MIND UP - MINDFULNESS AND INTERVALS FOR NURTURING DIRECTED ATTENTION IN UNIVERSITY PERFORMANCE: THE RESULTS OF A PILOT STUDY

MIND UP – MINDFULNESS E PAUSE ATTIVE PER POTENZIARE L'ATTENZIONE DIRETTA NELLA PERFORMANCE UNIVERSITARIA: RISULTATI DI UNO STUDIO PILOTA

Eugenia Treglia
Pegaso Digital University
eugenia.treglia@unipegaso.it

Anna Maria Mariani
Pegaso Digital University
annamaria.mariani@unipegaso.it

Double Blind Peer Review

Citation
Treglia, E., & Mariani, A.M. (2025). Mind up - mindfulness and intervals for nurturing directed attention in university performance: the results of a pilot study. *Giornale italiano di educazione alla salute, sport e didattica inclusiva*, 9(2).

Doi:
https://doi.org/10.32043/gsd.v9i2.1499

gsdjournal.it
ISSN: 2532-3296
ISBN: 978-88-6022-510-8

ABSTRACT
The study explores the effect of mindful active breaks—short pauses involving complex movements and body awareness—on the attention levels of university students. Following the intervention, a significant reduction in cognitive interference was observed (p = 0.04), particularly among female students, indicating benefits for inhibitory control. The gap between perceived and actual physical activity highlights the need for greater motor awareness.

Lo studio esplora l'effetto delle *mindful active breaks*, pause attive basate su movimenti complessi e consapevolezza corporea, sull'attenzione degli studenti universitari. Dopo l'intervento, si osserva una riduzione significativa dell'interferenza cognitiva (p = 0,04), in particolare tra le studentesse, indicando benefici sul controllo inibitorio. La discrepanza tra attività fisica percepita e reale evidenzia la necessità di maggiore consapevolezza motoria.

KEYWORDS
Active breaks, attentional functions, academic performance, mindfulness, physical activity
Pause attive, funzioni attentive, risultati accademici, mindfulness, attività fisica

Received 04/05/2025
Accepted 30/05/2025
Published 20/06/2025

1. Introduction

The intricate interplay between physical movement, mindful attention practices, and their impacts on cognitive functions and academic performance has emerged as a compelling area of inquiry. In an era marked by growing academic demands and increasingly sedentary lifestyles among university students, identifying effective strategies to support cognitive performance and well-being is more pressing than ever. How can structured interventions, such as movement during class hours and mindfulness-based practices, influence the executive function of attention, a critical foundation for learning and academic achievement? By addressing this question, this paper investigates the transformative potential of these practices, highlighting their implications for enhancing university students' attention and overall academic outcomes. Attention, as a core executive function, is pivotal for processing, retaining, and applying knowledge, which are essential skills for academic success. Despite its importance, traditional educational methods often overlook the integration of physical and mental well-being into academic frameworks. This study posits that introducing mindful movement breaks and structured physical activity during class hours offers a promising approach to addressing educational challenges connected to cognitive fatigue and sustaining directed attention, contributing to advance discussions on sustainable strategies for academic development.

2. Impact of Movement and Mindfulness on Student Cognition

The interplay between movement and mindfulness emerges as a vital component in enhancing student cognition and overall academic performance. Exploring the effects of physical activity, including structured exercises and active breaks, reveals significant improvements in executive functions, attention control, and emotional well-being. Complementing these insights, mindfulness practices demonstrate their effectiveness in fostering sustained attention, reducing stress, and promoting emotional resilience. Together, these elements provide a comprehensive framework for understanding how integrating movement and mindfulness into educational settings can bolster cognitive capacities and support student success.

2.1 Physical Activity and Executive Functions .

Physical activity plays a pivotal role in enhancing executive functions, such as inhibitory control, working memory, and cognitive flexibility (Song et al, 2022). Cognitively engaging exercises, which require simultaneous physical and mental effort, have shown significant potential in improving these cognitive domains, as they demand higher neural engagement (Diamond and Ling, 2020). Research by Mao et al. (2024) underlines that interventions extending beyond six weeks, with sessions of at least 20 minutes conducted more than twice a week, yield the greatest improvements in children and adolescents. Such interventions allow the brain to undergo structural and functional adaptations, fostering more robust cognitive outcomes (Mora-Gonzalez et al, 2024). Neuroimaging studies have demonstrated that engaging in cognitive tasks during physical exercise enhances blood flow and activates the prefrontal cortex, leading to improved cognitive performance compared to performing simple aerobic activities (Liu et al., 2023). Furthermore, cognitively engaging physical activity promotes the release of brain-derived neurotrophic factor (BDNF), a key protein involved in strengthening synaptic plasticity and boosting cognitive functioning (Schimdt et al., 2015; Voss et al., 2011). The variability in cognitive outcomes linked to different types of physical activities highlights their unique potential to target specific executive functions. Wang et al. (2024) identify ball games as particularly effective in improving updating accuracy due to their requirement for constant monitoring of dynamic stimuli. Similarly, cognitively engaging activities emphasize sustained attention and decision-making under pressure, making them highly effective for improving inhibition accuracy. Dance, with its structured yet adaptable nature, emerges as an exceptional tool for enhancing cognitive flexibility by reducing shifting reaction times (Wang et al., 2024; Lobach et al., 2023). High-Intensity Interval Training (HIIT), which alternates brief periods of vigorous activity with short rest intervals, has emerged as an effective approach for boosting physical fitness. Beyond its physical benefits, this training method also engages cognitive functions, contributing to the development of executive functions (Gilson et al., 2023; Leahy et al., 2020). These findings suggest that different forms of physical activity could be strategically integrated into educational contexts to target and enhance specific cognitive functions, such as adaptability and decision-making capabilities. By incorporating fun into physical and cognitive tasks, people, and specifically children, are more likely to stay engaged and motivated, gaining more practice and potential benefits for EF (Kolovelonis et al., 2023). Active breaks have also been recognized for their significant role in enhancing executive functions like attention and inhibition. Active Breaks, implemented during school/academic lessons, consist of brief pauses—typically lasting between 3 and 8 minutes—during which students engage in moderate to vigorous physical activity (Ferrer & Laughlin, 2017). These breaks can be seamlessly integrated into the educational content or take the form of stand-alone physical movements such as on-the-spot running or jumping (Webster et al., 2015). A standard active break session often begins with a short warm-up, followed by exercises like stretching, relaxation, aerobic movements, or strength-based routines, and concludes similarly to how it started (Perera et al., 2015). These activities may also be guided by exercise videos (Mok et al., 2020) or involve dance-based movement (Ahmed et al., 2007). Research has shown that ABs promote greater involvement in classroom tasks, increase overall physical activity levels, and enhance students' attitudes toward PA (Broad et al., 2023; Ting et al, 2023; Zhao et al., 2023). Moreover, they contribute to a more enjoyable classroom environment and have been linked to improved academic outcomes (Ferrer et al, 2017; Erwin et al., 2012; Reilly et al., 2012). Zurita-Ortega et al. (2025) provide evidence supporting the efficiency of active breaks, particularly when they incorporate both physical and cognitive components. Interventions featuring such breaks demonstrate stronger outcomes for attention and inhibition compared to non-cognitive activities. These findings suggest that movements designed with mental engagement in mind can maximize cognitive benefits. Incorporating such breaks into university classrooms could improve academic performance by maintaining mental sharpness, particularly during prolonged learning sessions.

Short bouts of physical activity during academic sessions can also facilitate faster cognitive processing and heightened attention. Pastor-Vicedo et al. (2024) found that students participating in experimental conditions with physical activity exhibited faster response times compared to controls. Thus, even brief physical movements during a classroom setting can heighten alertness and improve short-term cognitive flexibility. Furthermore, the effectiveness of these breaks is influenced by their structure. Research by Melguizo-Ibáñez et al. (2024) reveals that breaks lasting 30 minutes per session, implemented consistently over five to eight weeks, are notably effective in enhancing attention, with session duration yielding an impressive effect size. The positive correlation between physical activity and better performance on executive function tasks further underscores its value in academic settings. Salas-Gomez et al. (2020) observed significant associations between higher physical activity levels and improved Stroop test scores, particularly in Stroop Colors (Pearson's $r = 0.17$) and Stroop Test Color-Word (Pearson's $r = 0.15$). At brain level, active breaks that involve cognitive engagement may enhance the functioning of the dorsolateral prefrontal cortex—the brain region responsible for executive functions—and improve response inhibition. These effects are thought to be partly influenced by shifts in sedentary behavior and increased movement, such as stepping (Mazzoli et al, 2021).These results emphasize that frequent physical movement enhances attention control and cognitive endurance, enabling students to tackle demanding academic challenges more effectively. The multidimensional impact of physical activity on cognition and emotional well-being further strengthens its role in academic success. Data presented by Zhao et al. (2024) establish significant relationships between physical activity and enhanced executive function, reduced negative emotions and increased self-efficacy. This evidence points toward a positive feedback loop, where improved cognitive functioning contributes to academic success and, in turn, nurtures greater self-confidence and reduced stress levels. The physiological mechanisms underlying the relationship between physical activity and enhanced executive functions further validate the importance of movement in educational contexts. Moderate-intensity cycling (MIC) and vigorous-intensity cycling (VIC) contribute to increased cortical activation and improved retinal vessel diameters, signalling enhanced oxygen delivery to the brain (Yu et al., 2025). These physiological changes result in better neural efficiency, facilitating cognitive processes such as attention and mental flexibility. Furthermore, cognitively loaded physical tasks have demonstrated high efficacy in improving cognitive flexibility and fluency by engaging students in challenges that demand simultaneous physical and mental adaptability (Zurita-Ortega et al., 2025). These findings suggest that structured physical activity programs, such as on-campus cycling programs or mixed-intensity exercises, could serve as effective tools for boosting students' cognitive capacities and academic performance.

2.2 Mindful Attention Practices

Mindfulness-based interventions (MBIs) have demonstrated considerable potential in enhancing attention control and executive functioning, as evidenced by their ability to improve performance in sustained attention tasks and to reduce mind-wandering among participants undergoing mindfulness training. Mindfulness involves paying attention to the present moment with full awareness, including one's thoughts, feelings, actions, and perceptions (Kabat-Zinn, 1990). In particular, the attention is focused on the current experience with qualities such as curiosity, openness, acceptance, non-reactivity, and non-judgment (Bishop et al., 2004; Baer, 2003). These structured programs are specifically designed to cultivate one’s capacity to remain focused by actively combating cognitive distractions. For example, Morrison et al. (2014) highlight how mindfulness training improves task accuracy and decreases reaction time variability, directly benefiting students in academic environments where sustained focus is critical. The reduction in self-reported mind-wandering further supports the assertion that MBIs facilitate a more engaged and present learning experience. However, while these findings are promising, the question of how to ensure long-term benefits of such practices warrants further inquiry. Specifically, the durability of these cognitive improvements after the cessation of mindfulness programs is an area requiring additional longitudinal studies. The positive influence of mindfulness practices extends beyond attention control to mental health improvements, including reductions in stress and depression (Alzahrani, 2020). Improvements have also been reported in emotional regulation abilities (Jiménez-Picón et al., 2021; Salvarani et al., 2020; Alkoby et al., 2018), along with a reduction in emotional interference (Ortner et al., 2007). Gallo et al. (2023) provide evidence showing that students who engage in mindfulness training report significant relief from these conditions. The study from Mariani (2022) indicates that the practice of attention to the breath and one's body seems to have positive effects on the physiological somatization of anxiety in a sample of university students. Furthermore, By alleviating stress and associated cognitive overload, mindfulness enables students to better engage with academic matters. Moreover, reductions in symptoms of depression support consistent mental functioning, offering a further avenue for improved academic performance. MBIs also enhance dispositional mindfulness, particularly within the domains of non-reactivity and the observation of inner experiences. Training participants to observe their thoughts and feelings without impulsive reactions significantly reduces levels of impulsivity, as illustrated by structural changes in the brain, such as decreased caudate nucleus volume (Mas-Cuesta et al., 2024). These neurological transformations reflect improved cognitive regulation and impulse control, which are critical for effective academic decision-making.

Additionally, mindfulness-based interventions have been shown to significantly decrease perceived inattention among participants compared to control groups, as reported by Malboeuf-Hurtubise et al. (2024). This is particularly evident in younger populations, where mindfulness has been effective in stabilizing attention levels over time. For university students, who deal with heightened cognitive demands, these findings suggest a potential to improve focus during prolonged academic sessions. Interestingly, when compared to other interventions like physical exercise or biofeedback techniques, MBIs show comparable effectiveness in promoting executive functioning, mindful awareness, and attention control (de Bruin et al., 2016). This equivalence in impact underscores mindfulness as an accessible and feasible tool for university students, who may lack the time or resources for more physically demanding interventions. Beyond the cognitive domain, mindfulness practices contribute significantly to emotional resilience and stress reduction, particularly in high-pressure environments. As evidenced by Hidajat et al. (2023), MBIs have effectively alleviated occupational stress in teachers, a finding that extends to university students coping with academic pressures. By addressing stress-induced cognitive fatigue, mindfulness offers a holistic approach to improving both emotional well-being and sustained attention. Furthermore, according to Melnychuck et al. (2018), attention to breathing is particularly effective for regulating the production of norepinephrine, through the small area of the brainstem called the locus coeruleus, directly involved in the stress mechanism. Compared to the extensive research on physical activity and its cognitive benefits (Graham et al., 2021; Layne et al., 2021; Luteijn et al., 2022; Robinson et al., 2022; Schmidt et al., 2020), studies exploring the impact of mindfulness on cognition remain relatively scarce (Müller et al., 2021). Mindfulness techniques and cognitively loaded physical activity are proven to be successful tools for improving attention (Müller et al., 2021). Mindfulness-based interventions hold significant promise as a tool for enhancing attention control, emotional resilience, and overall academic performance. However, deeper investigations are necessary to address unanswered questions, such as the long-term sustainability of its benefits and potential synergies with other cognitive practices. There is an ongoing debate about whether their benefits are inherently distinct or simply mirror those of other cognitive-enhancing practices. Further research is necessary to explore integrated approaches combining mindfulness with physical exercises or biofeedback to determine whether their simultaneous application yields synergistic effects on cognitive and emotional regulation. These considerations could further refine the role of mindfulness in fostering academic and personal success for university students.

3. Methodology

This study was broadly aimed at exploring the relationship between engagement in physical activities and students' academic outcomes and attentional abilities. Within this context, an experimental intervention was implemented to assess the effect of a mindful active break on university students' attention function relative to a control condition. In line with the objectives of the present research, the following hypotheses were posited:

H1 - There is a correlation between the level of physical activity and academic performance.

H2 - The practice of motor activities influences attentional capacities.

H3 - Mindful active breaks during lessons have an impact on attentional capacities.

Recruitment for students involved a formal expression of interest; those interested in participating signed informed consents. All participants were allowed to withdraw from the study at any stage. In the preliminary phase of the study, a demographic questionnaire was administered to all participants to gather data on their background, academic performance. Physical activity levels were assessed using the Self-Assessment Questionnaire of Physical Activity Levels by Colella and Monacis (2024). The questionnaire is based on the 2020 WHO International Guidelines (Bull et al., 2020) and the National Guidelines on Physical Activity issued by the Italian Ministry of Health (2021), and is designed for the adult population (age range 19–25 years). It includes both single-item and multi-item sections exploring self-perceived physical activity, step tracking habits, frequency and type of physical activity performed during weekdays and weekends, intensity of effort, time of day of practice, sedentary behavior, and sleep patterns. Participants are asked to self-classify their physical activity level on a 5-point scale (from sedentary to highly active), reporting the frequency of engagement in various types of physical activities (e.g., team sports, walking, fitness, outdoor activities) lasting more than 30 minutes, both in weekdays and weekends and the daily sedentary hours. A global activity index is obtained by averaging the scores from frequency-based items related to physical activity during weekdays and weekends. To measure the attention performance the Digital Stroop Test has been administered (Stroop, 1935; MacLeod, 1991; Basu, 2023; Periáñez, 2021). The Digital Stroop Test is a computerised cognitive task that primarily assesses inhibitory control, cognitive flexibility, and selective attention by requiring participants to override automatic reading responses in favour of identifying the ink colour of incongruent stimuli. Participants were presented with colour words (e.g., "RED," "BLUE," "GREEN") displayed in incongruent ink colours (e.g., the word "RED" printed in blue ink) and were instructed to identify the colour of the ink rather than read the word itself. The task required the inhibition of the automatic reading response in favour of colour naming, thereby engaging executive control processes. Reaction times and accuracy were recorded as primary outcome measures. Higher reaction times and increased error rates were interpreted as indicators of greater difficulty in inhibitory control and cognitive flexibility. Initially, all participants underwent a baseline session in which only the Digital Stroop Test (Stroop, 1935; MacLeod, 1991;

Basu, 2023; Periáñez, 2021) was administered before and after a 3-hour lesson. Subsequently, in the following lesson, the participants completed the same set of questionnaires both pre- and post-intervention, with the engagement in a 15-minute Mindful Active Break midway through the three-hour lesson. The Mindful Active Break was structured into three sequential phases: (1) an initial phase (~5 minutes) consisting of somatic awareness exercises aimed at enhancing interoceptive attention and promoting embodied self-awareness; (2) a second phase (~5 minutes) involving moderate-intensity aerobic activities and movements incorporating cognitive demands, designed to stimulate executive functions such as cognitive flexibility and working memory; (3) a final phase (~5 minutes) focused on cultivating mindful awareness of breathing, bodily sensations, and spontaneous thoughts, to foster sustained attention and emotional regulation.

4. Results

4.1 Sample

The sample consists of 113 first-year university students enrolled in the Faculty of Education Sciences at the University of Cassino. Gender distribution shows a female majority with 71 females (62.83%) and 42 males (37.1%). The average age of the participants is 21.22 years (SD = 3.96 years). A total of 7.1% of participants have a specific learning disorder.

4.2 Academic Performance

On average, students had passed 3.25 exams with an average grade of 27.01. The analysis of self-perceived academic performance, divided by gender, revealed the following data: only 2 participants (1 female and 1 male, representing 1% each) reported a poor perception of their academic performance; 6% of females perceived their performance as sufficient, while no males reported this evaluation; the "satisfactory" perception was indicated by 42% of the total, confirming a moderately positive self-assessment in most cases; 39% of the sample evaluated their performance as "good," indicating an even more positive perception; 12% of females perceived their performance as "excellent," while no males attributed themselves this level of excellence. In summary, overall perception is markedly positive, with over 80% of participants rating themselves as satisfactory, good, or excellent. Females tend to report higher perception levels than males, both in absolute and relative frequencies. Regarding the level of satisfaction with their academic performance, the following results were found: only 1 female participant (1% of the total) declared being not at all satisfied with her academic performance. No male chose this option; 7% of females and 1% of males reported being slightly satisfied with their performance; the majority of participants declared being "fairly satisfied," namely 45% of females and 2% of males. A significant portion declared being "very satisfied" with their performance: 36% of females and 1% of males. Finally, 8% of females declared being fully satisfied. No male selected this option. Therefore, over 84% of participants expressed a medium-high or very high level of satisfaction regarding their academic performance, and only a minority (about 9%) reported low or no satisfaction (1% "not at all," 8% "slightly"). Females showed a generally higher level of satisfaction, with higher percentages in the "very satisfied" and "fully satisfied" categories.

4.3 Perceived and Practiced Level of Physical Activity

The survey explored several aspects related to participants' motor lifestyle, particularly self-perception of physical activity, the use of digital monitoring tools (apps), the average number of daily steps, and weekly frequency of physical exercise. Regarding the self-perception of physical activity, 49.6% (56 participants) defined themselves as moderately active; 21.2% (24 participants) as very active; 22.1% (25 participants) as slightly active; only 3.5% (4 participants) declared being sedentary and another 3.5% (4 participants) defined themselves as highly active. All participants who defined themselves as "sedentary," "slightly active," or "highly active" were female. The males were mainly distributed in the "moderately active" category. To the question "Do you use apps to monitor your physical activity?" 56.6% (64 participants) answered yes, while 43.4% (49 participants) answered no. Regarding the average number of daily steps, 38.1% (43 participants) declared not monitoring their steps; 28.3% (32 participants) reported walking between 3000 and 5000 steps per day; 13.3% (15 participants) between 5000 and 7000 steps; 8.8% (10 participants) between 7000 and 9000 steps; only 3.5% (4 participants) exceed 9000 steps daily; a small portion (8.0%) walk fewer than 3000 steps per day. Therefore, despite a good self-perception of physical activity, only a minority reach the recommended levels of high daily movement (>9000 steps). Regarding the weekly frequency of physical activity, 22.1% (25 participants) declared never exercising; 34.5% (39 participants) exercise 1–2 times per week; 31.9% (36 participants) engage in activity 3–4 times per week; 8.0% (9 participants) train 5–6 times per week; only 3.5% (4 participants) exercise more than 6 times per week. All participants who train more than 6 times weekly are female, while male habits appear more sporadic. The data show that more than half of the participants perceive themselves as moderately or very active, and approximately the same proportion use digital tools to monitor their physical activity. However, there is a noticeable discrepancy between the perception of activity and the objective data on steps and weekly exercise frequency: a significant portion does not meet the minimum recommended levels for an active lifestyle (WHO).

4.4 Stroop Test

The analysis of cognitive performance, conducted using the Stroop task, focused on the difference in reaction times between congruent and incongruent stimuli, used as an indicator of cognitive interference and, by extension, of inhibitory control capacity. The test was administered at four different moments during the university lecture path: at the beginning of the first lesson (Stroop 1), at the end of the same lesson (Stroop 2), at the beginning of a second lesson conducted on a different day (Stroop 3), and at the end of this latter session, after the introduction of an active break during the lecture (Stroop 4). See table 1

Condition	Congruent (ms)	Incongruent (ms)	Difference	Interference Classification
Stroop 1 – Baseline (start)	1120.7	1117.5	137.9	Moderately high – High
Stroop 2 – End of first lecture	901.7	981.5	106.7	Moderately high
Stroop 3 – Start of second lecture	845.2	938.8	111.5	Moderately high
Stroop 4 – End of second lecture	796.9	898.4	113.9	Moderately high

Table 1. Stroop test result

Overall, the total reaction times show a progressively decreasing trend: from 1120.7 milliseconds for congruent stimuli and 1117.5 for incongruent ones in the first administration, to 796.9 and 898.4 respectively in the fourth condition. This trend suggests an improvement in cognitive efficiency during the academic activity, probably linked to progressive task adaptation or increased sustained attention activation. However, cognitive interference — calculated as the difference between incongruent and congruent times — remains above 100 milliseconds. This value, falling within the moderately high range, indicates a certain degree of difficulty in inhibitory control. In particular, in the initial baseline condition (Stroop 1), the difference is 137.9 milliseconds, a value at the threshold of the high interference range. Gender-based data analysis reveals further interesting insights. In the first administration, the average difference in reaction times between congruent and incongruent stimuli is essentially similar for females and males, at 111.5 and 112 milliseconds respectively. This suggests that at the start of the lecture, attentional and inhibitory abilities are comparable across genders. In the second administration, conducted at the end of the same lecture, there is an increase in interference especially among males, who show a mean difference of 130.3 milliseconds, compared to 113.3 milliseconds among females. This increase suggests that the cognitive load of the lecture may have generated mental fatigue, with more marked effects in the male group. At the end of the first day, therefore, there is a general increase in interference, with a more evident worsening among male students. At the beginning of the second lecture, in the Stroop 3 condition, cognitive interference does not decrease. On the contrary, average values remain high: 138.2 milliseconds for females and 130.5 for males. The greater variance recorded among female students, at 137.1, also highlights notable individual variability in responses. This result suggests that neither night rest nor the simple time interval between lectures is sufficient to fully restore executive control efficiency. On the contrary, the beginning of a new teaching session may coincide with a level of interference comparable to or even higher than that observed at the end of the previous one. In the fourth and final condition, that is, at the end of the second lecture after the introduction of the active break, a reduction in average interference is observed among females, who drop to a difference of 105.6 milliseconds, lower than previous values. Among males, however, interference remains high, with an average of 136.3 milliseconds. This discrepancy suggests that the active break may have had a selective positive effect, with more marked benefits in the female group. Overall, the aggregated data show a slight decrease in average interference, but with significant variations among subgroups. A further analysis considered the individual distribution of participants by dividing them into four categories based on total reaction times: low, average, moderately high, and high. The comparison between the two final conditions, i.e., end of the first lecture (without break) and end of the second lecture (with active break), shows an increase in the number of subjects in the “low time” group, rising from 24 to 34. At the same time, there is a reduction in the “average” group, from 30 to 22 individuals. This finding does not translate into a statistically significant difference but suggests the presence of selective improvement in part of the sample, not detectable through mean analysis but observable in the internal performance distribution. Inferential analysis, conducted using paired samples t-tests, only partially confirmed these results. The comparison between Stroop 1 and Stroop 2 yielded a p-value of 0.85, well above the significance threshold of 0.05, indicating no statistically significant difference between the beginning and end of the first lecture. The comparison between Stroop 1 and Stroop 3 also returned a non-significant value ($p = 0.10$), suggesting that observed differences cannot confidently be attributed to a systematic change in performance. The same applies to the comparison between Stroop 2 and Stroop 4 ($p = 0.50$), which shows no significant differences between the end of the first lecture and the end of the second, even with the active break. The only statistically significant difference emerges from the comparison between Stroop 3 and Stroop 4, with a p-value of 0.04. This result allows for the rejection of the null hypothesis and suggests that the active break introduced during the second lecture had a measurable positive effect in reducing Stroop interference, improving the ability to manage cognitive conflict between the beginning and end of the session. Overall, the results highlight a complex dynamic: at the beginning of the first lecture, cognitive interference is relatively contained and similar across genders; at the end of the lecture, it increases, particularly among males, and tends to remain high even at the beginning of the following lecture, despite the time interval. The inclusion of an active break produces positive effects, especially among women, with a significant reduction in interference between the beginning and end of the second lesson. This indicates that, even in the absence of a uniform improvement at the sample mean level, the movement-based intervention can promote measurable benefits on executive functioning, particularly on inhibitory control, contributing to the recovery of cognitive efficiency during educational activities.

4.5 Correlations

The analysis of correlations between the number of exams taken, the average grades, the level of physical activity, and performance on the Stroop Task 1 revealed some interesting, albeit generally weak, links. A slight positive correlation emerged between the number of exams taken and the average grades ($r = 0.27$), indicating that students who complete a greater number of exams also tend to achieve slightly higher average grades. This suggests that more intense academic engagement is at least partially associated with better results, highlighting a possible component of motivation or personal organization. The relationship between the number of exams taken and the level of physical activity showed a very slight positive correlation ($r = 0.16$). Although the association is very weak, it could be hypothesized that students who are more active academically also tend to maintain slightly higher levels of physical activity, perhaps due to a general inclination towards a more dynamic and organized lifestyle. Similarly, a very slight positive correlation (r = 0.18) was observed between the number of exams taken and performance on Stroop Task 1. This suggests that those who are more academically active may perform slightly better in tasks requiring attention and executive control, although the strength of the relationship remains modest. Conversely, the correlation between average grades and physical activity level was found to be very slightly negative (r = -0.13). This might indicate that students with higher grades tend to have slightly lower levels of physical activity, although the relationship is so weak that no definitive interpretations can be made. A very slight negative correlation (r = -0.13) was also found between average grades and Stroop Task 1 performance, suggesting that those with better academic scores might, very slightly, be slower in inhibition tasks, although again, the magnitude of the relationship is minimal. Finally, the correlation between physical activity and Stroop Task 1 performance was practically non-existent (r = 0.04), indicating that the level of physical activity, in the analyzed sample, is not significantly associated with performance in selective attention tasks. In summary, the observed relationships are largely very weak. However, the slight positive association between academic productivity (number of exams) and academic performance (average grades), along with the slightly positive trend between academic activity and physical activity, may suggest the existence of a "proactive" lifestyle in some students, which reflects across various domains of daily life. On the other hand, the level of physical activity does not appear to directly influence basic cognitive abilities as measured by the Stroop task.

5. Discussion of the results

The results from this study provide an articulated overview of the relationships between perceived and practiced physical activity, academic performance, and cognitive functioning in a sample of first-year university students. Overall, academic performance was positive both in objective terms (average number of exams and grades obtained) and subjective terms (self-assessment of performance and satisfaction level), with over 80% of the sample reporting favorable perceptions. This suggests a good level of self-confidence among the students, particularly among female students, who tend to report higher satisfaction levels than their male peers. The level of physical activity, when considered in terms of self-perception, is mostly placed at medium or medium-high levels, but objective data on daily step count and weekly exercise frequency reveal a discrepancy from this perception. A significant portion of students does not meet the recommended levels of physical activity according to WHO guidelines, with a non-negligible part of the sample never engaging in exercise or doing so only sporadically. Gender differences are also observed in this area, with females showing greater polarization—towards both very high and very low levels of activity—while males tend to concentrate in the intermediate ranges. The cognitive data collected through the Stroop task highlight an interesting trend: overall reaction times decrease over the four administrations, indicating an improvement in executive efficiency and a possible task adaptation. However, cognitive interference—an important indicator of inhibitory control—remains at moderately high levels. Notably, the active break introduced in the second lesson is associated with a significant reduction in interference between the start and end of the session, especially among female students. This result, also supported by a statistically significant comparison between the third and fourth administration ($p = 0.04$), suggests that the inclusion of short movement moments during educational activities may contribute to the improvement of executive functions, at least in terms of inhibitory capacity. Gender-based analyses further show that while differences between males and females are minimal in the first part of the program, more marked divergences emerge later, particularly in how cognitive responses to mental fatigue are modulated. The active break seems to have a more pronounced effect in women, with observable improvements both in averages and in the internal distribution of reaction times. Finally, the correlation analyses, while revealing generally weak relationships, offer some interesting insights. The slight positive association between the number of exams taken and average grades confirms a coherence between quantity and quality of academic performance. Other relationships, such as those between physical activity and performance or between physical activity and cognitive performance, are instead very small or absent. This may reflect the complexity of the factors influencing these domains, as well as the need for more sensitive measures to detect acute or chronic effects of physical activity on cognition. In summary, the data confirm that an active lifestyle and the promotion of motor breaks during teaching activities can have a positive impact on executive functioning, with more visible effects in specific subgroups such as females. However, the absence of strong correlations between physical activity and cognitive performance suggests that such benefits are probably mediated by situational or contextual factors rather than consolidated habits. Further studies, with more controlled longitudinal or experimental designs, could clarify the nature of these relationships and validate the effectiveness of brief and targeted interventions within the university environment.

6. Conclusions

The results of this pilot study provide preliminary but significant evidence regarding the effectiveness of mindful active breaks in promoting the recovery of cognitive efficiency during university educational activities. In particular, the introduction of a structured break based on somatic exercises, cognitively demanding motor activities, and mindfulness practices led to a statistically significant reduction in cognitive interference (Stroop 3 vs Stroop 4, $p = 0.04$), especially in the female subgroup. This suggests that, in contexts of prolonged learning, short body-based interventions can contribute to the improvement of executive functions—particularly inhibitory control—positively affecting the quality of sustained attention. Another relevant aspect concerns the discrepancy observed between the self-perception of physical activity and objectively measured behaviors: many students consider themselves active while not reaching the minimum recommended levels according to international guidelines. This gap between perception and actual practice highlights the need to promote greater awareness regarding one's motor lifestyle, especially in a population—such as university students—often exposed to prolonged sedentary behavior. The correlations between physical activity, academic performance, and cognitive performance proved generally weak, suggesting that not so much the quantity, but the quality and context of physical activity may have a greater impact on executive functions. In this sense, short but structured interventions that integrate movement and awareness appear to be a more promising strategy than generic physical activity. The study presents some limitations. First, the gender imbalance in the sample limits the generalizability of the results and suggests the need for further investigations with more balanced groups. Secondly, the absence of neurophysiological measures or long-term follow-up does not allow for definitive conclusions about the duration of the observed effects. Finally, the non-randomized nature of the experimental design represents a potential source of bias. Based on the findings, future research could further explore the effectiveness of mindful active breaks through longitudinal designs, including psychophysiological variables (e.g., HRV or EEG measures), and expanding the range of observed profiles. In particular, it would be interesting to verify whether the regular integration of body-based interventions during university courses can contribute, in the long term, not only to improved attention but also to stress regulation, intrinsic motivation, and students' perceived well-being. Overall, the data collected support the idea that short, economically sustainable, and easily integrable interventions in the university context—such as mindful active breaks—

can represent an innovative educational resource supporting students' cognitive functions and overall well-being.

Author contributions

The work is the result of a joint design. Specifically, Section 1, 2 and 3 were written by Anna Maria Mariani; Sections 4, 5 and 6 by Eugenia Treglia.

References

Ahamed Y., Macdonald H., Reed K., Naylor P.J., Liu-Ambrose T., Mckay H. (2007). School-based physical activity does not compromise children's academic performance. *Medicine & Science in Sports & Exercise* 39(2), 371. DOI: 10.1249/01.mss.0000241654.45500.8e

Alkoby, A., Pliskin, R., Halperin, E., and Levit-Binnun, N. (2018). An Eightweek mindfulness-based stress reduction (MBSR) workshop increases regulatory choice flexibility. *Emotion*. 19, 593–604. doi: 10.1037/emo0000461.

Alzahrani A.M., Hakami A., AlHadi A., Batais M.A., Alrasheed A.A., Almigbal T.H. (2020). The interplay between mindfulness, depression, stress and academic performance in medical students: A Saudi perspective. *PLoS ONE*, 15, 4.

Baer, R.A. (2003). Mindfulness training as a clinical intervention: a conceptual and clinical review. Clin Psychol Sci Pract, 10: 125–43

Basu, S. (2023). Examining the reliability and validity of computerized stroop test in children aged 5-13 years: a preliminary study. *Qual Quant* **57**, 645–653. https://doi.org/10.1007/s11135-022-01376-y

Bishop, S.R., Lau, M., Shapiro, S., et al. (2004). Mindfulness: a proposed operational definition. Clin Psychol Sci Pract, 11: 230–41.

Broad A.A., Bornath D.P.D., Grisebach D., McCarthy S.F., Bryden P.J. et al. (2023). Classroom activity breaks improve on-task behavior and physical activity levels regardless of time of day. *Research Quarterly for Exercise and Sport*, 94(2), 1-13. DOI: 10.1080/02701367.2021.1980189.

Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, Carty C, Chaput JP, Chastin S, Chou R, Dempsey PC, DiPietro L, Ekelund U, Firth J, Friedenreich CM, Garcia L, Gichu M, Jago R, Katzmarzyk PT, Lambert E, Leitzmann M, Milton K, Ortega

FB, Ranasinghe C, Stamatakis E, Tiedemann A, Troiano RP, van der Ploeg HP, Wari V, Willumsen JF. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*., 54(24):1451-1462. doi: 10.1136/bjsports-2020-102955. PMID: 33239350; PMCID: PMC7719906.

Colella, D., Monacis, D. (2024). Questionario di autovalutazione dei livelli di attività fisica. In D. Colella e D. Monacis (Cur.), *Le Università che Promuovono Salute in Italia. Attività Fisica, Sport e Salute all'Università Report finale di Progetto* (pp. 62-68). Pensa Multimedia.

de Bruin, E. I., van der Zwan, J. E., & Bögels, S. M. (2016). A RCT comparing daily mindfulness meditations, biofeedback exercises, and daily physical exercise on attention control, executive functioning, mindful awareness, self-compassion, and worrying in stressed young adults. *Mindfulness*, 7(5), 1182-1192. https://doi.org/10.1007/s12671-016-0561-5

Diamond, A., and Ling, D. (2020). Review of the evidence on, and fundamental questions about, efforts to improve executive functions, including working memory. New York, NY, US: Oxford University Press, 143–431.

Erwin H., Fedewa A., Beighle A., Ahn S. (2012). A quantitative review of physical activity, health, and learning outcomes associated with classroom-based physical activity interventions. *Journal of Applied School Psychology* 28(1), 14-36. DOI: 10.1080/15377903.2012.643755

Ferrer M.E., Laughlin D.D. (2017). Increasing college students' engagement and physical activity with classroom Brain Breaks. *Journal of Physical Education, Recreation & Dance* 88(3), 53-6. DOI: 10.1080/07303084.2017.1260945

Gallo, G. G., Curado, D. F., Machado, M. P. A., Espíndola, M. I., Scattone, V. V., & Noto, A. R. (2023). A randomized controlled trial of mindfulness: Effects on university students' mental health. *International Journal of Mental Health Systems*, 17(32), 1-12. https://doi.org/10.1186/s13033-023-00604-8

Gallo, G. G., Curado, D. F., Machado, M. P. A., Espíndola, M. I., Scattone, V. V., & Noto, A. R. (2023). A randomized controlled trial of mindfulness: effects on university students' mental health. *International Journal of Mental Health Systems*, 17(32), 1-12. https://doi.org/10.1186/s13033-023-00604-8

Gilson, N. D., Andersson, D., Papinczak, Z. E., Rutherford, Z., John, J., Coombes, J. S., et al. (2023). High intensity and sprint interval training, and work-related cognitive function in adults: a systematic review. *Scand. J. Med. Sci. Sports* 33, 814–833. doi: 10.1111/sms.14349

Graham, J. D., Bremer, E., Fenesi, B., & Cairney, J. (2021). Examining the acute effects of classroom-based physical activity breaks on executive functioning in 11- to 14-year-old children: Single and additive moderation effects of physical fitness. *Frontiers in Pediatrics*, 3, Article 688251https://doi.org/10.3389/fped.2021.688251
Hidajat, T. J., Edwards, E. J., Wood, R., & Campbell, M. (2023). Mindfulness-based interventions for stress and burnout in teachers: A systematic review. *Teaching and Teacher Education*, 134, 104303. https://doi.org/10.1016/j.tate.2023.104303

Jiménez-Picón, N., Romero-Martín, M., Ponce-Blandón, J.A., Ramirez-Baena, L., Palomo-Lara, J.C., Gómez-Salgado, J. (2021). The Relationship between Mindfulness and Emotional Intelligence as a Protective Factor for Healthcare Professionals: Systematic Review, *Int J Environ Res Public Health*, 18, 10, 5491.

Kabat-Zinn, J. (1990). *Full Catastrophe Living: The Program of the Stress Reduction Clinic at the University of Massachusetts Medical Center.* New York, NY: Delta

Kolovelonis, A., and Goudas, M. (2023). The effects of cognitively challenging physical activity games versus health-related fitness activities on Students' executive functions and situational interest in physical education: a group-randomized controlled trial. *Eur J Investig Health Psychol Educ* 13, 796–809. doi: 10.3390/ejihpe13050060

Layne, T., Yli-Piipari, S., Knox, T. (2021). Physical activity break program to improve elementary students' executive function and mathematics performance. *Education* 3-13, 49(5), 583–591.https://doi.org/10.1080/03004279.2020.1746820

Leahy, A. A., Mavilidi, M. F., Smith, J. J., Hillman, C. H., Eather, N., Barker, D., et al. (2020). Review of high-intensity interval training for cognitive and mental health in youth. *Med. Sci. Sports Exerc.* 52, 2224–2234. doi: 10.1249/mss.0000000000002359

Liu, J., Min, L., Liu, R., Zhang, X., Wu, M., Di, Q., et al. (2023). The effect of exercise on cerebral blood flow and executive function among young adults: a double-blinded randomized controlled trial. *Sci. Rep.* 13:8269. doi: 10.1038/s41598-023-33063-9

Lobach, Y., Romero-Ramos, O., Romero-Ramos, N., Niznikowski, T., Fernandez-Rodriguez, E.F. (2023). *Pol. J. Sport Tourism,* 30, 4, 45-50

Luteijn, P. J., van der Wurff, I. S. M., Singh, A. S., Savelberg, H. C. M., & de Groot, R. H.M. (2022). The acute effects of standing on executive functioning in vocational education and training students: The phit2learn study. *Frontiers in Psychology,*13, Article 810007 https://doi.org/10.3389/fpsyg.2022.810007

MacLeod, C.M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, 109, 163-203.

Malboeuf-Hurtubise, C., Taylor, G., Lambert, D., Paradis, P.-O., Léger-Goodes, T., Mageau, G. A., Labbé, G., Smith, J., & Joussemet, M. (2024). Impact of a mindfulness-based intervention on well-being and mental health of elementary school children: results from a randomized cluster trial. *Scientific Reports*, 14(15894), 1–12. https://doi.org/10.1038/s41598-024-66915-z

Mao, F., Huang, F., Zhao, S., & Fang, Q. (2024). Effects of cognitively engaging physical activity interventions on executive function in children and adolescents: A systematic review and meta-analysis. *Frontiers in Psychology,* 15, 1–14. https://doi.org/10.3389/fpsyg.2024.1454447

Mariani, AM. (2022). Attention to the body and movement in training of educators 0-6: first results of an experimental study, *Italian Journal of Health Education, Sports and Inclusive Didactics,* Anno 6 n. 1, https://doi.org/10.32043/gsd.v6i1.613

Mas-Cuesta, L., Baltruschat, S., Cándido, A., Verdejo-Lucas, C., Catena-Verdejo, E., & Catena, A. (2024). Brain changes following mindfulness: Reduced caudate volume is associated with decreased positive urgency. *Behavioural Brain Research*, 461, 1–9. https://doi.org/10.1016/j.bbr.2024.114859

Mazzoli E, Salmon J, Teo W-P, Pesce C, He J, Ben-Soussan TD, et al. (2021) Breaking up classroom sitting time with cognitively engaging physical activity: Behavioural and brain responses. *PLoS ONE,* 16(7): e0253733. https://doi.org/10.1371/journal.pone.0253733

Melguizo-Ibáñez, E., Zurita-Ortega, F., González-Valero, G., Puertas-Molero, P., Tadeu, P., Ubago-Jiménez, J. L., & Alonso-Vargas, J. M. (2024). Los descansos activos como herramienta para mejorar la atención en el contexto educativo. Una revisión sistemática y meta-análisis. *Revista de Psicodidáctica*, 29(2), 147-157. https://doi.org/10.1016/j.psicod.2024.01.002

Melnychuk, M.C., Dockree, P.M., O'Connell, R.G., Murphy, P.R., Balsters, J.H., Robertson, I.H. (2018). Coupling of respiration and attention via the locus coeruleus: Effects of meditation and pranayama. *Psychophysiology*, 55, 9, e13091. doi: 10.1111/psyp.13091. Epub 2018 Apr 22. PMID: 29682753.

Mok M.M.C., Chin M.K., Korcz A., Popeska B., Edginton C.R. et al. (2020). Brain breaks® physical activity solutions in the classroom and on attitudes toward physical activity: A randomised controlled trial among primary students from eight countries. *International Journal of Environmental Research and Public Health* 17(5), 1666. DOI: 10.3390/ijerph17051666

Mora-Gonzalez, J., Esteban-Cornejo, I., Solis-Urra, P., Rodriguez-Ayllon, M., Cadenas-Sanchez, C., Hillman, C. H., et al. (2024). The effects of an exercise intervention on neuroelectric activity and executive function in children with overweight/obesity: the ActiveBrains randomized controlled trial. *Scand. J. Med. Sci. Sports* 34:e14486. doi: 10.1111/sms.14486

Morrison, A. B., Goolsarran, M., Rogers, S. L., & Jha, A. P. (2014). Taming a wandering attention: Short-form mindfulness training in student cohorts. *Frontiers in Human Neuroscience*, 7, 897. https://doi.org/10.3389/fnhum.2013.00897

Müller, C., Otto, B., Sawitzki, V., Kanagalingam, P., Scherer, J. S., Lind-berg, S. (2021). Short breaks at school: Effects of a physical activity and a mindfulness intervention on children’s attention, reading comprehension, and self-esteem. *Trends in Neuroscience and Education*, 25, Article 100160https://doi.org/10.1016/j.tine.2021.100160O

Ortner C.N.M., Kilner S.J., Zelazo P.D. (2007). Mindfulness meditation and reduced emotional interference on a cognitive task. *Motiv. Emot. 3*1, 271–283. 10.1007/s11031-007-9076-7

Pastor-Vicedo, J. C., León, M. P., González-Fernández, F. T., & Prieto-Ayuso, A. (2024). Effects of physical activity breaks on cognitive function in undergraduate students: a pilot study. *Cogent Social Sciences*, 10(1), 2326692. https://doi.org/10.1080/23311886.2024.2326692

Periáñez JA, Lubrini G, García-Gutiérrez A, Ríos-Lago M (2021). Construct Validity of the Stroop Color-Word Test: Influence of Speed of Visual Search, Verbal Fluency, Working Memory, Cognitive Flexibility, and Conflict Monitoring. Arch Clin Neuropsychol. 15, 36, 1, 99-111. doi: 10.1093/arclin/acaa034. PMID: 32514527.

Perera T., Frei S., Frei B., Bobe G. (2015). Promoting physical activity in elementary schools: Needs assessment and a pilot study of brain breaks. *Journal of Education and Practice* 6(15), 55-64.

Reilly E., Buskist C., Gross M.K. (2012). Movement in the classroom: Boosting brain power, fighting obesity. *Kappa Delta Pi Record* 48(2), 62-6. DOI:10.1080/00228958.2012.680365

Robinson, K. J., Lubans, D. R., Mavilidi, M. F., Hillman, C. H., Benzing, V., Valken-borghs, S. R., Barker, D., & Riley, N. (2022). Effects of classroom-based resistance training with and without cognitive training on adolescents’ cognitive function, on-task behaviour, and muscular fitness. *Frontiers in Psychology*, 13, Article811534 https://doi.org/10.3389/fpsyg.2022.811534

Salas-Gomez, D., Fernandez-Gorgojo, M., Pozueta, A., Diaz-Ceballos, I., Lamarain, M., Perez, C., Kazimierczak, M., & Sanchez-Juan, P. (2020). Physical activity is associated with better executive function in university students. *Frontiers in Human Neuroscience,* 14, 11, https://doi.org/10.3389/fnhum.2020.00011

Salvarani, V., Ardenghi, S., Rampoldi, G., Bani, M., Cannata, P., Ausili, D., Di Mauro, S., Strepparava, MG. (2020). Predictors of psychological distress amongst nursing students: A multicenter cross-sectional study, *Nurse Education in Practice,* 44, 1027-1058.

Schmidt, M., Mavilidi, M. F., Singh, A., & Englert, C. (2020). Combining physical and cognitive training to improve kindergarten children's executive functions: A cluster randomized controlled trial. *Contemporary Educational Psychology*, 63, Article 101908 https://doi.org/10.1016/j.cedpsych.2020.101908Taraban

Schmidt, M., Jäger, K., Egger, F., Roebers, C. M., and Conzelmann, A. (2015). Cognitively engaging chronic physical activity, but not aerobic exercise, affects executive functions in primary school children: a group-randomized controlled trial. *J. Sport Exerc. Psychol.* 37, 575–591. doi: 10.1123/jsep.2015-0069

Song, W., Feng, L., Wang, J., Ma, F., Chen, J., Qu, S., et al. (2022). Play smart, be smart? Effect of cognitively engaging physical activity interventions on executive function among children 4~12 years old: a systematic review and Meta-analysis. *Brain Sci.* 12:762. doi: 10.3390/brainsci12060762

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643-662.

Ting P.Y., Kuan G., Chin N.S., Kueh Y.C. (2023). Effects of brain breaks on attitudes and motivation in the Institute of Teacher Campuses. In: G. Kuan, Y.K. Chang, T. Morris, T. Eng Wah, R.M. Musa, A. Abdul Majeed (eds), *Advancing Sports and Exercise via Innovation* (pp. 311-23). Singapore: Springer Nature.

Voss, M. W., Nagamatsu, L. S., Liu-Ambrose, T., and Kramer, A. F. (2011). Exercise, brain, and cognition across the life span. *J. Appl. Physiol. (1985)* 111, 1505–1513. doi: 10.1152/japplphysiol.00210.2011

Wang, J., Yang, Y., Li, L., Yang, X., Guo, X., Yuan, X., Xie, T., Yang, K., & Zhuang, J. (2024). Comparative efficacy of physical activity types on executive functions in children and adolescents: A network meta-analysis of randomized controlled trials.

Journal of Science and Medicine in Sport, 27(2), 187-196. https://doi.org/10.1016/j.jsams.2023.11.006

Webster C.A., Russ L., Vazou S., Goh T.L., Erwin H. (2015). Integrating movement in academic classrooms: understanding, applying and advancing the knowledge base. *Obesity Reviews* 16(8), 691-701. DOI: 10.1111/obr.12285

Yu, Q., Zhang, Z., Ludyga, S., Erickson, K. I., Cheval, B., Hou, M., Pindus, D. M., Hillman, C. H., Kramer, A. F., Falck, R. S., Liu-Ambrose, T., Kuang, J., Mullen, S. P., Kamijo, K., Ishihara, T., Raichlen, D. A., Heath, M., Moreau, D., Werneck, A. O., Herold, F., & Zou, L. (2025). Effects of physical exercise breaks on executive function in a simulated classroom setting: Uncovering a window into the brain. Advanced Science, 12(3), 2406631. https://doi.org/10.1002/advs.202406631

Zhao, G., Sun, K., Fu, J., Li, Z., Liu, D., Tian, X., Yang, J., & Zhang, Q. (2024). Impact of physical activity on executive functions: A moderated mediation model. *Frontiers in Psychology*, 14, 1226667. https://doi.org/10.3389/fpsyg.2023.1226667

Zhao M., Kuan G., Kueh Y.C., Zhou K., Wang S. (2023). Effectiveness of brain breaks® for students: A systematic review and meta-analysis. In: G. Kuan, Y.K. Chang, T. Morris, T. Eng Wah, R.M. Musa, A. Abdul Majeed (eds). *Advancing Sports and Exercise via Innovation* (pp. 11-27). Singapore: Springer Nature.

Zurita-Ortega, F., González-Valero, G., Ubago-Jiménez, J. L., & Melguizo-Ibáñez, E. (2025). Analysis of cognitively loaded physical tasks and active breaks for the improvement of executive functions in the school context. *Revista de Psicodidáctica* (English ed.), 1-5. https://doi.org/10.1016/j.psicoe.2025.500163