Original Research

Feasibility and Preliminary Effects of a Structured Walking Intervention on Body Composition Among Biomedical Science Students: A Pilot Study

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ABSTRACT

Background: Sedentary behavior among university students contributes to adverse changes in body composition and long-term metabolic risk. Walking represents a simple and accessible form of aerobic activity with potential health benefits. **Objective:** This pilot study aimed to evaluate the feasibility and explore preliminary trends in body composition changes following a four-week structured walking intervention among biomedical science students. **Methods:** A pilot quasi-experimental study with a one-group pretest–posttest design was conducted among three undergraduate biomedical science students. Participants performed 30 minutes of light-to-moderate intensity walking, 3–4 times per week, for four weeks. Body composition parameters—including body weight, body mass index (BMI), body fat percentage, muscle percentage, and visceral fat—were assessed using bioelectrical impedance analysis (BIA). Data were analyzed descriptively. **Results:** After four weeks, varied changes in body composition were observed across participants. One participant showed a tendency toward reduced fat percentage in the later weeks of intervention, while muscle percentage was generally maintained or slightly decreased. Body weight showed modest increases across all participants. No adverse events were reported, and all participants completed the protocol, indicating good feasibility. **Conclusion:** A structured walking program appeared feasible and was associated with preliminary trends in body composition among young adults, though the direction and magnitude of changes varied individually. The findings should be interpreted cautiously, given the very small sample size. Larger randomized controlled trials with longer follow-up and dietary monitoring are required to confirm these preliminary observations.

Keywords: walking intervention; body composition; body fat percentage; muscle mass; pilot study

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1. INTRODUCTION

A sedentary lifestyle has become a growing global health concern alongside technological advancement and changes in human activity patterns. Daily activities dominated by prolonged sitting—such as working at computers, excessive use of digital devices, and limited structured physical activity—contribute significantly to declining physical fitness (Swift et al., 2018). This condition increases the risk of obesity, metabolic disorders, and musculoskeletal problems (Ross et al., 2020). Among young adults, particularly university students, sedentary behavior is often underestimated as a long-term health risk due to the absence of immediate clinical symptoms (Jayedi et al., 2024).

Obesity is a major consequence of energy imbalance caused by insufficient physical activity. Excessive and uncontrolled weight gain leads not only to increased subcutaneous fat accumulation but also to higher visceral fat deposits, which are strongly associated with cardiovascular disease, type 2 diabetes mellitus, and metabolic syndrome (Jayedi et al., 2024). In addition, obesity places excessive mechanical load on the musculoskeletal system, potentially resulting in joint pain, postural disorders, and reduced muscle and bone function (Ross et al., 2020). Therefore, preventing obesity through increased physical activity is a crucial strategy for maintaining population health.

Physical activity is defined as any bodily movement produced by skeletal muscle contraction that increases energy expenditure above resting levels (Swift et al., 2018). It can be categorized into light, moderate, and vigorous intensities. One of the simplest and most widely accessible forms of light-to-moderate physical activity is walking. Walking is an aerobic activity that requires no special equipment, can be performed in various environments, and carries a relatively low risk of injury. The World Health Organization (WHO) recommends walking as part of daily physical activity to promote health and prevent non-communicable diseases (Jayedi et al., 2024).

Regular walking has been shown to improve cardiorespiratory capacity, enhance insulin sensitivity, and support weight control (Chiu et al., 2023). From a physiological perspective, walking increases energy expenditure through rhythmic and continuous activation of skeletal muscles, stimulating the utilization of energy substrates, particularly fats and carbohydrates (Zhang et al., 2025). This process may enhance fat oxidation and potentially contribute to reductions in body fat over time, including visceral fat (Wei et al., 2025). Furthermore, walking improves blood flow to muscle tissue, supporting metabolic processes and tissue recovery (Chiu et al., 2023).

Body composition is a key indicator of health status, reflecting not only total body weight but also the proportion of fat mass and fat-free mass. Parameters include body weight, BMI, body fat percentage, skeletal muscle mass, total body water, visceral fat, bone mass, basal metabolic rate, and protein content (Zhang et al., 2025). Although BMI is commonly used to assess nutritional status, it does not distinguish between fat mass and muscle mass (Jayedi et al., 2024), making comprehensive body composition analysis a more accurate approach to health evaluation.

University students are at a critical stage for establishing lifelong healthy habits, yet academic demands and technology use frequently result in reduced physical activity (Jaremkow et al., 2024). Simple, low-cost interventions such as walking may represent practical strategies to increase physical activity in this population (Juniartati et al., 2023). However, studies specifically examining comprehensive body composition changes from walking interventions among university students within musculoskeletal education contexts remain limited. This study, therefore, aimed to evaluate the feasibility of a four-week structured walking intervention and to explore preliminary trends in body composition changes among students enrolled in a musculoskeletal course.

2. METHODS

2.1 Study Design

This study employed a pilot quasi-experimental design with a one-group pretest–posttest approach. The primary objective was to assess feasibility and generate preliminary exploratory data on body composition trends following a structured walking intervention. Given the pilot nature of this study, the absence of a control group is acknowledged as a primary limitation, and findings should not be interpreted

as establishing a causal relationship between walking and body composition changes.

2.2 Participants

Three undergraduate biomedical science students enrolled in the Musculoskeletal course were recruited using purposive sampling. As a pilot feasibility study, the small sample size was intentional—aimed at evaluating intervention protocol, measurement procedures, and generating preliminary trends rather than establishing generalizable conclusions. Baseline characteristics of participants are presented in Table 1.

Table 1. Baseline Characteristics of Participants

Participant	Age (years)	Sex	BMI (kg/m²)	Activity Level
Dewi Ageng	20	Female	18.9	Sedentary
Novita	21	Female	17.6	Sedentary
Rilensy	19	Female	14.8	Lightly Active

*BMI = Body Mass Index

Inclusion criteria were: (1) active undergraduate students enrolled in the Musculoskeletal course; (2) age 18–25 years; (3) willingness to participate in all study stages; and (4) absence of medical conditions or musculoskeletal disorders limiting walking activity. Exclusion criteria were: (1) history of acute musculoskeletal injury; (2) concurrent participation in other structured exercise programs or special dietary regimens; and (3) incomplete participation in the intervention or assessments.

2.3 Intervention

Participants performed a structured walking program at light-to-moderate intensity, individually adjusted for safety. Each session lasted approximately 30 minutes, conducted 3–4 times per week over four weeks. Participants were instructed to target 6,000–8,000 steps per session, monitored via smartphone pedometer applications. Participants were asked to maintain their usual dietary habits and refrain from additional structured exercise. Weekly adherence was self-reported. All participants completed the protocol (adherence rate: 100%).

2.4 Data Collection

Body composition was assessed at pretest (Week 0) and posttest (Week 4) using bioelectrical impedance analysis (BIA). Measurements were performed at the same time of day (07:00–08:00 AM) under standardized conditions: participants were fasted for at least 4 hours, refrained from vigorous activity for 12 hours, and maintained normal hydration. Parameters measured included body weight, BMI, fat mass (%), fat weight (kg), skeletal muscle mass (%), skeletal muscle weight (kg), total body water (%), visceral fat level, bone mass (kg), basal metabolic rate (kcal), and body protein (%).

2.5 Statistical Analysis

Data were analyzed using descriptive methods. Given the very small sample size (n = 3), inferential statistical tests were not performed, as this would yield unreliable results. Individual pretest and posttest values were compared for each parameter, and the percentage change was calculated as:

$$\% \text{ change} = [(\text{posttest - pretest}) / \text{pretest}] \times 100$$

Results were presented in tabular and graphical formats to illustrate trends. The pilot study was intended to generate preliminary data to inform the design of a future adequately powered randomized controlled trial.

3. RESULTS

3.1 Participant Flow and Adherence

All three participants completed the four-week intervention with no dropout or adverse events reported. Self-reported weekly adherence was 100% across all participants. No protocol deviations were recorded.

3.2 Complete Body Composition Parameters

Table 2 presents individual pretest and posttest values for all 11 body composition parameters. These data provide a comprehensive view of physiological trends associated with the four-week walking intervention.

Table 2. Individual Pretest and Posttest Body Composition Parameters

Parameter	Dewi Pre	Dewi Post	Novita Pre	Novita Post	Rilensy Pre	Rilensy Post
Body Weight (kg)	43.5	44.8	41.8	42.7	32.5	33.3
BMI (kg/m²)	18.9	19.4	17.6	18.0	14.8	15.2
Fat Mass (%)	11.5	12.9	13.1	14.4	4.8	5.2
Fat Weight (kg)	5.0	5.8	5.5	6.1	1.6	1.7
Muscle Mass (%)	85.1	83.5	83.7	82.6	92.3	91.7
Muscle Weight (kg)	37.0	37.4	35.0	35.3	30.0	30.5
Total Body Water (%)	60.2	59.4	59.8	58.7	65.4	64.9
Visceral Fat (level)	2	2	3	3	1	1
Bone Mass (kg)	1.85	1.87	1.74	1.75	1.42	1.43
Basal Metabolism (kcal)	1,180	1,195	1,145	1,162	962	975
Protein (%)	14.8	14.6	14.5	14.3	16.1	15.9

*Pre = pretest (Week 0); Post = posttest (Week 4)

3.3 Trends in Body Weight

Weekly body weight trends are presented in Table 3. All three participants showed a modest increase in body weight over the four-week period. Dewi Ageng increased from 43.5 kg to 44.8 kg (+1.3 kg, +3.0%), Novita from 41.8 kg to 42.7 kg (+0.9 kg, +2.2%), and Rilensy from 32.5 kg to 33.3 kg (+0.8 kg, +2.5%). These increases were modest and may reflect physiological adaptation, including early-phase increases in muscle hydration and glycogen storage.

Table 3. Weekly Body Weight (kg) by Participant

Week	Dewi Ageng (kg)	Novita (kg)	Rilensy (kg)
Pre (Week 0)	43.5	41.8	32.5
Week 1	43.8	42.0	32.7
Week 2	44.2	42.2	33.1
Week 3	44.6	42.5	33.3
Post (Week 4)	44.8	42.7	33.3

3.4 Trends in Body Fat and Muscle Percentage

Body fat percentage showed variable trends. Dewi Ageng demonstrated an initial increase (11.5% to 12.4% at Week 2) followed by a slight decrease toward Week 4 (12.9%), suggesting an early adaptation phase before the onset of fat mobilization. Novita showed a gradual increase in fat percentage throughout the study period (13.1% to 14.4%), which may reflect insufficient dietary control concurrent with light physical activity. Rilensy demonstrated the most stable pattern, with only a minor increase (4.8% to 5.2%), consistent with her higher baseline muscle mass.

Muscle percentage showed generally maintained or slightly decreased values. Dewi Ageng showed a slight decrease from 85.1% to 83.5% (predominantly due to the relative increase in fat and water proportion), while her absolute muscle weight increased (37.0 kg to 37.4 kg). Similarly, Novita's muscle percentage decreased from 83.7% to 82.6%, though absolute muscle weight increased marginally (35.0 kg to 35.3 kg). Rilensy maintained the

highest muscle percentage throughout, with a minor proportional decline (92.3% to 91.7%).

3.5 Summary of Mean Body Composition and Percentage Change

Table 4. Summary of Average Body Composition and Percentage Change

Participant	Avg Weight (kg)	Avg Fat (%)	Avg Muscle (%)	% Change Fat	% Change Muscle
Dewi Ageng	44.15	12.20	84.30	+12.2%	-1.9%
Novita	42.25	13.75	83.15	+9.9%	-1.3%
Rilensy	32.90	5.00	92.00	+8.3%	-0.6%

*% Change = [(post - pre) / pre] × 100

Rilensy demonstrated the most favorable body composition profile overall, characterized by the lowest fat percentage and highest muscle percentage, consistent with her slightly more active baseline. Dewi Ageng showed a modest adaptive response. Novita's data suggested that concurrent dietary regulation may be necessary to optimize body composition outcomes from walking activity alone.

4. DISCUSSION

This pilot study examined the feasibility and preliminary body composition trends associated with a four-week structured walking intervention among biomedical science students. The findings suggested tendencies toward varied individual responses in body weight, body fat percentage, and muscle percentage. All participants completed the protocol without adverse events, supporting the feasibility of this intervention in an academic context. However, caution is warranted in interpreting these results given the very small sample size (n = 3) and the absence of a control group.

The modest weight increase observed across participants is consistent with the possibility of early-phase physiological adaptations, including transient increases in muscle glycogen storage and total body water, rather than fat mass accumulation—a pattern that has been reported in the early stages of aerobic exercise programs (Swift et al., 2018). The tendency toward slight fat percentage increases in two participants, particularly Novita, may reflect insufficient energy expenditure relative to dietary intake, which was not monitored in this study. This finding is consistent with evidence suggesting that walking alone, without concurrent dietary intervention, may be insufficient to produce negative energy balance in individuals with adequate caloric intake (Wei et al., 2025).

The four-week duration of this intervention is a recognized limitation. Wei et al. (2025), whose systematic review and meta-analysis examined exercise interventions for body composition, reported that significant effects were generally observed in programs lasting eight weeks or longer. Therefore, the modest and inconsistent changes observed in the present study may partly reflect the insufficient duration of the intervention rather than the absence of an effect. Future studies should employ intervention periods of at least 8–12 weeks to allow sufficient time for measurable physiological adaptations.

Absolute muscle weight increased slightly in all three participants despite a decrease in the proportional muscle percentage, which is an important distinction. The decrease in muscle percentage was largely attributable to a relative increase in fat and water proportions rather than actual muscle loss. This is consistent with findings from Jaremkow et al. (2024), who observed that higher levels of physical activity in university students correlated positively with skeletal muscle maintenance, with changes in body composition percentage reflecting shifts in relative proportions rather than absolute tissue loss. These findings suggest that walking may support muscle maintenance even at light-to-moderate intensities.

Individual variability in responses was notable across all measured parameters. Such heterogeneity is well-documented in lifestyle-based intervention studies and reflects the complex interplay of baseline physiology, dietary behavior, habitual physical activity, and metabolic characteristics. In this study, the participant with the highest baseline muscle mass and lowest body fat (Rilensy) demonstrated the most stable body composition, while the participant with a higher baseline fat percentage (Novita) showed less favorable trends. This suggests that baseline physiological status may influence the direction and magnitude of short-term adaptations to light aerobic activity.

4.1 Practical Implications

The feasibility data from this pilot study suggest that a structured walking program can be safely implemented in an academic setting with full adherence. Walking requires no special equipment or dedicated facilities, making it a practical option for university students with predominantly sedentary lifestyles and time constraints. Even if body composition effects were modest in this short-term pilot, the absence of adverse events and 100% completion rate support the potential of walking as an entry-level physical activity strategy. These feasibility data may serve as a basis for designing a larger, adequately powered trial.

4.2 Strengths

This study evaluated multiple body composition parameters beyond body weight alone, providing a more comprehensive picture of physiological trends. Repeated measurements across four time points allowed observation of weekly trends. The use of standardized BIA measurement conditions (fixed time of day, fasting state, standardized hydration protocol) reduced potential measurement variability. The study also contributes feasibility data for a larger future trial in the student population.

4.3 Limitations

Several limitations must be acknowledged. First, the extremely small sample size (n = 3) substantially restricts statistical inference and external validity; all findings should be interpreted strictly as preliminary observations. Second, the absence of a control group precludes causal conclusions, as observed changes may reflect natural variation, measurement error, or uncontrolled confounders rather than the intervention effect. Third, the four-week intervention duration is likely insufficient for significant body composition changes based on existing literature (Wei et al., 2025). Fourth, dietary intake was not monitored, which is a significant confounder for body composition outcomes. Fifth, adherence was self-reported and not objectively verified. Sixth, BIA measurements are susceptible to hydration status variability; although standardized conditions were applied, residual measurement bias cannot be excluded. Future research must address these limitations through larger sample sizes, randomized controlled designs, longer follow-up periods, and concurrent dietary monitoring.

5. CONCLUSION

This pilot study demonstrated that a four-week structured walking intervention appeared feasible among biomedical science students, with full protocol completion and no adverse events. Body composition data showed a tendency toward varied individual responses, with absolute muscle weight marginally maintained or slightly increased across participants despite modest increases in overall body weight. These preliminary observations should not be interpreted as evidence of effectiveness, given the very small sample, absence of a control group, and short intervention duration. Future research involving larger randomized controlled trials, longer intervention periods (≥12 weeks), concurrent dietary monitoring, and objective adherence measurement is needed to determine the clinical significance and sustainability of walking-induced body composition adaptations in university student populations.

DECLARATION

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