

## A cross-sectional study on the assessment of nutritional status among young pharmacy students by measuring skinfold thickness

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### KEYWORDS

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### ABSTRACT

Estimating body contents is important for monitoring and delivering essential information on medical issues, evaluating nutritional health, and the consequences of nutrition-related illness development and therapies. The measurements employed in this investigation were the body mass index (BMI), weight, height, and skinfold thickness. Although skinfold thickness is regarded as one of the most accurate methods of measuring body fat, the assessment method is contingent upon the objective, e.g., determining undernutrition or obesity. As of 2017, the World Health Organization (WHO) reported that over four million deaths globally are associated with overweight or obesity. This indicates that obesity has reached epidemic proportions. Malnutrition causes stunting and growth problems in children, pregnant women, and teenage girls in India. Several factors, such as inadequate breastfeeding, low levels of education, poor sanitation, and poor maternal nutrition, underscore the need for more potent interventions.

BMI is an easy and affordable way to screen for weight categories that could cause health issues. Though skinfold thickness, bioelectrical impedance, and other methods are more direct ways to measure body fat, BMI is correlated with them. Because skinfold thickness measurements are accurate in determining body fat, they are used as the main statistical tool in this study. Skinfold thickness is measured with callipers intended to apply a certain amount of pressure in millimetres. The body is measured on one side to ensure consistency: Central locations (pectoral, subscapular, abdomen, supra-iliac) and limb sites (biceps, triceps, quadriceps, calf). The limb sites for skinfold thickness measurements will be the main focus of this study.

## INTRODUCTION:

Estimating body contents is an essential part of assessing nutritional status because it provides useful information about how a medical condition is likely to progress and makes it possible to track the impact of dietary interventions and the advancement of nutrition-related diseases. This study took into account measurements of skinfold thickness, body mass index, height, and weight. Skinfold thickness measurements are considered among the most accurate ways to measure body fatness, so they are used as the main tool for statistical analysis in our study. The best approach for utilising measurements of anthropometry to assess body composition depends on the goal (i.e., evaluating weight gain or malnutrition) <sup>[1]</sup>.

The World Health Organization (WHO) states that obesity has reached an epidemic level, with more than 4 million deaths annually from obesity or being overweight in 2017, which is consistent with the global burden of disease <sup>[2]</sup>. Malnutrition in India affects adolescent girls, pregnant women, and children, leading to stunting and growth issues. Key factors include poor maternal nutrition, inadequate breastfeeding, low education levels, and poor sanitation. Despite some progress, more effective measures are needed to tackle undernutrition and support the country's development <sup>[3]</sup>. Overview of Body Fat Measurement: BMI is an easy-to-use, reasonably priced instrument for determining possible weight-related health hazards. Although the thickness of skinfold measures and bioelectrical resistance are more accurate approaches to measuring body fat, BMI is not a direct substitute for these techniques. As a result, BMI can be used as a stand-in for precise measurements of body fat <sup>[4]</sup>.

Skinfold thickness is expressed in millimetres using callipers that exert a 10g/mm<sup>2</sup> compression. Measurements are made at central locations (pectoral, subscapular, abdomen, and supra-iliac) as well as limb sites (the bicep, triceps, muscles, quadriceps, and calf). For uniformity, measurements are usually done on one side of the body. Measurements at limb sites are the main focus of this investigation <sup>[5]</sup>. Skinfold thickness measurements (STM) are generally used to estimate the subcutaneous thickness of fat at different regions in the body. The four regions such as triceps, biceps, subscapular and supra-iliac, are measured in millimetres using pre-standardized callipers. To estimate the fold of the skin thickness, the overall average of three consecutive observations is used. The total skinfold thickness at each of the four locations is first determined. Lastly, the total skinfold thickness was computed in the supra-iliac, subscapular, bicep and arms regions <sup>[6]</sup>.

The formula for the calculation of body density is as follows: Age (years) 20-29

Equations for men  $D = 1.1631 - (0.0632 * L)$

Equations for women  $D = 1.1599 - (0.0717 * L)$

Where D = Predicted density of the body (g/ml), L = log of the total of the four skinfolds (mm). After obtaining the body density, using the Siri formula, we get the body fat percentage. The equation may include: Siri = % body fat =  $(495/\text{body density}) - 450$

Nutritional status, therefore, plays a critical role in the decision-making and functioning of pharmacy students. Thinking like an expert by weighing the evidence and making the right decisions about a patient to solve a patient's problems is a skill set that students should practice so it becomes automatic <sup>[7]</sup>. Reliability: While upper arm oedema is uncommon, the triceps skinfold

is the most accurate skinfold measurement to take. Because of their weaker muscles and skin, older people's measures are less accurate. Their muscles are, therefore, frequently taken in the skinfold. Skinfold measures can provide erroneous results in patients with dehydration, oedema, and chronic muscular disorders. Why Pharmacy students: The need for customised and specialised pharmacy services, such as deprescribing, home medication evaluations, chronic disease management, and geriatric drug management, is increasing in developed countries' health systems <sup>[8]</sup>.

A diet heavy in fat and sugar can cause a person to feel weak, have trouble concentrating, do worse in school, become apathetic, lack motivation, have low self-esteem, have mood swings, and have trouble sleeping. Students should eat a diet high in fibre-rich foods, such as fruits, vegetables, peas, beans, whole grain bread, cereals, brown rice, nuts, and seeds, as well as potatoes with skins, to prevent these side effects <sup>[9]</sup>. Physical Activity: College students can reduce stress by engaging in physical activity, according to the Anxiety and Depression Society of America. Running or working out for oneself is not a waste of time; rather, it is an investment in your self-care <sup>[10]</sup>. The improved bike split performance for males was not influenced by low skin-fold thicknesses. Due to their exhaustion from the cycling portion of the event, this element likewise had little effect on their running abilities <sup>[11]</sup>. MyotonPRO®, a non-invasive portable instrument for measuring the mechanical characteristics of muscular tissue, was introduced viir.at.al2006. It detects In the rectus femoris, tibialis anterior, and biceps brachii muscles, there is a difference in the association between the thickness of skinfold and plyometric parameters in men and women <sup>[12]</sup>. In HD patients, lower peripheral fat content and lower muscle mass are linked to increased all-cause mortality. Further research is required to confirm these results, which could have significant therapeutic ramifications for weight loss recommendations for dialysis patients both on and off the transplant list <sup>[13]</sup>.

Edwards et al.(1955) found Harpenden skinfold Callipers to be precise, with minimal instrument variation Significant observer differences were noted, linked to inconsistent skinfold site location and technique for accurate skinfold thickness <sup>[14]</sup>. To more accurately estimate the percentage of body fat in Asian-Chinese individuals, gender-specific formulas were created. The Body composition assessment is key for evaluating metabolic disease risks. DEXA, a modern and user-friendly method, is increasingly preferred over the traditional but cumbersome hydrostatic weighing <sup>[15]</sup>. The scales must be devoid of bias to assess group differences. The academic support scales did not consistently predict GPA over time or across demographic groups. The connection of the scales to external variables requires more investigation <sup>[16]</sup>. We validated two SFT equations for assessing fat mass and percentage fat mass in 5-15-year-old Sri Lankan children. There is a lack of similar data for South Asian populations, hindering comparative analysis. Further studies using multi-component assessments are needed to confirm these results <sup>[17]</sup>. Nutritional status evaluation is crucial for pharmacy students to ensure they maintain optimal health, which is essential for their roles as future healthcare professionals. This assessment involves measuring factors like weight, BMI, and dietary intake to determine an individual's nutritional status and energy needs. By understanding their nutritional status, pharmacy students can lead by example, promoting healthy lifestyles and better healthcare practices within their community.

## **METHODOLOGY:**

A cross-sectional, prospective observational study was conducted involving voluntary participants from the pharmacy student body at a South Indian university. Skinfold thickness was measured using standardised callipers at predefined anatomical sites to estimate body fat density

and percentage. Participants completed a comprehensive lifestyle and dietary questionnaire to provide context for their nutritional status. Data were analysed to identify correlations between lifestyle factors and nutritional health, as well as to determine the nutritional needs of malnourished students.

The body fat per cent of 75( males 38 Nos, females 37 Nos), the volunteer's measurements were recorded using Flovein Skinfold Caliper by skinfold thickness measurement technique and from BMI. The age range of the subjects involved in the study was 18 - 28 years of age. The study was carried out in Chengalpattu, Tamil Nadu, India, at SRM College of Pharmacy, SRMIST, Kattankulathur, for 14 days. Before the start of the study, ethical approval was taken from the institutional ethics committee of SRM MCH (8262/IEC/2022). Both genders of students between the ages of 18 and 24 were enrolled in this study. Students who met the following exclusion criteria have a medical condition that could affect the study's results. like eating disorders, peptic and duodenal ulcers, viral infections, etc., pupils who have experienced neurological, metabolic, or genetic illness in the past.

### **Procedure:**

These key body locations have been shown in studies to be indicative of the total amount of fat on the body: (a) the back of the upper arm (biceps); b) the front of the upper arm (biceps); c) the subscapular fossa of the scapula (subscapular); d) a diagonal fold immediately above the front protrusion of the hip bone (supramaculous). The fold is performed vertically on the underside of the upper arm, midway between the shoulder and elbow joints. Using his left hand, the analyst pulls the skin, positioning the calliper jaws ½ inch away from the fingers. The whole power of the jaw is applied to the skin fold when the calliper's trigger is fully released. When taking readings, the analyst holds the skin fold with his or her left hand and does not release it. The four best readings are selected and combined with the aid of the available charts. We'll compute the body fat percentage. The same process that was previously described for the triceps, subscapular, and suprailiac parts of the body will be applied to the bicep.

### **RESULTS:**

#### **Age and gender distribution:**

A total number of 75 subjects were involved in the study. The gender-wise distribution is shown in Table no 1, where male subjects were 38 (50.66%) and female subjects were 37 (49.33%). Between the age group 19-20 years, a total of 3 male subjects and 13 female subjects, a total of 16 (21.33%), 20-21 years, a total of 27 male subjects and 23 female subjects, a total of 50 (66.66%), 21-22 years total of 5 male subjects and one female subject which sums to a total of 6 (8.0%), 22-23 years total of 3 male subjects (4%) enrolled in the study. A total of 38 male subjects and 37 female subjects were included in the study. In these 38 male subjects, the BMI of the individuals was calculated by considering measurements like height and body weight. It was noted that the findings fell into the following categories: underweight, normal, overweight, pre-obesity, and obese type 1. Further details about the BMI-wise distribution of males & females were demonstrated in Table 1

**Table 1:** BMI wise distribution of subjects

<b>Bmi range</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>	<b>Percentage (%)</b>
Underweight	3	9	12	16 %
Normal	14	17	31	41.4 %
Overweight	8	4	12	16 %
Pre-obese	6	7	13	17.3 %
Obese type 1	7	0	7	9.3 %
<b>Total</b>	<b>38</b>	<b>37</b>	<b>75</b>	<b>100</b>

**Questionary :**

**How often the breakfast is skipped:** When the question asked How often the subjects skip their breakfast, the response was that 15.2% skipped very often, 37.9% skipped often, 16.7% always skipped, and 30.3% never skipped their breakfast. What kind of food habits do they follow? When asked about their food habits, 75.8% were reported as non-vegetarians and 24.2% reported as vegetarians.

**How often junk is consumed:** When asked about their junk food intake, 9.1% reported very often they take, 48.5% were often they take, 10.6% were always prone to junk foods, and 31.8% take rarely.

**Quality of sleep:** When asked about the quality of their sleep, 60.6% of students get regular and pleasant sleep, and 39.4% have split/ segmented sleep patterns

**Physical activity followed by the subjects:** When enquired about their physical activity such as exercises, 68.2% were rarely involved with any kind of physical activity such as gym or exercise, 10.6% of students do exercise very often, 13.6% do twice or thrice a week, 7.6% may do once a week.

**Adverse Habits:** Regarding drinking and smoking habits, 93.9% were found to be away from these habits and 6.1% were found to have the habit of smoking and drinking occasionally.

**About the Mental Status:** When asked about their mental status, i.e. the times when they feel depressed, the following responses were observed: 15.2% always feel depressed, 47% of the population feels depressed sometimes, 12.1% never get depressed, and 25.8% rarely get depressed.

**Eating habits during the depression:** When asked about the food habits they followed at the time of depressed mental state, 65.2% tend to overeat, and 34.8% of the population tend to overeat.

### Measurement of skin fold thickness :

The male and female skin fold thicknesses were measured in the biceps, triceps, subscapular, and suprailiac regions out of a total sample size of 75. For males and females, respectively, the mean and standard deviation were computed at the designated regions. The mean and standard deviations of the measures made of all the individuals, broken down by age and gender, are displayed, Further details about the Measurement of skin fold thickness for males were demonstrated in Table 2

Women's typical measurements of skinfold thickness were 6.7 mm for the bicep, 8.8 mm for the tricep, 11.3 mm for the subscapular, and 12.46 mm for the supra iliac at age 20. The measures at age 21 were 10.2 mm for the supra-iliac, 9.5 mm for the subscapular, 8.2 mm for the tricep, and 6.8 mm for the bicep. The thicknesses at age 22 were 5.3 mm, 6.3 mm, 7.3 mm, and 9.3 mm, in that order. No standard deviations were provided for the latter age. Further details about the Measurement of skin fold thickness for females were demonstrated in Table 3

The skin fold thickness measurements for both boys and females at different sites are included in the table, along with their mean and standard deviation. Males showed higher mean values than females for the bicep, tricep, sub-capsular, and supra-iliac skin folds. For these comparisons, the two-tailed P value is 0.0002, which shows how statistically significant the observed differences between males and girls are. Further details about the Comparison of Skin fold Thickness for Males and Females were demonstrated in Table 4

Among the 75 pupils, 38 of whom were male and the remaining 37 female, 18.42% of the boys and 5.40% of the girls were deemed to have high nutrition status. 26.31% of males and 35.15% of females had an average nutrition status, whereas 23.68% of males and 37.83% of females were found to have good nutrition status. Based on their skin fold thickness measurements, it was discovered that 21.05% of males and 8.1% of females were overweight, while 10.25% of males and 13.51% of females were underweight. Further details about the Nutrition Status of the Young Pharmacy Students were demonstrated in Table 5

**Table 2: Measurement of skin fold thickness for Males:**

Variables	Male		Female		P value
	Mean	Sd	Mean	Sd	
Bicep	7.3	2.39	6.2	1.01	0.0002*
Tricep	9.02	3.6	7.7	1.27	
Subcapsular	12.82	5.91	9.3	1.58	
Supra-iliac	13.53	6.2	7.99	2.04	

**Table 3: Measurement of Skin Fold Thickness for Females:**

Age	Bicep		Tricep		Subcapsular		Supra-iliac	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
20	6.7	1.04	8.8	1.76	11.3	1.92	12.46	2.62
21	6.8	1.99	8.2	2.07	9.5	2.82	10.2	3.52
22	5.3	0	6.3	0	7.3	0	9.3	0

**Table 4: Comparison of Skinfold Thickness for Male and Female:**

Age	Bicep		Tricep		Subcapsular		Supra-iliac	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
20	4.2	2.81	5.5	3.54	6.4	5.68	7.9	5.91
21	7.67	2.84	9.3	3.49	12.78	5.75	13.83	6.01
22	6.7	3.01	9.2	3.77	11.9	6.16	11.7	6.41
23	10.73	3.08	12.1	3.94	20.2	6.07	20.6	6.54

**Table 5: Nutrition Status of the Young Pharmacy Students:**

Nutrition status	Male (n=38)	Percentage	Female (n=37)	Percentage
Excellent	07	18.42%	02	5.40 %
Good	09	23.68%	14	37.83 %
Average	10	26.31%	13	35.15 %
Overweight	08	21.05%	0	8.10 %
Competition	04	10.25%	05	13.51 %
<b>Total</b>	<b>38</b>	<b>100%</b>	<b>37</b>	<b>100%</b>

## **DISCUSSION:**

There were 75 students in the study sample, with a gender distribution that was almost balanced at 50.66% male and 49.33% female. Participants' ages were distributed primarily in the 20-21 year old range, making up 66.66% of the sample. Given that students in undergraduate programs typically fall into this age range, it is likely that the sample fairly represents the demographic makeup of the general student body at universities. The study used skinfold thickness measurements and the Body Mass Index (BMI) to evaluate health and body composition. Based on these metrics, the results showed that 26.66% of the students were categorised as unhealthy. Of them, 14.66% were classified as overweight, meaning that their body weight was higher than ideal for their height. On the other hand, 12% of the students were categorised as underweight, indicating a weight below what is normal for their height.

Regarding gender disparities, the research revealed that male students exhibited a greater average body mass index (BMI) in contrast to their female peers. Men tend to have higher BMIs for a variety of reasons, such as higher weights due to increased muscle mass or higher levels of total body fat. However, the average body fat percentage was higher among female students. This is in line with overall physiological differences.

Since women typically have a higher body fat percentage than men. These results imply that women have a higher percentage of body fat than men, even though men in the study may have carried a greater total body, possibly as a result of higher muscle mass or fat accumulation. This suggests that while men might have a higher BMI, which would indicate more muscle or fat mass, women's higher body fat percentage indicates gender-specific variations in body composition. Overall, the data emphasises how important it is to take gender variations in body composition into account when assessing nutritional status and general health.

In our study of analysing skinfold thickness of young pharmacy students, there is a significant difference in Supra iliac region among other measurements, i.e. Male subjects have higher supra iliac fat than females, which is similar to that of a study conducted by Rajdeep Kaur, and Dr. Pritam Sing, in the year of 2018 <sup>[18]</sup>

In our study, the subscapular skinfolds were much higher in females, indicating a higher level of subcutaneous adiposity than the Male subjects, which is similar to the results of Meltem Soyulu et al. in the year 2021 <sup>[19]</sup>

In our study, it is clear that there is no linear relationship between body density and skinfold in either sex: in the more obese subjects, relatively large increases in skinfold thickness are associated with only small changes in body density, which is comparable to research done in 1972 by J. V. G. A. Durnin and J. Womersley <sup>[20]</sup>

Several lifestyle factors were found to have a significant impact on participants' obesity in our study. Remarkably, a sizable segment of the sample disclosed unhealthy behaviours: 69.7% of the individuals frequently skipped breakfast, a meal that is essential for preserving metabolic equilibrium and regulating appetite throughout the day. Furthermore, 68.2% of the participants ate junk food regularly. The frequency of junk food consumption was another factor used to further divide this group: 9.1% of participants consumed these foods frequently, which is frequently associated with making poor dietary choices and consuming too many calories.

Moreover, split or fragmented sleep patterns were reported by 39.4% of the participants. By upsetting the body's natural circadian rhythms, this kind of sleep disturbance can impact metabolic health by influencing energy expenditure and appetite regulation. When taken as a whole, skipping breakfast, consuming a lot of junk food, and having sleep disturbances are strongly linked to obesity. They affect general health and behavioural patterns, which indirectly contribute to overweight conditions, as well as directly through poor dietary choices and metabolic disruption. The interaction of these behaviours demonstrates the complexity of obesity and emphasises the necessity of all-encompassing lifestyle interventions to successfully address these causative factors.

## **CONCLUSION:**

The unhealthy subgroup exhibited several concerning behaviours. They claimed to sleep irregularly or insufficiently, eat a lot of junk food, and exercise little. Specifically, the fact that these individuals either slept for very little time at all or experienced frequent interruptions made their already generally depressed state even worse. Our recommendation is to address these issues by implementing a comprehensive approach to improving health. For the sick population, dietary modifications are essential, with an emphasis on foods high in protein, vitamins, and other essential elements. For those who have been diagnosed as fat, we advise giving up junk food, incorporating healthier food options, working out frequently, and establishing a regular sleep schedule. These steps are essential for promoting better health and minimising the negative effects of their current lifestyle choices.

However, this study has certain limitations. The small sample size may limit the generalizability of the results. For future research, a larger sample size might be helpful to get more precise and representative results. Moreover, skinfold thickness measurements only consider subcutaneous fat, potentially missing other types of body fat distribution. Furthermore, human error could happen when measuring, which could have an impact on the accuracy of the data collected. Future studies that take these limitations into account might provide a more complete picture of the health and body composition of this population. 26.66% of the pharmacy students in our sample were deemed unhealthy based on the skin fold thickness measurement. Of the individuals in this unhealthy group, 14.66% were classified as overweight and 12% as underweight. It's interesting to note that, in comparison to their male counterparts, female subjects had an average body fat percentage that was higher. Males had a higher average Body Mass Index (BMI) than females, even though females had a higher body fat percentage. This difference implies that although the proportion of body fat in women may be higher, men's total body mass is higher, which influences their BMI differently. We suggest sticking to a regular and sufficient sleep schedule, avoiding junk food, and implementing a balanced nutritional diet for the people this study determined to be unhealthy. These lifestyle adjustments are essential for resolving the noted problems and enhancing the students' general health and well-being.

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