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ORIGINAL ARTICLE

Decreased rehabilitation adherence, physical activity, and quality of life in individuals with idiopathic scoliosis in the COVID-19 Pandemic

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Purpose: This study compares the rehabilitation adherence, physical activity (PA) levels, and quality of life (QoL) of individuals with idiopathic scoliosis (IS) during and before the COVID-19 Pandemic.
Methods: This study included 74 individuals with IS between the ages of 9 and 18 years. The Exercise Adherence Rating Scale (EARS) was used to assess adherence to exercise therapy protocols, the International Physical Activity Questionnaire Short Form (IPAQ) was used to evaluate PA levels, and the Scoliosis Research Society-22 Patient Questionnaire (SRS-22) was used to measure QoL.
Results: Section B score of the EARS decreased (p=0.041), while Section C (p=0.636) and summed scores (p=0.54) did not change during the pandemic. The PA of the participants decreased (p=0.001), hours of sitting increased (p<0.001). While the body image, pain, and treatment satisfaction scores did not change; the function, mental health, subtotal, and total scores of the participants (respectively p=0.876, p=0.092, p=0.224, p=0.008, p<0.001, p<0.001, p<0.001) decreased.
Conclusion: The rehabilitation adherence in individuals with IS was affected negatively, PA levels decreased, sedentary behaviors increased, and QoL of participants decreased during the pandemic. In addition to other factors, the decreased PA levels in the pandemic period may have negatively affected QoL and rehabilitation process in participants with IS. In the light of future studies, it may be recommended to give importance to physical activity as well as other factors in the rehabilitation of individuals with IS.
Keywords: COVID-19 Pandemic, Scoliosis, Physical Activity, Treatment Adherence, Health-Related Quality of Life.

Covid-19 pandemisinde idyopatik skolyozlu bireylerde azalmış rehabilitasyon uyumu, fiziksel aktivite ve yaşam kalitesi

Amaç: Bu çalışmanın amacı, COVID-19 pandemisi sırasında ve öncesinde idyopatik skolyozlu (İS) bireylerin rehabilitasyona uyumunu, fiziksel aktivite (FA) düzeylerini ve yaşam kalitesini karşılaştırmaktı.
Yöntem: Bu çalışma, 9-18 yaşları arasında İS tanılı 74 bireyi içeriyordu. Egzersiz tedavisi protokollerine uyumu değerlendirmek için; Egzersize Uyumu Derecelendirme Ölçeği (EUDÖ), FA düzeylerini değerlendirmek için; Uluslararası Fiziksel Aktivite Anketi (UFAA), yaşam kalitesini değerlendirmek için ise; Skolyoz Araştırma Derneği-22 Hasta Anketi (SRS-22) kullanıldı.
Bulgular: Bireylerin pandemide EUDÖ Bölüm B puanı azalırken (p=0,041) Bölüm C (p=0,636) ve toplam puanları (p=0,54) değişmedi. Ayrıca FA düzeyleri azaldı (p=0,001), oturma saatleri arttı (p<0,001). Beden imajı, ağrı ve tedaviden memnuniyet puanları değişmezken, fonksiyon, mental sağlık, ara toplam ve toplam puanlarında (sıra ile p=0,876, p=0,092, p=0,224, p=0,008, p<0,001, p<0,001, p<0,001) azalma görüldü.
Sonuç: Pandemi sürecinde İS'li bireylerin rehabilitasyon uyumu olumsuz etkilenmiş, FA seviyeleri düşmüş, sedanter davranış artmış ve yaşam kaliteleri azalmıştır. İS'li bireylerde pandemi döneminde diğer faktörlerin yanı sıra, FA düzeylerinin azalması da yaşam kalitesini ve rehabilitasyon sürecini olumsuz etkilemiş olabilir. Yapılacak çalışmalar ışığında İS'li bireylerin rehabilitasyonunda diğer faktörlerin yanında fiziksel aktiviteye de önem verilmesi önerilebilir.
Anahtar kelimeler: COVID-19 pandemisi, Skolyoz, Fiziksel aktivite, Tedaviye uyum, Sağlıkla ilgili yaşam kalitesi.

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The novel coronavirus disease (COVID-19), which emerged in China in December 2019, was announced as a global pandemic by the World Health Organization in March 2020.[1] Since this time, countries around the world have implemented various preventative measures, such as city lockdowns and home quarantines, to control the spread of the pandemic. These measures have changed people's lifestyles and affected their health.[2]

The COVID-19 pandemic has been cited as the biggest challenge facing national health systems in the past century.[3] Medical care services changed during the COVID-19 Pandemic, and these changes affected all patients with chronic diseases whose outpatient visits were limited.[4] These interruptions to physiotherapy plans had a significant negative impact on the health of thousands of patients.[5]

Idiopathic scoliosis (IS) is an abnormal three-dimensional curvature of the spine with vertebral rotation that occurs in apparently healthy children.[6,7] IS can progress in relation to multiple factors during any rapid period of growth and is of unknown origin. The conservative treatment of IS includes exercise and bracing, which aims to prevent curve progression, prevent, or treat respiratory dysfunction and spinal pain syndromes, and improve individual's quality of life (QoL), psychological well-being, and disability.[6] The main exercise treatment of IS includes physiotherapeutic scoliosis-specific exercises (PSSE). In recent years, the number of studies investigating the impact of PSSE on Cobb angle, angle of trunk rotation, pain, and QoL in individuals with IS has increased.[8] In addition, interventions such as aerobic exercise, specific body-region exercises, and increases in general physical activity levels are recommended in addition to core treatment to improve patient health.[9] It has been highlighted that adherence is an important prerequisite for exercise success and can affect treatment outcomes[10], as the benefits of exercise can only be acquired when adhering to the prescribed protocols. Also, compliance plays a major role in the success of brace treatment and adherence to treatment is one of the main issues to be considered about IS management.[6,7]

Some studies have investigated treatment adherence, level of physical activity, and QoL in individuals with different disorders during the pandemic. In a study, 20.3% of the rheumatic patients spaced and stopped their treatment during the pandemic, and 37.4% of patients reported feeling a worsening of disease activity.[11] In another study of patients with rheumatic and musculoskeletal diseases, 45.6% were unable to continue exercising during the pandemic, and self-reported disease activity and reports of elevated pain were high.[12] During the pandemic, these negative effects on patients' overall health and well-being may be explained by the disruption to daily physical activity and non-adherence to treatment. It would therefore be beneficial to investigate rehabilitation process, physical activity levels, and QoL in patients during the pandemic to plan for any necessary interventions. However, there are no studies in the literature that have assessed adherence to treatment, alterations of physical activity, and QoL in individuals with IS during the pandemic.

The aim of the present study is to compare the rehabilitation adherence, physical activity levels, and QoL of individuals with IS before and during the pandemic. The hypotheses are as follows: Compared to before the pandemic, (a) the rehabilitation adherence of individuals with IS will be found to have been affected by the pandemic, (b) the level of physical activity of individuals with IS will be found to have decreased during the pandemic, and (c) the QoL of individuals with IS will be found to have changed during the pandemic.

METHODS

Participants

The study participants included 74 individuals with IS who had been undergoing rehabilitation in different centers. The participants' mean age was 14.7±2.3 years (range: 9–18 years), and the group consisted of 66 girls and 8 boys. The inclusion criteria were previous diagnosis with IS by a physician, a Cobb angle for the main curve of at least 10 degrees, and at least 6 months history of conservative treatment process (e.g., bracing and/or exercise) just before the pandemic. Their treatments included thoraco-lumbo-sacral brace and/or PSSE. Excluded from the analysis were participants who had neuromuscular, rheumatologic, renal, muscular, cardiovascular,

pulmonary, or vestibular diseases, those who were treated with surgery, or who had barriers to physical activity before or during the pandemic.

Hasan Kalyoncu University Research Ethics Committee (2020/069 on 29 September 2020) approved the study protocol. Participation in the study was voluntary, and participants were informed about the study. Before participation, there was an option for individuals and their parents to provide their informed consent on the online survey.

Measures and Procedures

This study took the form of a web-based cohort study planned to examine the impact of the pandemic, drawing on data routinely collected from individuals before the pandemic. The participants' who have been follow-up for 6-96 months' responses about their health status during the pandemic were collected from October 2020 to January 2021 via the online questionnaire. Participants were reached via e-mail and asked to answer the questionnaires on the internet. Of the 439 individuals with IS followed in different centers, 25 could not be reached and 28 did not meet the inclusion criteria. The survey link was shared with the remaining 386 individuals, and 74 answered the online survey and were included in the study. This online questionnaire comprised demographic data regarding age, body weight, and height; evaluation of adherence to rehabilitation regarding bracing and/or exercise protocols; and measurement of physical activity levels and QoL.

Clinical characteristics specific to scoliosis were the Cobb angle, curve pattern, and duration and content of the rehabilitation protocol. The following items also were included in the online survey: The Exercise Adherence Rating Scale (EARS), the International Physical Activity Questionnaire Short Form (IPAQ), and the Scoliosis Research Society-22 Questionnaire (SRS-22), and participants answered that according to their situations of before and after the pandemic.

The Cobb angle was measured on posteroanterior full spine radiographs as the standard method of quantifying the amount of lateral deviation of the spine.[13] Cobb angles of participants were measured from their spine radiographs, as there were patients who followed up undergoing rehabilitation in centers before the pandemic. The curve pattern was determined according to the Scoliosis Research Society (SRS) criteria as single thoracic, single thoracolumbar/lumbar, or double-curved regarding the region of the main curve.[14]

The duration of the rehabilitation protocol was recorded in months. The content of the rehabilitation was considered as exercise and/or bracing. Patients using braces were asked about their compliance with brace protocols. Participants scored their adherence regarding braces before and during the pandemic according to a 4-point Likert scale (0=little adherence, 1=moderate adherence, 2=fair adherence, and 3=complete adherence).

The EARS, a self-reported questionnaire, was developed to evaluate adherence to prescribed home exercise regimens. The EARS consists of sections A, B, and C. Section A collects qualitative information about the participants' exercise adherence behavior. Section B comprises 6 items designed to measure exercise adherence behavior. Section C gathers information about the reasons for adherence/non-adherence to exercise regimens and comprises 10 items about factors that hinder and facilitate the exercises. Both B and C's items were scored using a 5-point Likert scale (0=completely agree to 4=completely disagree). The summed score of Section B and Section C range from 0 to 24 and 0 to 40 respectively and the possible summed scores (Section B+ Section C) range from 0 to 64. A higher overall score on the EARS shows better exercise adherence.[15] In addition, the EARS was translated to Turkish, but it has been not yet published.

The IPAQ was developed in 1998 and is the most widely used physical activity questionnaire. The short form of the IPAQ records four different intensities of physical activity: vigorous, moderate, walking, and sitting. IPAQ scores are calculated for each activity based on the duration and frequency of the activity and multiplied by the metabolic equivalent of task (MET) per activity. The MET value of the vigorous activity is calculated with the following formula: 8.0 * vigorous-intensity activity minutes * vigorous-intensity activity days/week. The same formula is used for calculating: the MET of moderate-intensity activity is obtained by multiplying by 4.0, and the MET of walking multiplying by 3.3. The

total MET is computed as the sum of vigorous, moderate, and walking scores. Sitting time is not included in scores and is an indicator of sedentary behavior. The MET values of the participants were calculated by asking them to indicate how many days and minutes they did physical activity per week before and during the pandemic.[16] Turkish version of the IPAQ was found reliable and valid to assess physical activity by Saglam et al.[17]

The SRS-22 is used to assess an individual's scoliosis-specific QoL with 5 dimensions, which include function/activity, body image, mental health, pain, and treatment satisfaction. The SRS-22 consists of 22 items with scores ranging from 1 (worst) to 5 (best), and these are summed into a final summary score ranging from 1 (very poor QoL) to 5 (optimal QoL).[18] The sub-total score is calculated by adding the function, body image, mental health, and pain scores. In addition, the total score of the SRS-22 is calculated by adding the treatment satisfaction score to the sub-total score. The Turkish cultural and linguistic adaptation of SRS-22 was done by Alanay et al. and it was found reliable and valid to assess the quality of life for individuals diagnosed with idiopathic scoliosis.[19]

Statistical analysis

The statistical analysis was performed using SPSS version 23 (SPSS Inc., Armonk, New York, USA). According to the G* power analysis, the total sample size with 80% power was calculated to be 72 for the study to ensure statistical significance (0.33 effect size, 0.05 margin of error)[20]. Data were expressed as mean ±standard deviation and number (percentages). The alpha level was 0.05 for all tests. The Kolmogorov–Smirnov normality test was used to test whether the variables were normally distributed. Because the data were not normally distributed, the Wilcoxon signed-rank test was conducted to compare the data before and during the pandemic.

RESULTS

The clinical characteristics of the participants are presented in Table 1. When the treatments of the participants were examined, 15 participants had only exercise training, and 59 participants received exercise and brace treatments. Before the pandemic, 72% of the participants were followed in the clinic/hospital regarding their exercise treatment. During the pandemic, 54% stated that they were followed at home, 12% at the clinic/hospital, and 5% with a physiotherapist online, whereas 28% did not perform their exercises.

Table 1. Clinical characteristics of the participants.

	Mean±SD
Diagnosis (years)	3.1±1.8
Rehabilitation duration (months)	30.0±21.0
Cobb's angle (°)	
Thoracic	32.2±11.8
Lumbar	26.7±11.3
	n (%)
Curve pattern	
Single thoracic	21 (28.4)
Single lumbar	15 (20.3)
Double curve	38 (51.4)

SD: Standard Deviation

Brace adherence of the participants before and during the pandemic according to the self-reported question is shown in Table 2. Participants wearing a brace for the recommended time decreased during the pandemic period when compared to before the pandemic. According to the EARS, the score of Section B (exercise adherence behavior rating) decreased ($p<0.05$), while the Section C (reasons for adherence/non-adherence of exercises) scores did not change ($p>0.05$) during the pandemic.

When comparing the IPAQ scores before and during the pandemic, although there was no difference in the vigorous activity MET of the participants, there were differences in vigorous days and vigorous minutes. In addition, the days and minutes of vigorous activity decreased during the pandemic ($p=0.011$, $p=0.01$). As shown in Table 3, the severity of walking days, walking minutes, and walking MET of the participants decreased during the pandemic ($p<0.001$, $p<0.001$, $p<0.001$ respectively). Finally, the total MET values of the participants decreased ($p=0.001$) and hours of sitting increased ($p<0.001$) in participants during the pandemic.

While the body image, pain, and treatment satisfaction scores did not change, the function,

mental health, subtotal, and total scores of the participants (p=0.876, p=0.092, p=0.224, p=0.008, p<0.001, p<0.001, p<0.001, respectively) decreased during the pandemic compared to before its onset on the SRS-22, as shown in Table 3.

Table 2. Scores of Brace Adherence and Exercise Adherence Rating Scale (EARS) before and during pandemic.

	Before Pandemic n (%)	During Pandemic n (%)	p
Brace Adherence			
Few	6 (11)	6 (11)	
Moderate	7 (13)	11 (21)	<0.05
Fair	17 (32)	22 (42)	
Completely	23 (44)	14 (26)	
	Mean±SD	Mean±SD	
Exercise Adherence Rating Scale (EARS)			
Section B	13.9± 6.6	12.8± 6.1	0.041*
Section C	24.9± 6.5	24.9± 6.8	0.636
Summed score	38.9± 12.3	37.8± 12.0	0.540

*: p<0.05, SD: Standard Deviation

Table 3. Comparison of the IPAQ and SRS-22 scores before and during pandemic.

	Before Pandemic Mean±SD	During Pandemic Mean±SD	p
International Physical Activity Questionnaire (IPAQ)			
Vigorous Activity/Day	1.2±1.8	0.8±1.6	0.011*
Vigorous Activity/Minute	44.7±61.4	26.3± 40.9	0.010*
Vigorous Activity/MET	385.3±1272.8	480.6±1636.9	0.716
Moderate Activity/Day	1.7±1.9	1.35±1.9	0.117
Moderate Activity/Minute	39.4±45.1	32.9±42.2	0.516
Moderate Activity/MET	327.5±671.2	268.3±612.5	0.245
Walking/Day	3.7±2.4	2.0±2.1	<0.001
Walking/Minute	48.4±41.4	29.6±39.1	<0.001
Walking/MET	652.0±932.5	298.5±771.4	<0.001
Total MET	1360.3±1965.5	1043.9±2164.5	0.001*
Sitting (hours)	8.2±15.0	11.5±16.8	<0.001
Scoliosis Research Society-22 Patient Questionnaire (SRS-22)			
Function	4.2±0.6	4.0±0.7	0.008*
Body Image	3.4±0.6	3.4±0.6 (	0.876
Mental Health	3.5±0.6	3.1±0.8	<0.001
Pain	4.2±0.6	4.1±0.6	0.092
Subtotal Score	3.8±0.4	3.7±0.5	<0.001
Treatment Satisfaction	3.9±0.8	3.8±0.9	0.224
Total Score	3.8±0.4	3.7±0.5	<0.001

* p<0.05. SD: Standard Deviation

DISCUSSION

This study showed that rehabilitation adherence in participants with IS was affected negatively by the pandemic. However, the reasons for adherence/non-adherence to exercise regimens remained similar during this period. We found that physical activity levels decreased, and sedentary behaviors increased in individuals with IS during the pandemic. However, the function, mental health, and total QoL scores of the participants decreased during the pandemic.

One of the main treatment goals for individuals with IS is the prevention of the progression of the curvature.[8] Adherence to rehabilitation protocols in individuals with IS has been considered significant for the success of the treatment. Personal characteristics, such as behaviors, social support, self-motivation, treatment and disease variables, and patient-to-physiotherapist interaction, influence adherence to exercise programs.[21] Our study found that the exercise adherence behavior of individuals with IS was negatively affected by the pandemic. According to the EARS, however, the reasons for adherence/non-adherence did not change during the pandemic. Several factors influence the degree to which an individual adheres to any treatment/rehabilitation options, including exercise. The degree to which patients adhere to the treatment requirements is considered to determine the success of physiotherapy[21,22], but it became difficult and even sometimes impossible to maintain face-to-face patient-physiotherapist interaction in the pandemic.

Section A of the EARS ensured that we had collected qualitative information about participants' exercise adherence behavior.15 Participants listed the following reasons for adherence to their prescribed exercises: "To improve my health" "To recover", and "To improve my curve angle". The participants listed the following reasons for non-adherence to their prescribed exercises: I do not do my exercise because: "I am bored" "I do not have time" "I am lazy", "I am tired." When asked why they stopped doing exercises, patients provided similar responses, as well as "I could not go to my physiotherapist to change my exercises due to the pandemic", "It was difficult to do at home." The fatigue and laziness presented by the participants as the reason for non-adherence can be explained by the decrease in physical activity levels and the increase in sedentary behavior during the pandemic. Furthermore, this qualitative information about participants' exercise adherence behavior showed us that for it to be improved, we need to adapt the exercise programs and follow up with individuals in pandemic conditions.

During the pandemic, numerous treatment variables, such as treatment process and patient-to-physiotherapist interaction, were affected. All alterations can affect the individual's behaviors, self-motivation, and adherence to rehabilitation. Studies have shown negative mental health outcomes, such as stress, anxiety, or depression, during the pandemic.[23,24] In the present study, the percentage of participants wearing a brace for the recommended time decreased during the pandemic period compared to before the pandemic. The abovementioned psychological parameters may have affected the motivation to participate in treating individuals with IS. Objective methods such as sensor systems used to assess compliance to brace treatment were found useful for ensuring adherence to treatment for individuals with IS and their parents.[25] Adherence to the rehabilitation process may have been negatively affected by the pandemic, given that follow-up practices and the attitudes of patients and their parents about their treatment may have changed.

The COVID-19 Pandemic was previously shown to have a negative impact on physical activity and related mental well-being.[26] It was also shown that increase in the usage of digital media (i.e., computers/laptops, or smartphones) during the pandemic among younger people.[27] This study showed that vigorous activity, and walking decreased, and hours of sitting increased in participants with IS during the pandemic. Our study also showed that, even if reasons for adherence/non-adherence to PSSE do not change, decreased physical activity may negatively affect the mental health and function of individuals with IS. Chopra et al. observed decreased physical activity and increased sedentary behavior in patients with adolescent IS via device-based assessment when compared to healthy peers.[28] Another study on self-reported assessments found that individuals with IS had similar levels of physical activity as

individuals without IS.[29] It was shown that individuals with IS spent longer periods of time on computers and had reduced physical activity compared with controls.[30] The present study emphasizes the importance of physical activity in ensuring QoL in individuals with IS. Although individuals with IS have more free time to do their PSSE than before the pandemic, their exercise adherence behavior had been negatively affected. It can be inferred that being physically inactive negatively impacts their QoL and rehabilitation process. We suggest that physical activity programs should be encouraged for individuals with IS as well as PSSE. During a pandemic, home-based physical activity programs could be organized to help reduce the negative effects of the pandemic period on the treatment processes of individuals with IS.

As previously stated, QoL issues are an important aspect to consider in the treatment of individuals with IS.[15] Children, adolescents[31], and adults[32] were previously reported to have experienced decreased QoL and more mental health problems associated with decreased physical activity during the pandemic. It is obvious that sedentary time increased during the pandemic. In this study, the function, mental health, and total QoL scores of the participants decreased during the pandemic. The found negative effects of the pandemic on mental well-being, function, and QoL may create risks for the treatment success in our participants in the future. In case of the continuation of the pandemic or its persistent negative effects, strategies for adapting to home-based physical activity and rehabilitation may be suggested as a means of prevention.

Limitations

The limitation of the study is that the method used for measuring the level of physical activity was based on self-reported assessment and is complex to examine according to before the pandemic. Furthermore, this study does not provide a comparative prospective follow-up during the pandemic. However, keeping in mind the fact that the course of the pandemic has been unpredictable, this period did not give us the opportunity to meet with the patients face-to-face. The fact that the Cobb angles of the participants were not compared before and during the pandemic can be considered as another limitation of the study. Future studies may examine the long-term outcomes of pandemics on individuals with IS.

Conclusion

In conclusion, the found adverse effects of the pandemic on mental well-being, function, and QoL may create risks for the treatment process and success of individuals with IS in the future. The decreased physical activity levels and increased hours of sitting during the pandemic may have negatively affected QoL and the rehabilitation process in participants with IS. In the light of future studies, it may be recommended to give importance to physical activity programs as well as other factors in the rehabilitation of individuals with IS.

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