ISSN: 2573-9565

Research article

Journal of Clinical Review & Case Reports

Correlation between the self-reported and measured weight, height and self perceived nutritional status among Indian students of medical profession

N Prabhat[1], Nimmathota Arlappa[2*], Aatif Qureshi I[3], Baer Philip Ravikimar[3], Nagalla Balakrishna[4]

[1]*Department of Anthropology, University of Hyderabad, Hyderabad, India.*

[2]*Division of Public Health Nutrition, ICMR-National Institute of Nutrition (NIN), Hyderabad, India.*

[3]*Department of Community Medicine, Mamata Medical College, Khammam, India.*

[4]*Apollo Medical College, Hyderabad, Telangana, India.*

[*]Corresponding author
Nimmathota Arlappa, Division of Public Health Nutrition, ICMR-National Institute of Nutrition, Jamai-Osmania (P.O), Hyderabad-500 007, India.

Submitted: 24 Feb 2022; **Accepted**: 02 Mar 2022; **Published**: 10 March 2022

Citation: *N Prabhat, Nimmathota Arlappa, Aatif Qureshi I, Baer Philip Ravikimar, Nagalla Balakrishna (2022) Correlation between the self-reported and measured weight, height and self perceived nutritional status among Indian students of medical profession. J Clinical Review & Case Reports 7(3):28-36.*

Abstract

Background: *Accurate measurement of weight and height is a pre-requisite for calculation of body mass index (BMI) and assessment of nutritional status of individuals. Direct measurement of weights and heights of large sample of subjects in field require huge expenditure. While collection of self reported anthropometric data may minimise the cost of nutritional surveys significantly.*

Objective: *The objective of this study was to assess the correlation between the self-reported and measured weight, height and self perceived nutritional status*

Methods: *A cross-sectional study was carried out among 387 students of medical profession. Anthropometric measurements like weights and heights of all the available students were measured. Self-reported data on weight, height, and self perceived nutritional status was obtained from the same subjects.*

Results: *The mean self reported weight of students was 57.6 kg (95%CI: 56.3-58.8) as against the measured weight of 57.0 kg (95%CI: 55.9-58.2) and they under-reported the weight by 0.6 kg. Likewise, the self reported height was 163.7 cm (95%CI: 162.8-164.6) as against the measured height of 161.6 cm (95%CI: 160.7-162.5) and over reporting of height was 2.1 cm. The correlation between self reported and measured weight and height was 0.982 and 0.950 respectively. Under reporting of weight and over reporting of height was higher among female students and the agreement between the self perceived and measured nutritional status was higher among male students ($p<0.001$). The inter-observer agreement between the perceived and measured nutritional status as calculated using Kappa statistics is "moderate" (Males: 0.427 & Females: 0.492).*

Conclusion: *In general, the students under-reported their weight and over-reported their height and this proportion was significantly higher among female students. Therefore, it is imperative that all the adolescents and those in their early adulthood should be aware of their nutritional status to facilitate them to adopt and practice healthy dietary and lifestyle practices.*

Keywords: Nutritional Status, Weight, Height, Body Mass Index, Overweigh, Obesity.

Introduction

Anthropometric assessments are useful since they provide a simple and practical way of describing the overall nutritional status of the population groups. Their usefulness stems from anthropometry's close correlation with the multiple dimensions of individual health and development and their socio-economic and environmental determinants [1]. Anthropometric studies can help identify nutritional problems such as undernutrition and overnutrition and pinpoint groups with specific nutritional and health needs to be addressed in policy development and programming [2]. Anthropometric measurements such as weight and height are important anthropometric indicators for assessment of nutritional status, monitoring of growth and evaluating health- and/or nutrition-related problems [3]. Measurement of accurate weight and height are pre-requisite for calculation of an anthropometric index such as body mass index (BMI).These anthropometric

measurements are essential for the assessment of obesity in youth because of their role in calculating body mass index (BMI) [4].

Thus, accuracy of anthropometric data is essential to correctly classify nutritional status of individuals [5]. Epidemiological studies have large samples, and direct assessment of weight and height may increase research costs since they require training on anthropometrics and greater time availability. There are also difficulties due to the transportation of equipment to the field [6]. Thus, self-reported measures can be an alternative for epidemiological measurements aiming at reducing cost and simplifying fieldwork [7]. Using self-reported measures of height and weight instead of measured values is attractive in large scale studies for practical and financial reasons [8,9].Age-related increases in obesity and unhealthy eating that occur among youth are cause for concern as they are associated with increased risk of cardiovascular disease, cancer and diabetes [10,11]. Since overweight, obesity, and poor eating behaviours are prevalent among youth populations, it is important to promote healthier body weights and eating habits among youth populations [12,13].

In developing countries, the change in nutritional intake combined with increasingly sedentary lifestyles resulting from food market globalization and increasing urbanization, has led to the emergence of chronic diseases as a major new health threat [14]. Underweight and obesity are both among the top ten leading risk factors for the global burden of disease and the current double burden of malnutrition seen in many developing countries is brought about by a coupling of risk factors [15]. The problem of double burden of disease i.e. undernutrition and obesity are gaining importance in public health domain in India. The prevalence of child and adolescent obesity is on rise in India. Several studies carried out in western counties (on adults and adolescents) reported that people tend to underestimate their weights and overestimate their heights when self reported data are used. Therefore, awareness of one's own nutritional status is essential to initiate preventive intervention measures such as adopting healthy life style behaviour to improve nutritional status and for the prevention of obesity, the major risk factor for many non-communicable diseases (NCDs). Despite the existence of strong correlations between self-reported and measured anthropometric indices, a number of validation studies among adolescents have found an overestimation of actual height, but underestimation of actual weight and BMI [16-20]. However, such studies on self-reported anthropometric data and perception of self-nutritional status are not readily available for adolescents and young adults in India. Therefore, a cross-sectional study was carried out with the objective of assessing the correlation between the self-reported and measured weight, height and self- perceived nutritional status of students of medical profession.

Materials and Methods

A cross-sectional study was carried out among 387 medical (MBBS: Bachelor of Medicine, Bachelor of Surgery), dental (BDS: Bachelor of Dental Surgery) and nursing (B.Sc: Bachelor of Science) final year students of Mamata Medical College, Khammam, Telangana, India. Of them, 133(34.4%) were males and 254 (56.6%) were females. All the students were in the age group of 20 to 22 years. Anthropometric measurements like weights and heights of all the available students on the day of survey were measured using standard equipment and adopting standards procedures. Weight was measured without shoes nearest to 100 gm with SECA digital weighing scale during morning hours of the college i.e.10 AM to 12 Noon. Height was measured using anthropometric rod, with the subject standing erect on a flat surface (without footwear) with feet together and head aligned in the Frankfort horizontal plane. Self-reported weight, height, and self perceived nutritional status (i.e chronic energy deficiency (CED), normal nutritional status, overweight and obesity) was obtained from the subjects using pre-tested questionnaire. BMI was calculated as weight (kgs) divided by height in meters square [21]. The WHO recommended BMI cut-off values for Asian adults were used to calculate overweight and obesity [22]. Nutritional status of the students was categorized as underweight/chronic energy deficiency (BMI < 18.5 kg/m2), normal (BMI 18.5-23.0 kg/m2), overweight (BMI 23.0-27.5 kg/m2) and obese (BMI >27.5 kg/m2).

The study was approved by the Chairman, Human Ethics Committee, Mamata Medical College, Khammam. Verbal informed consent was obtained from all the participants after assuring them the confidentiality of the data and the same was recorded in their individual proforma. The Ethics Committee approved the procedure of verbal informed consent adopted in this study. Since the study does not involve any invasive/ bio-chemical procedures and it involve only anthropometric measurements such as weight and height, we have not obtained the informed written consent from the subjects.

Statistical Analysis

Statistical analysis was performed using SPSS version 19.0 [23]. Mean (95% Confidence Intervals) height, weight and body mass index (BMI) were calculated using descriptive statistics for each gender. Mean differences for self reported and measured anthropometric variables was assessed by paired t-test. Correlation co-efficient analysis was performed to assess the agreement between self-reported and measured weight, height and BMI, and the same was presented as scattered diagrams. Under or over reporting of weight and height was assessed using proportion test across gender. McNemar and Pearson Chi-Square tests were performed to assess the agreement and association between self-reported and measured weight, height and BMI across professional courses. Agreement between self-perceived and measured nutritional status (BMI categories) was also assessed using McNemar test. Inter observer agreement between perceived and measured nutritional status was calculated by Kappa statistics [24]. Level of significance was considered when $p<0.05$ (two-tailed).

Results

In general, the mean self reported weight was 57.6 kg (95%CI: 56.3-58.8) as against the measured weight of 57.0 kg (95%CI: 55.9-58.2) and they under-reported the weight by 0.6 kg. While

the self reported height was 163.7 cm (95%CI: 162.8-164.6) as against the measured height of 161.6 cm (95%CI: 160.7-162.5) and over reporting of height was 2.1 cm. The overall correlation between self reported and measured weight and height was 0.982 and 0.950, respectively and the correlation was higher among male students (Table 1 &Figure 1). Significantly ($p<0.001$), a higher proportion females' students (73.6%) over reported their height compared to their male counter parts (54.9%). Similarly, under reporting of weight was relatively higher ($p>0.05$) among females' students (30.7%) as compared to male students (28.6%).

Table 1: Mean (95% CI†) weight, height and BMI of subjects.

Variables	n	Measured	Self-reported	Difference	Correlation
Male students					
Weight (Kg)	133	66.7 (64.7-68.7)	66.3 (64.5-68.1)	+0.4	0.977**
Height (Cm)	133	170.6 (169.4-171.8)	172.0 (170.1-173.2)	-1.4	0.928**
BMI	133	22.9 (22.3-23.40)	22.4 (21.9-22.9)	+0.5	0.930**
Female students					
Weight (Kg)	254	52.8 (51.6-54.0)	52.2 (51.1-53.2)	+0.6	0.974**
Height (Cm)	254	156.9 (156.3-157.6)	159.3 (158.6-160.0)	-2.4	0.878**
BMI	254	21.4(21.0-21.8)	20.5 (20.2-20.9)	+0.9	0.938**
Pooled					
Weight (Kg)	387	57.6 (56.3-58.8)	57.0 (55.9-58.2)	+0.6	0.982**
Height (Cm)	387	161.6 (160.7-162.5)	163.7 (162.8-164.6)	- 2.1	0.950**
BMI	387	21.9 (21.6-22.3)	21.2 (20.9-21.5)	+ 0.7	0.935**
** Correlation is significant at the 0.01 level					
†: Figures in the parenthesis are 95% Confidence Intervals (CIs)					

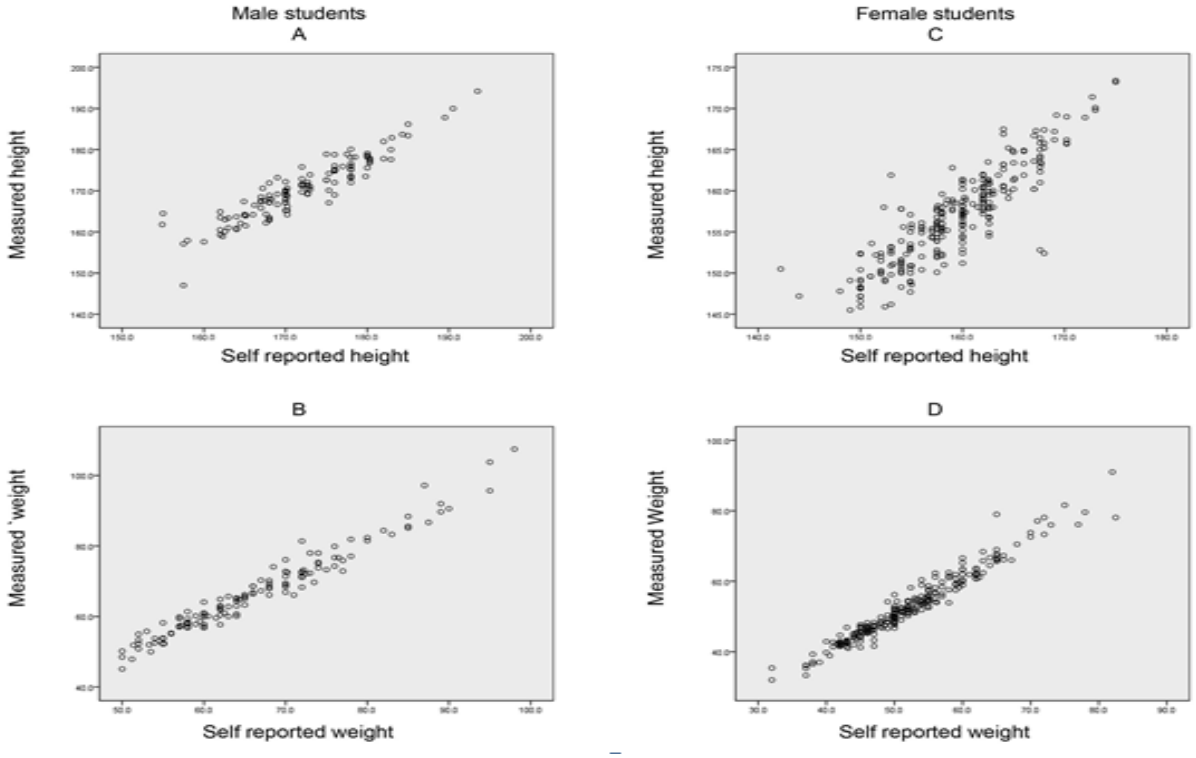

Figure 1: Scattered diagram showing correlation between self reported and measures height and weight among students by gender. The correlation between self reported and measures height (A) and weight (B) among male students was 0.928 and 0.977, respectively. While, the corresponding figures for the female students are 0.878 (C) and 0.974 (D), respectively.

Nutritional status of students as per BMI calculated based on measured weights and heights by medical profession and gender is presented in Table 2 & Figure 2. The proportion of students with undernutrition i.e. chronic energy deficiency (CED) was significantly (p<0.000) higher among nursing students (25.7%) compared to medical and dental students, while a higher proportion (42.3%) of medical students were overweight/obese. The prevalence of overweight/obesity was higher (46.6%) among male students as compared to female students (p<0.000).

Table 2: Distribution (%) of students according to nutritional status as per BMI calculated based on measured weights and heights by type of medical profession.

Particulars	Nutritional Status				
	n	CED†	Normal	Overweight	Obese
Professional Course					
MBBS (Medical)*	175	5.7(10)	52.0(91)	34.3 (60)	8.0(14)
BDS (Dental)*	107	13.1(14)	55.1(59)	20.6(22)	11.2(12)
B.Sc (Nursing)*	104	25.7(27)	58.1(61)	14.3(15)	1.9(2)
Pooled	387	13.2 (51)	54.5 (211)	25.1(97)	7.2 (29)
Pearson Chi-square: 38.66;p<0.000					
Gender					
Men	133	7.5 (10)	45.9 (61)	37.6 (50)	9.0 (12)
Women	254	16.1 (41)	59.1 (150)	18.5 (47)	6.3 (16)

Pearson Chi-Square: 38.66; p<0.000; †: CED: Chronic energy deficiency; *MBBS: Bachelor of Medicine, Bachelor of Surgery; BDS: Bachelor of Dental Surgery; B.Sc: Bachelor of Science.

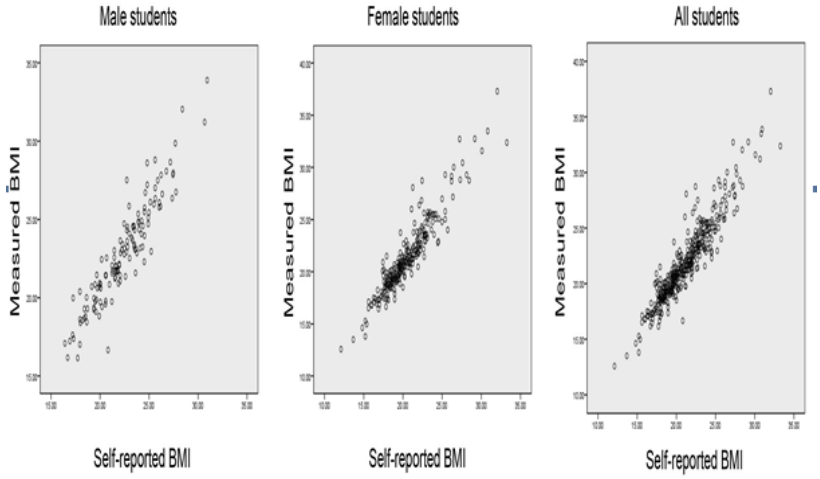

Figure 2: Scattered diagram showing correlation between self reported (weight and height) and measured BMI among students. In general, the overall correlation between self reported (weight and height) and measured BMI among the students of both gender is 0.935, while it is 0.930 among male and 0.938 among female students.

The agreement between self-reported (weight and height) and measured nutritional status of students in terms of BMI categories is presented in Table 3. In general, the agreement was high with respect to CED (86.3%) and normal nutritional status (81.5%), while the agreement was low with respect to overweight (63.9%) and obesity (42.9%). There was a good agreement with respect to CED among 80% and 87.8% of male and female students, respectively. However, the agreement with respect to overweight was low among female students (53.2%) compared to male students (74.0%). The agreement was high among the nursing students with CED, and among the medical students with overweight/obesity (Table 4).

Table 3: Distribution (%) of students according to nutritional status as per MBI calculated based on measured and self-reported weights and heights by gender.

Measured	n	Self-reported			
		CED†	Normal	Overweight	Obese
Male Students					
CED	10	80.0(8)	20.0(2)	0.0(0)	0.0(0)
Normal	61	9.8(6)	82.0(50)	8.2(5)	0.0(0)
Overweight	50	0.0(0)	24.0(12)	74.0(37)	2.0(1)
Obese	12	0.0 (0)	8.3 (1)	58.3 (7)	33.3 (4)
Female Students					
CED	41	87.8 (36)	12.2 (5)	0.0 (0)	0.0 (0)
Normal	150	17.3 (26)	81.3 (122)	1.3 (2)	0.0 (0)
Overweight	47	0.0 (0)	46.8 (22)	53.2 (25)	0.0 (0)
Obese	16	0.0 (0)	12.5 (2)	37.5 (6)	50.0 (8)
Pooled					
CED	51	86.3 (44)	13.7 (7)	0.0 (0)	0.0 (0)
Normal	211	15.2 (32)	81.5(172)	3.3(7)	0.0 (0)
Overweight	97	0.0 (0)	35.1(34)	63.9(62)	1.0 (1)
Obese	28	0.0 (0)	10.7 (3)	46.4 (13)	42.9(12)
Pearson Chi-square: 475.89; p<0.000; †: CED: Chronic energy deficiency					

Table 4: Distribution (%) of students according to nutritional status as per BMI calculated based on measured and self-reported weights and heights by Professional Course.

Measured	n	Self-reported			
		CED	Normal	Overweight	Obese
MBBS (Medical)					
CED	10	80.0(8)	20.0(2)	0.0(0)	0.0(0)
Normal	91	6.6 (6)	91.2(83)	2.2(2)	0.0(0)
Overweight	60	0.0(0)	28.3(17)	70.0(42)	1.7(1)
Obese	14	0.0 (0)	7.1(1)	35.7(5)	57.1(8)
BDS (Dental)					
CED	14	78.6(11)	21.4(3)	0.0 (0)	0.0 (0)
Normal	59	25.4(15)	71.2(42)	3.4(2)	0.0 (0)
Overweight	22	0.0 (0)	45.5(10)	54.5(12)	0.0 (0)
Obese	12	0.0 (0)	16.7(2)	58.3(7)	25.0(3)
B.Sc (Nursing)					
CED	27	92.6(25)	7.4(2)	0.0 (0)	0.0(0)
Normal	61	18.0(11)	77.0(47)	4.9(3)	0.0
Overweight	15	0.0 (0)	46.7(7)	53.3(8)	0.0 (0)
Obese	2	0.0 (0)	0.0 (0)	50.0(1)	50.0(1)
McNemar-Bowker Test: 18.51; p<0.001.					

The agreement between the students' self perceived nutritional status (i.e. chronic energy deficiency, normal nutritional status, overweight and obesity) and BMI calculated based on measured weights and heights are presented in Table 5. In general, the agreement was high with respect to normal nutritional status (89.6%), while it was poor in case of overweight (35.1%) and obesity (14.3%). Similarly, the agreement between the perception about their nutritional status and actual nutritional status was higher

among male students as compared to their female counterparts (p<0.001). As compared to other students, the agreement between the perceived and actual nutritional status with respect to CED and normal nutritional status was high among dental students (p<0.001) (Table 6). The interobserver agreement between perceived and measured nutritional status as calculated by Kappa statistics among both genders is "moderate" (Male Students: 0.427 & Female students: 0.492).

Table 5: Distribution (%) of students according to nutritional status as perceived by the students and BMI calculated based on measured weights and heights by gender.

Measured nutritional status	n	Perceived nutritional status			
		CED	Normal	Overweight	Obese
Male Students					
CED	10	60.0(6)	40.0(4)	0.0(0)	0.0(0)
Normal	61	11.5(7)	88.3(54)	0.0(0)	0.0(0)
Overweight	50	0.0(0)	64.0(32)	34.0(17)	2.0(1)
Obese	12	0.0(0)	8.3(1)	83.3(10)	8.3(1)
Female Students					
CED	41	48.8(20)	51.2(21)	0.0 (0)	0.0(0)
Normal	150	6.0(9)	90.0(135)	4.0(6)	0.0
Overweight	47	0.0 (0)	61.7(25)	36.2(17)	2.1(1)
Obese	16	0.0 (0)	6.3(1)	75.0(12)	18.8(3)
Pooled					
CED	51	51.0(26)	49.0(24)	0.0 (0)	0.0(0)
Normal	211	7.6(16)	89.6(189)	2.8(6)	2.1(2)
Overweight	97	0.0 (0)	62.9(61)	35.1(34)	2.2(2)
Obese	28	0.0	7.1(2)	78.6(22)	14.3(4)
McNemar-Bowker Test: 62.54; p<0.001.					

Table 6: Distribution (%) of Nutritional status as per perception of subjects and BMI calculated based on measured weights and heights by professional course.

Measured nutritional status	n	Perceived nutritional status			
		CED	Normal	Overweight	Obese
MBBS (Medical)					
CED	10	50.0(5)	50.0 (5)	0.0(0)	0.0(0)
Normal	91	7.7 (7)	86.8(79)	5.5(5)	0.0(0)
Overweight	60	0.0(0)	56.7(34)	41.7(25)	1.7(1)
Obese	14	0.0(0)	7.1(1)	64.3(9)	28.6(4)
BDS (Dental)					
CED	14	64.3(9)	35.7(5)	0.0(0)	0.0(0)
Normal	59	5.1(3)	93.2(55)	1.7(1)	0.0(0)
Overweight	22	0.0(0)	73.3(17)	22.7(5)	0.0(0)
Obese	12	0.0(0)	8.3(1)	91.7(11)	0.0(0)
B.Sc (Nursing)					
CED	27	44.4(12)	55.6(15)	0.0(0)	0.0(0)
Normal	61	9.8(6)	90.2(55)	0.0(0)	0.0(0)
Overweight	15	0.0(0)	66.7(10)	26.7(4)	6.7(1)
Obese	2	0.0(0)	0.0(0)	100.0(2)	0.0(0)
McNemar-Bowker Test: 18.51; p<0.001					

Discussion

Our study is, perhaps the first one that has been carried out on students of medical profession with an aim to study the correlation between their self reported and measured weights, heights and perceived nutritional status in India. In general, the students under-reported their weight and BMI, and over-reported their height. Gorber et al. [7] in their systematic review of 64 studies with similar objectives reported similar findings. Hodge et al. Engstrom et al. and also reported the similar observations [8,25]. A study carried out among young adult university students in Scotland reported a significant proportion of students under reported their weight and no difference observed between self reported height and measured height [9]. Merrill and Richardson reported the findings from National Health and Nutrition Examination Survey (NHANES) that men tend to overestimate their weight, but women underreport their weight, more so in younger ages [26]. A review of multi country data revealed that adult individuals in China and Russia over reported their heights as compared those in India and South Africa, who under reported their heights [27].

The correlation between self reported weight and height was higher among male students as against their female counter parts. Similar observation was reported by Bowman & Delucia and Engstrom [28,29]. In spite of the errors in self reporting of weight and height, the correlation between self reported weight and height were high in this study, and the correlation was relatively higher among male students as compared to their female counterparts. Spencer et al. and Wada et al. also reported similar correlation between self-reported and measured height and weight [30,31].

In our study, the proportion of under-reporting of weight and over reporting of height was higher among female students as compared to male students. A study carried out by De Vriendt et al. among Belgian adolescents also reported the similar observation [16]. Engstrom et al. reviewed 26 studies on the accuracy of self-reported height among women and adolescent girls and found that in 21 of them height was overestimated [25]. Similarly, they found weight was under-reported by women and adolescent girls in all of the 34 studies that they reviewed [25]. In the present study, under reporting of weight was relatively higher among females students as compared to male students ($p>0.05$) and other studies carried out in western counties reported similar trends where boys underestimated their weight to a lesser extent than girls did [32-35]. On the other hand, females students (73.6%) significantly ($p<0.001$) over reported their height as compared to their male counter parts (54.9%). This in conformation with the previous studies carried out in different parts of the world [20,33,35, 36]. We could attribute this tendency of under reporting of weight and over reporting of height among females to socio-cultural factors. Several studies have used a correlational approach to study socio-cultural predictors of body-related affect and behaviour [37]. Harrison found that exposure to thin-ideal TV was associated with a rise in eating disorder symptoms in adolescent girls; this effect was partially mediated through increasing perceived discrepancies between actual and ideal body shape [38]. Studies suggest that comparison processes may be triggered automatically for women as soon as attractive media models are presented [39,40].

In general, the correlation between self reported and measured weight, height and BMI was high in our study, indicating high percent of agreement between self reported and measured anthropometric measurements. A study carried out among Australian young adults also reported high agreement between self reported and measured weight, height and BMI among adolescents [41] and these correlations were high as compared to the correlations reported between self reported and measured weight, height and BMI by other studies [5,35,42]. This could be attributed to the medical profession of study subjects in our study.

Significantly, a higher proportion of male students were overweight/obese (46.6%) as compared to female students ($p<0.000$). Similarly, a significant ($p<0.000$) difference was observed in nutritional status of students across the courses, where a higher proportion of medical (MBBS) students were either overweight or obese (42.3%), and a higher proportion of nursing students (25.7%) were undernourished (CED). In general, 86.3% undernourished (CED) students and 81.5% of students with normal nutritional status correctly reported their nutritional status (as per BMI calculated based on self reported weight and height), while this proportion was only 63.9% and 42.9%, respectively among overweight and obese students. Similarly, 59.3% and 32.3% of overweight/obese female and male students respectively, reported their nutritional status as normal. Whereas, only 8.2% of normal male and 1.2% of normal female students reported their nutritional status as overweight and none of them reported as obese. A majority (91.2%) of medical (MBBS) students with normal nutritional status reported their nutritional status correctly as compared to the dental and nursing students. Likewise, a higher proportion (70%) of overweight medical (MBBS) students reported as overweight compared to other students.

However, the perceived nutritional status was low with respect to undernutrition (CED) in both genders, where only 60% and 48.8% of male and female undernourished students perceived their nutritional status correctly. In case of overweight, only 34% of male and 36.2% of female students with overweight correctly perceived the same. The agreement between self perceived and measured nutritional status was high (86.8- 93.2%) with respect to normal nutritional status and low (22.7- 41.7%) with respect to overweight across the courses.

Conclusion

A striking finding which stood out like a sore thumb was the ignorance exhibited by the students of medical profession concerning their own nutritional status. Surprisingly, the students possessed poor perception and awareness about their nutritional status. This lack of awareness on aspect of self nutritional status necessitates us to ponder whether self- reporting as a research method is pragmatic in the current context. Therefore, till the time situation improves, it would be prudent to stick to the time-tested

method of actual anthropometric measurements. Therefore, all the adolescents and young adults should be encouraged to be aware of their weight, height and BMI in order to understand their nutritional status. This could be achieved through devising effective health & nutrition education (HNE) and behaviour change communication (BCC) strategies. This would facilitate them to adopt and practice of primordial or primary preventive measures, such as healthy dietary and lifestyle practices for the prevention and control of non-communicable diseases in general, and overweight/obesity in particular, during adulthood and later stages of life.

Acknowledgement

We are very grateful to Dean & Principal, Mamata Medical College, Dr.Ratna Philip, Principal, Mamata Nursing College and Dr.G.Venkateswarlu, Principal, Mamata Dental College and for the support in successful completion of this study. We also acknowledge the co-operation rendered by Dr. Manoj Patki, Associate professor and Mr. George, Tutor, Department of Community Medicine, Mamata Medical College, Khammam.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

None

Author Contributions

NA, BPR, AQ: Preparation of Study proposal; data collection, data interpretation and analysis; manuscript draft and revision; approval of the submitted version.

NP: Review of literature; analysis; manuscript draft preparation; approval of the submitted version.

NBK: Data analysis; Data interpretation; approval of the submitted version.

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