

Skinfold Thickness: An Anthropometric Parameter to Determine the Nutritional Status among College Girls

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ABSTRACT

Body fat plays a crucial role in human physiology, and its distribution throughout the body influences the health outcomes (1). The types of fats differ based on location, function, and metabolic impact. Anatomically, there are several different depots of fat, including subcutaneous, visceral, intramuscular, intermuscular, and ectopic (2). Skinfold thickness measurement at common sites of the body, like triceps, biceps, subscapular, suprailiac, and thigh regions, provides an estimate of the body fat for health professionals to assess the health of a person (3). This research examines the skinfold thickness measurements of 106 female students between the ages of 16 and 25 years to evaluate their nutritional status. The measurement results of skinfold vary across participant girls, ranging from 47 mm to 140 mm, indicating substantial differences in subcutaneous fat. The Sum of skinfold (SSF) of samples Around 37.5% of the sample fell into the high-adiposity category (SSF >100 mm), while 33% had moderate levels of adiposity (SSF 70–100 mm). Subscapular and suprailiac skinfold measurements were used to measure central adiposity, which was highest in girls with higher body weights.

Keywords: Anthropometric Parameter, Skinfold Thickness, Sum of Skinfold, body fat, Nutritional Status,

INTRODUCTION

Clinically, body fat is classified in five different categories depending upon the place it is stored in the human body (2). First is Subcutaneous Fat, which is stored beneath the skin but above the muscles. This is about 90% of the body fat and generally found around the thighs, abdomen, arms, buttocks and upper back of the body (4–6). It is the fat, we observe when pinching. Main function of this subcutaneous fat is to store energy required for various hormones, providing insulation and maintaining body temperature, to provide cushion and first level of defence against injuries (1). Second is Visceral Fat, which surrounds the internal organs like, liver, pancreas, intestines, heart, etc. It's present deep inside the body and cushions the organs. This act as a source of energy for organs, but having too much visceral fat may be harmful and causes metabolic disorder (7). Belly fat comprises of both visceral and subcutaneous fat (8). Third is Intramuscular Fat, which is present in the skeletal muscles. It's main function is to provide energy to muscles, which help in locomotive activities. Fourth is Intermuscular fat lies between muscles or between distinct muscle groups. Intermuscular fat plays an important role in ageing, muscle health, and metabolic risk. Intramuscular fat is different from intermuscular fat in terms of location of its presence, while the former is inside muscles and the later between muscles (9). Generally, organs like the liver, heart, kidney, pancreas don't store fat, therefore accumulation of fat around them adversely affect their functioning. This is the fifth type of fat which is called Ectopic Fat (7). Ectopic fat is harmful and causes metabolic diseases.

Many pathological techniques like Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Ultrasound, Biopsy, etc. are being used to measure the intermuscular fat, intramuscular fat, ectopic fat and Visceral Fat in the human body. But, anthropometric methods of measurement of body fat, especially for subcutaneous fat and visceral fat, is the first line of diagnosis of a person's health and nutritional assessment. Skinfold thickness measurement is a widely used, cost-effective, non-invasive, quick and less time-consuming technique to assess the body fat and nutritional level. This study examines skinfold data obtained from 106

female students to find out the level of subcutaneous fat among college girls and identify their nutritional concerns related to obesity.

DATA COLLECTION AND METHODOLOGY

Skinfold thickness, An Anthropometric Parameter, Measurement technique

This is a practical method for estimating body fat percentage by measuring subcutaneous fat at standardised sites. When used correctly, it provides reliable data for fitness assessments, health screening, and tracking body composition over time. It involves using skinfold calipers to pinch and measure the thickness of skin and the underlying fat layer at specific sites on the body (10). Depending on the protocol used, skinfold thickness is measured at 3, 4, 7, or more standardised anatomical sites, like chest, abdomen, thigh, triceps, subscapular, suprailiac, midaxillary, etc, which are the depots of fat. Fat distribution on the body is different for men and women (11,12). Women tend to deposit more fat in the gluteal-femoral, hip, thigh, and lower body regions. The following skin fold measurements are commonly used in anthropometry to assess the fat at different body parts (13):

1. **Triceps Skinfold:** A Measure of vertical fold at the back of the upper arm, midpoint between the shoulder and elbow.
2. **Biceps Skinfold:** Measure of vertical fold at the front of the upper arm, midpoint between the shoulder and elbow.
3. **Suprailiac Skinfold:** Measure of horizontal fold at 2-3 cm above the hip bone
4. **Abdominal Skinfold:** Measure of horizontal fold at 2-3 cm side of navel and below the navel line.
5. **Subscapular Skinfold:** Measure of diagonal fold below the lower tip of the shoulder blade
6. **Thigh Skinfold:** Measure of vertical fold at the Front of the thigh, midway between the hip and the knee
7. **Chest Skinfold:** Measure of diagonal fold between the armpit and nipple (for males half way between the armpit and the nipple and for females its one-third way)
8. **Calf Skinfold:** Measure of the vertical fold at widest part of the calf
9. **Midaxillary Skinfold:** Measure of the vertical fold on the mid-axillary line which runs directly down from the center of the armpit
10. **Supraspinale Skinfold:** Measure of a diagonal fold of skin and fat measured just above the crest of the hip bone (iliac crest) along the midaxillary line
11. **Iliac Crest Skinfold:** Measure of horizontal or diagonal fold directly over the top of the iliac crest along the side of the torso.
12. **Other** Less common skinfold measurement sites are chin, forearm, chest, knee, neck and lower back etc, which are used for special health purposes or for athletes to monitor the local fat distribution in a particular body part.

Data Collection

Generally, girls have more body fat than boys, especially during puberty and adolescence. Observing this fat is essential for assessing the growth of girls and reducing the risk of any health issues that may arise due to undernutrition and obesity during this period. To ensure that a smaller number of skinfold measurements provides a reliable estimate of overall body fat, therefore biceps, Triceps, suprailiac, and Subscapular body

sites of measurement are chosen in participant girls (11). Data related to name, age, occupation of 106 girls of the college situated at Mansa District, Punjab, India, was collected after interaction with them individually and then the data related to weight, height, skinfold thickness at biceps, Triceps, suprailiac, and Subscapular collected by measuring their physical parameters using standardised tools. The tools used to measure the anthropometric parameters are; stadiometer for the measurement of the height of participants in centimeters, weighing scale (digital) for the measurement of weight in kilograms and caliper has been used for obtaining measurements of skinfold thickness in millimeter (14). The data so obtained is then transferred into spreadsheets and the sum of skinfold thickness is computed by adding the skinfold thickness values (in mm) measured at biceps, Triceps, suprailiac, and Subscapular sites of body.

Data Analysis and Result

The analysis of these measurements indicates that there is a wide variation in skinfold thickness among girls. Skinfold at Triceps ranges from 7–40 mm, Biceps ranges from 6–30 mm, Subscapular ranges 6–40 mm and Suprailiac ranges from 9–40 mm (15). Low values of skinfold indicate low fat stores or leanness and mid-range values indicate normal fat or normal nutrition and high values indicate overnutrition or obesity. The interpretation of the sum of skinfolds (SSF) measured at four body parts of girls provides information about their nutritional status. SSF indicated the amount of subcutaneous fat stored under the skin, which is about 40–60% of the total body fat. The higher the sum from the standard population, the more subcutaneous fat is present in the body. Considering the internationally recognised anthropometric references based on Durnin & Rahaman, Frisancho anthropometric reference values, International Body Composition (IBC) norms, and WHO adolescent growth principles (16), the nutritional status of participating girls was categorised as per Table-1.

Sum of Skinfold Measurements (mm)	Female Nutritional Status
< 60 mm	Malnutrition or Undernutrition
60 mm - 100 mm	Normal Nutrition
100 mm – 130 mm	Obesity
> 130 mm	High Obesity

Table-1: Nutritional Assessment using Skinfold anthropometric parameters

The body fat of girls assessed using the Sum of Skinfold thickness (SSF) has been interpreted using globally accepted cut-off standards as shown in fig-1. Those with sum of skinfolds exceeding 100 mm are at risk for higher adiposity and those with a sum of skinfolds below 60 mm are at prone to issues related to undernutrition.

The nutritional classification based on Sum of Skinfold indicated that 54% of the participant girls had normal fat levels, which is a sign of good nutritional health and 12.5% showed low fat, which implies undernutrition, while 25% and 8.5% high and very high fat levels, respectively, highlighting a significant number with excessive adiposity.

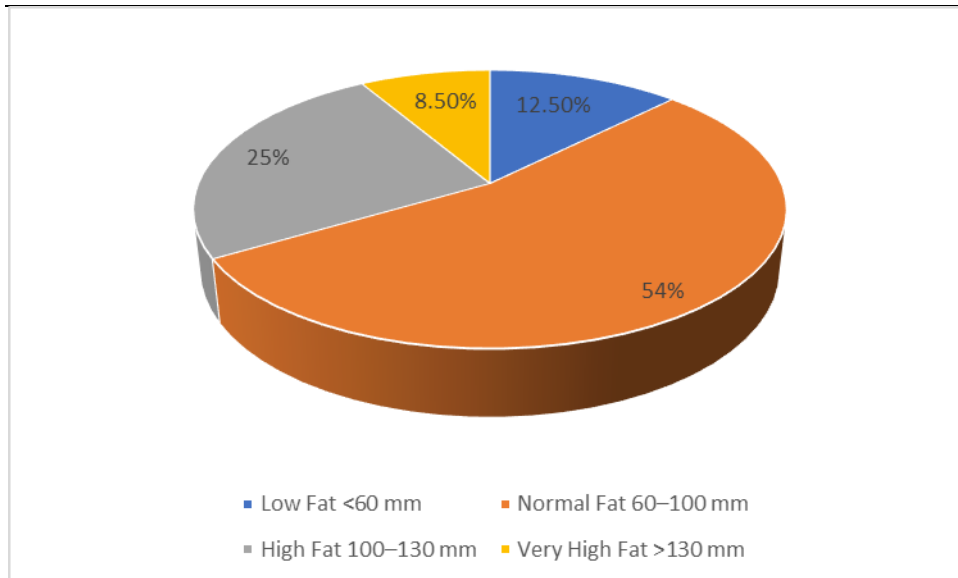


Fig-1: Nutritional Status of College Girls

Discussion: Interpretation of SSF-Based Nutritional Status Distribution

The nutritional status based on the Sum of Skinfolds (SSF) among the participants indicates that the largest proportion, 54%, falls within the normal nutrition category, indicating that more than half of the participant girls maintain an appropriate level of subcutaneous fat and are likely within a healthy nutritional range. This suggests that, for most individuals, energy intake and fat reserves are adequate to support normal physiological functions. Approximately 25% of the participants fall into the High Fat or obese range. This group of girls may be at risk of progressing toward overnutrition or increased fat accumulation if lifestyle factors such as diet and physical activity are not managed. Meanwhile, 8.5% girls have very high Fat, a group that may face health issues, including early onset of obesity-related disorders such as metabolic imbalance, insulin resistance and cardiovascular stress. On the other end of the spectrum, 12.5% of participants fall under the Low Fat category. Individuals in this group may be susceptible to undernutrition or nutritional deficiencies, which can impair immunity, hormonal balance, growth (in adolescents) and overall physical performance.

Overall, the distribution shows that while the majority of the group maintains a healthy fat level, a significant portion exhibits deviations in both directions—either insufficient or excessive fat—highlighting the need for targeted nutrition and lifestyle interventions for those outside the normal range.

CONCLUSION

The sample size limits generalizability, but the study demonstrates the nutrition status of college going girls and the practical use of field-based skinfold assessment in identifying nutritional status variations among young women. Skinfold measurements, an anthropometric parameter based assessment of nutritional status reveal that while the majority of participant girls fall within the normal fat range, indicating generally adequate nutritional health, a notable proportion display deviations that require attention. The presence of 12.5% with low fat levels suggests individuals who may be experiencing undernutrition or low energy which affecting growth, immunity and general health. At the same time, 33.5% of participant girls fall into the high or very high fat categories, indicating an high risk of overnutrition and health concerns such as excess obesity and metabolic strain(2). These findings underscore the importance of regular nutritional monitoring and personalized interventions to address both undernutrition and overnutrition within the group. The study highlights the need for balanced dietary intake and appropriate physical activity to maintain optimal body composition and prevent long-term health complications in college girls.

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