The Impact of Environment on Physical Activity Levels and Obesity among Saudi Arabia Youth: Comparison of Urban; Rural Farm and Rural Desert Geographical Locations

PAAH
PHYSICAL ACTIVITY AND HEALTH

RESEARCH

ubiquity press

ANWAR AL-NUAIM
AYAZULLAH SAFI

*Author affiliations can be found in the back matter of this article

ABSTRACT

Background: The inactive lifestyle is becoming prevalent in many developed and developing countries including Saudi Arabia. Thus, the aim of this study was to evaluate the impact of neighborhoods' characteristics on physical activity (PA) levels and body mass index (BMI) in Saudi adolescents.

Methods: The anthropometric measurement of 380 secondary-school (boys = 199; girls = 181) from different geographical locations such as urban, rural farm and rural desert was taken using the Seca digital scales for weight and Seca portable measure for height. The BMI was calculated using the formula kg/m^2 followed by participants wearing piezoelectric, New-Lifestyles NL-2000 PA Monitor, and completing the international physical activity short form questionnaire.

Results: The findings indicated, an average boys recorded 9180 steps per day compared to girls 5580 and the univariate ANOVA revealed a significant difference between genders steps per day in three geographical areas ($F_{1,334} = 70.01$, $p < 0.001$). The BMI results demonstrated that participant from rural farm had lower BMI (mean = 21.01 kg/m^2) compared to urban location (mean = 24.12 kg/m^2) and rural desert youth (mean = 25.58 kg/m^2) indicating significant differences in BMI status in geographical locations ($F_{2,379} = 16.40$, $p < 0.001$).

Conclusion: The inactivity and obesity prevalence are prevalent amongst demographic groups in Al-Ahsa. Therefore, future policies and interventions could target this populations especially the rural desert youth in which the health risk could be higher.

CORRESPONDING AUTHOR:

Anwar Al-Nuaim

Physical Education Department, Education College, King Faisal University, SA

aalnuaim@kfu.edu.sa

KEYWORDS:
Physical activity; BMI; Health; Youth in Saudi; pedometer; and IPAQ-SF; built environment; geographical areas; urban; rural farm; and rural desert

TO CITE THIS ARTICLE:
Al-Nuaim, A., & Safi, A. (2022). The Impact of Environment on Physical Activity Levels and Obesity among Saudi Arabia Youth: Comparison of Urban; Rural Farm and Rural Desert Geographical Locations. *Physical Activity and Health*, 6(1), pp. 86–95. DOI: https://doi.org/10.5334/paah.188

BACKGROUND

Engaging in regular physical activity (PA) has numerous health benefits such as reducing the risk of hypertension, cardiovascular diseases, anxiety, and depression (Hallal et al., 2012, Parker et al., 2021, Guo and Zhang, 2022, Liu et al., 2022, Jakicic et al., 2022, Howell and Booth, 2022). However, large proportions of the population in many developed and developing countries across the globe are leading inactive lifestyle (Hallal et al., 2012, Teo and Rafiq, 2021). For instance, the prevalence of inactivity among Saudi population is higher compared to Western countries including UK and the USA (Al-Nakeeb et al., 2012). The cross-cultural study found that, in the UK, 72.3% of youth in Birmingham and 77.2% of youth in Coventry reached the recommended level of total metabolic equivalent minutes per week (METmin/wk), whereas the percentage was only 26% among Saudi youth (Al-Nakeeb et al., 2012). More recently research has suggested that more than 63% of people living in the UK aged 16 and over has been classified as physically active whereas over 58% of Saudi population mostly female (68%) are considered as physically inactive (Almaqhawi, 2021, Sharara et al., 2018). Although few studies have been conducted in Saudi Arabia to identify the prevalence of PA levels, however, objectively monitoring PA levels in this population is scarce (Al-Hazzaa, 2007, Al-Hazzaa and Al-Rasheedi, 2007). Traditionally, studies have focused on individual demographics and psychological correlates to promote PA and prevent obesity (Saelens et al., 2012, Sallis et al., 2018). The influence of environmental characteristics is expected to have a long-term and significant impact on population, which could lead to the short-term effects of individually targeted interventions (Inoue et al., 2009). For instance, individuals from countries where PA is regarded as important for health are more likely to perceive fewer barriers, therefore, engage in regular PA compared to countries where PA is not a social norm (Safi and Myers, 2021). Furthermore, cultural attitudes towards PA and environmental differences were postulated as explanations for British participants being more active compared to counterparts in Saudi Arabia (Al-Nakeeb et al., 2012). Previous research has indicated, certain neighbourhood environmental characteristics such as residential density, accessibility, recreational facilities, aesthetics, and safety plays a major role in influencing PA and obesity (Casey et al., 2014). For instance, Canadian children and adults from rural areas are more physically active than those living in the urban areas (Simen-Kapeu et al., 2010).

Although, the number of nearby recreation facilities and parks were associated positively with girls' PA engagement, retail store ratio correlated positively with boys' PA engagement (Norman et al., 2006). Children living within one kilometre of a park playground were almost five times more likely to be classified as a healthy weight compared to children without nearby parks (Kaczynski et al., 2008). A systematic review conducted by (Larson et al., 2009) found that neighbourhood residents who have access to supermarkets and limited access to convenience stores tend to have healthier diets and lower levels of obesity. Moreover, an increasing number of studies examining the association between PA and built environment has been documented, but most studies were conducted in Western countries, particularly in the USA and UK (Rodriguez and Vogt, 2009, Saelens et al., 2012, Sallis et al., 2018, Clary et al., 2020, Arellana et al., 2020). To the best of researchers' knowledge, no study conducted in Saudi Arabia to determine the effects of the built environment on PA and obesity. Therefore, it was hypothesised that males participants will be more active compared to females and individuals from the rural farm area would report lower BMI status compared to counterparts from other geographical areas within this study. Thus, the aim of this study was to evaluate the impact of neighbourhoods' characteristics on PA levels and body mass index (BMI) amongst adolescents in Saudi.

METHODS

PARTICIPANTS AND PROCEDURES

Following an institutional ethical approval from King Faisal University an individual, parental, and school consents were gained prior commencing the data collection. A total of 380 secondary-school boys and girls aged 15–19 years old (male = 199; females = 181) representing different geographical areas such as urban (male = 96; female 86), rural farm (male = 54; female = 49) and rural desert (male = 49; female = 46) located within the Al-Ahsa Governorate in Saudi Aribia participated in this study. The data were kept confidential and instructions of completing the questionnaires and wearing PA pedometer were provided.

MEASURES

ANTHROPOMETRIC MEASUREMENT

The body weight was measured to the nearest 100 grams using Seca weight digital scales (Seca Ltd., Hamburg, Germany). Participants were weighed barefooted and without excess outer clothing. To ensure measurement accuracy, the scale was checked for a zero reading before each weighing. The standing height was measured to the nearest 0.5 centimetre using a Seca portable height measure (Seca Ltd., Hamburg, Germany). The body mass index (BMI) was calculated using the formula of height and weight kg/m^2. Sex and age specific International Obesity Task Force (IOTF) BMI cut-offs were used to define normal weight, overweight, and obesity (Cole, 2000). Participants were classified as follows: BMI <5th percentile = "underweight," BMI ≥ 5th percentile and <85th percentile = "normal weight," BMI ≥ 85th and ≤ 94.9th percentile = "overweight" and BMI ≥ 95th percentile = "obese".

PHYSICAL ACTIVITY MEASUREMENTS

The piezoelectric pedometer, New-Lifestyles NL-2000 Activity Monitor (US), was used to objectively measure PA levels. Previous research supported the use of Piezoelectric pedometer and determined to produce a valid and reliable data (Crouter et al., 2005, Schneider et al., 2004). The 20-step field check including replacing batteries to ensure accuracy were conducted prior handing over the pedometer to participants (Bassett Jr et al., 1996). Participants were instructed to wear the pedometer around the waist during the waking hours only (e.g., participants were informed to remove the pedometer when going to sleep and re-attach it in the morning before going to school). Participants were provided the pedometers on Wednesday morning at the start of school day and pedometers were collected on the following Sunday morning (the Saudi weekend is Friday and Saturday). The assessment of PA levels across four days (two weekdays and two weekends) were aligned with previous research (Trost et al., 2002, Tudor-Locke et al., 2005). Participants were classified either active or inactive based on the cut-off points of 11,000 steps per day for females and 13,000 steps per day for males (Vincent and Pangrazi, 2002).

The international physical activity questionnaire short form (IPAQ-SF) was used to assess PA subjectively. Previous research has used the IPAQ and reported that it is the most valid and reliable self-reported tool for measuring PA levels (Craig et al., 2003, Gustafson and Rhodes, 2006, Safi et al., 2022). The METs values were used in the calculation. This included 8 METs for vigorous activity, 4 METs for moderate activity and 3.3 METs for walking as per the IPAQ scoring guideline. The total METmin/wk converted into three activity categories as per the IPAQ-SF guideline and provided in Table 1.

PA INTENSITY	TOTAL METMIN/WK
Inactive	<600 moderate-intensity or vigorous intensity activities
Minimally active	≥ 600 <3000 MET-min/week of moderate or <1500 vigorous intensity activities
Active	3000≥ MET-min/week of moderate or ≥1500 vigorous intensity

Table 1 The IPAQ categorical score.

STATISTICAL ANALYSIS

A range of statistical analysis were conducted to determine if there is any associations and differences in the under-researched population PA levels and BMI from diverse geographical areas and genders. The descriptive statistics are presented as mean and standard deviation (SD) followed by 2-way and 3-way of variance (ANOVA) for comparisons of PA levels and BMI across age, genders, and geographical locations. A Bonferroni post-hoc tests were used to identify which groups were statistically significantly different. Additionally, the prevalence rates according to genders and geographical locations were compared using Chi-squared distribution statistics. To understand if there is any association between PA levels and BMI within different geographical locations a Pearson correlations was conducted. Finally, logistic regression analysis was conducted for further examination of relationship between some dependent variables such as total METmin/wk, average steps per day and BMI and geographical locations. The results are shown as unadjusted and adjusted odds ratio (OR) values and 95% confidence intervals (CIs). Statistical significance for all analyses conducted was at a level of $P < 05$.

DOI: 10.5334/paah.188

RESULTS

The M ± SD of the total BMI, METmin/wk and pedometer steps across age, gender and geographical areas is presented in Table 2. The results of univariate ANOVA revealed a highly significant difference between males and females in pedometers total steps per day across the three geographical areas ($F_{1,334}$ = 70.01, $p < 0.001$). The mean steps per day for males were 9180 whereas for females it was 5580 steps. With regards to the geographical location, the analysis shows that youth from the rural desert reported walking for 6888 steps per day which is less than urban youth that recorded 7146 steps per day and rural farm youth walked for 8484 steps per day. Furthermore, the results for genders indicated no significant difference between males from different geographical locations ($p > 0.05$), whereas females from rural desert were significantly less active than females from urban ($p = 0.016$) and rural farm areas ($p = 0.001$). the chi-square analysis determined a significant difference in the PA levels between males and females (χ^2_1 = 17.5560, $P < 0.001$). With regards to the females, 96.25% did not reach the cut-off point of recommended 11,000 steps per day. Conversely, 81.71% of males did not reach the recommended level of 13,000 steps per day.

IPAQ-SF METS MINUTES PER WEEK

There was a positive correlation between objectively assessed and self-reported PA ($r = 0.370$, $p < 0.001$). In the IPAQ-SF, univariate ANOVA revealed a highly significant differences in PA levels of males and females ($F_{1,376}$= 86.92, $p < 0.001$). The mean total METmin/wk for males and females were 1772.66 and 443.36 METs, respectively. This highly significant difference between genders was found across the three geographical areas. Moreover, Chi-square analysis revealed a significant difference in the PA levels between males and females (χ^2_2 = 75.546, $p < 0.001$). With regards to the females, 72.06% were inactive, 26.26% were minimally active, and only 1.68% were active. Conversely, 31.82% of males were inactive, 41.92% were minimally active and 26.26% were active. A univariate ANOVA also revealed a significant difference in PA levels of youth from different geographical locations ($F_{2,633}$= 11.46, $p < 0.001$). Bonferroni post-hoc analysis indicated that youth from rural desert areas were significantly less active than youth from urban ($p = 0.003$) and rural farm areas ($p < 0.001$). However, there was no significant difference between urban youth and rural farm areas in total METmin/wk ($p > 0.05$) as outlined in Table 2.

DIFFERENCES IN WEIGHT STATUS

The prevalence of overweight and obesity among participants were 22.37% and 15.53%, respectively. With respect to gender, the prevalence of overweight and obesity in males were 18.09% and 19.10%, respectively, whereas in females it was 27.07% and 11.60%, with no significant difference between genders in BMI ($p > 0.05$). However, there was significant differences in BMI status from different geographical location ($F_{2,379}$ = 16.40, $p < 0.001$). for instance, participants from rural farm had significantly lower BMI (mean = 21.01 kg/m^2) compared to urban location (mean= 24.12 kg/m^2) or rural desert youth (mean = 25.58 kg/m^2). However, there was no significant difference between urban youth and rural desert youth ($p > 0.05$); 18.45% of rural youth were overweight or obese, whereas the prevalence of overweight and obesity for urban and rural desert youth were 42.86% and 49.47%, respectively.

DISCUSSION

The Kingdom of Saudi Arabia has witnessed substantial lifestyle changes during the last three decades. Subsequently, physical inactivity, and an ever-increasing rate of obesity has become prevalent in Saudi society (Al Hazzaa, 2004, Al-Hazzaa, 2007). To the authors' knowledge, the current study is the first of its kind to be conducted in Saudi Arabia focusing on the impact of geographical locations on PA level and BMI. Moreover, the unique feature of this study is the use of objective and self-report methods to assess PA levels. The current study found that there is a high association between pedometer determined PA and PA as measured using the IPAQ-SF. The triangulation of objective and self-report measures to assess PA provided a strong insight into the PA patterns of under researched population.

DOI: 10.5334/paah.188

Table 2 Mean ± SD of the main dependent variables for the total sample and sub-samples.

VARIABLE	URBAN		RURAL FARM		RURAL DESERT		WHOLE SAMPLE		TOTAL N = 380
	MALE N = 96	FEMALE N = 86	MALE N = 54	FEMALE N = 49	MALE N = 49	FEMALE N = 46	MALE N = 199	FEMALE N = 181	
Age	15.96 ± 0.74	16.37 ± 0.84	15.98 ± 0.86	16.45 ± 0.79	16.35 ± 0.75	16.33 ± 0.83	16.06 ± 0.79	16.38 ± 0.82	16.21 ± 0.82
Weight	66.46 + 19.13	59.26 + 14.58	53 + 9.32	50.80 + 11.96	74.45 + 22.95	55.91 + 11.51	64.78 + 19.72	56.12 + 13.57	60.65 + 17.59
Height	167.29 + 7.36	155.01 + 5.21	163.08 + 5.95	151.02 + 5.67	167.90 + 5.28	150.63 + 5.35	166.30 + 6.79	152.82 + 5.74	159.88 + 9.23
BMI	23.63 ± 6.13	24.66 ± 5.89	19.97 ± 3.61	22.17 ± 4.53	26.43 ± 8.13	24.68 ± 5.03	23.32 ± 6.56	23.99 ± 5.42	23.64 ± 6.05
IPAQ-SF Total MET's-min/week	1934 ± 1658	3281 ± 544	2262 ± 2428	850 ± 822	918 ± 683	219 ± 277	1772 ± 1808	443 ± 636	1141 ± 1532
Pedometer Steps per day	8387 ± 4106	5723 ± 2682	10281 ± 4519	6440 ± 2309	9546 ± 6423	4362 ± 2214	9180 ± 4853	5580 ± 2574	7460 ± 4320

The findings shows that most participants both boys and girls did not reach the recommended level of PA for average steps per day and total METmin/wk. Yet the result of pedometers and IPAQ-SF showed that boys were significantly more engaged in PA than girls. For instance, the average steps per day for girls were 5580.43 and METmin/wk was reported to be 443 whereas for boys it was 9180.33 steps per day and 1773 METmin/wk. The present findings are consistent with previous study of (Al-Hazzaa et al., 2011). However, the disparity in PA levels between genders might be caused by several social and institutional factors; these may include social norms, expectations, perceptions, and opportunities for PA afforded by both home and the wider community for boys and girls. For instance, females in Saudi are generally not outwardly encouraged to participate in PA or sports, as this contradicts social norms and what is deemed by society as 'appropriate' behaviours for a female. Furthermore, physical education (PE) is not part of the educational curriculum for females in Saudi Arabia, significantly limiting girls' opportunities for and exposure to sport and PA and impairing their learning of skills to enable them to be more active. Moreover, Saudi females are widely expected to be conservative in terms of both their clothing and behaviours (Al-Hazzaa et al., 2011). Thus, the practicalities for females in wearing clothes deemed as socially acceptable often contradict with the clothing that is most appropriate for sport and PA. The present findings support previous research by (Safi and Myers, 2021) exploring the barriers to PA of Afghans living in the UK and Afghanistan and found that the lack of single sex PA facilities and having to be fully covered outside of the home, were identified as important by all Afghan females irrespective of where they resided.

When exploring gender differences in weight status, the prevalence of overweight and obesity according to BMI was high in both males (37.19%) and females (38.67%). A previous study on adolescents from the Al-Ahsa region revealed a combined prevalence of obesity and overweight of 23.9% (9.7% obese and 14.2% overweight) among males aged 10–14 years by (Amin et al., 2008). Hence, the current findings draw attention to the incremental prevalence of obesity amongst youth in this region. Also, an earlier cross-sectional household survey that involved 13,177 youth and adults Saudis aged 15 years and over indicated that the prevalence of overweight (BMI 25–30) was higher among males than females (29% versus 27%), while the prevalence of obesity (BMI > 30) was higher among females than males (24% versus 16%) (Al-Nuaim, 1997). This equates to 45% of males and 51% of females being classified as overweight or obese. Furthermore, a study by (El Mouzan et al., 2010) reported that the overall prevalence of overweight was 11.7% and obesity 15.8% amongst males aged 6 to 18 years. The highest prevalence of obesity was recorded in the capital city of Riyadh (18%). A more recent study on the dietary behaviours and lifestyle of Saudi female university students reported an overweight rate of 31.4% and obesity of 16.5%. This represents a total of 47.9% of young female adults who were either overweight or obese (Al Qauhiz, 2010). Additionally, a recent systematic review on obesity in the Gulf Co-operation Council States that reviewed 45 studies, reported prevalence of overweight and obesity in adults of 25–50% and 13–50%, respectively, with a higher prevalence of obesity amongst women (Alhyas et al., 2011). The strong body of evidence highlights the high overweight and obesity prevalence in Saudi Arabia, particularly in females. The current study findings support previous literature, by highlighting a high overweight and obesity prevalence, although the overweight and obesity prevalence was higher in females than males, this difference was not statistically significant ($p > 0.05$).

In terms of the geographical areas in the current study, significant differences in PA and weight status were clearly evident in Table 2. For instance, rural desert youth were significantly less active and had higher BMI compared to those living in rural farm or urban environments. The difference between these geographical locations is possibly due to several environmental factors. For instance, regarding PA, the harsh desert climate, that is extremely hot in summer and very cold and windy in winter, is usually not conducive to PA engagement for a substantial period across the year, a problem further compounded by the absence of appropriate facilities for sports and recreational activities in these locations. This might be part of the reason why youth in rural desert areas are less active than youth in rural farm areas. Furthermore, youth in rural farmlands are expected to take part in some of the farming activities that are physically demanding, like ploughing, planting, and harvesting. In general, engagement in PA by young people, particularly in rural environments of Saudi Arabia, is not regarded as a leisure time activity due to cultural attitudes and beliefs (Hayball and Pawlowski, 2018, Sandercock et al., 2010, McCrorie et al., 2020). Additionally, there is a general lack of availability of parks, sports grounds, and facilities that could potentially help youth to become involved in PA or sports within Al-Ahsa and in particular the rural desert regions. Moreover, attitudes, societal norms, and expectations of rural desert communities are often stricter (Huyette, 1984) and less encouraging towards engagement in sporting activities that require more adherence to particular outfits/ clothing than other communities. The present findings align with previous research suggesting that clothing has been identified as a barrier to PA within Afghans and seen as imbued with western cultural values for those residing in Afghanistan (Safi and Myers, 2021). Moreover, youth living in rural farm or urban environments generally have better access to sports facilities compared to rural desert youth. Moreover, these results are consistent with a range of previous studies in children and young people indicating associations between built environmental factors, PA participation and weight status (Rodriguez and Vogt, 2009, Saelens et al., 2012, Sallis et al., 2018, Clary et al., 2020, Arellana et al., 2020). Although the current findings contribute novelty and can be generalisable in other context of environments and cultures, it is important to note that inactivity and obesity prevalence are highly prevalent amongst demographic groups in Al-Ahsa. Therefore, future policies and interventions could target this populations in which the health risk is greatest, such as in rural desert youth.

CONCLUSION

This study provided an important insight into the influences of built environmental factors on Saudi adolescences PA levels and BMI between age groups and genders. To our knowledge, this is the first study assessing the association between built environment with PA and BMI in Saudi Arabia. Hence, findings support the generalisability of this study and the association between environmental factors with PA and BMI across other parts of Saudi Arabia and extending to the Western countries. Despite the novel results of geographical locations and its association on young people PA levels and BMI, this study is not with limitations. For instance, the approach of this study was pure quantitative, provided data about how much and where in terms of PA levels and BMI across environments. However, mixed methods approach of quantitative and qualitative would have provided further insight into challenges young people are facing in their geographical areas as qualitative approach provide an insight into why and how (Emadian and Thompson, 2017, Hill-Mey et al., 2013). This study also provides foundation of knowledge for future research to build upon and investigate factors such as the impact of time spent sedentary on health behaviours of this population.

INSTITUTIONAL REVIEW BOARD STATEMENT

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethical Review Board of King Faisal University (KFU-REC-2022-APR-EA000564).

ETHICS AND CONSENT

Written Consent was obtained from all subjects involved in this study.

ACKNOWLEDGEMENTS

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia under the annual research project (GRANT511). The authors are grateful to participants for taking part in this study.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Conceptualization, A.A., and S.A.; methodology, A.A., and S.A.; software, A.A., and S.A.; validation, A.A., and S.A.; formal analysis, A.A.; investigation, A.A., and S.A.; resources, A.A., and S.A.; data curation, A.A.; writing—original draft preparation, A.A.; writing—review and editing, A.A., and S.A.; visualization, A.A., and S.A.; supervision, A.A., and S.A.; project administration A.A., and S.A. All authors have read and agreed to the published version of the manuscript.

AUTHOR AFFILIATIONS

Anwar Al-Nuaim
1Physical Education Department, Education College, King Faisal University, SA
Ayazullah Safi orcid.org/0000-0003-0963-8353
Centre for Nutraceuticals, School of Life Sciences, University of Westminster, London, GB

REFERENCES

Al Hazzaa, H. (2004). Prevalence of physical inactivity in Saudi Arabia: a brief review. *EMHJ-Eastern Mediterranean Health Journal, 10*(4–5), 663–670. DOI: https://doi.org/10.26719/2004.10.4-5.663

Al-Hazzaa, H. M. (2007). Pedometer-determined physical activity among obese and non-obese 8-to 12-year-old Saudi schoolboys. *Journal of physiological anthropology, 26*, 459–465. DOI: https://doi.org/10.2114/jpa2.26.459

Al-Hazzaa, H. M., Abahussain, N. A., Al-Sobayel, H. I., Qahwaji, D. M., & **Musaiger, A. O.** (2011). Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *International Journal of Behavioral Nutrition and Physical Activity, 8*, 1–14. DOI: https://doi.org/10.1186/1479-5868-8-140

Al-Hazzaa, H. M., & **Al-Rasheedi, A. A.** (2007). Adiposity and physical activity levels among preschool children in Jeddah, Saudi Arabia. *Saudi medical journal, 28*, 766.

Al-Nakeeb, Y., Lyons, M., Collins, P., Al-Nuaim, A., Al-Hazzaa, H., Duncan, M. J., & **Nevill, A.** (2012). Obesity, physical activity and sedentary behavior amongst British and Saudi youth: A cross-cultural study. *International journal of environmental research and public health, 9*, 1490–1506. DOI: https://doi.org/10.3390/ijerph9041490

Al-Nuaim, A. R. (1997). Population-based epidemiological study of the prevalence of overweight and obesity in Saudi Arabia, regional variation. *Annals of Saudi Medicine, 17*, 195–199. DOI: https://doi.org/10.5144/0256-4947.1997.195

Al Qauhiz, N. M. (2010). Obesity among Saudi Female University Students: Dietary Habits and Health Behaviors. *The Journal of the Egyptian Public Health Association, 85*, 45–59.

Alhyas, L., Mckay, A., Balasanthiran, A., & **Majeed, A.** (2011). Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the Gulf: systematic review. *JRSM short reports, 2*, 1–16. DOI: https://doi.org/10.1258/shorts.2011.011019

Almaqhawi, A. (2021). Perceived barriers and facilitators of physical activity among Saudi Arabian females living in the East Midlands. *Journal of Taibah University Medical Sciences*. DOI: https://doi.org/10.1016/j.jtumed.2021.11.002

Amin, T. T., Al-Sultan, A. I., & **Ali, A.** (2008). Overweight and obesity and their relation to dietary habits and socio-demographic characteristics among male primary school children in Al-Hassa, Kingdom of Saudi Arabia. *European journal of nutrition, 47*, 310–318. DOI: https://doi.org/10.1007/s00394-008-0727-6

Arellana, J., Saltarín, M., Larrañaga, A. M., Alvarez, V., & **Henao, C. A.** (2020). Urban walkability considering pedestrians' perceptions of the built environment: a 10-year review and a case study in a medium-sized city in Latin America. *Transport reviews, 40*, 183–203. DOI: https://doi.org/10.1080/01441647.2019.1703842

Bassett, D. R., Jr., Ainsworth, B. E., Leggett, S. R., Mathien, C. A., Main, J. A., Hunter, D. C., & **Duncan, G. E.** (1996). Accuracy of five electronic pedometers for measuring distance walked. *Medicine and science in sports and exercise, 28*, 1071–1077. DOI: https://doi.org/10.1097/00005768-199608000-00019

Casey, R., Oppert, J.-M., Weber, C., Charreire, H., Salze, P., Badariotti, D., Banos, A., Fischler, C., Hernandez, C. G., & **Chaix, B.** (2014). Determinants of childhood obesity: what can we learn from built environment studies? *Food Quality and Preference, 31*, 164–172. DOI: https://doi.org/10.1016/j.foodqual.2011.06.003

Clary, C., Lewis, D., Limb, E. S., Nightingale, C. M., Ram, B., Rudnicka, A. R., Procter, D., Page, A. S., Cooper, A. R., & **Ellaway, A.** (2020). Weekend and weekday associations between the residential built environment and physical activity: Findings from the ENABLE London study. *PloS one, 15*, e0237323. DOI: https://doi.org/10.1371/journal.pone.0237323

Cole, T. J. (2000). Secular trends in growth. *Proceedings of the Nutrition Society, 59*, 317–324. DOI: https://doi.org/10.1017/S0029665100000355

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., & **Sallis, J. F.** (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & science in sports & exercise, 35*, 1381–1395. DOI: https://doi.org/10.1249/01.MSS.0000078924.61453.FB

Crouter, S. E., Schneider, P. L., & **Bassett, D. R., Jr.** (2005). Spring-levered versus piezo-electric pedometer accuracy in overweight and obese adults. *Medicine and science in sports and exercise, 37*, 1673–1679. DOI: https://doi.org/10.1249/01.mss.0000181677.36658.a8

El Mouzan, M. I., Foster, P. J., Al Herbish, A. S., Al Salloum, A. A., Al Omer, A. A., Qurachi, M. M., & **Kecojevic, T.** (2010). Prevalence of overweight and obesity in Saudi children and adolescents. *Annals of Saudi medicine, 30*, 203–208. DOI: https://doi.org/10.4103/0256-4947.62833

Emadian, A., & **Thompson, J.** (2017). A Mixed-Methods Examination of Physical Activity and Sedentary Time in Overweight and Obese South Asian Men Living in the United Kingdom. *International journal of environmental research and public health, 14*, 348. DOI: https://doi.org/10.3390/ijerph14040348

Guo, Z., & **Zhang, Y.** (2022). Study on the Interactive Factors between Physical Exercise and Mental Health Promotion of Teenagers. *Journal of Healthcare Engineering*. DOI: https://doi.org/10.1155/2022/4750133

Gustafson, S. L., & **Rhodes, R. E.** (2006). Parental correlates of physical activity in children and early adolescents. *Sports medicine, 36*, 79–97. DOI: https://doi.org/10.2165/00007256-200636010-00006

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & **Group, L. P. A. S. W.** (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The lancet, 380*, 247–257. DOI: https://doi.org/10.1016/S0140-6736(12)60646-1

Hayball, F. Z., & **Pawlowski, C. S.** (2018). Using participatory approaches with children to better understand their physical activity behaviour. *Health Education Journal, 77*, 542–554. DOI: https://doi.org/10.1177/0017896918759567

Hill-Mey, P. E., Merrill, R. M., Kumpfer, K. L., Reel, J., & **Hyatt-Neville, B.** (2013). A focus group assessment to determine motivations, barriers and effectiveness of a university-based worksite wellness program. *Health promotion perspectives, 3*, 154.

Howell, N. A., & **Booth, G. L.** (2022). The weight of place: Built environment correlates of obesity and diabetes. *Endocrine Reviews*. DOI: https://doi.org/10.1210/endrev/bnac005

Huyette, S. S. (1984). *Political Adaptation In Sa'udi Arabia: A Study Of The Council Of Ministers (Development, Modernization, Saudi Arabia)*. Columbia University.

Inoue, S., Murase, N., Shimomitsu, T., Ohya, Y., Odagiri, Y., Takamiya, T., Ishii, K., Katsumura, T., & **Sallis, J. F.** (2009). Association of physical activity and neighborhood environment among Japanese adults. *Preventive medicine, 48*, 321–325. DOI: https://doi.org/10.1016/j.ypmed.2009.01.014

Jakicic, J. M., Berkowitz, R. I., Bolin, P., Bray, G. A., Clark, J. M., Coday, M., Egan, C., Evans, M., Foreyt, J. P., & **Fulton, J. E.** (2022). Association Between Change in Accelerometer-Measured and Self-Reported Physical Activity and Cardiovascular Disease in the Look AHEAD Trial. *Diabetes Care*.

Kaczynski, A. T., Potwarka, L. R., & **Saelens, B. E.** (2008). Association of park size, distance, and features with physical activity in neighborhood parks. *American journal of public health, 98*, 1451–1456. DOI: https://doi.org/10.2105/AJPH.2007.129064

Larson, N. I., Story, M. T., & **Nelson, M. C.** (2009). Neighborhood environments: disparities in access to healthy foods in the US. *American journal of preventive medicine, 36*, 74–81. e10. DOI: https://doi.org/10.1016/j.amepre.2008.09.025

Liu, Q., Huang, K., Liang, F., Yang, X., Li, J., Chen, J., Liu, X., Cao, J., Shen, C., & **YU, L.** (2022). Long-term exposure to fine particulate matter modifies the association between physical activity and hypertension incidence. *Journal of Sport and Health Science*. DOI: https://doi.org/10.1016/j.jshs.2022.01.004

Mccrorie, P., Mitchell, R., Macdonald, L., Jones, A., Coombes, E., Schipperijn, J., & **Ellaway, A.** (2020). The relationship between living in urban and rural areas of Scotland and children's physical activity and sedentary levels: A country-wide cross-sectional analysis. *BMC public health, 20*, 1–11. DOI: https://doi.org/10.1186/s12889-020-8311-y

Norman, G. J., Nutter, S. K., Ryan, S., Sallis, J. F., Calfas, K. J., & **Patrick, K.** (2006). Community design and access to recreational facilities as correlates of adolescent physical activity and body-mass index. *Journal of physical activity and health, 3*, S118–S128. DOI: https://doi.org/10.1123/jpah.3.s1.s118

Parker, A. G., Trott, E., Bourke, M., Klepac Pogrmilovic, B., Dadswell, K., Craike, M., Mclean, S. A., Dash, S., & **Pascoe, M.** 2021. Young people's attitudes towards integrating physical activity as part of mental health treatment: A crosssectional study in youth mental health services. *Early intervention in psychiatry*. DOI: https://doi.org/10.1111/eip.13189

Rodriguez, A., & **Vogt, C. A.** (2009). Demographic, environmental, access, and attitude factors that influence walking to school by elementary schoolaged children. *Journal of School Health, 79*, 255–261. DOI: https://doi.org/10.1111/j.1746-1561.2009.00407.x

Saelens, B. E., Sallis, J. F., Frank, L. D., Cain, K. L., Conway, T. L., Chapman, J. E., Slymen, D. J., & **Kerr, J.** (2012). Neighborhood environment and psychosocial correlates of adults' physical activity. *Medicine and science in sports and exercise, 44*, 637–646. DOI: https://doi.org/10.1249/MSS.0b013e318237fe18

Safi, A., Cole, M., Kelly, A. L., Deb, S., & **Walker, N. C.** (2022). A Comparison of Physical Activity and Sedentary Lifestyle of University Employees through ActiGraph and IPAQ-LF. *Physical Activity and Health, 6*, 5–15. DOI: https://doi.org/10.5334/paah.163

Safi, A., & **Myers, T. D.** (2021). Barriers to Physical Activity: A Comparison of Afghans Living in the UK and Afghanistan. *Advances in Physical Education, 11*, 103–117. DOI: https://doi.org/10.4236/ape.2021.111008

Sallis, J. F., Conway, T. L., Cain, K. L., Carlson, J. A., Frank, L. D., Kerr, J., Glanz, K., Chapman, J. E., & **Saelens, B. E.** (2018). Neighborhood built environment and socioeconomic status in relation to physical activity, sedentary behavior, and weight status of adolescents. *Preventive medicine, 110*, 47–54. DOI: https://doi.org/10.1016/j.ypmed.2018.02.009

Sandercock, G., Angus, C., & **Barton, J.** (2010). Physical activity levels of children living in different built environments. *Preventive Medicine, 50*, 193–198. DOI: https://doi.org/10.1016/j.ypmed.2010.01.005

Schneider, P. L., Crouter, S. E., & **Bassett, D. R.** (2004). Pedometer measures of free-living physical activity: comparison of 13 models. *Medicine and science in sports and exercise, 36*, 331–335. DOI: https://doi.org/10.1249/01.MSS.0000113486.60548.E9

Sharara, E., Akik, C., Ghattas, H., & **Obermeyer, C. M.** (2018). Physical inactivity, gender and culture in Arab countries: a systematic assessment of the literature. *BMC public health, 18*, 1–19. DOI: https://doi.org/10.1186/s12889-018-5472-z

Simen-Kapeu, A., Kuhle, S., & **Veugelers, P. J.** (2010). Geographic differences in childhood overweight, physical activity, nutrition and neighbourhood facilities: implications for prevention. *Canadian Journal of Public Health, 101*, 128–132. DOI: https://doi.org/10.1007/BF03404357

Teo, K. K., & **Rafiq, T.** (2021). Cardiovascular risk factors and prevention: a perspective from developing countries. *Canadian Journal of Cardiology, 37*, 733–743. DOI: https://doi.org/10.1016/j.cjca.2021.02.009

Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., & **Sirard, J.** (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine and science in sports and exercise, 34*, 350–355. DOI: https://doi.org/10.1097/00005768-200202000-00025

Tudor-Locke, C., Burkett, L., Reis, J., Ainsworth, B., Macera, C., & **Wilson, D.** (2005). How many days of pedometer monitoring predict weekly physical activity in adults? *Preventive medicine, 40*, 293–298. DOI: https://doi.org/10.1016/j.ypmed.2004.06.003

Vincent, S. D., & **Pangrazi, R. P.** (2002). An examination of the activity patterns of elementary school children. *Pediatric Exercise Science, 14*, 432–441. DOI: https://doi.org/10.1123/pes.14.4.432

TO CITE THIS ARTICLE:
Al-Nuaim, A., & Safi, A. (2022). The Impact of Environment on Physical Activity Levels and Obesity among Saudi Arabia Youth: Comparison of Urban; Rural Farm and Rural Desert Geographical Locations. *Physical Activity and Health*, 6(1), pp. 86–95. DOI: https://doi.org/10.5334/paah.188

Submitted: 05 May 2022
Accepted: 28 May 2022
Published: 15 June 2022

Physical Activity and Health is a peer-reviewed open access journal published by Ubiquity Press.