57)	1		1	
2nd	292 (62.79)	1.787 (1.431-2.230)	<0.001	1.564 (1.230-1.987)	<0.001
3rd	241 (67.69)	2.218 (1.726-2.852)	<0.001	1.786 (1.355-2.356)	<0.001
4th	225 (71.42)	2.647 (2.018-3.471)	<0.001	2.162 (1.594-2.931)	<0.001
5th (the richest)	179 (71.60)	2.669 (1.979-3.599)	<0.001	2.186 (1.565-3.054)	<0.001
Mother age (years)					
<30	109 (62.28)	1		1	
30-39	947 (60.16)	0.914 (0.662-1.261)	0.586	0.928 (0.653-1.319)	0.680
≥40	424 (56.15)	0.775 (0.553-1.087)	0.140	0.794 (0.528-1.196)	0.271
Father age (years)					
<30	596 (61.44)	1		1	
30-39	739 (57.64)	0.854 (0.720-1.015)	0.069	0.859 (0.697-1.058)	0.153
≥40	141 (57.78)	0.859 (0.645-1.142)	0.296	0.940 (0.653-1.353)	0.742
Residential area					
The poorest	154 (43.38)	1		1	
Poor	331 (54.80)	1.582 (1.215-2.060)	0.001	1.300 (0.980-1.724)	0.069
Moderate	551 (62.40)	2.166 (1.686-2.781)	<0.001	1.431 (1.085-1.888)	0.011
Rich	243 (65.14)	2.439 (1.809-3.290)	<0.001	1.507 (1.065-2.133)	0.020
The richest	202 (69.41)	2.962 (2.138-4.103)	<0.001	1.694 (1.166-2.461)	0.006
Age (years)*					
10	217 (58.02)	1			
11	612 (58.62)	1.024 (0.806-1.302)	0.840	-	
12	652 (59.92)	1.081 (0.852-1.373)	0.517	-	

OR=Odds ratio, CI=Confidence interval, *SES=Socioeconomic status

compared to the boys (OR = 0.347; 95% CI: 0.280–0.412). Higher maternal education increases the children's PA significantly (OR = 1.709; 95% CI: 1.186–2.463). The children's PA was not found in this study to be significantly related to the parents' age and the fathers' level of education.

The concentration index was calculated to determine inequality. The concentration index for insufficient PA is −0.25 (95 CI: −0.30 to −0.21), which indicates an insufficient PA among the groups with a low SES ($P < 0.001$). The insufficient PA curve is above the equality line and thus indicates insufficient PA in individuals with a low SES [Figure 1].

After measuring inequality, we used Oaxaca decomposition to deconstruct the inequality in outcome variable. The variables affecting the logistic regression model were entered into the Oaxaca model. According to the decomposition results [Table 3], the prevalence of insufficient PA is 51.38% (95% CI: 48.45–54.31) in the less wealthy group and 28.40% (95% CI: 22.80–33.99) in the wealthier group, revealing a gap of 22.98% between the two groups, 42.12% of which can be explained by the intergroup differences in the study variables, including gender, maternal education, and the place of residence or the explained component, with maternal education

Table 3: Decomposition of the difference in insufficient physical activity between the poor and nonpoor

PA	Prediction (%)	*P*	95% CI
PA proportion in the poorest group	51.38	<0.001	48.45-54.31
PA proportion in the richest group	28.4	<0.001	22.80-33.99
Difference (total gap)	22.98	<0.001	16.67-29.29
Due to endowment (explained)			
Residential area			
The poorest	−0.01	0.017	0.25-2.60
Poor	0.49	0.429	−0.65-1.52
Moderate	−0.01	0.843	−0.12-0.09
Rich	0.49	0.444	−0.77-1.76
The richest	1.48	0.107	−0.32-3.28
Sex			
Male	−0.44	0.274	−1.24-0.35
Female	−0.44	0.274	−1.24-0.35
Mother education			
Uneducated	1.57	0.001	0.61-2.53
Elementary	1.25	0.025	0.16-2.34
Guidance	0.02	0.842	−0.19-0.23
High school	4.23	0.262	−0.16-0.59
Academic	0.44	0.005	1.27-7.20
Subtotal gap (explained part)	10.20	<0.001	5.90-14.50
Due to endowment (unexplained)			
Residential area			
The poorest	−0.12	0.852	−1.36-1.12
Poor	1.03	0.442	−1.59-3.65
Moderate	2.73	0.217	−1.61-7.07
Rich	−0.63	0.697	−3.81-2.55
The richest	−0.86	0.586	−3.96-2.24
Sex			
Male	−0.96	0.510	−3.80-1.89
Female	1.85	0.509	−3.64-7.35
Mother education			
Uneducated	0.44	0.688	−1.69-2.56
Elementary	−0.80	0.487	−3.07-1.46
Guidance	1.92	0.114	−0.46-4.31
High school	−0.13	0.931	−2.95-2.70
Academic	−1.91	0.371	−6.10-2.27
Subtotal gap (unexplained part)	12.80	<0.001	5.60-19.90

PA=Physical activity, CI=confidence interval

contributing the most to the differences, followed by the place of residence. The rest of this gap is unexplained and is related to the differences of the coefficients or other factors not examined in the study.

Discussion

This study is the first that used the Oaxaca decomposition to investigate inequality in insufficient PA in children. According to our results, 40.90% of the participants do not have sufficient PA.

Consistent with the results of previous studies, our study suggested pro-poor insufficient PA. Drenowatz *et al*.[23] reported a relationship between PA and SES ($P < 0.02$). SES may influence accessibility to sports/exercise facilities as well as safety, where rich children were more involved in club sports and have more access to sports requirements, as well as the study by Finger *et al*.[24] (OR = 1.2; 95% CI: 1.00–1.50), which showed a direct relationship between PA and SES; in this study, low physical well-being (e.g., feeling tired or sick, having disease) and lack of parental support for PA in children with low SES were reported as barriers for PA.

In the present study, maternal education was found to contribute the most to the inequality. Maternal education is thus directly related to PA. This finding is also consistent with the results of the study by Finger *et al*.,[24] which revealed maternal education to be the most protective factor against insufficient PA (OR = 0.80; 95% CI: 0.6–1.00). Leisure time PA of children related to their parents. In this

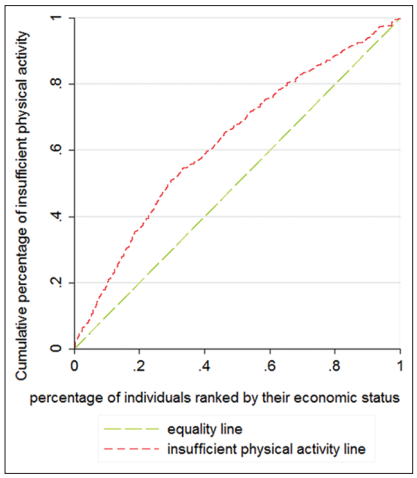

Figure 1: Concentration curve for insufficient physical activity, Kurdistan, Iran, 2015

study, parental guidance was an enabling factor to ensure proper engagement in PA.

According to the results, the place of residence was one of the important factors to contribute in PA inequality among children. Children in low SES area had lower PA. This finding is consistent with the results of previous study[25] which showed that those living in impoverished areas have a higher PA ($P < 0.05$). Living in suburban versus traditional neighborhoods, limited public transport availability, aspects of neighborhood design around schools, parental concerns regarding traffic injury, and lower population density have been reported to have insufficient PA in children, as well as with the results of the study by Yen and Kaplan[26] ($P < 0.0001$), where those living in impoverished areas have a lower level of PA by 0.67 units. The amount of change in leisure-time PA was much lower for those who resided in the impoverished areas due to lack of access to the resources (such as parks, recreational facilities, and commercial gyms); having marginal or inadequate income had larger declines in activity in these areas.

The present study showed that insufficient PA is higher in girls than in boys, which is consistent with the others study.[27] They suggested boys prefer to watch sports on television or online more than girls which could motivate them to perform more PA.

Our study has some limitations

The study setting was limited to Sanandaj; it cannot be representative of all different regions of Iran.

We used income proxy variable (asset index) due to lack of access to proper information on household's income.

In this study, PA wasn't measured objectively, and there were biases regarding the self-report nature of the questionnaires and recall biases considering the fact that the questions posed to the participants were related to the activities performed over the past year.

Based on our finding, residence of living is an important factor on PA. Our study has not considered much of the evidence on the environmental attributes, including research will need to account aspects of environmental building, like urban design presence of sidewalk, traffic density and speed, design of venues for PA (e.g., playgrounds, parks, and school yards), crime, and safety and investigate their relationships with PA.

Conclusions

The results of this study indicated a high prevalence of insufficient PA in the examined participants. There was inequality in the distribution of insufficient PA in the community, which represents pro-poor insufficient PA. Maternal education and the place of residence were the most important determinants of inequality. To reduce inequality, special attention should be paid to mother's education, and special intervention must be designed for the residential area.

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Conflicts of interest

There are no conflicts of interest.

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