

A Review on Body Mass Index as an Indicator of Flexibility Among Young Adults

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Abstract

Background: Flexibility is a key component of physical fitness that supports joint mobility, muscular efficiency, and injury prevention. Among young adults, especially university students, unhealthy lifestyle patterns such as reduced physical activity and poor diet have led to increasing Body Mass Index (BMI), which may impact flexibility. BMI, although a simple anthropometric index, is widely used to assess weight status, but its influence on musculoskeletal function, particularly flexibility, remains underexplored.

Objective: To review body mass index as an indicator of flexibility among young adults and its effect on the body.

Methodology: A literature search was conducted using the keywords Body Mass Index, flexibility, young adults, and physical fitness in databases including PubMed, Google Scholar, ScienceDirect, and ResearchGate. The search included full-text, English-language articles from 2016 to 2024. Studies were screened based on inclusion and exclusion criteria and critically appraised using CASP tools. A total of 342 articles were identified; 12 high-quality studies were included in the final review.

Result: The findings reveal a non-linear, inverted U-shaped relationship between BMI and flexibility. Individuals with a normal BMI consistently demonstrated better flexibility (measured by sit-and-reach scores) compared to underweight or overweight/obese peers. Underweight individuals showed limited flexibility due to reduced muscle mass, while overweight individuals exhibited joint restrictions and increased muscle stiffness. Gender and activity level also influenced outcomes.

Conclusion: Maintaining a healthy BMI is essential for optimal flexibility and overall physical function in young adults. Both high and low BMI values can negatively impact musculoskeletal performance. These findings highlight the need for BMI monitoring and flexibility training as part of health and fitness programs for young adults.

Keywords: Body mass index, flexibility, obesity, overweight, physical fitness, sit and reach test, young adults

INTRODUCTION

Flexibility is a fundamental component of physical fitness, crucial for maintaining joint mobility, muscular efficiency, and overall functional movement. It plays a significant role in preventing musculoskeletal injuries and enhancing performance in both athletic and daily activities. Among young adults, particularly college-aged individuals, flexibility is essential for sustaining physical performance and functional independence. However, recent lifestyle trends marked by sedentary behavior and poor dietary

habits have contributed to increased rates of overweight and obesity in this age group, as reflected by rising Body Mass Index (BMI) levels. ^[1] BMI is a widely used, simple anthropometric index that categorizes individuals based on body weight relative to height. Although it does not differentiate between fat and lean mass,

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it remains a useful tool for assessing body composition at the population level [2]. Numerous studies have explored the relationship between BMI and components of physical fitness, such as cardiovascular endurance, strength, and flexibility. While several studies suggest that higher BMI may negatively affect flexibility due to mechanical restrictions, such as excess adipose tissue and reduced physical activity, some research, found no significant correlation between BMI and flexibility in specific populations.[3][4]

Conversely, individuals within a healthy BMI range tend to demonstrate better joint mobility and flexibility, although underweight individuals may also experience flexibility limitations due to insufficient muscle mass and strength. Young adults with elevated BMI frequently show restricted joint range and muscular tightness, particularly in the hamstrings and lower back. These limitations may reduce flexibility and heighten injury risk during physical exertion. Notably, females often exhibit greater flexibility than males across BMI categories, likely due to anatomical and hormonal differences [5].

Moreover, the type and frequency of physical activity, combined with sedentary behaviors, can mediate the impact of BMI on flexibility. For instance, a cross-sectional study in India identified a significant inverse correlation between BMI and sit-and-reach test scores, a common metric for lower back and hamstring flexibility [6]. Similarly, research from East Asia found that students with normal BMI consistently outperformed their overweight or obese counterparts on flexibility tests [7]. Understanding the interplay between BMI and flexibility is essential for developing effective physical education and health-promotion strategies for young adults. Integrating flexibility training into weight management programs can enhance functional performance and reduce long-term

risks to musculoskeletal health [8].

OBJECTIVE: To review body mass index as an indicator of flexibility among young adults and its effect on the body.

METHODOLOGY

Study design: Literature review

Search engines: PubMed, Google Scholar, Science Direct, Research Gate

Keywords: Body mass index, Flexibility, Obesity, Overweight, Young adults, Physical fitness, Sit and reach test

Search year: 2016-2024

Inclusion Criteria

- Full text articles in the English language, including only after 2016
- *Population:* Young adults (aged 17–30), including university and college students.
- *Intervention:* Including obesity management, physical therapy, physical education, exercise therapy, sit and reach test

PROCEDURE

Phase1: Article Selection According To Prisma Guidelines

This narrative review was conducted in alignment with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. A manual search was also performed in the reference list, including articles and previously published reviews, in order to find articles.

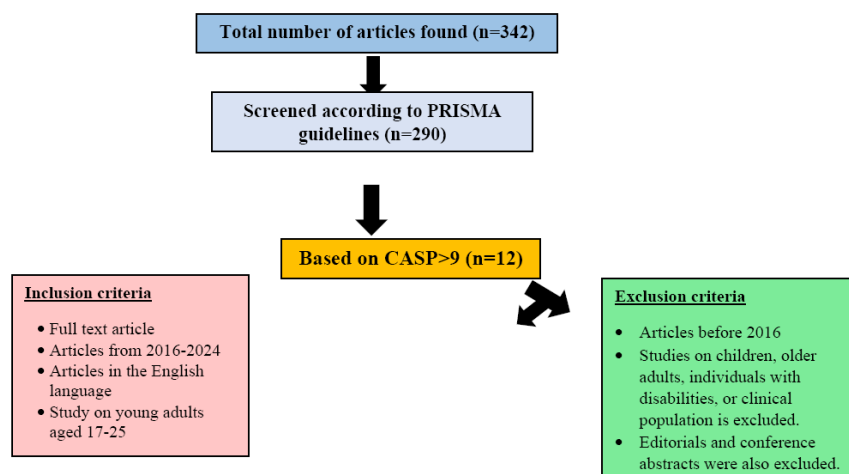


Figure 1: Flowchart of article scrutinization

Phase 2: Articles Selected Are Screened Based On Inclusion And Exclusion Criteria

The total number of articles screened based on inclusion and exclusion criteria and then selected for critical appraisal.

Phase 3: Critically appraising the articles

The articles filtered are critically appraised with a score of more than 9 out of 12 considered high for view, where n=12 articles based on the level of evidence.

REVIEW LITERATURE

Table 1: Review of Literature

Authors & year	Type of articles	Population	Conclusion	Level of evidence
Kung YT, Chang CM, Hwang FM, Chi SC. The association between body mass index and physical fitness of normal weight/overweight/obese university students. Kung et al. (2020)	Cross-sectional study	University students (normal, overweight, obese)	Higher BMI reduces flexibility due to adipose tissue restricting motion	2
Association between BMI and health-related physical fitness: A cross-sectional study in Chinese high school students. QIN et al.(2022)	Cross-sectional study	176,655 Chinese high school (17 years)	Multidimensional evaluation reveals that underweight/obese students underperform physically	2
Associations between body mass index and physical fitness indicators among Chinese university students: a multicenter cross-sectional study. Wu et al. (2024)	Cross-sectional study	29,371 Chinese university students	Confirms inverted U-shaped BMI–flexibility link; influenced by gender	2
The relationship between BMI and physical fitness among 7451 college freshmen in Beijing, China. Guo et al. (2024)	Systematic review	7,451 Chinese college freshmen	A very low BMI may reduce flexibility due to poor muscle mass	1
Relationship between body composition and upper limb physical fitness among Chinese students: A four-year longitudinal follow-up and experimental study. Wang Q., et al (2023)	Longitudinal observational study	183 Chinese male university students	Healthy BMI supports upper-limb fitness; extremes impair neuromuscular output	2
The association between BMI and health-related physical fitness among Chinese college students: a cross-sectional study. Chen et al. (2020)	Cross-sectional study	11,100 Chinese college students (19–22 years)	High BMI affects mobility and endurance more negatively than strength	2
Relationship between body mass index and physical fitness index of Uyghur, Kazakh, and Han college students. Li W et al. (2024)	Cross-sectional study	3,600 college students (varied ethnicity)	Cultural and ethnic factors influence BMI and fitness outcomes	2
The Relation of Body Mass Index to Mechanical Properties in Normal and Overweight Individuals. Usgu et al. (2021)	Cross-sectional study	172 sedentary young adults (normal vs overweight)	BMI affects mechanical muscle properties, especially upper-limb elasticity	2
Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. NCD-RisC et al. (2016)	Meta-analysis	Global sample (19.2 million adults)	Long-term elevated or reduced BMI is linked to poor physical and health outcomes	1

RESULTS

The relationship between BMI and physical fitness in young adults, particularly flexibility, follows a non-linear, inverted U-shaped pattern. Individuals with a normal BMI tend to perform best across various fitness measures, including flexibility, endurance, and strength. Multiple cross-sectional studies have revealed that sit-and-reach scores a common measure of flexibility, are highest in individuals within the normal weight range. Both underweight and overweight/obese groups demonstrate lower flexibility, possibly due to reduced muscle mass in underweight individuals and increased fat mass or muscle stiffness in overweight ones. A large-scale survey involving over 170,000 university students further confirmed that overall fitness, including flexibility, peaks at a normal BMI and declines on either end of the weight spectrum. Similarly, a longitudinal cohort study found that moderate BMI correlated with better upper-body strength, while extremes in BMI were linked to poorer physical outcomes. Biomechanical assessments also support these trends, showing that overweight individuals experience greater muscle stiffness and reduced tissue elasticity, which may impair joint movement and overall flexibility. Meanwhile, underweight individuals may lack sufficient muscular strength, further limiting physical performance. In summary, maintaining a healthy BMI appears critical for optimal physical fitness and flexibility in young adults, with both low and high BMI values negatively impacting performance.

DISCUSSION

Body Mass Index (BMI) as an indicator in physical fitness among young adults is increasingly recognized as non-linear, with a marked trend indicating that individuals within a normal BMI range perform better in physical assessments, particularly those evaluating flexibility. This pattern, described as an inverted U-shape, suggests that both extremes, underweight and overweight/obese, are linked to suboptimal fitness outcomes^[9]. Flexibility, a key component of physical fitness, is largely influenced by factors such as muscle elasticity, joint range of motion, and connective tissue integrity. In overweight individuals, excess adipose tissue can create mechanical limitations, hindering joint movement and increasing the resistance encountered during stretching or mobility exercises^[10]. Moreover, studies using biomechanical assessments have reported increased muscle stiffness and decreased tissue elasticity in individuals with higher BMI, which can further restrict flexibility^[11].

Conversely, underweight individuals often lack adequate muscle mass and strength, which are essential for

supporting joint function and sustaining proper movement mechanics^[12]. Inadequate muscle development may reduce control during physical activities and limit the efficiency of movement, contributing to lower flexibility scores. Furthermore, nutritional deficiencies that often accompany low BMI may negatively impact musculoskeletal health, leading to compromised flexibility and endurance^[13].

In a broader context, cross-sectional studies involving large populations of university students consistently demonstrate that physical performance metrics such as sit-and-reach scores, endurance tests, and strength assessments peak in the normal-weight category^[14]. Both underweight and overweight groups fall behind, emphasizing that optimal physical function depends on balanced body composition rather than simply low or high body mass^[15]. It is also important to consider psychosocial and behavioral factors. Young adults with a high or low BMI may be less likely to participate regularly in physical activity due to body image concerns, discomfort, or low self-efficacy, further reducing their overall physical fitness^[16].

In some cases, even when overweight individuals demonstrate reasonable muscular strength, their performance in endurance and flexibility domains may suffer due to excess weight impeding movement. Gender-based variations have also been observed. Males, for instance, tend to show a more pronounced decline in flexibility at higher BMI levels, possibly due to differences in fat distribution and muscle tightness.^{[17][18]}

Meanwhile, females may retain greater flexibility but still experience reductions in performance when BMI exceeds or falls below the normal range^[19]. From a public health and educational standpoint, these findings highlight the importance of maintaining a healthy BMI during young adulthood, not only for long-term disease prevention but also for preserving functional physical capacity^[20]. Institutions and policymakers should consider these associations when designing fitness and wellness programs for university populations^[21].

CONCLUSION

The reviewed literature highlights a consistent and significant association between Body Mass Index (BMI) and flexibility among young adults. Most studies demonstrate a non-linear (often inverted U-shaped) relationship, where individuals within the normal BMI range tend to exhibit better flexibility and overall physical fitness than those classified as underweight or overweight/obese. Excess body fat may limit range of motion and increase muscle stiffness, while being underweight may reflect insufficient

muscle mass or reduced strength, both of which negatively impact flexibility. Findings also reveal that sex differences, body composition, and cultural or ethnic factors may influence the strength and nature of this association. Although most evidence is derived from cross-sectional studies, a few high-quality cohort and pooled studies support these trends, strengthening confidence in the observed patterns. Together, the evidence emphasizes the importance of maintaining a healthy BMI through balanced nutrition and regular physical activity to enhance flexibility, muscular performance, and functional movement in young adults. Going forward, more longitudinal and experimental studies are needed to clarify causal pathways and develop targeted interventions. Nevertheless, existing data strongly support integrating BMI monitoring and flexibility training into health promotion programs on university campuses and within youth fitness frameworks.

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