Ergoterapi ve Rehabilitasyon Dergisi, 9(3), 2021, 79-88

Original Research

Comparison of Physical Activity Levels of Individuals Using Orthosis Without Pain and Kinesiophobia with Healthy Controls and within Themselves

Ağrısı ve Kinezyofobisi Olmayan Ortez Kullanan Bireylerin Fiziksel Aktivite Düzeylerinin Sağlıklı Kontrollerle ve Kendi Içinde Karşılaştırılması

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ABSTRACT

Purpose: Using orthosis due to orthopedic problems are common in adults. Positive effects of orthoses are correcting existing deformities, preventing progression and immobilizing a weak/injured segment. However, the effect of orthosis on level of physical activity in pain-free individuals has not been investigated. This controlled trial investigated the level of physical activity of individuals without pain and kinesiophobia who use orthoses and compared the results with healthy individuals. **Material and Methods:** 244 participants (94 using orthoses, 150 healthy individuals) who were 18-65 years old participated in this study. Individuals who were painless according to the Nordic Musculoskeletal Questionnaire and without kinesiophobia according to the Tampa Kinesiophobia Scale were included in the study. Physical activity was measured with The International Physical Activity Questionnaire (IPAQ). **Results:** The IPAQ scores showed that healthy individuals had a statistically higher level of physical activity compared to those who used orthotic devices for any part of their body ($p<0.001$). When the orthosis subgroups were analyzed, there was no statistically significant difference in physical activity amongst the subgroups ($p=0.906$, $p=0.819$, $p=0.537$). **Discussion:** This study shows that in addition to the clinical benefits provided by orthoses, they can lead to complications such as significant decrease in physical activity in individuals. Raising awareness that physical activity may decrease in patients using orthoses, and therefore increasing physical activity levels, should become an important part of rehabilitation.

Keywords: Orhotic devices; Physical activity; Lower extremity; Upper extremity; Spine

ÖZ

Amaç: Ortopedik problemler nedeniyle ortez kullanımı yetişkin popülasyonda oldukça yaygındır. Ortezlerin olumlu etkileri, mevcut deformiteleri düzeltmesi, ilerlemesini engellemesi ve zayıf/yaralı bir segmenti hareketsiz hale getirmesidir. Ancak ortez kullanan ağrısız bireylerde ortezin fiziksel aktivite düzeyine etkileri henüz araştırılmamıştır. Bu kontrollü çalışma, ortez kullanan ağrısız ve kinezyofobisi olmayan bireylerin fiziksel aktivite düzeylerini araştırmış ve sonuçları sağlıklı bireylerle karşılaştırmıştır. **Gereç ve Yöntem:** Bu çalışmaya 18-65 yaş arası toplam 244 birey (94 ortez kullanan, 150 sağlıklı birey) katılmıştır. Nordic Kas İskelet Sistemi Anketi'ne göre ağrısız olan ve Tampa Kinesiyofobi Ölçeği'ne göre kinezyofobisi olmayan olgular çalışmaya dâhil edildi. Fiziksel aktivite, Uluslararası Fiziksel Aktivite Anketi (IPAQ) ile ölçüldü. **Sonuçlar:** IPAQ skorlarına göre, sağlıklı bireylerin, vücutlarının herhangi bir yerinde ortez kullananlara kıyasla istatistiksel olarak daha yüksek fiziksel aktivite düzeyine sahip olduğunu bulundu ($p<0,001$). Ortez alt grupları incelendiğinde; fiziksel aktivite düzeyleri açısından alt gruplar arasında istatistiksel olarak anlamlı bir fark olmadığı görüldü ($p=0,906$, $p=0,819$, $p=0,537$).**Tartışma:** Bu çalışma, ortezlerin sağladığı klinik yararların yanında bireylerde fiziksel aktivitenin önemli ölçüde azalması gibi bir komplikasyona yol açabileceğini göstermektedir. Ortez kullanan hastalarda fiziksel aktivitenin azalabileceğinin farkındalığını yaratmak ve dolayısıyla fiziksel aktivite düzeylerini artırmak rehabilitasyonun önemli bir parçası haline gelmelidir.

Anahtar kelimeler: Ortez cihazları; Fiziksel aktivite; Alt ekstremite; Üst ekstremite; Omurga

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Geliş Tarihi (Received): 03.05.2021; Kabul Tarihi (Accepted): 03.12.2021

Orthotic devices are classified according to their biomechanical effects, components and potential value to their users. Orthoses are external aids that are often used to treat pain and diseases affecting the spine, lower or upper extremity (Dvorznak, Fitzpatrick, Karmarkar et al, 2006). The aim of orthotic treatment is to correct an existing deformity, to prevent progression according to the three-point pressure principle (by which two aligned forces oppose a single force placed at the area of deformity or angulation), to stabilize and immobilize weak or damaged body segments, to reduce the axial load on the affected sections of the body segments and to control motion (Zarghooni, Beyer, Siewe et al, 2013; Elattar, Smith, Ferguson et al, 2018). Therefore, orthotics serve many functions for people who have various disabilities.

Regular physical activity is a clearly proven health resource in rehabilitation and in the prevention of many diseases. Physical activity can help prevent cardiovascular disease, type II diabetes and obesity as well as other numerous physical and mental disorders (Bauman, 2004). The immobilization of a joint via the use of an orthosis, can bring about a sedentary behavior (Rickert, Grabowski, Gosheger et al, 2020). Therefore, determining the level of physical activity in this context may be potentially significant for individuals who use orthosis. In the literature, there are studies reporting that orthosis both improves physical activity levels and negatively affects physical activity levels in individuals using orthoses (Wang, Goel, Rahemi et al, 2019; Rickert, Grabowski, Gosheger et al, 2020). There is no consensus on this issue in the literature. Additionally, how physical activity levels are affected by the region where orthoses are used has not been shown.

To the best of our knowledge, no study has identified subgroups of patients who use orthoses and compared the level of physical activity to that of healthy individuals. Therefore, the aim of this study was to investigate the level of physical activity of individuals without pain and kinesiophobia who regularly use orthoses and compare the results with healthy individuals.

The hypothesis of this study is that using orthosis in individuals without pain and kinesiophobia affects physical activity level.

MATERIAL AND METHODS

Participants and Procedure

The study was conducted at Gazi University, department of physiotherapy and rehabilitation. The participants included in the study were 18-65 years old, were using an orthosis for an orthopedic situation of the; lower extremity, upper extremity or trunk and had no pain in the respective body region. The subjects were selected via convenience sampling. The participants included in the control group consisted of healthy subjects who; were 18-65 years old and did not use orthosis for any reason at all. All participants were native Turkish speakers and were literate in Turkish. Participants who had any neurological or systemic disorder that would interfere with the study were excluded from the study.

The Nordic Musculoskeletal Questionnaire (NMQ) was used to rule out pain. To make sure pain had no effect on the participants' level of physical activity, all patients completed the NMQ. Therefore, only participants who reported that they had no pain in the body region the orthosis was used, were included in the study. Furthermore, to ensure that participants had no limitation in physical activity due to kinesiophobia, all participants completed the Tampa Scale of Kinesiophobia (TSK). The flow chart of the study can be seen in Figure 1. The physical characteristics of the participants including age, height, weight, body mass index, gender, kinesiophobia according to TSK and level of physical activity according to International Physical Activity Questionnaire (IPAQ) were recorded for each participant.

The study was approved by the Ethical Committee of Gazi University with the approval number of 2021-80. The authors conformed to the ethical guidelines of the 1975 Declaration of Helsinki. Informed consents were obtained from participants before the study and the study was completed with 244 participants.

Tampa Scale of Kinesiophobia is a 17-item self-reporting questionnaire based on evaluation of fear of movement, fear of physical activity, and fear avoidance. The original TSK was first developed in 1991 by R. Miller et al., and was initially developed to distinguish between non-excessive fear and phobia in patients with chronic musculoskeletal pain, especially in patients with chronic low back pain (Miller, Kori, and Todd, 1991). The TSK has been used increasingly for pain related to different body parts including the cervical spine (Lundberg, Styf, and Jansson, 2009; Pool, Hiralal, Ostelo et al, 2009). The total score of the scale ranges from 17- 68, where 17 means the individual has no kinesiophobia, 68 means the individual has severe

kinesiophobia, and a score of ≥37 indicates that the individual has kinesiophobia. According to our inclusion criteria, the participants in the present study needed to have no kinesiophobia, therefore, only participants who had a TSK score of <37 were included in the study. Participants who had kinesiophobia were excluded. The Turkish version of the scale was used. The reliability of the Turkish version was demonstrated by Yilmaz et al (Yilmaz, Yakut, Uygur et al, 2011).

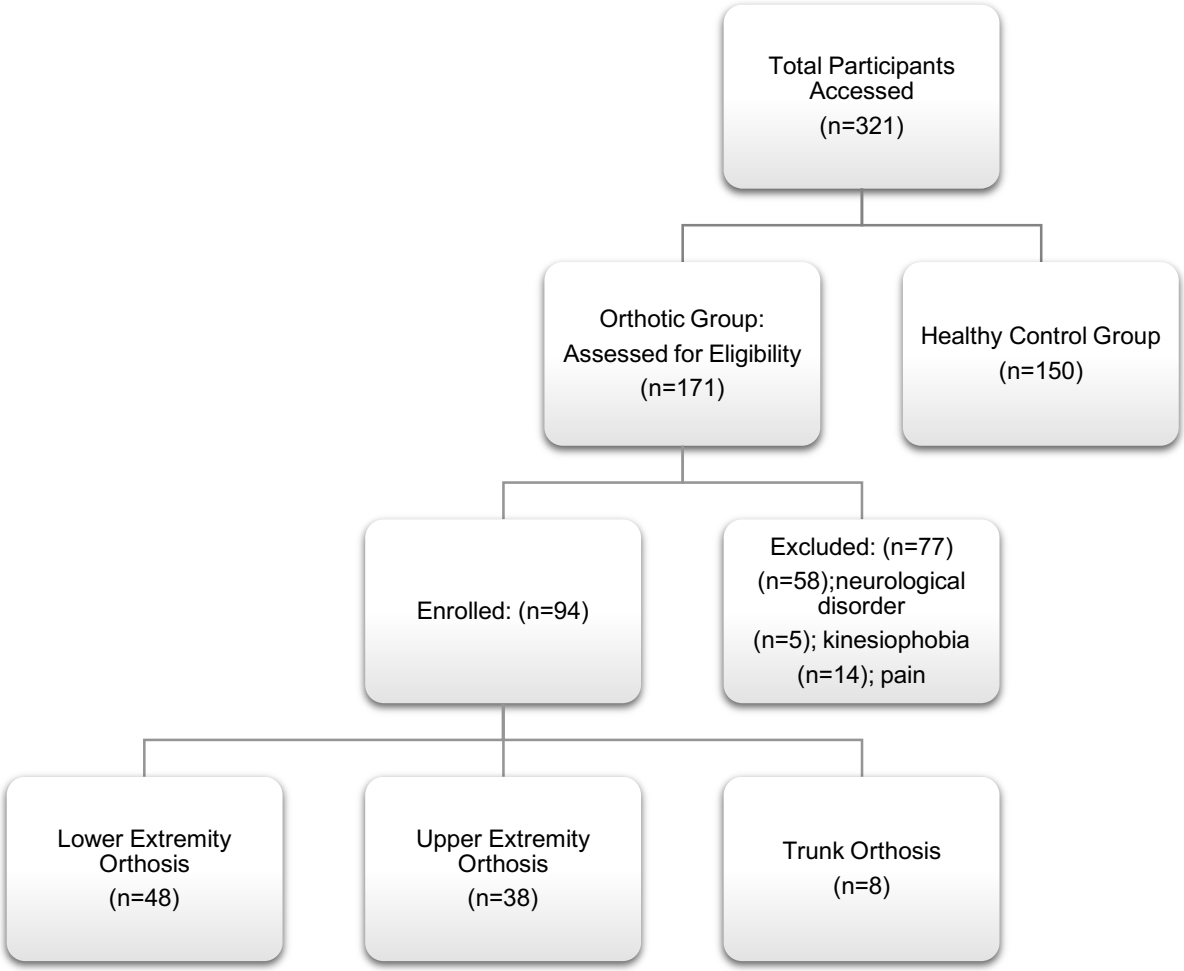

Figure 1. The flow chart of the study

The Nordic Musculoskeletal Questionnaire (NMQ) was developed from a project funded by the Nordic Council of Ministers (Kuorinka, Jonsson, Kilbom et al, 1987). The aim was to develop and test a standardized questionnaire methodology allowing comparison of musculoskeletal problems and pain among different body regions for use in epidemiological studies. It has been stated that the NMQ is suitable for application in studies that include large numbers of participants (Dickinson, Campion, Foster et al, 1992). The questionnaire includes 27 items investigating the presence of musculoskeletal symptoms during a 12-month period covering nine different parts of the body. It also has items pertaining to severity grades, determined according to functional status and the presence of musculoskeletal symptoms during the last 7 days. All answers are given according to a dichotomous 'yes/no' response (Kuorinka, Jonsson, Kilbom et al, 1987). In the present study,
the participants were included in the study according to the answers of NMQ. According to our inclusion criteria, the participants needed to have no pain in the body region the orthosis was used. Therefore, a 'no' response was required in the region where an orthosis was used. Participants who reported pain were not included in the study. The Turkish version of the form was applied in this study. The validity and reliability of the Turkish version of the form was shown by Kahraman et al (Kahraman, Genç, and Göz, 2016).

The International Physical Activity Questionnaire is a scale which measures health-related physical activity

(Craig, Marshall, Sjöström et al, 2003). IPAQ long form was preferred in the present study as it is more comprehensive. IPAQ long form covers four domains of physical activity: work-related, transportation, housework/gardening and leisure-time activity. In each of the four domains the time spent (per day) and number of days spent (per week) in both moderate and vigorous activity were recorded by each participant. To calculate the weekly physical activity, the number of hours dedicated to each activity dimension was multiplied by the specific MET (Metabolic Equivalent Task) for that activity. Walking time is assessed in the domains of work, transportation and in leisure time. Moderate intensity activity was defined as 3–6 MET and vigorous intensity activity was defined as >6 MET, according to the American College of Sports Medicine (Garber, Blissmer, Deschenes et al, 2011). The Turkish version of the form was used in this study. The validity and reliability of the Turkish version of the form was shown by Saglam et al (Saglam, Arikan, Savci et al, 2010).

Statistical Analysis

Statistical analyses of the study were carried out with "statistical package for social sciences" (SPSS) version 21.0 (SPSS INC., Chicago, IL, USA) software. Categorical variables were noted in frequency and percentage. The variables were investigated using visual (histogram and probability graphs) and analytical (Shapiro-Wilk test) methods. As physical activity levels measurements were not normally distributed the Kruskal-Wallis test were conducted to compare parameters. The Mann-Whitney U Test was performed to test the significance of pairwise differences using Bonferroni correction to adjust for multiple comparisons. The level of significance was set at $p< 0.05$.

RESULTS

A total of 244 participants were included in this study. The lower extremity group consisted of 48 individuals, the upper extremity group consisted of 38 individuals, the trunk orthosis group consisted of 8 individuals. In total, 94 individuals who use orthoses and 150 healthy individuals were included. The main characteristics of the study population in each group can be seen in Table 1. When the health-related physical activity (IPAQ) results were compared, it was seen that healthy individuals had a higher level of physical activity when compared to those who used orthotic devices for any part of their body (Table 2). When the subgroups of orthotic devices were compared, it could be seen that there was no statistically significant difference amongst the subgroups in terms of total IPAQ scores. Plot Graphs of IPAQ sub-scores amongst groups can be seen in Figure 2. The IPAQ scores of each subgroup and the healthy individuals can be seen in Table 3. Furthermore, it can be seen that statistically, individuals who used trunk orthosis spent more time in sitting when compared to individuals who used orthotic devices on any part of their body, and healthy individuals (Table 3).

Table 1. Characteristics of subjects

	Individuals Using Trunk Orthoses Median IQR	**Individuals Using Upper Extremity Orthoses Median IQR**	**Individuals Using Lower Extremity Orthoses Median IQR**	**Healthy Individuals**	**P Between Groups**
Age	35 18.75/59.25	45 36.50/51	29.50 22/48.50	32 27/44.50	0.041
Height	165.50 160.50/175.75	163.50 160/173	165 160/170	170 162/176	0.217
Weight	64.50 54.25/84.50	71 61.50/86.25	68 59/78	69.50 59/82	0.788

$p < 0.05$ with the groups changes between groups (Kruskal Wallis Test). ***IQR:*** *Interquartile range*

Table 2. Comparison of The International Physical Activity Questionnaire sub-scores amongst groups

IPAQ	Individuals Using Trunk Orthoses Median IQR	Individuals Using Upper Extremity Orthoses Median IQR	Individuals Using Lower Extremity Orthoses Median IQR	Healthy Individuals	P Between Groups
Vigorous	0 0/1200	**0** **0/350**	**0** **0/0**	120 0/1200	**0.010**
Moderate	690 165/1208	490 101/1620	660 180/1420	1020 360/2483	**0.039**
Walking	883 569/990	1007 540/2129	932 388/1411	1683 1188/3539	**<0.001**
Sitting	3570 2865/4662	3000 1920/4170	3690 2520/5085	2910 1800/4050	**0.031**
Total	2015 968/5226	2752 1080/4377	2151 1044/4080	4495 2591/7082	**<0.001**

p < 0.05 with the groups changes between groups (Kruskal Wallis Test). Asymptotic significants are displayed. ***IPAQ:*** *The International Physical Activity Questionnaire,* ***IQR:*** *Interquartile range*

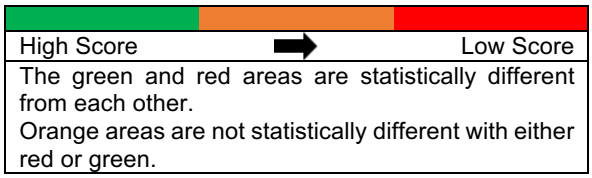

Table 3. Post-hoc analysis of The International Physical Activity Questionnaire sub-scores amongst groups

SAMPLE 1-SAMPLE 2	Vigorous Significant p	Moderate Significant p	Walking Significant p	Sitting Significant p	Total Significant p
Trunk Orthoses-Lower Extremity Orthoses	0.365	0.912	0.556	0.817	0.906
Trunk Orthoses - Upper Extremity Orthoses	0.490	0.805	0.309	0.404	0.819
Trunk Orthoses – Healthy Individuals	0.754	0.381	**0.003**	0.288	**0.021**
Lower Extremity Orthoses - Upper Extremity Orthoses	0.705	0.804	0.433	0.057	0.537
Lower Extremity Orthoses - Healthy Individuals	**0.003**	**0.030**	**<0.001**	**0.004**	**<0.001**
Upper Extremity Orthoses - Healthy Individuals	**0.026**	**0.023**	**<0.001**	0.737	**<0.001**

p < 0.05 with the groups changes between groups after post-hoc analysis. Each row tests the null hypothesis that

the Sample 1 and Sample 2 distributions are the same.

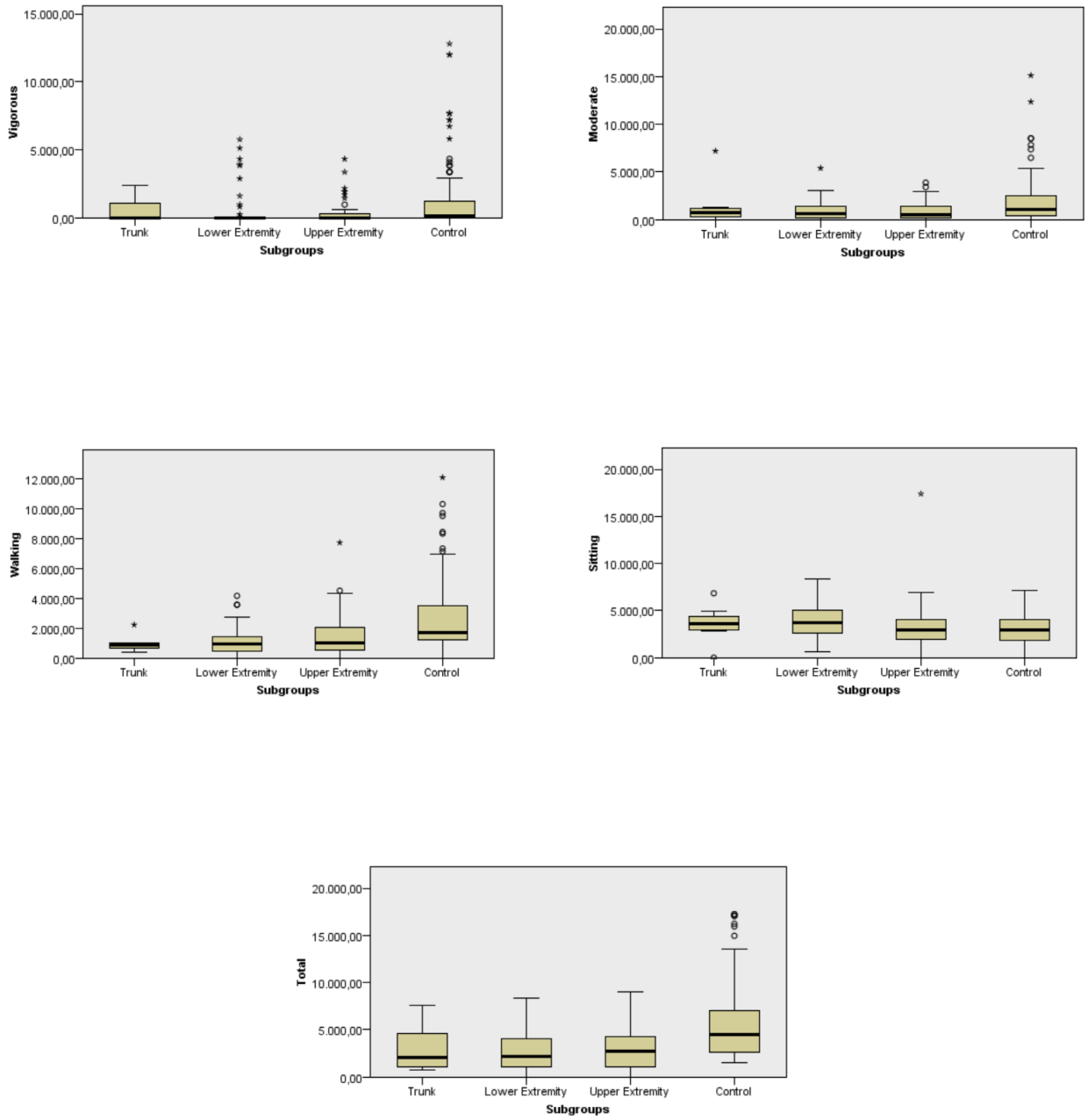

Figure 2. Box Plot Graphs of The International Physical Activity Questionnaire sub-scores amongst groups

DISCUSSION

This study was conducted to determine the level of physical activity of individuals who use orthoses regularly due to orthopedic problems. According to our knowledge, this study is the first to investigate the level of physical activity in individuals who use orthoses related to an orthopedic problem in the lower extremity, trunk or upper extremity segments and presents the results for each subgroup in comparison with healthy individuals. The results of the present

study have shown that the physical activity levels of individuals using orthosis are lower than healthy individuals in all of the subgroups. In addition, individuals using trunk orthoses spend more time sitting than those using orthoses on the other part of their body and healthy individuals. When the IPAQ scores of the subgroups were analyzed amongst groups, even though it was not statistically significant, the individuals using upper extremity orthosis had a higher level of physical activity when compared to the other orthosis using subgroups. When the subgroups were investigated, it was seen that the physical activity levels of individuals using upper extremity orthosis, including hand, elbow and shoulder orthosis, were found to be lower than healthy individuals. Supporting this result, proved that in individuals using shoulder immobilization orthosis, the use of the orthosis significantly led to the reduction of the activity level from moderate activity to low activity level according to the number of daily steps tracked with an activity monitor (Rickert, Grabowski, Gosheger et al, 2020). Although it is known that orthoses applied to the distal joints of the upper extremity will lead to compensatory effects on the proximal joints, it is predicted that immobilization of the proximal joints via orthoses will have a greater negative impact on the individuals' level of physical activity when compared to orthosis of the distal joints (Adams, Grosland, Murphy et al, 2003; Mell, Friedman, Hughes et al, 2006). Among the individuals evaluated in this study, 81% of the group using upper extremity orthosis consisted of patients using hand orthosis. This may be an important factor in explaining the higher level of physical activity of this group compared to other groups.

In our results, physical activity levels of individuals using lower extremity orthoses were found to be significantly lower than healthy individuals. In addition to this result, when the level of physical activity was compared amongst the groups, even though the results were not statistically significant, it can be seen that the lower extremity subgroup had lower IPAQ total scores than the upper extremity subgroup and higher IPAQ total scores than the trunk subgroup. We believe that this result may be related to the dominance of the lower extremities' role in parameters closely related to physical activity (walking, weight transfer, climbing up and down stairs etc.). Ankle and foot orthoses used in the lower extremities are highly effective and widely used in the treatment of both neurological diseases and various musculoskeletal disorders (Mills, Blanch, Chapman et al, 2010). There are a few studies in the literature that argue that lower extremity orthoses used due to neurological deficits improve the physical activity level of patients (Laufer, Hausdorff, and Ring, 2009; van Swigchem, Vloothuis, den Boer et al, 2010). Lower extremity orthoses used in the geriatric population provide a significant improvement in the level of physical activity by reducing the fear of falling associated with loss of balance (Wang, Goel, Rahemi et al, 2019). In their study, Dinkel et al. stated that the ankle foot orthoses used in individuals with peripheral arterial disease increased the level of physical activity (Dinkel, Hassan, Despiegelaere et al, 2020). The fact that our sample consists of individuals using orthoses due to orthopedic problems brings about a different perspective to the relationship between orthotic use and physical activity level. In orthoses used for orthopedic reasons, the pathomechanical corrective forces are adjusted to ensure joint alignment, support the muscles and reduce pain, as well as bringing about optimal weight and plantar pressure distribution in the foot (Collins, Bisset, McPoil et al, 2007; Telfer, Abbott, Steultjens et al, 2013). Studies have shown that using insoles or knee braces lead to improvements in the walking abilities of patients and improves their functional levels (Hsieh, and Lee, 2014; Priore, Lack, Garcia et al, 2020). It is expected that the improvement seen in these functions will indirectly contribute to the physical activity levels of individuals however when literature is examined, it can be seen that this is not the case. In their study which examined the effects of 6-week orthosis use on the physical activity level of individuals with knee osteoarthritis, Sliepen et al. reported that there was no significant improvement in the physical activity level (Sliepen, Mauricio, and Rosenbaum, 2018). Amer et al. advocated that the use of insoles in individuals with foot pain did not affect the physical activity level in the short term (Amer, Jarl, and Hermansson, 2014).

In our study, the physical activity levels of individuals who used trunk orthosis were found to be significantly lower than healthy individuals, furthermore, individuals using trunk orthosis spent more time in sitting when compared to the healthy individuals. Although long-term use of spinal orthoses is debated due to the potential complications that may arise, such as muscle weakness and joint contractures, the short-term use is known to decrease pain and improve function during the treatment period (Muzin, Isaac, Walker et al, 2008; Azadinia, Takamjani, Kamyab et al,

2017). The effective role of spinal orthoses in reducing pain arises from their ability to stabilize the spine and decrease motion, thus causing a limitation of function (Choo, and Chang, 2020). Cervical and lumbosacral spine orthoses are used especially for immobilization. Therefore, it is thought that these orthoses can significantly affect the level of physical activity as they notably restrict the movement of the treated part of the spine (Zarghooni, Beyer, Siewe et al, 2013). Scoliosis orthoses, on the other hand, cause a much more serious limitation in the trunk, since they primarily target the correction of the spine with their anti-rotation and traction effect and require a long usage time of 23 hours (Negrini, Grivas, Kotwicki et al, 2009). Therapists should guide individuals who use trunk orthosis to exercise therapy appropriate to their functional capacities that will contribute to their physical activity level. Additionally, due to the limitation it creates, the optimal duration of orthotic treatment in the spine should be determined correctly and the treatment course should be followed by clinicians.

This study has some limitations. Firstly, the physical activity levels of the individuals prior to orthosis use were not evaluated. Furthermore, our sample was not homogeneously distributed in number according to the type of orthosis used in the subgroups. Future studies must be conducted with equal numbers of individuals in each subgroup. Moreover, in the present study, physical activity was assessed using subjective self-reported questionnaires. Questionnaires are beneficial since they are inexpensive and easy to use in clinical studies. However, they may have some limitations such as recall bias that results in overestimation of physical activity and underestimation of sedentary activities (Sebastiao, Gobbi, Chodzko-Zajko et al, 2012; Wanner, Probst-Hensch, Kriemler et al, 2016). Thus, accelerometers which are more objective measures of physical activity should be used in future studies.

As a result, movement performance is indirectly affected if any of the components of the musculoskeletal system are immobilized with the use of an orthosis or splint. In addition to the clinical benefits of orthoses, a complication such as a significant decrease in physical activity in individuals should not be ignored by clinicians. Thus, creating awareness and improving physical activity levels of patients using orthoses should become a significant part of rehabilitation.

Author Contribution

Conceptualization: Fatmagul Varol; Study Design: Melek Volkan-Yazici; Data Acquisition: Fatmagul Varol; Data Analysis & Interpretation: Melek Volkan-Yazici; Literature Research: Melek Volkan-Yazici & Fatmagul Varol; Provision of Cases: Melek Volkan-Yazici & Fatmagul Varol; Provision of Equipment: Melek Volkan-Yazici & Fatmagul Varol; Writing-Original Draft: Melek Volkan-Yazici; Writing-Review & Editing: Fatmagul Varol; Critical Review: Melek Volkan-Yazici & Fatmagul Varol

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

The authors would like to thank Gokhan Yazici and Cagla Ozkul for their contributions to the study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Ethical approval was obtained from Gazi University Ethics Board with the approval number of: 2021-80.

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