

Research



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Prevalence and risk factors associated with overweight and obesity in adolescents aged 13 to 20 years: a multivariate analysis

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Abstract

Introduction: this study aimed to assess the prevalence, and risk factors associated with overweight and obesity among adolescents in secondary schools in Ajman, United Arab Emirates (UAE). **Methods:** a population-based cross-sectional analysis was conducted between 2021 and 2023. Adolescents aged 13-20 years underwent anthropometric measurements. A multi-stage cluster sampling method was used to

randomly select 2000 adolescents. The prevalence of overweight/obesity was determined based on body mass index cutoff values, adjusted for age and sex, and, analyzed using poisson regression through multivariate analysis. The odds ratio and its confidence interval were calculated to determine the strength of the link. **Results:** the results showed that the prevalence of overweight/obesity was 22.95% and 5.35%, respectively. The prevalence of overweight/obesity varied across age groups, with no discernible trend. The highest prevalence of overweight/obesity was observed in 19-20-year-olds. There is an association between overweight and obesity and certain factors such as having a family of four or fewer members, receiving a daily allowance of over 40 AEDs, having an overweight or obese parent, and watching more than three hours of television per day. However, no consistent associations were found between overweight and obesity in adolescents and their study/play time. Families with a monthly income equal to or greater than 20,000 AEDs or more were found to have a 2.31 times higher risk of obesity (95% CI: 1.09-4.43) of obesity. **Conclusion:** despite efforts to prevent obesogenic behaviors among adolescents, the high prevalence of overweight/obesity among adolescents is a cause for concern. More effective campaigns are needed to help them make healthier choices.

Introduction

Obesity is a major public health problem. It is the fifth leading cause of death worldwide. Obesity is a major lifestyle disease, leading to further health problems, and contributing to chronic diseases. The World Health Organization (WHO) has predicted that by 2030, 30% of deaths worldwide will be caused by lifestyle diseases, that are preventable with proper identification and treatment of associated risk factors and behavioral interventions [1]. This is why it is important to detect and diagnose obesities early. Obesity, as defined by WHO, refers to excess fat stored in the body that can affect health [2]. Over the past two

decades, obesity rates (defined by a body mass index <BMI> greater than 30 kg/m² in adults) have increased at an alarming rate in both developed and developing countries [3]. In 2014, there were 641 million adults with obesity, up from just 105 million in 1975 [4]. Overweight and obesity are linked to more deaths worldwide than underweight [5]. Obesity affects over 1 billion people worldwide: 650 million adults, 340 million adolescents, and 39 million children, and the numbers are on the rise. WHO predicts that by 2025, 167 million people will have impaired health due to overweight or obesity [6].

Factors contributing to excess adolescent weight gain include gender, birth weight, parental occupation, socioeconomic status, parental education level, parental BMI, types and amounts of foods and beverages consumed, level of physical activity, amount of time spent in sedentary behaviors such as watching television, using a computer, or talking and texting on the phone, and genetic predisposition [7]. There is a lack of studies that estimate the extent of obesity and the risk factors that are associated with it among adolescents in the Emirate of Ajman (UAE). Therefore, to estimate the prevalence of overweight/obesity and the risk factors associated with it in school adolescents between the ages of 13 and 20 years, this study was conducted. Finally, this study aims to assist policymakers in understanding the health implications of obesity among adolescents in secondary schools and to identify findings that can guide school and public health officials to further mitigate the threats and to effectively manage adolescent overweight/obesity.

Methods

Study design: this is a descriptive, cross-sectional survey that focused on a representative sample of students aged 13 to 20 years old. It was conducted over 16 months from October 2021 to January 2023. We used the STROBE cross-sectional reporting guidelines.

Population sampling: the population of the Ajman Emirate was 4.96% of the total population of UAE in 2022 [8]. About 13.26% of the Ajman Emirate population were adolescents between 13 and 20 years of age. To select the required sample size of adolescents, a multi-stage cluster sampling method was used, and the methodology was described in a published paper [9]. With parental consent, a total of 2000 participants were enrolled in the study. The study was completed in 16 months period from 1st October 2021 till 30th January 2023. Healthy adolescents both male and female aged 13-20 years attending private and government secondary schools selected from a list of 35 schools (16 public vs 19 private schools) provided by educational directorates. The sample size requirement was calculated based on an estimated prevalence of obesity of 0.5 and a tolerance margin of error of 0.1 [9]. In the presence of the researcher in the classroom, students were asked to complete the first part of the questionnaire. Information about school, age, and gender was collected.

Variables of interest

Anthropometrical measurements: anthropometrics data were collected as follows: Body weight (Kg) was measured (using a daily calibrated scale with an error ± 10 g error), height (cm) was assessed using daily pedometer calibration with SD (0.1 cm error), body mass index (weight/height², kg/m²), waist circumference (WC cm), hip circumference (HC cm), mid-upper arm circumference (MUAC, at the midpoint between the shoulder and elbow tips using a tape measure calibrated in centimeters), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), television watching/day (h), daily hours of study, daily playing hours, and daily allowance (pocket money) in Arabic Emirati Dirhams “AEDs” (Table 1). In addition, sociodemographic and other key characteristics were recorded in Table 2: gender (female or male), nationality (UAE national or non-UAE national), type of school (public or private), maternal employment (employed or unemployed), family monthly income in AEDs (≥ 20000 or <

20000), family size (≥ 4 or < 4 members), transportation to and from school (walking, bus, private car), daily television viewing (> 3 or ≤ 3 hours), daily study time (≤ 5 or > 5 hours), consumption of fresh fruits and vegetables (yes or no), and daily allowance as pocket money (≤ 40 or > 40 AEDs), maternal and paternal BMI (normal, overweight, obese). Body Mass Index (BMI), which is calculated by dividing your weight in kilograms by the square of your height in meters, was also calculated for parents based on self-reported weight and height. Overweight was defined as a BMI between 25 and 30 kg/m² and obesity as a BMI >30 kg/m². Other key measures were the amount of time spent in sedentary activities like watching television, using a computer, or making phone calls or text messages, how often the adolescents ate junk food, and how often they drank carbonated soft drinks. The detailed methodology used to measure anthropometrics was largely described in our previous published study in 2022 [9]. Measurements were recorded to within 0.5 cm [10]. The values for WHR and WHtR were calculated by dividing WC, HC and height. Overweight and obesity were defined for girls and boys between the ages of 13 and 20 years using the international BMI cutoffs developed by Cole *et al.* [11].

Statistical analysis: the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA, version 22.0) was used for the statistical analysis [12]. The chi-squared test and the t-test were used, where applicable. To identify risk factors that are associated with overweight/obesity, multivariate analysis was performed using binary logistic regression. Overweight and obesity (each categorized as a dichotomous variable) were the dependent outcome variables in the logistic models. In the forward likelihood ratio estimation models, all independent categorical covariates were tested, and the final models had significant predictors only when they were dichotomous. Only significant predictive variables were included in the final models. Statistical significance was

defined as a probability value of less than or equal to 0.05.

Ethical approval: this study was conducted under current ethical considerations and all investigations were according to the principle of Helsinki Declaration. The Ministry of Education of the United Arab Emirates approved the project, providing the list of secondary schools within the city of Ajman. The headmasters of the selected schools were contacted for their consent to be part of the study. Approval for the study was obtained from the National Ethics Committee and the UAE Ministry of Education.

Results

Descriptive characteristics of the study population: a total of 2000 adolescents were enrolled in the study (920 boys and 1080 girls). Aged between the ages of 13 and 20. The average age of boys was 16.5 and the average age of girls was 16. Approximately 30.0% of the boys were of UAE nationality. 70.0% were of non-UAE nationality. Only 28% of the mothers of adolescents were in employment and 72% were unemployed. Table 1 details the adolescent's daily habits, allowance, and anthropometric characteristics. Boys spent more time outdoors and in front of the TV than girls. They spent less time studying.

Anthropometry: the anthropometric measurements collected included weight, height, WC, HC, and MUAC. The means and standard deviations of descriptive characteristics and gender comparison are shown in Table 1. Boys weighed on average 71.65 kg and girls 59.51 kg. The mean height was 169.42 for boys and 156.37 for girls. Boys were heavier and taller than girls and had a larger waist circumference, smaller hip circumference, and smaller mid-upper arm circumference. Using independent samples t-test for BMI and HC, there were no significant differences between boys and girls. However,

significant differences were found for other continuous variables.

Prevalence of overweight and obesity in adolescents: of the total 2000 adolescents, only 3.60% were underweight and 68.10% were normal weight. However, among all participants, 22.95% were overweight and 5.35% were obese. As shown in Figure 1, the prevalence of underweight, overweight, and obesity worsened according to the age group, without a clear trend. The highest prevalence of overweight and obesity was among 19 to 20 year-olds. Table 2 shows the prevalence of overweight and obesity by socio-demographic characteristics. There were no statistically significant differences between girls and boys (P value for overweight was 0.91 and the P value for obesity was 0.82). The prevalence of overweight and obesity according to sociodemographic parameters is shown in Table 3.

Multivariate analysis of risk factors associated with being overweight or obese: we performed a multivariate logistic regression on the overall sample to estimate the odds ratios of risk factors associated with overweight/obesity. Risk factors that were significantly linked to being overweight in the multivariate analysis are shown in Table 4. Compared with those aged 13-14, those aged 18-19 (OR = 1.52; 95% CI 0.81-2.97) and those aged 19-20 (OR = 3.15; 95% CI 1.64-6.06) were more likely overweight. Female adolescents had a higher (odds) of being overweight (OR = 1.3). Significantly associated with an increase in the odds of being overweight were several family members ≤ 4 , adolescents a daily allowance > 40 AEDs, having a mother or father who is overweight or obese, and daily television viewing for > 3 hours. Risk factors significantly associated with obesity in the multivariate analysis are reported in Table 5. Adolescents with a total family income of more than AEDs 20000 per month (OR=2.31), those who watched more than three hours of television per day (OR=1.96), those with a daily allowance was more than AEDs 40 (OR=3.42) and adolescents with overweight or obese fathers or mothers were more likely to be obese. Because the risk of

obesity in adolescents is strongly influenced by parental weight status, these findings suggest that parents may play an important role in preventing childhood obesity.

Discussion

It is noteworthy that the prevalence of overweight among adolescents in Ajman Emirate (24.67% for males and 24.62% for females) is much higher than that of adolescents in Ethiopia (7.6%). However, compared to Saudi Arabian and Qatari adolescents' obesity was lower, 5.43% for males and 5.27% for females [13-15]. Overweight and obesity were both associated with watching more than three hours of television daily. Overweight and obese, with no clear trend between boys and girls, differed by age group, 13-20 years. Obesity was found to be associated with income >20000 AEDs/month and daily allowance >40 AEDs/day. Research conducted at Harvard University first established the link between television viewing and obesity more than 25 years ago [16]. Since then, the link between TV viewing and obesity in children and adolescents has been confirmed by extensive research in countries around the world. One reason why many organizations recommend that children and young people limit their TV and media use to two hours a day [17]. However, this result is different from the one found by Jabre *et al.* [18]. Who did not find a significant association between television viewing time and obesity, while it is in agreement with Al-Ghamdi [19] who found a positive association between the number of hours of television viewing and the development of obesity among Saudi children. TV viewing may reduce energy expenditure, since prolonged sedentary behavior may disrupt the regulation of energy balance by uncoupling food intake from energy expenditure [20].

A family size of less than 4 persons had a significant association with being overweight. However, Halliday *et al.* did not find a significant association between the size of the family and

being overweight [21]. An increase in the size of the family could potentially increase the risk of overweight in adolescents, based on the hypothesis of a trade-off between quantity and quality. This hypothesis posits that, in the presence of a budget constraint, an increase in the number of children will increase the marginal cost of family investments that affect the health of the children, as measured by indicators of excess body weight [22]. In contrast, our study found no association between sugar-sweetened beverages (SSBs) and overweight or obesity, although 93% of the studies concluded that there was a positive association with the onset of overweight or obesity in both children and adults [23]. Reducing the consumption of SSBs and promoting healthy alternatives such as water should therefore be part of public health policy.

We did not find consistent associations between overweight and obesity in adolescents for studying, playing, bringing fruit and vegetables to school, or eating junk food, fizzy drinks, and chocolate. There is no clear link between dietary habits and measures of overweight and obesity was found by Janssen *et al.* [24]. The study found that both the father's and mother's BMI were linked to childhood overweight and obesity. Vitoratou *et al.* [25] showed that adolescents with an obese parent were more likely to be overweight than adolescents with an overweight parent, with a stronger association with maternal BMI than with paternal BMI. This finding is consistent with several recent studies showing that being overweight in parents, and possibly especially in mothers, is correlated with a higher likelihood of being overweight in children [26]. Many studies have described the relationship between parental overweight/obesity and that of their child [27], but the underlying mechanisms are not well understood. Parental and child share approximately 50% of the same genes, and these genetic factors are likely to explain some of the observed intergenerational association. Parents and children also share an environment that could be associated with BMI and adiposity status, such

as the same food preferences and similar physical activity [9].

Fewer studies have examined the association between the educational level of the parents and the overweight status of the adolescent. Maternal and paternal education was not associated with overweight and obesity in adolescents in our study. These results are consistent with the findings of Jabre *et al.* [18]. Moore *et al.* [28] found that the prevalence of overweight and obesity was inversely associated with both parents' education levels, with a stronger association with maternal education. Among Colombians, mother's education had an odds' ratio (confidence interval) of 1.90 (1.23 to 2.94) for being overweight. These findings are consistent with previous research showing that maternal and paternal education levels are positively associated with adolescent weight status [27,28].

Limitations: this study is limited by BMI's inability to distinguish between fat and fat-free mass; self-reporting studies are inherently biased by how the person felt when they completed the questionnaire.

Conclusion

The current study showed that the prevalence of overweight/obesity among adolescents aged 13 to 20 years living in Ajman (UAE) was very high. In addition, the main risk factors associated with being overweight were a number of family members ≤ 4 , the adolescent's daily allowance > 40 AEDs, having a mother or father who is overweight or obese, and daily television viewing > 3 hours. Nevertheless, factors significantly associated with obesity were adolescents with a total family income of more than 20000 AEDs per month, television watching more than 3 hours per day, daily allowance of more than 40 AEDs, and having a father or mother who is overweight or obese. Consequently, these data suggest that measures to prevent and manage overweight and obesity should be a public health priority in the Emirate of

Ajman. As a reference for efforts to reverse these trends, these findings will be presented to the relevant departments.

What is known about this topic

- *The prevalence of overweight and obesity among secondary school students in Ajman, UAE, is linked to sedentary lifestyles, lack of physical activity, and unhealthy food preferences;*
- *Overweight/obesity coincides with the nutrition transition process.*

What this study adds

- *This study highlights the urgent need for overweight/obesity screening in schools and emphasizes the importance of health promotion campaigns and interventions, especially in public schools. In addition, the present findings can inform the direction of public health policies aimed at improving the lifestyles of adolescents by focusing on the importance of factors associated with overweight and obesity among secondary school students in Ajman (UAE);*
- *Being overweight could be just the beginning of obesity, or it could be a catalyst for self-awareness that turns into an ideal opportunity to prevent further obesity development;*
- *The risk of obesity in adolescents is strongly influenced by parental weight status.*

Competing interests

The author declares no competing interest.

Authors' contributions

Conceived and designed the study: Sayar Insaf and Abderraouf Ben Abderrahman; analyzed the data: Sayar Rhouma; contributed materials/data collection: Sayar Insaf and Abderraouf Ben Abderrahman; wrote the paper: Sayar Insaf;

reviewed and approved the manuscript: Sayar Insaf, Sayar Rhouma and Abderraouf Ben Abderrahman. All the authors have read and agreed to the final manuscript.

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Tables and figure

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Figure 1: prevalence (%) of under/overweight and obesity among adolescents in Ajman's Secondary Schools by age group

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Table 1: anthropometric parameters, daily study/play time and daily pocket money of adolescents in Ajman's Secondary Schools according to their gender

Variable	Total study population (n=2000); mean±SD	Boys (n = 920); mean±SD	Girls (n = 1080); mean ± SD	P- score
Weight (Kgs)	65.58 ±14.27	71.65 ±16.42	59.51 ±12.13	0.15
Height (cm)	162.895 ±5.77	169.42 ±5.93	156.37 ±5.62	0.18
Body mass index (BMI Kg/m ²)	24.765 ±5.69	25.08 ±6.12	24.45 ±5.27	0.5
Waist circumference (WC cm)	75.5 ±12.63	81 ±15.03	70 ±10.24	<0.0005
Hip circumference (HC cm)	90.5 ±8.79	90 ±8.74	91 ±8.84	0.58
Mid upper arm circumference	37.63±14.88	35.47±12.23	39.79±16.34	0
Waist-hip ratio (WHR)	0.835 ±0.03	0.90 ±0.04	0.77 ±0.02	0
Waist- height ratio (WHtR)	0.53 ±0.01	0.48 ±0.01	0.58 ±0.02	<0.0005
Television watched/day (hours)	3.35 ±1.45	3.5 ± 1.5	3.2 ± 1.4	<0.0005
Daily studying hours	4.5 ±1.4	4.2± 1.3	4.8 ± 1.5	<0.0005
Daily playing hours	1.85 ±1.35	2.2 ± 1.5	1.5 ± 1.2	<0.0005
Daily allowance (AEDs*)	19.45 ±8.25	20.5 ± 9.3	18.4 ± 7.2	<0.0005
*AED 1.00 (Arab Emirati Dirham) = 0.272 USD (\$), SD: standard deviation				

Table 2: socio-demographic and other key characteristics of under/overweight and obesity in 2000 adolescents in Ajman's secondary schools

Variable	Underweight N (%)	Normal N (%)	Overweight N (%)	Obesity N (%)	Probability value	
					Overweight vs. normal	Obesity vs. normal
Age groups (year)					0.005	0.125
13-14	17 (04.03)	287 (68.01)	91 (21.56)	27 (06.40)		
15-16	14 (03.36)	290 (69.54)	94 (22.54)	19 (04.56)		
16-17	16 (03.88)	283 (68.70)	93 (22.57)	20 (04.85)		
18-19	15 (03.46)	298 (68.66)	100 (23.04)	21 (04.84)		
19-20	10 (03.17)	204 (64.76)	81 (25.71)	20 (06.36)		
Gender					0.91	0.82
Females	45 (4.16)	712 (65.92)	266 (24.62)	57 (5.27)		
Males	40 (3.70)	603 (65.54)	227 (24.67)	50 (5.43)		
Nationality					0.03	0.07
UAE National	29 (02.07)	915 (65.36)	393 (28.07)	63 (04.50)		
Non-UAE National	56(09.33)	374 (62.33)	126 (21.00)	44 (07.34)		
School type					0.01	0.25
Public	55 (05.98)	480 (52.17)	340 (36.96)	45 (04.89)		
Private	35 (03.24)	517 (47.87)	466 (43.15)	62 (05.74)		
Mother's employment					0.25	0.4
Employed	24(04.29)	352 (62.85)	155 (27.68)	29 (05.18)		
Unemployed	61 (04.24)	932 (64.72)	370 (25.69)	77 (05.35)		
Family monthly income (AEDs*)						
≥ 20000	25 (01.92)	920 (70.77)	322 (24.77)	33 (02.54)		
< 20000	37 (05.29)	450 (64.29)	151 (21.58)	62 (08.86)		
Family size					<0.0005	<0.0005
≥ 4	42 (03.78)	755 (68.02)	236 (21.26)	77 (06.94)		
< 4	25 (02.81)	672 (75.51)	172 (17.08)	41 (04.60)		
Mother's BMI					0.007	<0.0005
Normal	20 (02.41)	640 (77.11)	142 (17.11)	28 (03.37)		
Overweight	32 (03.72)	601 (69.80)	176 (20.44)	52 (06.04)		
Obese	27 (08.074)	190 (61.49)	67 (21.68)	25 (08.09)		
Father's BMI					<0.0005	<0.00105
Normal	25 (03.96)	501 (79.27)	91 (14.40)	15 (02.37)		
Overweight	28 (02.86)	710 (72.52)	188 (19.20)	53 (05.42)		
Obese	27 (06.94)	220 (56.56)	106 (27.25)	36 (09.25)		

*AED 1.00 (Arab Emirati Dirham) = 0.272 USD (\$), P: probability; BMI: body mass index

Table 3: overweight and obesity in 2000 adolescents in secondary schools in Ajman according to their sociodemographic parameters

Variable	Normal N (%)	Overweight N (%)	Obesity N (%)	P-value	
				Overweight vs. normal	Obesity vs. normal
Transport to and from school				<0.001	0.001
By foot	598 (74.47)	150 (18.68)	55 (06.85)		
By bus	302 (86.04)	41 (11.68)	8 (02.28)		
Private car	609 (06.84)	98 (02.28)	54 (07.08)		
TV watched/day (hours)				<0.001	<0.0005
3	600 (71.00)	180 (21.30)	65 (07.70)		
≤ 3	904 (84.49)	109 (10.18)	57 (05.33)		
Hours of study				0.05	0.29
≤ 5	847 (72.64)	245 (21.02)	74 (06.34)		
> 5	540 (72.10)	163 (21.76)	46 (06/14)		
Fresh fruit and vegetable consumption				0.41	<0.01
Yes	465 (76.74)	117 (19.30)	24 (03.96)		
No	955 (71.60)	289 (21.66)	90 (06.74)		
Daily allowance (*AEDs)				<0.001	<0.001
≤40	797 (8.75)	160 (16.21)	30 (03.04)		
> 40	678 (69.33)	231 (23.62)	69 (07.05)		

*AED 1.00 (Arab Emirati Dirham) = 0.272 USD (\$), P: probability, BMI: body mass index

Table 4: multivariate analysis of the factors associated with being overweight among adolescents in Ajman’s Secondary Schools according to age groups

Variable	Odds ratio (95% CI)	P-value
Age categories (year)		
13-14	1	
15-16	0.83 (0.34 - 1.75)	0.454
17-18	1.46 (0.74 - 2.94)	0.392
18-19	1.52 (0.81 - 2.97)	0.041
19-20	3.15 (1.64 - 6.06)	0.001
Gender		
Male	1	
Female	1.3 (1.09 - 1.65)	0.032
Family size		
> 4	1	
≤ 4	1.81 (1.46 - 2.32)	<0.0005
Daily allowance (AEDs)		
≤ 40	1	
> 40	1.75 (1.35 - 2.18)	<0.0005
TV watched/day (h)		
≤ 3	1	
> 3	1.38 (1.09 - 1.73)	0.039
Mother’s BMI (Kg/m²)		
Normal	1	
Overweight	1.52 (1.12 - 1.99)	0.015
Obese	1.85 (1.26 - 2.72)	0.002
Father’s BMI (Kg/m²)		
Normal	1	
Overweight	1.38 (1.01 - 1.71)	0.02
Obese	2.93 (1.78 - 3.44)	<0.0005

Odds ratio = (odds of the event in the exposed group)/(odds of the event in the non-exposed group); BMI= (body mass index)

Table 5: multivariate analysis of the factors associated with being obese among the adolescents in the secondary schools of Ajman according to age group

Variable	Odds ratio (95% CI)	P-value
Family income (AEDs)		
Below average	1	
Average (20000 AEDs)	2.37 (1.15 - 4.89)	0.031
Above average	2.31 (1.09 - 4.43)	0.043
Daily allowance (AEDs)		
≤ 40	1	
> 40	3.42 (1.98 - 6.01)	0.0004
TV watched/day (h)		
≤ 3	1	
> 3	1.96 (1.24 - 3.12)	0.005
Mother's BMI (Kg/m²)		
Normal	1	
Overweight	2.45 (1.45 - 4.12)	0.002
Obese	2.25 (1.11 - 4.47)	0.03
Father's BMI (Kg/m²)		
Normal	1	
Overweight	4.08 (1.68 - 7.13)	0.006
Obese	6.81 (2.89 - 12.57)	<0.0004
CI : confidence interval		

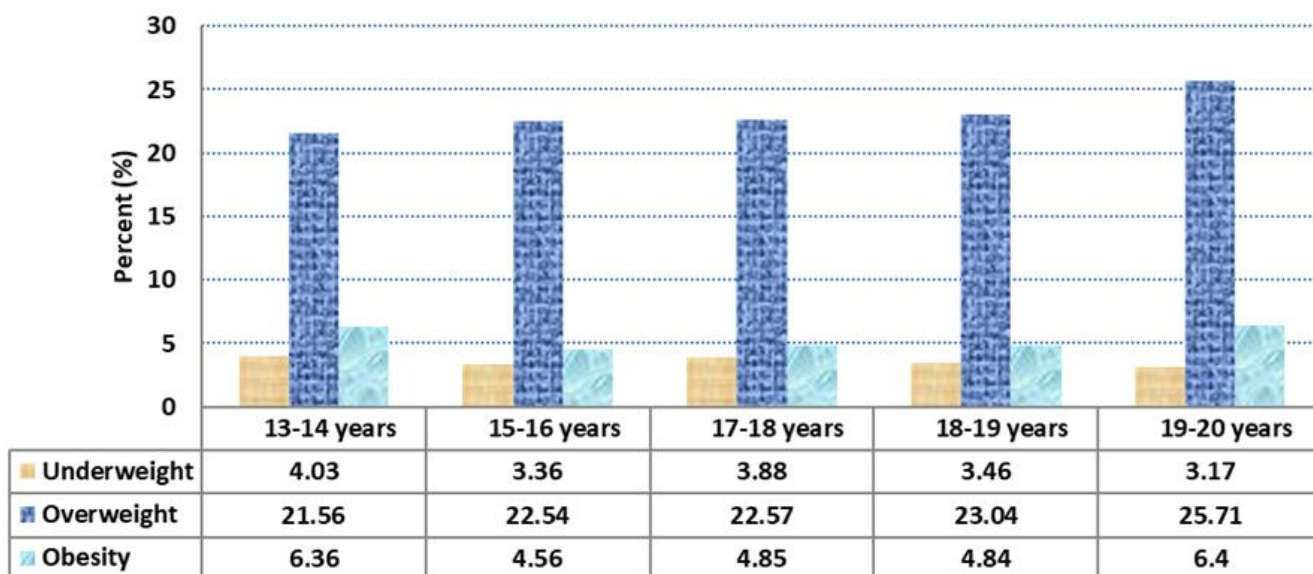


Figure 1: prevalence (%) of under/overweight and obesity among adolescents in Ajman’s secondary schools by age group