

# Inactivity May Matter More Than Activity: Associations with Perceived Stress in a Cross-Sectional Study in Healthy Adults

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## Abstract

Physical activity is generally associated with better psychological well-being, yet the role of sedentary behavior as a distinct contributor to perceived stress remains insufficiently understood. This study aimed to examine the associations of total physical activity and sedentary behavior with perceived stress and its components in a cross-sectional sample. A total of 40 adults (24 females) participated in the study. Perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10), including the total score and the helplessness and self-efficacy subcomponents. Physical activity and sedentary behavior were assessed using the International Physical Activity Questionnaire–Short Form (IPAQ-SF). Multiple linear regression analyses were conducted to examine associations between physical activity indicators and perceived stress outcomes, adjusting for sex and age. Sedentary behavior was positively associated with total perceived stress ( $B = 0.35$ , 95% CI [0.08, 0.62],  $p = .018$ ) and perceived helplessness ( $B = 0.41$ , 95% CI [0.14, 0.68],  $p = .005$ ), but not with self-efficacy ( $B = -0.01$ , 95% CI [-0.34, 0.32],  $p = .941$ ). Total physical activity was not significantly associated with any perceived stress outcome (all  $p \geq .556$ ), suggesting that sitting time, rather than overall activity volume, was more consistently related to perceived stress. Sedentary behavior appears to be more strongly related to perceived stress than total physical activity. Interventions targeting stress regulation may benefit from focusing not only on increasing physical activity but also on reducing prolonged sitting.

**Keywords:** sedentary behavior · physical activity · perceived stress · helplessness · self-efficacy · stress regulation

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## Introduction

Regular physical activity is widely recognized as a protective factor for psychological well-being, including perceived stress. Higher levels of physical activity have been associated with lower stress, improved mood, and better emotional functioning across populations (Stults-Kolehmainen & Sinha, 2014; Kandola et al., 2020). However, findings are not entirely consistent, and the magnitude of these associations appears to depend on how physical activity is defined and measured.

In parallel, a growing body of research suggests that sedentary behavior should not be conceptualized simply as the absence of physical activity, but as a distinct behavioral construct with independent effects on health (Owen et al., 2010). Individuals may meet recommended levels of physical activity while still engaging in prolonged periods of sitting, indicating that active and sedentary behaviors can coexist within the same daily pattern. Importantly, sedentary behavior has been linked to adverse health outcomes even after accounting for physical activity levels (Ekelund et al., 2016, 2019), supporting the notion that these behaviors represent partially independent processes.

Within the psychological domain, sedentary behavior has been associated with poorer mental health outcomes, including higher levels of psychological distress and reduced well-being (Teychenne et al., 2010; Hallgren et al., 2018). More recent evidence further supports these associations, indicating that sedentary time remains related to mental health outcomes even after controlling for physical activity, and that patterns of sedentary behavior may also play a role (Hallgren et al., 2020; Kandola et al., 2020).

Several mechanisms may underlie these relationships. From a physiological perspective, prolonged sitting is associated with reduced metabolic and autonomic activation and unfavorable shifts in cardiovascular and neuroendocrine regulation, which may influence stress-related regulatory systems (Thosar et al., 2015; Carter et al., 2017; Dempsey et al., 2018). From a behavioral and cognitive perspective, sedentary time is often characterized by passive, screen-based activities that may increase exposure to daily stressors, sustain attentional load, and facilitate maladaptive cognitive processes such as repetitive negative thinking (Hallgren et al., 2020; O'Connor et al., 2022). Recent evidence further indicates that higher sedentary time is associated with increased perceived stress and poorer stress-related outcomes independently of physical activity levels (Zhang et al., 2022). In contrast, movement-

based behaviors may support emotional regulation through acute changes in arousal, autonomic flexibility, and interoceptive engagement (Bernstein & McNally, 2018; Kandola et al., 2020).

Therefore, the aim of the present study was to examine the associations of total physical activity and sedentary behavior with perceived stress and its components in a cross-sectional sample. By including both activity and inactivity indicators within the same models, the study seeks to clarify their relative contributions to perceived stress.

## Method

### *Study Design*

The present study employed a cross-sectional design to examine associations between physical activity indicators and perceived stress.

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Novi Sad (approval number: 51-03-21/2025-1). The study protocol was preregistered on the Open Science Framework (OSF). All participants provided written informed consent prior to participation.

### *Participants*

Sample size estimation was conducted using G\*Power 3.1 (Faul et al., 2009) for an F-test within a linear multiple regression framework, corresponding to the primary regression models used in this study. The reference parameters were set at a significance level of  $\alpha = 0.05$  and statistical power  $(1-\beta) = 0.80$ . Based on these parameters, it was estimated that a sample of approximately 40 participants would be required to detect moderate effect sizes in the regression models.

The sample consisted of 40 participants recruited as part of a broader study examining the relationship between physical activity and emotional functioning. Participants were selected according to predefined inclusion and exclusion criteria to ensure a generally healthy adult sample. The inclusion criteria were: (i) age between 18 and 49 years; (ii) absence of chronic diseases or injuries that could affect physical activity or safe participation in testing; (iii) absence of diagnosed psychological disorders; (iv) non-professional athlete status; and (v) provision of complete and valid questionnaire responses. The exclusion criteria were: (i) age  $\geq 50$  years; (ii) chronic medical conditions or injuries affecting physical functioning; (iii) psychological disorders; (iv) professional athlete status; and (v)

incomplete, inconsistent, or invalid questionnaire data.

The upper age limit was applied to reduce potential confounding related to age-associated physiological, behavioral, and psychosocial changes that may influence sedentary behavior, physical activity patterns, and perceived stress.

### Measures

#### Perceived Stress (PSS-10)

Perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10; Cohen & Williamson, 1988), a widely used self-report instrument designed to measure the degree to which individuals appraise situations in their lives as stressful. The PSS-10 consists of 10 items rated on a 5-point Likert scale ranging from 0 ("never") to 4 ("very often"), with higher scores indicating greater perceived stress. Total scores were calculated according to standard scoring procedures. The validity and reliability of the PSS-10 have been confirmed in recent studies across different populations (e.g., Barbosa-Leiker et al., 2021). For the present analysis, the total PSS score was standardized within the sample (z score) and used as the dependent variable. Subscale scores reflecting perceived helplessness and self-efficacy were also analyzed.

#### Physical Activity Assessment (IPAQ-SF)

Physical activity was assessed using the short form of the International Physical Activity Questionnaire (IPAQ-SF), a widely used self-report instrument designed for population-level surveillance of physical activity (Craig et al., 2003). The IPAQ-SF captures physical activity across key intensity levels (vigorous, moderate, and walking) and includes an item assessing daily sitting time. Based on these responses, total physical activity is expressed in metabolic equivalent minutes per week (MET-min/week). In the present study, two indicators derived from the IPAQ-SF were used: total physical activity, representing the overall volume of physical activity, and sedentary behavior, represented by average daily sitting time. Both variables were standardized (z scores) before analysis.

#### Covariates

Sex was included as a categorical factor, whereas age was included as a continuous covariate. Age was standardized (z score) before analysis.

### Procedure

Data were collected as part of a larger study conducted under controlled conditions. Measurements were performed in a standardized laboratory environment, with efforts to minimize external influences such as temperature variation and environmental distractions. Participants completed self-report questionnaires as part of the assessment protocol.

### Statistical Analysis

All models were inspected for linearity, normality of residuals, and homoscedasticity. No substantial violations of model assumptions were observed. Associations between physical activity indicators and perceived stress outcomes were examined using multiple linear regression models. Three dependent variables were analyzed: total perceived stress, perceived helplessness, and perceived self-efficacy, all standardized as z scores. Two physical activity indicators were included as predictors in separate models: total physical activity and sedentary behavior.

For each outcome, two regression models were estimated, resulting in a total of six models. All models included sex (coded as a categorical variable) and age (standardized) as covariates. Sex was entered as a fixed factor, and age as a continuous predictor. Model specification was as follows:

$$Y = \beta_0 + \beta_1(\text{IPAQ variable}) + \beta_2(\text{Sex}) + \beta_3(\text{Age}) + \varepsilon$$

Because all continuous predictors and outcomes were standardized before analysis, regression coefficients for continuous predictors can be interpreted as standardized regression coefficients. Regression coefficients (B), standard errors (SE), 95% confidence intervals (CIs), and p values were reported. Statistical significance was set at  $p < .05$ . Standardized regression coefficients ( $\beta$ ) were interpreted as measures of effect size, with values of approximately 0.10, 0.30, and 0.50 reflecting small, moderate, and large effects, respectively (Cohen, 1988). All analyses were conducted using linear regression models in Python (statsmodels package). Given the modest sample size, the results were interpreted cautiously, with particular attention to effect-size magnitude and consistency across related outcomes.

## Results

### Sample characteristics

The sample consisted of 40 participants, including 24 females and 16 males, with a mean age of 27.60

± 8.52 years. The sample exhibited moderate levels of perceived stress, with a more pronounced contribution of helplessness than self-efficacy (Table 1). Participants demonstrated a wide range of physical activity levels while also reporting

substantial sedentary behavior, indicating considerable variability in daily movement patterns. Notably, active and sedentary behaviors appeared to coexist within the sample.

**Table 1. Descriptive statistics of study variables**

Variable	M ± SD
Total Perceived Stress (score)	13.95 ± 5.53
Perceived Helplessness (score)	9.26 ± 4.78
Perceived Self-Efficacy (score)	4.69 ± 2.35
Total Physical Activity (MET-min/week)	7630.14 ± 3762.93
Sitting Time (min/day)	697.14 ± 292.11

Values are presented as mean ± standard deviation (M ± SD).

*Associations between physical activity indicators and perceived stress outcomes*

Multiple linear regression analyses were conducted to examine associations between physical activity indicators and perceived stress outcomes, adjusting for sex and age (Table 2).

Total physical activity was not significantly associated with any perceived stress outcome. Specifically, total physical activity showed non-significant associations with total perceived stress (B = -0.09, 95% CI [-0.38, 0.20], p = .556), perceived helplessness (B = -0.07, 95% CI [-0.36, 0.22], p = .631), and perceived self-efficacy (B = -0.06, 95% CI [-0.37, 0.25], p = .713). Models including total physical activity explained between 4.1% and 19.8% of variance in perceived stress outcomes. Although the overall models for total perceived stress,  $F_{(3, 36)} = 3.14$ , p = .037,  $R^2 = .198$ , adjusted  $R^2 = .135$ , and perceived helplessness,

$F_{(3, 36)} = 2.93$ , p = .046,  $R^2 = .188$ , adjusted  $R^2 = .124$ , reached statistical significance, the effect of total physical activity itself was not significant. The model predicting perceived self-efficacy was not significant,  $F_{(3, 36)} = 0.54$ , p = .655,  $R^2 = .041$ , adjusted  $R^2 = -.034$ .

In contrast, sitting time showed significant positive associations with total perceived stress (B = 0.35, 95% CI [0.08, 0.62], p = .018) and perceived helplessness (B = 0.41, 95% CI [0.14, 0.68], p = .005). The model predicting total perceived stress was significant,  $F_{(3, 36)} = 5.50$ , p = .003,  $R^2 = .303$ , adjusted  $R^2 = .247$ . Similarly, the model predicting perceived helplessness was significant,  $F_{(3, 36)} = 6.43$ , p = .001,  $R^2 = .337$ , adjusted  $R^2 = .284$ . Sitting time was not associated with perceived self-efficacy (B = -0.01, 95% CI [-0.34, 0.32], p = .941), and the corresponding model was not significant,  $F_{(3, 36)} = 0.50$ , p = .685,  $R^2 = .038$ , adjusted  $R^2 = -.038$ .

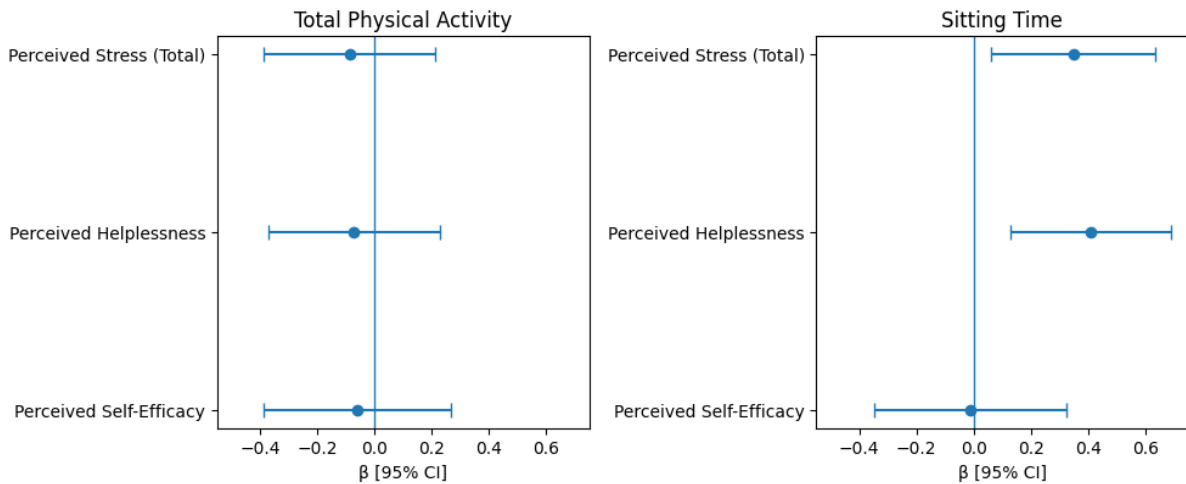
**Table 2. Associations between physical activity and perceived stress (adjusted models)**

Outcome	Total Physical Activity		Sitting Time	
	B ± SE	p	B ± SE	p
Perceived Stress (Total)	-0.09 ± 0.15	.556	<b>0.35 ± 0.14</b>	<b>.018</b>
Perceived Helplessness	-0.07 ± 0.15	.631	<b>0.41 ± 0.14</b>	<b>.005</b>
Perceived Self-Efficacy	-0.06 ± 0.16	.713	-0.01 ± 0.17	.941

All continuous variables were standardized as z-scores prior to analysis. Values are presented as regression coefficients (B) with standard errors (SE). For continuous predictors, these coefficients are interpretable as standardized regression coefficients. Models were adjusted for sex and age. Significant effects are shown in bold.

Overall, these findings indicate that sedentary behavior, rather than total physical activity, is more

consistently related to perceived stress in this sample (Figure 1).



**Figure 1. Associations between perceived stress and physical activity (left) and sitting time (right)** Standardized regression coefficients ( $\beta$ ) with 95% confidence intervals, grouped by physical activity indicators. Because all continuous variables were standardized prior to analysis, these coefficients are interpretable as standardized regression coefficients.

## Discussion

The present study examined the associations of total physical activity and sedentary behavior with perceived stress and its components. The main finding was that sedentary behavior, but not total physical activity, was significantly associated with perceived stress. Specifically, greater sitting time was related to higher total perceived stress and greater helplessness, whereas sedentary behavior showed virtually no relationship with perceived self-efficacy, the positive appraisal component of perceived stress.

Because all continuous variables were standardized before analysis, the coefficients for sitting time can be interpreted as standardized effects. The magnitude of these associations was moderate ( $\beta \approx 0.35\text{--}0.41$ ), indicating a meaningful relationship between sedentary behavior and perceived stress outcomes (Cohen, 1988). Notably, the effects were specific to total perceived stress and its helplessness component, suggesting that sedentary behavior may be more closely linked to a perceived lack of control than to broader beliefs about coping capacity. In contrast, total physical activity did not show meaningful associations with perceived stress, further emphasizing the relative importance of sedentary behavior in this context.

This pattern suggests that inactivity-related processes may be more relevant for perceived stress than overall activity volume. Although physical activity is generally considered protective, the present findings indicate that simply accumulating activity may not be sufficient to influence stress-related outcomes if prolonged sedentary behavior is

also present. In this sense, active and sedentary behaviors appear to represent partially independent dimensions of daily functioning, with distinct implications for psychological processes (Ekelund et al., 2019; Dempsey et al., 2020).

One possible explanation lies in sedentary behavior itself. Prolonged sitting is characterized by low physiological activation and reduced autonomic engagement, which may limit the organism's capacity to dynamically respond to stressors (Thosar et al., 2015; Carter et al., 2017). In contrast, movement-based behaviors involve fluctuations in arousal and increased physiological variability, which are linked to more adaptive stress regulation (O'Connor et al., 2022). From a behavioral perspective, sedentary time is often associated with passive or screen-based activities that may increase exposure to daily stressors or facilitate maladaptive cognitive processes such as repetitive negative thinking. Recent evidence further supports this association, showing that higher sedentary time is linked to increased psychological distress and stress-related outcomes, even when accounting for physical activity levels (Werneck et al., 2021; Meyer et al., 2020).

Importantly, the observed effects were specific to the helplessness component of perceived stress, whereas the association with self-efficacy was virtually zero. This suggests that sedentary behavior may be more closely related to a perceived lack of control or a reduced capacity to manage stressors than to the positive appraisal of coping ability. Such differentiation is consistent with the multidimensional structure of perceived stress and aligns with theoretical models that distinguish

between perceived demands and perceived coping resources (Cohen et al., 1983).

These findings also align with a broader pattern observed in the present dataset, in which sedentary behavior showed consistent associations with negative affective outcomes, while total physical activity did not demonstrate robust relationships. Together, these results support the notion that inactivity may play a more central role in affective and stress-related processes than previously assumed, particularly when considered independently of physical activity.

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference, and the directionality of associations cannot be established. Second, physical activity and sedentary behavior were assessed via self-report, which may introduce measurement bias. In addition, the IPAQ-SF assesses total sitting time but does not distinguish between different types of sedentary behavior, such as mentally active sitting related to work or study and more passive forms of sitting such as television viewing. This distinction may be important because the psychological correlates of sedentary behavior could depend on the cognitive, emotional, and social context in which sitting occurs. Future studies should therefore examine whether the type and context of sitting moderate associations between sedentary behavior and perceived stress. Third, the relatively small sample size limits statistical power and generalizability. Despite these limitations, the consistency of findings across related outcomes strengthens the observed pattern.

## Conclusion

From a practical perspective, the results suggest that interventions targeting stress reduction may benefit from focusing not only on increasing physical activity but also on reducing sedentary time. Reducing prolonged sitting and introducing regular movement throughout the day may represent relevant strategies for supporting stress regulation.

**Declaration of interests:** The authors report there are no competing interests to declare.

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