

# Is Lean Body Mass Linked to Self-Perceived Body Image among Youth in the United Arab Emirates?

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**Abstract.** *Background and Aim:* Lean body mass may be a promising tool to screen body image disorders. This study aim was to explore the relationships between fat free mass index (FFM-I) on self-perceived body image and shape among university students in the United Arab Emirates. *Methods:* Cross-sectional study, using questionnaires to evaluate demographics, body figure, shape and image dissatisfaction; in addition to anthropometrics like BMI and FFM-I. Accordingly, participants were categorized into adequate muscle mass (AMM) and low muscle mass (LMM) individuals. *Results:* A total of 402 participants (50.4% females) aged between 18 and 25 years, were recruited. Almost third (33.8%) of the participants were overweight/obese, 81% had AMM; 48.5% and 76.3% of them were concerned about their body shape and image, respectively; 55.2% desired to be thinner. Males (M) had significantly higher BMI and body fat compared to females (F). Subjects with LMM, irrespective of sex, were underweight (49% F; 40.7% M), desired to be heavier (44.9% F; 74.1% M) and they had a lower agreement in their perceived BMI versus actual ( $k=0.024$ ; poor) compared with those with AMM ( $k=0.408$ ; fair); and in general males had a better agreement between their perceived and actual BMI compared to females (0.432, moderate vs. 0.308, fair). *Conclusions:* Our results conclude that female sex and LMM were associated with higher body image and shape dissatisfaction; thus, highlighting the importance of increasing awareness among youth to assess body composition and engage in muscle mass building activities as an effective step towards improving body image perception. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** nutrition, fat free mass index, lean body mass, youth, body image

## Introduction

Over the past years, extensive focus on ideal body image among youth has created unrealistic weight expectations and body image misperception. This has made the relationship between self-perceived body image, body size, and body composition an important area of research (1).

Body image is a multifaceted and subjective concept, entailing a person's perceptions, beliefs, and feelings about their body (2). It is shaped by media, sports,

and personal relationships (3, 4). University students are particularly vulnerable to the predominant social models, predisposing them to the development of body image dissatisfaction (BID) (5). The latter has been linked with an increase in weight-related unhealthy behaviors, eating disorders (6-8), poor food choices, and excessive (8) or very low levels of physical activity (9). Whereas, a positive body image, is linked to better health and quality-of-life (4, 10), healthier eating habits and weight control(11), This, in turn, leads to serious health implications such as loss of muscle

mass and malnutrition, excess adiposity, inflammation, a higher risk of developing chronic diseases and all-cause mortality, depression, and poor quality-of-life (12-14).

Furthermore, the discrepancy between measured and perceived body image is common (15-17). This may promote increased body weight through unhealthy diet, anxiety, and depression, ultimately enhancing vulnerability to physical and mental health problems (18-20).

Investigating factors associated with BID and inaccurate perception of one's body weight can help health care professionals tailor make prevention programs targeting malnutrition, and sarcopenic obesity among young adults. Hence, this study aims to explore the effect of fat free mass index (FFM-I) on the agreement between perceived and actual body image, shape and BMI among a convenient sample of university students in the United Arab Emirates (UAE).

## Methods

### *Study Design*

This cross-sectional study was carried from March to April 2019, at the University of Sharjah (UOS), UAE, using a self-administered, structured questionnaire. Ethical approval of this study was obtained from the UOS Research Ethics Committee (Ref. REC-19-03-07-03-S). The aim and objectives of the research study were explained to all the participants before providing the written informed consent. Participation was voluntary and participants were assured confidentiality of all the collected information.

### **Study Population**

A convenience sampling method was used to identify participants, due to the lack of evidence on the outcome of interest (FFMI) in the target population. Inclusion criteria comprised of healthy university students, from the 2 sexes, between 18 and 25 years of age. Participants with musculoskeletal abnormalities, chronic diseases, pregnancy, or those who did not

provide the informed consent were excluded from the study. Consenting participants, meeting the inclusion criteria were interviewed face-to-face by the trained research team, after which anthropometrics were collected and questionnaires were administered. The duration of the interview session was approximately 15 minutes without the measurement recording

## Data Collection Tools

The questionnaire was administered in the English language. It included socio-demographic information (e.g. age and sex), weight-related behavior questions (e.g. diet and physical activity), the Stunkard Figure Rating Scale (FRS) adapted from Stunkard et al. (21), and the Body Shape Questionnaire adapted from Cooper et al (22).

*Weight-related behavior questionnaire* evaluated whether the participants followed a specific type of diet and the reasons, and if they regularly performed physical activity.

### *Body Image Dissatisfaction*

The Stunkard FRS consists of nine silhouettes that range from very thin to very obese (labeled 1 to 9) (21). The scale is commonly used as a measure of Body image dissatisfaction (BID). It evaluated the participant's desired body image – “how they would like to look” and perceived body image – “how they look” in comparison to their actual body size. The BID variable is created by subtracting the participant's current body image FRS score from the desired body image FRS score. Discrepancies between actual and ideal body images among the participants is the diagnostic tool of BID. A positive value indicates the “desire to be thinner”; a negative value reflects the “desire to be heavier” and a value of zero indicates “satisfaction with current body size”.

### *Body Shape Questionnaire*

The body shape questionnaire (BSQ) is an 8-item self-report questionnaire developed to investigate concerns about one's appearance over the past four weeks

(22). Questions were scored based on a 6-point Likert scale ranging from 1 (never) to 6 (always). The sum of all items generates a score, whereby a higher BSQ score indicates increased concern about current body shape, as follows: <19 is interpreted as no concern with body shape; 19-25 mild concern with body shape; 26-33 moderate concern with body shape; >33 high concern with body shape. In the current study, scores reflecting mild and moderated concern with body shape were merged into 1 category.

### *Anthropometric Measurements*

Actual anthropometrics were measured by a research assistant: height, weight, neck (NC) and waist (WC) circumference (cm). For these measurements, participants removed their shoes and wore minimal lightweight clothing as per WHO guidelines (23), also participants stood erect with their arms by their sides and feet close together. Weight, height and circumferences (waist and neck) were measured using SECA Hamburg Germany, SECA 220 Telescopic Measuring Rod for Column Scales and SECA 201 inextensible measuring tape respectively. The numbers were recorded at the nearest 0.1 kg and 0.1cm. Waist to-height (WHtR) ratio was calculated by dividing the WC (cm) by the height (cm) (23). A cut-off of 0.5 was used to define abdominal obesity, whereby a WHtR<0.05 was considered normal (24). Discrepancy of weight was measured by the discrepancy between perceived BMI and actual BMI according to previously published literature (25, 26). Perceived Body mass index (BMI) (kg/m<sup>2</sup>) which was calculated from the reported weight and height of the participants while actual BMI (kg/m<sup>2</sup>) was calculated based on the measured weight and height. Both perceived and actual BMI were classified based on the World Health Organization (WHO) (27): underweight (BMI < 18.5), normal weight (BMI 18.5–24.9), overweight (BMI 25–29.9), and obese (BMI ≥ 30). Participants' body composition including body fat mass (BF) (kg), lean body mass (measured through fat free mass) (kg), and visceral fat rating (%) was measured using TANITA SC-331S Body Composition Analyzer. This device measured participants'

body composition parameters by evaluating differences in impedance of body components (eg, muscle

and lean tissue) as described by Kyle et al.(28) The cut-off point of the percentage BF was 25% and 35% for men and women, respectively (29). FFM-I was calculated by dividing the fat-free mass (kg) by height squared (m<sup>2</sup>). For women, the cut-off value was <15 kg/m<sup>2</sup> and for men, <17 kg/m<sup>2</sup>(30), indicative of malnutrition. Accordingly, participants were assigned into 2 groups: adequate muscle mass (AMM) if their FFM-I was > 15 kg/m<sup>2</sup> for women and > 17 kg/m<sup>2</sup> for men and low muscle mass (LMM) if their FFM-I was <15 kg/m<sup>2</sup> for women and <17 kg/m<sup>2</sup> for men.

### **Data Analysis**

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp, New York, USA). Descriptive analysis was performed to describe continuous variables in means and standard deviations (SD) and categorical variables in frequencies and percentages. Comparative statistics were calculated using the Chi-square ( $\chi^2$ ) test for categorical variables. Independent *t*-test was conducted to compare the difference in the mean values of obesity-related anthropometric variables between the FFM-I subgroups. *P*-values <0.05 were considered statistically significant for all analyses. Agreement between perceived and actual BMI was calculated according to Cohen (21). Linear weighted Kappa (k) values, their standard errors, and 95% confidence intervals were presented, whereby k<0.2, 0.21-0.40, 0.41-0.60, 0.61-0.80, 0.81-1.00 were interpreted as poor, fair, moderate, good and very good strength of agreement, respectively. Dataset is available at <https://data.mendeley.com/datasets/3yfmngkwchr>.

### **Results**

Five hundred students were invited to participate in the study, and 402 consented (response rate 80.4%). Table 1 shows the sociodemographic characteristics of the sample. There were 203 (50.5%) females, with a mean age of 19.7 (SD=1.42) years, and majority (85%) were Arabs. The mean perceived (reported) weight, height, and accordingly calculated BMI were 67.5 (SD=16.5) kg, 168.5 (SD=10.3) cm,

**Table 1.** Sociodemographic characteristics of the participants (N=402)

Age (years)	19.7(1.42)*
Sex	
Female	203(50.5)†
Nationality (Arab/Non-Arabs)	
Arabs	342(85)†
Perceived weight (Kg)	67.5(16.5)*
Perceived height (cm)	168.5(10.3)*
Perceived BMI (kg/m <sup>2</sup> )	23.6 (4.3)*
Actual height (cm)	168.1 (9.8)*
Actual weight (Kg)	67.52 (16.5)*
Actual BMI (kg/m <sup>2</sup> )	23.7 (4.58)*
WC (cm)	82.67 (13.29)*
Waist-to-height ratio	0.49(0.07)*
Neck circumference (cm)	35.24 (4.59)*
Visceral fat (%)	3.04 (3.84)*
Body fat (kg)	14.71 (8.81)*
Fat-Free Mass (kg)	52.25 (11.5)*
Fat-Free Mass Index (kg/m <sup>2</sup> )	18.13 (2.70)*
Did you follow any type of diet?	
No	294(73.1)†
Do you regularly perform some type of physical activity in your free time?	
No	153(38.1)†

\* Mean (Standard Deviation); † frequency (%)

and 23.6 (4.3) kg/m<sup>2</sup> respectively. Whereas, the actual (measured) weight, height and BMI were 67.52 (SD=16.5) kg, 168.1 (SD=9.8) cm, and 23.7 (SD=4.58) kg/m<sup>2</sup> respectively. The mean WC, WHtR, and NC were 82.67 (SD=13.29) cm, 0.49 (SD=0.07) and 35.24 (SD=4.59) cm respectively. The mean visceral fat, body fat mass, fat-free mass and the FFMI were 3.04% (SD=3.84), 14.71 (SD=8.81) kg, 52.25 (SD=11.5) kg and 18.13 (SD=2.70) kg/m<sup>2</sup> respectively. The majority did not follow any type of diet (73.1%) and 61.9% were regularly performing some type of physical activity in their free time.

Table 2 depicts the comparison of the anthropometric measurements of the participants with low muscle mass (LMM) compared to adequate muscle mass (AMM). Participants with AMM had significantly higher obesity-related anthropometric measures (BMI p=0.014; WC, NC, Visceral fat (VF), BF, p<0.001) compared to the LMM ones.

As per Table 3, half of the participants had a normal BMI (53.7%) and a normal WHtR (57.2%). The majority (81.1%) had AMM, did not follow any type of diet (66.6%), and performed physical activity regularly (61.9%). Nearly half of the participants (48.5%) were concerned about their body shape. The majority were dissatisfied with their body image (76.3%), and specifically more than half desired to be thinner (55.2%).

**Table 2.** Comparison of the anthropometric measurements of the participants with LMM & AMM

Variables	Fat free mass index		P value
	LMM (N=76)	AMM (N=326)	
	Mean (SD)	Mean (SD)	
Body weight (kg)	56.45 (9.74)	73.88 (16.23)	<0.001
Body Mass Index (kg/m <sup>2</sup> )	19.16 (2.36)	24.76 (4.31)	0.014
Waist circumference (cm)	72.64 (9.15)	85.01 (13.02)	<0.001
Neck circumference (cm)	32.78 (3.44)	35.81 (4.64)	<0.001
Visceral fat (%)	2.06 (4.98)	3.26 (3.5)	<0.001
Body fat (kg)	9.61 (5.77)	15.90 (8.98)	<0.001
Fat-Free Mass (kg)	42.41 (7.0)	55.49 (10.96)	<0.001
Fat-Free Mass Index (kg/m <sup>2</sup> )	14.66 (1.69)	18.84 (2.28)	<0.001

LMM: Low muscle mass

AMM: Adequate muscle mass

**Table 3.** Characteristics of the participants according to the anthropometric measurements, body image and weight-related behavior

		N (%)
Body mass index (kg/m <sup>2</sup> )	Underweight	44 (10.9)
	Normal weight	216 (53.7)
	Overweight/Obese	136 (33.8)
Waist-to-height ratio	Adequate	230 (57.2)
Fat free mass index (kg/m <sup>2</sup> )	Adequate	326 (81.1)
Body shape concern	No concern	207 (51.5)
	Mild to moderate concern	169 (42.0)
	High concern	26 (6.5)
Body image dissatisfaction	Desire to be heavier	85 (21.1)
	Satisfaction with current weight	95 (23.7)
	Desire to be thinner	222 (55.2)
Weight-related behavior: Followed a special diet & its reason	I did not follow any diet	268 (66.6)
	Weight loss diet	80 (19.9)
	Weight gain diet	24 (6.0)
	Followed a special diet	30 (7.5)

The characteristics of the participants by sex and muscle mass adequacy are displayed in Table 4. Overall, more male participants had a high BMI, high BF, and high WHtR compared with females ( $p < 0.0001$ ). Yet, more female participants followed specific diets compared with males ( $p = 0.001$ ). Indeed, satisfaction with body image varied between male and female participants ( $< 0.0001$ ).

When analyzed based on the adequacy of muscle mass, more participants with LMM, irrespective of sex, were underweight (49% in females; 40.7% in males), had a normal WHtR (98% in females; 81.5% in males) and desired to be heavier (44.9% in females; 74.1% in males), compared with participants with AMM. The latter mostly desired to be thinner (67.5% in females; 57% in males).

As shown in Figure 1, among the participants who were satisfied with their body image ( $N = 95$ ; 23.7% of the total sample), the vast majority (85.3%) had an adequate muscle mass. Yet, concomitantly, among the participants desiring to be thinner ( $N = 222$ ; 55.2% of the total sample), 91% also had an AMM. In contrast, among the participants who desired to be heavier ( $N = 85$ ; 21.1% of the total sample),

half had AMM (50.6%); the other half had LMM (49.4%).

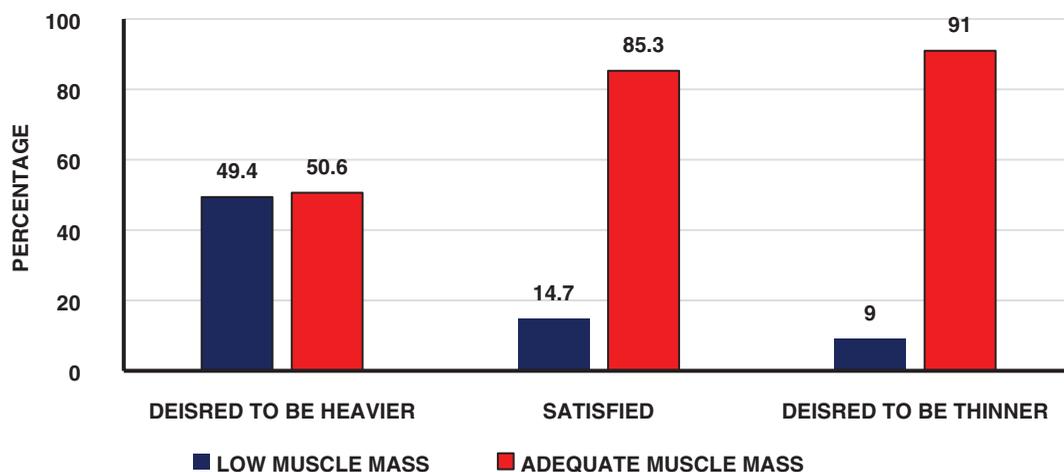
Figure 2 showed the distribution of lean body mass (LMM and AMM) among different BMI categories. According to the figure, the majority of the underweight participants ( $N = 44$ ; 10.9% of the total sample), had LMM (79.5%). While only 1.5% of the overweight/obese participants ( $N = 136$ ; 33.8% of the total sample) had LMM. Regarding those participants with normal weight ( $N = 216$ ; 53.7% of the total sample), the majority (82.4%) had AMM.

As shown in Table 5, in general, the agreement between perceived and actual BMI was fair among the participants ( $k = 0.4$ ). Nevertheless, segregated analyses show that participants with LMM had a lower agreement in their perceived versus actual BMI ( $k = 0.024$ ; poor) compared with those with AMM ( $k = 0.408$ ; fair). Participant sex-based analyses revealed the same findings, whereby LMM was associated with a lower agreement in perceived versus actual BMI. Overall, males had a better agreement between perceived and actual BMI compared with females (0.432, moderate vs. 0.308, fair). When segregated based on muscle mass adequacy, also males had a greater agreement compared with females.

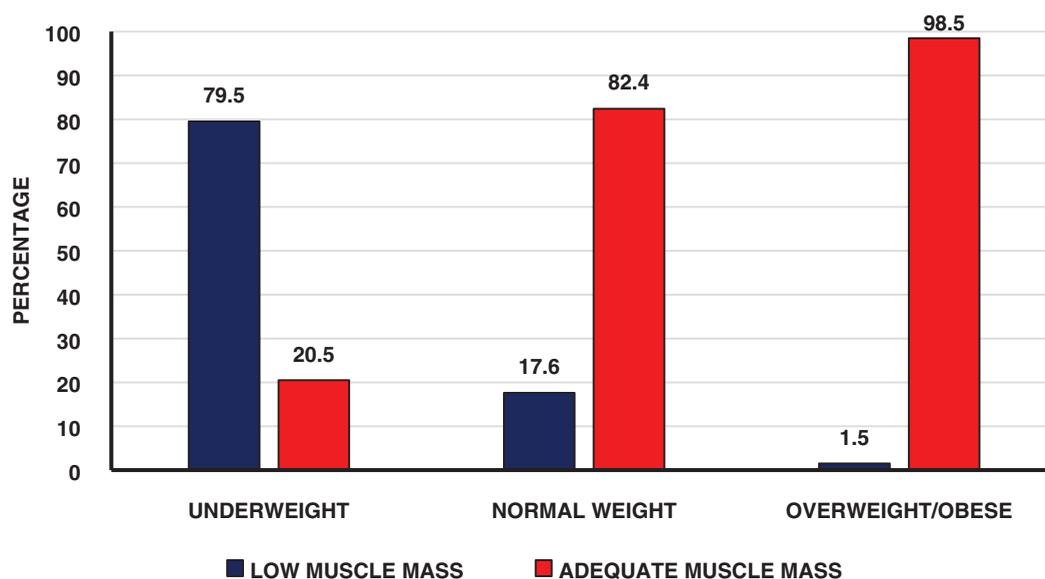
**Table 4.** Characteristics of the participants by sex and muscle mass adequacy (N=402)

		Females (N=203)		Males (N=199)		Between-sexes <i>p</i> -value
		LMM	AMM	LMM	AMM	
		<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Body image dissatisfaction	Desire to be heavier	22 (44.9)	15 (9.7) <sup>‡</sup>	20 (74.1)	28 (16.3) <sup>‡</sup>	<0.0001
	Satisfied	10 (20.4)	35 (22.7)	4 (14.8)	46 (26.7)	
	Desire to be thinner	17 (34.7)	104 (67.5)	3 (11.1)	98 (57)	
<i>Between muscle mass categories p</i> -value		<0.0001		<0.0001		
Body Mass Index	Underweight	24 (49)	9 (5.8) <sup>‡</sup>	11 (40.7)	0 (0) <sup>‡</sup>	<0.0001
	Normal	25 (51)	108 (70.1)	14 (51.9)	75 (43.6)	
	High	0 (0)	37 (24)	2 (7.4)	97 (56.4)	
<i>Between muscle mass categories p</i> -value		<0.0001		<0.0001		
Body Fat	Normal	49 (100)	147 (95.5)	27 (100)	147 (85.5) <sup>‡</sup>	<0.0001
	High	0 (0)	7 (4.5)	0 (0)	25 (14.5)	
<i>Between muscle mass categories p</i> -value		0.129		0.003		
Waist-to-height ratio	Normal <0.5	48 (98)	96 (59.7) <sup>‡</sup>	22 (81.5)	61 (33.6) <sup>‡</sup>	<0.0001
	High ≥0.5	1 (2)	58 (40.3)	5 (18.5)	111 (66.3)	
<i>Between muscle mass categories p</i> -value		<0.0001		<0.0001		
Diet	Yes	7 (14.3)	41 (26.6)	3 (11.1)	57 (33.1) <sup>‡</sup>	0.001
	No	42 (85.7)	113 (73.4)	24 (88.9)	115 (66.9)	
<i>Between muscle mass categories p</i> -value		0.077		0.001		
Physical activity	Yes	24 (49)	80 (51.9)	17 (63)	128 (74.4)	0.073
	No	25 (51)	74 (48.1)	10 (37)	44 (25.6)	
<i>Between muscle mass categories p</i> -value		0.717		0.078		

<sup>‡</sup>Significant difference across categories within-sexes  
LMM: low muscle mass, AMM: Adequate muscle mass



**Figure 1.** Comparison of the fat free mass index in different body image dissatisfaction categories (irrelevant of sex). (N=402).



**Figure 2.** Comparison of the fat free mass index in different body weight categories (irrelevant of sex). (N=402).

**Table 5.** Agreement between perceived and actual Body Mass Index (N=402)

	Weighted Kappa	Standard error	95% Confidence Interval
All participants (n=402)	0.400	0.022	0.357 to 0.443
Males (n=199)	0.432	0.027	0.379 to 0.485
Females (n=203)	0.308	0.038	0.233 to 0.383
AMM (n=326)	0.408	0.023	0.363 to 0.454
Males (n=172)	0.423	0.030	0.365 to 0.481
Females (n=154)	0.338	0.041	0.257 to 0.419
LMM (n=76)	0.024	0.023	-0.0215 to 0.0689
Males (n=27)	0.064	0.057	-0.0470 to 0.175
Females (n=49)	0.00	0.00	0.000 to 0.000

## Discussion

Lean body mass evaluation in the context of body shape and image dissatisfaction is important for better understanding of the diet related corrective actions needed for body image disorders among youth. Our findings suggest that BID and body shape concerns are highly prevalent among youth in UAE, since, more than half of our sample desired to be thinner.

The discrepancy between actual and perceived weight among our sampled university students, seems to be universal (31). Other studies have reported that majority of undergraduate students from both sexes were dissatisfied with their body image in UAE (26),

but the issue was more prominent among females (74.8%)(32). Typically, normal-weighted individuals who perceive themselves as being overweight, may engage in negative behaviors such as unnecessary dieting, binge eating (33), and lower levels of physical activity (34, 35). In contrast, overweight people who perceive themselves as normal-weighted may not feel the need to manage their excess weight, which puts them at risk to become obese (25, 33, 36). Also in some western countries like Morocco(37), Egypt and Oman (38, 39); being heavier is more desired among youth and they tend to underestimated their body weight, which also leads to body image and shape dissatisfaction (40).

Sub analysis of results between the sexes identified participants' sex as a determinant of BID, whereby more than half of our female participants showed a higher BID with a greater desire for slimmer silhouettes, when compared to males. On the other hand, many males desired to be heavier, and male sex showed a positive correlation with body image satisfaction and resulted in lower discrepancy between perceived and actual BMI. These findings are in line with previous research, documenting a great dissatisfaction among females desiring to be smaller (26), and males desiring to be bigger and more muscular (mesomorphic appearance)(41). This is coherent with the findings from Tunisia, where a preference for lower body weight was highlighted (42). This disparity can be due to the fact that some Arab countries are aligned with Western values, where feminine attractiveness is defined based on thinness (43); hence the preference of women for thin bodies, who tend to perceive themselves as overweight (44), follow restrictive diets(45), and have higher desire for lower weight (45). These factors come in parallel to the increasing prevalence of eating disorders among females (46). Nevertheless, the risk of eating disorders among males seems to be higher than previously reported (15, 40). This finding could be driven by obesity (40), or even by muscle dysmorphia or dissatisfaction with muscularity, and subsequent disordered eating behaviors to achieve increased muscle mass (15, 47).

When it comes to body composition and muscle mass, AMM was positively correlated with body image satisfaction, and lower discrepancy between perceived and actual BMI; this was in line with the literature (48); the pattern of dissatisfaction among our participants significantly varied based on muscle mass adequacy, whereby participants with LMM desired to be heavier, whereas those with AMM were more satisfied with their body image. As shown elsewhere, the magnitude of body weight dissatisfaction is associated with FFMI categorization (49). In our results, most of the overweight/obese have adequate muscle mass; this was in line with the literature, where by looking beyond the BMI for nutritional status evaluation is advocated and using more specific tools that distinguish the body compartments into fat-free and fat masses (50); the latter being considered primary determinants

of health, outperforming BMI in predicting morbidity and mortality (51). Moreover, high BMI has been associated with BID and overvaluation of one's body size, potentially leading to dietary concerns, and increased risk of poor self-esteem, anxiety, and depression (63-65). Consequently, FFMI and Body Fat Mass Index were suggested to be more accurate than FFM and BF, or even percentages of FFM and BF, in assessing the nutrition status (51). Mclester (48) shed light on the matter and explained that knowledge of body composition among females can negatively affect their body image satisfaction; however, it can encourage both sexes to accept that more physical activity is essential to acquire a healthy body composition (48).

Accordingly, it is crucial to underline the importance of body composition assessment prior to attempts of weight control. BID among university students is highly prevalent in UAE, and even more prominent among those with inadequate muscle mass. People with BID try to lose weight, if not coupled with exercise, it will result in muscle loss also, which has multiple negative health implications (52). Hence, the focus should be directed not only on weight loss but on improving body composition, specifically on sustainably losing fat mass while maintaining lean body mass (52).

## Conclusion

This study revealed the high prevalence of body image and shape dissatisfaction among youth in UAE and that body image is affected by individual's body composition and sex; low muscle mass and female sex increased the risk of BID. The study findings contribute to highlighting the importance of integrating body composition related screening, awareness, and education programs in academic settings for improving body image perception and better health.

**Limitations:** Our analysis has some limitations, such as the small sample, which was also not representative of the university student population in the country. In addition, dietary intake was not collected, and information related to physical activity was not detailed. Moreover, the cross-sectional nature of the study allowed us to delineate lines of association between the assessed variables, but not confirm causality. Finally, we used self-reported data, which can be a potential source of recall bias, which could affect the accuracy of

our results. Future studies can explore other components associated with body image and shape disorder among female and male students and explore their association with weight management and exercise, while elucidating sex-based differences at these levels.

**Conflicts of interest/Competing interests:** Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

**Ethics approval:** Ethical approval of this study was obtained from the UOS Research Ethics Committee (Ref. REC-19-03-07-03-S).

**Consent to participate:** Only consenting participants were included in the study.

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