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Musculoskeletal Symptoms and Sleep Quality in Esports Athletes: A Cross-Sectional Study

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ABSTRACT

Purpose: This study examined the association between musculoskeletal complaints and sleep quality in esports players and investigated whether regular physical exercise moderates this relationship.
Method: This cross-sectional study was conducted among university students engaged in esports at Adıyaman University using convenience sampling. The final sample consisted of 238 participants. An a priori power analysis indicated that at least 194 participants were required (80% power, $\alpha = 0.05$). Musculoskeletal complaints were assessed using a questionnaire based on the Standardized Nordic Musculoskeletal Questionnaire (NMQ), and sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). Spearman correlation, Mann–Whitney U tests, and multiple linear regression with an interaction term were used for statistical analysis ($p < 0.05$).
Results: Musculoskeletal complaints were reported by 68.1% of participants, and 72.7% had poor sleep quality (PSQI > 5). The number of musculoskeletal complaint regions was positively associated with PSQI score ($\rho = 0.228$, $p = 0.010$). Participants with musculoskeletal complaints had poorer sleep quality ($p < 0.001$). The association was weaker among participants who reported regular physical exercise. In regression analysis, musculoskeletal complaints and daily gaming duration independently predicted poorer sleep quality.
Conclusion: Musculoskeletal complaints were associated with poorer sleep quality in esports players, and regular physical exercise appeared to attenuate this relationship. Ergonomic adjustments, scheduled breaks, and structured exercise programmes may help improve health outcomes; however, causal relationships cannot be inferred due to the cross-sectional design.
Keywords: Esports; musculoskeletal complaints; sleep quality; exercise; psqi

ÖZET

Espor Sporcularında Kas-İskelet Sistemi Semptomları ile Uyku Kalitesi Arasındaki İlişki: Kesitsel Bir Çalışma

Amaç: Bu çalışma, espor oyuncularında kas-iskelet sistemi şikâyetleri ile uyku kalitesi arasındaki ilişkiyi incelemeyi ve düzenli fiziksel egzersizin bu ilişki üzerindeki olası düzenleyici (moderatör) rolünü değerlendirmeyi amaçlamıştır,
Yöntem: Bu kesitsel çalışma, Adıyaman Üniversitesi'nde espor faaliyetlerine katılan üniversite öğrencileri arasında kolayda örnekleme yöntemi kullanılarak gerçekleştirilmiştir. Nihai örneklem 238 katılımcıdan oluşmuştur. Önceden yapılan güç analizi, en az 194 katılımcının gerekli olduğunu göstermiştir (%80 güç, $\alpha = 0.05$). Kas-iskelet sistemi şikâyetleri, Standartlaştırılmış Nordic Kas-İskelet Sistemi Anketi'ne (NMQ) dayalı bir anket ile değerlendirilmiş; uyku kalitesi ise Pittsburgh Uyku Kalitesi İndeksi (PUKİ) kullanılarak ölçülmüştür. Analizlerde Spearman korelasyon analizi, Mann–Whitney U testi ve etkileşim terimi içeren çoklu doğrusal regresyon analizi kullanılmıştır ($p < 0.05$).
Bulgular: Katılımcıların %68.1'i kas-iskelet sistemi şikâyeti bildirmiş, %72.7'sinde ise kötü uyku kalitesi (PUKİ > 5) saptanmıştır. Kas-iskelet sistemi şikâyetlerinin görüldüğü vücut bölgelerinin sayısı ile PUKİ skoru arasında pozitif yönde anlamlı bir ilişki bulunmuştur ($\rho = 0.228$, $p = 0.010$). Kas-iskelet sistemi şikâyeti olan katılımcıların uyku kalitesi, şikâyeti olmayanlara kıyasla daha kötü bulunmuştur ($p < 0.001$). Bu ilişkinin düzenli fiziksel egzersiz yapan katılımcılarda daha zayıf olduğu gözlenmiştir. Regresyon analizinde kas-iskelet sistemi şikâyetleri ve günlük oyun süresi, daha kötü uyku kalitesinin bağımsız yordayıcıları olarak belirlenmiştir.
Sonuç: Espor oyuncularında kas-iskelet sistemi şikâyetleri daha kötü uyku kalitesi ile ilişkili bulunmuş ve düzenli fiziksel egzersizin bu ilişkiyi zayıflatabileceği görülmüştür. Ergonomik düzenlemeler, planlı molalar ve yapılandırılmış egzersiz programları sağlık sonuçlarının

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iyileştirilmesine katkı sağlayabilir; ancak çalışmanın kesitsel tasarımı nedeniyle nedensel çıkarımlar yapılamamaktadır.
Anahtar Kelimeler: espor, kas-iskelet sistemi şikâyetleri, uyku kalitesi, egzersiz, puki

INTRODUCTION

Electronic sports (esports) have rapidly evolved into a competitive domain characterized by prolonged screen exposure, repetitive motor activity, sustained static postures, and substantial cognitive demands. Unlike recreational gaming, participation in esports is typically structured, intensive, and performance-driven, which has raised increasing concerns regarding the potential health consequences associated with long-term engagement (DiFrancisco-Donoghue et al., 2019; Toth et al., 2020).

Musculoskeletal disorders (MSDs) represent one of the most commonly reported physical health concerns associated with prolonged digital device use and sedentary behavior. Systematic reviews conducted in gaming populations have demonstrated that extended gaming duration is associated with a higher prevalence of musculoskeletal complaints, particularly in the neck, shoulders, back, and upper extremities (Smith et al., 2019; Lindberg et al., 2020). These complaints are frequently attributed to reduced postural variability, sustained static postures, forward head positioning, repetitive hand and wrist movements, and suboptimal ergonomic conditions (Pereira et al., 2021).

Within esports-specific contexts, musculoskeletal complaints appear to be particularly prevalent. Cross-sectional studies involving competitive esports players consistently report neck and lower back pain as the most frequently reported complaints, followed by shoulder and hand–wrist symptoms (Lindberg et al., 2020; Soffner et al., 2023). Such musculoskeletal symptoms have been associated with reduced training and gaming continuity, impaired daily functioning, and decreased perceived performance among esports players (DiFrancisco-Donoghue et al., 2019).

Sleep quality constitutes another critical health-related factor within esports populations. Adequate sleep is essential for cognitive functioning, motor learning, recovery processes, and overall health. Nevertheless, observational evidence suggests that excessive gaming behavior is associated with poorer sleep quality, delayed sleep onset, and irregular sleep–wake patterns (Lee et al., 2020; Wong et al., 2020). Late-night gaming, prolonged exposure to blue light, heightened cognitive arousal, and competition-related stress have been identified as key contributors to sleep disturbances among gamers and esports athletes (Exelmans and Van den Bulck, 2016; Hale and Guan, 2015).

Importantly, musculoskeletal complaints and sleep quality are not independent phenomena but are closely interconnected through shared physiological and behavioral mechanisms. Poor sleep quality has been shown to increase pain sensitivity, while persistent musculoskeletal discomfort may disrupt sleep initiation and maintenance through discomfort and altered neurophysiological processes (Finan et al., 2013; Hrozanova et al., 2020). Experimental and longitudinal evidence further supports a bidirectional relationship between pain and sleep, whereby each may exacerbate the severity of the other (Haack and Mullington, 2005).

In the context of esports, this interaction may be further intensified due to prolonged sedentary behavior and extended gaming sessions, which simultaneously increase mechanical strain on the musculoskeletal system and disrupt circadian rhythms. Consequently, esports participants may be particularly vulnerable to the combined negative effects of musculoskeletal discomfort and impaired sleep quality.

Regular physical exercise is widely recognized as a protective factor against both musculoskeletal complaints and sleep disturbances in the general population as well as among athletic populations. Engagement in physical activity has been shown to reduce the severity of musculoskeletal symptoms, improve postural control, facilitate pain modulation, and enhance sleep quality (Kelley and Kelley, 2017; Kredlow et al., 2015). Exercise-induced physiological adaptations, such as reduced systemic inflammation and improved neuromuscular function, may mitigate the adverse effects associated with prolonged sedentary behavior (Pedersen and Saltin, 2015; Gleeson et al., 2011).

Despite these well-established benefits, the role of regular physical exercise among individuals engaged in esports remains insufficiently explored. Although limited evidence suggests that physically active esports participants may demonstrate more favorable musculoskeletal health profiles and overall well-being, empirical studies examining exercise as a moderating factor in the relationship between musculoskeletal complaints and sleep quality are scarce (Lindberg et al., 2020; Toth et al., 2020; DiFrancisco-Donoghue et al., 2019).

Accordingly, the primary aim of the present study was to examine the relationship between musculoskeletal complaints and sleep quality among university students engaged in esports. The secondary aim was to evaluate the potential moderating role of regular physical exercise in this relationship.

METHODS

Research Design

The present study employed a cross-sectional observational design to investigate the association between musculoskeletal complaints and sleep quality among university students engaged in esports and to examine the potential moderating role of regular physical exercise in this relationship.

Participants

A total of 238 volunteers engaged in esports and registered as members of the Adıyaman University Esports Community participated in this study. The survey was available online for approximately eight weeks, and participants were allowed to submit the questionnaire only once in order to prevent duplicate responses. The study population consisted of university students engaged in esports activities. A total of 260 individuals accessed the online survey; however, 22 responses were excluded due to incomplete data. Consequently, the final analytical sample comprised 238 participants. Participants were recruited using a convenience sampling method. The inclusion criteria were: (1) membership in the esports community, (2) active engagement in esports activities, (3) age ≥18 years, and (4) completion of all questionnaire sections. Participants with missing data were excluded from the analysis. An a priori sample size calculation indicated that a minimum of approximately 194 participants would be required to detect a correlation of $\rho = 0.20$ with 80% statistical power at an alpha level of 0.05. The final sample size of 238 participants therefore exceeded the required sample size.

Data Collection Methods and Tools

Demographic variables: Participants provided demographic and gaming-related information through the online questionnaire, including age, daily gaming duration, regular physical exercise status, dominant hand during gaming, and primary gaming input device (e.g., keyboard and mouse, gamepad/controller, or mobile touchscreen). Daily gaming duration was categorized as 1–3 hours, 4–6 hours, and ≥7 hours. Regular physical exercise was defined as engaging in structured physical activity at least 2–3 times per week.

Nordic Musculoskeletal Questionnaire: Musculoskeletal complaints were assessed using a questionnaire developed based on the Nordic Musculoskeletal Questionnaire, originally designed to evaluate the prevalence of musculoskeletal symptoms in

epidemiological research (Kuorinka et al., 1987). The instrument has also undergone cross-cultural adaptation and validation studies in Turkish populations (Kahraman et al., 2016). Participants were asked to indicate whether they had experienced musculoskeletal complaints in nine body regions (neck, shoulders, upper back, lower back, elbows, hand–wrist/hand, hips/thighs, knees, and ankles/feet) during the previous 12 months and the last 7 days. For analytical purposes, the total number of body regions with reported complaints was calculated (range: 0–9), with higher scores reflecting greater musculoskeletal involvement.

Pittsburgh Sleep Quality Index (PSQI): Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a widely used instrument developed to evaluate subjective sleep quality and sleep-related disturbances over the preceding month (Buysse et al., 1989). The PSQI consists of seven subcomponents, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored on a scale ranging from 0 to 3, and the sum of these components yields a global score ranging from 0 to 21, with higher scores indicating poorer sleep quality. The Turkish version of the PSQI has demonstrated satisfactory validity and reliability (Ağargün et al., 1996). Consistent with established recommendations, participants with a global PSQI score greater than 5 were classified as having poor sleep quality.

Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from the Adıyaman University Social and Humanities Ethics Committee (Ethics approval no: 02/2026–27). All procedures were conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants prior to participation.

Data Analysis

All statistical analyses were performed using IBM SPSS Statistics version 26.0. All tests were two-tailed, and the level of statistical significance was set at $\alpha = 0.05$. Descriptive statistics were presented as mean ± standard deviation, median (interquartile range), or frequency (percentage), as appropriate. As global PSQI scores did not meet normality assumptions, non-parametric tests were applied. The association between the number of musculoskeletal complaint regions and PSQI scores was examined using Spearman's rank correlation coefficient. Differences in PSQI scores between participants with and without musculoskeletal complaints were assessed using the Mann–Whitney U test. Multiple linear regression analysis was performed to examine the independent association between

musculoskeletal complaints and sleep quality. The PSQI global score was entered as the dependent variable, while the number of complaint regions, age, daily gaming duration, and regular physical exercise status were included as independent variables. An interaction term (complaint regions × regular exercise) was included to evaluate the moderating effect of regular physical exercise. Model fit statistics, including the F-statistic and coefficients of determination (R^2 and adjusted R^2), were reported. A post-hoc power analysis based on the present sample size (n = 238) indicated that correlations of approximately $\rho \approx 0.18$ or greater could be detected with 80% statistical power at an alpha level of 0.05. The observed correlation coefficient ($\rho = 0.228$) exceeded this threshold, indicating that the study had adequate statistical power to detect the observed association.

RESULTS

As shown in Table 1, a total of 238 esports participants were included in the study. The mean age of the participants was 20.70 ± 2.95 years. Approximately half of the participants reported gaming for 1–3 hours per day (50.7%), while 26.1% reported gaming for 4–6 hours and 23.2% for ≥7 hours. Regular physical exercise was reported by 63.8% of participants. Most participants reported using the right hand as their dominant hand during gaming (59.4%), and mobile touchscreen devices were the most commonly used gaming input device (49.3%). The mean PSQI global score was 8.14 ± 3.63, and 72.7% of participants were classified as having poor sleep quality (PSQI > 5). Musculoskeletal complaints were reported by 68.1% of participants, with a median of 3 (IQR: 2–4) affected body regions.

Table 1. Participant characteristics and gaming behaviour (n = 238)

Variable	Mean ± SD / n (%)
Age (years)	20.70 ± 2.95
Daily gaming duration	
1–3 hours	121 (50.7%)
4–6 hours	62 (26.1%)
≥7 hours	55 (23.2%)
Regular physical exercise	
Yes	152 (63.8%)
No	86 (36.2%)
Dominant hand during gaming	
Right	141 (59.4%)
Left	24 (10.1%)
Both hands equally	73 (30.4%)
Primary gaming input device	
Mobile touchscreen	117 (49.3%)
Keyboard + mouse	65 (27.5%)

Variable	Mean ± SD / n (%)
Gamepad / controller	31 (13.0%)
Other	25 (10.1%)
PSQI global score	8.14 ± 3.63
Poor sleep quality (PSQI > 5)	173 (72.7%)
At least one musculoskeletal complaint (past 12 months)	162 (68.1%)
Number of body regions with musculoskeletal complaints (0–9)	3 (2–4)

PSQI: Pittsburgh Sleep Quality Index. Poor sleep quality was defined as PSQI > 5.

As presented in Table 2, the most commonly reported musculoskeletal complaints during the previous 12 months were located in the neck (58.0%), lower back (43.7%), and upper back (40.8%), followed by the shoulders (37.8%) and hand–wrist region (27.3%). A similar distribution was observed for symptoms reported during the last 7 days, with the neck and trunk regions remaining the most frequently affected body areas.

Table 2. Prevalence of musculoskeletal complaints by body region (n = 238)

Body region	Last 12 months n (%)	Last 7 days n (%)
Neck	138 (58.0%)	79 (33.2%)
Lower back	104 (43.7%)	72 (30.3%)
Upper back	97 (40.8%)	65 (27.3%)
Shoulder	90 (37.8%)	83 (34.9%)
Hand–wrist	65 (27.3%)	59 (24.8%)

Table 3. Associations between musculoskeletal complaints, exercise status, and sleep quality.

Analysis / Variable	Statistic	p
Correlation analysis (Spearman)		
Number of body regions with musculoskeletal complaints ↔ PSQI global score	ρ = 0.228	0.010
Subgroup correlations		
Regular exercisers (n = 152)	ρ = 0.12	>0.05
Non-exercisers (n = 86)	ρ = 0.30	<0.01
Group comparison (Mann–Whitney U test)		
PSQI score (≥1 complaint vs. no complaints)	Median: 9 vs. 6	<0.001
Multiple linear regression model	β (95% CI)	p
Number of complaint regions	0.41 (0.15–0.67)	0.002
Regular exercise (yes/no)	−0.61 (−1.78–0.56)	0.304
Daily gaming duration (category)	1.15 (0.32–1.98)	0.015
Age	−0.08 (−0.21–0.05)	0.236
Complaint regions × regular exercise	−0.35 (−0.70–−0.01)	0.048

Model fit statistics $F(5,232) = 14.8$, $R^2 = 0.242$, Adjusted $R^2 = 0.226$

As shown in Table 3, a weak but statistically significant positive association was observed between the number of body regions with musculoskeletal complaints and the PSQI global score ($\rho = 0.228$, $p = 0.010$). Participants reporting musculoskeletal complaints had significantly higher PSQI scores than those without complaints (median: 9 vs. 6; $p < 0.001$). Subgroup analyses showed that the association was not significant among participants who engaged in regular exercise ($\rho = 0.12$, $p > 0.05$), whereas a significant association was observed among non-exercisers ($\rho = 0.30$, $p < 0.01$).

In the multiple linear regression model, the number of musculoskeletal complaint regions ($\beta = 0.41$, $p = 0.002$) and daily gaming duration ($\beta = 1.15$, $p = 0.015$) were significant predictors of PSQI score. The interaction between musculoskeletal complaints and regular exercise was also significant ($\beta = -0.35$, $p = 0.048$). The overall regression model was statistically significant ($F(5,232) = 14.8$, $p < 0.001$) and explained 24.2% of the variance in PSQI scores ($R^2 = 0.242$; adjusted $R^2 = 0.226$).

DISCUSSION

The present study aimed to examine the relationship between musculoskeletal complaints and sleep quality among university students engaged in esports and to explore the potential moderating role of regular physical exercise in this association. The findings of this study indicate that musculoskeletal complaints are common among esports participants and are associated with poorer sleep quality. These results are consistent with previous research suggesting that musculoskeletal health, sedentary behaviour, and sleep regulation are closely interconnected in gaming and esports populations (Lee et al., 2020; Bayrakdar et al., 2022; Owen et al., 2020).

The prevalence of musculoskeletal complaints observed in the present study (68.1%) is consistent with previous research reporting a high frequency of musculoskeletal symptoms among esports players (Lindberg et al., 2020; Carara et al., 2025). In the current study, complaints were most frequently reported in the neck and trunk regions. Similar findings have been reported in earlier studies identifying the cervical and lumbar regions as the most commonly affected body areas among gamers and esports athletes (Lindberg et al., 2020; Carara et al., 2025). These patterns may be explained by the biomechanical characteristics of esports participation, which typically involve prolonged static postures, repetitive fine motor movements, and sustained screen exposure that increase mechanical loading on the spine (Chang et al., 2015; Katzmarzyk et al., 2019; Owen et al., 2020; Gotum et al., 2025).

Poor sleep quality was also highly prevalent in the present sample, with 72.7% of participants classified as poor sleepers according to PSQI criteria. This finding is consistent with previous studies indicating that excessive gaming behaviour is associated with delayed sleep onset, irregular sleep–wake schedules, and reduced sleep duration (Lee et al., 2020; Wong et al., 2020). Prolonged evening screen exposure, cognitive arousal during gaming, and blue light emitted from digital devices have been identified as key factors contributing to sleep disturbances among gamers (Exelmans and Van den Bulck, 2016; Hale and Guan, 2015). Consequently, esports participants may be particularly vulnerable to sleep-related problems due to the behavioural and environmental characteristics of gaming activities.

Although the association between musculoskeletal complaints and sleep quality was statistically significant, the magnitude of the correlation observed in this study was modest ($\rho = 0.228$). This suggests that musculoskeletal complaints represent only one of several factors influencing sleep quality in esports populations. Consistent with this interpretation, regression analysis indicated that musculoskeletal complaints remained an independent predictor of sleep quality after adjustment for age, gaming duration, and exercise status. However, the regression model explained approximately 24% of the variance in PSQI scores, indicating that additional behavioural, psychological, and environmental factors may also contribute to sleep disturbances among esports participants.

The association observed in this study is consistent with the well-established bidirectional relationship between pain and sleep. Previous research has shown that poor sleep quality may increase pain sensitivity and impair recovery processes, while persistent musculoskeletal discomfort may interfere with sleep initiation and maintenance (Finan et al., 2013; Haack and Mullington, 2005; Huang and Ihm, 2021; Walsh et al., 2021). In the context of esports, prolonged sedentary behaviour and extended gaming sessions may further exacerbate this interaction between musculoskeletal discomfort and sleep disturbances (Sanz-Milone et al., 2021; Leong et al., 2022).

In line with this, recent evidence further reinforces this bidirectional interaction, indicating that sleep quality is a significant predictor of musculoskeletal injury risk and recovery capacity in athletic populations. Insufficient sleep has been associated with an increased risk of musculoskeletal injuries, highlighting the critical role of sleep in maintaining musculoskeletal health. These findings suggest that inadequate sleep may increase vulnerability to musculoskeletal complaints, particularly in populations exposed to prolonged sedentary behaviour and repetitive loading, such as esports athletes (Viegas et al., 2022).

An important finding of the present study is that regular physical exercise appeared to moderate the relationship between musculoskeletal complaints and sleep quality. The weaker association observed among participants who reported regular exercise suggests that physical activity may exert a protective effect. Previous studies have demonstrated that exercise may reduce musculoskeletal pain and improve sleep quality through several physiological and behavioural mechanisms, including improved circulation, enhanced muscular support, and improved recovery processes (Kelley and Kelley, 2017; Kredlow et al., 2015). In addition, exercise may counteract some of the negative effects associated with prolonged sedentary behaviour, which is a common characteristic of esports participation (Pedersen and Saltin, 2015; Gleeson et al., 2011).

From a practical perspective, these findings highlight the importance of promoting healthy lifestyle behaviours among esports participants. Structured physical exercise programmes may support musculoskeletal health and contribute to improved sleep quality. Furthermore, ergonomic interventions such as appropriate workstation design, postural education, and scheduled breaks during gaming sessions may help reduce mechanical strain associated with prolonged gaming activities (Gürgan and Şevgin, 2024).

Several limitations should be considered when interpreting these findings. First, the cross-sectional design of the study prevents causal inference and limits conclusions regarding the directionality of the observed associations. Second, participants were recruited using a convenience sampling strategy from a single university, which may limit the generalizability of the findings. Third, regular physical exercise was assessed using a dichotomous variable, which prevented a more detailed examination of exercise frequency, intensity, and type. In addition, ergonomic and postural factors were not directly assessed, although these variables are known to influence musculoskeletal loading in gaming populations (Chang et al., 2015; Owen et al., 2020). Finally, demographic variables such as gender distribution and body mass index were not collected and may represent potential confounding factors.

CONCLUSION

This study demonstrated that musculoskeletal complaints are common among esports players and are associated with poorer sleep quality. Participants reporting a greater number of musculoskeletal complaint regions had significantly higher PSQI scores. In addition, regular physical exercise appeared to attenuate this relationship, suggesting a potential protective role of physical activity in esports populations. These findings highlight the

importance of considering musculoskeletal health and lifestyle behaviours when addressing sleep-related problems among individuals engaged in esports.

Suggestions

Based on these findings, esports participants should be encouraged to engage in regular physical exercise to support musculoskeletal health and improve sleep quality. Ergonomic interventions, including appropriate workstation setup, postural education, and scheduled breaks during gaming sessions, may also help reduce musculoskeletal strain. Future research should employ longitudinal designs and include additional variables such as ergonomic factors, body mass index, and gender to better understand the mechanisms underlying musculoskeletal complaints and sleep disturbances in esports populations.

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