Scholars Academic Journal of Biosciences
Abbreviated Key Title: Sch Acad J Biosci
ISSN 2347-9515 (Print) | ISSN 2321-6883 (Online)
Journal homepage: https://saspublishers.com
NLM ID:101629416
OPEN ACCESS
Anthropology

Anthropometric Techniques in Assessing Human Growth and Development: A Comprehensive Review

Bushra[1], Abdul Malik[2*], Samreen Ansari[3], Ahtasham Khatoon[3]

[1]Final Year Student, B.Sc. Anthropology (Hons.), IGNOU, New Delhi, India
[2]Associate Professor, Department of Human Anatomy, State Takmil ut Tib College & Hospital, Lucknow, U.P. India
[3]PG Scholar, Department of Human Anatomy, State Takmil ut Tib College & Hospital, Lucknow, U.P. India

DOI: https://doi.org/10.36347/sajb.2026.v14i06.007 | **Received:** 29.04.2026 | **Accepted:** 05.06.2026 | **Published:** 30.06.2026

***Corresponding author:** Abdul Malik
Associate Professor, Department of Human Anatomy, State Takmil ut Tib College & Hospital, Lucknow, U.P. India

Abstract **Review Article**

Anthropometry, which can be described as the systematic study of the human body, is one of the key methodological tools in the field of biological anthropology that is used to assess the growth and development. It provides a non-invasive and cost-effective and highly applicable method of determining nutritional status, health status, and biological variability among communities. The current review critically summarizes the recent literature on the significant anthropometric methods, such as stature, body weight, body mass index (BMI), circumferential measurements, and skinfold thickness. Also, derived measures like height- for-age, weight- for-height and BMI- for-age are analyzed relative to their interpretative quality based on international growth standards. The review also addresses the methodological rigor, its use in clinical and population health settings, and the limitations that are inherent in anthropometric methodology. New innovations, such as digital tools, and AI-assisted growth modelling are also brought up. In general, anthropometry remains an inevitable method of measuring the growth and development of humans under a standardized protocol and context-specific interpretation.

Keywords: Anthropometry, Human Growth, Development, BMI, Nutritional Assessment, Growth Standards.

1. INTRODUCTION

Anthropometry is an essential part of biological anthropology which is concerned with the quantitative determination of dimensions of the human body. The field offers the necessary instruments to analyze the trend of growth, development, and variation among and between populations. Growth is quantifiable changes in body size whereas development is qualitative changes in physiological as well as functional functions with time.

Anthropometric measurements are very common in modern studies and clinical practice because of the simplicity of the process, cost-effectiveness, and ability to apply to various settings. These techniques are especially useful in the resource-constrained environment where a high level of diagnostic equipment might not be easily available. The anthropometrical indicators are considered a proxy of nutritional health and health in general, which makes it possible to detect the abnormalities of growth and the risk of diseases early [1]. Current world studies have shown a drastic change in anthropometry trend especially in the increasing obesity rates and chronic under feeding in developing countries [2]. These trends highlight the importance of using anthropometric measurement in resolving global health issues.

2. MATERIALS AND METHODS

The given study takes the form of a narrative review, summarizing the recent academic publications published.

2.1 Data Sources

A comprehensive literature search was conducted using:

- PubMed
- Google Scholar
- Official reports from international health organizations

2.2 Inclusion Criteria

Studies were included if they:

- Were peer-reviewed and published
- Focused on anthropometric techniques or growth assessment
- Were written in English

2.3 Exclusion Criteria

The review excluded:

- Non-peer-reviewed or anecdotal sources
- Studies lacking methodological clarity
- Publications not directly relevant to anthropometry

2.4 Data Analysis

The literature that was selected was analyzed thematically. Themes such as measurement methods, derived indices, methodology issues as well as new innovations were identified. In this way, it was easy to synthesize the existing knowledge in a systematic manner.

3. Anthropometric Techniques

3.1 Stature (Height)

The height or stature is one of the most basic anthropometric measurements; it is used to assess human growth and long-term nutritional condition. It reflects an increase in growth through the genetic, environmental and nutritional factors throughout time. Height unlike body weight can vary over a time thus making it a stable indicator of chronic health and nutritional status. Straight standardization is necessary during measurement of stature which is normally done in stadiometer with the person standing in an upright position with heels in contact and the head in Frankfurt plane to assure accuracy and repeatability.

Height is also of great importance during the pediatric examination, in which abnormality in height development can be a sign of chronic under nutrition or a disease condition. Low height-for- age, also known as stunting, is an indicator of long-term nutritional deficiency and frequent infections in the early years. This type of growth impairment may lead to the long-term effects of decreased cognitive development and the risk of morbidity in adulthood [3].

Interpretation of height data however should be done with caution, considering population specific genetic and ethnic variations. Social economic status, dietary habits, and access to health care are also other environmental factors, which play a major role in determining stature. Thus, the accuracy of height measurements should be most informative when they are compared with standardized growth references, e.g. those generated by the World Health Organization.

In general, stature is an anthropometric parameter that is a reliable and widely used parameter in the field of biological anthropology and in the context of the health of the population. It is imperative because it enables us to determine the actual health status of the population, child growth, and chronic nutritional deficiencies as it can be used to measure the long-term growth trends.

3.2 Body Weight

BMI is also an essential anthropometric parameter indicating the total mass of a person and giving an idea of the current nutritional and health condition. In contrast to height, body weight is very responsive to the changes in the short-term and thus it is especially effective in tracking the acute conditions like recent illness, dehydration or rapid weight loss. The calibrated weighing scales are normally used to measure it under standardized conditions and thus accuracy.

Weight is a significant parameter in the clinical and field environment, particularly in the diagnosis of conditions like undernutrition, wasting and obesity. Weight-for-age is often used as a general indicator of nutritional status in children but it fails to differentiate between acute and chronic malnutrition. Quick fluctuations in body weight can also be an indicator of urgent health problems and need to be addressed in time [4].

Body weight, in spite of its practical value, is limited. It fails to give data regarding body composition, including the fat, muscle and bone mass. Consequently, similar people in terms of weight, can have vastly different health statuses. In the case of the body weight, higher body weight can be associated with the excess fat or more muscle mass, which possess different health implications.

In order to circumvent these constraints, body weight is commonly combined with other anthropometric measures like height, BMI as well as circumferences. The combination of the two methods enhances the precision of nutritional evaluation and the possibility to have a more detailed view of the health condition of a person. Therefore, body weight is a necessary yet supplementary measure in anthropometric measurement.

3.3 Body Mass Index (BMI)

Body Mass Index (BMI) is among the most popular anthropometric indices of determining nutritional status among adults and children. It is obtained by dividing the body weight by the square of height in meters (kg/m 2). This basic equation enables one to classify oneself as either underweight, normal weight, overweight, or obese and hence BMI is a convenient instrument either in the clinical or the general public health practice.

The usefulness of BMI is especially in its convenience of measure and the fact that it can be applied to large populations. It is normally employed in epidemiological research to determine the prevalence of obesity and associated health risks such as cardiovascular diseases, diabetes and metabolic disorders. BMI-for-age is desirable in children and adolescents, where there are differences in growth and development in different age groups [5].

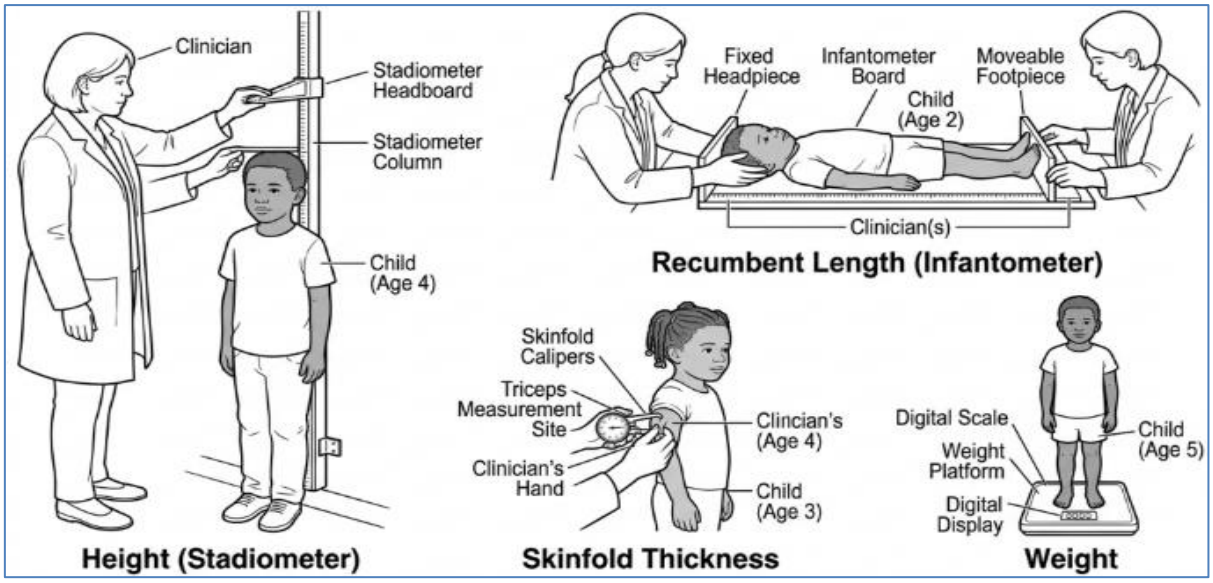

Figure 1: Illustrating Anthropometric technique

Notwithstanding, BMI has a number of limitations, which should be taken into account. Its main weakness is the fact that it cannot distinguish fat mass and lean body mass. An example is the case of athletes with high muscle mass that might be considered obese or overweight even when they have low body fat. On the same note, even people with normal BMI can still be having excess body fat which is called normal-weight obesity.

Considering these shortcomings, BMI cannot be used alone as a diagnostic instrument. Rather, it is to be viewed in conjunction to other anthropometric measures like waist circumference, skinfold thickness or body composition analysis. Although it has its flaws, BMI is a handy and acceptable screening method of determining nutritional health and those people who are at risk of health-related problems.

3.4 Circumferential Measurements

Circumferential measurements are essential anthropometric measurements applied in determining body composition, fat distribution as well as muscle mass. These measurements consist of measuring the circumference of certain body parts with the help of a flexible measuring tape, with the standardized procedures to maintain the accuracy. They are applicable especially in clinical practice as well as field-based studies because they are simple and cheap.

Waist circumference is one of the most widely used measurements that give the estimation of the central or abdominal obesity. Waist circumference is closely correlated with the high risk of developing metabolic disorders, including cardiovascular disease and type 2 diabetes. The other parameter that is commonly used is the mid-upper arm circumference (MUAC) that is particularly effective when evaluating nutritional status in children and expectant women in low-resource environments. MUAC is a quick assessment device of recognizing acute malnutrition and does not involve the use of complex equipment.

Another important measure is head circumference especially in young children and infants. It is an indication of brain growth and development and is applied to identify abnormalities like microcephaly or hydrocephalus. Head circumference should be monitored regularly to develop an early diagnosis of developmental disorders.

Circumferential measurements are very popular in epidemiological surveys and community health programs as they are simple to measure and do not need much training. Nevertheless, measurement precision is conditional upon the appropriate methodology and measurement procedures. In general, these measurements give useful information about the state of health and nutrition in addition to other anthropometric measurements. [6]

3.5 Skinfold Thickness

Skinfold thickness measure is an anthropometric technique that is applied to determine the composition of subcutaneous fat and total body fat. It entails measurement of skinfolds thickness at certain parts of the anatomy using special callipers like triceps, biceps, subscapular and suprailiac areas. These measurements are premised on the fact that a large percentage of the total body fat is stored under the skin.

The method is especially effective in the research and clinical environments where a more comprehensive study of the body composition is necessary. Skinfold measurement is capable of giving a fairly accurate value of body fat percentage when done correctly. They are frequently combined with predictive

equations to estimate the nutritional status and track the body composition changes with time [7-9].

Skinfold measurement is however technical and should be trained to make it reliable. Measurement errors can be caused by variations in technique, inappropriate location of the site and inter-observer differences. Also, the technique can be less precise in persons with excessive obesity or low body fat. Irrespective of such shortcomings, the skinfold thickness is a useful anthropometric measure because it is non-invasive and comparatively inexpensive when compared to other sophisticated imaging measures. It is common in field of sports science, nutrition studies and body health evaluation to determine accumulation of body fat and general health status.

Table 1: Major Anthropometric Measurements and Their Significance

Measurement	Description	Significance
Height (Stature)	Linear body measurement	Indicates long-term growth
Weight	Body mass	Reflects short-term nutritional status
BMI	Weight/Height²	Classifies nutritional status
MUAC	Arm circumference	Assesses malnutrition (field use)
Waist Circumference	Abdominal girth	Indicates central obesity
Skinfold Thickness	Subcutaneous fat measurement	Estimates body fat percentage

(a) **(b)** **(c)** **(d)** **(e)** **(f)**

Figure 2: Anthropometric instruments; (a) Skinfold Calliper (b) Head measuring tape (c) Infantometer (d) Spreading Calliper (e) Stadiometer (f) Mid-upper arm circumference tape

4. Anthropometric Indices

Anthropometric indices are standardized measures, which are based on simple body measurements (height and weight) which are aimed to give a clear picture on human growth and nutritional status. These indices can be used to make comparisons among people and populations because instead of interpreting the raw values separately, these indices are compared to age- and sex-specific reference standards. They have extensive applications in the fields of biological anthropology, pediatrics, and public health to track growth patterns and detect deviations to the healthy development [10].

Height-for-age is one of the most popular indices that indicate linear growth and nutritional status in the long run. Low height-for-age value is a sign of stunting, in turn, a symptom of long-term undernourishment, frequent infections, and poor environmental factors. Stunting does not only have a physical developmental impact but also a long-term developmental effect of cognitive growth and productivity in adulthood [3].

Weight-for-height is also another vital index that is used to determine body mass in relation to height and is mainly used in the detection of wasting. Wasting is an indication of acute malnutrition and usually it is caused by recent illness or improper dietary intake. The index is most applicable in emergency and clinical practices when there is a need to provide nutritional assessment quickly [4].

Body mass index (BMI)- for-age is a commonly applied method of assessing overweight and obesity in children and adolescents. This index is more appropriate in young people as opposed to adult BMI because it takes into consideration the growth changes with age. It is useful in the detection of early risk factors of metabolic and lifestyle-related conditions [5].

These indices are normally represented by Z-scores, which are used to show the number of standard deviations that a measurement is not equal to the reference median. This method can be used to ensure that the interpretation is consistent across various populations by international standards [11]. On balance, the anthropometric indices are the necessary ones to identify the abnormalities of the growth early and to apply the specific health and nutrition interventions.

Table 2: Anthropometric Indices and Interpretation

Index	Formula / Basis	Interpretation
Height-for-age	Height vs age	Stunting (chronic malnutrition)
Weight-for-age	Weight vs age	Underweight
Weight-for-height	Weight vs height	Wasting (acute malnutrition)
BMI-for-age	BMI vs age	Overweight/Obesity

Table 3: WHO Z-score Classification

Z-score Range	Interpretation
> +2 SD	Overweight
+1 to +2 SD	Risk of overweight
-2 to +1 SD	Normal
-3 to -2 SD	Moderate malnutrition
< -3 SD	Severe malnutrition

5. Growth Standards and Reference Systems

Growth standards give a guideline on the understanding of the anthropometric data. The WHO growth standards are founded on the data of healthy children brought up under the optimum conditions and are regarded to be universal. The latest updates also focus on the fact that it is necessary to apply such standards to global comparisons but also emphasize the necessity of population-specific references in some scenarios [10]. In such countries as India, specific region-specific growth charts have already been created to consider genetic, environmental, and socioeconomic factors [12,13,14].

6. Applications of Anthropometric Techniques

6.1 Nutritional Assessment

Anthropometry is important in determining undernutrition as well as over nutrition. It is common in the clinical and community settings to track nutritional interventions [4].

6.2 Public Health

The anthropometric data are required to determine the health of the population and make policy decisions. They assist in monitoring the trends like stunting, wasting and obesity.

6.3 Clinical Applications

Anthropometry can be used in clinical practice to diagnose growth disorders, endocrine, and chronic diseases [15]. Anthropometric techniques are valuable for assessing growth and health, enabling identification of illness risks. For children, height and arm size are measured to evaluate nutrition and growth issues, while for adults, these measurements can indicate muscle loss or obesity. Utilizing charts aids in intervention decisions,

and integrating computer technology enhances care delivery, even in resource-limited settings. Overall, anthropometric assessments benefit individuals of all ages.

6.4 Biological Anthropology

Anthropometry is a branch of anthropology that has helped to study human diversity, adaptation and evolutionary events, which provide information on how the population reacts to environmental forces [16]. Biological anthropology studies body measurements to investigate human evolution and adaptation, examining influences on height and development through head shapes and arm lengths. It compares fossils and modern humans to understand genetic and environmental interactions, highlighting growth patterns in various populations. The field also explores human migration and settlement, aiming to elucidate bodily changes and adaptations over time.

7. Methodological Considerations

The precision of anthropometric measurements requires a high level of compliance with the established guidelines. The issues of calibration of the instruments, training of the observer and repetition of measurements are important in reducing error. An error in measurement may occur as a result of technical variation, or biases in the observer. Thus, quality control should be considered in the research and clinical context [17].

8. Limitations

While anthropometry is highly practical, it has inherent limitations:

- It does not directly measure internal body composition
- Results may be influenced by genetic and environmental factors
- It may not detect early or subclinical conditions

Despite these limitations, anthropometry remains a valuable screening tool when used appropriately.

Table 4: Advantages and Limitations of Anthropometry

Advantages	Limitations
Non-invasive	Cannot directly measure body composition
Low cost	Requires standardization
Easy to perform	Observer error possible
Suitable for large populations	Limited sensitivity in early disease

9. Recent Advances

The latest progress has made a great contribution to the anthropometric assessment. Growth indices can be calculated accurately using digital software like WHO Anthro. To calculate anthropometric measures, including height-for-age and BMI-for-age, the WHO developed the software program WHO Anthro that uses standardized reference data. It will help in assessing the growth and nutrition of the children below the age of five years and promote consistency in data collection and reporting across the world. It is common in both public health programs and research to monitor child development and identify malnutrition and can read dBase files on IBM-compatible systems.

Besides, the new technologies (such as artificial intelligence) are already being incorporated into the growth prediction models, enhancing accuracy and predictive power [18]. Such developments are broadening the scope and application of anthropometry in current studies.

10. DISCUSSION

The anthropometric methods remain crucial in the measurement of the growth and development of humans. They are of great value, especially in large scale research and low resource settings due to their simplicity and cost effectiveness.

Nevertheless, the restrictions of more traditional ways of doing things point to the necessity of incorporating more modern technologies and supplementary assessment instruments. An anthropometric methodology that involves the use of molecular and imaging methods can be used to have a more holistic picture of human development.

11. CONCLUSION

Anthropometric methods are still essential in assessment of growth and development of humans. They give important information on nutritional conditions, morbidity, and demographics. The pertinence and precision of anthropometric tests are likely to become even greater with the continued technological and methodological progress.

Conflict of Interest: No

Funding: The research does not report any financial support or funding sources.

Ethical Considerations

As this is a literature-based study, no human or animal subjects were involved, and thus no ethical clearance was required. However, due academic integrity was maintained through proper citation and referencing practices.

REFERENCES

1. NCD Risk Factor Collaboration (2020). Height and BMI trends. *The Lancet*, 396(10261), pp. 1511–1524. https://doi.org/10.1016/S0140-6736(20)31859-6
2. Ezzati, Majid & Bentham, James & Di Cesare, Mariachiara & Bilano, Ver & Bixby, Honor & Zhou, Bin & Stevens, Gretchen & Riley, Leanne & Taddei, Cristina & Hajifathalian, Kaveh & Lu, Yuan & Savin, Stefan & Cowan, Melanie & Paciore, Christopher & Chirita-Emandi, Adela & Hayes, Alison & Katz, Joanne & Kelishadi, Roya & Kengne, Andre & Cisneros, Julio. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. LANCET. 390. https://doi.org/10.1016/S0140-6736(17)32129-3
3. de Onis, M., & Branca, F. (2016). Childhood stunting: a global perspective. Maternal & child nutrition, 12 Suppl 1(Suppl 1), 12–26. https://doi.org/10.1111/mcn.12231
4. Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., Uauy, R., & Maternal and Child Nutrition Study Group (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet (London, England), 382(9890), 427–451. https://doi.org/10.1016/S0140-6736(13)60937-X
5. Nuttall, Frank. (2015). Body Mass Index. Nutrition Today. 50. 10.1097/NT.0000000000000092.
6. Ogbu, Innocent Sidney & Obeagu, Emmanuel. (2024). Anthropometric Parameters in Health and Diseases: A Review. 2. 62-70.
7. Wells, J.C.K. and Fewtrell, M. S. (2006) Measuring body composition. Archive of Diseases of Childhood, 91, 612-617. doi:10.1136/adc.2005.085522
8. Tungdim, Mary & Aurora, Heemanshu & Kapoor, Satwanti. (2015). Outcome of Tuberculosis Treatment on Measures of Obesity and Adiposity Indices Among the Tribals of Northeast India. Mycobacterium Diseases. 10.4172/2161-1068.1000182.
9. WHO Multicentre Growth Reference Study Group (2006). WHO child growth standards. Acta Paediatrica Supplement.
10. Onis, Mercedes. (2007). WHO Child Growth Standards based on length/height, weight and age: WHO Child Growth Standards. Acta Paediatrica - ACTA PAEDIAT. 95. 76-85. 10.1111/j.1651-2227.2006.tb02378. x.
11. Onis, M. (2008). The new WHO child growth standards. Paediatria Croatica, Supplement. 52. 13-17. https://doi.org/10.1016/S0140-6736(08)60131-2
12. Khadilkar, V., Yadav, S., Agrawal, K. K., Tamboli, S., Banerjee, M., Cherian, A., Goyal, J. P., Khadilkar, A., Kumaravel, V., Mohan, V., Narayanappa, D., Ray, I., & Yewale, V. (2015). Revised IAP growth charts for height, weight and body mass index for 5- to 18-year-old Indian children. Indian pediatrics, 52(1), 47–55. https://doi.org/10.1007/s13312-015-0566-5
13. Duggan, Maureen. (2010). Anthropometry as a tool for measuring malnutrition: Impact of the new WHO growth standards and reference. Annals of tropical paediatrics. 30. 1-17. 10.1179/146532810X12637745451834.
14. Gibson, R.S. (2005). Principles of Nutritional Assessment. 2nd ed. Oxford University Press.
15. Styne, D. M., Arslanian, S. A., Connor, E. L., Farooqi, I. S., Murad, M. H., Silverstein, J. H., & Yanovski, J. A. (2017). Pediatric Obesity-Assessment, Treatment, and Prevention: An Endocrine Society Clinical Practice Guideline. The Journal of clinical endocrinology and metabolism, 102(3), 709–757. https://doi.org/10.1210/jc.2016-2573
16. Wells, J.C.K. (2021). Human adaptation and variability. *Annual Review of Anthropology*, 50, pp. 341–356. https://doi.org/10.1146/annurev-anthro-101819-110020
17. Ulijaszek, S. J., & Kerr, D. A. (1999). Anthropometric measurement error and the assessment of nutritional status. The British journal of nutrition, 82(3), 165–177. https://doi.org/10.1017/s0007114599001348
18. Erravelli B, Bandi L, CH S, Kodamala PR, Ravulakollu KK, Sambangi SSS, Kuthadi D. Clinical Evaluation of an AI-Based System for Pediatric Growth Screening in Routine Practice: A Retrospective Cross-Sectional Study. Research Square; 2026. doi: https://doi.org/10.21203/rs.3.rs-9190460/v1. PPR: PPR1173620.