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

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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.\cite{19} The prevalence rates of inactivity among Saudis concur with those estimates reported worldwide.\cite{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.\cite{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.\cite{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%).\cite{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.\cite{23} Results from research conducted by Nakeeb et al. indicated that just over 26% of all youth are active, with...
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 twice a week.\[26\] 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.\[33\] Al-Faris 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.\[35\] Another study by Alghadir et al. reported a higher consumption of fast food and sweetened beverages among participants aged 12–16 years.\[36\] 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.\[38\]

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.\[31\] Alghadir et al. found that approximately 40% of participants reported not eating fresh fruit and vegetables, 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 et al. 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 et al. 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 et al. 2012[23]  | 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 et al. 2015[31] | Al-Khobar (Eastern region), Jeddah (Mecca), and Riyadh | Secondary school students (14–19 years) | 2888        | Multistage stratified cluster random sample | | 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 et al. 2015[23]  | Riyadh, Saudi Arabia | Male adolescents (15–20 years) | 453         | Stratified cluster random sample   | Physical inactivity: Not practicing physical activity.                                                                 | 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. |
| Bajamal et al. 2017[29]  | Jeddah (Mecca), Saudi Arabia | Female adolescents (13–18 years) | 405         | Stratified random sample           | Physical inactivity: Inadequate 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). |
| Taha 2005[22]           | Al-Khobar area of Eastern Province of Saudi Arabia (2001–2002) | Male and female students (16.3±1.7 years) | 2571        | Multistage stratified random sample | Physical inactivity: Decrease practice of physical exercises.                                                            | Mean physical activity level measured through the Physical Activity Questionnaire for Adolescents was 2.1 (SD = 0.66), which is low. |

(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 ($p=0.006$). 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. |
| Mahfouz et al. 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 et al. 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). 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. |
| Shaikh et al. 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 et al. 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 et al. 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 et al. 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..)
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] Mausaiger 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] Wasi 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
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weight gain, and health concerns. The top disincentives of physical inactivity included a lack of local sports facilities as well as a lack of support from friends. 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. 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. 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. 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. Others support assertions that school-based nutritional education programs significantly improve the dietary habits of students.

The leading reasons Saudi adolescents reported for being physically inactive were time constraints and lack of facilities. The recommended minimum requirement for physical activity at a moderate to vigorous level was not reached by over 70% of adolescents. A main contributing factor for physical inactivity included access to transportation, particularly for boys. 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. 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. Further, occasionally, high outdoor temperatures cause adolescents to stay indoors and overuse automotive transportation even for short distances. In a study carried out in Hungary among 881 high school students, parents were found to be an essential correlate of students’ well-being. 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.

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. 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. 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.

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. One place to start is with the idea that breakfast is the most important meal of the day.

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.

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. 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. Moreover, more than half of Greek-Cypriot children and adolescents achieved the physical activity guidelines. Similarly, about 50% of Finnish adolescents aged 15–16 years spend at least 60 min doing physical activity everyday. 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.

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. 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.

**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.

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**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.

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**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, Sardahaee 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. Alhaththi FS, Alhaththi JS, Alotaibi AA, Alhaththi 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].
32. Shaikh MA, Al Sharaf F, Shehzad K, Shoukat F, Naeem Z, Al Harbi S, Al-Sobayel H, Al-Hazzaa HM, Abahussain NA, Qahwaji DM, Bajamal E, Robbins LB, Ling J, Smith B, Pfeiffer KA, Sharma D. Physical activity and life style among male adolescents in Riyadh, Saudi Arabia. Saudi Med J 2003;24:27-33.

33. Al-Hazzaa HM. The public health burden of physical inactivity in Saudi Arabia. J Family Community Med 2004;11:45.

34. 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.

35. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Liberati A, Tetzlaff J, Altman DG. Meta-analysis of observational studies in epidemiology: A proposal for reporting. Meta-analysis of observational studies in epidemiology (MOOSE) group. JAMA 2000;283:208-12.

36. 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.

37. Al-Nuaim AA, Al-Nakeeb Y, Lyons M, Al-Hazzaa HM, Neill V, 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.

38. Alzahrani SG, Watt RG, Sheikh A, Aracu M, Tsakos G. Patterns of clustering of six health-compromising behaviours in Saudi adolescents. BMC Public Health 2014;14:1215.

39. Qahwaji DM. Physical activity and life style amongst male adolescents in Jeddah, Saudi Arabia. Life Sci 2012;9:1163-72.

40. Al-Almaie S. Knowledge of healthy diets among adolescents in eastern Saudi Arabia. Ann Saudi Med 2005;25:294.

41. Shaw ME. Adolescent breakfast skipping: An Australian study. Adolescence 1998;33:851-61.

42. Al-Almaie S. Knowledge of healthy diets among adolescents in eastern Saudi Arabia. Ann Saudi Med 2005;25:294.

43. 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, Western region of Saudi Arabia. Saudi Med J 2007;28:415-21.

44. Al-Rufaidan MO. Obesity among Saudi male adolescents in Riyadh, Saudi Arabia. J Family Community Med 2004;11:45.

45. Al-Rafaee SA, Al-Hazzaa HM. Physical activity profile of adult males in Riyadh city. Saudi Med J 2001;22:784-9.

46. Al-Rukban MO. Obesity among Saudi male adolescents in Riyadh, Saudi Arabia. J Family Community Med 2004;11:45.

47. Al-Rafiee SA, Al-Hazzaa HM. Physical activity profile of adult males in Riyadh city. Saudi Med J 2001;22:784-9.

48. Al-Rukban MO. Obesity among Saudi male adolescents in Riyadh, Saudi Arabia. J Family Community Med 2004;11:45.

49. Tomé G, de Matos MG, Simões C, Camacho I, AlvesDiniz J. How can chronic diseases be prevented? Strategies from the 2015 Global Survey. Br J Nutr 2007;98:218-25.
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-Heggebo 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.