



## EVALUATION OF PREVALENCE OF OBESITY-RELATED RISK FACTORS AMONG ADOLESCENT STUDENTS AT MAKKAH IN SAUDI ARABIA 2022

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### Abstract

#### Background

Obesity is a major international disaster health problem that leads to increasing the risk of several chronic complications occurrence. The present study aiming to Evaluation of prevalence of obesity-related risk factors among adolescent students at Makkah in Saudi Arabia 2022. The prevalence of obesity is increasing rapidly worldwide.1 This may leads to of heart disease and other chronic diseases including hyperlipidemia, hyper-insulinaemia, hypertension, and early atherosclerosis. The adolescent students, including secondary school students are in a high risk side when obesity is concerned. This is mainly because of the modernization and industrialization which has led to sedentary life style and unhealthy eating pattern. The issue of being overweight and obese is becoming an increasingly prevalent problem in both the developed and developing world, and it is one of the most serious public health challenges of the 21st century .

**The study aimed:** To evaluation of prevalence of obesity-related risk factors among adolescent students at Makkah in Saudi Arabia 2022.

**Method:** Cross-sectional survey was utilized adolescent students in Makkah Al-Mukarramah in Saudi Arabia 2022 during the November to December, 2022, a total of 200 student aged 12–18 years, available adolescent students. A structured self-reported questionnaire sheet was used To evaluation of prevalence of obesity-related risk factors among adolescent students at Makkah in Saudi Arabia 2022

**Result:** show the total number of participants was 200 more than half of the participants (69.0%) answer No practice Physical activities or exercise physical, regarding If yes What is type of physical activities or exercises the majority of the participants running were (48.72%), regarding you stop aerobic exercise for two consecutive days or more per week the majority of the participants always were (71.79%). Regarding Risk factor the majority of the participant's High blood pressure were (31.0%).

**Conclusion:** The measurement of obesity using guideline shows a definite increase in prevalence of obesity among adolescent students. Reinforcing the need to encourage healthy lifestyle, healthy food habits and a physically active daily routine, among the adolescents, including secondary school need to be focused to prevent this obesity related disease epidemic.

**Keywords:** Evaluation, prevalence, obesity, risk, factors, adolescent, students, Saudi Arabia, Makkah.

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## Introduction

Adolescent obesity is associated with several health problems such as high blood pressure, high cholesterol, breathing problems, impaired glucose tolerance, joint problems, and fatty liver disease [1]. Additionally, adolescents with obesity can suffer psychological issues such as depression; anxiety; and poor self-esteem, body image, and peer relationships [2]. Obesity threatens the healthy growth of adolescents and lowers their quality of life [3]. Moreover, adolescent obesity is associated with the risk of adult obesity, cardiovascular morbidity, and mortality [4]. Thus, adolescent obesity can be considered an important public health issue [5].

In the Saudi Arabia, the prevalence of obesity among adolescents aged 12–19 years increased from 5% in 1980 to nearly 21% in 2012 [6]. In Saudi Arabia, several local and national reports have shown a similar problem, with the prevalence of overweight and obesity among adolescent children ranging between 30% and 46% [7]. As childhood obesity is likely to continue into adulthood, it puts the affected children at higher risk of obesity-related disorders such as diabetes and cardiovascular, respiratory, gastrointestinal and or the obesity diseases at a younger age [8]

Obesity, which is defined as the condition of excessive fat in the body, has significant health consequences. It is the result of undesirable weight gain caused when people consume more energy than they expend [9]. The explanation of the primary cause of being overweight and obese is not clear in adolescents, although dietary, genetic, and physical activity patterns must be important factors [10]. It is seen as a problem associated with adulthood; obesity during childhood is also becoming a concern. However, childhood obesity is an important public health issue with increasing prevalence and important consequences (comorbidities of obesity in childhood include type 2 diabetes, hypertension, dyslipidemia, emotional and behavioral problems, asthma, and sleep apnea) [11]

The prevalence of Obesity is common in KSA, so there is a need to explore 'awareness of Obesity in the primary care physicians in Makkah toward management of Obesity'. So that policymakers can devise policies to educate the young generation [12]

The prevalence of Obesity in various regions has attracted significant attention of the medical experts, also thereby increasing disease the prevalence of diabetes and Obesity is expected to increase in the future due to changes in lifestyle and unhealthy diets of individuals in KSA [13]

According to a study of obesity and eating habits, it was found that there is a rapid socio-cultural change as a result of the growing economy of the Saudi Arabia. This has affected the eating patterns and thus it has been reported for the recent increases in overweight and obesity among Saudi population. [14] Another important factor in obesity is psychological stress such as life in adolescent period. [15] adolescent period can play a significant role in encouraging healthy behavior in students. Unhealthy lifestyle is prevalent among school students and therefore there is a need to integrate health education programs for school students. [16]

## Literature Review

The results of one study in the US showed that physicians' knowledge in the treatment of Obesity was not enough and knowledge level of different medical groups such as general practitioners, specialists, internal medicine residents and medical students had significant differences with each other [17]

Several studies on obesity trends in the 2000s have shown increasing rates of obesity among adolescents [18]. In particular, the prevalence of obesity among Korean adolescents increased from 10.7% in 2006 to 12.2% in 2012–2015; the increase was higher for boys than girls [19]. However, recent studies have supported the decreasing or stabilizing trends of adolescent obesity prevalence in some developed countries [20] and European countries [21]. Since the trends in obesity prevalence can change and differ from country to country and time to time, we need more information on the time trends of obesity among Saudi Arabia adolescents to establish public health policies and intervention strategies for timely obesity management. Many previous studies have reported the relationship between obesity and its risk factors [22] and trends in the prevalence of obesity however, few studies have been conducted to identify trends in obesity-related risk factors, such as physical activity and dietary behavior, along with trends in obesity prevalence. [23]. Despite the high prevalence of childhood/adolescent obesity and the importance of academic performance of high-school students in shaping their future education [24], there has been a lack of studies of the association between overweight/obesity and academic performance among Saudi Arabian students. The objective of the current study was to assessment of prevalence and factors associated with obesity among secondary school students at Makkah in Saudi Arabia 2022. In Aseer region, Al-shahrani and Al-khalidi (2013) estimated the prevalence of obesity among 14,252

diabetic patients attended PHC centers . The prevalence of obesity among diabetic patients was 46%. About half of the diabetics had poor diabetic control, with significant association with obesity [25]

#### **Rationale:**

Obesity is getting to be a more prevalent disease all over the world.1-3 It is estimated that there are nearly 250 million obese and overweight persons in the world. In the last 3 decades, the prevalence of adolescent students obesity has risen to as high as in developed countries such as the Saudi Arabia, With the changes in major lifestyles, the prevalence of obesity is increasing among adolescent students and secondary school students therefore, this issue implicated to complicate the outcome, well -being and productivity. Improved quality of life has been regarded as a key goal of all healthcare interventions including a special interest in obesity and its related complication, particularly in type II diabetic patient's obesity and affected to diabetes mellitus management. Up to the researcher's knowledge the prevalence of obesity is increasing.

#### **The study aimed**

To evaluation of prevalence of obesity-related risk factors among adolescent students at Makkah in Saudi Arabia 2022 .

#### **Methodology**

##### **Study design:**

Cross-sectional design in the present study

##### **Study area and population:**

Adolescent student's obesity in the secondary school students who registered in primary health care center and schools in Makkah

##### **Inclusion criteria**

- Adolescent student's obesity.
- Both males and females.

##### **Sample size:**

Sample size was calculator by Raosoft Online sample size calculator It was 200 Adolescent student's obesity, based on assumption that during the last 4 weeks, the total number of diabetic patients who visited the primary health care center or schools in Makkah 200 patients, prevalence was considered as 50%, confidence level was 95%, margin of error was 5%. By adding 10% for defaulter and non-respondent, 200 students were invited to participate in the study.

##### **Sampling technique**

Systematic sampling technique was used. Approximately 20 patients visit the PHC center daily. Ten adolescent student's obesity were

selected daily by choosing every other student . Thus, nearly 14 working days were needed to collect the sample

##### **Data collection tool**

Self-administrated questionnaire was used for data collection. It was adopted from a previous Saudi study. Some modifications were done and the new format was validated by three consultants (family medicine, Endocrinology and community medicine). The final draft of the questionnaire consists of two sections:

-First section: Includes socio-demographic and personal characteristics of the participants.

-Second section: Includes associated factors with obesity (physical exercise, diet habit. Additionally, the body mass index (BMI) was calculated by an expert nurse.

##### **Data Collection technique**

- During the study period (during the November to December, 2022), the researcher was available at the involved conducted secondary school students
- The researcher distributed the questionnaire in the waiting area by themselves to the selected student.
- The questionnaires were collected at the same time.

##### **Data entry and analysis**

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS version 24). Categorical variables were presented as frequency and percentage whereas continuous variables were presented as mean and standard deviation ( $\pm$ SD).

Statistical significance was determined at  $p < 0.05$  for all comparisons.

##### **Pilot study/pretesting**

A pilot study was conducted on 20 patients, representing approximately 10% of the sample size. It was done in another school student at Makkah, rather than those involved in the study to test the clarity of the questions and feasibility of the methodology. No modifications were made according to the pilot results.

##### **Ethical considerations**

Research committee approval ,Written permission from the joint program of family medicine in Makkah , written permission from concerned school authority in Makkah Al-Mukarramah , Individual verbal consent from all participants before data collection Acknowledgments of all supervisors, advisors, helpers, facilitators and participants. All collected data were kept confidential.

**Budget:** Self-funded

## Results

**Table 1.** Distribution of Socio-demographic characteristics of the studied participated (Age, Gender, Marital status, Level of education)(n=200)

	N	%
<b>Age</b>		
<14	62	31
14-16	48	24
More than 16	90	45
<b>Sex</b>		
Male	74	37
Female	126	63
<b>Income level</b>		
Below 5000 SR	62	31
5000 – 10000 SR	48	24
10,000 – 20,000 SR	40	20
Above 20,000 SR	50	25
<b>Educational level</b>		
Intermediate school	132	66
Secondary school	68	34
<b>Sources of information about obesity</b>		
Booklets and brochures	62	31
Mass media	30	15
Own personal experience	44	22
Educational films	64	32

Table 1 show the total number of participants was 200 regarding the age most participants were classified into 3 age groups, most of them were (45.0%) in the more than 16 years regarding gender of participated female were (63.0%). Regarding Income level in study the most of participant's Below 5000 SR were (31.0%).

Regarding Educational level in study the most of participant's Intermediate school were (22.0%) regarding Sources of information about obesity most of participant's educational films were (32.0%)

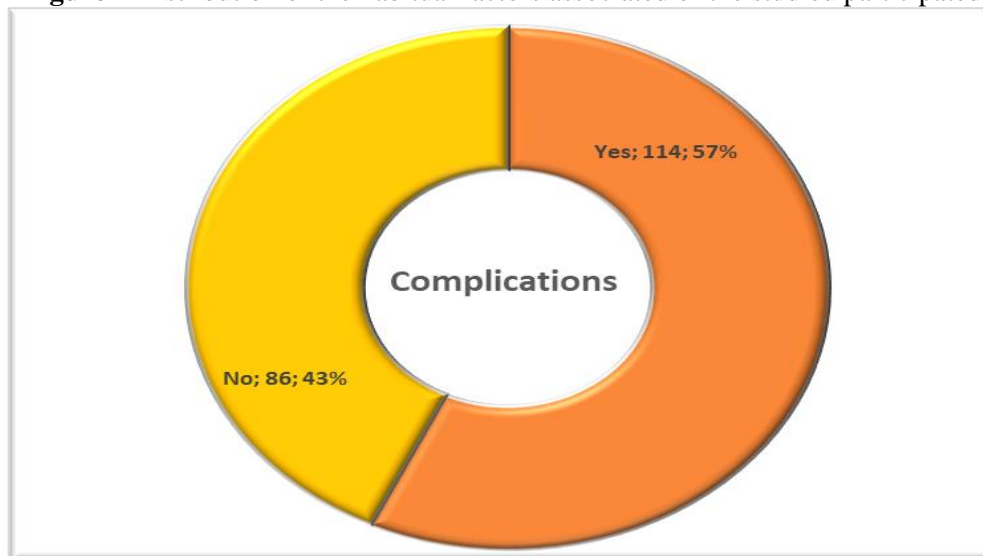
**Table 2** Distribution of the habitual factors associated of the studied participated

	N	%
<b>Do you have any complications from obesity?</b>		
Yes	114	57
No	86	43
<b>If you have any complication, please select it?</b>		
Complication on foot	39	34.21
Complication on eye	25	21.93
Complication on kidney	31	27.19
Cardiovascular complication	11	9.65
Neuropathy	8	7.02

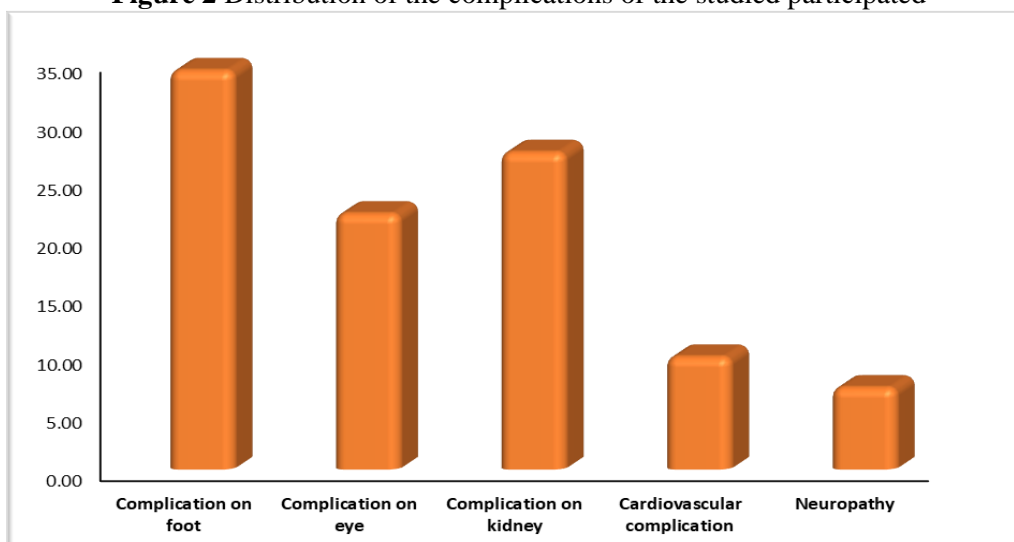
Table 2 show regarding do you have complications from obesity most of participants answer Yes (57.0%), follow by No were(43.0%) , regarding

have any complication, please select it most of participant Complication on foot were(34.21%) follow by kidney complication were (27.19%).

**Figure 1** Distribution of the habitual factors associated of the studied participated



**Figure 2** Distribution of the complications of the studied participated



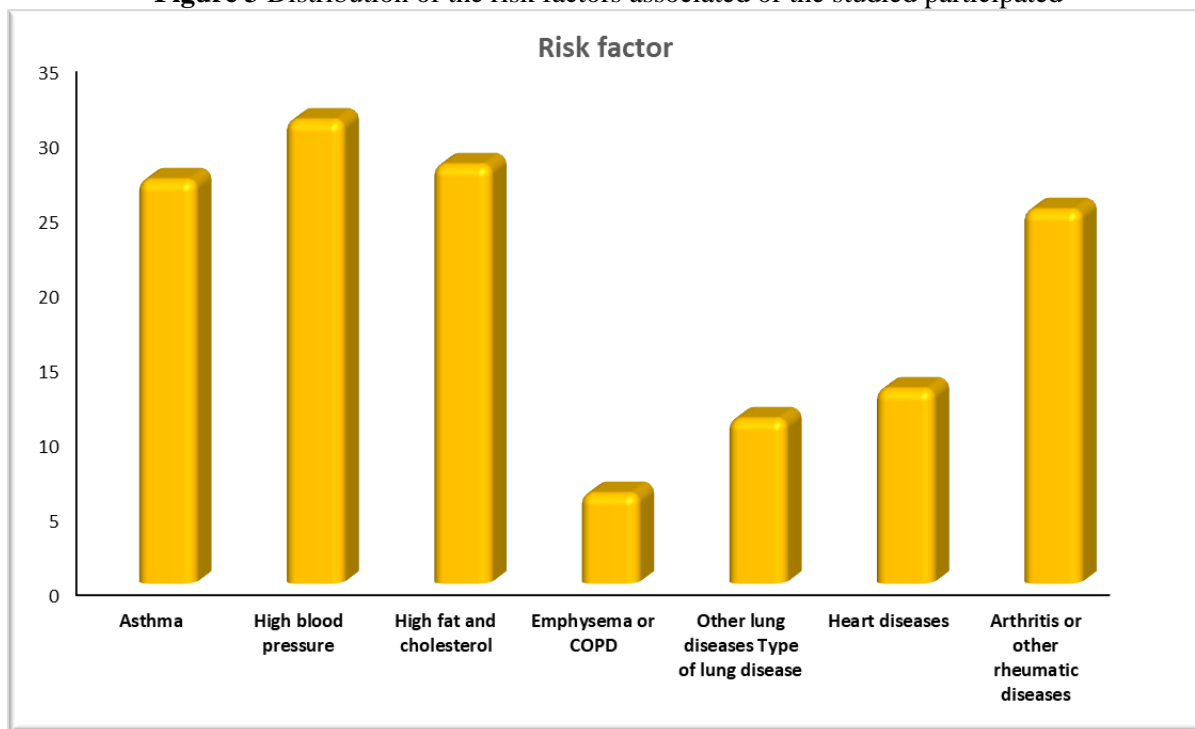
**Table 3** Distribution of the habitual factors (Physical activities) associated of the studied participated

	N	%
<b>Physical activities or exercises</b>		
No	122	69
Yes	78	31
<b>If yes What is type of physical activities or exercises</b>		
Walking	38	48.72
Running	18	23.08
Both	22	28.21
<b>Do you stop aerobic exercise for two consecutive days or more per week?</b>		
Always	56	71.79
Sometimes	12	15.38
No	10	12.82
<b>Risk factor</b>		
Asthma	54	27
High blood pressure	62	31
High fat and cholesterol	56	28
Emphysema or COPD	12	6
Other lung diseases Type of lung disease	22	11
Heart diseases	26	13
Arthritis or other rheumatic diseases	50	25

Table 3 show more than half of the participants (69.0%) answer No practice Physical activities or exercise physical , regarding If yes What is type of physical activities or exercises the majority of the participants running were (48.72%), regarding you

stop aerobic exercise for two consecutive days or more per week the majority of the participants always were (71.79%). Regarding Risk factor the majority of the participants High blood pressure were (31.0%).

**Figure 3** Distribution of the risk factors associated of the studied participated



## Discussion

This study identified the trends in adolescent obesity prevalence, dietary behaviors, and physical activity from 2022 using nationally representative sample data. First, the prevalence of obesity among adolescents doubled from in 2019, increasing significantly by on average annually. According to previous studies, the average obesity prevalence among Saudi Arabia has been increasing since 2019, showing a remarkable increase for boys [26]. The findings of this study indicate that the prevalence of obesity among adolescents in Saudi Arabia differs from that in some other developed countries, where studies have shown stable or decreasing obesity rates [27]. Studies analyzing the trends of obesity among Chinese adolescents between 2015 have shown a decline in obesity rates since 2011, unlike in Saudi Arabia.

Obesity and overweight are major public health problems among adolescents student, with significant health, demographic and socio-economic implications [28]. Food environments have changed in past decades and obesity and overweight rates have increased dramatically in both developing and developed countries . The present study To assessment of prevalence and factors associated with obesity among adolescents

school students at Makkah in Saudi Arabia 2021 . It also investigated the factors associated with overweight/obesity. The study established that overweight and obesity prevalence is high and linked with sedentary behavior, poor eating habits and limited dietary diversity.[25]

Overweight and obesity prevalence was lower than what has been reported in the literature. Although this prevalence was similar to that in other studies[29], it was higher than the rate among pre-school student participating in a cross-sectional study conducted in twenty-six African countries. Several others have shown that urban student, because of favorable environmental and socio-economic conditions, generally manifest better nutritional status than their rural counterparts [30]. A similar study among rural adolescent's school students will be necessary to confirm or refute this hypothesis in KSA. The anther survey found higher prevalence rates of overweight and obesity in girls than in boys, which concurs with other reports from low- and middle-income countries, but the opposite held true in high-income countries where overweight and obesity rates were higher in boys than in girls[30,31]. This observation might be related to cultural behavior's [31]. Differences in physical activity and energy expenditure between

boys and girls may also have contributed to the lower prevalence of overweight and obesity among boys. Differences in published data on prevalence may be explained by study design, population included and cut-offs defining overweight and obesity. Indeed, many cut-off values have been published; each method has its advantages and limitations, and should be used cautiously [32]

While overweight and obesity in adolescent's school students have definitely become a worldwide public health concern, malnutrition remains the greatest problem in developing countries [31]. Given the fact that severe underweight is almost always a sign of malnutrition we can assume that malnutrition persists in KSA, even in urban areas. In addition, some overweight/obese children may be malnourished as well.[33]

### Conclusion

Obesity prevention campaigns are considered to be successful through changes in environments such as schools, especially if they occur early in life. Thus, it is particularly relevant to identify the factors associated with overweight and adolescent students and in secondary -school populations in the specific context settings in KSA country. Findings on dietary diversity in the indicated that many school adolescent students had diets with little variety, as disclosed by the fact that one-third of them consumed fewer than four food groups daily. The most neglected food groups were dairy products, tubers, eggs, fruits, meats and vegetables, as reported in other investigations.

### References

1. Tanaka, M. (2020). Improving obesity and blood pressure. *Hypertension Research*, 43(2), 79-89.
2. Sethna, C. B., Alanko, D., Wirth, M. D., Shivappa, N., Hebert, J. R., Khan, S., & Sen, S. (2021). Dietary inflammation and cardiometabolic health in adolescents. *Pediatric Obesity*, 16(2), e12706.
3. Martland, R., Mondelli, V., Gaughran, F., & Stubbs, B. (2020). Can high-intensity interval training improve physical and mental health outcomes? A meta-review of 33 systematic reviews across the lifespan. *Journal of sports sciences*, 38(4), 430-469.
4. Delvecchio, M., Pastore, C., Valente, F., & Giordano, P. (2020). Cardiovascular implications in idiopathic and syndromic obesity in childhood: an update. *Frontiers in endocrinology*, 11, 330.
5. Azemati, B., Kelishadi, R., Ahadi, Z., Shafiee, G., Taheri, M., Ziaodini, H., ... & Heshmat, R. (2020). Association between junk food consumption and cardiometabolic risk factors in a national sample of Iranian children and adolescents population: the CASPIAN-V study. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 25(2), 329-335.
6. Al Shaikh, A., Aseri, K., Farahat, F., Abaalkhail, B. A., Kaddam, I., Salih, Y., ... & Tamimi, W. (2020). Prevalence of obesity and overweight among school-aged children in Saudi Arabia and its association with vitamin D status. *Acta Bio Medica: Atenei Parmensis*, 91(4).
7. Al-Hazzaa, H. M. (2018). Physical inactivity in Saudi Arabia revisited: A systematic review of inactivity prevalence and perceived barriers to active living. *International journal of health sciences*, 12(6), 50.
8. Wang, H. H., Lee, D. K., Liu, M., Portincasa, P., & Wang, D. Q. (2020). Novel insights into the pathogenesis and management of the metabolic syndrome.
9. Falkner, B. (2020). Maternal and gestational influences on childhood blood pressure. *Pediatric Nephrology*, 35(8), 1409-1418.
10. Caprio, S., Santoro, N., & Weiss, R. (2020). Childhood obesity and the associated rise in cardiometabolic complications. *Nature Metabolism*, 2(3), 223-232.
11. Kongtip, P., Nankongnab, N., Kallayanatham, N., Pundee, R., Yimsabai, J., & Woskie, S. (2020). Longitudinal study of metabolic biomarkers among conventional and organic farmers in Thailand. *International journal of environmental research and public health*, 17(11), 4178.
12. Alshareef, M. N. S., Alharbi, S. S., Alshantay, H. M. A., Al-Shareef, H. M., Albeladi, B. H., Alwafi, A. M., ... & Al-Sharif, A. A. A. (2021). Assessment Prevalence of the Obesity and Effected in Type 2 Diabetes and Obesity-Related Risk Factors on Patients Attending in Primary Health Care Center in Makkah Al-Mokarramah 2021. *Annals of the Romanian Society for Cell Biology*, 25(6), 21343-21358.
13. Tashkandi, M. A., Almalki, M. A., Alhazmi, A. A., Alotaibi, K. S., Al-Harbi, W. M., Khairullah, F. A., ... & Al, A. A. (2021). Assessment of Prevalence and Factors Associated with Obesity among Secondary School Students at Makkah in Saudi Arabia 2021. *Annals of the Romanian Society for Cell Biology*, 25(7), 2284-2294.

14. Esawi, H. H., Al Hazmi, M. A., Alshareef, T. N. S., Al Muzaini, M. S., Bassuoni, A. M., Alhawsawi, H. M., ... & Moh, W. (2021). Assessment of Knowledge, Attitudes, and Practices of Primary Care Physicians in Makkah 2021 at Saudi Arabia toward Management of Type 2 DM in RAMADAN. *Annals of the Romanian Society for Cell Biology*, 25(7), 2259-2273.
15. Alluhaybi, H. F., Mutwalli, A., Alsharif, H., Koshak, N., & ALalwani, A. (2021). Assessment of Knowledge, Attitudes, and Practices of Type 2 Diabetes Patients about Physical Activity Attending in Primary Health Care Center in Makkah Al-Mokarramah in Saudi Arabia 2021. *Annals of the Romanian Society for Cell Biology*, 25(7), 2186-2205.
16. Aljohani, D. A. E., Atoodi, A. A., Algorashi, S. M., Almalki, A. E. M., Filfilan, O. J., Bukhari, A. A. A., ... & Salem, F. THE EFFECT OF OBESITY AND ITS ASSOCIATED RISK FACTORS ON PATIENTS WITH TYPE 2 DIABETES WHO ATTEND IN PRIMARY HEALTH CARE CENTER IN MAKKAH AL-MOKARRAMAH 2021.
17. Zelenytė, V., Valius, L., Domeikienė, A., Gudaitytė, R., Endzinas, Ž., Šumskas, L., & Maleckas, A. (2021). Body size perception, knowledge about obesity and factors associated with lifestyle change among patients, health care professionals and public health experts. *BMC Family Practice*, 22(1), 1-13.
18. Ogden, C. L., Fryar, C. D., Martin, C. B., Freedman, D. S., Carroll, M. D., Gu, Q., & Hales, C. M. (2020). Trends in obesity prevalence by race and Hispanic origin—1999-2000 to 2017-2018. *Jama*, 324(12), 1208-1210.
19. Park, E., & Ko, Y. (2022). Trends in Obesity and Obesity-Related Risk Factors among Adolescents in Korea from 2009 to 2019. *International Journal of Environmental Research and Public Health*, 19(9), 5672.
20. Albaladejo-Vicente, R., Villanueva-Orbaiz, R., Carabantes-Alarcon, D., Santos-Sancho, J., Jiménez-García, R., & Regidor, E. (2021). Reversal of the Upward Trend of Obesity in Boys, but Not in Girls, in Spain. *International journal of environmental research and public health*, 18(4), 1842.
21. Breda, J., Farrugia Sant'Angelo, V., Duleva, V., Galeone, D., Heinen, M. M., Kelleher, C. C., ... & McColl, K. (2021). Mobilizing governments and society to combat obesity: Reflections on how data from the WHO European Childhood Obesity Surveillance Initiative are helping to drive policy progress. *Obesity Reviews*, 22, e13217.
22. Mahumud, R. A., Sahle, B. W., Owusu-Addo, E., Chen, W., Morton, R. L., & Renzaho, A. (2021). Association of dietary intake, physical activity, and sedentary behaviours with overweight and obesity among 282,213 adolescents in 89 low and middle income to high-income countries. *International Journal of Obesity*, 45(11), 2404-2418.
23. Al Busaidi, N., Shanmugam, P., & Manoharan, D. (2019). Diabetes in the Middle East: government health care policies and strategies that address the growing diabetes prevalence in the Middle East. *Current diabetes reports*, 19(2), 1-10.
24. Hazazi, A., & Wilson, A. (2022). Noncommunicable diseases and health system responses in Saudi Arabia: focus on policies and strategies. A qualitative study. *Health Research Policy and Systems*, 20(1), 1-10.
25. Al-sharafi BA, Gunaid AA. Prevalence of obesity in patients with type 2 diabetes mellitus in Yemen. *Int J Endocrinol Metab*. 2014;12(2):1-5
26. Heo, S., Kwon, S., Lee, Y. M., Shin, J. Y., & Lee, D. H. (2020). Comparison of trends in blood pressure and the prevalence of obesity among Korean and American adolescents: a 12-years cross-sectional study. *Journal of Preventive Medicine and Public Health*, 53(1), 45-55.
27. Alturki, H. A., Brookes, D. S., & Davies, P. S. (2020). Does spending more time on electronic screen devices determine the weight outcomes in obese and normal weight Saudi Arabian children?. *Saudi Medical Journal*, 41(1), 79.
28. Tadesse, Y., Derso, T., Alene, K. A., & Wassie, M. M. (2017). Prevalence and factors associated with overweight and obesity among private kindergarten school children in Bahirdar Town, Northwest Ethiopia: cross-sectional study. *BMC research notes*, 10(1), 1-6.
29. Alzaman, N., & Ali, A. (2016). Obesity and diabetes mellitus in the Arab world. *Journal of Taibah University Medical Sciences*, 11(4), 301-309.
30. Wimalawansa, S. J. (2018). Associations of vitamin D with insulin resistance, obesity, type 2 diabetes, and metabolic syndrome. *The Journal of steroid biochemistry and molecular biology*, 175, 177-189
31. Diao, H., Wang, H., Yang, L., & Li, T. (2020). The impacts of multiple obesity-related interventions on quality of life in children and adolescents: a randomized controlled



- trial. *Health and quality of life outcomes*, 18(1), 1-9.
32. Diendéré, J., Kaboré, J., Somé, J. W., Tougri, G., Zeba, A. N., & Tinto, H. (2019). Prevalence and factors associated with overweight and obesity among rural and urban women in Burkina Faso. *The Pan African Medical Journal*, 34.
33. Gomes, F., Bergeron, G., Bourassa, M. W., & Fischer, P. R. (2021). Thiamine deficiency unrelated to alcohol consumption in high-income countries: a literature review. *Annals of the New York Academy of Sciences*, 1498(1), 46-56.