STUDY PROTOCOL

Effects of Recreational Badminton on Sleep Quality and Salivary Melatonin in Physically Inactive Young Adults: A Randomized Controlled Trial

Official Title: Effects of Recreational Badminton on Sleep Quality and Salivary Melatonin in Physically Inactive Young Adults: A Randomized Controlled Trial

NCT Number: Not yet assigned

Original Protocol Date: September 17, 2026

Document Revision Date: October 27, 2026

Principal Investigator: Assoc. Prof. Dr. Nurkan Yılmaz

Institution: İnönü University, Faculty of Sport Sciences, Malatya, Türkiye

Collaborating Researchers: Assoc. Prof. Dr. Fahri Safa Çınarlı; Lecturer Dr. Zeynep Ünver; Assist. Prof. Dr. Faruk Dişli

Revised protocol incorporating clarified randomization, badminton intervention, and control-group descriptions. The factual accuracy of these descriptions must be confirmed against study records prior to submission.

1. BACKGROUND AND RATIONALE

Sleep is an essential biological process that plays an important role in cognitive functioning, psychological well- being, physical health, immune function, and quality of life. Young adults, particularly university students, may experience inadequate or poor-quality sleep due to academic demands, stress, changes in lifestyle, and insufficient physical activity. Physical inactivity is increasingly recognized as an important factor associated with poor sleep. Previous studies have reported that regular physical activity may reduce sleep latency, increase sleep duration, and improve overall sleep quality. Exercise may also influence melatonin secretion and thereby contribute to the regulation of circadian rhythms. Recreational exercise represents a potentially accessible and enjoyable form of physical activity for young adults. Badminton is a recreational sport involving aerobic and intermittent physical activity and may therefore have beneficial effects on sleep-related outcomes. However, studies directly examining the effects of a structured recreational badminton intervention on both subjective sleep quality and salivary melatonin levels in physically inactive young adults remain limited. Therefore, this randomized controlled trial was designed to investigate whether a four-week recreational badminton intervention improves sleep quality and alters salivary melatonin levels in physically inactive young adults.

2. STUDY OBJECTIVES

2.1 Primary Objective

The primary objective of this study is to determine the effect of a four-week recreational badminton intervention on sleep quality in physically inactive young adults.

2.2 Secondary Objective

The secondary objective is to investigate the effect of the recreational badminton intervention on salivary melatonin levels measured at different times of the day.

3. STUDY HYPOTHESIS

The study hypothesizes that physically inactive young adults participating in a four-week recreational badminton intervention will demonstrate:

1.Improved sleep quality compared with the control group.

2. Changes in salivary melatonin levels compared with the control group.

4. STUDY DESIGN

This study is designed as a randomized controlled, parallel-group intervention study. Participants will be allocated to either:

- •Recreational Badminton Intervention Group
- • Control Group

The intervention period will last four weeks. Participants will undergo assessments before and after the intervention. Overall design: Screening → Eligibility assessment → Informed consent → Baseline assessment → Randomization → 4-week intervention/control period → Post-intervention assessment.

5. STUDY SETTING

The study will be conducted at İnönü University, Faculty of Sport Sciences, Malatya, Türkiye. The recreational badminton intervention will be conducted in the sports facilities of İnönü University. Salivary melatonin samples will be analyzed at İnönü University, Faculty of Medicine, Basic Medical Sciences, Department of Physiology, Malatya, Türkiye.

6. STUDY POPULATION

The study population will consist of healthy young adults aged 18–30 years. Participants will be university students who meet the predefined eligibility criteria.

7. SAMPLE SIZE

The sample size was calculated using G*Power 3.1. Based on a previous study and an anticipated effect size of 0.40, with an alpha level of 0.05 and statistical power of 0.95, the required sample size was calculated. The original project application states that, for two groups and three measurements, at least 9 participants per group and 18 participants in total were required.

8. ELIGIBILITY CRITERIA

8.1 Inclusion Criteria

- Age 18–30 years.
- Being a university student.
- Being physically inactive before enrollment.
- Being able to participate safely in recreational badminton.
- Providing informed consent.
- Being willing to comply with study procedures.

8.2 Exclusion Criteria

- A diagnosed medical condition that prevents participation in physical exercise.
- A current musculoskeletal injury limiting participation in badminton.
- Regular participation in structured exercise training.
- Use of medications or substances that may substantially affect sleep or melatonin secretion.
- Inability to complete study assessments.
- Withdrawal of informed consent.

9. DEFINITION OF PHYSICAL INACTIVITY

For the purposes of this study, physically inactive participants will be defined according to the predefined physical activity eligibility criteria used by the research team. The BAP project document defines sedentary individuals as those performing less than 30 minutes of exercise per week.

10. RANDOMIZATION

Eligible participants who provided written informed consent were randomly assigned to either the recreational badminton intervention group or the control group in a 1:1 allocation ratio. Randomization Method: A computer-generated random sequence was used to allocate participants to the two study groups. Allocation Ratio: 1:1.

11. STUDY ARMS

11.1 Recreational Badminton Intervention Group

Participants assigned to the intervention group participated in a supervised recreational badminton program for four consecutive weeks. The intervention consisted of moderate-intensity recreational badminton activities, with a minimum total exercise duration of 150 minutes per week. Training sessions were conducted at the sports facilities of İnönü University under the supervision of the research team. Total Intervention Duration: 4 weeks. Weekly Exercise Duration: At least 150 minutes. Exercise Intensity: Moderate intensity. Exercise Modality: Supervised recreational badminton.

11.2 Control Group

Participants allocated to the control group did not participate in the structured recreational badminton intervention during the four-week study period. They were instructed to maintain their usual daily activities and avoid initiating any new structured exercise or sports training program throughout the intervention period. The control group underwent the same baseline and post-intervention outcome assessments as the recreational badminton group.

12. OUTCOME MEASURES

12.1 Primary Outcome: Sleep Quality

Sleep quality will be assessed using the Pittsburgh Sleep Quality Index (PSQI). The PSQI will be administered at baseline and after completion of the intervention. Time Frame: Baseline and 4 weeks after randomization.

12.2 Secondary Outcome: Salivary Melatonin Levels

Salivary melatonin concentrations will be assessed using saliva samples collected at predefined times:

- 08:00
- 20:00
- 00:00

Melatonin concentrations will be determined using an enzyme-linked immunosorbent assay (ELISA) method. Time Frame: Baseline and 4 weeks after randomization.

13. STUDY PROCEDURES

Visit 1 – Baseline

1. Eligibility criteria will be assessed.
2. Written informed consent will be obtained.
3. Sociodemographic information will be collected.
4. Baseline sleep quality will be assessed using the PSQI.
5. Baseline salivary melatonin samples will be collected.
6. Eligible participants will be randomized.

Intervention Period

The intervention group will participate in the four-week recreational badminton program. The control group will continue usual activities without participation in the structured badminton intervention.

Post-Intervention Assessment

1. PSQI will be reassessed.

2. Salivary melatonin samples will be collected at predefined time points.
3. Laboratory analyses will be performed.
4. Study data will be entered into the statistical database.

14. SALIVARY MELATONIN PROCEDURE

Saliva samples will be collected according to the standardized study procedure. Samples will be collected at 08:00, 20:00, and 00:00, appropriately labeled, stored, and transferred to the designated laboratory for analysis.

15. DATA MANAGEMENT

Participant information will be coded using unique study identification numbers. Personal identifying information will not be used in the statistical analysis dataset. Study data will be stored securely and will be accessible only to authorized members of the research team.

16. STATISTICAL ANALYSIS

Statistical analyses will be performed using IBM SPSS Statistics version 26.0. Descriptive statistics will be presented using appropriate measures such as mean, standard deviation, frequency, and percentage. Between-group comparisons will be performed using appropriate statistical tests according to the distribution and characteristics of the data. Repeated-measures analysis will be used to evaluate changes in melatonin levels over time. The statistical significance level will be set at $p < 0.05$.

17. SAFETY MONITORING

Participants will be monitored during the recreational badminton intervention for exercise-related adverse events. Any adverse event occurring during the study will be documented and evaluated by the research team. Participants may discontinue participation at any time.

18. ETHICAL CONSIDERATIONS

The study will be conducted in accordance with the ethical principles applicable to research involving human participants. Written informed consent will be obtained from all participants before any study-specific procedures are performed. Ethics committee approval will be obtained from the relevant institutional ethics committee before initiation of participant-related procedures. Ethics Committee: Inönü University Health Sciences Scientific Research Ethics Committee Approval Number: 2025/7204 Approval Date: 11-03-2025

19. CONFIDENTIALITY

All participant data will be treated confidentially. Participants will be identified by study codes rather than names in the research database and statistical analyses. Only authorized research personnel will have access to identifiable study information.

20. WITHDRAWAL FROM THE STUDY

Participants may withdraw from the study at any time without providing a reason and without any penalty. The investigator may also discontinue a participant's involvement when continued participation is considered inappropriate or unsafe. The reason for withdrawal, when available, will be documented.

21. STUDY DURATION

Intervention duration: 4 weeks

22. STUDY LOCATION

Primary Study Location:

İnönü University, Faculty of Sport Sciences, Malatya, Türkiye Laboratory:

İnönü University, Faculty of Medicine, Basic Medical Sciences, Department of Physiology, Malatya, Türkiye

23. SPONSOR / FUNDING

Sponsor: İnönü University Funding Source: İnönü University Scientific Research Projects Coordination Unit (BAP) The submitted BAP application states that the project is not supported by another organization.

24. DISSEMINATION OF RESULTS

The results of the study will be analyzed and prepared for dissemination through scientific publications and/or presentations at scientific meetings.

25. PROTOCOL AMENDMENTS

Any substantive amendment to the approved study protocol will be documented and submitted to the relevant ethics committee when required. ClinicalTrials.gov will be updated when applicable.

26. PROTOCOL SUMMARY

Study type: Interventional Study design: Randomized controlled trial Allocation: Randomized Participants: Physically inactive young adults Age: 18–30 years Intervention: Recreational badminton Intervention duration: 4 weeks Comparator: Control group Primary outcome: Sleep quality Primary instrument: Pittsburgh Sleep Quality Index Secondary outcome: Salivary melatonin Melatonin measurement: 08:00, 20:00, 00:00 Laboratory method: ELISA Statistical software: IBM SPSS 26.0 Significance level: $p < 0.05$ Study location: İnönü University, Malatya, Türkiye