Evaluating the Effectiveness of Interventions for Neck Pain in University Students with Problematic Internet Use: A Randomized Trial

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Abstract

Aim: The proliferation of digital technology has made internet usage an integral part of daily life, inadvertently leading to increased physical inactivity among peers. This study aims to examine the effectiveness of different interventions for neck pain in university students with problematic internet use.

Method: This randomized controlled trial (RCT) was conducted with 40 participants, aged 18 to 20, experiencing non-specific neck pain. All participants were randomly divided into the home exercise group (Group 1; n=20) and the walking group (Group 2; n=20). Posture and stretching exercises were recommended to the home exercise group over eight weeks. The walking group was given a daily walking program of 7000 steps over the same eight weeks. After examining the subjects' demographic information, participants were assessed before and after the program using the Neck Disability Index, Perceived Stress Scale, Pittsburgh Sleep Quality Index, and Beck Anxiety Inventory.

Results: The study revealed that symptoms associated with neck pain significantly decreased in the home exercise group (p=0.001). No significant improvements in stress and anxiety levels were observed in either group (p>0.05). Although sleep quality improved significantly in both the home exercise group (p=0.005) and the walking group (p=0.016), there was insufficient supportive evidence that one group was more effective.

Conclusion: The increasing prevalence of internet usage contributes to heightened physical inactivity among peers. Establishing regular exercise routines and scheduling specific physical activity breaks are crucial to counteract the detrimental effects of this trend.

Keywords: Exercise therapy, internet use, neck pain, physical activity, walking.

Problemli İnternet Kullanımı Olan Üniversite Öğrencilerinde Boyun Ağrısına Yönelik Girişimlerin Etkinliğinin Değerlendirilmesi: Randomize Bir Çalışma

Öz

Amaç: Dijital teknolojinin yaygınlaşması, internet kullanımını günlük yaşamın ayrılmaz bir parçası haline getirmiş ve istemeden de olsa akranlar arasında fiziksel hareketsizliğin artmasına neden olmuştur. Bu çalışmanın amacı, problemli internet kullanımı olan üniversite öğrencilerinde boyun ağrısına yönelik farklı müdahalelerin etkinliğini incelemektir.

Yöntem: Bu randomize kontrollü çalışma (RKÇ), yaşları 18 ila 20 arasında değişen ve spesifik olmayan boyun ağrısı yaşayan toplam 40 katılımcı ile yürütülmüştür. Tüm katılımcılar rastgele iki gruba ayrılmıştır: ev egzersiz grubu (Grup 1; n=20) ve yürüyüş grubu (Grup 2; n=20). Ev egzersizi grubuna sekiz haftalık bir süre boyunca duruş ve esneme egzersizleri önerilmiştir. Yürüyüş grubuna ise aynı sekiz haftalık süre boyunca 7000 adımdan oluşan günlük bir yürüyüş programı verilmiştir. Deneklerin demografik bilgilerinin incelenmesinin ardından, katılımcılar programdan önce ve sonra Boyun Engellilik İndeksi, Algılanan Stres

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ETHICAL STATEMENT: This study was carried out with the approval of the Ethics Committee of Istanbul Medipol University, dated 11/08/2023 and numbered E-10840098-772.02-4942. A signed subject consent form in accordance with the Declaration of Helsinki was obtained from each participant.

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Ölçeği, Pittsburgh Uyku Kalitesi İndeksi ve Beck Anksiyete Envanteri kullanılarak değerlendirilmiştir.

Bulgular: Çalışma, boyun ağrısı ile ilişkili semptomların ev egzersizi grubunda önemli ölçüde azaldığını ortaya koymuştur (p=0,001). Her iki grupta da stres ve anksiyete düzeylerinde anlamlı bir iyileşme gözlenmemiştir (p>0,05). Uyku kalitesi hem ev egzersizi grubunda (p=0,005) hem de yürüyüş grubunda (p=0,016) önemli ölçüde iyileşmiş olsa da bir grubun diğerinden daha etkili olduğuna dair yeterli destekleyici kanıt bulunamamıştır.

Sonuç: İnternet kullanımının giderek yaygınlaşması, akranlar arasında fiziksel hareketsizliğin artmasına katkıda bulunmaktadır. Düzenli egzersiz rutinleri oluşturmak ve belirli fiziksel aktivite molaları planlamak, bu eğilimin zararlı etkilerine karşı koymak için çok önemlidir.

Anahtar Sözcükler: Egzersiz tedavisi, internet kullanımı, boyun ağrısı, fiziksel aktivite, yürüme.

Introduction

Internet usage constitutes a widely embraced global technology that significantly impacts our daily lives. The International Telecommunication Union (ITU) reported that approximately 5.4 billion individuals, comprising 67% of the world's population, actively use the internet[1,2]. According to the 2023 data from the Turkish Statistical Institute (TUİK), internet usage has steadily risen, reaching 87.1% among the population[3]. The increasing popularity of the internet is particularly impacting adolescents and adults. Previous studies have indicated that problematic internet use is more prevalent among adolescents globally, with rates reaching approximately 25%, and among adults, about 23%[4].

Problematic internet use, or internet addiction, is characterized by an inability to regulate internet consumption, thereby interfering with daily activities and responsibilities and resulting in psychological or physical health issues[5]. Research has emphasized the adverse health impacts of increased physical inactivity, noting that problematic internet use often entails prolonged static postures that compromise body ergonomics, induce muscle tension in the neck, and result in neck pain[6]. Studies have consistently demonstrated a correlation between prolonged screen time and musculoskeletal disorders, particularly in the cervical spine, which can lead to chronic pain if not addressed early[7,8].

Neck pain is the second most prevalent musculoskeletal complaint and a significant cause of disability worldwide among individuals aged 15 to 64 years 7. It is often caused by muscle tension, poor posture, or trauma. Prolonged focus on a fixed point can lead to decreased neck mobility and increased discomfort[6,7]. Previous studies have confirmed that extended periods of internet use contribute significantly to the prevalence of neck pain, particularly in younger populations. This can be attributed to the poor ergonomic setup during internet use, such as slouched postures or prolonged staring at screens, which strains the neck muscles and leads to discomfort[6,8]. In addition, research conducted by Alaca supports these findings and reveals a high prevalence of neck pain among young people with problematic internet use[9].

It is, therefore, important to effectively manage neck pain associated with problematic internet use in young adults. Exercise interventions are crucial in managing neck pain related to problematic internet use among young adults[10]. Previous research has

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demonstrated that neck-focused exercises, such as stretching and strengthening, have been shown to alleviate pain in various studies[11,12]. Additionally, regular moderate-intensity aerobic exercise positively impacts overall health. Brisk walking on flat terrain, a highly effective form of aerobic exercise, has been reported to significantly improve musculoskeletal health and reduce neck pain[10,12]. The effects of exercise on reducing stress and improving sleep quality have also been well-documented, suggesting that exercise can address multiple psychological and physical symptoms commonly associated with problematic internet use[12]. Based on this information, our study is designed to compare the effects of integrating neck exercises and walking programs into daily routines. The aim is to investigate the impact of these interventions on alleviating neck pain symptoms, sleep quality, stress, and anxiety in university students with problematic internet use.

Material and Methods

Participants

University student internet users with neck pain at Bahcesehir University were invited to participate in this study. The inclusion criteria are listed as follows: (1) Subclinical chronic neck pain that has persisted for more than three months; (2) Neck Disability Index (NDI) score range of 5–14/5013; (3) a score of ≥ 50 on the Internet Addiction Test[9]; (4) 18–25 years of age; (5) According to the International Physical Activity Questionnaire score, being inactive or minimally active[14]. Participants were excluded from the study if they met any of the following conditions: (1) visual, auditory, vestibular, or neurological deficits; (2) traumatic injuries, fractures, or surgical interventions to the spine or lower extremities within the year preceding the study; (3) severe pain that restricts joint movement or shows clinical symptoms; (4) participation in any neck muscle strengthening programs in the past 12 months.

Material and Methods

Participants who agreed to participate in the study were randomly divided into two groups: the home exercise group (Group 1; n=20) and the walking group (Group 2; n=20). Randomization was performed using www.random.org. The purpose and process of the study were explained to participants in both groups, and each potential participant was screened using an online form designed specifically for this study.

Participants completed forms that included demographic information (gender, age, height, and weight), the International Physical Activity Questionnaire for physical activity levels, and the Internet Addiction Test for internet usage levels. To be included in the study, participants needed to meet specific score thresholds on ***the International Physical Activity Questionnaire and the Internet Addiction Test;*** those scoring below the required thresholds were excluded. To assess intervention outcomes, participants in both groups were evaluated before the treatment protocol began and after the eight-week program. The Neck Disability Index was used to evaluate neck pain, the Pittsburgh Sleep Quality Index for sleep quality, the Beck Anxiety Inventory for anxiety, and the Perceived Stress Scale for stress levels.

The International Physical Activity Questionnaire (IPAQ), designed to evaluate physical activity levels in people between the ages of 15 and 65, includes

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inquiries regarding recent physical activity. IPAQ categorizes physical activity into three levels: “inactive,” “minimally active,” and “highly active.” Physical activity levels were classified as inactive (<600 MET-min/week), minimally active (600–3000 MET-min/week), and very active (>3000 MET-min/week), considering the numerical data obtained as well as MET calculation[15].

The Internet Addiction Test (IAT) was developed by Young as a 20-item self-report scale to measure the severity of Internet dependency. Each question is rated on a 6-point Likert scale ranging from "Never" (0 points) to "Continually" (5 points). According to the scoring system, a total score between 0 and 30 indicates no internet addiction and a low risk. Scores between 31 and 49 suggest mild internet addiction with a low to moderate risk. Scores from 50 to 79 reflect moderate internet addiction, implying a moderate to high risk. Finally, a score between 80 and 100 indicates severe internet addiction and a high risk[16].

The Neck Disability Index (NDI) evaluates neck-related disability based on responses from the previous week. It consists of ten items, each scored on a 6-point scale ranging from 0 to 5, with 0 representing no disability and 5 representing complete disability, resulting in a total score ranging from 0 to 50. Higher scores indicate a more significant disability. Scores below 21 suggest mild to moderate disability, scores between 22 and 35 indicate severe disability, and scores above 36 reflect complete disability[17].

The Pittsburgh Sleep Quality Index (PSQI) is a comprehensive tool designed to evaluate an individual's sleep quality over the preceding month. This 24-item measure comprehensively evaluates several elements of sleep, such as duration, disruptions, efficiency, daytime dysfunction, and general sleep quality. Higher scores on the PSQI indicate lower sleep quality. The total score ranges from 0 to 21. The validity and reliability of the Turkish version of the PDQ was performed by Ağargün et al. in 1996[18,19].

The Beck Anxiety Inventory (BAI) scale is widely used to evaluate neck dysfunction and related pain perception while going about daily tasks. BAI is a valid and dependable measure utilized in clinical practice and research. This scale measures the degree of neck pain felt during various everyday tasks and activities, such as driving, dressing, lifting, reading, getting a headache, concentrating, engaging in work-related tasks, and engaging in leisure activities. Each result or lack of pain is represented by a number on the scale, which goes from"0," the most favorable outcome, to"50," which is the most significant degree of discomfort or disability[20,21].

Perceived Stress Scale (PSS), developed by PSS, Cohen, Kamarck, and Mermelstein, measures stress perceptions. In this scale, which has 14 questions in total, the answers are “Never”, “Rarely”, “Sometimes”, “Quite often” and “Very often”. In this test, the lowest "0" and the highest "56" points can be obtained; high values indicate the height of the person's perceived stress[22].

Participants in Group 1, the home exercise group, were instructed to follow a standard home exercise program five times a week for eight weeks. The exercise protocol included a general range of motion exercises for warming up and cooling down, followed by stretching/mobilization and strengthening exercises targeting the cervical and upper thoracic spine. The stretching/mobilization exercises consisted of neck flexion and

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extension stretches, upper trapezius stretches, and upper thoracic extension mobilization performed while seated. The strengthening exercises included chin tucks, isometric neck flexion, extension, lateral flexion, chin tucks with overpressure, shoulder blade pulls, shrugs, and shoulder rotations. Each exercise was performed for 8 to 10 repetitions, with rest intervals of 30 to 60 seconds between exercises. A complete exercise session lasted between 20 to 30 minutes[23]. Participants in Group 1 received a brochure detailing the prescribed neck exercises. The exercises were demonstrated to the participants in the first week and were subsequently reinforced by a physiotherapist during their weekly visits to the Department of Physiotherapy and Rehabilitation. Exercise adherence was monitored using daily exercise diaries maintained by the participants. These diaries were reviewed weekly by the physiotherapist to evaluate adherence to the program. Feedback was provided during the weekly visits to ensure proper execution of the exercises. Participants who performed the home exercises fewer than three times a week were excluded from the study[24]. Participants in Group 2, the walking exercise group, were instructed to follow a structured walking program five times a week for eight weeks. Each participant was asked to install the Runtastic Pedometer© (Runtastic, Austria) smartphone application on their devices. Daily walking data were collected using this application, which is considered valid and reliable for tracking steps[8]. Participants were instructed to walk 7000 steps daily on flat surfaces while carrying their smartphones in their pockets, adhering to the recommendations of the American College of Sports Medicine for achieving health benefits through specific physical activity levels[25]. To ensure adherence and monitor progress, participants were required to maintain a daily log of their steps, which was reviewed weekly by a physiotherapist. Participants who performed fewer than three sessions per week were excluded from the study in Group 1 and Group 2. This approach allowed for ongoing adjustments to the program and addressed any issues related to compliance, ensuring that participants consistently met the activity goal throughout the study.

Ethical Statement

The study was randomized from August 2023 to March 2024 at Bahçeşehir University's Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation. Approval for the study was granted by the Istanbul Medipol University Ethics Committee (Date: 11/08/2024; reference number E-10840098-772.02-4942). The study adhered to the principles outlined in the Helsinki Declaration and was registered with ClinicalTrials.gov (Identifier: NCT06009081). Individuals who signed the Informed Consent Form and agreed to participate were included in the study.

Statistical Analysis

Using G*Power version 3.1.9.4, the sample size was calculated through repeated measures analysis of variance (ANOVA) between groups. The alpha and power (1-β error probability) were set at 0.05 and 0.85, respectively. An anticipated effect size of 0.576 from Kutlu's[26] study was used as a reference for group 2. Based on these findings, the sample size for each group was initially determined to be 19, totaling 38 participants. To account for potential participant dropout, 45 individuals who met the inclusion criteria were randomly assigned to the study. However, 5 participants dropped out during the follow-up period, and the study was completed with 40 participants. All participants

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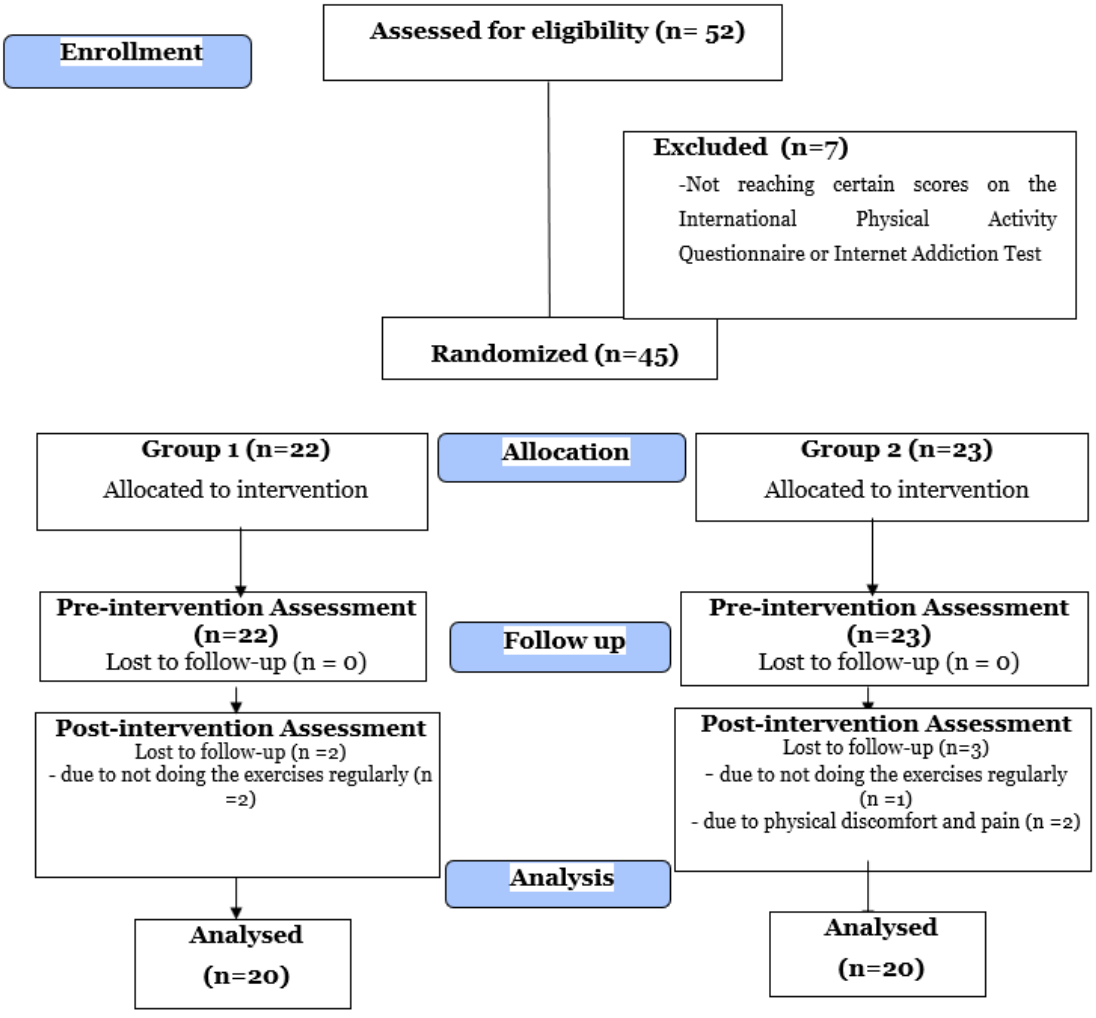
were informed about the study and provided their written consent. Participants were informed about the study, and their written consent was obtained.

The collected data were examined using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). In the case of continuous data that was not normally distributed, the median and interquartile ranges were used to represent the data. Frequency and percentage were used to depict categorical data—the repeated measures t-test was employed to look at dependent changes in each group for inferential analysis. A p-value of less than 0.05 indicated statistical significance. Each group's dependent variables' assumed normal distribution was examined. The assumption of homogeneity of variances is satisfied because the Levene test of equality of error variances was met, and Box's M test revealed a p-value>0.001.

Results

After baseline assessments, students were divided into two groups using a computer-assisted randomization table (Group 1, n=20 and Group 2, n=20) (Figure 1).

Figure 1. Consolidated standards of reporting trials (consort) flow chart for trial recruitment.



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The characteristics of the participants, including their pre-program physical activity levels and internet addiction scores, are presented in Table 1. There were no significant differences among all variables regarding age, gender, BMI, IPAQ, and IAT scores (p>0.05).

Table 1. The comparison of participants' characteristics, physical activity levels, and internet addiction scores.

	Group 1 (n=20)	**Group 2 (n=20)**	**p**
Female (%) **Male** (%)	25 75	40 60	0.343
Age (year, $\bar{x}$±sd)	22.05±1.15	22.40±1.35	0.450
BMI (kg/m², $\bar{x}$±sd)	24.28±4.86	23.79±2.87	0.759
IPAQ	802± 880.2	927 ±574.9	0.637
IAT	62.10±10.18	56.25±6.02	0.290

Results are given as x±sd or %. BMI: Body Mass Index, IPAQ: The International Physical Activity Questionnaire, IAT: Internet Addiction Test, n: number of patients, $\bar{x}$: mean, sd: standard deviation, kg: kilogram, m²: meters-square.

Comparative data on pre- and post-program parameters for the groups are shown in Table 2. Post-treatment NDI scores indicated a statistically significant improvement in Group 1 compared to Group 2, both within groups (p=0.001) and between groups (p=0.008) comparisons (p<0.05). Significant increases in PSQI scores were observed in both groups (Group 1: p=0.005, Group 2: p=0.016; p<0.05), although no significant differences were found between the groups (p>0.05). Additionally, BAI and PSS scores did not show statistically significant differences within or between groups.

Table 2. Comparative analysis of pre-and post-program parameters for groups.

	Group 1 (n=20)			**Group 2 (n=20)**			**Inter-group p**
	Pre-Program ($\bar{x}$±sd)	**Post-program ($\bar{x}$±sd)**	**p**	**Pre-programs ($\bar{x}$±sd)**	**Post-program ($\bar{x}$±sd)**	**p**	
NDI	10.2±3.76	8.75± 3.66	0.001*	9.30± 3.72	9.1± 3.74	0.408	0.008*
PSQI	14.25±3.69	13.20±3.94	0.005*	14.75± 4.31	14.30±4.34	0.016*	0.113
BAI	29.9± 12.9	29.7± 12.66	0.163	19.8± 14.05	19.75±13.98	0.330	0.646
PSS	31.23±6.41	27.45±4.71	0.058	29.5± 6.21	28.75±8.37	0.611	0.641

NDI: Neck Disability Index, PSQI=Pittsburgh Sleep Quality Index, BAI: Beck Anxiety Inventory, PSS= Perceived Stress Scale $\bar{x}$ ±sd: mean ±standard deviation, * p<0.05.

Discussion

This study comparing home-based and walking exercise interventions for reducing neck pain symptoms in university students with problematic internet use revealed that only the home exercise group demonstrated a significant reduction in neck disability. Both interventions improved sleep quality, with no superior effect observed for either method.

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Additionally, neither intervention led to significant improvements in stress and anxiety levels in the participants.

Recent research has extensively investigated the effects of regular physical exercise on the general population. A meta-analysis has demonstrated that consistent physical activity can benefit pain, sleep quality, and stress levels. Notably, exercise interventions ranging from 2 to 10 weeks have significantly improved overall health[27]. Studies examining the influence of physical exercise on the negative consequences of prolonged internet use—such as musculoskeletal pain, stress, and sleep disturbances—have underscored the potential benefits of these interventions[7,11,28]. However, to our knowledge, no studies have specifically investigated the effects of walking and neck exercises on neck pain associated with problematic internet use.

Extensive research has documented the association between elevated internet usage and musculoskeletal pain[29]. The neck is notably one of the most affected areas among individuals with heightened internet use. Moreover, severe pain in the cervical spine is frequently linked to reduced physical activity[30,31]. Given the existing literature, our study aimed to investigate the effects of different exercise interventions on NDI scores in students with problematic internet use. The findings of the studies notably demonstrated improvements in NDI scores exclusively within the home exercise group. These home-based exercises likely targeted neck-specific muscles directly, thereby addressing cervical spine issues more effectively than walking interventions. Similarly, a meta-analysis has shown that home exercises focusing on self-mobilization positively impact NDI scores, whether alone or in conjunction with other treatments[32]. Specifically, isometric and stretching exercises performed at home have been reported to enhance cervical lordosis and alleviate pain[33]. Consistent with these findings, our study observed a significant improvement in NDI scores within the home exercise group, where neck-specific exercises were implemented.

In contrast, Sitthipornvorakul reported reduced neck pain during a 6-month follow-up for participants who increased their daily walking to a minimum of 7,000 steps, exceeding the threshold examined[10]. However, our study did not significantly improve neck pain within the walking group despite participants meeting the 7000 steps daily target. This discrepancy may be attributed to insufficient walking steps or differences in the pain assessment tools used in this study.

Problematic internet use leads to numerous adverse outcomes, including sleep disturbances and anxiety issues. Research indicates that college students with high levels of internet use and sleep problems are more likely to exhibit elevated anxiety and depressive symptoms[34,35]. A study on prolonged internet use in students suggested enhancing physical activity could help alleviate symptoms associated with excessive internet use[36]. Another study found that exercise had extensive positive effects on anxiety, depression, interpersonal sensitivity, loneliness, and overall mental health in students with problematic internet use[37]. Furthermore, a longitudinal study demonstrated that a 12-week exercise program significantly reduced internet use, decreased depression, and improved sleep quality, with sleep assessed using the PSQI questionnaire, similar to our study[38]. Consistent with our findings and the existing literature, improvements in sleep scores were observed in both the exercise and walking

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group[39].

Previous research has demonstrated that exercise can be an effective strategy for managing and coping with stress, provided the exercise is appropriately tailored to the individual's needs[38]. Yan et al. demonstrated in a meta-analysis that exercise interventions have a positive impact on internet addiction and psychological symptoms such as stress[40]. However, this intervention did not significantly affect individuals with moderate to severe internet use[6]. This study mainly involved students with moderate internet usage. Despite this, there was no significant increase in PSS and BAI scores, which measure stress and anxiety, in either intervention group. Surprisingly, the home exercise and walking programs implemented in our study did not produce discernible effects on stress and anxiety levels. This unexpected outcome may be attributed to the baseline stress and anxiety levels of the participants, which may not have been significantly elevated at the start of the study.

This study has several limitations that should be considered. First, the sample size may be insufficient to generalize the findings to a broader population. Additionally, the reliance on self-reported measures, such as surveys and scales, may introduce subjective bias, potentially affecting the accuracy of the data. The homogeneity of the study group, consisting of individuals with specific demographic or clinical characteristics, may also limit the applicability of the results to other populations. Future research should consider increasing the sample size and employing diverse assessment methods to strengthen the findings. Furthermore, as this study focused on participants with a specific level of internet addiction, future studies should examine the effects of interventions across different levels of addiction, providing deeper insights into how interventions may affect individuals at various stages of internet addiction.

Conclusion

As a result of this study, problematic internet use and related symptoms can be alleviated by exercise, but it is unknown which exercise is more effective. Research should examine the mechanisms of exercise-based interventions against problematic internet use and investigate which symptoms of increased internet use may be better reduced by exercise. We also suggest that the effect of exercise intervention on stress in other musculoskeletal pain conditions associated with increased internet use should be examined.

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Ethical Approval: This study was approved by Medipol University Non-Interventional Clinical Research Ethics Committee (Date:11/08/2024; Number: E-10840098-772.02-4942).

Author Contributions: GD: Concept, Design, Data Collection and Processing, Analysis and/or Interpretation, Literature Review, Article Writing. HG: Concept, Consulting, Analysis and/or Interpretation, Article Writing.

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