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A single active break intervention improves cognitive performance in university students with low physical activity levels

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A single active break intervention improves cognitive performance in university students with low physical activity levels

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Abstract

Active breaks have been found to improve cognitive performance in students from various ages. However, literature on the influence of active breaks on cognition of university students is scarce and with contrasting results. The aim of this work was to provide further evidence along or against the positive effects of a single active break intervention on the cognitive performance of university students. Participants performed the Raven's Standard Progressive Matrices test and a physical activity level questionnaire (IPAQ-SF). The experimental set-up followed a pre-post intervention study design. We found that participants with low physical activity level increased significantly their score on the cognitive task after the active break. Future research should consider the use of a concise instrument to assess participants' physical activity levels to better discern the effects of a single active break intervention on cognitive performance.

Key words: Acute intervention, cognitive task, fitness level, university students.

Deskantsu aktiboko esku-hartze bakar batek jarduera fisiko maila baxua duten unibertsitateko ikasleen errendimendu kognitiboa hobetzen du

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Laburpena

Hainbat ikerketek nabarmendu dute deskantsu aktiboek adin desberdinetako ikasleen errendimendu kognitiboa hobetzen dutela. Dena den, unibertsitateko ikasleen kognizioan deskantsu aktiboek duten eraginaren gaineko ikerketak oraindik urriak dira eta emaitza kontrajarriak erakusten dituzte. Lan honen helburua deskantsu aktiboaren saio bakar batek unibertsitateko ikasleen errendimendu kognitiboan izan zezakeen eraginari buruzko aldeko edo kontrako ebidentziak ematea izan zen. Ikerketan parte hartu zuten ikasleek Raven-en Matrize Progresibo Estandarren proba egin zuten eta jarduera fisikoaren maila neurtzeko galdetegia (IPAQ-SF) bete zuten. Diseinu esperimentalak esku-hartzearen aurreko eta ondorengo neurketetan oinarritutako diseinua jarraitu zuen. Emaitzek erakutsi zuten jarduera fisikoaren maila baxua zuten ikasleek modu esangarrian hobetu zutela zeregin kognitiboan lortutako puntuazioa deskantsu aktiboaren ondoren. Etorkizuneko ikerketek parte-hartzaileen jarduera fisikoaren maila ebaluatzeko tresna zehatzen erabilera kontutan hartu beharko lukete, deskantsu aktiboaren saio bakar batek errendimendu kognitiboan duen eragina zehaztasun handiagoz ebazteko.

Hitz gakoak: esku-hartze akutua, zeregin kognitiboa, egoera fisikoaren maila, unibertsitateko ikasleak.

1. Introduction

It is well established that regular physical activity has positive effects on cognitive and academic performance in students of varying age ranges (Chacón-Cuberos et al., 2020; Liu et al., 2025; Luque-Illanes et al., 2021). Physically active students perform better in subjects as languages, science and mathematics (Altenburg et al., 2016; Castelli et al., 2007; Hillman et al., 2008; Palmer et al., 2013; Sannino et al., 2020). Physical activity causes physiological responses that affect cognitive functioning. These physiological responses include changes in blood flow to the brain as well as changes in blood hormones (dopamine, norepinephrine and epinephrine; Basso & Susuki, 2017), stimulating memory, spatial perception, language attention, perception of nonverbal cues, and the ability to make decisions (Blakemore, 2003; Jensen, 2000). Physical activity performed regularly has been found to influence brain plasticity, resulting in the identification of variables enhancing cognition. For instance, regular physical activity increases the brain-derived neurotrophic factor which, in turn, enhances learning. Furthermore, the brain-derived neurotrophic factor promotes structural changes in the hippocampus, and increases neurons, dendrites and synapses; all essential cellular and structural elements of the nervous system (Cotman et al., 2002; Jensen, 2000).

An increasing volume of academic research associates active breaks with benefits in cognitive performance in students ranging from primary school to university (Mavilidi et al., 2021; Melguizo-Ibañez et al., 2024; Pinar-Baños & Oliva, 2024; Zurita-Ortega et al., 2025). Active breaks (AB) consist of some form of low- to moderate-intensity physical activity that can be described as intentional, short interventions built into the school –or working– routine (Melguizo-Ibañez et al., 2024). These breaks typically consist of exercises performed from 10 to 40 minutes, although five-minute activities of vigorous intensity may also lead to cognitive improvements (Daly-Smith et al., 2018). AB interventions might be performed as a single session implementation (acute effect) or as repeated sessions implementations (chronic effect; Berton et al., 2025). The exercise involved may vary from walks to slow cycling, stretching, coordination exercises or low-intensity workouts (Chang et al., 2013; Martínez-López et al., 2021; Melguizo-Ibañez et al., 2024). AB have been shown to be associated with greater attention and concentration levels in primary and secondary education (Altenburg et al., 2016; Martínez-López et al., 2021; Melguizo-Ibañez et al., 2024; Zurita-Ortega et al., 2025), which in turn improve cognitive performance (Ruiz-Hermosa et al., 2019). They have also been shown to be effective for inhibitory control, and for developing memory and cognitive flexibility (Graham et al., 2021).

According to a review by Chang et al. (2012), there are four major variables that need to be considered when examining the influence of a single session of AB (acute effect) on cognitive performance: (1) exercise intensity and duration, (2) timing of the cognitive task relative to execution

of the exercise, (3) type of the cognitive task, and (4) physical activity level of the participants. In relation to exercise intensity, the Inverted-U hypothesis, originally proposed by Yerkes and Dodson (1908), suggests that optimal performance occurs at an intermediate level of arousal, while both low and high levels of arousal will result in impaired performance outcomes. In the context of the present study, the inverted-U hypothesis predicts that physical activity of moderate intensity will have the greatest cognitive outcomes (Knaepen et al., 2010). Regarding PA duration, Brisswalter et al. (2002) concluded that at least 20 minutes of exercise is necessary for cognitive effects. However, five-minutes of vigorous exercise may also lead to cognitive improvements (Daly-Smith et al., 2018).

Regarding the timing of the administration of the cognitive task after AB, results vary depending on whether the cognitive task was administered during the activity, immediately following activity (within 0-10 minutes after AB completion), or after a delay. The largest positive effects on cognition are observed following 11-20 minutes of delay after AB completion, with effects subsiding after longer (>20 minutes) delays (Chang et al. 2012).

In accordance with the Transient Hypofrontality hypothesis proposed by Dietrich (2006), the performance of the physical exercise and the cognitive task may require similar neural structures and metabolism. Therefore, depending on the cognitive task and/or the exercise the active break may have beneficial or detrimental effects on cognition. Physical activities with greater cognitive demands—rather than just mechanical ones—have been shown to be effective achieving significantly higher attention and concentration levels (Melguizo-Ibáñez et al., 2024; Schmidt et al., 2016; Watson et al., 2019; Zurita-Ortega et al., 2025). Performing complex, coordination exercises require engaging in considerable cognitive efforts, promoting neural plasticity, and thereby, helping to improve cognitive functions (de Greef et al., 2018; Mazzoli et al., 2021; Raichlen & Alexander, 2017; Wang et al., 2024). Finally, academic research suggests that the cognitive response to an implementation of a single session of physical activity may depend on the physical activity level of the participant (Zolads et al. 2008), with largest positive effects observed in participants with low physical activity levels (Llorens et al., 2015).

Literature about the influence of regular physical activity on academic performance in university students is scarce and with contrasting results (Basso et al., 2014; Bertón et al., 2025; Dodwell et al., 2018; El Ansari & Stock, 2014; Hopkins et al. 2012; Keating et al., 2013; Muñoz-Bullón et al., 2017), although a general interest exists on university students' reasoning abilities and learning strategies (e.g., Aizpurua et al., 2018). In a recent systematic review Bertón et al. (2025) found that the implementation of a single AB in university students was mainly positive on cognitive performance: attention, learning, executive functions, concentration and mathematical competence improved after

intervention. Only one study reported in that review did not show significant improvements in attention (Lobach et al., 2023).

The main aim of this work was to investigate the influence of a single AB intervention on the cognitive performance in university students, and to provide further evidence along or against the beneficial effects of active breaks. Based in previous empirical work, it was expected that participants performing a single AB intervention would score higher on the cognitive task, compared to those who do not perform any AB. In addition, it was predicted that the largest positive effect on the cognitive task would be observed in participants with low physical activity level. Physically fit participants, i.e. those accustomed to engaging in regular physical activity, may not benefit from a single AB intervention.

2. Methodology

2.1. Participants

Eighty-three undergraduate students from the Education and Sports Faculty of the University of the Basque Country UPV-EHU (ages 20–24; average = 21.6 ± 1.03 years) participated in the study; 42 females (50.6%) and 41 males (49.4%). Recruited participants were evaluated in university classrooms during the second semester in their 3rd year. Informed consent was obtained prior to the experiments. Research protocol followed the ethical principles and guidelines of the Helsinki Declaration (World Medical Association, 2013). None of the participants received monetary compensation or course credit. Participants also filled in an *ad hoc* questionnaire about their socio-demographic data, such as age, sex, and identification number.

2.2. Instruments

2.2.2. Cognitive task

Participants cognitive performance was assessed with Raven's Standard Progressive Matrices test (SPM; Raven et al., 2001). This test measures the participants' reasoning ability, which is part of the deductive component of Spearman's general intelligence (g factor) and cognitive ability (Kalat, 2014). The SPM test is a nonverbal group test typically used in educational settings, and it may be administered to groups ranging from 5-year-olds to the older adults (Bilker et al., 2012). It comprises a set of 60 diagrammatic puzzles exhibiting serial change in 2 dimensions simultaneously and listed in order of difficulty. Each puzzle is a set of geometric figures that has a part missing, which the participant must identify among the options provided. There are over 40 studies examining the reliability of the test, the general findings include evidence regarding internal consistency and test-retest reliability (Raven et al., 2001).

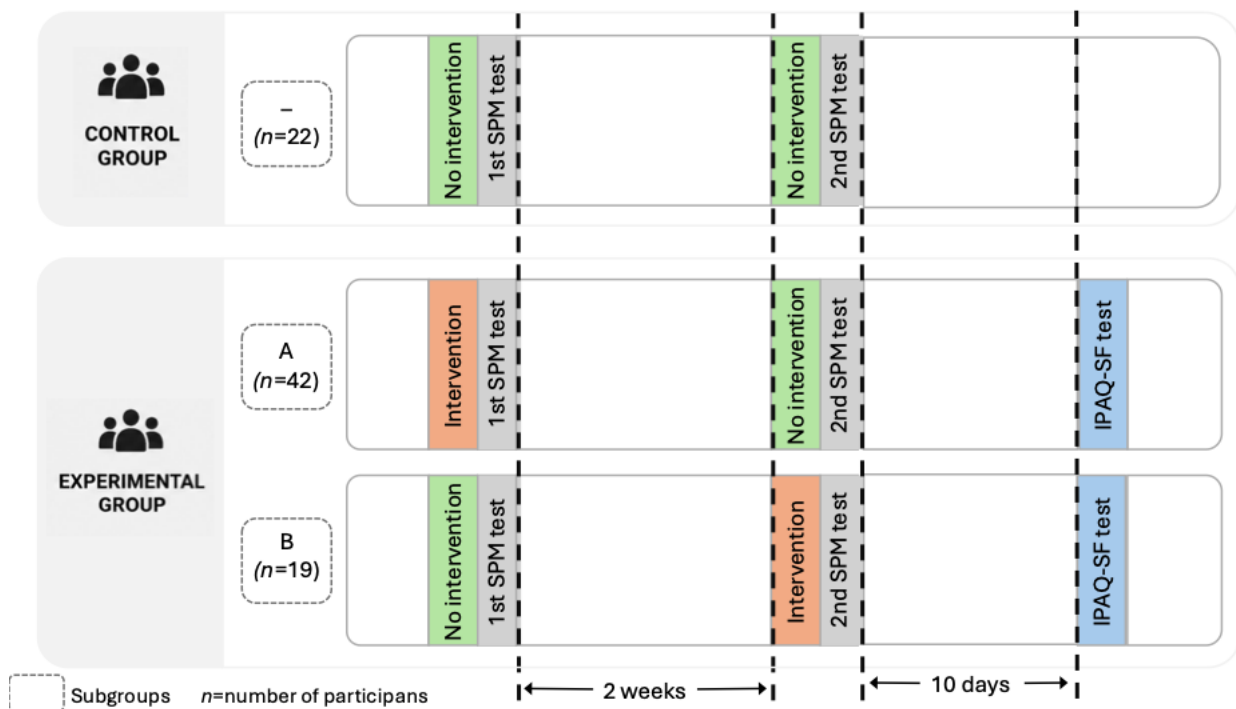
2.2.3. Physical activity level

Physical activity level of participants was measured individually with a Basque translation of the short form version of the International Physical Activity Questionnaire (IPAQ-SF; Craig et al., 2003). This 9-item questionnaire records the activity of four intensity levels: (1) vigorous-intensity activity such as aerobics, (2) moderate intensity activity such as leisure cycling, (3) walking, and (4) sitting. In each of the four categories, the number of days spent per week, and time spent per day are recorded. Outcome measures were MET (Metabolic Equivalent Task) hours per week –one MET is equal to the energy expenditure during rest and is approximately equal to $3.5 \text{ ml O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ (Hagstromer et al., 2006). Data obtained from the IPAQ-SF were transformed into energy expenditure estimates as MET (Ainsworth et al., 2000). The number of hours dedicated to each activity type was multiplied by the specific MET score for that activity (Craig et al., 2003). Following the proposal of Lee et al. (2011), physical activity levels were divided into three categories: (1) low activity level, as MET scores below 3; (2) moderate activity levels, as MET scores between 3 and 6; and (3) high activity level, as MET scores above 6.

2.3. Procedure

The experimental set-up followed a pre-test/post-test intervention design, where participants were divided into two groups: Experimental Group (EG) and Control Group (CG). The SPM test was administered at the onset of the current study twice, with two weeks between the first and second pass, for all participants. The EG was further divided into two subgroups: A and B. The EG-A proceeded with the intervention (active break) before SPM test was administered at the second time, whereas the EG-B proceeded with the intervention before the SPM test was administered at the first time (see Figure 1). SPM test was administered after 10 to 15 minutes of delay following the active break completion, for all students. The control group did not perform any physical activity for at least 2 hours before SPM test, since they were attending to prior subjects in the classrooms. None of the participants were aware of the group they belonged to. This process aimed to limit contamination among the participants of both the experimental and the control groups. Participants were asked to record the duration of the SPM test (i.e. test duration). Time spent on the SPM test (hereafter referred as test duration) was included in the analyses as a dependent variable. The IPAQ-SF was administered only to the participants on the experimental group 10 days after the second SPM test was administered (Figure 1).

Figure 1. Experimental set-up, for each of the subgroups within the Control Group and the Experimental Group. Dashed boxes encompass subgroups (A and B for the experimental group; “–” denotes lack of subgroups within the Control Group) and the number of participants in each subgroup (*n*). “No intervention” refers that the participants didn’t perform the active break, whereas “intervention” refers that the participants performed the active break. Own elaboration.



2.4. Intervention (activity break)

As previously discussed, and following Brisswalter et al. (2002) and Knaepen et al. (2010) the intervention consisted of a single session (acute effect) of physical activity of moderate intensity and 20 minutes of duration. Participants were instructed that they should reach a moderate intensity (i.e. they should be able to maintain a conversation while exercising) and try to maintain that intensity for as much of the exercises as possible. The session consisted of five exercises organized in stations, with four to six students at each station per time. At station 1, participants were required to jump rope. At the second station, they were required to jump over benches from side to side; the height of the bench was 35 cm. At the third station, participants were required to perform jumping jacks. At station 4, they were required to skip over 18 rings laying on the floor, alternating the left foot and the right foot. After skipping over the 18 rings, they would have to start over. The last task consisted of arm exercises with 2-3 kg medicinal balls. Subjects exercised for 4 minutes at each station, with 1 minute of resting time between stations. This session was designed and performed under the supervision of two lecturers of Physical Education of the Education and Sports Faculty of the University of The Basque Country (EHU).

2.5. Statistical analyses

Prior Shapiro-Wilk tests indicated that variables violated the assumption of normality. All variance inflation factors showed values below 3, indicating that there was no collinearity among the variables (Cohen et al., 2002). Preliminary visual inspections of distributions plots between sexes on SPM test and the IPAQ-SF scores indicated no major differences in data distribution. Also, the Wilcoxon Rank Sum test and the Pearson's Chi-squared test showed that there were no differences between sexes on SPM test scores ($W = 720.5$; $p = .19$) and IPAQ-SF levels ($\chi^2 = .79$; $p = .67$), respectively. Consequently, both sexes were combined in all further analyses. Mean differences in SPM scores among the CG, the EG, and the experimental subgroups (EG-A and EG-B); mean differences in SPM scores among different IPAQ-SF levels; and time expended performing the SPM tests among the CG and experimental subgroups were compared with the Kruskal-Wallis test. Wilcoxon rank sum tests were used for multiple pairwise comparisons.

All analyses were performed in *R* software v.4.1.0 (R Foundation for Statistical Computing, n.d.). The significance level was set at .05.

3. Results

Average SPM test scores increased 1.7 points for the CG after intervention and increased 1.6 points for the EG (see Table 1 and 2). SPM scores increased 1.8 points for the EG-A, whereas SPM scores increased 1.0 points for the EG-B. A Kruskal-Wallis H test was conducted to determine whether SPM test scores differed between experimental conditions. The analysis showed that there were not statistically significant differences ($H(19) = 24.22$; $n = 83$; $p = .19$). Multiple pairwise Wilcoxon comparisons showed no significant differences between experimental groups or subgroups (Table 2).

Table 1. Raven’s Standard Progressive Matrices test scores (SPM scores) for the Control Group and the Experimental Group before and after the intervention. Median, 1st and 3rd quartile, range and outliers are included.

Group	Condition	Median (Q1–Q3)	Range	Outliers
Control Group (<i>n</i> =22)	Pre-intervention	52 (51.3–56)	47–60	None
	Post-intervention	55 (54–57)	50–60	49
Experimental Group (<i>n</i> =61)	Pre-intervention	52 (49–55)	43–58	34
	Post-intervention	53 (51–56)	46–59	42 and 43

n = number of individuals

Table 2. Average Raven’s Standard Progressive Matrices test scores (SPM scores) and standard deviations ($\pm$ SD) for the Control Group, the entire Experimental Group (A + B) and for the Experimental Subgroups A and B, before and after the intervention (active break). Pairwise Wilcoxon test values (*W*) and significance levels are included. “–” denotes lack of subgroups within the Control Group. Median, 1st and 3rd quartile are also included.

Group	Subgroups	Pre-intervention SPM scores		Post-intervention SPM scores		<i>W</i>	<i>p</i>
		Median (Q1–Q3)	Mean $\pm$ SD	Median (Q1–Q3)	Mean $\pm$ SD		
Control Group	– (<i>n</i> =22)	52 (51.3–56)	53.1 $\pm$ 3.7	55 (54–57)	54.8 $\pm$ 2.0	177.5	0.13
	A + B (<i>n</i> =61)	52 (49–55)	51.4 $\pm$ 4.6	53 (51–56)	53.0 $\pm$ 3.9	1526	0.08
Experimental Group	A (<i>n</i> =42)	51 (48–53)	50.2 $\pm$ 4.5	52.5 (50–53)	52.0 $\pm$ 3.9	685.5	0.08
	B (<i>n</i> =19)	55 (52–57)	54.2 $\pm$ 3.3	56 (52–57.5)	55.3 $\pm$ 3.0	150	0.38

n = number of individuals

Average SPM scores increased by 3.1 points for the low physical activity level group after intervention, increased 1.1 for the moderate physical activity level group, and by 0.4 points for the high physical activity level group (see Table 3). A Kruskal-Wallis H test was conducted to determine

whether SPM test scores differed between physical activity levels before and after intervention. The analysis showed that there were no overall statistically significant differences ($H(5) = 9.17; n = 83; p = .10$). However, in the low physical activity level group the Wilcoxon test revealed a significant difference in SPM scores before and after the intervention, with higher scores following the intervention (Table 3).

Table 3. Average Raven's Standard Progressive Matrices test scores (SPM scores) and standard deviations ($\pm$ SD) for the different activity levels before and after intervention. Pairwise Wilcoxon test values (W) and significance levels are included. Median, 1st and 3rd quartile are also included.

Activity level	Pre-intervention SPM scores		Post-intervention SPM scores		W	p
	Median (Q1–Q3)	Mean $\pm$ SD	Median (Q1–Q3)	Mean $\pm$ SD		
Low ($n=17$)	50 (47–52)	49.1 $\pm$ 5.6	53 (51–56)	52.2 $\pm$ 3.9	81	0.03
Moderate ($n=30$)	52 (51–56)	52.6 $\pm$ 3.5	53.5 (51–56)	53.7 $\pm$ 3.5	410	0.57
High ($n=14$)	52.5 (51–56)	51.9 $\pm$ 4.4	53.5 (50–55)	52.3 $\pm$ 4.8	89.5	0.71

n = number of individuals

Average test duration decreased by more than 10 minutes for the CG from the first to the second SPM test administration, by 2.5 minutes for the EG-A subgroup, and by 12.5 minutes for the EG-B subgroup (see Table 4). The Kruskal-Wallis H test used to analyse overall differences in test duration among subgroups did not show any statistically significant differences ($H(34) = 47.62; n = 83; p = .06$), but pairwise Wilcoxon comparisons indicated statistically significant differences within subgroups, between the first and second SPM test durations (see Table 4).

Table 4. Average test duration (in minutes) and standard deviations ($\pm$ SD) for the different subgroups at the first and second SPM test administrations. 1st SPM test for the EG-A subgroup was after intervention (see 2.4. Intervention in Methods). Pairwise Wilcoxon test values (W) and significance levels are included. “–” denotes lack of subgroups with the Control Group. Median, 1st and 3rd quartile are also included.

Group	Subgroups	1 st SPM test duration		2 nd SPM test duration		W	p
		Median (Q1–Q3)	Mean $\pm$ SD	Median (Q1–Q3)	Mean $\pm$ SD		
Control Group	– ($n=22$)	29.5 (25.3–37.3)	33.7 $\pm$ 11.6	23.5 (18–25)	23.1 ($\pm$ 6.8)	388	0.0006
Experimental Group	A ($n=42$)	18 (17–22)	22.2 $\pm$ 4.1	21 (17–24)	19.7 ($\pm$ 4.5)	340.5	0.000003
	B ($n=19$)	25 (22–37)	29.8 $\pm$ 10.0	17 (14.5–19.5)	17.3 ($\pm$ 2.8)	557.5	0.004

n = number of individuals.

4. Discussion

The main aim of this work was to investigate the effects of a single session of AB on the cognition of university students, to further provide evidence along or against its positive effects. First, it was hypothesized that participants performing a single AB session would score higher on the cognitive task (Raven’s Standard Progressive Matrices test; SPM test), compared to participants in the control groups that did not perform any active breaks. However, the experimental intervention did not reveal any significant effects between groups. One reason for that may be the fact that the second pass of the cognitive task was administered two weeks after the first pass. Several of the participants commented after finishing the SPM test for the second time, that they were able to remember some of the task’s puzzles, realised about the mistakes they did (according to their account), and changed their wrong answers. To minimize this, similar studies using pre-test/post-test intervention design where the same test is administered for both passes, have waited one to three months between first and second pass (i.e. Reed et al., 2010). However, it is worth mentioning that, whereas some of the students did correct some of their wrong answers, others changed their right answer for other wrong ones. A measure to compensate for the timing in the present work was the experimental procedure followed, where the experimental group –EG– was divided in 2 subgroups: EG-A and EG-B. On the EG-A subgroup participants performed the AB before the first SPM test, whereas on the EG-B subgroup participant performed the AB before the second SPM test. Time spent performing the tests was, indeed, significantly lower on the second pass of the test, suggesting that participants were able to remember, to an extent, some of the puzzles. Here again several participants of the EG-A subgroup

commented that, comparatively, they felt “mentally less agile” or “more obtuse” on the cognitive task, even though they were performing the test for the second time.

Secondly, it was also predicted that the largest positive effect on the cognitive task would be observed in participant with low physical activity level, or those students not accustomed to performing physical activity on a regular basis. Indeed, the present study did show a significant effect of a single AB intervention for the low physical activity level students, whereas for the moderate and high activity level students no statistically significant difference was found. Previous studies have also found largest positive effects of single exercise sessions in participants with low physical activity or low fitness level (i.e., Llorens et al., 2015; Zolads et al. 2008). Physical activity may act as an external stressor for students on the low activity category, triggering greater physiological responses, which include increased heart rate, which in turn increases blood flow and oxygenation in the brain. It also modifies the production and release of plasma catecholamines such as dopamine, norepinephrine and epinephrine (Basso & Suzuki, 2017), enabling the brain to become alert and ready to the task ahead (Chang et al. 2012). The greater the stressor the greater will be the stress response (Schneiderman et al., 2011). This, again, relates to the potential mechanisms of the effects, with active breaks triggering a greater physiological response in participants with low physical activity level (Zolads et al. 2008), whereas participants with moderate to high activity levels are accustomed to the stressor (i.e., activity break), and therefore, there are no (or very low) physiological responses.

4.1. Limitations

The present study has some limitations that should be acknowledged. First, the small number of participants ($n = 83$) prevents the findings of this study to be generalized to a broader scale. Secondly, although the short version of the International Physical Activity Questionnaire (IPAQ-SF; Craig et al., 2003) is widely used and recommended, Lee et al. (2011) found that only a small correlation is achieved with objective measures of activity, in most validation studies. Since the questionnaire reports self-perceived activity levels, Lee et al. (2011) concluded that the participants tended to overestimate the amount of physical activity, compared to an objective device such as accelerometers or a heart-rate monitors. Therefore, two conclusions could be unfolded: 1) the participants in this study are physically less active than suggested by the questionnaire, and 2) the use of more reliable and accurate procedures to measure the physical activity levels of participants may be advisable (i.e., Hagströmer et al. 2006). A third potential limitation might be the limited control on the intensity at which participants performed the active break. Participants were instructed to reach a moderate intensity and try to maintain it throughout the intervention as much as possible, however, no monitoring devices were employed. The use of heart rate monitors would help controlling that participants were performing at moderate activity intensities according to their maximal oxygen consumption and/or heart rates (Astrand, 1960; Whaley et al., 2006).

4.2. Conclusions

The findings of this research show that a 20-minute long, single session of moderate-intensity exercise may have a positive effect on the cognitive performance of university students, with the largest positive effect observed in participants with low activity level. In their systematic review, Bertón et al. (2025) reported seven studies showing results of single implementations of active breaks on cognitive performance. Six of those studies showed positive effects, while only one did not show any significant improvement. (i.e. Lobach et al., 2023). However, none of the studies included any instrument to measure the physical activity or fitness level of the participants. Future studies should consider including an instrument that reliably measures participant's physical activity or fitness levels in order to better discern the effects of single AB intervention on cognition.

The cognitive benefits of this study occurred at an exercise duration that can be performed within a common break of 20-30 minutes between classes, pointing to the applicability in a university setting. Also, university students who want to improve at cognitive tasks (i.e., exams), should perform beforehand a moderate physical activity of about 20 minutes (for example, walking at a brisk pace or resistance exercises) with 10-15 minutes of delay between exercise completion and beginning of the cognitive task. These findings have relevant theoretical and practical implications and should be addressed in future research with varying exercise intensities and durations and cognitive task

Data availability

The study datasets are available on Mendeley: <https://data.mendeley.com/datasets/s8m87d7tyz/1>

Disclaimer

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