

Effects of Short-Term Reduced Physical Activity on Body Composition, Muscle Strength, and Heart Rate in Young Adults

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ABSTRACT

Background: Inactivity of young adults – especially short-term inactivity while studying, working remotely, or maintaining sedentary behaviour – is a growing concern worldwide. The study aimed to assess the effect of short-term reduced physical activity on body composition, strength, and heart rate (HR) in young adults.

Methods: An experimental study was conducted to evaluate two-week reduced physical activity (<2,500 steps/day) in young adults (18–22 years old). Participants were divided into control ($n = 7$) and intervention ($n = 8$) groups. Muscle strength of knee flexors and extensors (*Biodex System 3*), body composition (*Tanita TBF-300*), and HR (*Polar H10*) during 1.5 W/kg and 2.0 W/kg load of cycling at 60 rpm were evaluated before and after the two-week period.

Results: Body composition measurements and muscle strength did not change significantly ($p > 0.05$) in both groups. HR was significantly ($p < 0.05$) higher in the intervention group than control group after a two-week reduction in step count.

Conclusion: Short-term step count reduction per day to less than 2,500 steps has increased HR during loaded cycling, but did not have a significant effect on muscle strength and body composition.

Keywords: Young adults, step count, short-term inactivity, heart rate, muscle strength, body composition

1. INTRODUCTION

Being physically active helps all people lead healthier lives. World Health Organization (WHO) states that people can achieve the recommended activity levels by simply being more active during the day (World Health Organization, n.d.). In addition to that, WHO has established a new recommendation regarding the reduction of sedentary behaviours and reaffirms the idea that some physical activity is better than no physical activity and that more physical activity increases the likelihood of optimal health outcomes (Bull et al., 2020). The number of steps acquired per

day shows an easy way of measuring physical activity. The goal of 10,000 steps per day is widely understood as being optimal for general health, but it is not rooted in evidence and instead originates from a Japanese marketing campaign (Lee et al., 2019). However, a meta-analysis from 15 studies showed that taking more steps per day was linked to progressively lower risk of mortality – the risk decreased for older adults (aged ≥ 60 years) at approximately 6,000–8,000 steps per day and for younger adults (aged < 60 years) at approximately 8,000–10,000 steps per day (Paluch et al., 2022).



Defining sedentary level (i.e. <5,000 steps/day) was further split into two additional graduations: <2,500 steps/day as basal activity and 2,500–4,999 steps/day as limited activity (Tudor-Locke et al., 2011). In another study researchers found that taking 6,000 to 9,000 steps per day was associated with a 40% to 50% lower risk of cardiovascular diseases, compared with taking 2,000 steps per day (Paluch et al., 2023). Findings in health markers and least number of steps per day is still unclear as it might differ based on age, sex, and previous physical condition. There are number of physical activity studies with older adults and children, but there is limited research exploring young adults between 18–25 years of age, of which more than 80% are students (Eurostat, 2026). University students are often highly sedentary due to the life transition they undergo, academic stress, and pressure (Guerriero et al., 2025). In university students, many health protection factors, such as muscle strength and cardiorespiratory capacity, which are trained with regular physical activity, are in decline, especially during exam sessions (Kljajević et al., 2022; Moscatelli et al., 2023). We hypothesise that short-term physical inactivity will negatively affect physical health markers in young adults aged 18–25 years. The aim of this study is to investigate the effect of taking fewer than 2,500 steps per day for two weeks on body composition, muscle strength, and heart rate (HR) in young adults.

2. METHODS

Study design and participants

An experimental study was carried out in the laboratories of the Lithuanian Sports University with the approval of Kaunas Regional Biomedical Research Ethics Committee (No. BE-2-98, obtained on 26 October 2020). Subjects were invited to participate in the study via an official announcement. The time was agreed with those contacted, and they were informed about the progress of the study, tests, measurements, and possible inconveniences. Those who agreed to take part in the study were given consent forms to sign and a unique code to protect the confidentiality of the data. Volunteers were required not to be actively participating in sports or regular training sessions, have normal body mass index and no chronic, metabolic diseases or acute conditions during the time of testing which could affect research results. A total of 17 participants were selected, two of whom did not complete the

intervention. Participants were divided into control (CON) and intervention (INT) groups. Intervention group reduced daily steps to <2,500 for a two-week period while control group maintained their regular activity. Following measurements were taken before and after the two-week period.

Instruments and measurements

Data were collected using a socio-demographic questionnaire and other instruments:

Muscle strength measurements. Biodex System 3 (*Medical system, Shirley, New York*) was used to assess muscle strength and endurance. The subjects were seated in a chair adapted to their measurements, with the right leg at 90 degrees. They had to perform four maximal flexions and extensions alternately for 5 s each with one-minute breaks between them.

Anthropometric measurements. Participants' height was measured using a Harpenden anthropometer set (*Holtain Ltd, Crymych, Dyfed, Wales, United Kingdom*). Body weight, body mass index (BMI), and fat percentage (%) were assessed using a body composition analyser Tanita TBF-300 (*Tanita, UK Ltd, West Drayton, United Kingdom*).

HR measurements. HR monitors Polar H10 (*Polar Electro Oy, Kempele, Finland*) were attached to participants' chest area while the participants were given exercise on a bicycle ergometer Monark 874E (*Monark Medical, Kista, Sweden*) at 1.5 W/kg and 2.0 W/kg at a cadence of 60 revolutions per minute (rpm) for 3 min at each intensity without rest in between. HR was taken every 15 seconds during the third minute of exercise at both intensities.

Physical activity recording. Each participant was given a wrist band (*Xiaomi Mi Smart Band 6 – 1.56-inch display*) for step count tracking and each of them installed the official application where for a two-week period researchers could see the activity level of the participants.

Data analysis. Statistical analysis and calculations were made using IBM SPSS (v20) and Excel software. Shapiro–Wilk Test indicated normal data distribution. For comparison, pre- and post-intervention and between-groups paired samples t-test was applied. The level of significance was set at $p \leq 0.05$. Data are presented as means $\pm$ SD.

3. RESULTS

Participants were randomly divided into two groups. The control group had four males and three females, and the intervention group had three males

and five females, whose age ranged from 18 to 22 years old. There were no significant ($p > 0.05$) differences between the groups. The intervention group

reduced daily steps to no more than 2,500 per day for two weeks. Full groups' characteristics are presented as means and standard deviations in Table 1.

Table 1. Characteristics of participants

Characteristic	Control ($N = 7$; $m = 4$, $f = 3$)	Intervention ($N = 8$; $m = 3$, $f = 5$)
Age (years)	20.9 (± 1.2)	20.0 (± 2.0)
Height (cm)	177.1 (± 4.8)	173.4 (± 8.7)
Steps per day (steps)	7,353 ($\pm 1,569$)	2,079 (± 106)

Notes: cm – centimetres; n – number; m – male; f – female.

According to the measurements obtained before and after the two-week intervention period using the Tanita TBF-300 body composition analyser, none of the changes in body weight, body

mass index (BMI), fat percentage (FAT%), fat mass (FAT M), fat free mass (FFM), and total body water (TBW) were statistically significant after intervention and between the groups ($p > 0.05$) (Table 2).

Table 2. Body composition of the participants before and after the intervention

Metric Aspect	CON (pre)	CON (post)	INT (pre)	INT (post)
Weight (kg)	75.1 (± 12.3)	77.9 (± 11.3)	67.2 (± 10.3)	67.7 (± 10.6)
BMI (kg/m^2)	23.9 (± 3.2)	24.6 (± 3.0)	22.3 (± 2.2)	22.5 (± 2.2)
FAT (%)	21.5 (± 6.6)	21.0 (± 6.9)	26.0 (± 6.0)	27.3 (± 6.6)
FAT M (kg)	16.0 (± 5.3)	16.3 (± 6.0)	17.4 (± 4.9)	18.4 (± 5.1)
FFM (kg)	59.1 (± 11.2)	61.6 (± 10.3)	49.8 (± 9.9)	49.4 (± 10.6)
TBW (%)	43.3 (± 8.2)	45.1 (± 7.3)	36.5 (± 7.3)	36.2 (± 7.8)

Notes: kg – kilograms; kg/m^2 – kilograms divided by metres squared; % – percentage.

Changes in knee extension (EXT) and knee flexion (FLEX) strength were not statistically significant ($p > 0.05$) after the intervention and between the groups. Extension to flexion (EXT/FLEX) ratio did not change significantly over the two-week intervention period in either group. HR of the participants during the 1.5W/kg load cycling

did not change significantly after two weeks, but the intervention group had higher HR than control group ($p < 0.05$). During the 2.0 W/kg load cycling, the control group showed no significant changes, but in the intervention group, HR was significantly higher than two weeks ago and higher than the control's ($p < 0.05$) (Table 3).

Table 3. Muscle strength and heart rate of the participants before and after intervention

Physical Aspect	CON (pre)	CON (post)	INT (pre)	INT (post)
EXT (Nm)	258.8 (± 88.9)	283.4 (± 91.4)	200.9 (± 66.3)	192.6 (± 69.8)
FLEX (Nm)	108.9 (± 28.7)	111.1 (± 30.8)	95.4 (± 22.9)	89.6 (± 26.8)
EXT/FLEX ratio	0.4 (± 0.1)	0.4 (± 0.1)	0.5 (± 0.1)	0.5 (± 0.1)
HR 1.5 W/kg (beats/min)	150.0 (± 15.0)	144.0 (± 5.0) °	157.5 (± 10.6)	160.1 (± 13.1) °
HR 2.0 W/kg (beats/min)	170.0 (± 14.0)	162.0 (± 6.0) °	174.5 (± 10.5)	178.9 (± 9.3) * °

Notes: Nm – Newton-metre; ° – $p < 0.05$ between the groups; * – $p < 0.05$ after the intervention.

4. DISCUSSION

This study investigated the effects of a two-week period of reduced physical activity on body composition, muscular strength, and aerobic capacity. The findings in this intervention study highlighted the physical and physiological changes in young adults when daily step count reduced to less than 2,500. In our study, changes in fat mass and fat percentage were not statistically significant. In contrast, Bowden et al. (2018), who used a similar step reduction protocol with 45 participants, reported a significant increase in fat mass and decrease in lean mass. The difference between the findings might be explained by a larger sample size and older age (37y) of the participants in Bowden et al.'s study (2018). Another study performed by Olsen et al. (2008) showed that step reduction to 1,500 per day increased intrabdominal fat, but fat mass maintained the same, although the participants ($N = 8$) were male and older (27y) than ours, researchers saw the same fat-free mass reduction as in the previous study (Bowden et al., 2018). Similarly, Breen et al. (2013) performed a step reduction (<3,500) study with older healthy adults (72y) for three days and found fat-free mass reduction, but no changes in fat mass, which could support the idea that the duration of the intervention can affect the metabolic response, although fat-free mass changes might strongly connect to age.

No significant changes in knee flexion or extension strength were observed over the two-week period in our study. Similar observations were made by McGlory et al. (2016) where 13 older adults reduced daily step count to 970 for two weeks, peak maximum voluntary isometric contraction (MVIC) did not change significantly despite metabolic deterioration. Furthermore, Walker et al. (2024) also revealed that there were no significant changes in maximal isometric leg-press force or body composition, following a similar protocol with step count reduction to <2,000 per day for two weeks in older adults. In contrast, Pinto et al. (2023) reported around 8% reduction in muscle strength after short-term inactivity, but particularly with sedentary behaviour increase and drastic activity reduction. Oikawa et al. (2019) also highlighted significant reduction of MVIC force after daily step count reduction (<750) in older adults, but the difference from our study was the calorie restriction (−500 kcal/day), which could be the key to muscle force reduction.

HR response differed both in 1.5 W/kg and 2.0 W/kg load veloergometer cycling between the groups after the intervention, intervention group

showed significantly higher increase in HR than control group. Krogh-Madsen et al. (2010) followed a similar protocol and found that a two-week step reduction to less than 1,500 steps per day induced a 7% decline in cardiovascular fitness in healthy young adults (aged 23.8 years (SD 1.5), and a similar decline (6.6%) was observed in Pinto et al. (2023). Walker et al. (2024) measured physiological responses during the treadmill walking starting 3 km/h and following 5 km/h speed each four minutes and found that at 3 km/h HR was significantly increased (compared to 5 km/h) but changes in $\dot{V}O_{2\max}$ were not found. Findings suggest that the two-week step reduction did not necessarily affect cardiorespiratory responses in the same direction and can vary between population and protocols.

Limitations

This study is based on a small sample of young adults aged 18–22 years, therefore, the findings cannot be fully generalised to other populations as most of other similar interventions are performed with older adults. The step count data collection mostly relied on participant's responsibility to wear the device consistently throughout a two-week intervention period. Participants were instructed to charge the device during the night or a completely inactive period during the day. Such reliance can increase the risk of missing data, but no device-related errors were noticed during the intervention by researchers or reported by participants. Finally, no food consumption, water intake, and sleep duration were observed during the study.

5. CONCLUSIONS

Findings demonstrate that two weeks of reduced daily physical activity were associated with HR changes in submaximal exercise while no significant changes were observed in muscle strength or body composition.

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