ORIGINAL RESEARCH PAPER

Nutritional Science

PHYSIOLOGICAL AGE VERSUS CHRONOLOGICAL AGE: INSIGHTS FROM BODY AGE ESTIMATION USING BIOELECTRICAL IMPEDANCE IN YOUNG ADULTS

KEY WORDS: Physiological Age, Chronological Age, BIA, Delta Age

Arushi Magotra*

Consultant Dietitian, Department of Dietetics Acharya Sri Chander College of Medical Sciences and Hospital Jammu, India * Corresponding Author

ABSTRACT

Chronological age does not always reflect physiological health. Body age, as measured by bioelectrical impedance analysis (BIA), offers insight into internal health and potential disease risk. Body age is a novel indicator reflecting an individual's biological rather than chronological aging, which can serve as a critical marker of physical health. This study aimed to compare physiological age and chronological age among young adults using BIA and assess gender -based differences. A descriptive cross-sectional study was conducted on 50 college students from Jammu. Data was collected on a single day through voluntary participation. Participants were evaluated using Omron BIA device, which estimated body age based on body composition parameters. The Mean chronological age was 21.2 ± 2.1 years; the mean body age was 22.8 ± 3.4 years. Paired t-test revealed a statistically significant difference between two measures ($t = 30.741$, $p < 0.001$), confirming that physiological age exceeded chronological age in majority of the students. The independent t-test showed no significant difference in Delta ( ) age between males and females ($t = -0.277$, $p = 0.785$). But the elevated body age in a majority of participants indicates the early onset of physiological aging. These findings highlight the potential of body age as a non-invasive marker to assess overall health status and promote early lifestyle interventions among young adults. Body age estimation using BIA provides an early indication of physiological deviations in healthy young adults.

INTRODUCTION

The concept of body age, distinct from chronological age provide practical insights into an individual's physiological status. Body age is influenced by various factors including fat mass, lean body mass, metabolic rate, and visceral fat accumulation. In young adults, especially college students, early detection of unfavourable trends in body composition can help mitigate long-term health risks such as obesity, diabetes, and cardiovascular disease. Chronological age has been the conventional metric to assess growth, development, and risk for age-related health outcomes. However, this approach assumes a linear and uniform aging process across all individuals, which may not reflect actual physiological status. In recent years, the concept of physiological age also known as 'biological or body age' has gained significant attention in medical and public health research. Biological age also termed as physiological age has emerged as an integrative indicator of systemic health (Bonner,2018). Physiological age takes into account functional markers and biomarkers that reflect the actual health of bodily systems rather than the passage of time alone (Jylhava et al., 2017).

Body age can differ significantly from chronological age depending on lifestyle, metabolic health, body composition, stress, and physical activity levels. The growing interest in estimating body age stems from its utility in identifying individuals at elevated risk of chronic diseases, even when their chronological age suggests otherwise. Studies have indicated that metrics such as body fat percentage, muscle mass, visceral fat, and metabolic rate correlate with accelerated or decelerated aging (Cho et al, 2023).

Bioelectrical impedance activity (BIA) has emerged as a practical, non-invasive method to assess body composition and derive an estimated body age. BIA measures the resistance and reactance of body tissues to the flow of a small electrical current, providing indirect information on body fat, lean mass, total body water, and metabolic health (Kyle et al., 2004).

Some advanced BIA devices, such as Omron HBF series, provide a "body age" output derived from composite physiological data, allowing quick estimation in both clinical and field settings. Recent literature suggests BIA-derived metrics can be used as surrogate markers for Body Age especially in adult populations. Studies have reported that resistance index, and other BIA measures correlated reliability with chronological age and muscle quality indices across the adult life span (Oshita et al., 2025). Such observations indicate that body Age can be assessed even in healthy young adults, yet literature focusing exclusively on college student populations remains scarce. Hence, this cross-sectional study addresses this gap by measuring BIA-derived Body Age in young, healthy adults, and comparing it with chronological age to determine prevalence of "accelerated ageing."

For young adults, particularly college students, early detection of physiological age advancement can serve as a motivator for lifestyle changes and health optimization. College years are often marked by stress, irregular diet, sedentary behaviour, and changes in sleep patterns, all which can accelerate physiological aging. Thus, evaluating body age among this demographic is essential to designing early intervention strategies.

Although numerous studies have assessed body composition parameters individually, few have investigated the relationship between estimated body age and chronological age using BIA based approach in a healthy young adult population. This study aims to fill that gap by analysing data from college students to explore whether discrepancies exist between chronological and physiological age, and what body composition factors are most associated with such differences.

MATERIAL AND METHODS

A descriptive cross- sectional study was conducted among 50 college students aged 18-25 years. Data was collected on a single day through voluntary participation and informed consent was obtained from all participants. Participants were advised to follow standard pre-assessment conditions for accurate results. Chronological age was verified through institutional records. Body age was assessed using calibrated Omron BIA device and compared with chronological age. The difference Δ (Delta) age = Body age – chronological age was calculated for every participant. A paired t-test was used to evaluate the statistical difference between chronological age and body age within individuals. An independent t-test was applied to compare Δ age between male and female participants.

The dataset used in this study was previously analysed for a separate manuscript focusing on body composition variables, which has been submitted for publication. The current analysis specifically explores physiological age, a distinct outcome not examined in the earlier study.

RESULTS

The study included 50 young adult participants aged between 18 and 25 years. The mean chronological age recorded was 21.2 ± 2.1 years, while the mean body age was 22.8 ± 3.4 years. About 68% of participants exhibited a body age higher than their chronological age, indicating a trend toward accelerated physiological aging. A paired t-test was performed to compare chronological age and body age between participants. As shown in Table no.1, the analysis revealed a statistically significant difference $t=30.741$, $p< 0.001$, demonstrating that the estimated physiological age was significantly greater than the actual age. To explore gender-based differences, an independent t-test was conducted on the Δ age. The test showed no statistically significant difference between males and females $t= -0.277$, $p= 0.785$, suggesting that gender did not significantly influence the age discrepancy as shown in Figure no.1.

Table 1: Statistical Analysis

Test	t-value	p- value	Significance
Paired t-test	30.741	p < 0.001	Statistically significant
Independent t-test (Gender)	-0.277	p = 0.785	Statistically insignificant

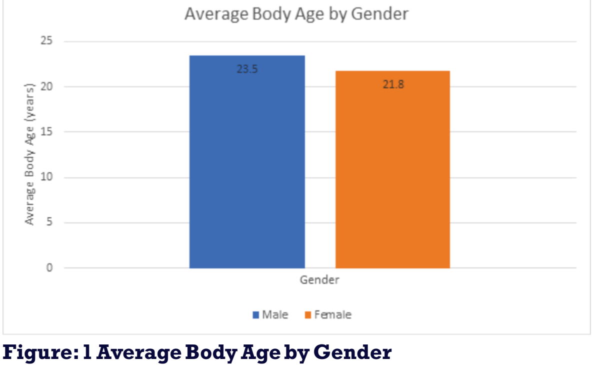

Figure: 1 Average Body Age by Gender

DISCUSSION

The findings from this study reinforces that physiological age may provide more accurate insights into an individual's health than chronological age, as majority of the participants exhibited signs of advanced biological aging.

The result of the paired t-test supports the assertion that even healthy-appearing young adults may be undergoing early aging processes due to lifestyle factors. Prior studies have documented similar findings, associating biological aging with environmental exposures, sedentary behaviours, and poor nutritional choices (Lopez-otin et al.,2013, Belsky et al., 2015).

Lack of gender difference in Δ age observed in this study suggests that biological aging may not manifest differently between sexes during early adulthood. This contrasts with some previous studies that reported men showing faster physiological decline (Chen et al., 2022). However, the small sample size may limit the power to detect such differences.

CONCLUSION

This study underscores the difference between body and chronological age in young adults and highlights the role of BIA in early detection of physiological aging. With most participants showing advanced body age, there is an urgent need for health awareness programs in educational institutions. Routine screening, personalised nutrition, and activity-based interventions can be instrumental in reversing early signs of aging. It is recommended that colleges integrate BIA assessments into health screening protocols to motivate healthier lifestyles among students.

REFERENCES

1. Belsky, D. W., et al. (2015). Quantification of biological aging in young adults. Proceedings of the National Academy of Sciences, 112(30), E4104- E4110.
2. Bonner, C. (2018). What is your real "biological age"? The University of Sydney News.
3. Chen, X., et al. (2022). Gender differences in biological aging: A cross-sectional study using epigenetic and body composition markers. Aging Cell, 21(2), e13532.
4. Cho, C., Jeon, K., &Lee, S. (2023). Body composition evaluation of elementary school students using bioelectrical impedance analysis in South Korea. Iranian Journal of Public Health, 52(2), 499-450.
5. Jylhava J., Pederson, N.L., & Hagg, S. (2017). Biological age predictors. eBioMedicine,21 29-36.
6. Kyle, U.G., Bosaeus, I., De Lorenzo, A.D., Deurenenberg, P., Elia, M., Gomez, J.M., & Pichard, C. (2004). Bioelectrical impedance analysis- part II: Utilization in clinical practice. Clinical Nutrition, 23(6), 1430- 1453.
7. Oshita, K., Hikita, A., Myotsuzono, R., & Ishihara, Y. (2025). Relationship between age and various muscle quality indices in Japanese individuals via bioelectrical impedance analysis. Journal of Physiological Anthropology, 44(1), 8.
8. Lopez-otin, C., et al. (2013). The hallmarks of aging. Cell, 153(6), 1194-1217.