

Patterns of physical activity and dietary habits among adolescents in Saudi Arabia: A systematic review

Ibrahim Alasqah^{1,2},
Ilias Mahmud¹,
Leah East²,
Kim Usher²

¹Department of Public Health, College of Public Health and Health Informatics, Qassim University, Al Bukayriyah, Saudi Arabia, ²School of Health, University of New England, Armidale, NSW, Australia

Address for correspondence:

Ibrahim Alasqah,
Department of Public Health, College of Public Health and Health Informatics, Qassim University, Al Bukayriyah, Al Qassim, Saudi Arabia.
E-mail: i.alasqah@gmail.com

WEBSITE: ijhs.org.sa

ISSN: 1658-3639

PUBLISHER: Qassim University

ABSTRACT

Objective: Physical inactivity and unhealthy dietary habits are behavioral risk factors associated with non-communicable diseases. The current study aimed to determine the prevalence of physical activity and dietary habits among adolescents in Saudi Arabia.

Methods: A systematic electronic literature search of PubMed, SCOPUS, Web of Science, and BIOSIS was conducted through April 2018 using the following keywords: (Physical activity OR physical inactivity OR diet OR dietary habits) AND Saudi Arabia. Extracted data from each study were tabulated, and data were synthesized narratively.

Results: Eighteen studies published within 2007–2017 were included in the narrative synthesis. The prevalence of physical activity among adolescents in Saudi Arabia ranged from 4% to 44.5%. Fast foods consumption, skipping breakfast, and low fruit and vegetable consumption were the most reported unhealthy dietary habits.

Conclusion: Our review highlights that physical inactivity and unhealthy dietary habits were high among adolescents in Saudi Arabia. These findings require immediate actions and plans to increase levels of physical activity and healthy dietary habits among Saudi adolescents.

Keywords: Physical activity, diet, adolescents, Saudi Arabia, public health

Introduction

Non-communicable diseases (NCDs) account for 70% of all annual global deaths. High blood pressure, high cholesterol levels, lack of fruit and vegetables in one's diet, obesity, lack of physical activity, and smoking are all risk factors for NCDs (WHO).^[1] As many of these risk factors are related to nutrition and activity levels, maintaining good habits in these areas are essential to maintain individual health and prevent disease.^[2]

Physical inactivity is a major risk factor for mortality and is associated with cardiovascular diseases (CVD), diabetes, certain types of cancer, and high cholesterol levels.^[3] Lack of physical activity is also associated with premature mortality.^[4] Conversely, physical activity is essential for reducing the risk of CVD,^[5] type-2 diabetes,^[6] stroke, obesity, depression,^[7] dementia,^[8] and benign prostatic hyperplasia.^[9] A recent study of 507 adolescents in Saudi Arabia reported a 66.3% were overweight and/or obesity, while the prevalence of undiagnosed high blood pressure and high blood glucose reached of 8.3% and 0.6%, respectively, was found.^[10] Another study among public schools students in Jeddah ($n = 4042$) reported a prevalence of 23% of participants being overweight, and also noted that 6.4% had hypertension, 4% of males had

hypercholesterolemia, and 0.4% had hyperglycemia.^[11]

Unhealthy dietary habits are closely related to NCD-related mortality. In 2004, low fruit and vegetable consumption was related to approximately 1.7 million (2.8%) deaths worldwide.^[12] Likewise, low consumption of fruits and vegetables raises the risk of CVD, stomach cancer, and colorectal cancer.^[12] A study regarding CVD in a Finnish population determined that unhealthy eating patterns play a role through enhancing the CVD risk factors including blood pressure elevation and cholesterol level elevation.^[13] Eating breakfast is also essential for a healthy eating style as demonstrated by a study of American teenagers that indicated that teens who regularly ate breakfast were 30% less likely to become overweight later in life.^[14]

In Saudi Arabia, as in the rest of the global adolescent population, physical inactivity and sedentary lifestyles are becoming more prevalent among adolescents, thus representing a significant public health issue.^[15,16] A study that focused on boys aged from 12 to 20 years in Riyadh, concluded that 50% of the population were inactive.^[17] Another study focused on individuals from 7 to 23 years of age in Saudi Arabia found that physical activity levels decreased 30% from childhood to

young adulthood. Concurrently, time spent watching television tripled.^[18] The prevalence rates of inactivity among Saudis concur with those estimates reported worldwide.^[18]

The current study aimed to systematically review and highlight the evidence from the published literature concerning the prevalence of physical activity and dietary habits among adolescents of Saudi Arabia.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Checklist and Meta-analysis of Observational Studies in Epidemiology statement guidelines were followed during the preparation of this systematic review.^[19,20] All steps were performed in strict accordance with the Cochrane Handbook of Systematic Review and Meta-analysis (Higgins, Green, and Series, 2008).

Literature search strategy

An electronic literature search of PubMed, SCOPUS, Web of Science, and BIOSIS was carried out through April 2018 using the following keywords: (Physical activity OR physical inactivity OR exercise OR diet OR dietary habits) AND Saudi Arabia.

Study selection

Two authors independently screened the literature search results for relevant studies. The eligibility screening was performed in two steps: The first step was to screen titles and abstracts of the retrieved records and the second step was to screen full-text articles of abstracts selected in the first step. Discussion with a third author resolved any discrepancies between research investigators.

Eligibility criteria

Studies satisfying the following criteria were included in this review: (1) Cross-sectional studies that were published in the last decade (2007–2017), (2) studies in which the population was Saudi Arabian adolescents, and (3) studies evaluating the prevalence of physical activity and dietary habits among the Saudi Arabian population. Studies that did not fit the eligibility criteria were excluded from the study. Case reports, case series, letters, editorials, theses, reviews, book chapters, comments, and non-available full draft papers were also not considered. Studies with overlapped data sets, non-Saudi Arabian population, duplicated reports, and studies with data that could not be extracted were also excluded from the study.

Data extraction

Data were extracted independently by two authors through a pre-organized data extraction sheet. The extracted data included (1) characteristics of the study design of included

studies, (2) characteristics of the study population, and (3) data of the study outcomes.

Quality assessment

The Newcastle-Ottawa scale tool for risk of bias assessment of cross-sectional studies was used. This tool comprises various domains such as sampling plan, statistical analysis description, and outcomes. Two authors blindly evaluated the quality of included studies and any disagreements were settled through discussion with a third author.

Results

Characteristics of included studies

Our search strategy retrieved 850 citations. Following eligibility screening, 43 were found to be potentially eligible. Of them, only 18 articles published between 2007 and 2017 were finally eligible for inclusion. The studies came from different regions; Riyadh ($n = 6$), Al-Ahsa ($n = 2$), Eastern region ($n = 3$), Mecca ($n = 6$), Northern Borders ($n = 1$), Al-Qassim ($n = 1$), and Asir ($n = 2$) and one study did not specify the region. The flow diagram of the study selection process is shown in Figure 1.

The summary of the study design and population characteristics of included studies is shown in Table 1.

Quality of included studies

All included articles were considered of good quality according to the Newcastle-Ottawa scale tool. A total of 11 papers had eight stars, while seven studies had seven stars. All articles were granted stars concerning sample representativeness, satisfactory recruitment rate, validated measurement tool, and statistical methods. Seven studies were scored B regarding sample size.

Prevalence of physical activity among adolescents

Most studies reported low levels of physical activity among adolescents. Al-Hazzaa *et al.* reported that only 43.5% of males and 12.9% of females did meet daily physical activity guidelines.^[21] Females were associated with significantly more sedentary and much less physical activity than males. Taha *et al.* found a significantly higher proportion of male students engaging in physical activity than females (91% and 81.8%).^[22] A marked number of male students exercised three or more times per week and for more than 0.5 h per session compared to females ($P < 0.001$). A study conducted by Alsubaie *et al.* concluded that approximately 36% of teenagers gained enough physical exercise on weekdays and approximately only 15% reached the recommended level of physical activity at least 5 days/week.^[23] Results from research conducted by Nakeeb *et al.* indicated that just over 26% of all youth are active, with

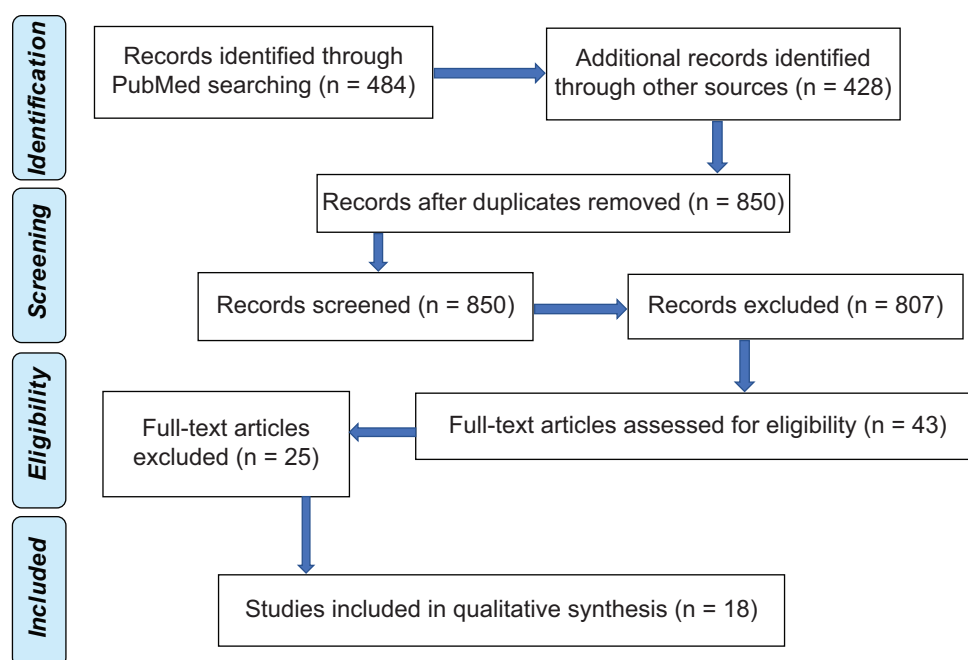


Figure 1: Preferred reporting items for systematic reviews and meta-analyses 2009 flow diagram

the percentage of active males considerably higher than the percentage of active females.^[24]

A study by Al-Nuaim *et al.* found that the percentages of active individuals varied greatly between males and females.^[25] In males, approximately 36% were inactive, 20% minimally active and 44% were active. In females, approximately 82% were inactive, 14% were minimally active, and 4% were active. Alzahrani *et al.* reported that 64% of the participants had low physical activity and half of the adolescents reported the involvement in physical fights at least once or more during the previous year.^[26] A study by Qahwaji *et al.* of Saudi teenagers revealed that physical activity among adolescents varied from one area to another.^[27] Mahfouz *et al.* found that approximately 26% of the males and 43% of the females had not exercised for more than 30 min during the week prior.^[28] When looking at physical exercise taking place in schools, approximately 31% of the boys and 100% of the girls had not participated in any physical exercise during the prior week.

Bajamal *et al.*^[29] assessed physical activity using the Physical Activity Questionnaire for Adolescents and deduced that the mean physical activity level was 2.1 (standard deviation (SD) = 0.66), which is considered to be a low level score.^[29,30] Al-Sobayel *et al.* reported that the average of the total time spent in physical activity per week was 90 and 77 min for leisure and non-leisure physical activity, respectively.^[31] In addition, males spent more time in physical activity than females, and females in private schools spent more time in leisure physical activities than females in state schools.^[31]

Prevalence of dietary habits among adolescents

Several indicators were used to identify unhealthy food habits. Fast foods were the most reported form of unhealthy diets. The highest prevalence of fast food was reported by Shaikh *et al.* who found that 80% of schoolchildren consumed fast food and soft drinks regularly at least between once or twice a week.^[32] Alenazi *et al.* reported that 60% of participants were eating fast food more than twice per week, while 73.4% were eating junk food at least once per day.^[33] AlFaris *et al.* reported that 52.8% of adolescent females consumed fast food once per week and 25.2% were eating fast food at least twice per week.^[34] Al-Hazzaa *et al.* (2011) found that around 25% of female adolescents in Saudi Arabia were eating fast foods at least 3 times per week, while 6% consumed fast foods everyday.^[21] Another study by Alghadir *et al.* reported a higher consumption of fast food and sweetened beverages among participants aged 12–16 years.^[35] Farghaly *et al.* reported that average fast food consumption was 2 ± 1.7 times/month.^[36]

Regarding skipping breakfast, the highest prevalence recorded was 54% in the research by Washi *et al.*^[37] followed by 46.9% in Alzahrani *et al.*^[26] followed by 40.9% in Alenazi *et al.*^[33] then 19% reported by Alghadir *et al.*^[35] Farghaly *et al.* reported 72% of primary school students and approximately 50% among students of secondary school students were regularly having breakfast.^[36]

In relation to fruit and vegetables, Al-Hazzaa *et al.* reported that most adolescents in their study did not eat fruit and vegetables on a daily basis.^[21] Alghadir *et al.* found that approximately 40% of participants reported not eating fresh fruit and vegetables,^[35] while Alzahrani *et al.* reported that

Table 1: Summary table of included studies

Author, year	Setting	Population (age)	Sample size	Sampling method	Forms of physical inactivity or unhealthy dietary habits	Key outcomes
Al-Hazzaa <i>et al.</i> 2011 ^[21]	Al-Khobar (Eastern region), Jeddah (Mecca) and Riyadh (2009–2010)	Secondary school students (14–19 years)	2908	Multistage stratified random sample	Physical inactivity: Sedentary behaviors (TV viewing/ playing video games/ computer use/decreased daily physical activity). Dietary habits: Sugar-sweetened drinks/fast foods/ energy drinks/French fries and potato chips/cakes and doughnuts/candy and chocolate.	Almost half of the males and three-quarters of the females did not meet daily physical activity guidelines. The majority of adolescents did not have a daily intake of breakfast, fruit, vegetables, and milk.
Al-Nakeeb <i>et al.</i> 2012 ^[24]	Al-Ahsa, Saudi Arabia	Secondary school students (15–17 years)	465	Stratified random sample	Physical inactivity: Sedentary behaviors (TV viewing/ playing video games/ computer use/decrease daily physical activity).	The percentage of active youth (males and females) was 26.5%. Males were more physically active than females.
Al-Nuaim <i>et al.</i> 2012 ^[25]	Al-Ahsa, Saudi Arabia	Secondary school students (15–19 years)	1270	Random sample	Physical inactivity: Sedentary behaviors (TV viewing/ playing video games/ computer use/decrease daily physical activity).	Significant differences in the physical activity levels of youth were evident about gender, geographical areas, and type of school. Normal-weight males reported the highest levels of physical activity compared to overweight and obese males.
Al-Sobayel <i>et al.</i> 2015 ^[31]	Al-Khobar (Eastern region), Jeddah (Mecca), and Riyadh	Secondary school students (14–19 years)	2888	Multistage stratified cluster random sample	Dietary habits: Sugar-sweetened drinks including soft drinks/doughnuts and cake/sweets and chocolate/ energy drinks/fast food.	Males spent more time in physical activity than females. Furthermore, the total time of physical activity per week was 90 and 77 min for the leisure and non-leisure physical activity, respectively.
Alsubaie <i>et al.</i> 2015 ^[23]	Riyadh, Saudi Arabia	Male adolescents (15–20 years)	453	Stratified cluster random sample	Physical inactivity: Not practicing physical activity.	36.4% of the students reported that they had enough exercise during their usual weekdays, while only 15.5% of the students were found to be practicing physical activity at the recommended level (≥ 5 days/week).
Bajamal <i>et al.</i> 2017 ^[29]	Jeddah (Mecca), Saudi Arabia	Female adolescents (13–18 years)	405	Stratified random sample	Physical inactivity: Inadequate physical activity.	Mean physical activity level measured through the Physical Activity Questionnaire for Adolescents was 2.1 (SD = 0.66), which is low.
Taha 2005 ^[22]	Al-Khobar area of Eastern Province of Saudi Arabia (2001–2002)	Male and female students (16.3 \pm 1.7 years)	2571	Multistage stratified random sample	Physical inactivity: Decrease practice of physical exercises.	Most male and female students knew that physical activity is protective against diseases in general (92.9% and 91.8%, respectively) and in the prevention of obesity (69.4% and 78.5%) but had inadequate knowledge about the role of physical activity in the prevention of diabetes mellitus and hypertension.

(Contd...)

Table 1: (Continued)

Author, year	Setting	Population (age)	Sample size	Sampling method	Forms of physical inactivity or unhealthy dietary habits	Key outcomes
Qahwaji 2012 ^[27]	Jeddah (Mecca), Saudi Arabia	Secondary school male students (16–17 years)	530	Multistage stratified random sample	No definition.	Time in minutes spent per week in different types of physical activity by adolescents revealed a non-significant difference in walking weekly, and stairs use per day, jogging/running, biking and swimming, whereas it was significant in minutes walking per time ($p=0.013$) and minutes biking ($p=0.006$).
Mahfouz <i>et al.</i> 2011 ^[28]	Southwestern (Asir) Saudi Arabia	Adolescent school students (11–19 years)	1869	Random sample	Physical inactivity: Sedentary behaviors (TV viewing/ playing video games/ computer use/decrease daily physical activity). Dietary habits: Consuming more (soft drinks, rice, bread, meat, and chicken)/Consuming less (fresh juices, fresh fruits, fresh vegetables, and fish).	25.7% of boys and 42.9% of girls did not practice any physical exercise (for more than 30 min) during the previous week. 27.1% of boys and 23.4% of girls did not consume any fresh fruits during the previous week.
Alghadir <i>et al.</i> 2016 ^[35]	Overall Saudi Arabia	School students (12–16 years)	214	Convenience sampling	Physical inactivity: Sedentary behaviors (TV viewing/ playing video games/ computer use/decrease daily physical activity). Dietary habits: Soft drinks/ fast food/sweets and chocolates.	Of the 214 respondents, 81% ($n=174$) reported that they ate breakfast every day while 19% ($n=40$) reported that they did not eat breakfast every day.
Shaikh <i>et al.</i> 2016 ^[32]	Qassim region of Saudi Arabia (2013–2014)	Secondary and intermediate school students (12–14 years)	242	Convenience sampling	Physical inactivity: Sedentary behaviors (TV viewing/ decrease daily physical activity). Dietary habits: Number of meals per day/daily skipping breakfast/soft drinks/weekly eating fast food/daily eating snacks and junk food.	90% of all participants drank at least one soft drink daily, and 30% of them, predominately males, consumed three soft drinks/day. 81% of the participants consumed fast food at least once a week and 36% of them consumed junk food at least 3 times/week, more boys than girls had this tendency.
Alenazi <i>et al.</i> 2015 ^[33]	Arar (Northern Borders), Saudi Arabia (March and April 2012)	Male students (15–19 years)	523	Random sample	Dietary habits: Fast food consumption patterns.	51.2% of the students were eating three meals/day, and only 28.3 % were eating ≥ 4 meals/day.
Washi <i>et al.</i> 2010 ^[37]	Jeddah (Mecca), Saudi Arabia	Primary, secondary, and intermediate school students (13–18 years)	239	Cluster random sample	Dietary habits: High fast food consumption.	Compared with the Dietary Reference Intake, carbohydrate and fat intakes were higher while calcium, iron, and zinc intakes were lower. Higher cholesterol and lower hemoglobin levels were found in 30.5% and 53.6% of the adolescents, respectively.
AlFaris <i>et al.</i> 2015 ^[34]	Riyadh, Saudi Arabia (March–April 2010)	Intermediate and secondary school female students (13–18 years)	127	Random sample	Physical inactivity: Sedentary behaviors (smoking/decrease daily physical activity)/less frequent tooth brushing. Dietary habits: Low fruit consumption/high sweet consumption.	Fast food was consumed once per week by 52.8% of adolescent girls. 25.2% of adolescent girls consumed fast food twice or more weekly. Carbonated soft drinks were the main beverages usually consumed with fast food meals.

(Contd...)

Table 1: (Continued)

Author, year	Setting	Population (age)	Sample size	Sampling method	Forms of physical inactivity or unhealthy dietary habits	Key outcomes
Alzahrani <i>et al.</i> 2014 ^[26]	Riyadh, Saudi Arabia	Intermediate and secondary school students (13–19 years)	1335	Stratified cluster random sample	Physical inactivity: Watching television during family main meal. Dietary habits: Breakfast intake/daily snack consumption/daily milk consumption.	About 85% of adolescents ate fruit less than once per day, 74% brushed their teeth less than twice daily, 64% had low physical activity, 51% had been involved in physical fighting at least once or more in the previous 12 months, 43% ate sweets once or more daily, and 23% smoked tobacco.
Al-Muammar <i>et al.</i> 2014 ^[39]	Riyadh, Saudi Arabia	Female intermediate school students (12–15 years)	107	Random sample	Physical inactivity: Sedentary behaviors (TV viewing/playing video games/computer use/decrease daily physical activity)/sleeping. Dietary habits: Fast food consumption.	The main meal for most of the participants was lunch (76.2%). Over half of the total number of participants ate breakfast (53.2%). More than half of the studied sample (58.9%) drank <6 cups of water per day.
Farghaly <i>et al.</i> 2007 ^[36]	Abha (Asir), Saudi Arabia (April 2000)	Primary, secondary, and intermediate school students (7–20 years)	767	Two-stage random sample	Physical inactivity: Sedentary behaviors (TV viewing/playing video games/computer use/decrease daily physical activity)/sleeping. Dietary habits: Fast food consumption.	Breakfast was never taken by 6% of the students in different grades (range: 2.5–17.2%) and was often skipped by 28% (19.7–48.3%). It was noted to be a regular meal for 72% of children in primary school, but only for 49% of children in secondary school.
Mausaiger and Zagzoog 2013 ^[38]	Jeddah (Mecca), Saudi Arabia	Adolescent girls (12–19 years)	512	Multistage stratifying sample	Physical inactivity: TV viewing/eating while watching TV/increase hours using internet per day/reduced levels of physical activity. Dietary habits: High intake of soft drinks, fast food, sweets and chocolates/low daily intake of fruit and vegetables, milk and dairy products, fish, red meat and chicken.	The frequency intake (≥ 4 times/week) of vegetables (37.9%), fruit (37.3%), and fish (10.4%) was low. Girls in private schools were likely to consume (≥ 4 times) the quantity of vegetables ($P < 0.000$), fruit ($P < 0.0000$), and red meat and chicken ($P < 0.0159$) than their peers in government schools.

approximately 85% of adolescents did not eat fruit everyday.^[26] Mahfouz *et al.* found that 27.1% of boys and 23.4% of girls had not eaten fresh fruits in the week preceding his study.^[28] In contrast, Alenazi *et al.* also found that 49.1% and 58.1% ate fruits and vegetables at least once a day.^[33] Mausaiser and Zagzoog reported that the frequency of vegetables and fruits consumption (≥ 4 times/week) were 37.9% and 37.3%, respectively. The daily consumption of vegetables, fruits, red meat, and chicken among female adolescents in private schools was higher than that in government schools.^[38]

Various other dietary habits were reported in the reviewed studies. Alenazi *et al.*^[33] reported that 51.2% of participants were eating three meals a day, and only 28.3% were eating ≥ 4 meals a day. Al-Muammar *et al.* reported that the main meal for 76.2% of the participants was lunch.^[39] In addition, a total of 58.9% drank <6 cups of water per day. Alzahrani *et al.* reported that 43% ate sweets once or more daily.^[24] Alghadir *et al.*^[35] reported that 35% of participants reported not drinking

milk every day, while Farghaly *et al.* found that 51.5% of the sample were drinking milk on a daily basis.^[36] Washi *et al.* indicated that the mean total protein intake among adolescents was about 1.6 times higher than that recommended by the American Dietetic Association. Of note, males had higher dietary intakes than females.^[37]

Discussion

Our findings revealed that the prevalence of physical activity among Saudi adolescents ranged from 4% to 44.5%. Most of the studies stratified the prevalence of physical inactivity by gender and suggested that female adolescents have limited opportunities to engage in physical activity compared to male adolescents in Saudi Arabia due to cultural reasons.

The top motivators for teenagers to participate in physical exercise were to improve muscle mass and strength, to play with friends, to improve their physical appearance by avoiding

weight gain, and health concerns.^[22] The top disincentives of physical inactivity included a lack of local sports facilities as well as a lack of support from friends.^[23]

Several indicators were utilized to identify the unhealthy food habits. Fast food consumption was more commonly reported, with prevalence rates ranged from 25% to 80%. The prevalence of breakfast skipping ranged from 19% to 54%. The common reasons for skipping breakfast among adolescents were not having enough time in the morning, not feeling hungry at breakfast time, and not enjoying a breakfast meal.^[40] Furthermore, several studies analyzed fruit and vegetable consumption and observed a low prevalence of eating fruit and vegetables. Two studies confirmed that low fruit and vegetable consumption was positively correlated with low physical activity.^[21,26] Al-Almaie *et al.* reported that 51% of the male and 65% of the female students in their study considered unsaturated fatty acids as healthy and about 10% of the male and 8% of the female students reported saturated fats as healthy foods.^[41] These findings highlight the importance of education in changing adolescents' attitudes and awareness toward physical activity and dietary habits. This has been advocated by different studies that emphasized the value of physical education in the school curriculum as a means to enhance health promotion and disease prevention.^[42] Others supports assertions that school-based nutritional education programs significantly improve the dietary habits of students.^[43]

The leading reasons Saudi adolescents reported for being physically inactive were time constraints and lack of facilities.^[16] The recommended minimum requirement for physical activity at a moderate to vigorous level was not reached by over 70% of adolescents.^[15] A main contributing factor for physical inactivity included access to transportation, particularly for boys.^[44,45] Moreover, contributing to the issue is the excessive amount of time spent watching videos and playing computer games. It is important to recognize that physical inactivity is a key component of the obesity epidemic occurring among adolescents.^[46]

Adolescents tend to spend more time with friends compared to the time spent with their families. When teens become more independent, they also tend to eat meals away from home. It has been estimated that adolescents have approximately 30% of their meals away from home and they were also influenced by what their peers ate.^[37] Further, occasionally, high outdoor temperatures cause adolescents to stay indoors and overuse automotive transportation even for short distances.^[47] In a study carried out in Hungary among 881 high school students, parents were found to be an essential correlate of students' well-being.^[48] In another larger study, peers had a direct effect in adolescents' risk behaviors. In addition, communication and relations with parents correlated with adolescents' behaviors, health and the overall well-being.^[49]

Watching television for more than 2 h a day is associated with consuming higher amounts of snack foods and soft

drinks, and thereby consuming more calories. Importantly, television watching also promotes a sedentary lifestyle by infringing on the time available for physical activity.^[35,50] Bajamal *et al.* suggested that addressing perceived barriers to physical activity, leisure physical activity, and social support to enhance physical activity commitment can indeed be a fruitful interventions to increase physical activity among Saudi adolescents.^[29] The WHO has recommended that children and adolescents aged 5–17 years should spend at least 60 min/day in moderate to vigorous physical activity.^[51]

To combat growing obesity among teenagers, several steps need to be taken. These steps include improving their understanding about healthy nutrition, improving their diet, and increasing their levels of physical activity throughout the week. These strategies need to be handled on multiple levels, including within the family and school system. Teenagers are well known for resisting the advice of adults. However, rather than simply telling teenagers what they should do, holding an open discussion regarding the factors contributing to obesity can assist them in taking ownership of the problem and make changes for themselves.^[37] One place to start is with the idea that breakfast is the most important meal of the day.^[52]

Systematic studies analyzing the physical activity levels and eating habits of Saudi teenagers have not previously occurred. Physical activity levels of teenagers have been found to vary across Arab countries from 33% for males in Oman to <5% for girls in Egypt. The numbers were typically around 20% for males and 10–15% for girls in other Arab countries such as Emirates, Djibouti, Jordan, Libya, and Morocco.^[53]

Regarding Westerns studies, in a published report in 2015, the Youth Risk Behaviour Surveillance System in the USA detected that 14.3% of the adolescents in their study had not participated in any physical activity for at least 60 min daily. The study also revealed that 5.2% of students in secondary school had never eaten fruit or had fresh juices, and 6.7% had never tried vegetables.^[54] The results from the European Youth Heart Study using an accelerometer for physical-activity measurements demonstrated that about 82% of male adolescents aged 16 years had met the recommended level of health-enhancing physical activity.^[55] Moreover, more than half of Greek-Cypriot children and adolescents achieved the physical activity guidelines.^[56] Similarly, about 50% of Finnish adolescents aged 15–16 years spend at least 60 min doing physical activity everyday.^[57] A systematic review published in 2014 concluded that the prevalence rate of physical inactivity ranged from 2.3% to 93.5% among Brazilian adolescents. Similar to the findings of this review, females were associated with higher rates of physical inactivity than males.^[58]

Due to the lack of local guidance on specific dietary regimen and physical activity plan for Saudi adolescents, this paper highlights on the importance of the dietary regimen

recommended by the American Dietary guidelines 2015–2020 to be followed by the Saudi adolescents. It is a four steps plan; (1) add fruits, vegetables, all grains, and fat-free or low-fat milk and milk products to your food, (2) consider lean meats, poultry, fish, beans, eggs, and nuts, (3) your diet should be low in sugar, fat, cholesterol, and salt, and (4) do not go over assumed daily calories.^[59] In addition, the US Department of Health and Human Services has recommend that children and adolescents aged 6–17 years should 60 min or more of moderate-to-vigorous intensity daily physical activities for at least 3 days a week. We recommend such physical program for the Saudi youth community.^[60]

Limitations

The study has been limited by small sample sizes and lack of quantitative analysis which may affect the results' generalizability. The included studies were conducted in eight different regions around Saudi Arabia and did not represent all 13 regions. Moreover, most included studies were conducted in big cities such as Riyadh and Jeddah with six studies conducted in each of these cities.

Conclusion

The future economic burden of physical inactivity may be higher if the current levels of physical inactivity are not reduced over time. It is obvious that engaging in regular physical activity is associated with several health benefits and plays a major role in modifying many coronary heart disease risk factors. The results of the current study could be applied as the basic reference to develop and implement public health programs in Saudi Arabia, mainly in the regions having significantly high rates of physical inactivity and unhealthy dietary habits, to maintain satisfactory life quality. Our review highlights the relatively high level of physical inactivity and unhealthy dietary habits are relatively high among adolescents in Saudi Arabia. Further public health efforts, such as educational TV programs and school awareness campaigns, are recommended to increase the awareness of adolescents about regular physical activity and healthy dietary habits.

Authors' Declaration Statements

Ethics Approval and Consent to Participate

Not applicable.

Availability of Data and Material

The data used in this study are available and will be provided by the corresponding author on a reasonable request.

Competing Interests

Authors have no conflict of interests.

Funding Statement

This work was not funded by any organization.

Authors' Contributions

IA conceptualized the study, did literature review, analysis and wrote first draft. IM, LE and KU supervised IA throughout the process and provided critical inputs. All authors read and approved final version of the manuscript.

Acknowledgments

Not applicable.

ORCID link of the submitting author: 0000-0002-0316-1374

Ilias Mahmud: 0000-0003-1330-7813

Leah East: 0000-0002-4757-2706

Kim Usher: 0000-0002-9686-5003

References

1. Waxman A. WHO global strategy on diet, physical activity and health. *Food Nutr Bull* 2004;25:292-302.
2. Williams PT. Physical fitness and activity as separate heart disease risk factors: A meta-analysis. *Med Sci Sports Exerc* 2001;33:754-61.
3. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: The evidence. *CMAJ* 2006;174:801-9.
4. Katzmarzyk PT, Janssen I, Ardern CI. Physical inactivity, excess adiposity and premature mortality. *Obesity Rev* 2003;4:257-90.
5. Sofi F, Capalbo A, Cesari F, Abbate R, Gensini GF. Physical activity during leisure time and primary prevention of coronary heart disease: An updated meta-analysis of cohort studies. *Eur J Cardiovasc Prev Rehabil* 2008;15:247-57.
6. Qin L, Knol MJ, Corpeleijn E, Stolk RP. Does physical activity modify the risk of obesity for Type 2 diabetes: A review of epidemiological data. *Eur J Epidemiol* 2010;25:5-12.
7. Teychenne M, Ball K, Salmon J. Physical activity and likelihood of depression in adults: A review. *Prevent Med* 2008;46:397-411.
8. Aarsland D, Sardaheae FS, Anderssen S, Ballard C. Is physical activity a potential preventive factor for vascular dementia? A systematic review. *Aging Ment Health* 2010;14:386-95.
9. Parsons JK, Kashefi C. Physical activity, benign prostatic hyperplasia, and lower urinary tract symptoms. *Eur Urol* 2008;53:1228-35.
10. Alharthi FS, Alrahimi JS, Alotaibi AA, Alhamdi DA, Ibrahim BM, Badeeb YA. Prevalence of undiagnosed cardiovascular risk factors in adults aged 20-40: A cross-sectional study in 2016 in Jeddah, Saudi Arabia. *Cardiol Res* 2017;8:111-6.
11. Ghabrah TM, Bahnassy AA, Abalkhail BA, Al-Bar HM, Milaat WA. The prevalence of cardiovascular risk factors among students in Jeddah, Saudi Arabia. *J Family Community Med* 1997;4:55-63.
12. World Health Organisation. Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. Geneva: World Health Organisation. Available from: https://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf. [Last accessed on 2020 Jun 12].

13. Mikkilä V, Räsänen L, Raitakari OT, Marniemi J, Pietinen P, Rönnemaa T, *et al.* Major dietary patterns and cardiovascular risk factors from childhood to adulthood. The cardiovascular risk in young finns study. *Br J Nutr* 2007;98:218-25.
14. Boutelle K, Neumark-Sztainer D, Story M, Resnick M. Weight control behaviors among obese, overweight, and nonoverweight adolescents. *J Pediatr Psychol* 2002;27:531-40.
15. Al-Hazzaa HM. Physical activity, fitness and fatness among Saudi children and adolescents: Implications for cardiovascular health. *Saudi Med J* 2002;23:144-50.
16. Al-Rafae SA, Al-Hazzaa HM. Physical activity profile of adult males in Riyadh city. *Saudi Med J* 2001;22:784-9.
17. Al-Rukban MO. Obesity among Saudi male adolescents in Riyadh, Saudi Arabia. *Saudi Med J* 2003;24:27-33.
18. Al-Hazzaa HM. The public health burden of physical inactivity in Saudi Arabia. *J Family Community Med* 2004;11:45.
19. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med* 2009;6:e1000097.
20. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, *et al.* Meta-analysis of observational studies in epidemiology: A proposal for reporting. Meta-analysis of observational studies in epidemiology (MOOSE) group. *JAMA* 2000;283:2008-12.
21. Al-Hazzaa HM, Abahussain NA, Al-Sobayel HI, Qahwaji DM, Musaiger AO. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *Int J Behav Nutr Phys Act* 2011;8:140.
22. Taha AZ. Self-reported knowledge and pattern of physical activity among male school students and their teachers in Al Khobar, Saudi Arabia. *J Family Community Med* 2005;12:19-25.
23. Alsubaie AS, Omer EO. Physical activity behavior predictors, reasons and barriers among male adolescents in Riyadh, Saudi Arabia: Evidence for obesogenic environment. *Int J Health Sci (Qassim)* 2015;9:400.
24. Al-Nakeeb Y, Lyons M, Collins P, Al-Nuaim A, Al-Hazzaa H, Duncan MJ, *et al.* Obesity, physical activity and sedentary behavior amongst British and Saudi youth: A cross-cultural study. *Int J Environ Res Public Health* 2012;9:1490-506.
25. Al-Nuaim AA, Al-Nakeeb Y, Lyons M, Al-Hazzaa HM, Nevill A, Collins P, *et al.* The prevalence of physical activity and sedentary behaviours relative to obesity among adolescents from Al-Ahsa, Saudi Arabia: Rural versus Urban variations. *J Nutr Metab* 2012;2012:417589.
26. Alzahrani SG, Watt RG, Sheiham A, Aresu M, Tsakos G. Patterns of clustering of six health-compromising behaviours in Saudi adolescents. *BMC Public Health* 2014;14:1215.
27. Qahwaji DM. Physical activity and life style among male adolescents in Jeddah, Saudi Arabia. *Life Sci J* 2012;9:1163-72.
28. Mahfouz AA, Shatoor AS, Khan MY, Daffalla AA, Mostafa OA, Hassanein MA. Nutrition, physical activity, and gender risks for adolescent obesity in Southwestern Saudi Arabia. *Saudi J Gastroenterol* 2011;17:318.
29. Bajamal E, Robbins LB, Ling J, Smith B, Pfeiffer KA, Sharma D. Physical activity among female adolescents in Jeddah, Saudi Arabia: A Health promotion model-based path analysis. *Nurs Res* 2017;66:473-82.
30. Kowalski KC, Crocker PR, Donen RM. The physical activity questionnaire for older children (PAQ-C) and adolescents (PAQ-A) manual. *Coll Kinesiol Univ Saskatchewan* 2004;87:1-38.
31. Al-Sobayel H, Al-Hazzaa HM, Abahussain NA, Qahwaji DM, Musaiger AO. Gender differences in leisure-time versus non-leisure-time physical activity among Saudi adolescents. *Ann Agric Environ Med* 2015;22:344-8.
32. Shaikh MA, Al Sharaf F, Shehzad K, Shoukat F, Naeem Z, Al Harbi S, *et al.* Prevalence and trends of overweight and obesity amongst Saudi school children, a study done by using three noninvasive methods. *Int J Health Sci (Qassim)* 2016;10:381-7.
33. Alenazi SA, Koura HM, Zaki SM, Mohamed AH. Prevalence of obesity among male adolescents in Arar Saudi Arabia: Future risk of cardiovascular disease. *Indian J Community Med* 2015;40:182.
34. ALFaris NA, Al-Tamimi JZ, Al-Jobair MO, Al-Shwaiyat NM. Trends of fast food consumption among adolescent and young adult Saudi girls living in Riyadh. *Food Nutr Res* 2015;59:26488.
35. Alghadir AH, Gabr SA, Iqbal ZA. Television watching, diet and body mass index of school children in Saudi Arabia. *Pediatr Int* 2016;58:290-4.
36. Farghaly NF, Ghazali BM, Al-Wabel HM, Sadek AA, Abbag FI. Life style and nutrition and their impact on health of Saudi school students in Abha, Southwestern region of Saudi Arabia. *Saudi Med J* 2007;28:415-21.
37. Washi SA, Ageib MB. Poor diet quality and food habits are related to impaired nutritional status in 13-to 18-year-old adolescents in Jeddah. *Nutr Res* 2010;30:527-34.
38. Musaiger AO, Zagzoog N. Dietary and lifestyle habits among adolescent girls in Saudi Arabia: A comparison between private and government schools. *Nutr Food Sci* 2013;43:605-10.
39. Al-Muammar MN, El-Shafie M, Feroze S. Association between dietary habits and body mass index of adolescent females in intermediate schools in Riyadh, Saudi Arabia. *East Mediterr Health J* 2014;20:39-45.
40. Shaw ME. Adolescent breakfast skipping: An Australian study. *Adolescence* 1998;33:851-61.
41. Al-Almaie S. Knowledge of healthy diets among adolescents in eastern Saudi Arabia. *Ann Saudi Med* 2005;25:294.
42. Weepie AK, McCarthy AM. A healthy lifestyle program: Promoting child health in schools. *J Sch Nurs* 2002;18:322-8.
43. Nicklas TA, Johnson CC, Myers L, Farris RP, Cunningham A. Outcomes of a high school program to increase fruit and vegetable consumption: Gimme 5 a fresh nutrition concept for students. *J Sch Health* 1998;68:248-53.
44. Al-Hazzaa HM. Obesity and physical inactivity among Saudi children and youth: Challenges to future public health. *J Family Community Med* 2006;13:53.
45. Abahussain NA, Musaiger AO, Nicholls PJ, Stevens R. Nutritional status of adolescent girls in the eastern province of Saudi Arabia. *Nutr Health* 1999;13:171-7.
46. Tremblay MS, Willms JD. Is the Canadian childhood obesity epidemic related to physical inactivity? *Int J Obes* 2003;27:1100-5.
47. Badran M, Laher I. Obesity in arabic-speaking countries. *J Obes* 2011;2011:686430.
48. Piko BF, Hamvai C. Parent, school and peer-related correlates of adolescents' life satisfaction. *Child Youth Serv Rev* 2010;32:1479-82.
49. Tomé G, de Matos MG, Simões C, Camacho I, AlvesDiniz J. How can peer group influence the behavior of adolescents: explanatory model. *Glob J Health Sci* 2012;4:26.
50. Bowman SA. Television-viewing characteristics of adults: Correlations to eating practices and overweight and health status. *Prev Chronic Dis* 2006;3:A38.
51. World Health Organisation. Assessing National Capacity for the Prevention and Control of Noncommunicable Diseases: Report of the 2015 Global Survey. Geneva: World Health Organisation; 2020. Available from: <https://www.who.int/ncds/surveillance/ncd-capacity/en>. [Last accessed on 2020 Jul 15].
52. Miller GD, Forgac T, Cline T, McBean LD. Breakfast benefits children in the US and Abroad. *J Am Coll Nutr* 1998;17:4-6.
53. Guthold R, Cowan MJ, Autenrieth CS, Kann L, Riley LM. Physical activity and sedentary behavior among schoolchildren: A 34-country comparison. *J Pediatr* 2010;157:43-9.e1.

54. Kann L, McManus T, Harris WA, Shanklin SL, Flint KH, Hawkins J, *et al.* Youth risk behavior surveillance United States, 2015. *Morb Mortal Wkly Rep* 2016;65:1-174.
55. Riddoch CJ, Bo Andersen L, Wedderkopp N, Harro M, Klasson-Heggebø L, Sardinha LB, *et al.* Physical activity levels and patterns of 9 and 15-yr-old European children. *Med Sci Sports Exerc* 2004;36:86-92.
56. Loucaides CA, Jago R, Theophanous M. Physical activity and sedentary behaviours in Greek-Cypriot children and adolescents: A cross-sectional study. *Int J Behav Nutr Phys Act* 2011;8:90.
57. Tammelin T, Ekelund U, Remes J, Näyhä S. Physical activity and sedentary behaviors among Finnish youth. *Med Sci Sports Exerc* 2007;39:1067-74.
58. Filho VC, de Campos W, Ada SL. Epidemiology of physical inactivity, sedentary behaviors, and unhealthy eating habits among Brazilian adolescents: A systematic review. *Cien Saude Colet* 2014;19:173-93.
59. DeSalvo KB, Olson R, Casavale KO. Dietary guidelines for Americans. *JAMA* 2016;315:457-8.
60. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, *et al.* The physical activity guidelines for Americans. *JAMA* 2018;320:2020-8.