

## **PROJECT TITLE**

*Effects of brief active breaks on attentional and executive functions in undergraduate university students*

## **LABORATORY / DEPARTMENT**

*Exercise Science and Sport Laboratory, Degree Programme in Sport Sciences and Techniques, Department of Translational Biomedicine and Neuroscience (DiBrain), University of Bari – Aldo Moro*

## **STUDY DESIGN**

*Randomized crossover*

## **EXPECTED START AND END DATE**

*April 2025 – May 2025*

## **FUNDING: NO**

## **DOCUMENT DATE: 28-05-2026**

## **SCIENTIFIC RATIONALE**

Recent studies indicate that the majority of university students exhibit high levels of sedentary behavior (Castro et al., 2020; Felez-Nobrega et al., 2018). Only a small percentage of university students meet the recommended amount of physical activity, and most do not engage in any physical activity at all (Silva et al., 2022). Physical inactivity and sedentary behavior are linked to risks associated with non-communicable chronic diseases, such as heart conditions, type 2 diabetes, and cancer (Z. Gao & Lee, 2022; Santos-Lozano et al., 2021; Zhu, 2022). Evidence suggests that high levels of sedentary behavior may negatively impact mental well-being, including an increased risk of anxiety, stress, and depression (Castro et al., 2020). Regular physical activity, in addition to reducing the negative effects on physical health, can reduce stress, improve mood, and increase energy levels (Chen et al., 2022). Furthermore, the positive correlation between physical activity (PA) and cognitive performance has generated strong scientific interest in integrating physical activity into classrooms and academic timetables (De Bot et al., 2020; Paulus et al., 2021).

Active breaks (ABs) during school time represent an emerging strategy to improve student well-being. Recent studies report that incorporating PA into academic schedules through ABs does not compromise student attention and may positively influence selective attention (Fiorilli et al., 2021; Haverkamp et al., 2020; Infantes-Paniagua et al., 2021; Peiris et al., 2021). Differences have been found regarding duration, type, and intensity, suggesting that an AB lasting 5–10 minutes is more suitable than a 20-minute AB (Watson et al., 2019). In addition, ABs using exergames have been found to be feasible in a university context, improving the cognitive performance of university students (Y. Gao et al., 2014; Gu et al., 2023; Staiano & Calvert, 2011; Wan Yunus et al., 2020). Currently, the effects of exergame-based ABs on cognitive abilities in university students are not yet fully understood.

## **PURPOSE AND HYPOTHESES**

### **Outcome**

The aim of this study is to investigate the effects of brief active and inactive breaks on the cognitive parameters of university students. In particular, it will assess how different types of breaks (no physical activity, outdoor physical activity, and exergame) influence participants' cognitive abilities.

### **Hypothesis**

It is hypothesized that both experimental interventions — the outdoor physical activity break (OPAB) and the exergame physical activity break (PABEx) — will have a positive impact on the cognitive abilities of university students compared to the no physical activity break (NPAB).

## **PARTICIPANT CHARACTERISTICS**

The study aims to recruit at least 50 university students between 18 and 30 years of age.

### **Inclusion Criteria:**

- University students (equitable gender representation)
- 18–35 years of age
- Absence of serious acute medical conditions that would prevent safe participation in physical activity
- Students who have provided informed consent to participate in the study

### **Exclusion Criteria:**

- Expected absence of more than one week during the intervention period
- Lack of medical fitness clearance confirmed by a physician
- Musculoskeletal or joint disorders (e.g., mobility limitations, prostheses, etc.)
- Students who do not provide informed consent to participate in the study

## **SAMPLE SIZE**

An a priori power analysis (Kang, 2021), with an assumed Type I error of 0.05 and a Type II error rate of 0.9 (statistical power of 90%), effect size  $f$  (ES) = 0.25, calculated that 12 participants per group would be sufficient.

## **RECRUITMENT PROCEDURE**

Participants will be recruited at the University Sports Centre (CUS) of Bari, enrolled in the Degree Programme in Sport and Exercise Sciences, and randomly assigned to one of three groups:

- No Physical Activity Break (NPAB)
- Outdoor Physical Activity Break (OPAB)
- Exergame Physical Activity Break (PABEx)

### **Measurements:**

*Anthropometric parameters:*

- Height
- Weight
- BMI

#### *Cognitive Measurements:*

- TMT test (Giovagnoli et al., 1996)
- STROOP test (Caffarra et al., 2002)

## **EXPERIMENTAL DESIGN**

Prior to the intervention, all subjects will sign an informed consent form, anthropometric measurements will be recorded, and medical fitness certificates will be collected. Participants will be asked to refrain from engaging in any strenuous activity for at least 30 minutes before the experiment. After 2 hours of frontal lectures, each participant will perform the three assigned weekly conditions for ten minutes in a randomized and counterbalanced order:

- No Physical Activity Break (NPAB)
- Outdoor Physical Activity Break (OPAB)
- Exergame Physical Activity Break (PABEx)

The 10-minute passive break in a university setting will serve as the No Physical Activity Break (NPAB). The task will involve interrupting academic activities while remaining seated at the study station, without the use of smartphones or other technological devices.

Each Outdoor Physical Activity Break (OPAB) session will last 10 minutes, divided into 3 phases: **Warm-up** (2 min): aimed at increasing heart rate, improving muscle blood flow, and preparing major joints for the subsequent working phase. **Main activity (outdoor walk)** (6 min): a low-to-moderate intensity walk in the outdoor working environment at a predetermined speed of 4.5 km/h. **Cool-down** (2 min): relaxation and static stretching exercises.

Each Exergame Physical Activity Break (PABEx) session will last 10 minutes, divided into 3 phases: **Warm-up** (2 min): aimed at increasing heart rate, improving muscle blood flow, and preparing major joints for the subsequent working phase. **Main activity (Exergame)** (6 min): through the immersive virtual reality of the system (Homing®, Tecnobody, Bergamo, Italy), participants will replicate movements in virtual environments and receive visual and auditory feedback to correct performance. This 6-minute phase will involve the use of one of the available interactive activities simulating a low-to-moderate intensity walk at a predetermined speed of 4.5 km/h. **Cool-down** (2 min): relaxation and static stretching exercises.

## **EXPECTED RESULTS AND RELEVANCE**

Although the positive effect of brief active breaks on cognitive variables in university students has already been demonstrated, the impact of integrating and comparing multiple modalities of experimental protocols remains largely unexplored. It is not yet entirely clear which protocol may be most effective for improving cognitive parameters in university students.

At the end of this study, we expect to observe improvements in cognitive parameters in both experimental groups. We also believe that the PABEx group may experience

greater positive effects than the OPAB group, given the innovative modality of the instrument used.

## **CRITICAL SITUATIONS AND POTENTIAL ADVERSE EFFECTS**

The main risks, though rare, may include:

- Falls or injuries: the proposed exercises, if performed incorrectly or without supervision, may present a risk of falls or musculoskeletal injuries.

### **Risk Management Strategies:**

- Continuous monitoring during each group's sessions. Experimental sessions will be supervised by qualified exercise professionals (researchers/PhD students/interns) to ensure participant safety, maintain the appropriate intensity level, and correct exercise technique.
- Emergency procedures: to ensure safety, an emergency plan will be in place. Operators are adequately trained to recognize symptoms of fatigue or cardiovascular distress and to intervene promptly if needed.
- Medical support: before starting, participants will provide an exercise fitness assessment signed by their physician/cardiologist, confirming their eligibility to participate. Additionally, proximity to the main local medical facility (Policlinico di Bari, Piazza Giulio Cesare 11, 70124, Bari — approximately 15 minutes by car, 6.2 km) has been considered to allow rapid access to emergency services.

### **Documentation in the Research Protocol:**

All preventive measures and management strategies are included in the protocol:

- In the 'intervention' section, the session structure, exercise intensity control, and supervision by qualified personnel are described.

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