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Original article

Physical activity pattern and its relationship with overweight and obesity in saudi children

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ABSTRACT

Background: Overweight and obesity among children and adolescents are emerging public health problems. Modifiable lifestyle factors such as physical inactivity and eating out are responsible for the increased prevalence of obesity and related health risks.
Objective: To examine physical activity level and weight status among Saudi children in relation to age and gender.
Study design: In a cross-sectional study, 200 apparently healthy Saudi children (118 boys and 82 girls), aged 5–15 years, were enrolled from the Pediatric clinics at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. To determine physical activity level, the International Physical Activity Questionnaire-Short Form-A was used. Anthropometric measurements were taken for all participants.
Results: Central obesity was highly prevalent among adolescents as compared with a higher prevalence of general obesity in children. Physical activity level was significantly higher among adolescent boys than adolescent girls ($P<.05$). Girls scored almost double the total metabolic equivalent scores. More boys were considered highly active (59% vs. 40%) in contrast with more girls with low physical activity (38% vs. 26%). Among girls, high physical activity score was higher in children than in adolescents (40% vs. 21%) and an increasing number of adolescents were of low physical activity than children (64% vs. 38%). The majority of the study population were spending more than 2 h per day in watching TV and playing electronic games, but a slightly higher number of children showed sedentary behavior than adolescents. Adolescent girls were significantly spending more time watching TV than adolescent boys ($P<.01$). Significant inverse associations with most anthropometric measures and the time spent in watching TV and doing desk work were demonstrated in both genders.
Conclusion: This study reports significant influence, by age and gender, contributing to physical inactivity and weight status among Saudi children.

1. Introduction

Obesity and being overweight among children and adolescents are emerging public health problems in many parts of the world [1,2]. Childhood obesity is associated with cardiovascular risk factors such as diabetes mellitus, hypertension, hyperlipidemia, and metabolic syndrome, once known to be diseases of adults only [3–7].

Evidence suggests that the modifiable lifestyle factors such as physical inactivity, dining out, and excessive intake of high-fat, dense-caloric foods, and refined carbohydrates are largely responsible for the global increased prevalence of obesity and related health risks [8–10].

In Saudi Arabia, remarkable progress in economic transition and urbanizations has been accompanied by changes in dietary and lifestyle habits, such as limited intake of vegetables, fruits, and wholegrain products when compared with the increased consumption of fast foods and soda beverages along with physical

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inactivity in all age groups [11–15].

Preestablished lifestyle habits during childhood and adolescence may highly impact general health and well-being. Overall, physical activity is expected to enhance the quality of life as well as cardiometabolic fitness [16,17]. Recently, we have reported that physical activity in girls revealed a greater proportion of variation in body mass index (BMI), while for boys, it was their eating habits that revealed the greater proportion of variation in BMI [18].

A better understanding of the relationship between physical activity and childhood obesity is considered necessary for effective prevention and management of obesity-related risk factors. Thus, the aim of the present study is to examine physical activity level and weight status among Saudi children in relation to age and gender.

2. Method

In this cross-sectional study, 200 apparently healthy Saudi children (118 boys and 82 girls), aged 5–15 years, were enrolled at the Pediatric clinics at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia. Subjects with chronic conditions such as asthma, type 1 diabetes mellitus, hypertension, history of cardiac, kidney, or liver disease, use of medications known to affect body weight (such as steroids), psychiatric conditions, and those with secondary obesity due to endocrinopathies were excluded from the study. All selected participants were free from any physical challenges to perform physical activity. Informed consent was obtained from the parents of each participant. The study was approved by the KAUH Ethical Committee, King Abdulaziz University.

A structured questionnaire was used to collect demographic and socio-economic characteristics, family history, sedentary lifestyle, physical activity, and dietary practices of the child. The questionnaire was designed to collect information on frequency, duration, and intensity of a variety of light-, moderate-, and vigorous-intensity physical activities during a typical week.

To determine the level of physical activity of study participants, the International Physical Activity Questionnaire-Short Form-A (IPAQ–SF–A) was used. The IPAQ was developed by WHO in 1998, to facilitate the monitoring of physical activity based on a worldwide standard. It has been validated in 12 developed countries, and it was translated into several languages, including Arabic [19]. Physical activities were classified into three categories: vigorous, moderate, and walking. Frequency (days/week) and duration (time/day) were recorded for each type of activity. Physical activities were calculated in metabolic equivalent (MET), which was based on the compendium of physical activity [20]. Vigorous activity was given 8 METs, moderate 4 METs, and walking 3.3 METs [19]. For each activity, the score was calculated by multiplying its METs x frequency (days per week) x duration (time per min). The subject's overall physical activity using IPAQ–SF–A (total physical activity MET-min/week) was the sum of (walking + moderate + vigorous) MET-min/week scores. Using these values, three levels of physical activity were identified: high, moderate, and low.

Information on activities of children during their leisure time such as viewing television, computer use, playing games, and internet use was collected in the sedentary lifestyle section of the questionnaire. The average number of daily hours spent on each of the activities during weekdays and weekends were also collected from all study participants. For the total screen time cut-off point, we used the American Academy of Pediatrics' guidelines of a maximum of 2 h/day [21].

Body weight was measured without shoes and with light clothing to the nearest 100 g using weight scales (Seca Ltd., Hamburg, Germany). Height was measured to the nearest 0.5 cm using a wall-mounted stadiometer, with the children not wearing shoes, with their shoulders in a relaxed position, and arms hanging freely. BMI was calculated as a ratio of weight (in Kg) divided by height (in m^2). The International Obesity Taskforce age- and sex-specific BMI cutoff reference standards were used to identify overweight and obesity in children between the ages of 5 and 15 years [22]. Waist circumference (WC) was measured at a level midway between the lower rib margin and iliac crest using a tape with 1 mm accuracy, and abdominal obesity was considered at a cutoff value of ≥90th percentile [23]. Waist height ratio (WHtR) was calculated and the value of ≥0.5 was used to determine abdominal obesity [24].

Results are reported as mean ± SEM. Differences between 2 groups were assessed using independent samples t tests. Differences between >2 groups were assessed using the one way analysis of variance associated with a post hoc test (Bonferroni). A χ [2] test was conducted on the frequency data. Pearson's correlation was used to assess the association between variables. A *P* value of .05 or less was considered statistically significant. Statistical analysis was carried out using the Statistical Package for the Social Science (SPSS 21.0, Chicago IL, USA).

3. Results

Two hundred study participants were stratified by age and gender into 4 subgroups. Overall, they were students of grades one to eleven, 73% were enrolled in public schools in comparison with 27% being enrolled in private schools. Their academic achievement varies from A (35%), B (51%) to C (15%).

Table 1 presents anthropometric measurements of the study population, stratified by age and gender. Central obesity was highly prevalent among adolescents when (42% in boys and 57% in girls) compared with children (10% in boys and 16% in girls), as determined by the WC ≥ 90th percentile value. However, almost half of each group was considered with central obesity (as defined by the cutoff of WHtR ≥0.5). About 40% and 10% of each group were considered overweight and obese, respectively, according to the BMI classes (Fig. 1).

Table 2 demonstrates physical activity patterns in MET scores and sedentary behavior of the study population. Physical activity level, as measured by total METs (min/week), was significantly higher among adolescent boys than adolescent girls (*P*<.05). With respect to age, girls scored almost double the total METs of adolescent girls (1824.7 [234.6] vs. 977.1 [410.7]).

Fig. 2 illustrates that an increasing number of boys were considered highly active (59% vs. 40%) in contrast with an increasing number of girls with low physical activity (38% vs. 26%) among children. A similar pattern was noticed with adolescents, 57% of boys scored a high level of physical activity as compared to only 21% in girls, and 64% of girls scored a low level of physical activity versus 30% in boys. Among girls, there was a slightly different pattern, children scored a high level of physical activity than adolescents (40% vs. 21%) and an increasing number of adolescents scored a low level of physical activity than children (64% vs. 38%). The proportion of subjects with moderate physical activity levels was comparable in all subgroups of groups.

The majority of the study population was spending more than 2 h per day watching TV and playing electronic games, but a slightly increased number of children showed sedentary behavior than adolescents, based on age stratification (Table 2). However, no significant differences were evident between the subgroups. In addition, significantly more time was spent in watching TV (min/day) by adolescent girls than adolescent boys (*P*<.01). As for boys, children were spending more time watching TV than adolescents (*P* <.0001). With respect to the time spent at desk work (min/day), adolescents had significantly spent more time than children in both

Table 1
Anthropometric measurements of study participants by age and gender (N = 200).

	Boys (n = 118)		Girls (n = 82)		*P*
	Children (n = 58)	Adolescents (n = 60)	Children (n = 68)	Adolescents (n = 14)	
Age (years)	8.9 (0.2)	13.3 (0.2)	8.7 (0.2)	14.7 (0.2)[c]	<.0001
Body weight (kg)	40.1 (1.9)	54.1 (1.6)	38.4 (1.6)	57.1 (3.3)	<.0001
Body height (cm)	130.7 (1.6)	149.3 (1.1)	129.1 (1.4)	154.6 (2.2)[d]	<.0001
BMI (kg/m^2)	23.2 (0.8)	24.1 (0.6)	22.7 (0.8)	23.9 (1.3)	NS
WC (cm)	71.5 (1.8)	79.9 (2.0)	70.3 (1.6)	85.8 (3.9)	<.0001
WC ≥ 90th percentile	6 (10)	25 (42)	11 (16)	8 (57)	<.05
HC (cm)	81.9 (1.6)	90.1 (1.6)	80.4 (1.4)	95.7 (2.8)	<.0001
WHR	0.87 (0.0)	0.88 (0.0)	0.87 (0.0)	0.89 (0.0)	NS
WHtR	0.55 (0.0)	0.54 (0.0)	0.55 (0.0)	0.56 (0.0)	NS
WHtR ≥ 0.05	32 (55)	29 (48)	36 (53)	8 (54)	NS

Numeric data are presented as mean ± SEM and as frequency (percentage). Categorical data were compared by the χ [2] test. Continuous variables were compared using the ANOVA test or Kruskal Wallis test for nonnormally distributed data. BMI: body mass index, HC: hip circumference, NS: not significant, WC: waist circumference, WHR: waist hip ratio, and WHtR: waist height ratio. A significant difference between boy children and girl children groups is indicated as [a]*P*<.0001 and [b]*P*<.05; a significant difference between adolescent boys and adolescent girls groups is indicated as [c]*P*<.0001 and [d]*P*<.05.

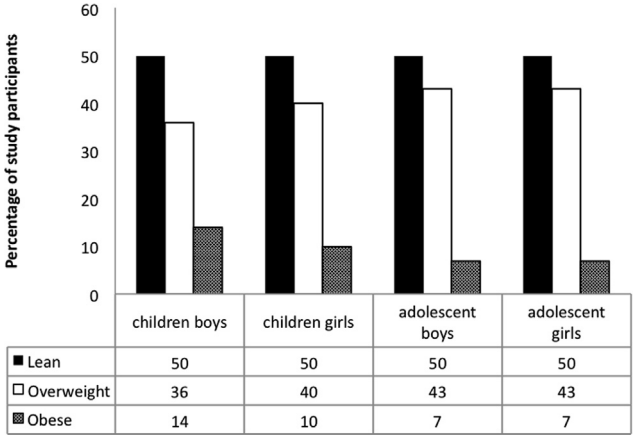

Fig. 1. BMI classification of the study participants by age and gender (N = 200) according to the International Obesity Task Force (IOTF). Overall, obesity is defined by BMI ≥85th − <95th percentile for overweight children and BMI ≥95th percentile for obese children.

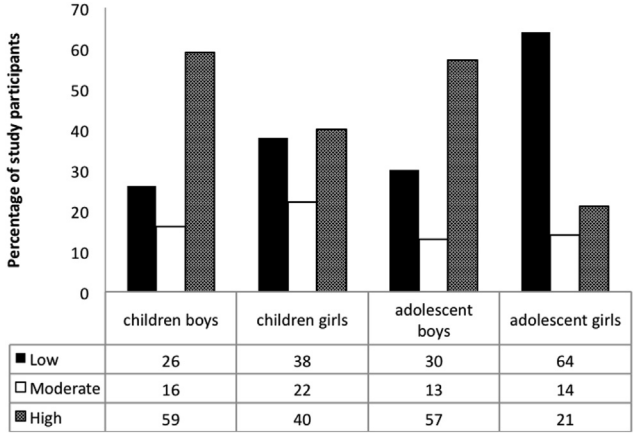

Fig. 2. Total METs score (min per week) of the study participants by age and gender (N = 200). High physical activity level is characterized by vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-min/week or 7 or more days of any combination of walking and moderate-intensity or vigorous-intensity activities achieving a minimum total physical activity of at least 3000 MET-min/week. Moderate physical activity level is characterized by spending 3 or more days of vigorous-intensity activity of at least 20 min per day or 5 or more days of moderate-intensity activity and/or walking of at least 30 min per day or 5 or more days of any combination of walking and moderate intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET-min/week. Those individuals who did not meet criteria for high or moderate were considered to have a low physical activity level.

genders (*P*<.05).

Pearson's correlation revealed that the total physical activity level (METs-min/week) showed significant inverse associations with all anthropometric measures except for body height (Table 3). Similarly with sedentary behavior measures, negative associations were recorded between total METs (min/week) with the time spent (min/day) in watching TV and desk work in both genders.

4. Discussion

The rise of the global obesity epidemic during the past few decades is substantial [1,2]. Evidence supports the contribution of

Table 2
Patterns of physical activity levels and sedentary behaviors of study participants by age and gender (N = 200).

	Boys (n = 118)		Girls (n = 82)		*P*
	Children (n = 58)	Adolescents (n = 60)	Children (n = 68)	Adolescents (n = 14)	
Physical activity levels					
Total MET score (min/week)	2110.3 (213.8)	2464.0 (272.4)[d]	1824.7 (234.6)	977.1 (410.7)	<.05
Sedentary behaviors					
TV viewing (min/day)	150.0 (15.1)	93.0 (4.60)	133.2 (10.9)	124.3 (4.29)[d]	<.0001
Electronic use (min/day)	90.0 (9.50)	88.0 (7.19)	84.7 (6.32)	64.3 (15.9)	NS
Desk work (min/day)	437.6 (13.6)	480.0 (0.0)	457.9 (9.3)	480.0 (0.0)	<.05
>2 h/day	41 (71)	33 (55)	48 (71)	9 (64)	NS

Data are presented as mean ± SEM and as frequency (percentage). Categorical data were compared by using the χ [2] test. Continuous variables were compared using the ANOVA test or Kruskal Wallis test for nonnormally distributed data. MET: metabolic equivalent value and TV; television. A significant difference between boy children and girl children groups is indicated as [a]*P* < .0001 and [b]*P* < .05; a significant difference between adolescent boys and adolescent girls groups is indicated as [c]*P* < .0001 and [d]*P* < .05.

Table 3
Correlation coefficients of total physical activity level (METs-min/week) with anthropometric measures and sedentary behaviours among the study participants (N = 200).

	All population (N = 200)	Boys (n = 118)	Girls (n = 82)
	r	R	r
Body weight (Kg)	- 0.341[b]	−0.356[b]	−0.439[b]
BMI (Kg/m^2)	- 0.413[b]	−0.490[b]	−0.352[a]
WC (cm)	- 0.433[b]	−0.443[b]	−0.486[b]
HC (cm)	- 0.436[b]	−0.392[b]	−0.562[b]
WHR	- 0.271[b]	−0.383[b]	NS
WHtR	- 0.421[b]	−0.468[b]	−0.347[a]
TV viewing (min/day)	- 0.272[b]	−0.285[a]	−0.304[a]
Desk work (min/day)	- 0.243[a]	−0.309[a]	NS

BMI: body mass index, HC: hip circumference, MET: metabolic equivalent value, NS: not significant, TV; television, WC: waist circumference, WHR: waist hip ratio, WHtR: waist height ratio. [a] $P < .05$, [b] $P < .0001$.

both excess energy intake and decreased energy expenditure in the obesity epidemic [25]. Physical activity is expected to enhance the quality of life as well as cardiometabolic fitness [16,17]. For positive health outcomes, children should spend at least 60 min in moderate to vigorous physical activity each day, based on the reviewed evidence relating physical activity to health [26].

The aim of the study was to examine physical activity level and weight status among Saudi children in relation to age and gender.

This study confirmed the high prevalence of central obesity, particularly among adolescents. This is in accordance with the data collected from a national study on the prevalence of overweight and obesity among Saudi children and adolescents, being 23.1% and 9.3%, respectively [27]. In addition, evidence from three major Saudi national cross-sectional studies has previously indicated the rising trends in BMI of Saudi adolescents [28]. By contrast, the two employed cutoff values to define central obesity (i.e., WC and WHtR) gave more indication than the BMI classification of general obesity in our study population (Table 1).

Overall, slightly over half of the boys and almost one third of the girls were classified as highly active (Fig. 2). Similar results were reported by other international studies [29,30]. Our figures are also consistent with the findings of a national study conducted among children who had met the recommended moderate-intensity physical activity level of 60 min/day [31].

Girl children scored a higher level of total METs-min/week than adolescent girls and the opposite is true for boys (Table 2). Yet, more boy children were of high physical activity level than girl children, based on their METs-min/week. It is noteworthy that the Global School-based Student Health Survey indicated that only 24% of boys and over 15% of girls across 34 countries met the physical-activity recommendations [32]. In line with the general consensus that physical activity decreases with age [33], our results show that more adolescents were of low physical activity level than children (Fig. 2).

Predominant low physical activity levels in children and adolescents were reported from girls. Indeed, more girl children were overweight than boy children (Fig. 1). A similar gender difference in physical activity level has also been observed in local studies among Saudi children and adolescents (18,31). Apparently school age children are not engaged in health-enhancing physical activity of sufficient duration and frequency. In keeping with other studies [30,34], we found that boys were more active than girls (Fig. 2).

An analysis of the sedentary behavior showed that over two thirds of the study population were spending more than 2 h/day in watching TV and playing with electronic games (Table 2). A higher proportion of children were reported to spend more than 2 h/day on screen time in other studies, especially among girls [35,36]. A strong relationship between the time length of watching TV and obesity was indicated in previous studies [37]. Spending more time watching TV was positively associated with the prevalence of overweight and obesity in girls but not in boys [36,38].

It has been argued that sedentary behavior is not simply a lack of physical activity, but is a cluster of individual behaviors where sitting or lying is the dominant mode of posture and energy expenditure is very low; it is a multifaceted behavior that might take place at work, school, or home [39]. Therefore, it is plausible to consider excessive use of information and communication technology, especially watching TV, playing digital games, and using computers as sedentary factors causing childhood obesity. Differences in the level of physical activity among various studies are most likely multifactorial and could be influenced by factors like BMI, climate, etc. Nonetheless, childhood obesity is still a major public health concern.

We have demonstrated that the level of physical activity was inversely and significantly associated with general and central adiposity measures (Table 3). Our findings are in agreement with other studies [15,40]. It is not surprising that overweight and obese children are less likely to practice physical activity than their lean peers. The negative association between physical activity and overweight and obesity in both genders is consistent with previous reports ([18,41]). This could be related to the hours spent sitting in classrooms and probably related to their sedentary lifestyles during their leisure time (i.e., watching TV, playing games, and using computers) as previously demonstrated [38,42].

The study is not without limitations. Although the IPAQ–SF–A has been used in many studies and has widely accepted reliabilities [19,43], the collected information might be influenced by recall and reporting bias, leading to under- or overestimating the actual physical activity level. Also, various activities listed in the questionnaire (e.g., ice hockey, aerobics, ringette, skateboarding, etc.) were not well-adapted in our Saudi culture. As with the cross-sectional study design, it is not possible to determine the direction of causality, which can be addressed in longitudinal follow-up studies.

In conclusion, this study reports significant influence, by age and gender, contributing to physical inactivity and weight status among Saudi children. Considering the high prevalence of overweight and obesity, our findings emphasize the need to establish a national program aiming at preventing and controlling obesity among Saudi children and adolescents. An obesity control program should incorporate the dietary management of obesity, promotion of physical activity, and health education campaigns.

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paper; EA had primary responsibility for final content. All authors read and approved the final manuscript."

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2020.000000.

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