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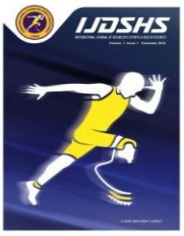

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RESEARCH ARTICLE

The Effect of Taekwondo Training on Children's Functional Movement Screen (FMS) Scores and Athletic Performance Parameters

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Abstract

Taekwondo sport has a significant risk of injury. This can be reduced with a pre-accession screening tool that can identify the risk of injury. The Functional Movement Screen (FMS®) is used as a reliable clinical tool to predict athletes' injury risk. The aim of this prospective, single-blind observational study is to investigate the effect of taekwondo on functional movement analysis (FMS®) scores, balance, strength and vertical jump in school-age children. The research was conducted on athletes aged 7-18 (n=30) who have been attending taekwondo training for at least one year (n=15) and who have just started this education (maximum 2 weeks) (n=15). The demographic data of the children (age, gender, bmi*) were recorded, and the evaluation of FMS, balance, strength and vertical jump was applied by an evaluator who did not know which group the children were in. Among the children included in the assessment, the mean age of the group that received taekwondo training was 10.33± 2.12 years, and the mean age of the group that had just started education was 11.73± 2.12 years. No significant difference was found between groups in FMS®, strength, balance and vertical jump measurements ($p>0.05$). As a result, taekwondo training alone in children is insufficient in reducing the risk of injury and improving physical fitness parameters. We think that it would be appropriate to give additional corrective exercises together with taekwondo training. Moreover, this result emphasized the importance of pre-participation screenings once again.

Keywords
Balance, Functional Movement Screen, Strength, Taekwondo, Vertical Jump

INTRODUCTION

The literal meaning of taekwondo is "tae" to hit with a foot, "kwon" means to hit with a hand or a fist, and "do" is about art. In other words, the meaning of taekwondo is expressed as the art of kick and punch (Lee and Kim, 2007). The physical and physiological demands of modern-day taekwondo competition require athletes to be competent in several aspects of fitness (Bridge et al., 2014). It is a kind of sport with a high risk of injury due to physical forces and contacts applied to the athlete (Kazemi et al., 2009). Although the risk of musculoskeletal conditions and injuries is multifactorial, preliminary evidence suggests that neuromuscular and strength training programs may be beneficial for preventing the occurrence of these conditions (Teyhen et al., 2012).

The studies on the effects of sports throughout the growth period have not produced definitive results yet. In sports science, studies in the field of children and sports continue intensively (Top et al., 2018). Previous researches have reported the effects of Taekwondo training on children's physical fitness (Nam and Lim, 2019; Won, 2017). There is no conclusive evidence in the literature that taekwondo practice can improve anaerobic fitness or muscle strength. However, taekwondo training may have some benefits in

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aerobic capacity, body composition (fat loss) and flexibility (Fong and Ng, 2011).

Studies investigating the effects of taekwondo sport on children's physical fitness and injury risks are insufficient in the literature. Main hypothesis of this study is; there is a difference between FMS scores of the participants. The aim of this study is to investigate the effect of taekwondo training on children's injury risk, functional sufficiency and physical fitness such as strength, balance and vertical jump.

METHOD

The study was designed as a prospective, single-blind, observational study with the approval of the University of Health Sciences Scientific Research Ethics Committee (21/172). Children between 7-15 years of age who have been attending taekwondo training for at least 1 year (n = 15) and who have just started this education (less than 2 weeks) (n = 15) were included in the study. Children with any injuries affecting the musculoskeletal system in the last 6 months were excluded from the study. The voluntary consent form was taken from both the parent and the child. Demographic information (age, gender, height, weight) of the children was recorded. The tests were administered by an evaluator who did not know which group the children were in.

Functional Movement Screen (FMS)

Injury risk analysis and functional status of the participants was performed with FMS. The FMS attempts to address multiple movement factors, with the goal of predicting general risk of musculoskeletal conditions and injuries. This system is designed to identify functional movement deficiencies and asymmetries that predict general musculoskeletal disorders and injuries, and its purpose is to be able to modify the movement defects identified through a personalized exercise prescription (Teyhen et al., 2012).

FMS® is a screening tool used to simultaneously evaluate multiple functional areas (balance, strength, range of motion) and increase the accuracy of risk identification in athletes. The subtests of FMS are deep squat, in-line lunge, hurdle step, shoulder mobility, trunk stability push up, active straight leg raise and rotary trunk stability. Each test is scored on a ranking scale of 0–3 to produce a composite score out of 21, with higher scores indicating better movement (Cook et al., 2014).

Strength Assessment

Grip strength was measured with a hand dynamometer (JLW Instruments, Chicago, USA) in order to have an idea about the general muscle strength of the participants (Wind et. Al, 2010). Participants grasped the dynamometer with full force with their dominant hand, the arm on the side of the body and the elbow at 90 degrees of flexion. Measurements were sequentially performed three times. The average of these measurements was recorded.

Balance Assessment

Participants' balance assessment was performed using the Y Balance Test (Linek et al, 2017). Before this test was performed, a device consisting of tape measure fixed to the ground in a straight line in medial, superolateral and inferolateral directions with an angle of 120-120-120 degrees in between was made with the help of goniometer (Cramer et al., 2017). Subjects stood on one leg (bare feet) in the center of the Y balance test setup, while the free side toe tip extended in medial, inferolateral, and superolateral directions. Children were asked to reach the furthest point they could reach and return to their former position and the distance they could reach was measured in cm (Linek et al., 2017; Westrick, 2012).

Vertical Jump

Vertical Jump Test was performed using Jump Meter (Takei Scientific Instruments Co., Ltd). Participants jumped as high as they could on sensitive ground, and the distance they jumped was determined in centimeters on the device. The best score of the athletes after jumping 2 times was recorded as the vertical jump value.

Statistical Analysis

IBM SPSS Statistics for Windows (Version 21.0. Armonk, NY: IBM Corporation) is used for analysis. Demographic data and FMS scores of the participants are shown via mean and standard deviations. One-Sample Kolmogorov Smirnov test was used to analyse the normality of the data. According to the results of this test, Mann-Whitney U test was used to investigate the differences between groups.

RESULTS

The demographic data of the participants are presented in Table 1. There was no statistical difference was found between groups in all parameters($p>0.05$) Functional Movement Scores of the participants are shown in table 2. There was asymmettries in both groups' Hurdle Step, Shoulder Mobility, Active Leg Raise subtests.

Group comparisons of FMS are shown in Table 3. There was no statistical difference between two groups ($p>0.05$)

Group comparisons of Y Balance Test, Vertical Jump Test and Hand Grip Strength evaluation are shown in Table 4. There was no statistical difference between two groups ($p>0.05$)

Table 1. Demographic data of the participants

Personal characteristics (n=30)	Group I (n=15)	Group II (n=15)
Gender (n)	4 female, 11 male	9 female, 6 male
Age (mean, ±)	10.33± 2.12	11.73± 2.12
Height (mean, ±)	1.36± 0.09	1.41± 0.04
Weight (mean, ±)	33.8± 8.16	39.8± 4.32
Body Mass Index (mean, ±)	18.03± 2.67	19.92± 1.39

Note: Group I: Taekwondo Group, Group II: New Beginners

Table 2. Mean functional movement screen scores of the individuals

FMS Parameters	Group I		Group II	
	Left	Right	Left	Right
Deep Squat	1.53		1,33	
Hurdle Step	1.53	1.6	1.66	1.8
In Line Lunge	1.2	1.2	1.4	1.4
Shoulder Mobility	2.2	2.4	2.33	2.6
Active Leg Raise	2.2	2.4	2.33	2.53
Trunk Stability Push-Up	1.13		1.4	
Rotary Stability	1.86	1.86	1.8	1.8
FMS TOTAL SCORE	11.33		12.26	

Note: FMS: Functional Movement Screen, Group I: Taekwondo Group, Group II: New Beginners

Table 3. Group comparisons of FMS scores

Parameters	Left		Right	
	Z	p	Z	p
Deep Squat	Z=-1.87 p= 0.227			
Hurdle Step	-650	0.515	-993	0.321
In Line Lunge	-1.175	0.240	-1.175	0.240
Shoulder Mobility	-472	0.637	-486	0.627
Active Leg Raise	-672	0.502	-519	0.604
Trunk Stability Push-Up	Z=-1.624 P= 0.104			
Rotary Stability	-482	0.630	-482	0.630
FMS TOTAL SCORE	Z=-1155 p= 248			

FMS: Functional Movement Screen

Table 4. Group comparisons of Y balance, vertical jump tests and hand dynamometer results

Parameters	Left		Right	
	Z	p	Z	p
Y Balance Posterolateral	-437	0.662	-083	0.934
Y Balance Posteromedial	-1308	0.191	-1560	0.119
Y Balance Anterior	-1018	0.309	-810	0.419
Y Balance Composite Score	-124	0.901	-332	0.740
Grip Strength	-1390	0.165	-601	0.548
Vertical Jump Test Score (Time)	Z= - 353 p= 0.724			
Vertical Jump Test Score (Height)	Z= - 353 p= 0.724			

Note: Mann Whitney U Test

DISCUSSION

Our study aimed to compare the results of functional movement analysis, strength, balance and vertical jump tests of children who received taekwondo training at least one year and have just started taekwondo training. According to the results of our study, there was no significant difference in FMS Scores, Y Balance Test, Grip Strength and Vertical Jump Test scores between two groups.

Numerous studies have shown a high injury rate in beginner taekwondo athletes (Lystad, 2009; Schlüter-Brust, 2011). It has also been stated that taekwondo athletes can be injured due to their musculoskeletal tissue strength and training method (Schlüter-Brust, 2011). There are studies in which injury risks of young taekwondo athletes (aged between 19 and 27 years) have been evaluated with FMS® (Razi, 2016). However, there is no study in the literature evaluating the risk of injury in children with FMS®. In our study, we also aimed to investigate whether the standard training program of taekwondo has a corrective effect for FMS®.

It has been stated in the literature that there is no difference between the FMS scores of beginner and experienced taekwondo players (Razi, 2016). Similarly, we determined that the risk of injury in children who have been attending taekwondo for at least one year is not different from those who have just started. This result suggests that taekwondo training should be done together with corrective exercises.There are studies in the literature stating that grip strength reflects general muscle strength (Wind et al., 2010). For this reason, we evaluated grip strength, which is a practical test, to get an idea of overall muscle strength.

Taekwondo athletes need muscular strength and endurance to effectively perform and sustain technical and tactical actions in a match (Bridge et al., 2014). Nevertheless, when the literature is reviewed, it appears that there is no conclusive evidence that taekwondo practice can improve anaerobic fitness or muscle strength (Fong and Ng, 2011). Heller et al. (1998) stated that arm flexion, knee extension, hand grip and explosive leg strength in elite taekwondo athletes were above the "norm" in both genders (Heller et al., 1998). For recreational taekwondo athletes, Toskovic et al. (2004) compared muscle strength between black belt practitioners and beginners and found that black belt practitioners had more power in the lower body than beginners, regardless of gender (Toskovic et al, 2004). Thompson and Vinueza (1991) stated that taekwondo training has no effect on force (Thompson and Vinueza, 1991).

Shirley et al. (2013), in their randomized controlled study, stated that taekwondo training increased isokinetic knee muscle strength in children with developmental coordination disorder, but had no effect on balance (Fong et al., 2013). In another study designed similarly to our study, they stated that taekwondo players with an average age of about 11 years had better muscle strength and vertical jump height compared to the control group with a similar average age (Jlid et al., 2016). However, we could not find any difference between the groups in terms of strength, balance and vertical jump height in our study.

We observed the effect of taekwondo training on strength in studies evaluating local muscle strength, and this effect is mostly on the

lower extremity. Taekwondo is characterized by fast and high strokes that require good flexibility and strength. The muscles of the lower limbs are crucial in explosive kicking, jumping and maintaining postures. It is reasonable to assume that taekwondo athletes can gain muscle strength through such bodyweight resistance exercises (Fong and Ng, 2011). The lack of effect on grip strength, which we evaluated in this study to get an idea of general muscle strength, may prove that taekwondo increases local muscle strength rather than general. However, the results of studies showing the effect of taekwondo on balance and vertical jump are similar to our results.

CONCLUSION

We determined that taekwondo training in children has no effect on FMS scores, which indicates the risk of injury, and these children have a high risk of injury. We think that combining taekwondo training with corrective exercises may reduce injury risks for children who participate this training. Secondly, taekwondo training should be arranged in a way to increase physical fitness parameters such as strength, balance and vertical jump in children. Limitations of this study were, low count of participants and absence of an isokinetic assessment of muscle strength.

Conflict of interest: The authors declare no conflict of interest. No financial support was received.

Ethics Statement

The studies involving human participants were reviewed and approved by the University of Health Sciences Scientific Research Ethics Committee (Date: 12.02.2021; Decision / Protocol number: 21/172). Written informed consent to participate in this study was provided by the patients/participants.

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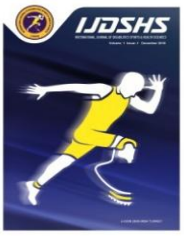

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RESEARCH ARTICLE

Examination of Elite Physically Disabled Athletes' Motivation Levels of Participation in Sports

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Abstract

Determining which motivation source athletes have is important as it will ensure that correct and effective steps are taken to ensure success. The study focuses on examining the motivation of elite physically disabled athletes to participate in sports according to various variables. General survey model was used in the research. A total of 57 national athletes, including 16 arm wrestling, 13 swimming and 23 wheeled basketball athletes, participated in the study. The "Personal Information Form" developed by the researchers and the "Motivation of Participation in Sports for Persons with Disabilities Scale (MPSPDS)" developed by Demir et al. (2018) were used in the study. In the analysis of the data, besides descriptive statistics, Mann-Whitney U Test was used for paired comparisons and Kruskal Wallis H Test for multiple comparisons. In the findings obtained, it was found that there was a significant difference in motivation sources according to the variable of income and the second branch, but no significant difference was found according to the variables of gender, marital status, education level, branch, and time of disability. As a result, it was concluded that the physically disabled elite athletes, those who define their income level as medium in intrinsic and extrinsic motivations and those who have a secondary branch, have high motivation and show different characteristics from each other and cause them to be affected by different motivation sources.

Keywords
Motivation, Physically Disabled, Sports, National Athlete, Participation in Sports

INTRODUCTION

Motivation is a term used to describe a person's behavior, desires and needs, and is defined as the sincere and willing fulfillment of what is to be done to achieve something. Motivation, which enables the individual to be emotionally satisfied while mobilizing for his/her goals, is a phenomenon that directs the individual to work, prod him/her into action and arouses desire in this regard (Wigfield & Cambria 2010; Clancy, 2016). In other words, as well as being a general concept that includes wishes, desires, needs, impulses, interests, motivation gives energy and direction to behavior (Cüceloğlu, 1999; Aydın, 2001; Ergül, 2005). The concept of motivation is at the center of many social psychological theories that aim to explain behavior (Hagger &

Chatzisarantis, 2007). Sport is one of these areas. Sport enables it to appeal to large masses both individually and socially. When it is done at higher levels, besides a certain economic return to individuals, it is known that it has positive effects on both physical and psychological health of

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individuals (McAllister & et al., 2001; Donaldson & Ronan, 2006; Snyder et al., 2010). This overarching feature of sport has a significant impact on both handicapped and non-handicapped athletes.

Although the success of athletes depends on many factors, motivation is considered among the most important factors (Başer, 1985; Soyer et al., 2010; Aktop, 2002). The fact that sports includes many different branches and disciplines makes it inevitable for people to differentiate their motivation to participate in sports. Some individuals participate in sports for reasons such as rivalry, struggle, competition, while others participate in sports for reasons such as enjoyment, socialization, health or leisure time (Robert et al., 1999; Doty, 2006; Sukys, 2019). Social and psychological needs that encourage the person to sport are needs such as being active, self-discovery, self-expression, self-assertion, self-knowledge, prestige, showing superiority, desire to dominate, enthusiasm for adventure, and dominance in decision-making process (Hosseinalipour, 2015). Determining these needs plays an active role in achieving the participation, sustainability and success of individuals with the right motivation techniques. There are many theoretical approaches in the literature on the subject of motivation in sports. However, it is seen that the social and cognitive perspective has dominated research in recent years (Spray et al., 2006; Calvo et al., 2010; Batista et al., 2019; Murphy & Carbone, 2008). "Self-Determination Theory", which is one of these perspectives and which forms the theoretical framework of our study, developed by Deci and Ryan (1985), is the most frequently used of these. According to the self-determination theory, the drives that cause us to be engaged in various activities display a multidimensional structure and are divided into three types of behavioral regulation associated with varying degrees of self-determining motivation. The first form is intrinsic motivation, which refers to situations in which individuals freely participate in activities that they find interesting and enjoyable and that provide opportunities for learning. Internally motivated people engage in certain activities for the pleasure, fun, and satisfaction inherent in their participation. The second type of motivation is the extrinsic motivation that individuals engage in activities because they value results. Such results include external rewards and appreciation and praise of the environment or society. The third category of motivation is amotivation, a psychological state in which people lack either a sense of competence or a sense of control in achieving the desired result (Deci & Ryan, 2000). In other words, people cannot regulate themselves according to their behavior (Ntoumanis et al., 2004). In this situation, the person does not feel in control (Deci & Ryan, 2000). It is emphasized that the basis of the self-determination theory are active organisms which have a consistent personality and competence, tendencies for psychological development and strive to integrate their lives and overcome existing obstacles (Deci & Ryan, 2002). This state of activity does not matter in terms of whether individuals are normally developing individuals or disabled individuals (McLoughlin, 2017).

The effects of sports on the developmental areas of individuals with disabilities as well as individuals with normal development have been supported by many studies (Çevik & Kabasakal, 2013; Brittain, 2004; Limoochi, 2020; Jaarsma, 2019). Supporting the participation of persons with disabilities in sports is important for these individuals in terms of equal opportunity and full participation. The term "participation" is defined by the World Health Organization as the nature and extent of a person's participation in life situations and includes self-care, mobility, socialization, education, recreation and community life activities. Participation in activities is a situation where people establish friendships, develop their skills and competencies, express their creativity, gain mental and physical health, and determine their purpose in life (Law et al., 2006). In studies conducted on factors affecting sports participation, it is seen that the factors that ensure participation in sports for people without disabilities and physically disabled people are very similar: Enjoyment, motivation, health benefits and social aspects were mentioned in both groups (Wu & Williams, 2001; Shihui et al. , 2007; Kehn & Kroll, 2009). However, it has been concluded in the studies conducted that personal factors such as motivation and health are more important in participation in sports compared to environmental factors (Saebu & Sorensen, 2011). In a study conducted on Paralympic athletes, they reported that participation in sports is not only due to effort, but also depends on external factors such as a wheelchair (Pensgaard et al., 1999). People with

disabilities do not always have the same opportunities to participate in sports activities as individuals without disabilities (Kasser & Lytle, 2005; Jaarsma et al., 2014). In order to provide these opportunities, it is necessary to remove the obstacles against these individuals, direct them to sports and increase their motivation levels (Aycan & Yıldız, 2016, Yaşar-Sönmez, 2018; Yılmaz, 2019). Studies that adopt social model approaches for disability and sport have provided scientifically based evidence of obstacles to sports participation across different types of disability (Devas, 2003; Tregaskis, 2003). Obstacles such as lack of motivation, lack of energy and sports background against the participation of disabled individuals in sports have been reported as personal obstacles to participation in sports (Speet-Schijndel, 2014; Rimmer et al., 2000; Lieberman & MacVicar, 2003). In addition, there are social (Mahy et al., 2010; Saebu & Sorensen, 2011; Shields & Synnot, 2016), environmental (Jaarsma et al., 2014; Speet-Schijndel, 2014; Bodde & Seo, 2009) obstacles. Lack of motivation among these obstacles is another important factor (Ayan & Ergin, 2017). As a matter of fact, it has been stated in the studies that disabled and non-disabled people have similar motives in factors such as improving their sports skills, achieving goals, enjoying competitions, being a part of a team, having fun and achieving success (Farrell et al., 2004; Shapiro, 2003). Lack of sports facilities (Tasiemski et al., 2004; Stroud et al., 2009) as well as difficulties related to accessibility (Kinne, 1999; Tasiemski et al., 2004) and transportation (Rimmer et al., 2008) were reported by physically handicapped adults among the factors that prevent participation in sports (Tasiemski et al., 2004; Rimmer et al., 2008). In order to better understand the limitations experienced by disabled people and to remove the obstacles, in supporting participation in sports, government policies, educators and families should use the sources of motivation of the individuals with disabilities to participate in sports in the most efficient way. In this way, the integration of disabled people with the society, equality of opportunity, full participation, independent life and self-realization will be ensured. Studies have reported that the intrinsic and extrinsic motivation levels of individuals with disabilities who are engaged in sports are higher than those who do not engage in sports (Abdullah et al., 2017; Cadete, 2021; Huang, 2018; Demir & İlhan, 2020).

For this reason, it is thought that it is important to investigate the sources of motivation and produce solutions for physically disabled individuals to participate in sports. In addition, it is thought that conducting the study on elite handicapped athletes will contribute to both families and children with disabilities and the field of sports sciences. For this purpose, the study focused on examining the motivation of elite physically handicapped athletes to participate in sports, and the answers to the following variables were sought.

Are there any significant differences in elite physically handicapped athletes' motivations to participate in sports in terms of variables such as gender, marital status, education level, branch, income, a second branch, time of disability and working status at a second job?

MATERIALS AND METHODS

This research was designed with survey model, which is one of the quantitative research methods. Survey model is a study that aims to collect data by using interviews or questionnaires in order to determine the specific characteristics of a group, to identify their views or characteristics such as interests, skills, abilities, attitudes, etc. (57). For the study, the permission of the ethics committee of Muş Alparslan University, 13.10.2020, E-10879717-050.01.04-11831 was obtained.

Study Group

Participants of the study consist of 57 national athletes, 16 arm wrestling, 13 swimming, 23 wheeled basketball athletes who do sports at physically disabled national team level, who voluntarily agreed to participate in the study. While choosing the sample group, the groups that we can reach were selected and the convenience sampling method was used. Ethics committee report of Muş Alparslan University, Date and Number of Documents: 13.10.2020-11765 was received for the study.

Table 1: Statistical distribution of experiment and elite athletes according to their demographic features

Gender	N	%	Educational status	N	%
1. Female	9	15.8	1. High school and lower	31	54.4
2. Male	48	84.2	2. University and higher	26	45.6
Total	*57*	*100.0*	*Total*	*57*	*100.0*
Marital status			Branch		
1. Married	14	24.6	1. Arm wrestling	16	28.1
2. Single	43	75.4	2. Swimming	13	22.8
Total	*57*	*100.0*	3. Basketball	28	49.1
			Total	*57*	*100.0*
Second branch			Working status at a second job		
1. Yes	17	29.8	1. Yes	16	28.1
2. No	40	70.2	2. No	41	71.9
Total	*57*	*100.0*	*Total*	*57*	*100.0*
Income			Time of Disability		
1. Low	12	21.1	1. Before Birth	18	31.6
2. Middle	44	77.2	2. During Birth	17	29.8
3. High	1	1.8	3. After Birth	22	38.6
Total	*57*	*100.0*	*Total*	*57*	*100.0*

When Table 1 is examined, it is seen that 15.8% of the participants are female and 84.2% are male elite disabled athletes. Findings regarding the educational status of elite disabled athletes show that 54.4% graduated from high school or lower education programs, and 45.6% graduated from university and higher education programs. According to the marital status variable, the distribution was 24.6% as married athletes and 75.4% as single athletes. According to the branch variable, 28.1% of the athletes compete in arm wrestling, 22.8% in swimming and 49.1% in basketball. While 29.8% of the athletes are competitors in a second sports branch, 70.2% of them are not competitors in a second sports branch. While 28.1% of the athletes work at a second job, 71.9% do not engage in any second job. When the income status of the athletes was examined, it was determined that 21.1% had low income, 77.2% had medium income and 1.8% had a high level of income. It was determined that 31.6% of the disability of athletes occurred before birth, 29.8% during birth, and 38.6% after birth.

Data Collection Tools

A personal information form created by the researchers and the "Motivation of Participation in Sports for People with Disabilities Scale (MPSPDS)" developed by Demir et al. (2018) were used to collect the data. The motivation levels of the participants were examined in terms of gender, marital status, education level, branch, income, a second branch, the time of the disability and the working status at a second job.

Motivation of Participation in Sports for People with Disabilities Scale (MPSPDS)

The Motivation of Participation in Sports for People with Disabilities Scale is a valid and reliable scale developed to determine the motivation sources of physical, hearing and visually impaired individuals to participate in sports. The scale consists of 22 items and 3 sub-dimensions. The sub-dimensions of the scale are "Intrinsic Motivation", "Extrinsic Motivation" and "Amotivation". To test the reliability of the developed scale, the Cronbach Alpha internal consistency coefficient was calculated, and it was reported that the internal consistency coefficient was 0.98 in the overall scale, 0.94 in the intrinsic motivation sub-dimension, 0.84 in the extrinsic motivation sub-dimension, and 0.88 in the amotivation sub-dimension (58).

Data Analysis

SPSS 23 program was used in the analysis of the research data. Arithmetic mean, standard deviation, frequency/percentage, normal distribution test (Kolmogorov, Shapiro-Wilks Test) was performed and it was determined that the data were not normally distributed ($p < 0.05$).

In addition to descriptive statistics, Mann-Whitney U Test was used for paired comparisons and Kruskal Wallis H Test for multiple comparisons.

RESULTS

Table 2: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to gender variable

Dependent Variables	Gender	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	Female	9	35.11	316.00	161.000	.227
	Male	48	27.85	1337.00		
Extrinsic Motivation	Female	9	37.28	335.50	141.500	.102
	Male	48	27.45	1317.50		
Amotivation	Female	9	27.06	243.50	198.500	.698
	Male	48	29.39	1409.50		

As a result of the analysis, no statistically significant difference was found between the gender variable and intrinsic motivation (U=161.000, p>0.05), extrinsic motivation (U=141.500, p> 0.05) and amotivation (U=198.500, p> 0.05) sub-dimensions (Table 2).

Table 3: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to the educational status variable

Dependent Variables	Educational Status	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	1. High school and lower	31	28.11	871.50	375.500	.659
	2. University and higher	26	30.06	781.50		
Extrinsic Motivation	1. High school and lower	31	28.26	876.00	380.000	.712
	2. University and higher	26	29.88	777.00		
Amotivation	1. High school and lower	31	27.39	849.00	353.000	.417
	2. University and higher	26	30.92	804.00		

As a result of the Mann-Whitney U test conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes to participate in sports according to the educational status variable, no statistically significant difference was found between the educational status variable and the intrinsic motivation (U=375.500, p> 0.05), extrinsic motivation (U=380.000, p> 0.05) and amotivation (U=353.000, p> 0.05) sub-dimensions (Table 3).

Table 4: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to the marital status variable

Dependent Variables	Marital Status	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	1. Married	14	28.36	397.00	292.000	.867
	2. Single	43	29.21	1256.00		
Extrinsic Motivation	1. Married	14	25.75	360.50	255.500	.397
	2. Single	43	30.06	1292.50		
Amotivation	1. Married	14	30.64	429.00	278.000	.666
	2. Single	43	28.47	1224.00		

As a result of the Mann-Whitney U test conducted to test whether there is a significant difference between the motivation of elite disabled athletes participation in sports according to the marital status variable, no statistically significant difference was found between the marital status variable and intrinsic motivation (U=292.000, p>0.05), extrinsic motivation (U=255.500, p>0.05) and amotivation (U=278.000, p>0.05) sub-dimensions (Table 4).

Table 5: Variance analysis results of elite disabled athletes' motivation levels to participate in sports according to the branch variable

Dependent Variables	Branch	N	Mean Rank	sd	χ2	p
Intrinsic Motivation	1. Arm Wrestling	16	32.91			
	2. Swimming	13	31.46	2	2.343	.310
	3. Basketball	28	25.63			
Extrinsic Motivation	1. Arm Wrestling	16	29.41			
	2. Swimming	13	36.42	2	4.010	.135
	3. Basketball	28	25.32			
Amotivation	1. Arm Wrestling	16	27.38			
	2. Swimming	13	33.31	2	1.178	.555
	3. Basketball	28	27.93			

As a result of the Kruskal Wallis H test conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes to participate in sports according to the branch variable, no statistically significant difference was found between the branch variable and its sub-dimensions of intrinsic motivation $\chi 2$ (sd=2, n=57) = 2.343, p>0.05), extrinsic motivation $\chi 2$ (sd=2, n=57) = 4.010, p>0.05) and amotivation $\chi 2$ (sd=2, n=57) = 1.178, p>0.05) (Table 5).

Table 6: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to the second branch variable

Dependent Variables	Second Branch	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	1. Yes	17	38.29	651.00	182.000	**.006***
	2. No	40	25.05	1002.00		
Extrinsic Motivation	1. Yes	17	36.15	614.50	218.500	**.034***
	2. No	40	25.96	1038.50		
Amotivation	1. Yes	17	29.26	497.50	335.500	.937
	2. No	40	28.89	1155.50		

The Mann-Whitney U test was conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes for participation in sports according to the second branch variable. As a result of the analysis, a statistically significant difference was found between the second branch variable and the intrinsic motivation (U = 182.000, p <0.05) and extrinsic motivation (U = 218.500, p <0.05) sub-dimensions. It was determined that this significance was in favor of those who said yes at the mean rank level in the intrinsic and extrinsic motivation sub-dimensions. However, no statistically significant difference was found between the second branch variable and the amotivation (U = 335.500, p> 0.05) sub-dimension (Table 6).

Table 7: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to the perceived income variable

Dependent Variables	Income	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	Low	12	13.54	162.50	84.500	**.001**
	Middle	44	32.58	1433.50		
Extrinsic Motivation	Low	12	16.21	194.50	116.50	**.003**
	Middle	44	31.85	1401.50		
Amotivation	Low	12	29.67	356.00	250.00	.777
	Middle	44	28.18	1240.00		

Mann-Whitney U test was conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes to participate in sports according to the perceived income variable. As a result of the analysis, while a statistically significant difference was found between the income variable and sub-dimensions of intrinsic motivation (U = 84.500, p <0.05) and extrinsic motivation (U = 116.500, p <0.05), no significant difference was found between the income variable and amotivation (U = 250.000, p> 0.05) (Table 7).

Table 8: Analysis results of the motivation levels of elite disabled athletes to participate in sports according to the variable of working status at a second job

Dependent Variables	WSSJ	N	Mean Rank	Total Rank	U	p
Intrinsic Motivation	1. Yes	16	32.72	523.50	268.500	.289
	2. No	41	27.55	1129.50		
Extrinsic Motivation	1. Yes	16	29.63	474.00	318.000	.859
	2. No	41	28.76	1179.00		
Amotivation	1. Yes	16	30.81	493.00	299.000	.602
	2. No	41	28.29	1160.00		

Mann-Whitney U test was conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes to participate in sports according to the variable of working status at a second job. As a result of the analysis, no statistically significant difference was found between the variable of working status at a second job and sub-dimensions of intrinsic motivation (U = 268.500, p> 0.05), extrinsic motivation (U = 318.000, p> 0.05) and amotivation (U = 299.000, p> 0.05) (Table 8).

Table 9: Variance analysis results of the motivation levels of elite disabled athletes to participate in sports according to the time of disability variable

Dependent Variables	Time of Disability	N	Mean Rank	sd	χ2	p
Intrinsic Motivation	1. Before Birth	18	29.86			
	2. During Birth	17	28.82	2	0.077	.962
	3. After Birth	22	28.43			
Extrinsic Motivation	1. Before Birth	18	34.11			
	2. During Birth	17	29.59	2	3.466	.177
	3. After Birth	22	24.36			
Amotivation	1. Before Birth	18	32.58			
	2. During Birth	17	28.94	2	1.547	.462
	3. After Birth	22	26.11			

As a result of the Kruskal Wallis H test conducted to test whether there is a significant difference between the motivation levels of elite disabled athletes to participate in sports according to the time of disability variable, no statistically significant difference was found between the time of disability variable and sub-dimensions of intrinsic motivation $\chi 2$ (df = 2, n = 57) = 0.077, p>

0.05), extrinsic motivation $\chi 2$ (df = 2, n = 57) = 3.466, p> 0.05) and amotivation $\chi 2$ (sd = 2, n = 57) = 1.547, p> 0.05) (Table 9).

DISCUSSION AND CONCLUSION

Sport is universal and unites individuals on a common denominator. In this direction, the study aimed to examine the motivation of elite physically handicapped athletes to participate in sports according to various variables.

It was determined that there was no statistically significant difference in all sub-dimensions between the gender variable and the motivation level of participation in sports of the elite physically handicapped athletes discussed in the study. It can be said that the gender variable is not effective in terms of motivation to participate in sports. here are studies that found results contrary to our study. Demir and İlhan (2019), Kaman et al. (2017), Oyar et al. (2001) and McCallister (1999) stated in their studies that female athletes were more willing to participate in sports than male athletes. In the amotivation sub-dimension, it is seen that the mean rank of elite handicapped male athletes is higher than the mean rank of elite handicapped female athletes. In studies, it is stated that amotivation is caused by not feeling sufficient or not believing that it will give the desired result (Deci & Ryan, 2000; Seligman, 1975).

There was no statistically significant difference between the education status variable and elite handicapped athletes' motivation for participation in sports. Looking at the mean rank, it was determined that the mean rank of the elite handicapped athletes who graduated from a university or higher education program was higher than the mean rank of the elite handicapped athletes who graduated from a high school or less education program (Table 3). It is stated that the level of education is important in terms of motivation as it increases individual awareness and expectation (Aygün & Yetim, 2017). Meriç and Turay (2012) support our findings in their study. Accordingly, it can be said that the increase in the level of education has an effect on motivation sources.

No statistically significant difference was found between the marital status variable and the motivation level of participation in sports of elite handicapped athletes. Looking at the mean rank, it is seen that married elite handicapped athletes have higher mean rank in the amotivation sub-dimension. In the intrinsic and extrinsic motivation sub-dimensions, it was determined that single elite handicapped athletes had higher mean ranks (Table 4). It can be said that this is due to the fact that single athletes cannot have responsibilities such as spouse, children, home, just like married athletes. Such responsibilities are among the factors that affect participation in sports (Humphreys & Ruseski, 2007; Farrel & Shields, 2002).

Looking at Table 5, it is seen that there is no statistically significant difference between the branch variable and elite handicapped athletes' motivation levels for participation in sports. When the mean rank is examined, it can be said that in the intrinsic motivation sub-dimension, elite handicapped athletes competing in arm wrestling have higher intrinsic motivation levels than elite handicapped athletes competing in swimming and basketball branches. In the sub-dimensions of extrinsic motivation and amotivation, it is seen that elite handicapped athletes competing in swimming branch have higher values than mean rank of elite handicapped athletes competing in arm wrestling and basketball (Table 5). Participation in sports offers individuals the opportunity to evaluate their own performance, abilities and individual goals (Treasure, et al., 2001). When athletes want to realize these factors, all kinds of motivation have an important role in achieving success. While Yalçın et al. (2017), Polat et al. (2018) stated in another study they conducted that the level of motivation is important in their study, Demir and İlhan (2019) found that the intrinsic and extrinsic motivation sub-dimensions of the disabled athletes from different branches differ from their amotivation sub-dimensions.

According to Table 6, no statistically significant difference was found between the second branch variable and elite handicapped athletes' motivation to participate in sports in the amotivation sub-dimension. A statistically significant difference was found in the intrinsic and extrinsic motivation sub-dimensions. It is seen that this difference is in favor of those who say yes in the intrinsic and extrinsic motivation sub-dimensions. In this direction, it was determined that the athletes dealing with a second branch have higher intrinsic and extrinsic motivation levels. This can be explained as athletes are motivated

more with the desire to be successful in a second branch (Table 6). Durand-Bush and Salmela (2002) stated in their study that self-confidence and high motivation are the main and common psychological characteristics of success in athletes who are successful at the Olympic level.

Looking at Table 7, no statistically significant difference was found between the income variable and elite handicapped athletes' motivation to participate in sports in the amotivation sub-dimension. However, a statistically significant difference was found in the intrinsic and extrinsic motivation sub-dimensions. In this difference, it was determined that the mean rank of elite handicapped athletes with middle income level was higher than the mean rank of elite handicapped athletes with low income level (Table 7). As a result, it can be said that the financial anxieties and worries of middle-income athletes may have been eliminated compared to athletes with a lower level, thus they focus themselves more on the branch they have done and are motivated more positively. In their study, Yalçın et al. (2017), Gökkaya and Biçer (2017) also supported the findings of the study.

It was determined that there was no statistically significant difference between the secondary job status variable and the motivation level of participation in sports of elite handicapped athletes. When the mean rank is examined, it is seen that in all sub-dimensions, elite handicapped athletes who have to work in a second job have higher mean rank than elite handicapped athletes who do not work in a second job (Table 8). It was stated that working in multiple jobs or doing additional work is one of the methods used to take precautions against various financial problems arising in the working lives of individuals or to fulfill their various requests (Altan, 2020).

No statistically significant difference was found between the time of disability variable and the motivation level of participation in sports of elite handicapped athletes (Table 9). The research conducted by Yılmaz et al. (2019) supports our study. Disabled individuals, although not always, may be pessimistic and have negative thoughts in terms of motivation due to their disadvantaged situation (Özdemir, 2017). Regardless of the time of disability, it can be said that this result is due to the fact that the problems they encounter because of social, legal and environmental factors do not change.

In conclusion, it is seen that the motivation to participate in sports does not affect the motivation of participation in sports in terms of gender variable, but the motivation levels of elite handicapped female athletes are higher in the intrinsic and extrinsic motivation sub-dimensions in terms of mean rank. It was determined that there was no difference in the motivation levels of participation in sports in terms of the educational status variable, and the motivation levels of elite handicapped athletes who graduated from a university or higher education program were higher in the intrinsic, extrinsic and amotivation sub-dimensions at mean rank level. It was found that the marital status variable does not affect the motivation levels of participation in sports, but when the mean rank is examined, single elite handicapped athletes have higher levels of motivation in the intrinsic and extrinsic motivation sub-dimensions. It was determined that there was no statistically significant difference between the branch variable and athletes' motivation levels for participating in sports, and that there was no difference between the second branch variable and athletes' participation in sports motivation levels, while the motivation level of those with the second branch was higher in the intrinsic and extrinsic motivation sub-dimensions. In terms of income variable, it was determined that there was no difference in the amotivation sub-dimension, but elite handicapped athletes with middle income level had higher levels of motivation in intrinsic and extrinsic motivation sub-dimensions. While there was no difference between the motivation level of participation in sports and working status at a second job variable, it was found that the motivation levels of elite handicapped athletes working in a second job were higher in all sub-dimensions when mean rank was examined. Accordingly, it can be said that athletes participate in sports by being influenced by different sources of motivation. The facts that handicapped individuals show different characteristics from each other and are affected by different sources of motivation require a multi-dimensional approach in terms of participating in sports, supporting and sustaining them. In this direction, based on the findings of our study, it is recommended to focus on creating appropriate environments especially in the fields of education and employment, both supporting participation in sports and ensuring sustainability.

Conflict of interest: The authors declare no conflict of interest. No financial support was received.

Ethics Statement

The studies involving human participants were reviewed and approved by the Muş Alpaslan University, Scientific Research Ethics Committee (Date: 12.10.2020; Decision / Protocol number: E-10879717-050.01.04-11831). Written informed consent to participate in this study was provided by the patients/participants

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RESEARCH ARTICLE

High School Teachers' Burnout Levels

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Abstract

The purpose of this study is to determine the burnout levels of teachers according to the perceptions of teachers working in public high schools, and to reveal whether the perceptions of teachers differ significantly according to some personal characteristics of teachers and the characteristics of the school. The research is a study in general survey model. The study universe of the research, in the 2019-2020 academic year, the province of Istanbul; While the 2983 permanent high school teachers working in the state high schools in Beşiktaş, Beyoğlu, Şişli and Kağıthane districts were formed, the sample was made up of 358 teachers. "Maslach Burnout Inventory-Educator Form" was used as the data collection tool of the study. As a result of the research; from the lower dimensions of burnout. In the emotional exhaustion sub-dimension; It has been determined that teachers are rarely (sometimes very close to their level, $\bar{X}$=1.58 ± 0.77) burnout. Teachers' perceptions show a statistically significant difference according to gender, professional seniority, and branch variables (p>0.05). In the desensitization sub-dimension; It turns out that teachers rarely show burnout ($\bar{X}$=0.82 ± 0.65). Teacher perceptions show a statistically significant difference according to the variables of professional seniority, school type, number of students (p>0.05). In the personal success sub-dimension; It was determined that teachers were rarely in burnout ($\bar{X}$=2.75 ± 0.54). Teachers' perceptions show a statistically significant difference according to number of children, and professional seniority variables (p>0.05).

Keywords
Burnout, High School Teachers, High School Teachers' Burnout

INTRODUCTION

The definition of the concept of burnout, which fundamentally affects the life of society, was first made by Bradley (1969) and then by Herbert Freudenberger, an American psychologist, in 1974. Although different definitions have been made in the future, the most well-known name among researchers about burnout is Christina Maslach, who developed the Maslach Burnout Inventory (Izgar, 2001; Tansel, 2015; Girgin, 1995). The increase in the workload of the individual and its continuousness cause emotional burnout. Since burnout causes individuals to feel helpless, exhausted, insoluble, and self-closing, it includes more negativity than stress (Girgin, 2010).

Burnout syndrome is seen in all areas of work, however, schools are among the most densely experienced places (Kabaklı Çimen and Karaboğa, 2015). Although teachers can be influenced by what they experience in other professions, they do a job that should not reflect the problems they encounter in their business or private life, especially to the students while performing their profession. Many reasons such as crowded classrooms, insufficient personal rights, lack of opportunities to improve themselves increase the risk of teachers' burnout syndrome

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and this affects the quality of education (Akçamete et al., 2001). In addition, job requirements, many different activities in the school environment, discipline problems in the classroom, bureaucracy, lack of support, workload, time pressure, and lack of benefits are among various factors related to teachers' professional stress (Mearns and Chain, 2003).

The fact that high school teachers coincide with the adolescence period of the students requires them to support their physical, emotional and cognitive development quickly. For this reason, it is very important for teachers to have motivation in their work, as well as for their students (Elbadi, 2019). Unhappy and anxious teachers cannot behave tolerant and supportive towards their students, and they are emotionally inadequate (Girgin, 1995). Under normal conditions, there are different situations that affect the burnout of high school teachers. In recent years, Many factors such as the high school curricula being far from scientific facts and contemporary realities, inequalities between permanent and paid teachers, insufficient number of schools and classrooms, crowded class sizes, education provided in education faculties at a level that cannot meet today's needs, insufficient personal rights of teachers, lack of physical capacity of schools, negativity created by dual education increase the burnout of high school teachers (Milliyet, 2018).

Through this research, it was aimed to determine the burnout levels of teachers working in state high schools in Beşiktaş, Beyoğlu, Şişli and Kağıthane districts of Istanbul and to develop solutions for teachers' levels of burnout.

Purpose of the research

The aim of this study is to determine the algorithms of teachers working in public high schools according to their perceptions on burnout dimensions, to show and reveal that some of the teachers' perceptions are personalized and the school is not reported.

In order to achieve this goal, answers to the following questions were sought:

1. According to teachers' perceptions, what is the level of burnout of teachers in terms of emotional exhaustion, depersonalization and personal accomplishment?

2.Teachers' perception levels of burnout dimensions, does it differ significantly according to their

a) their sex,
b) their marital status,
c) their professional seniority,
d) the type of school they work in,
e) its branches,
f) year of study at school,
g) the number of students in the classes they teach?

The Importance of Research

With this research, it was tried to determine the burnout levels of teachers working in high schools. In the light of the findings obtained at the end of the study, it is expected that high school administrators and higher levels officials will take measures to minimize teachers 'burnout and thus contribute to teachers' having higher quality instructional behavior.

MATERIALS AND METHODS

Research, Istanbul province; It is a research in general screening model that aims to determine the burnout levels of permanent teachers working in state high schools in Beşiktaş, Beyoğlu, Şişli and Kağıthane districts.For the research, Istanbul Okan University Ethics Committee unanimously decided that it is ethically appropriate with the decision number 21 at the meeting numbered 117 on 08.01.2020.

Participants

The study universe of the study consisted of 2983 permanent teachers working in state high schools in the districts of Beşiktaş, Beyoğlu, Şişli and Kağıthane in the 2019-2020 academic year under the Ministry of National Education of Rurkish Republic. They are close to each other as a working universe; Districts of Beyoğlu, Beşiktaş, Kağıthane, Şişli have been determined. The sample consisted of 358 teachers working in high schools in these districts and voluntarily filling in the measurement tool.

Data Collection Tool

The questionnaire in the first part of the scale used to obtain research data was organized to reveal personal characteristics and school characteristics. The Personal Information Form prepared for this purpose was prepared to determine the demographic variables of high school teachers and consists of 11 questions. These questions are gender, marital status, age, number of children, professional seniority, type of high school, branch, number of years worked in the

institution, the average number of students in the classes taught and the last educational institution completed. In the second part of the scale; The Maslach Burnout Inventory developed by Maslach and Jackson was adapted to educators by Maslach, Jackson and Schwab with some modifications, and the "Maslach Burnout Inventory-Educator Form" adapted into Turkish by Ince and Şahin (2015) was used.

In İnce and Şahin's study (2015), the Cronbach Alpha coefficient was determined as 0.88 in the emotional exhaustion dimension, 0.78 in the depersonalization dimension, and 0.74 in the personal accomplishment dimension. The Cronbach Alpha values obtained in our study, in which five options were used, were determined as 0.73 in the emotional exhaustion dimension, 0.69 in the depersonalization dimension, and 0.71 in the personal accomplishment dimension. Points equivalents of the options vary between 0 and 4. Factor loadings (CFA), CFA Model Goodness of Fit Index results, Reliability Analysis results were also recalculated (Yurttaş, 2020).

Statistical Analyses

The analysis of the research data was made with the SPSS 22 program. The arithmetic mean was used to determine the burnout levels of the participants. While examining whether the perceptions differ significantly according to the variables, for two variables; if the group showed normal distribution, the t-test was used for independent groups, and the Mann Whitney-U test was used if the group did not show normal distribution. In cases where the group showed homogeneity, t-Test, ANOVA and LSD test were used. The following ranges were used in the dimension of emotional exhaustion and depersonalization in the comments made according to the arithmetic mean: Never for the range of 000-0.80, "Rarely" for 0.81-1.60, "Sometimes" for 1.61-2.40, "Most of the time" for 2.41-3.20, "Always" expressions are used for between 3.21-4.00. The personal success dimension is inversely related. As the score increases, burnout decreases. Therefore, between 0-0.80 always, between 0.81-1.60 most often, between1.61-2.40 sometimes, between 2.41-3.20 rarely, 3.21-4.00 never shows.

RESULTS

According to the perceptions of teachers, burnout levels are based on emotional, depersonalization and personal accomplishment dimensions.

Teachers' perceptions of the emotional exhaustion dimension ($\bar{x}$=1.58 ± 0.77) are at the level of "rarely". Teachers rarely perceive emotional exhaustion. Teachers, with the lowest average ($\bar{x}$=0.94 ± 0.95) in the item "Working with students makes me very stressful", with the highest average ($\bar{x}$=2.28 ± 1.04) "I feel exhausted when I finish the day at school. They reported perception in the item "I feel".

Teachers' perceptions about the depersonalization dimension ($\bar{x}$=0.82 ± 0.65) are at the level of "rarely". Teachers "rarely" perceive depersonalization. Teachers, with the lowest average ($\bar{x}$=0.64 ± 0.82) in the item "I don't really care what happens to some students", and the highest average ($\bar{x}$=1.09 ± 1.04) "I think teaching makes me stiff emotionally. They reported perception in the article".

Teachers' perceptions of personal achievement ($\bar{x}$=2.75 ± 0.54) are at the level of "rarely". Teachers rarely perceive emotional exhaustion. Teachers, with the lowest average ($\bar{x}$=2.30 ± 0.99) in the item "I feel very fit", and the highest average ($\bar{x}$=3.09 ± 0.7) "I can easily understand how my students feel about a topic They reported perception in the article " (Table 1).

The perception levels of teachers regarding the dimensions of burnout were examined in terms of gender, marital status, professional seniority, type of high school, branch, year of working in the institution, average number of students in the classes taught, and the last educational institution variables.

Findings of Burnout Regarding High School Teachers by Gender Variable

The level of teachers' perception of burnout according to their gender, Depersonalization (t=1.70; p=0.09; sd:2/356) and Personal Achievement (t=0.63; p=0.53; df:2/356) does not differ in size. It shows a significant difference in the Emotional Exhaustion dimension (t=2.12; p=0.035; df:2/356). Looking at the arithmetic averages in the emotional exhaustion dimension, women ($\bar{x}$=1.66) show more emotional exhaustion than men ($\bar{x}$=1.48) (Table 2).

Burnout Findings Regarding High School Teaching According to the Vocational Seniority Variable

df:4/353) and personal accomplishment (F=5.42; p=0.000; df:4/353), teachers' opinions about burnout differ statistically significantly according to their professional seniority (Table 3). Emotional exhaustion (F=3.45; p=0.008; df:4/353), depersonalization (F=4.94; p=0.001;

Table 1. Teachers' perceptions on emotional burnout, depersonalization and personal achievement dimensions

Boyut	Items	n	x̄	ss
Emotional Burnout	1. I feel emotionally cold from teaching	358	1,44	1,02
	2. I feel exhausted when I finish the day at school	358	2,28	1,04
	3. I feel tired when I have to get up in the morning and start a new work day	358	1,81	1,08
	6. Working with students all day really challenges me	358	1,60	1,01
	8.I feel that teaching consumes me	358	1,52	1,15
	13. I think the teaching profession disappoints me	358	1,38	1,15
	14. I feel that my work load in teaching is too much	358	2,24	1,08
	16. Working with students makes me very stressed	358	0,94	0,95
	20. I feel like I cannot stand teaching any longer	358	1,04	1,08
	Total	**358**	**1,58**	**0,77**
Depersonalization	5. I feel like I'm treating some students as if they were objects.	358	0,80	0,94
	10. Since I started teaching I have become more insensitive to students.	358	0,88	0,98
	11. I think being a teacher made me emotionally stiff.	358	1,09	1,04
	15. I don't really care what happens to some students	358	0,64	0,82
	22. I feel students blaming me for some of their problems.	358	0,77	0,88
	Total	**358**	**0,82**	**0,65**
Personal Achievement	4. I can easily understand how my students feel about a topic.	358	3,09	0,70
	7. I am dealing with my students' problems very effectively.	358	2,71	0,89
	9. As a teacher, I feel that I am influencing students' lives positively.	358	2,88	0,81
	12. I feel very energetic	358	2,30	0,99
	17. I can easily create a comfortable working environment with my students.	358	2,63	0,92
	18. I feel filled with enthusiasm after a work that I have done with my students.	358	2,97	0,96
	19. I have achieved a lot of remarkable things in teaching	358	2,77	0,84
	21. I deal with the emotional problems I encounter in my job quite calmly.	358	2,68	0,92
	Total	**358**	**2,75**	**0,54**

Table 2. T test measurements of teachers' perceptions of burnout according to their gender

Dimensions	Gender	n	x̄	ss	t	df	p
Emotional Burnout	Female	213	1,66	0,75	2,117	356	0,035
	Male	145	1,48	0,78			
Desensitization	Female	213	0,77	0,62	1,702	356	0.09
	Male	145	0,89	0,69			
Personal Success	Female	213	2,74	0,54	0,63	356	0.53
	Male	145	2,78	0,55			

According to the results of the LSD test conducted to determine the source of the difference, in the emotional exhaustion dimension, teachers with professional seniority of 6-10 years are among those whose professional seniority is 21 years and above (I-J=0.31; p=0.007); Teachers with a professional seniority of 11-15 years have higher burnout than teachers with a professional seniority of 21 years or more (I-J=0.34; p=0.015).

According to LSD test results, in the depersonalization dimension, teachers with professional seniority of 6-10 years are more than

teachers with professional seniority of 21 years or more (I-J=0.34; p=0.000); Teachers with a professional seniority of 11-15 years, and those with a professional seniority of 21 years or more

According to the LSD test results, in the personal achievement dimension, teachers with professional seniority of 21 years or more, professional seniority 1-5 years (I-J=0.21; p=0.045), 6-10 years (I-J=0.28; p=0.000)), 11-15 years (I-J=0.37; p=0.000) and 16-20 years (I-J=0.15; p=0.011). Accordingly, teachers with a seniority of 21 years or more with higher scores are less burnout than teachers with lower scores (due to reverse scoring) (Table 4).

(I-J=0.39; p=0.001); Teachers with a professional seniority of 16-20 years ar more burnout than teachers with a professional seniority of 21 years or more (I-J=0.22; p=0.011).

Table 3. F (Variance) test measurements of teachers' perceptions of burnout according to their professional seniority

Dimensions	Professional Seniority	n	x̄	ss	Variance Test (Anova) Results Source	SS	df	MS	F	p
Emotional Burnout	1-5 Years	30	1,34	0,76	intergroup	8,006	4	2,001	3,449	0,008*
	6-10 Years	68	1,78	0,84	In-group	201,936	353	0,572		
	11-15 Years	38	1,82	0,68	Total	209,942	357			
	16-20 Years	89	1,57	0,78						
	21 Years and above	133	1,48	0,71						
	Total	358	1,58	0,77						
Desensitization	1-5 Years	30	0,76	0,58	intergroup	7,988	4	1,997	4,941	0,001*
	6-10 Years	68	0,99	0,68	In-group	142,683	353	0,404		
	11-15 Years	38	1,04	0,62	Total	150,671	357			
	16-20 Years	89	0,87	0,72						
	21 Years and above	133	0,65	0,57						
	Total	358	0,82	0,65						
Personal Success	1-5 Years	30	2,69	0,65	intergroup	6,046	4	1,511	5,419	0,000*
	6-10 Years	68	2,63	0,54	In-group	98,446	353	0,279		
	11-15 Years	38	2,53	0,51	Total	104,491	357			
	16-20 Years	89	2,75	0,50						
	21 Years and above	133	2,90	0,51						
	Total	358	2,76	0,54						

Burnout Findings Regarding High School Teaching According to the Variable of School Type They Work

Teachers' perceptions of burnout differed in the depersonalization dimension (F=2.97; p=0.020; df:4/353) according to the type of school they work in, emotional exhaustion (F=1.67; p=0.158; df:4/353) and personal success (F=1.34; p=0.253; df:4/353) does not differ in dimensions (Table 5).

Table 4. LSD Test measurements of teachers' views on emotional burnout, on depersonalization and on personal success sub-dimension according to their seniority status

Dimensions	**Professional Seniority** (I)	**Professional Seniority** (J)	Average Difference(I-J)	p
Personal Success	6-10 years	21 years and above	0,31	0,007
	11-15 years	21 years and above	0,34	0,015
Desensitization	6-10 years	21 years and above	0,34	0,000
	11-15 years	21 years and above	0,39	0,001
	16-20 years	21 years and above	0,22	.011
Personal Success	21 years and above	1-5 Years	0,21	0,045
		6-10 Years	0, 28	0,000
		11-15 Years	0,37	0,000
		16-20 Years	0,15	0,011

Table 5. F (Variance) test measurements of teachers' perceptions of burnout according to school types they work

Dimensions	**School Types**	**Variance Test (Anova) Results**								
		n	**x̄**	**ss**	**source**	**SS**	**df**	**MS**	**F**	**p**
Emotional Burnout	1	88	1,42	0,68	intergroup	3,888	4	0,972	1,665	0,158
	2.	52	1,63	0,75	In-group	206,055	353	0,584		
	3	110	1,59	0,76	Total	209,942	357			
	4	58	1,68	0,79						
	5	50	1,72	0,88						
	Total	358	1,59	0,77						
Desensitization	1	88	0,64	0,58	intergroup	4,908	4	1,227	2,972	0,020*s
	2.	52	1,00	0,67	In-group	145,763	353	0,413		
	3	110	0,83	0,69	Total	150,671	357			
	4	58	0,89	0,67						
	5	50	0,82	0,60						
	Total	358	0,82	0,65						
Personal Success	1	88	2,88	0,48	intergroup	1,567	4	0,392	1,344	0,253
	2.	52	2,70	0,50	In-group	102,924	353	0,292		
	3	110	2,76	0,54	Total	104,491	357			
	4	58	2,68	0,62						
	5	50	2,71	0,59						
	Total	358	2,76	0,54						

1. Project School, 2. Anatolian High School, 3. Anatolian Vocational and Technical Secondary Education Institutions, 4. Multi-Program High School, 5. Anatolian Imam Hatip high school

Table 6. LSD test measurements of teachers' perceptions on desensitization sub-dimension according to school type

Dimensions	**School Type** (I)	**School Type** (J)	Average Difference(I-J)	p
Desensitization	Anatolian High Schools	Project Schools	0,36	0,001
	Anatolian Vocational and Technical Secondary Education Institutions	Project Schools	0,19	0,038
	Multi-Program High Schools	Project Schools	0,25	0.021

According to the results of the LSD test conducted to determine the source of the difference in desensitization dimension, the teachers working in Anatolian High Schools were among the teachers working in the project schools (I-J=0.36; p=0.001); The teachers working in Anatolian Vocational and Technical High Schools are among the teachers working in the project schools (I-J=0.19; p=0.038); Teachers working in multi-program high schools have higher burnout than teachers working in project schools (I-J=0.25; p=0.021) (Table 6).

Findings of Burnout Regarding High School Teaching According to the Branch Variable

Table 7. F (Variance) test measurements of teachers' perceptions of burnout according to their branches

Dimensions	Branch	Variance Test (Anova) Results							
		n	x̄	ss	source	SS	df	MS	F	p
Emotional Burnout	Turkish-literatue	52	1,92	0,70	intergroup	9,685	6	1,614	2,829	0,011*
	Social sciences	32	1,57	0,68	In-group	200,257	351	0,571		
	Science	44	1,49	0,75	Total	209,942	357			
	Maths	42	1,61	0,81						
	Foreign languages	73	1,70	0,83						
	fine Arts	73	1,46	0,70						
	others	69	1,44	0,81						
	Total	358	1,59	0,77						
Desensitization	Turkish-literatue	52	1,00	0,69	intergroup	2,474	6	0,412	0,977	0,441
	Social sciences	32	0,75	0,64	In-group	148,197	351	0,422		
	Science	44	0,74	0,61	Total	150,671	357			
	Maths	42	0,79	0,63						
	Foreign languages	73	0,85	0,62						
	fine Arts	73	0,76	0,65						
	others	69	0,82	0,68						
	Total	358	0,85	0,65						
Personal Success	Turkish-literatue	52	2,71	0,50	intergroup	1,826	6	0,304	1,041	0,399
	Social sciences	32	2,74	0,52	In-group	102,665	351	0,292		
	Science	44	2,82	0,69	Total	104,491	357			
	Maths	42	2,69	0,40						
	Foreign languages	73	2,62	0,68						
	fine Arts	73	2,81	0,49						
	others	69	2,82	0,57						
	Total	358	2,76							

Teachers' perceptions of burnout do not differ in terms of depersonalization (F=0.98; p=0.441; df:6/351) and personal achievement (F=1.04; p=0.339; df:6/351), but emotional depletion (F=2.83; p=0.011; df:6/351) (Table 7).

Table 8. LSD Test Measurements According to the Branches of Teachers' Perceptions on Emotional Burnout Dimension

Dimensions	Branch (I)	Branch (J)	Average difference(I-J)	p
Emotional Burnout	Turkish-literatue	Social sciences	0,36	0.037
		Science	0,43	0.005
		maths	0,32	0.044
		Foreign languages	0,23	0.138
		Fine Arts	0,47	0.001
		Other	0,49	0.000

According to the results of the LSD test conducted to find the source of the difference, in the emotional exhaustion dimension, teachers whose branches are Turkish-literature, social studies (I-J=0.36; p=0.037), science (I-J=0.43; p=0.005), They scored higher than teachers of mathematics (I-J=0.32; p=0.044), fine arts (I- J=0.47; p=0.001) and other (I-J=0.49; p=0.000) (Table 8).

Accordingly, teachers whose branch is Turkish-Literature see themselves more exhausted than teachers whose branches are Social Studies, Science, Mathematics, Fine Arts and others.

DISCUSSION AND CONCLUSION

Teachers' perceptions of the emotional exhaustion dimension ($\bar{x}$=1.58 ± 0.77) are at the level of "rarely". This finding shows that high school teachers rarely have a perception of emotional exhaustion. Teachers showed the highest perception level ($\bar{x}$=2.28 ± 1.04) in this dimension in the item "I feel exhausted when I finish the day at school".This means chronic fatigue and is an indicator of burnout. Kaya (2019) found that the level of emotional exhaustion ($\bar{x}$=2.84 ± 0.49) was "sometimes at the level" in his research "Investigation of the Burnout Levels of Teachers Working in the Field of Special Education". This result is higher than the result found in our study. Accordingly, it can be said that the emotional burnout of high school teachers is lower than the emotional burnout of teachers working in the special education field. Çolak (2017), in his master's thesis "Investigation of the Burnout Levels of Managers and Teachers Working in Primary and Secondary Schools", found that the average burnout levels of the participants were 15.52 ± 7.03 in the emotional burnout sub-dimension. According to this score, the emotional exhaustion subscale of the participants is at a low level. Çolak (2017) found that the average burnout levels of the participants in his master's thesis "Investigation of the Burnout Levels of Administrators and Teachers Working in Primary and Secondary Schools" was 4.79 ± 3.42 in the depersonalization sub-dimension. According to this score, the depersonalization sub-dimension of the participants is low. In Çolak (2017), in his master's thesis "Investigation of the Burnout Levels of Administrators and Teachers Working in Primary and Secondary Schools", the average burnout levels of the participants are 21.33 ± 4.04 in the personal achievement sub-dimension. According to this score, it is seen that the participants experience moderate burnout in the personal achievement sub-dimension. Billingsley et al. (1995) compared 470 special education and regular school teachers and found that the burnout rate of teachers working in the special education field ranged from 5.8 to 7.9 percent, while this rate was 4.6 to 5.8 percent for teachers working in regular institutions. .(Akçamete et al.2001).

Kuloğlu-Aksaz (1996) compared the burnout levels of teachers working with disabled and non-disabled children using the Maslach Burnout Inventory. According to the results of this study, it was found that there was no difference between the total burnout scores of the two groups of teachers, both groups did not differ in terms of emotional exhaustion and depersonalization, but primary school teachers saw themselves more successful than teachers working with disabled children.(Akçamete et al., 2001)

Teachers' perceptions about the depersonalization dimension ($\bar{x}$=0.82 ± 0.65) are at the level of "rarely". This finding shows that high school teachers rarely have a sense of depersonalization. Teachers showed the highest perception level ($\bar{x}$=1.09 ± 1.04) in this dimension in the item "I think teaching makes me stiff emotionally".Teachers' feeling of solidification can prevent them from interacting well with students. Şanlı and Tan (2017) found that teachers' perceptions of depersonalization sub-dimension ($\bar{x}$=1.87) were "rarely" in their study in which they analyzed their burnout levels. This result coincides with the finding obtained from our study.

Teachers' perceptions of personal achievement ($\bar{x}$=2.75 ± 0.54) are at the level of "rarely". Since there is an inverse relationship in this dimension, the higher the success score, the lower the level of burnout. Therefore, teachers' burnout is at the "rarely" level. Teachers showed the highest level of perception ($\bar{x}$=3.09 ± 0.7) in this dimension in the item "I can easily understand how my students feel about a subject". Gündüz (2006), in his study to determine the burnout levels of school administrators and teachers, found that their perceptions of personal achievement ($\bar{x}$=1.20) were at the level of "rarely". The finding of our study coincides with Gündüz's (2006) research findings.

Teachers' perceptions do not differ according to their gender in Depersonalization and Personal Achievement dimensions. It shows a significant difference in the Emotional Exhaustion dimension (t=2.12; p=0.035; df:2/356). Looking at the arithmetic averages in the emotional exhaustion dimension, women ($\bar{x}$=1.66) show more emotional exhaustion than men ($\bar{x}$=1.48). It can be said that

this situation is due to the higher workload and responsibilities of women in the family, as well as their occupational workload. This finding is similar to the result obtained from the study in which Cemaloğlu and Erdemoğlu Şahin (2007) found that the level of emotional exhaustion was highest in women and the lowest in men in their study on teachers. Similarly, in the study of Maslach and Jackson (1981), a high level of emotional exhaustion was observed in women in the emotional exhaustion sub-dimension (Maslach and Jackson, 1981). In their study, Sezgin and Kılınç (2012) found that there was no gender difference in depersonalization sub-dimension, similar to our study. Karahan and Uyanık Polat (2011), in their study investigating the burnout levels of educators, determined that unlike our study, educators' views of personal achievement differ according to their gender. In a study conducted by Antoniou, Polychroni, and Vlachakis (2006) in Greece, they focused on the gender difference in occupational stress and occupational burnout among primary and high school teachers, and it was reported that female teachers have higher burnout levels than male teachers, unlike our study (Antoniou et al., 2006). In the study in which Erkul and Dalgıç (2014) examined the occupational burnout levels of vocational high school teachers in Şişli, Istanbul; While the thoughts of the participants in emotional exhaustion dimension vary according to gender, their thoughts in depersonalization and personal success sub-dimensions do not change according to gender. Therefore, in the emotional exhaustion dimension, it was determined that female teachers felt more emotional exhaustion than male teachers (Erkul and Dalgıç, 2014). This difference between male and female teachers in burnout; It is possible to attribute this to their inability to acquire or use appropriate psychological coping resources in line with the demands of the profession. Teachers may have difficulty in coping with problems that may cause them to experience burnout with the effect of their social status in their daily lives.

Teachers' perceptions of burnout according to their marital status, Emotional Exhaustion (F=0.805, p=0.45, sd:2/355), Depersonalization (F=0.086, p=0.91, sd:2/355) and Personal success (F=0.309, p=0.27, sd:2/355) does not differ in size. In their study, Sezgin and Kılınç (2012) determined that there is a statistical difference between burnout sub-dimensions and marital status variable, similar to our study. Izgar (2001), in his research named "Burnout in School Administrators", found that the burnout levels of school principals differ significantly in the emotional exhaustion and personal achievement sub-dimensions, unlike our study, and it was found that there was no significant difference in the depersonalization sub-dimension. Similarly, Ardıç and Polatçı (2008) found that there was no significant difference in emotional exhaustion dimensions in terms of marital status, and there was no significant difference in depersonalization and personal success dimensions. This finding is similar to the data of the study in which Bahar's (2006) study named Burnout Syndrome, An Application in Front Office Employees in Hotel Businesses, there is no significant difference in the personal success sub-dimension of married and unmarried people. Emotional exhaustion (F=3.45; p=0.008; sd:4/353), depersonalization (F=4.94; p=0.001; sd:4/353) and personal achievement (F=5.42; p=0.000; sd:4/353), teachers' opinions about burnout differ statistically according to their professional seniority.

According to the results of the LSD test conducted to determine the source of the difference, in the emotional exhaustion dimension, teachers with professional seniority of 6-10 years are among those whose professional seniority is 21 years and above (I-J=0.31; p=0.007); Teachers with a professional seniority of 11-15 years have higher burnout than teachers with a professional seniority of 21 years or more (I-J=0.34; p=0.015). In the depersonalization dimension, teachers with professional seniority of 6-10 years are more than teachers with professional seniority of 21 years or more (I-J=0.34; p=0.000); Teachers with a professional seniority of 11-15 years, and those with a professional seniority of 21 years or more (I-J=0.39; p=0.001); Teachers with a professional seniority of 16-20 years are more burnout than teachers with a professional seniority of 21 years or more (I-J=0.22; p=0.011). In the dimension of personal success, teachers with professional seniority of 21 years or more, professional seniority 1-5 years (I-J=0.21; p=0.045), 6-10 years (I-J=0.28; p=0.000), 11-15 scores higher than teachers with years (I-J=0.37; p=0.000) and 16-20 years (I-J=0.15; p=0.011). Accordingly, teachers with a seniority of 21 years or more with higher scores are less burnout than teachers with lower scores (due to reverse scoring).

Girgin (2010), in his research, concluded that there is a significant difference between the years of seniority and emotional burnout, which supports our study. Similar to our study, Elbadi (2019) found no statistically significant difference between professional seniority and Emotional Exhaustion and personal achievement sub-dimensions. Soyer, Can, and Kale (2009) found in their study "Examining the job satisfaction and professional burnout levels of physical education teachers in terms of various factors", different from our research, that there is no statistically significant difference between the seniority of teachers and depersonalization and personal achievement sub-dimensions. Similarly, Sezgin and Kılıç (2012) found that there was no significant difference between teachers' professional seniority levels and their burnout levels.

Teachers' perceptions of burnout differ in depersonalization dimension (F=2.97; p=0.020; sd:4/353) according to the type of school they work in, while emotional exhaustion (F=1.67; p=0.158; sd:4/353) and personal success (F=1.34; p=0.253; sd:4/353) does not differ in terms of dimensions. According to the results of the LSD test conducted to determine the source of the difference in desensitization dimension, the teachers working in Anatolian High Schools were among the teachers working in the project schools (I-J=0.36; p=0.001); The teachers working in Anatolian Vocational and Technical High Schools are among the teachers working in the project schools (I-J=0.19; p=0.038); Teachers working in multi-program high schools have higher burnout than teachers working in project schools (I-J=0.25; p=0.021).

Şanlı and Tan (2017), in their study examining teachers 'burnout levels, found that there was no statistically significant difference between teachers' school types and Emotional Exhaustion and personal achievement sub-dimensions. This result is similar to our research. Dağcı (2019) found in her study that there was no statistically significant difference between the school type variable and the burnout level sub-dimensions. Similar to our findings. Similar to our findings, Cemaloğlu and Erdemoğlu Şahin (2007) found a statistically significant difference between teachers' school types and depersonalization sub-dimension in their study to determine the professional burnout levels of teachers.

Teachers' perceptions of their burnout according to their branches, did not differ significantly in terms of depersonalization (F=0.98; p=0.441; sd:6/351) and personal achievement (F=1.04; p=0.339; sd:6/351) dimensions. shows a significant difference in the dimension of emotional exhaustion (F=2.83; p=0.011; sd:6/351).

According to the results of the LSD test conducted to find the source of the difference, in the emotional exhaustion dimension, teachers whose branches are Turkish-literature, social studies (I-J=0.36; p=0.037), science (I-J=0.43; p=0.005), They scored higher than teachers of mathematics (I-J=0.32; p=0.044), fine arts (I-J=0.47; p=0.001), and other (I-J=0.49; p=0.000). Accordingly, teachers whose branch is Turkish-Literature see themselves more exhausted than teachers whose branches are Social Studies, Science, Mathematics, Fine Arts and others.

Ersoy Yılmaz et al. (2014) found a statistically significant difference between the branches of teachers and the Emotional Exhaustion and personal achievement sub-dimensions, similar to the findings we obtained from our study, in their study to determine teachers' burnout levels. Dağcı (2019) found in her study that there was no statistically significant difference between the branch variable and the burnout level sub-dimensions. Izgar (2001) found that there is a statistically significant difference between the branches of teachers and the depersonalization sub-dimension, unlike our research.

CONCLUSION

The conclusions reached according to the Sub-Problems can be listed as follows:

Teachers' perceptions of the emotional exhaustion, depersonalization and personal success dimensions are at the level of "rarely". When the results obtained according to the sub-problems are summarized according to the dimensions: In the emotional exhaustion dimension, teachers' perceptions of burnout show statistically significant differences according to the variables of gender, professional seniority, and branch. Teacher perceptions do not show a statistically significant difference according to marital status, school type, year of study, number of students, and educational status. In the depersonalization dimension, teachers' perceptions of burnout show statistically significant differences according to the

variables of professional seniority, school type, and number of students. Teacher perceptions do not show a statistically significant difference according to the variables of gender, marital status, branch, working year, and educational status. In the personal achievement dimension, teachers' perceptions of burnout show statistically significant differences according to professional seniority variables. Teacher perceptions do not show a statistically significant difference according to the variables of gender, marital status, school type, branch, working year, number of students, and educational status.

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Ethics Statement

The studies involving human participants were reviewed and approved by the Okan University, Scientific Research Ethics Committee (Date: 08.01.2020; Decision / Protocol number: 21/117). Written informed consent to participate in this study was provided by the patients/participants.

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RESEARCH ARTICLE

Effects of Diaphragmatic Mobilization and Diaphragmatic Breathing Exercises on Pain and Quality of Life in Individuals with Shoulder Pain: A Randomized Controlled Trial

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Abstract

Purpose: This study aimed to investigate the effects of diaphragmatic mobilization and diaphragmatic breathing exercises on pain and quality of life in individuals with shoulder pain. **Methods:** A total of 72 individuals with shoulder pain were included in the study. The individuals included in the study were randomly divided into 3 groups as Diaphragmatic Mobilization Group (DMG) (n=24), Diaphragmatic Breathing Group (DBG) (n=24), and control group (n=24). In addition to classical physiotherapy treatment, diaphragmatic mobilization to mobilization group and diaphragmatic breathing exercises to breathing group were applied by the physiotherapist 3 days a week for 8 weeks. On the other hand, only classical physiotherapy treatments were applied to the control group. Individuals were evaluated in terms of pain and quality of life. Pain levels assessed with the Visual Analogue Scale (VAS) and quality of life assessed with Short Form-36 (SF-36). **Results:** In our study, it was observed that the pain level was reduced and the quality of life was improved in all groups ($p<0.05$). When DMG and DBG were compared with the control group, there was found a significant difference among groups in terms of reducing pain and improving quality of life in favor of DMG and DBG ($p<0.05$). When DMG and DBG were compared, no statistically significant difference was found between the groups ($p>0.05$). **Conclusion:** The study results demonstrated that diaphragmatic mobilization and diaphragmatic breathing exercises are found to be effective in reducing pain and improving quality of life in individuals with shoulder pain.

Keywords
Diaphragmatic Mobilization, Breathing Exercises, Shoulder pain, Quality of life

INTRODUCTION

Shoulder pain is a common musculoskeletal problem that significantly affects the general population. The prevalence of shoulder pain is between 6% and 26% worldwide. It is thought that one out of every three people will experience shoulder pain at least once in their lifetime. The most common clinical types of shoulder pain are rotator cuff lesions, adhesive capsulitis, and glenohumeral osteoarthritis (Struyf et all., 2016; Oliveira et all., 2017).

The shoulder pain is a health problem that is not limited to personal factors but also affects the physical and psychosocial working environment of the individual. It significantly affects the quality of life of the individual (Ariëns et all., 2001). It is one of the important public health problems that can have major medical and economic consequences

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on individuals, communities and industries and it may restrict productivity in workplaces (Sundstrup and Andersen, 2017; Murray et all., 2013).

In individuals with shoulder pain, it is very important to distinguish the source of the pain, considering that the shoulder pain originating from the glenohumeral joint usually might be compensated by the scapulothoracic joint (Magee, 2008).

In case of increased strength and stress; If biomechanical connections such as optimal muscle flexibility, muscle strength, proprioception, and endurance can not be established, it may cause pain and injury in the shoulder joint (Sciascia and Cromwell 2012; Karandikar and Vargas 2011).

The factors that cause shoulder pain are not always clear. It can be caused by different complex reasons that, the shoulder pain does not always consist of dysfunction of structures such as muscles or joints. It should be considered if there is a musculoskeletal disorder existed or not, only it should be taken into account also the common shoulder pain which is experienced after stroke. (Langhorne, 2000). On the other hand, shoulder pain and dysfunction can also be caused by pathological conditions in the spine, rib cage or internal organs. It is known that pain from dysfunctions anywhere in the spine or rib cage can accelerate shoulder dysfunction. For this reason, the relationships between the rib and the shoulder, which are important in respiration, should not be ignored (Donatelli, 2012).

Shoulder pain can lead to decreased normal joint range of motion, sleep disorders, anxiety and anxiety disorder in individuals (Neviaser and Hannafin 2010; Ryan et all., 2016).

In individuals with shoulder pain, deep breathing exercises and relaxation exercises are considered to improve daily life activities by reducing the pain of the patient (Friesner et all., 2006; Schaffer and Yucha, 2004).

It has been mentioned in many studies that breathing exercises significantly affect the physical and mental state of the individual. These studies have revealed that diaphragm training has an effect on the body's organs and musculoskeletal system. Eliminating the symptoms of gastroesophageal reflux and improving lumbosacral muscle proprioception are typical examples of these findings (Nobre et all., 2013).

Diaphragm activity affects respiratory capacity and generally changes the perception of pain in individuals. In addition, by providing deep breathing and increasing the diaphragm efficiency, a healthy posture and body position are maintained (Bordoni and Marelli, 2016; Bordoni et all., 2016).

In the literature, there are studies that report on the effects of breathing exercises on pain, function, and balance. (Lee, 2015; Stephens et all., 2017). However, there is no study in the literatüre that investigate the effectiveness of the diaphragmatic mobilization and diaphragmatic breathing exercise on shoulder pain and quality of life in individuals with shoulder pain.

The aim of this study was to investigate the effects of diaphragmatic mobilization and diaphragmatic breathing exercises on shoulder pain and quality of life in individuals with shoulder pain. The study hypothesis was that the diaphragmatic mobilization and diaphragmatic breathing exercises applied in addition to classical physiotherapy treatment would have a greater effect than solo classical physiotherapy treatment on decreasing shoulder pain and improving the quality of life.

MATERIALS AND METHODS

The study was conducted on individuals with shoulder pain in Gaziantep Büyükşehir Belediyesi Inayet Topcuoglu Hospital. Approval for this randomized controlled trial was granted by the Human Research Ethics Committee of Hasan Kalyoncu University (date-decision no: 19/01/2021-2021/008). All study procedures conformed to the provisions of the World Medical Association Declaration of Helsinki. Written informed consent was obtained from all participants. Our study was carried out between 20 January - 30 May 2021. The individuals included in our study were randomized by drawing lots.

Participants

A total of 72 individuals with shoulder pain, aged between 18-64 were included in the study. The participants were divided into three groups according to the simple random method as the 1st control group (n:24), the 2nd mobilization group (n:24) and the 3rd breathing group (n:24).

The inclusion criteria of our study were shoulder patients diagnosed by a physician between the ages of 18-65 and individuals with pain in active shoulder flexion and abduction or with normal range of motion limitation.

The exclusion criteria of our study; individuals who smoked, have muscle strength below 4, have neurological pathology, have cardiological problems, have shoulder surgery, have shoulder dislocation or subluxation, have thoracic surgery, have a respiratory disorder, were diagnosed with mental health problems and did not accept to volunteer.

Measurements

At the start of the study, the demographic information of all the subjects in all groups was recorded, then Visual Analogue Scale (VAS) and Short Form-36 (SF-36) were recorded. In addition, pulse and oxygen saturation were evaluated by pulse oximetry. At the end of training sessions completed in a 8-week period, all the evaluations and scales were applied again.

The Visual Analog Scale (VAS)

This scale was used to evaluate the pain. According to the VAS, pain severity is graded as "no pain" as 0 points and "worst pain imaginable" as 10 points (10 cm scale) (Hawker et al., 2011). VAS is a reliable and valid pain measurement method in the evaluation of pain (Kurşun et al., 2015).

The Short Form-36 Health Survey (SF-36)

The Short Form-36, which is frequently used to assess the quality of life, provides a wide-angle measurement. The scale consists of eight subscales including physical function, physical role, emotional function, social function, general health, mental health, pain, and vitality. Each subscale scores between 0-100 and the scale is directly proportional to the quality of life. 100 points reflect the best health status, while 0 pounds indicate the worst health status. The Turkish validity and reliability study of the quality of life questionnaire which is Short Form-36 (SF-36) conducted (Koçyiğit et al., 1999).

The Pulse Oximetry

Pulse oximetry is a device that non-invasively measures oxygen saturation by recording the light absorption of different hemoglobins in arteries with a beating heart (Kuzu et al., 2017). It is a painless and reliable tool (Khan et al., 2017). Finger type pulse oximeter device was used to measure oxygen saturation and pulse.

Intervention

Only classical physiotherapy treatments were applied to individuals in the control group. In addition to classical physiotherapy treatment, diaphragmatic mobilization to mobilization group and diaphragmatic breathing exercises to breathing group were applied by the physiotherapist 3 days a week for 8 weeks. Classical physiotherapy treatment includes Transcutaneous Electrical Nerve Stimulation (TENS) for 15 minutes, hotpack on the painful area for 15 minutes, and theraband exercises in the directions of shoulder flexion, abduction, external and internal rotation were prescribed as strengthening exercises.

Diaphragmatic mobilization was applied to the mobilization group by the physiotherapist while the participant was in a supine and relaxed position. Thumbs are placed on the xiphoid process. The costae are grasped and closed up together, with the remaining fingers together and the fingertips reaching into the lumbar region and drawing a virtual 8 motion. The diaphragmatic mobilization was applied in each session for 3 minutes (Fig.1).

Figure 1. Diaphragmatic mobilization

Diaphragmatic breathing exercise is performed as the patient placing one hand on the chest and the other hand on the abdomen while the individual is in the supine position, with minimal chest movement, breathing slowly and deeply through the nose for 4 seconds and exhaling through the mouth for 6 seconds approximately. The patient is instructed not to move the hand on the chest and pushing the air to the abdomen causing the hand there to move (Fig.2).

Figure 2. Diaphragmatic breathing exercise

Statistical Analysis

Data obtained in the study were analyzed statistically using IBM SPSS vn. 21.0 software (SPSS Inc, Chicago, IL, USA). As the data did not conform to a normal distribution, non-parametric tests were used in the analyses. In the comparisons of the mean values of three independent groups, the Mann-Whitney U test was used. The mean values within a group of the measurements taken before and after the exercise training were evaluated using the Wilcoxon Signed-Rank test. In the determination of the differences between groups of categorical variables, the Chi-square test was applied. In all the data analyses, a value of $p<0.05$ was accepted as statistically significant.

RESULTS

A total of 72 individuals with shoulder pain, 59 female (%82) and 13 male (%18), aged between 18-64, were included in the study. It was observed that the control group (age: 41.67±12.06 years, body mass index: 26.08±2.81 kg/m^2) mobilization group (age: 36.62±9.09 years, body mass index: 26.275±4.03 kg/m^2) and respiratory group (age: 39.5±7.08 years, body mass index: 27.77±3.69 kg/m^2) were similar in terms of age and body mass index. Demographic characteristics of individuals such as gender, occupational group, diagnosis, respiratory type, chest type, and dominant side were recorded. The demographic features of the all groups are shown in Table 1.

Table 1. Demographic features

		Control group (n=24)		*Mobilization group (n=24)*		*Breathing group (n=24)*	
		n	**%**	**n**	**%**	**n**	**%**
Gender	Male	21	87.5	16	66.7	22	91.7
	Female	3	12.5	8	33.3	2	8.3
Profession	Office worker	1	4.2	2	8.3	2	8.3
	Housewife	15	62.5	12	50	16	66.7
	Student	2	8.3	2	8.3	-	-
	Worker	1	4.2	5	20.8	4	16.7
	Retired	3	12.5	2	8.3	1	4.2
	Unemployed	2	8.3	1	4.2	1	4.2
Diagnosis	Adhesive capsulite	4	16.7	3	12.5	2	8.3
	Impingement	4	16.7	1	4.2	3	12.5
	Rotator cuff lesion	8	33.3	16	66.7	13	54.2
	Tenosynovitis	8	33.3	4	16.7	6	25
Respiratory type	Chest breathing	15	62.5	16	66.7	15	62.5
	Diaphragm breathing	7	29.2	7	29.2	5	20.8
	Mix	2	8.3	1	4.2	4	16.7
Chest type	Normal	18	75	16	66.7	22	91.7
	Pigeon chest	4	16.7	5	20.8	2	8.3
	Barrel chest	2	8.3	3	12.5	-	-
Dominant side	Right	20	83.3	23	95.8	23	95.8
	Left	4	16.7	1	4.2	1	4.2

When the pain severity and respiratory values of the groups were compared before and after the treatment, a statistically significant decrease in pain was found in all three groups ($p<0.05$). When peripheral oxygen saturation values were examined, there was a statistically significant increase in DMG and DSG ($p<0.05$). There was no significant difference in pulse values before and after the treatment ($p>0.05$). When the quality of life sub-parameters of the groups were evaluated before and after the treatment, an improvement in the quality of life was observed in all groups ($p<0.05$). Comparison of pain, respiratory parameters and quality of life of the groups before and after the treatment are shown in Table2.

Table 2. Comparison of Pain, Respiratory Parameters and Quality of Life of The Groups Before And After The Treatment

Measurements	*Control group (n=24)*		*Mobilization group (n=24)*		*Breathing group (n=24)*	
	z	**p**	**z**	**p**	**z**	**p**
Pain Activity	-4.301	0.000	-4.304	0.000	-4.315	0.000
Pain Rest	-4.306	0.000	-4.300	0.000	-4.331	0.000
Pain Sleep	-4.222	0.000	-4.296	0.000	-4.212	0.000
SpO2	-1.393	0.164	-1.966	0.049	-2.847	0.004
Pulse	-0.053	0.958	-0.660	0.509	-0.815	0.415
Physical Functioning	-4.222	0.000	-4.298	0.000	-4.296	0.000
Physical Role Functioning	-4.406	0.000	-4.418	0.000	-4.365	0.000
Emotional Role Functioning	-4.036	0.000	-4.244	0.000	-4.358	0.000
Vitality(energy)	-3.358	0.001	-4.035	0.000	-3.937	0.000
Mental Health	-3.127	0.002	-4.265	0.000	-4.213	0.000
Social Function	-4.164	0.000	-4.303	0.000	-4.334	0.000
Pain	-4.205	0.000	-4.203	0.000	-4.296	0.000
General Health	-3.826	0.000	-4.302	0.000	-4.232	0.000

*p<0.05 Wilcoxon Signed Ranks Test, SpO2; Peripheral Oxygen saturation

When the pain severity among the groups were examined, it was found that there was a significant decrease in pain activity, pain resting and pain sleep parameters after treatment ($p<0.05$). There was no difference in the comparison of peripheral oxygen saturation values between the groups before and after the treatment ($p>0.05$). When the pulse values among the groups were examined, a statistically significant increase was found in the pulse values after the treatment ($p<0.05$). The intergroup comparison of pain and respiratory parameters is shown in Table 3.

As a result of the comparison of the quality of life sub-parameters among the groups, an improvement in the quality of life was observed in the parameters of emotional role difficulty, mental health, pain, and general health perception ($p<0.05$). In the energy parameter, there was an improvement in the values before and after the treatment ($p<0.05$). No statistically significant difference was found in all other parameters ($p>0.05$). The intergroups comparison of quality of life are shown in Table 4.

Table 3. The Intergroups comparison of pain and respiration parameters

Measurements		*Controlgroup (n=24)*	*Mobilization group (n=24)*	*Breathing group (n=24)*		
		X±SD	**X±SD**	**X±SD**	**X^2**	**p**
Pain Activity	Before Treatment	8.54±1.22	8.63±1.10	8.75±1.36	0.717	0.699
	After Treatment	3.46±2.13	1.79±1.69	1.5±1.62	**12.845**	**0.002**
Pain Rest	Before Treatment	6.88±1.60	7.63±1.93	6.67±1.93	3.568	0.168
	After Treatment	2.42±1.93	0.83±1.34	1.04±1.20	**11.332**	**0.003**
Pain Sleep	Before Treatment	6.96±2.51	7.63±2.24	7.83±2.60	3.210	0.201
	After Treatment	2.04±1.94	0.83±1.44	0.88±1.26	**8.430**	**0.015**
SpO2	Before Treatment	96.46±1.98	96.88±1.68	96.04±2.31	1.632	0.442
	After Treatment	96.83±1.63	97.42±1.25	97.25±1.33	1.666	0.435
Pulse	Before Treatment	78.67±6.64	79.42±10.73	83.96±9.59	5.324	0.070
	After Treatment	78.5±6.64	80.04±8.81	82.88±6.04	**7.242**	**0.027**

*p<0.05 Kruskal Wallis Test, X^2; ki-kare X; Mean, SD; Standard Deviation, SpO2; Peripheral Oxygen saturation

Table 4. The Intergroups comparison of quality of life

SF-36 Sub-Parameters		*Control group (n=24)*	*Mobilization group (n=24)*	*Breathing group (n=24)*		
		X±SD	**X±SD**	**X±SD**	**X^2**	**p**
Physical Functioning	Before Treatment	59.17±22.10	53.33±16.40	48.75±21.23	3.797	0.150
	After Treatment	76.88±19.27	83.75±10.14	79.58±13.98	1.326	0.515
Physical Role Functioning	Before Treatment	31.25±26.84	24.38±19.47	16.88±17.68	3.487	0.175
	After Treatment	72.92±24.36	73.13±17.99	63.54±22.09	2.639	0.267
Emotional Role Functioning	Before Treatment	34.28±31.89	14.04±16.99	15.26±19.60	5.834	0.054
	After Treatment	83.35±19.64	72.24±23.40	63.90±16.80	**12.859**	**0.002**
Vitality(energy)	Before Treatment	38.96±18.06	45.62±17.71	51.88±14.05	**6.452**	**0.040**
	After Treatment	47.71±15.88	64.79±14.10	68.75±14.98	**20.198**	**0.000**
Mental Health	Before Treatment	43.33±19.69	51.79±17.95	52.67±13.08	4.527	0.104
	After Treatment	53.92±15.33	65.88±11.78	67.25±11.35	**12.296**	**0.002**
Social Function	Before Treatment	44.77±20.83	32.12±20.13	36.45±14.71	4.557	0.102
	After Treatment	64.56±16.38	67.15±10.86	70.83±14.12	2.302	0.316
Pain	Before Treatment	30.29±20.22	23.12±15.43	27.60±16.24	1.571	0.456
	After Treatment	59.39±16.38	78.54±18.19	76.43±14.50	**15.003**	**0.001**
General Health	Before Treatment	34.38±19.30	39.17±24.83	45.42±20.59	2.572	0.276
	After Treatment	45.62±19.07	64.17±18.51	61.46±16.45	**11.297**	**0.004**

*p<0.05, Kruskal Wallis Test, X^2; ki-kare

In the pairwise comparison of the groups; improvements after the treatment in favor of DMG and DSG were noted in terms of pain activity, pain rest, and pain sleep parameters, as the quality of life sub-parameters of energy, mental health, pain, and general health perception ($p<0.05$). After the treatment, an improvement was observed in the quality of life in favor of DSG in terms of the quality of life emotional role difficulty parameter ($p<0.05$). The pairwise comparison of groups are shown in table 5.

Tablo 5. Pairwise comparison of groups

	Control Mobilization		Control Breathing		Mobilization Breathing	
	z	p	z	p	z	p
Pain Activity	**-2.776**	**0.005**	**-3.299**	**0.001**	-0.624	0.532
Pain Rest	**-3.038**	**0.002**	**-2.568**	**0.010**	-0.767	0.443
Pain Sleep	**-2.548**	**0.011**	**-2.328**	**0.020**	-0.290	0.771
Emotional Role Functioning	-1.898	-1.898	**-3.525**	**0.000**	-1.767	0.077
Vitality (energy)	**-3.624**	**0.000**	**-3.994**	**0.000**	-1.142	0.253
Mental Health	**-2.992**	**0.003**	**-3.031**	**0.002**	-0.549	0.583
Pain	**-3.380**	**0.001**	**-3.276**	**0.001**	-0.532	0.594
General Health	**-3.034**	**0.002**	**-2.674**	**0.007**	-0.698	0.485

*p<0.05 Mann-Whitney U Test,

DISCUSSION

The aim of this study was to investigate the effects of diaphragmatic mobilization and diaphragmatic breathing exercises on shoulder pain and quality of life in individuals with shoulder pain. Diaphragm mobilization and diaphragmatic breathing exercises, which are applied in addition to classical physiotherapy treatment are found to be effective in reducing pain and improving the quality of life in individuals with shoulder pain. Therefore, we think that the diaphragm mobilization technique and diaphragmatic breathing exercises should be a part of shoulder rehabilitation in the literature with their role in reducing pain perception and improving the quality of life. A pilot study was conducted with 27 people diagnosed with rotator cuff injury and its findings have not been shared yet. In this study, 3 groups consisting of 9 people in each group were formed. Myofascial trigger point treatment was applied to the control group, manual therapy to the diaphragm group, and diaphragm mobilization with respiratory exercise to the respiratory group. (Fernández-López et all., 2021). We think that the sample we created with 72 individuals as a result of the power analysis and literature study is more comprehensive than the studies in the literature.

In the literature, the effect of breathing exercises on pain, shoulder joint range of motion and balance has been investigated (Lee, 2015; Stephens et all., 2017). The originality of our study is that it is the first study to examine the effects of diaphragmatic mobilization and diaphragmatic breathing exercises on pain and quality of life in individuals with shoulder pain.

There is no study in the literature that reveals the effects of diaphragmatic mobilization and diaphragmatic breathing exercises on pain and quality of life in individuals with shoulder pain. The findings of a study investigated the effect of deep breathing exercise training applied with Proprioceptive Neuromuscular Facilitation (PNF) exercises on shoulder normal range of motion and pain in a female case. The 46-year-old patient underwent resistance exercise in the upper extremity flexion, abduction and external rotation pattern. In addition, deep breathing exercises were applied for 3 weeks, 3 sessions per week for 30 minutes. As a result of the research, an increase in

the patient's normal range of motion and a decrease in pain was found (Lee, 2015).

In our study, pain assessment was performed with VAS. When the groups were compared before and after the treatment, a significant difference was found in the reduction of pain level in all three groups. As a result of the pairwise comparison of the groups, when the VAS values of the diaphragmatic mobilization and diaphragmatic breathing exercise groups were compared to the control group, it was statistically revealed that there was a greater decrease in pain level. VAS is a reliable and valid pain measurement method in the evaluation of pain (Kurşun et all., 2015). We think that diaphragmatic mobilization and diaphragmatic breathing exercises applied in the treatment of individuals with shoulder pain reduce sleep problems, increase the treatment motivation of individuals and reduce the perception of pain.

Shoulder pain is considered a multifactorial health problem that is not only limited to individual factors but also related to both the physical and psychosocial work environment (Ariëns et all., 2001). As it causes pain and disability in individuals with rotator cuff lesions, which is one of the most common causes of shoulder pain, it affects performance in activities of daily living. Shoulder pain significantly affects the quality of life of individuals (Osborne et all., 2016). In individuals with shoulder pain, deep breathing exercises and relaxation exercises are considered to improve the daily life of the patient by reducing the pain (Friesner et all., 2006; Schaffer and Yucha, 2004).

When the pre-treatment and post-treatment SF-36 parameters of all groups included in our study were evaluated, it was determined that the quality of life increased in all groups. When the quality of life was examined among the groups, a significant difference was found in the improvement in the sub-parameters of SF-36 emotional role difficulty, energy, mental health, pain and general health perception. In the pairwise comparison of the groups, SF-36 energy, mental health, pain, and general health perception parameters improved in favor of DMG and DSG compared to the control group. In our study, it was observed that the exercise and mobilization practices we performed for DMG and DSG, to increase the efficiency of the diaphragm, which plays an important role in respiration, apart from the practices in the control group, improved the quality of life to a greater extent in favor of DMG and DSG.

The respiratory and autonomic nervous systems have a close relationship with each other. The phrenic nerve, which provides the innervation of the movement of the diaphragm muscle, is connected to the vagus (parasympathetic) nerve (Kocjan et all., 2017). Diaphragmatic breathing exercise activates parasympathetic nerve activity while suppressing sympathetic nerve activity (Ambrosino, et all., 1981). Chang et al. reported that 8 deep breaths per minute predominated the balance of parasympathetic nerve activity. (Chang et all., 2013). Jerath et al. They stated that breathing stimulates vagal activation of gamma-aminobutyric acid pathways in the brain and reduces stress and anxiety. In addition, it is seen that diaphragmatic breathing exercise has a positive effect on the cardiovascular system and brain by improving autonomic balance (Jerath et all., 2015).

In our study, when the groups were compared, a significant improvement was observed in the SF-36 emotional role difficulty sub-parameter only in favor of the diaphragmatic respiratory group. We think that this significant improvement in favor of the only DSG is due to the positive effect of respiratory exercises on the mental health of the individual in terms of biopsychosocial.

During this period of the Covid-19 pandemic, our study contributed to the awareness of breathing exercises. Not only the mobilization and breathing exercise groups but also the control group were informed about effective and correct breathing.

There were some limitations to this study. While our study was being planned, it was considered to use a pulmonary function test in order to evaluate the diaphragm efficiency with more quantitative measurements. However, the prohibition of the use of pulmonary function tests in hospitals except in very emergency situations due to the Covid-19 pandemic caused the diaphragm efficiency to not be evaluated quantitatively enough.

Although our study was carried out with a large number of participants compared to the literature, one of the limitations of our study was that it was conducted in a single center.

This study could not be carried out with a homogeneous gender distribution, since the participants were mostly female.

The fact that the education levels of the individuals participating in our study were mostly low, caused a great loss of time, especially in the evaluation part based on the questionnaire. In the literature, strong conclusions could not be made due to the few studies examining the shoulder-diaphragm relationship in patients with shoulder pain.

We think that our study, which we carried out in a single center and with individuals who are very similar in terms of sociodemographics, is carried out by multiple centers and groups of individuals from all parts of the society, may increase the reliability of future studies.

As a result, diaphragmatic mobilization and diaphragmatic breathing exercises were effective in reducing pain and improving the quality of life in individuals with shoulder pain. We think that increasing the activity of the diaphragm muscle via diaphragmatic mobilization and diaphragmatic breathing exercise plays a role in reducing shoulder pain because of a clear relationship between the diaphragm and the shoulder both in terms of anatomy and through myofascial connection. For this reason, we think that it would be beneficial to include diaphragmatic mobilization and diaphragmatic breathing exercises in addition to the classical physiotherapy program in the treatment protocols of individuals with shoulder pain.

Conflicts of interest

All authors have no conflicts of interest with respect to the data collected and procedures used within this study. Authors declare that they have no sponsor in the study design, collection, analysis, writing of the manuscript, and decision to submit the manuscript for publication.

Ethics Statement

The studies involving human participants were reviewed and approved by the Hasan Kalyoncu University, Non-Interventional Research Ethics Committee (Date: 19.01.2021; Decision / Protocol number: 2021/008). Written informed consent to participate in this study was provided by the patients/participants.

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RESEARCH ARTICLE

Comparison of the Supervised and Home-Based Physiotherapy Program in Patients with Lateral Epicondylitis

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Abstract

Objective: This study aimed to compare the effectiveness of a supervised and home-based physiotherapy program in the reduction of pain and in improving functional status and quality of life in patients with lateral epicondylitis. **Method:** Patients diagnosed with lateral epicondylitis and referred to the physiotherapy clinic were evaluated retrospectively. A total of 32 patients were separated into two groups as supervised and home-based physiotherapy groups. All the patients received standard physiotherapy program consisting of static stretching exercises of the ECRB tendon, eccentric exercises of the wrist extensors and cold application, for 3 weeks. The groups were compared in terms of pain severity, range of motion, functional status (Quick-DASH) and quality of life (SF-36) after treatment. **Results:** Fifteen patients (12 females, 3 males) with a mean age of 44.20±7.35 years were included in the supervised physiotherapy group, and 17 patients (15 females, 2 males) with a mean age of 48.65±12.33 years in the home-based physiotherapy group. There was no statistically significant difference in activity (p=0.980) and rest pain (p=0.483), wrist flexion (p=0.775) and extension (p=0.838) range of motion, functionality (p=0.346) and quality of life (p=0.923) between groups. **Conclusion:** Patients participating in a home-based physiotherapy program had similar clinical outcomes in terms of pain intensity, range of motion, functionality, and quality of life as patients participating in a supervised physiotherapy. Further prospective randomized studies can be conducted by increasing the sample size and comparing with cost analyzes to determine the rehabilitation regimen that will provide the best outcomes in lateral epicondylitis rehabilitation.

Keywords

Lateral Epicondylitis, Home Based Physiotherapy, Supervised Physiotherapy, Pain, Function, Quality of Life

INTRODUCTION

Lateral epicondylitis, also known as Tennis Elbow or Lateral Elbow Tendinopathy, which causes limitation in daily living activities, is one of the most common overuse syndromes in the elbow (Day et al., 2019). As a result of recurrent mechanical overuse or overload, the tendon's ability to repair itself becomes impaired and eventually fails. This then leads to structural alteration (tendon tearing), fibrosis and calcification (Cohen, & da Rocha Motta Filho, 2015).

Although there is no gender difference in prevalence (Ma & Wang, 2020) symptoms are more prolonged and severe in women (Waugh et al., 2004). Dominant extremity involvement is common and the extensor carpi radialis brevis (ECRB) is most affected tendon (Alizadehkhaiyat & Frostick, 2015).

Pain and point tenderness over lateral epicondyle, weak grip strength, functional limitation are typical findings (Brummel et al., 2014). Although it is easy to diagnose, a

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universally accepted treatment regimen has not been defined to date (Vaquero-Picado et al., 2017). However, the therapeutic goals in the treatment of lateral epicondylitis are control of elbow pain, preservation of movement in the affected extremity, improvement in grip strength and endurance, return to normal function, and prevent further histological and clinical deterioration (Ahmad et al., 2013). Conservative treatment including home-based or supervised exercise programs is one of the most recommended physiotherapy modalities for these purposes (Weber et al., 2015).

Home-based regimens can be performed at any time of the day without clinician supervision and include patient visits once or twice a week for further instruction. Supervised regimens are performed every day in the clinic under the supervision of a therapist and are more costly. (Stasinopoulos et al., 2005). The aim of this study was to compare the effectiveness of a supervised and home-based physiotherapy program in the reduction of pain and in improving functional status and quality of life in patients with lateral epicondylitis.

MATERIALS AND METHODS

Patients diagnosed with lateral epicondylitis in the Orthopaedics and Traumatology Department of a university hospital and referred to the School of Physical Therapy and Rehabilitation for treatment were evaluated retrospectively. The study was approved by the Clinical Research and Ethics Committee of the authors' affiliated institution.

The inclusion criteria were as follows: age older than 18 years, positive diagnosis of lateral epicondylitis, pain or tenderness persisting for at least 8 weeks on the lateral epicondyle, increased pain during resisted wrist extension, grip and supination, patients who included in a supervised or home-based physiotherapy program. Exclusion criteria were as follows: steroid injections at the lateral epicondyle within the last 6 months, receiving treatments such as non-steroidal anti-inflammatory drugs or physiotherapy for lateral epicondylitis during the last 2 weeks, comorbid diseases such as rheumatoid arthritis, neurologic or muscular disorders, diagnosed with or treated for cervical radiculopathy or herniation of intervertebral disc, a history of previous injury of the elbow.

Sixty-three patients datas reviewed, and 31 patients were excluded because of not meet inclusion criteria (n=12), being directed to different treatments (n=12), incomplete data (n=7). The final study sample consisted of 32 patients, with 15 in the supervised physiotherapy program group and 17 in the home-based physiotherapy program.

Patients with lateral epicondylitis referred to our clinic received the same exercise program: static stretching exercises of the ECRB tendon (30-45 s and 3 times before and after the eccentric exercises), slow progressive eccentric exercises of the wrist extensors (3 sets of 10 repetitions with 1-min rest between sets), cold pack (15 minutes). To reduce the potential for further damage to the affected tissues, it was aimed to perform the exercises gently without or with mild pain. The exercise program was performed for 3 weeks, 5 times per week, either under the supervision of a physiotherapist (supervised physiotherapy group) or at home without supervision (home-based physiotherapy group). In the home exercise group, patients were called to physical therapy clinics to ensure that they understood how to perform the exercises. During these visits, patients' adherence was questioned. In addition, all patients are given a patient education booklet with recommendations such as ergonomics, activity modification technique, activity avoidance or excess, and lifestyle changes.

All evaluations performed after treatment. Demographic (age, gender) and clinical data (body mass index, dominant and affected extremity) of patients were recorded. Visual analogue scale was used to evaluate elbow pain during rest and activity. Wrist flexion/extension range of motion was assessed by universal goniometer. Upper extremity functionality was assessed with Quick Disability of the Arm, Shoulder, and Hand questionnaire (QUICK-DASH) and quality of life with Short Form-36 (SF-36). Quick DASH consists of 11 items to measure physical function and symptoms in people with musculoskeletal disorders of the upper limb. The final score ranges between 0 (no disability) and 100 (most severe disability) (Düger et al., 2006).

Short Form-36 (SF-36) was used to determine a patient's health-related quality of life. The total score of the questionnaire ranged from 0 to 100, with a higher score indicating better quality of life (Koçyiğit et al., 1999).

Statistical Analysis

Statistical analysis was performed using the software package SPSS (Version 21, SPSS Inc, Chicago, IL, United States). Continuous variables (age and BMI) were presented as mean ± standard deviation, while categorical variables (gender, dominant and affected extremity) were presented as absolute numbers and percentages. The distribution of data was evaluated using the Shapiro Wilk test. Independent Samples t-test for parametric test assumptions (pain level, QUICK-DASH and SF-36 scores) and Mann-Whitney U Test for non-parametric test assumptions (wrist flexion/extension range of motion) were used for comparison of the groups. The statistical significance level was set as $p<0.05$.

RESULTS

Demographic and clinical characteristics of the patients are given in Table 1. The supervised physiotherapy group consisted of 15 patients (mean age, 44.20 years; 12 female and 3 male) and home-based physiotherapy group consisted of 17 patients (mean age, 26.83 years; 15 female and 2 male). 14 (93.3%) patients in the supervised, 13 (76.5%) in the home-based physiotherapy group presented dominant extremity injury.

Table 1. Descriptive data of patients

	Supervised group (n=15)		Home-based group (n=17)	
Variables	Min-Maks	X±SD	Min-Maks	X±SD
Age (year)	33-57	44.20±7.35	28-72	48.65±12.33
Body mass index (kg/m^2)	17.91-30.86	26.75±3.08	22.06-31.93	26.83±2.74
	n	%	n	%
Gender				
Female	12	80	15	88.2
Male	3	20	2	11.8
Dominant extremity				
Right	14	93.3	14	82.4
Left	1	6.7	3	17.6
Affected extremity				
Dominant	14	93.3	13	76.5
Nondominant	1	6.7	4	23.5

Min: Minimum, Max: Maximum, X: Mean, SD: Standard Deviation, kg: Kilogram, m: meter

The comparison of clinical outcome scores of the groups are shown in Table 2. There was no statistically significant difference in activity ($p=0.980$) and rest pain ($p=0.483$), wrist flexion ($p=0.775$) and extension ($p=0.838$) range of motion, functionality ($p=0.346$) and quality of life ($p=0.923$) between groups.

DISCUSSION

This study was planned to compare the effectiveness of a supervised and home-based physiotherapy program in the reduction of pain and in improving functional status and quality of life in patients with lateral epicondylitis. According to the results of this study, home-based physiotherapy is as beneficial as supervised physiotherapy in terms of pain, wrist range of motion, physical function, and quality of life outcomes.

Eccentric strengthening and static stretching exercises are among the most commonly used conservative techniques in the treatment of lateral elbow tendinopathy (Manias & Stasinopoulos (2006; Martinez-Silvestrini et al, 2005; Wen et al., 2011). Although there are conflicting results about which of the eccentric strengthening and static stretching exercises are more effective (Martinez-Silvestrini et al, 2005; Svernlöv & Adolfsson 2001), it is recommended that both be included in

the treatment program in the rehabilitation of tendinopathies (Dimitrios 2016; Dimitrios & Manias 2013). In present study, eccentric strengthening and static stretching exercises were applied to both groups, and patient outcomes were improved without any difference between the groups.

Table 2. Comparison of the groups in terms of pain, range of motion, function, and quality of life

	Supervised group (n=15)		Home-based group (n=17)		
Variables	Min-Max	Mean±SD (Median)	Min-Max	Mean±SD (Median)	p
Pain-rest	2-7	3.87±1.41 (4)	0.00-7.5	3.88±2.03 (4)	0.980
Pain-activity	4-9	6.67±1.72 (6)	4.5-9.5	7.06±1.34 (7)	0.483
Flexion	80-90	85.53±4.44 (86)	80-90	85.87±4.98 (90)	0.775
Extension	65-70	69.07±1.71 (70)	65-70	69.07±1.75 (70)	0.838
QUICK-DASH	2.25-59	32.08±17.13 (36.25)	13.15-63.75	37.32±13.18 (36.25)	0.346
SF-36 physical	29-100	66.27±22.82 (57)	29-71	56.18±11.84 (57)	0.139
SF-36 mental	24-100	64.73±24.02 (62)	38-100	67.29±17.58 (67)	0.736
SF-36 total	23-100	62.07±21.48 (69)	46-80	61.47±10.39 (57)	0.923

Min: Minimum, Max: Maximum, X: Mean, SD: Standard Deviation, QUICK-DASH: Quick Disability of the Arm, Shoulder, and Hand questionnaire, SF-36: Short Form-36

Home-based and supervised exercise can be equally effective on patient clinical outcomes in musculoskeletal disorders (Gutiérrez-Espinoza et al., 2020; Granviken & Vasseljen., 2015). Home-based exercises can also improve pain, muscle strength, functionality, and quality of life in patients with lateral epicondylitis (Martinez-Silvestrini et al, 2005; Peterson et al., 2014; Svernlöv & Adolfsson, 2001; Wen et al., 2011). Dimitrios and Manias reported that a supervised exercise program was more effective than home-based exercise in reducing pain and improving function. However, different exercise protocols were applied to the groups (Dimitrios & Manias 2013). In the present study, the same treatment program was applied to both groups for 3 weeks, and the outcomes of the supervised physiotherapy program were similar to those of the home-based. Based on these findings home-besed physiotherapy may be preferred in patients with lateral epicondylitis.

The success of exercise interventions largely depends on patient adherence. Dimitrios and Manias stated that patients who underwent home exercise program did not comply with the exercise regimen (Dimitrios and Manias., 2013). In this study, we questioned the exercise compliance of the home-based group during weekly clinical visits, and we did not observe non-compliance. Our study duration was relatively short. In long-term follow-up studies, mobile health technologies, self-monitoring and patient education can be used to increase patient compliance of home-based exercise programs (Argent et al, 2018).

Both groups had moderate activity pain and health-related quality of life after treatment. The short-term implementation of both exercise programs may not have provided sufficient reduction in pain intensity. Although the positive effect of exercise for tendinopathy has been proven, the evidence for optimal dosing and loading strategy is insufficient (van Ark et al. 2016). There is also a relationship between pain and quality of life (Samagh et al, 2015). The moderate level of pain severity of our

participants may have caused the health-related quality of life scores to be moderate.

This study has some limitations. The main limitations of this study are that it was a nonrandomized study and absence of pretreatment evaluations. The other limitation of our study is that follow-up duration is very short. In future randomized controlled trials, a longer follow-up period and sample size may be important to gain more information on the effectiveness of exercise methods.

In conclusion, this study showed that for patients with lateral epicondylitis, patients participating in a home-based physiotherapy program had similar clinical outcomes in terms of pain intensity, range of motion, functionality, and quality of life as patients participating in a supervised physiotherapy. Further prospective randomized studies can be conducted by increasing the sample size and comparing with cost analyzes to determine the rehabilitation regimen that will provide the best outcomes in lateral epicondylitis rehabilitation.

Conflict of interests:

The authors have no conflict of interests to declare. No financial support was received for this study.

Ethics Statement

The studies involving human participants were reviewed and approved by the Pamukkale University, Non-Interventional Clinic Research Ethics Committee (Date: 13.07.2021; Decision / Protocol number: E-60116787-020-77774). Written informed consent to participate in this study was provided by the patients/participants.

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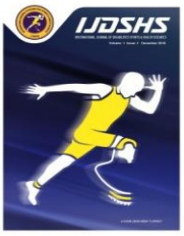

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RESEARCH ARTICLE

The Relationship of Kinesiophobia and Pain Catastrophizing with Pain, Range of Motion, Muscle Strength and Function in Osteoarthritis

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Abstract

Objective: This study aimed to investigate the relationship between kinesiophobia and pain catastrophizing with pain, range of motion, muscle strength, and function in patients with knee osteoarthritis. **Methods:** 18 female knee osteoarthritis patients between the ages of 50-70 who were found to have kinesiophobia and pain catastrophizing were included in the study. Kinesiophobia, pain catastrophizing, pain, range of motion, muscle strength, and functional status were evaluated within the scope of the study. **Results:** A statistically significant strong positive correlation between kinesiophobia and pain intensity during activity ($r=0.80$, $p<0.001$); a statistically significant moderate negative correlation between kinesiophobia and active knee flexion angle ($r=-0.48$, $p<0.05$); a statistically significant moderate positive correlation between kinesiophobia and the Five Times Sit to Stand Test time and the Stair Climb Test time ($r=0.51$, $p<0.05$; $r=0.67$, $p<0.05$, respectively) was found. A statistically significant moderate positive correlation between pain catastrophizing and resting pain intensity, pain intensity at night, pain intensity during activity, and passive knee extension angle ($r=0.66$, $p<0.01$; $r=0.61$, $p<0.01$; $r=0.47$, $p<0.05$; $r=0.48$, $p<0.05$, respectively); a statistically significant moderate negative correlation between pain catastrophizing and active knee flexion angle ($r=-0.49$, $p<0.05$) was found. **Conclusions:** It was determined that as kinesiophobia increased in patients with knee osteoarthritis, pain, range of motion, muscle strength, and functional status worsened, and the increase in pain catastrophizing was associated with worsening in pain and range of motion. Therefore, it was concluded that reducing kinesiophobia, and pain catastrophizing levels would contribute to improving functions in patients with knee osteoarthritis

Keywords
Osteoarthritis, Kinesiophobia, Pain Catastrophizing, Pain, Function

INTRODUCTION

Osteoarthritis is a degenerative joint disease in which all joint structures are affected, including cartilage, subchondral bone, synovium, ligaments, joint capsule, and muscles. Osteoarthritis, which is the most common form of arthritis, is one of the important health problems that cause severe limitation of movement and pain (Bijlsma et al., 2011; Felson et al., 2000; A. D. Woolf and Pfleger, 2003). Osteoarthritis increases with age and is often seen in the elderly (Loeser Jr, 2000). It is thought that there are around 300 million osteoarthritis patients in the world (James et al., 2018). It has been determined that the prevalence of symptomatic knee osteoarthritis in Turkey is 8% in men over 50 years old, 22.5% in women, and 14.8% in total (Kacar et al., 2005). Osteoarthritis is a disease with multiple etiologies, which is caused by the inflammatory, metabolic and mechanical factors (Felson et al., 2000). Risk factors in knee osteoarthritis are classified as modifiable and non-

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modifiable, such as age, gender, family history, obesity, trauma, and malalignment (Abramoff and Caldera, 2020; Felson et al., 1995; Lespasio et al., 2017; Zhang and Jordan, 2010).

Pain, edema, bone growth, crepitation, locking sensation, stiffness, muscle weakness, decrease in range of motion and deformity are common symptoms in patients with knee osteoarthritis. Knee osteoarthritis negatively affects daily life by causing deterioration in the function and quality of life (Abramoff and Caldera, 2020; Felson et al., 1995; Hunter and Bierma-Zeinstra, 2019).

In long-term pain conditions such as osteoarthritis, sensitivity to pain and chronic pain may develop. This sensitivity and chronic pain occur as a result of neuroplasticity (C. J. Woolf and Salter, 2000). After injuries, while primary hyperalgesia occurs as a result of peripheral sensitization in the site of inflammation; secondary hyperalgesia occurs as a result of central sensitization in areas of the body where there is no inflammation (Coderre et al., 1993). After tissue healing occurs, peripheral and secondary hyperalgesia disappears. However, as in osteoarthritis, if inflammation and pain are prolonged due to continuous anabolic and catabolic activities in the site of injury, sensitization and hypersensitivity continue. This causes an increase in the severity of pain and the formation of chronic pain (Kehlet et al., 2006). Sensitization and hypersensitivity continue in cases of fear developed against pain (Leeuw et al., 2007; Vlaeyen and Linton, 2000). People who react inconsistently and violently to pain develop avoidance behaviors against injury/re-injury. Therefore, kinesiophobia and pain catastrophizing are important psychological factors that cause pain and worsening in function (Leeuw et al., 2007).

Kinesiophobia (Perrot et al., 2018) and pain catastrophizing (M. Sullivan et al., 2009) decrease the efficiency of treatment and patient satisfaction in cases of long-term pain due to their negative effects on pain and function. Therefore, the effects of kinesiophobia and pain catastrophizing in osteoarthritis patients should be determined. For this reason, this study aimed to investigate the relationship between kinesiophobia and pain catastrophizing with pain, range of motion, musle strength and function in knee osteoarthritis patients.

MATERIALS AND METHODS

Study Design and Participants

The study was carried out with 18 female knee osteoarthritis patients between the ages of 50-70 who were planned to have total knee arthroplasty surgery and were admitted to the Gazi University Hospital Orthopedic Service. Since it was determined that there were differences in muscle morphology and functional outcomes in women compared to men, only female patients were included in the study so that the differences would not affect the results of the study (Behan et al., 2018; Gustavson et al., 2016).

The inclusion criteria of the study were (1) woman between the ages of 50-70, (2) knee osteoarthritis of stage 3-4 according to the Kellgren-Lawrence Osteoarthritis Classification System, (3) Tampa Scale of Kinesiophobia score of ≥37, (4) Pain Catastrophizing Scale score of ≥30. The exclusion criteria of the study were (1) neurological, rheumatological, or oncological disease, (2) anxiety diagnosed by a specialist physician, (3) Mini Mental Test score of <24. The study protocol was approved by the ethics committee of Gazi University (No: 611). All the assessments were conducted in accordance with the Helsinki declaration. All cases provided a written informed consent approved by the ethics committee.

Measurements

Mini-mental state, kinesiophobia, and pain catastrophizing assessments were performed to determine eligibility for participation in the study. Demographic, physical, and pathological information of the patients were recorded. Also, pain, range of motion, muscle strength, and functional status were evaluated and recorded in the evaluation form.

Mini Mental Test

The Standardized Mini-Mental Test was used in the evaluation of educated patients, and the Modified Mini-Mental Test was used in the evaluation of illiterate patients (Folstein et al., 1975). The validity and reliability of the Standardized Mini-Mental Test (ICC: 0.99) were performed by Güngen et al. in 2002 (Güngen et al., 2002), and the validity and reliability study of the Modified Mini-Mental Test by Ayhan et al. in 2018 (IC: 0.70) (Ayhan et al., 2018). The Mini-Mental Tests are methods that allow the numerical evaluation of cognitive status. The tests consist of

11 items in 5 sections: orientation (time and space orientation), recording memory, attention and calculation, recall, and language. By scoring 11 items, the total score varies between 0-30 (Folstein et al., 1975). The cut-off point of Mini-Mental Test scores was determined as 23/24 (Ayhan et al., 2018; Güngen et al., 2002).

Tampa Scale of Kinesiophobia

Kinesiophobia was evaluated with the Tampa Scale of Kinesiophobia, of which Turkish validity and reliability were studied (Kori, 1990; Yilmaz et al., 2011). The Tampa Scale of Kinesiophobia includes injury/re-injury and fear of movement parameters and consists of 17 questions. A 4-point Likert scale (1= strongly disagree, 4= totally agree) is used to evaluate the questions. The total score is calculated after reversing the scores of questions 4, 8, 12 and 16. The total score ranges from 17 to 68 (Kori, 1990; Vlaeyen et al., 1995). Scores of 37 and above on the Tampa Scale of Kinesiophobia indicate the presence of high kinesiophobia (ICC: 0.806) (Vlaeyen et al., 1995).

Pain Catastrophizing Scale

Pain catastrophizing was assessed using the Pain Catastrophizing Scale. In 2017, Ugurlu et al. conducted a Turkish validity and reliability study of the Pain Catastrophizing Scale (Ugurlu et al., 2017). The Pain Catastrophizing Scale is a 13-item scale that evaluates pain magnification, worrying about pain, and coping with pain. Each item is evaluated on a 5-point Likert scale, between 0-4 points (0=never, 4=always). The total score ranges from 0 to 52 points (Domenech et al., 2013; M. J. Sullivan et al., 1995). Scores of 30 and above on the Pain Catastrophizing Scale indicate the presence of high pain catastrophizing (ICC: 0.830) (M. J. Sullivan, 2009).

Numerical Pain Rating Scale

The pain was evaluated separately with Numerical Pain Rating Scale (NPRS) at rest, at night, and during activity. Pain during activity was evaluated by questioning the pain intensity of the patients on walk throughout the day. The patient was asked to express the severity of pain in numbers that would accurately reflect her pain, with a score of zero if there was no pain, and ten for the most severe pain (ICC: 0.84) (Briggs and Closs, 1999; DeLoach et al., 1998; Jensen and McFarland, 1993).

Range of Motion Testing

Knee range of motion was measured with a universal goniometer with proven validity and reliability for knee joint flexion and extension movements in the supine position. 2 measurements were made for each evaluation and the highest values were recorded in degrees (Jakobsen et al., 2010; Watkins et al., 1991).

The cases where 0 degrees could not be reached in the evaluation of knee extension were recorded as positive values, and the degrees of knee extension performed more than 0 degrees were recorded as negative values (Jakobsen et al., 2010).

Evaluation of active and passive knee flexion: The pivot point of the goniometer was placed in the middle of the lateral condyle of the femur while the patient was lying in the supine position.

To determine active knee flexion, the patient was asked to flex the knee as much as possible, and the active knee flexion angle was determined so that one arm of the goniometer was parallel to the femur while the other arm followed the midline of the fibula (ICC: 0.81) (Jakobsen et al., 2010).

To determine passive knee flexion, the patient's knee was manually extended without causing pain or discomfort in the patient, and the passive knee flexion angle was determined so that one arm of the goniometer was parallel to the femur while the other arm followed the midline of the fibula (ICC: 0.96) (Jakobsen et al., 2010).

Evaluation of active and passive knee extension: A roller was placed under the heel of the lower extremity to be evaluated while the patient was lying in the supine position, and the pivot point of the goniometer was placed in the middle of the lateral condyle of the femur.

To determine active knee extension, the patient was asked to extend the knee as much as possible, and the active knee extension angle was determined so that one arm of the goniometer was parallel to the femur while the other arm followed the midline of the fibula (ICC: 0.86) (Jakobsen et al., 2010).

To determine passive knee extension, the patient's knee was manually extended without causing pain or discomfort in the patient, and the passive knee extension angle was determined so that one arm of the goniometer was parallel to the femur while the other arm followed the midline of the fibula (ICC: 0.70) (Jakobsen et al., 2010).

Five Times Sit to Stand Test

The Five Times Sit to Stand Test (FTSTS) can be used to evaluate lower extremity muscle strength during sitting and standing movements in the elderly (Csuka and McCarty, 1985; Schaubert and Bohannon, 2005; Tiedemann et al., 2008). The patient sat in a standard-height (43 cm.) chair with their backs against the chair, hands crossed on their chests, and feet touching the floor. During the test, they were asked not to use their hands to get support from the arms or lower extremities of the chair. In addition, participants were allowed to position their feet comfortably. Patients were asked to sit and stand up to 5 times in a row as quickly and safely as they could. FTSTS was repeated one time unless there was a problem in performing the test. When there was a problem in performing the test, the patient was rested and then the test was repeated. The time between the first moment of movement and the moment of resting on a chair for the last time was recorded in seconds with a stopwatch (ICC: 0.80) (Tiedemann et al., 2008).

Timed Up and Go Test

In the Timed Up and Go Test (TUG), the patient was asked to get up from the chair as fast as she could, walk the specified 3 meters distance, turn around, and sit on the chair by walking the same path again. TUG was repeated one time unless there was a problem in performing the test. When there was a problem in performing the test, the patient was rested and then the test was repeated. The time at which the test was completed was measured with a stopwatch and recorded in seconds (ICC: 0.97) (Bennell et al., 2011; Steffen et al., 2002).

Stair Climb Test

In the Stair Climb Test (SCT), patients were first asked to climb 9 steps with a step height of approximately 20 cm, then return and descend 9 steps. SCT was repeated one time unless there was a problem in performing the test. When there was a problem in performing the test, the patient was rested and then the test was repeated. The time at which the test was completed was measured with a stopwatch and recorded in seconds (ICC: 0.93) (Bennell et al., 2011; Rejeski et al., 1995).

Statistical Analysis

SPSS 22.0 statistical package program was used in the analysis of the data. Number (n)-percent (%), mean±standard deviation (mean±sd), median, and minimum-maximum (min-max) values were used as descriptive statistics. In the study, the conformity of the data to the normal distribution was evaluated with the Kolmogorov-Smirnov test. Since it was observed that the data were not normally distributed, Spearman correlation analysis was used in the correlation analysis of the data. Spearman's correlation coefficient interpretation is similar to that of Pearsons. The Pearson correlation coefficients were interpreted as; 0-0.19= very weak, 0.20-0.39= weak, 0.40-0.69= mederate, 0.70-0.89= strong, 0.90-1.0= very strong (Streiner et al., 2015). Statistical significance level was accepted as $p<0.05$ in all analyzes performed in the study.

RESULTS

Age, body mass index, duration of disease, education level, exercise habit and smoking status were evaluated as demographic features of the patients (Table 1).

Table 1. Demographic features of the patients

Demographic Features		**Total (n=18)**
Age (years, mean±SD)		63±6
BMI (kg/m2, mean±SD)		31.2±4.03
Duration of Disease [year, med (min-max)]		6 (2-30)
Level of Education (n, %)	Uneducated	5 (27.8)
	Primary School	12 (66.7)
	High School	1 (5.5)
Exercise Habit (n, %)	Yes	0 (0)
	No	18 (100)
Smoking Status (n, %)	Yes	2 (11.1)
	No	16 (88.9)

n: number of patients, SD: standard deviation, med: median, min: minimum, max: maximum, kg: kilogram, m: meter, %: percentage

Pain were evaluated at rest, at night and during activity. The median pain intensity of the patients in all pain assessments was found to be 5 or above. In the range of motion measurements, passive and active knee flexion and extension were evaluated. The FTSTS, the TUG and the SCT were the functional tests performed in the study (Table 2).

Table 2. Pain, range of motion, muscle strength, and functional results of the patients

Variables	Total (n=18) Med (min-max)
Resting Pain (NPRS)	5 (0-9)
Night Pain (NPRS)	6 (0-10)
Activity Pain (NPRS)	7 (2-10)
Passive Knee Flexion (degree)	98 (20-115)
Passive Knee Extension (degree)	1 (-5-8)
Active Knee Flexion (degree)	81 (55–109)
Active Knee Extension (degree)	5 (0–10)
FTSTS (second)	23.85 (12.40–51.20)
TUG (second)	15.4 (8.80–37.90)
SCT (second)	30.7 (20.60–43.84)

med: median, min: minimum, max: maximum, NPRS: Numerical Pain Rating Scale, FTSTS: Five Times Sit to Stand Test, TUG: Timed Up and Go Test, SCT: Stair Climb Test.

Kinesiophobia was found correlated with pain intensity during activity, active knee flexion angle, the FTSTS time and the TUG time ($p<0,05$). There was no statistically significant correlation between kinesiophobia and resting pain intensity, pain intensity at night, active knee extension angle and the SCT ($p>0.05$). Pain catastrophizing was found correlated with resting pain intensity, pain intensity at night, pain intensity during activity, passive knee extension angle and active knee flexion angle ($p<0.05$). There was no statistically significant correlation between pain catastrophizing and functional tests ($p>0.05$), (Table 3).

Table 3. Correlation between kinesiophobia and pain catastrophizing with pain, range of motion, muscle strength, and function

	TSK		PCS	
	r	**p**	**r**	**p**
Resting Pain (NPRS)	0.40	0.093	**0.66**	**0.003**
Night Pain (NPRS)	0.34	0.161	**0.61**	**0.007**
Activity Pain (NPRS)	**0.80**	**0.000**	**0.47**	**0.047**
Passive Knee Flexion (degree)	0.23	0.350	-0.31	0.902
Passive Knee Extension (degree)	0.22	0.368	**0.48**	**0.041**
Active Knee Flexion (degree)	**-0.48**	**0.044**	**-0.49**	**0.039**
Active Knee Extension (degree)	0.18	0.471	0.29	0.233
FTSTS (second)	**0.67**	**0.022**	0.28	0.397
TUG (second)	**0.51**	**0.030**	0.38	0.112
SCT (second)	-0.23	0.341	0.10	0.694

$p<0.05$, TSK: Tampa Scale of Kinesiophobia, PCS: Pain Catastrophizing Scale, NPRS: Numerical Pain Rating Scale, FTSTS: Five Times Sit to Stand Test, TUG: Timed Up and Go Test, SCT: Stair Climb Test.

DISCUSSION

In this study, the relationship between kinesiophobia and pain catastrophizing with pain, range of motion, muscle strength, and function in knee osteoarthritis patients was investigated. It was determined that there was a relationship between kinesiophobia with pain intensity during activity, active knee flexion angle, FTSTS time, TUG time. Pain catastrophizing was found to be associated with pain intensity at rest, at night and during activity, passive knee extension angle, and active knee flexion angle.

The resting pain intensity of the patients was 5 (0-9), the pain intensity at night was 6 (0-10), and the pain intensity during activity was 7 (2-10) in our study. When these values evaluated out of 10 according to NPRS, it is seen that the pain severity of the patients is high. In a study conducted by Aykut Selçuk et al., patients with high kinesiophobia levels also had high pain intensity at resting, at night and during activity (Aykut Selçuk and Karakoyun, 2020). The results of our study show that the pain intensity of patients with knee osteoarthritis are similar to the literature.

In our study, the passive knee flexion angle was 98 (20-115) degrees, and the passive knee extension angle was 1 (-5-8) degrees. In the study of Steultjens et al., the passive knee flexion and extension angles of the patients were more limited compared to our study (Steultjens et al., 2000). The reason for this situation can be shown as the fact that the patients included in our study have a stage 3 or 4 osteoarthritis level according to the Kellgren-Lawrence Osteoarthritis Classification and that they have limited range of motion at the level for which total knee arthroplasty will be planned. In our study, active knee flexion angles of the patients were 81 (5-109) degrees, and active knee extension angles were 5 (0-10) degrees. In our literature research, no study was found comparing the results of kinesiophobia and active knee range of motions in osteoarthritis patients.

The TUG time in our study was found to be 15.40 (8.80–37.90) seconds. Since the scores above 14 seconds in the TUG indicate the risk of falling, it was determined that the patients in our study were at risk of falling, similar to the literature (Shumway-Cook et al., 2000). The SCT time of the patients in our study was 30.70 (20.60–43.84) seconds, and the FTSTS time was 23.85 (12.40–51.20) seconds.

Kinesiophobia is one of the crucial factors that cause pain and worsening of function after TKA (Perrot et al., 2018). Therefore, it is important to evaluate kinesiophobia and determine its relationship with pain and function in osteoarthritis. A statistically significant relationship was found between kinesiophobia and pain intensity during activity in our study. This result obtained in our study shows that kinesiophobia can be effective not only on function but also on pain. There are conflicting results in the literature on this subject. While there was a relationship between kinesiophobia and pain intensity during activity in the study conducted by Alaca (Alaca, 2019), no relationship was found in the study conducted by Aykut Selçuk et al. (Aykut Selçuk and Karakoyun, 2020). In a systematic review that included 63 studies with a total of 10726 participants, higher levels of kinesiophobia were also found to be associated with higher levels of pain (Luque-Suarez et al., 2019). In our study, it was determined that the active knee flexion angle decreased as the kinesiophobia levels increased. This result shows that kinesiophobia may limit active knee movement in patients with knee osteoarthritis. It was also observed that as the kinesiophobia levels increased, the SCT time and the FTSTS time increased in a correlated way. These results show that kinesiophobia negatively affects the functional status. In the study conducted by Alaca, the functional status assessment was evaluated with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and a relationship was found between kinesiophobia and WOMAC score (Alaca, 2019). Similarly, in the study conducted by Aykut Selçuk et al., a relationship was found between kinesiophobia and WOMAC score in female patients (Aykut Selçuk and Karakoyun, 2020). The result of these studies shows that the subjective functional status is also affected by kinesiophobia. When the results of these studies and our study are considered together, function worsens as kinesiophobia levels increase.

Pain catastrophizing negatively affects the pain experience by inhibiting pain inhibition in cases of long-term pain (Leeuw et al., 2007). For this reason, pain catastrophizing affects pain and function negatively in osteoarthritis patients. In our study, it was determined that there was a statistically significant relationship between pain catastrophizing and pain intensity at rest, at night,

and during activity. This result in our study supports the conclusion that pain catastrophizing is the most important psychological factor related to pain (M. J. Sullivan et al., 1995). Similarly, in the study of Odole et al., it was observed that as the pain catastrophizing levels increased, the intensity of pain also increased (Odole et al., 2019). In our study, it was determined that the passive knee extension and active knee flexion angles decreased as the pain catastrophizing levels increased. In our literature research, we did not find any study investigating the correlation between pain catastrophizing and knee range of motion angles. No significant relationship was found between pain catastrophizing and functional tests in our study. In the study conducted by Ong et al., functional status was evaluated with WOMAC and they determined that an increase in pain catastrophizing levels was associated with worsening in function (Ong et al., 2021). The reason for this difference may have arisen from the difference between the level of functional status reported subjectively by patients in WOMAC in the study of Ong et al. and the objective measures of functional tests of our study.

This study had several limitations. One of these limitations was the relatively small sample size. The absence of a healthy control group and a low-level kinesiophobia group was another limitation of the study. Another limitation was not questioning the use and dosage of non-steroidal anti-inflammatory drugs and analgesics before the evaluation. The lack of evaluation of the subjective functional status and quality of life of the patients can also be said as a limitation of the study.

Conclusion

In conclusion, it was determined that as kinesiophobia increased in patients with knee osteoarthritis, pain, range of motion, muscle strength, and functional status worsened, and the increase in pain catastrophizing was associated with worsening in pain and range of motion. Therefore, it is important to determine the levels of kinesiophobia and pain catastrophizing in patients with knee osteoarthritis. It was concluded that reducing kinesiophobia and pain catastrophizing levels in patients with knee osteoarthritis who had functional limitations would contribute to improve functions.

Conflict of interests

The authors have no conflict of interests to declare. No financial support was received for this study.

Ethics Statement

The studies involving human participants were reviewed and approved by the Gazi University, Clinical Research Ethics Committee (Date: 28.06.2021; Decision / Protocol number: 2021/611). Written informed consent to participate in this study was provided by the patients/participants.

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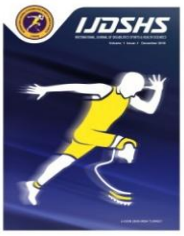

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RESEARCH ARTICLE

Relationship of Hand Grip Strength on The Upper Extremity Function, Activities of Daily Living and Physical Activity Level in Patients with Postmastectomy Lymphedema: A Pilot Study

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Abstract

This study aimed to investigate the relationship of hand grip strength on upper extremity functionality, activities of daily living, and physical activity level in female patients with lymphedema who have undergone breast cancer surgery. A total of 15 female patients with a diagnosis of lymphedema associated with breast cancer treatment were included in the study. The presence and severity of lymphedema were determined by circumference measurement. A hand dynamometer was used to evaluate the hand grip strength. Disabilities of Arm, Shoulder and Hand Questionnaire (DASH); Milliken Activities of Daily Living Scale (MAS);and the long form of the International Physical Activity Questionnaire(IPAQ) were used to evaluate upper extremity functionality, daily living activity, and physical activity level, respectively. The mean age of the patients was 51±10.6 years. DASH score was significantly related with age (r:0.639; p:0,010). The relationship between the hand grip strength of the affected side and the hand grip strength of the unaffected side was statistically positively significant (r:0.756; p:0.001).It was determined that hand grip strength was related to the total MAS value and the DASH score (r:0.609;p:0.016 and r:-0.624; p:0.013, respectively). The relationship between postoperative lymphedema development time with affected side hand grip strength and total MAS score was statistically significant (r:0.574; p:0.025 and r:0.766; p:0.001, respectively). There were no correlations between IPAQ score and hand grip strength, DASH, and MAS values (p>0.05). Considering these results, we concluded that improving hand grip strength in the early period may increase upper extremity functionality and quality of life for these patients.

Keywords
Breast Cancer, Lymphedema, Hand Grip Strength, Activities Of Daily Living, Physical Activity

INTRODUCTION

Breast cancer is the most common malignancy in women and it has better survival rates than other cancers (Hayes et al. 2005). Lymphedema is defined as a disease that occurs as a result of the accumulation of water, plasma proteins, extravascular fluid, and parenchymal cells in the interstitial space due to the low carrying capacity of the lymphatic system in the report of the International Society of Lymphology (ISL) (Orhan et al. 2019).

In the literature, the incidence of secondary lymphedema after breast cancer treatment was 16%, and when the data of the cohort studies were analyzed, this frequency increased to 21%. Factors that increase the development of lymphedema after breast cancer treatment are axillary lymph node dissection, chemotherapy, radiotherapy, and infection in the incision site after the operation (Schmitz et al. 2009). A body mass index of 30 kg/m² and above is also a defined risk factor for

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lymphedema associated with breast cancer. The increase in body mass index causes physical activity and exercises not to be done regularly (Zhu et al. 2014).

Breast cancer-related lymphedema is one of the most stressful symptoms and one of the most common complications for individuals due to its prognosis (Sakorafas et al. 2006). Although improvements in treatment increase survival in breast cancer, shoulder dysfunction associated with upper extremity functions, upper extremity muscle weakness, and lymphedema are observed in patients after treatment (Lee et al., 2001, Radina et al. 2004; Gary, 2007; Büyükakıncak et al. 2014). Voogd et al. reported that women with lymphedema most frequently experience problems with the upper extremity (Voogd et al. 2003). Lymphedema that develops after breast cancer surgery often negatively affects the glenohumeral joint by increasing the tension in the tendons of the rotator cuff muscles and disrupting the scapulohumeral rhythm (Herrera & Stubblefield, 2004). Moreover, lymphedema reduces upper extremity muscle strength and range of motion, may cause symptoms such as pain and fatigue, resulting in activity limitations and a decrease in upper extremity functional level (Taghian et al. 2014; Klernas et al. 2015). Decreases in muscle strength affect physical performance and decrease the level of independence in daily life (Khan et al. 2012; Fu, 2014).

There are studies in the literature examining the effects of lymphedema on upper extremity functionality, quality of life, disability, muscle weakness, and shoulder pain (Kwan et al. 2002; Beaulac et al., 2002, Ahmed et al., 2008, Atalay et al. 2011; Ridner, 2005). However, the effect of hand grip strength on activities of daily living has not been evaluated in studies. This study aimed to examine the relationship of hand grip strength with upper extremity functionality, activities of daily living, and physical activity level in female patients with lymphedema who had undergone breast cancer surgery. It was hypothesized that hand grip strength in lymphedema patients might be related to upper extremity function, activities of daily living, and physical activity level.

MATERIALS AND METHODS

Ethics Approval

The study protocol was approved by the Uskudar University Non-Invasive Ethics Committee (Decision number: 2020-80; Date: 29.01.2020). The participants were informed about the scope and procedures of the study. Written informed consent was obtained from all participants in line with the principles of the Declaration of Helsinki.

Patients

In this study, female patients between the ages of 30 and 70 years who were operated unilaterally for breast cancer and diagnosed with lymphedema associated with breast cancer treatment at Acibadem Maslak Hospital Senology Research Institute between February 2020 and December 2020, and those who volunteered to participate in the study were included in the study. Fifteen female patients who met the study criteria were included in the study group. Patients with bilateral lymphedema, patients with metastatic breast cancer, patients aged 70 years and older, patients with secondary shoulder problems in the affected arm, and existing upper extremity infections were excluded from the study.

Participants' demographic data (age, height, weight, body mass index) and detailed medical history (dominant and affected side, type of surgery, other cancer-related treatments, post-operative lymphedema onset time, and lymphedema duration) were recorded.

Evaluation of Lymphedema

For the diagnosis of upper extremity lymphedema on all participants, the circumference was measured with a standard tape measure, taking the anterior projection of the styloid process of the ulna as a reference, by marking the reference points at intervals of 10 centimeters (cm) up to the axillary region. The severity of lymphedema was determined according to the values accepted by the American Physiotherapy Association (Taylor et al. 2006). If the difference between the extremities was less than 3 cm, it was accepted as mild lymphedema, 3-5 cm as moderate, and greater than 5 cm as severe lymphedema (Karadibak et al. 2009).

Table 1. Summary of patient characteristics

Patients with lymphedema after breast cancer surgery (n=15)		
	Mean±SD	**(Min-Max)**
Age (years)	51±10.60	35-69
Height (m)	1.61±0.078	1,48-1,76
Weight (kg)	74.16±13.87	55-97
BMI (kg/m²)	28.60±5.47	21.48-36.21
Onset time of lymphedema (months)	24.33±54.07	1-216
Duration of Lymphedema (months)	25.13±73.26	1-288
Grip affected side (kgf)	20.63±3.82	16,6-28
Grip unaffected side (kgf)	20.55±4.71	13.6-28.1
	n	**%**
Type of surgery		
Modified Radical Mastectomy (MRM)	7	46.6
Breast Conserving Surgery (BCS)	4	26.7
Breast Reconstruction Surgery (BRS)	4	26.7
Affected arm		
Right	5	33.3
Left	10	66.7
Dominant hand		
Right	13	86.7
Left	2	13.3
Chemotherapy	14	93.3
Radiotherapy	13	86.7
Lymphedema severity		
Mild (<3 cm)	7	46.7
Moderate (3-5 cm)	5	33.3
Severe (>5 cm)	3	20.0

SD standart deviation; Min-Max minimum-maximum

Evaluation of Hand Grip Strength

Hand grip strength, in both hands in the standard position recommended by the "American Society of Hand Therapists"; was measured with a hand dynamometer (Saehan Corporation, Masan, Korea) with the elbow flexed to 90˚ and the forearm and wrist in the neutral position. Before the measurements, the participants were informed verbally. When participants were ready, they were asked to grip the dynamometer with all their strength for 3 seconds and then release it. Each evaluation was repeated 3 times and averaged. Participants rested for 1 minute between measurements. A difference of ≥ 10% between the non-lymphedema and lymphedema sides was considered as a decrease in hand grip strength on the lymphedema side (Hladiuk et al. 1992).

Disabilities of Arm, Shoulder and Hand Questionnaire (DASH)

It is a 30-item self-report questionnaire consisting of three parts, developed to evaluate upper extremity functional status and musculoskeletal symptoms. Each item is scored on a 5-point Likert (1-5) scale. According to the survey, the smallest number 1 indicates 'no difficulty' and the highest number 5 'serious difficulties'. The total score of this questionnaire ranges from 0-100. An increase in score means worsening of functional status. When the results are calculated, the number '0' is considered 'no disability, while the number '100' is considered the 'most severe disability'. The total score is calculated as a percentage over 100 points, using the formula (Total score of marked items/number

of marked items – 1) × 25. (Hudak et al. 1996; Gummesson et al. 2006). The Turkish validity and reliability study of the questionnaire was conducted (Düger et al. 2006).

Milliken Activities of Daily Living Scale (MAS)

MAS is a patient-centered assessment of activity limitation that measures upper extremity impairment. The questionnaire can be used in any disorder that results in upper extremity activity limitation. MAS provides scales that simultaneously measure "ability" and "necessity" for each item. MAS is a 47-item self-report questionnaire designed to include bilateral and unilateral tasks that require both gross and fine motor skills, in addition to varying grip patterns and resistance levels. This questionnaire covers the three main areas of The International Classification of Functioning (ICF) and is divided into six sections for clinical utility with the following task groups:

1. Preparing and eating food (8 items),
2. Personal care (9 items),
3. Dressing (8 items),
4. Object manipulation (9 items),
5. House cleaning and laundry (7 items),
6. Other Activities (6 items).

For each item, there is a 5-point scale to score the current skill level and a 3-point scale to score the requirement level. For each item, the ability level is scored first, followed by the requirement level. The total score for all sections is obtained by adding the current skill level points for each section. The total score ranges from 47-235. In the combined scoring procedure, each skill score is multiplied by the requirement score and the resulting scores are summed. This procedure results in 15 points for each item, with a combined total score of up to 705 (Seaton et al. 2005). A validity and reliability study of the questionnaire was conducted for the Turkish population (Akel et al. 2010).

International Survey of Physical Activity (IPAQ)

IPAQ is used to determine the physical activity levels of the patients. This questionnaire evaluates the severe, moderate activities and walking activities of the individuals in the last seven days. The long form evaluates activities in this area such as housework, gardening, work activity, transportation, and leisure activities in detail. Time spent sitting is recorded as weekdays and weekends.

There are two different evaluations in calculating the total score. The first includes specific scoring (work, transportation, gardening, leisure), and the second includes activity-specific scoring (walking, moderate activity, severe activity). A score is obtained in "metabolic equation (MET)-minutes". A MET-minute is calculated by multiplying the minute of activity performed by the MET score. MET-minute scores are based on kilocalories for a 60-kilogram person.

Weekly MET-minute (min) scores are calculated by multiplying the metabolic equation (MET) values corresponding to each activity (very severe physical activity=8 METs, severe physical activity=6.0 METs, moderate-severe physical activity=5.5 METs, moderate physical activity=4.0 METs, mild physical activity = 3.3 METs), the duration of the activities (min) and the frequency (number of days) (Craig et al. 2003; Committee, 2005). The Turkish validity and reliability study of the questionnaire was conducted (Sağlam et al. 2012).

Statistical Analysis

The data obtained in the study were analyzed using the Statistical Package for Social Sciences (SPSS) Program version 26.0. The variables used in the study were expressed using percentage (%), mean ± standard deviation (x±SD), and number. The normal distribution of the obtained numerical variable was determined visually (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk Tests, Variation Coefficient Analysis). Numerical variables were shown as median and IQR (25-75), and categorical variables were shown as frequency and percentage (%). The level of relationship between the two variables was evaluated with Spearman's correlation test. The results were accepted in a 95% confidence interval and significance was accepted as $p<0.05$.

RESULTS

The sociodemographic, physical, and clinical characteristics of the individuals participating in the study are shown in Table 1. The mean age was 51±10.60 years and the mean body mass index (BMI) was 28.60±5.47 kg/m². The mean duration of lymphedema development after the operation of the study group was 24.33±54.07 months, and the duration of lymphedema was 25.13±73.26 months.

According to the lymphedema evaluation results, 46.7% (n=7) of the patients were classified as having mild lymphedema, 33.3% (n=5) as moderate lymphedema, and 20.0% (n=3) as severe lymphedema.

The upper extremity functionality, activities of daily living, and physical activity levels of the participants are shown in Table 2. The mean value of the upper extremity functionality level of the patients was 39.33±19.11. The mean total score of daily living activity was 493.13±57.48. The mean total score of the physical activity levels of the patients was 681.06±538.85.

Table.2. Mean scores of the scales

	Mean±SD	Median (min-max)
The upper extremity functionality		
DASH score	39.33±19.11	39.16 (2.77-73.33)
Activities of daily living		
Total MAS score	493.13±57.48	488 (420-640)
Physical activity levels		
IPAQ moderate activity	57±66.16	0 (0-180)
IPAQ walking	554.4±499.45	462 (0-1848)
Total IPAQ score	681.06±538.85	568.5 (0-1848)

SD standart deviation; DASH: The Arm, Shoulder, and Hand Problems Questionnaire MAS: Milliken Activities of Daily Living Scale; IPAQ: International Physical Activity Questionnaire

Table 3 shows the correlation of hand grip strength with arm, shoulder, and hand problems, activities of daily living, and physical activity level in patients with lymphedema after breast cancer surgery. When the relationship between the scales was examined; there was no statistically significant difference between DASH score, total MAS score, and IPAQ scores ($p>0.05$). A good positive correlation was found between the hand grip strength of the affected side and the total MAS score (r: 0.609; p: 0.016). A negative correlation was found between the hand grip strength of the affected side and the DASH score (r: -0.624; p: 0.013).

A positive correlation was found between the development time of lymphedema after the operation and the coarse hand grip strength of the affected side (r: 0.574; p: 0.025). A weak positive correlation was found between the duration of postoperative lymphedema and the total MAS score (r: 0.766; p: 0.001). The relationship between the hand grip strength of the affected side and the hand grip strength of the unaffected side was statistically positively significant (r: 0.756; p: 0.001).

DISCUSSION

This study aimed to evaluate the relationship of hand grip strength with upper extremity functionality, daily living activities, and physical activity level in female patients who were operated on for unilateral breast cancer and developed secondary lymphedema. The primary finding of this study is that the affected side hand grip strength is associated with activities of daily living and upper extremity function.

Upper extremity dysfunctions after breast cancer surgery cause difficulties in the daily activities of individuals and negatively affect their quality of life. The most important of the upper extremity problems is lymphedema (Quiron, 2010; Beaulac et al. 2002). In a study, 30-50% of breast cancer survivors had persistent arm and shoulder disorders, defined as limited shoulder mobility, lymphedema, and arm/shoulder pain (Lee et al. 2008). These problems encountered after breast cancer treatment mostly limit the activities of daily living in which the upper extremity is used (Brach et al. 2004). It has been reported in the literature that the prevalence of lymphedema in patients who underwent axillary dissection after breast cancer surgery varies between 6-30% (Sclafani et al. 2008; DiSipio et al. 2013).

Table 3. Correlation of hand grip strength with age(years), post-op lymphedema onset time, arm, shoulder, and hand problems and activities of daily living and physical activity level in patients with lymphedema after breast cancer

r: Spearman's correlation coefficient, *p<0.05, **p<0.01.

		Age	Postop lymphedema duration	Hand grip strength affected side(kg)	Hand grip strength unaffected side(kg)	Total MAS Score	DASH Score	IPAQ-moderate intensity activities	IPAQ-walking	IPAQ Score
Age(years)	r	1	-0,008	-0,431	-,641**	0,391	,639*	-0,226	-0,28	0,292
	p		0,977	0,109	0,010	0,149	0,010	0,418	0,312	0,291
Postop lymphedema duration	r	0,008	1	,574*	0,429	,766**	-0,465	-0,171	0,165	0,133
	p	0,977		0,025	0,111	0,001	0,081	0,543	0,558	0,637
Hand grip strength affected side(kg)	r	0,431	,574*	1	,756**	,609*	-,624*	-0,225	0,109	0,012
	p	0,109	0,025		0,001	0,016	0,013	0,421	0,698	0,966
Hand grip strength unaffected side(kg)	r	,641**	0,429	,756**	1	,580*	-0,464	-0,222	0,305	0,264
	p	0,010	0,111	0,001		0,023	0,082	0,427	0,269	0,342
Total MAS score	r	0,391	,766**	,609*	,580*	1	-,575*	0,103	0,025	0,105
	p	0,149	0,001	0,016	0,023		0,025	0,714	0,930	0,710
DASH score	r	,639*	-0,465	-,624*	-0,464	-,575*	1	-0,210	-0,157	0,176
	p	0,010	0,081	0,013	0,082	0,025		0,453	0,577	0,529
IPAQ-moderate intensity activities	r	0,226	-0,171	-0,225	-0,222	0,103	-0,210	1	-0,145	0,192
	p	0,418	0,543	0,421	0,427	0,714	0,453		0,606	0,493
IPAQ-walking	r	0,280	0,165	0,109	0,305	0,025	-0,157	-0,145	1	,918**
	p	0,312	0,558	0,698	0,269	0,930	0,577	0,606		0,000
IPAQ Score	r	0,292	0,133	0,012	0,264	0,105	-0,176	0,192	,918**	1
	p	0,291	0,637	0,966	0,342	0,710	0,529	0,493	0,000	

BMI, body mass index; MAS, Milliken Activities Of Daily Living Scale; DASH, Disabilities of Arm, Shoulder and Hand; IPAQ, International Physical Activity Questionnaire

Lymphedema results in decreased shoulder range of motion (12-32%), pain (12-51%), and muscle weakness (18-23%) (Shamley et al. 2012; Collins. 2004). Lymphedema, which is a chronic and progressive disease, causes a significant decrease in the quality of life due to its prognosis (Karki et al. 2005; Schmitz et al. 2012). Thus, the incidence of chronic upper extremity morbidity increases (Keramopoulos et al. 1993).

The prevalence of impaired hand grip strength in the arm with lymphedema was investigated in several studies (Liu et al., 2009,

Rietman et al. 2006; Kootstra et al. 2010; Ververs et al. 2001). It is very important to consider the inherent difference (about 10%) between the dominant and non-dominant extremity when assessing hand grip strength (Petersen et al. 1989). In one study, muscle weakness was found in the arm with lymphedema compared to the unaffected side in 36% of the subjects (Petersen et al. 1989). In a prospective study involving 2.5 years of follow-up after breast cancer surgery, a significant reduction in hand grip strength (11%) was observed on both the affected and unaffected sides (Sagen et al. 2014). It has been reported that the hand dynamometer is reliable and evaluates the general function in breast cancer patients (Cantarero- Villanueva et al. 2012; Kim et al. 2014). In the study of Rietman et al., it was reported that there was a significant decrease of 3.4 kg in hand grip strength two years after sentinel lymph node biopsy of the patients (Rietman et al. 2006). In another study, axillary lymph node dissection was found to cause more weakness than sentinel lymph node biopsy (Sagen et al. 2014). Research findings in our study support the literature. Patients were found to have lower hand grip strength on the affected arm. Many of our patients are hesitant to use their affected arm, which often results in muscle atrophy, weakness, and functional limitations (Lee et al. 2015).

In the study of Korucu et al., published in 2020, in which 107 patients who underwent breast cancer surgery and axillary lymph node dissection were evaluated, the DASH score of patients with lymphedema was 35.83, while this value was found 26.66 in patients without lymphedema (Korucu et al. 2020). In our study, it was found that patients with MRM had higher DASH scores than the ones that underwent other types of surgery and therefore, they had less upper extremity function. In this article, the relationship between the hand grip strength of the affected side, activities of daily living, and upper extremity functionality was found to be significant. Decreased hand grip strength on the affected side causes a decrease in the level of physical activity in the upper extremity and limitations in daily living movements. In our study, a significant correlation was found between the DASH score and another variable, age. In a study, it was found that older patients had a decrease in shoulder range of motion and hand grip strength (Swenson et al. 2002; Fleissig et al. 2006). In our study, it was found that the hand grip strength of the affected side was better in patients with a later development time of lymphedema after the operation. In our cases, it was thought that the quality of life and upper extremity functionality increased due to the decrease in the side effects of chemotherapy and radiotherapy over time.

In many studies in the literature, it has been found that a body mass index higher than 25 kg/m² increases the difficulty of daily living activities in patients (Kootstra et al. 2010; Karki et al. 2005). In our study, it was found that all patients with severe lymphedema had a BMI higher than 25 kg/m². This result supports the literature. Therefore, post-operative weight control is important.

Regular physical activity and exercise have positive effects on breast cancer patients during and after treatment. These include treatment-related side effects, such as fatigue (Kangas et al. 2008), gastrointestinal symptoms (Winningham & MacVicar, 1988), and emotional problems (Duijts et al. 2011). In addition, regular exercise has positive effects such as increased cardiopulmonary capacity, muscle strength (Furmaniak et al. 2016), improved immune function (Fairey et al. 2002), and improved survival rates (Chen et al. 2011). Despite these beneficial effects, a decrease in physical activity level has been reported in patients with breast cancer after diagnosis (Irwin et al. 2003). Regular exercise has become an important approach to alleviate these side effects. In one study, it was reported that exercise improved the use of muscle pumps in patients with lymphedema after breast cancer surgery and, accordingly, increased the stimulation of lymphatic transport (Gebruers et al. 2017). In addition, physical activity level was found to be a risk factor in the increase of functional problems in daily living activities in patients who developed lymphedema after breast cancer surgery (De Vrieze et al. 2020). Therefore, it is important to encourage patients to reach an adequate level of physical activity. In our study, more than half of the patients were at the inactive level (<600 MET-min/week), and there

were no moderate or severe activities in the sufficiently active category. In addition, no relationship was found between hand grip strength and physical activity level. Further studies with more patients may be needed to investigate this relationship.

In conclusion, hand grip strength, upper extremity functionality, and physical activity levels should be evaluated in the early follow-up and treatment planning of patients undergoing breast cancer surgery. In a study, it was stated that it benefited the development of hand grip strength capacity, general muscle strength, endurance and flexibility (Kümmel et al. 2016; Dourado et al. 2006). In the literature, studies on exercise are becoming more common in patients who develop lymphedema due to breast cancer. It is known that exercise improves the quality of life, general physical fitness, and upper extremity function and reduces fatigue (Kilbreath et al. 2012; Herrero et al. 2006; Hayes et al. 2013). The effects of exercise on reducing the volume of lymphedema have also been reported in a few studies (Kim et al. 2010). In a study evaluating scapular dyskinesia after breast cancer surgery, it was stated that there were significant differences between the upper extremities of patients with shoulder pain after treatment and that starting exercises that increase scapular control may be effective in preventing shoulder pain and/or dysfunction (Sayaca and Simsek, 2020). Considering these results, it was concluded that improving hand grip strength in the early period and adding hand grip strength exercises to the treatment program would increase upper extremity functionality and quality of life in these patients. Finally, it is thought that there is a need for studies comparing the effectiveness of exercises for hand grip strength before and after surgery.

This study has some limitations: (i) the low number of patients, (ii) the lack of normal distribution on lymphedema onset time and duration of lymphedema measurements, (iii) the absence of a control group, and (iv) the lack of the evaluation of different sides of the hands (dominant and non-dominant). Also, the fact that the patients were not evaluated before surgery may be a limitation. There is a need for new studies in which more patients are evaluated before and after surgery and followed up for a longer-term.

Conflict of interests

The authors have no conflict of interests to declare. No financial support was received for this study.

Ethics Statement

The studies involving human participants were reviewed and approved by the Uskudar University Non-Invasive Ethics Committee (Date: 29.01.2020; Decision / Protocol number: 2020-80). Written informed consent to participate in this study was provided by the patients/participants.

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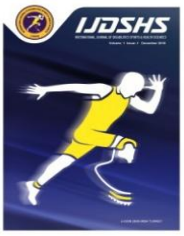

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RESEARCH ARTICLE

Effects of kinesio taping on upper extremity functionality in patients with cerebral palsy: a randomized controlled trial

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Abstract

The aim of this study was to investigate the effects of kinesio taping application on upper extremity functionality in patients with CP. This study included 40 children aged 6-16 years, diagnosed with CP. The children with CP were divided into 2 groups, the study group and the control group. Ligth touch Kinesio taping was applied to study group to improve posture and function in shoulder area. Assessments were done three times for each group (baseline - 45min later – 1 week later). Frenchay Arm Test and Moberg Pick-Up Test were used to evaluate upper extremity functionality in participants with CP. In the control group, no significant difference was found ($p>0.05$). The level of change in Frenchay Arm Test and Moberg Pick-Up Test measurement results performed in different times was found significant in study group ($p<0.05$). As a result of the application of kinesio taping for functional correction of the upper extremity in children with CP, an improvement in fine motor functions was revealed. This is one of the first studies giving evidence about the positive effects of pediatric kinesio taping application on functionality in children with CP.

Keywords
Cerebral palsy, Kinesio Taping, Upper Extremity, Functionality, Pediatric Rehabilitation

INTRODUCTION

Cerebral palsy (CP) is the most common cause of physical disability in childhood. Immature brain is a neurodevelopmental disorder caused by non-progressive lesions leading to spasticity, muscle weakness, decreased selective motor control, and secondary musculoskeletal problems often accompanied by sensory and cognitive disorders (Bax et al, 2005).

Hand is one of the most affected parts in CP. Effective use of hand function for daily activities depends on the complex interaction between fine motor functions and perceptions of tactile, proprioceptive and visual information / accuracy (Kase, Wallis, and Kase, 2003). The main prerequisites for this are (a) independent control capacity on fingers, (b) a complex somatosensory system to direct finger movements, and (c) conversion ability (Cepeda, 2008). Primitive and autonomic movements become more evident due to lesions in the sensory motor cortex and corticospinal system, which play a key role in sensitive grip and finger movements in CP. Tonus disorder leads to abnormal movements (loss of motor control, contraction, mutual inhibition) and limitation of movement. As a result of these, children with CP develop dysfunction in fine motor skills (Cepeda, 2008; Kase, Martin, and Yasukawa, 2006).

There are many treatment approaches (neurodevelopmental therapy, sensory integration, targeted training and hand-arm bimanual therapy) and kinesio taping to ensure the development of fine motor skills in children with CP (Cepeda, 2008; Kase, Martin, and Yasukawa, 2006) Kinesio

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taping helps stimulate cutaneous receptors and mechanoreceptors and helps muscle excitability (Roy, 2018; Mohamed, 2016). Kinesio taping technique can be used to increase sensory stimulation, strengthen weak muscles, inhibit spastic muscles, increase joint stability, increase functional motor skills, assist postural control, and improve functional independence in pediatric rehabilitation clinics in addition to other therapeutic techniques (Kase, Martin, and Yasukawa, 2006).

Kinesio taping application, together with other rehabilitation programs used in children with CP, affects the sensorimotor system positively and improves voluntary control and coordination of the upper extremities (Kase, Martin, and Yasukawa, 2006; Chitaria et al., 2015; Yasukawa, Patel, and Sisung, 2006). The aim of this study is to investigate the effects of Kinesio taping on upper extremity functionality in participants with CP.

MATERIALS AND METHODS

Participants:

Necessary permission and approval was obtained from the University Ethical Research Ethics Committee for the study to be carried out (Number: KA20/46). The clinical trial number for this study is NCT04529486.

This study included children diagnosed with CP by a physician and children between 6 and 16 years old. Both genders were included in our study. According to the Gross Motor Function Classification System, 14 (35%) children were 3rd level 26 (65%) children were at the 2nd level. None of the participants had spasticity including upper extremity. The study consists of a total of 40 participants with CP. Before the study, the families of children with CP were informed about the purpose of the study, all applications and evaluations during the study and they were informed about the results and benefits of these applications. “Informed Consent Form” was signed to the families of children with CP who agreed to participate in the study voluntarily with their consent.

Inclusion criteria were as follows;

• To have a cognitive level to comprehend the instructions

• Not having a cooperative problem that may prevent communication

• Continuing physical therapy and special education regularly

Exclusion criteria were as follows;

• Those with orthopedic problems

• Any surgical procedure

• Participants with cognitive problems

• Participants who do not regularly receive physiotherapy

The children with CP included in this study consisted of 2 groups, the study group (n=20) and the control group (n=20). No application was made to the control group. The assessments were done three times for each group (baseline - 45min later – 1 week later) (Figure 1). An experienced physiotherapist carried out all assessments and another experienced physiotherapist made the applications in order to provide a single blinded study. The participants were randomly allocated to the groups by computer randomization.

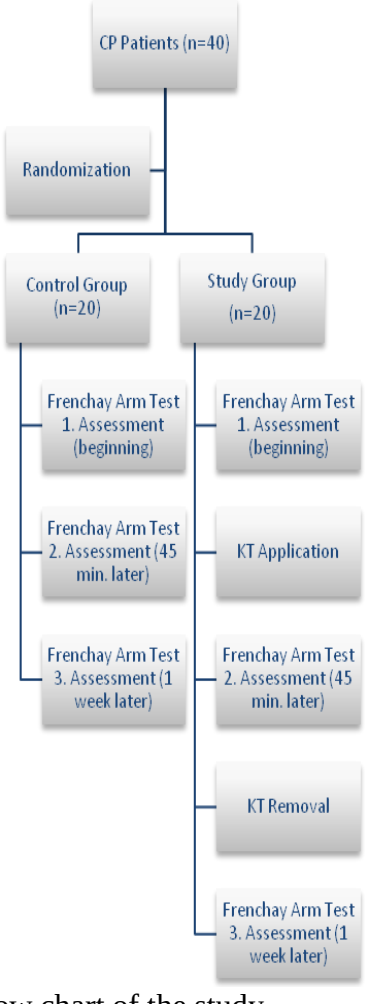

Figure 1. Flow chart of the study

Assessments:

Socio-demographic and clinical information of each child was obtained from their families and

hospital files before detailed evaluations within the scope of the study were carried out. An experienced physiotherapist carried out all assessments. The evaluation was carried out in a quiet and calm environment in order to eliminate the factors that may affect the evaluation results such as difficulty of concentration and distraction in children.

Frenchay Arm Test and Moberg Pick-Up Test were used to evaluate upper extremity functionality in participants with CP.

Frenchay Arm Test:

The total duration of the test is 3 minutes. Each task is scored as 1 point. The participant sits in the chair with a table in front of him and puts his hands on his knees and tries to perform the following sequential tasks with the affected arm / hand.

1. Fixing the ruler: the participant holds the ruler on one sheet of paper with the affected hand and draws a straight line with the other hand. To be considered successful, the ruler must be firmly and properly fixed.
2. Holding a roller: Grasps a 12 mm diameter and 5 cm long roller while standing about 15 cm in the middle of the table edge, lifts it about 30 cm and releases it without dropping it.
3. Raising the cup: It takes a half-full glass of water, standing at a distance of 15-30 cm from the edge of the table, drinks a little water and leaves it in place without spilling any water.
4. Attaching a latch to the bar: A wooden stick with a diameter of 10 mm, 15 cm long, inserted into the hole in the middle, is placed 15-30 cm away from the edge of a 10-square square wooden table. A latch is attached to the bar in the middle of the board. The participant is asked to open the latch with the affected hand and remove it from the rod and then put it back on. During testing, it should not drop the latch and hit the rod.
5. Combing hair: combs the hair with the affected hand (or pretends to be combing the hair). The comb should be held at the top of the head and the back and both sides should be combed. The test is found reliable and valid (r = 0.68 -0.99) (Poole & Whitney, 2001).

Moberg Pick-Up Test:

Required test objects; 50 cents coin, wing nut screw, 6-point screw nut, 4-point screw nut, 1-lira coin, key, screw, screw washer, nail, paper clip, safety pin, large 6-point nut, chronometer, small box, sleep glasses.

The child sits on a chair and is asked to put the objects one by one in the middle box as fast as he can. The child is told not to take the object by sliding it to the corner of the table. When ready, the test is started and the time is recorded with the stopwatch. The test is performed with the dominant hand. Test is repeated three times, recording the best time. The application is found valid and reliable (Moberg, 1958).

Treatment:

Kinesio taping was applied to the study group to improve posture and improve function in the shoulder area. Measurements were carried out for the study group before and after application (with tape on). The tape was then removed and the measurements were repeated after 1 week. Before applying the tape, it was checked whether the children were allergic. Tape was first started from the distal part of the fingers and taped with 0% tension with Kinesio Taping Functional Correction Technique. Another I tape was applied from palmar area of the hand to spina scapula for supination of the forearm and external rotation of the shoulder with %0 tension to make functional correction (Figure 2). Kinesio Taping Functional Correction method is suggested to be done with 75% of tension but for children, we applied it with 0% tension to minimize the shear effects to the skin (Kase, 2006). Kinesio Tex Ligth Touch Plus tape was used for taping application (Kinesio Co., USA).

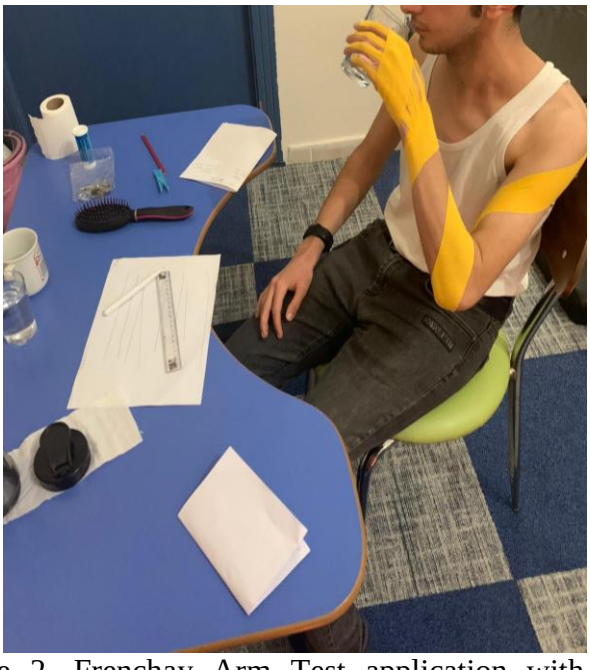

Figure 2. Frenchay Arm Test application with Kinesio taping.

Data Analysis

The power analysis indicated that 20 participants for each group were needed with 80 % functionality as the primary outcome. The data were analyzed using statistical software (SPSS version 18, Inc., Chicago, IL, USA). All the statistical analyses were set a priori at an alpha level of $p < 0.05$. The tests for homogeneity (Levene's test) and normality (Shapiro-Wilk) were used to determine the appropriate statistical methods to apply for comparison between the groups. If parametric conditions are provided in the evaluation of intra-group differences (change between 3 time factors), two-way analysis of variance is used in repeated measurements, and t-test is used to evaluate differences between groups. The effect size was evaluated to determine the effectiveness of the intervention in the study group. For the effect size value, it is accepted as 0,1-0,3 "low", 0,3-0,5 "medium" and > 0,5 "high".

power and a 5 % type 1 error. The power analysis of our study showed a power of 80% with

RESULTS

A total of 40 cases, 10 girls and 30 boys, aged 6-16 years, who were voluntarily accepted to participate in the study, were diagnosed with CP, were evaluated. It was observed that the cases were between 12-80 kg and their height was between 84-181 cm. The majority of children with CP (35.7%) were found to have an average of 11.36 ± 3.61 years of illness in secondary school students. The most common type of spasticity was ataxic spasticity (35.7%), and the presence of epilepsy was found in 21.4% of children with CP. The most common involuntary movements were tremor (64.3%), and the most frequently detected pathological reflex was hypotonia (50%) (Table 1).

Table 1. Sociodemographic characterictics of the participants

	Kinesio Group (n=20) X±SD	Control Group (n=20) X±SD	p
Age (year)	11.29±3.71	12,24±2.98	0.865
Body Weigth (kg)	32.46±18.87	32.61±16.97	0.923
Heigth (cm)	124.29±31.34	123.59±32.21	0.982
Gender			
Female (n)	10	11	0.954
Male (n)	10	9	
CP Type			0.034*
Ataxic (n)	6	12	
Dyskinetic (n)	14	8	

*p<0.05, X±SD = Mean±Standard Deviation, Min-Max=Minimum-Maximum

In the control group, the level of change in the Frenchay Arm Test and Moberg Pick-Up Test measurement values performed at the 3 time factors was found to be statistically insignificant ($p >0.05$). The effect size of the Frenchay Arm Test and Moberg Pick-Up Test applied to the control group over time was found to be low (0.071; 0.067) (Table 2).

In kinesio group, the level of change in the Frenchay Arm Test and Moberg Pick-Up Test measurement values performed at the 3 time factors was found to be statistically significant ($p<0.05$). The effect size of the Frenchay Arm Test and Moberg Pick-Up Test applied to the control group over time was found to be high (0.831; 0.862) (Table 2).

Considering the effect of kinesio taping application on upper extremity functionality, both tests were found significantly different in 45 minutes and 1 week after application in kinesio group ($p<0.05$). No significant difference was found between 45 min. and 1 week measurements ($p>0.05$) (Table 3).

Table 2. The change in groups for upper extremity functionality tests

		1. Assessment	2. Assessment (45 min. later)	3. Assessment (1 week later)	p	Eta^2
		X±SD (Median; Min-Max)	X±SD (Median; Min-Max)	X±SD (Median; Min-Max)		
FRENCH AY ARM TEST	**Control Group (n=20)**	2.29±1.20 (2.50; 0-4)	2.36±1.28 (2.50; 0-4)	2.26±1.25 (2.50; 0-4)	0.985	0.071
	Kinesio Group (n=20)	2.39±1.30 (2.40; 0-4)	3.50±1.09 (4.0; 1-5)	3.29±1.14 (3.0; 1-5)	0.18*	0.831
MOBERG PİCK-UP TEST	**Control Group (n=20)**	58.10±30.34; (51.69; 22.10-145.17)	55.63±30.61 (49.97; 19.58-143.17)	55.98±30.86 (50.61; 20.27-143.52)	0.566	0.067
	Kinesio Group (n=20)	57.69±30.41; (51.63; 21.14-144.32)	47.37±22.86 (43.60; 19.02-107.47)	48.30±23.06 (44.41; 21.57-109.30)	0.01*	0.862

*p<0.05, Repeated measures ANOVA test, X±SD = Mean±Standard Deviation, Min-Max=Minimum-Maximum, Effect size: Eta2

Table 3. The differences between time factors in upper extremity functionality tests

	Control Group (p)		Kinesio Group (p)	
	Frenchay Arm Test	**Moberg Pick-Up Test**	**Frenchay Arm Test**	**Moberg Pick-Up Test**
1. Assessment - 2. Assessment (45 min. later)	1.00	0.96	≤0.01*	≤0.01*
2. Assessment (45 min. later) - 3. Assessment (1 week later)	1.00	0.84	0.247	0.342
1. Assessment - 3. Assessment (1 week later)	1.00	0.77	≤0.01*	≤0.01*

*p<0.05, T test, Post-hoc Bonferorroni correction

DISCUSSION

In this study we investigated the effects of Kinesio Taping on upper extremity functionality in participants with CP, and found that Kinesio taping application may be an effective tool for improving the functional capacity of upper extremities in participants with CP.

In the study of Chitaria et al. (2015), similar to this study, Kinesio Taping method applied on wrist extensor muscles. It has been found that the Clutch and Visual Engine Integration subtest results result in a significant increase. In our study Kinesio Taping Functional Correction method was used to affect functionality of upper extremity in participants with CP. Kinesio Taping Functional Correction method is suggested to be done with 75% of tension but for children, we applied it with 0% tension to minimize the shear effects to the skin (Kase, 2006) Kinesio Tex Ligth Touch Plus tape was used for taping application (Kinesio Co., USA). This tape is said to be suitable for pediatric and geriatric populations due to its nanotechnologicproperties(www.kinesiotaping.com, n.d.).

In their study, Yasukawa et al. (2006) concluded that Kinesio Taping improved kinesthetic inputs and facilitated advanced control of the forearm and wrist muscles to improve voluntary control of muscle and tendon movement during activities, thereby improving hand grip and thus improving hand functions. It can be concluded that extending the tape over the dorsal face of the wrist increases carpal and metacarpal stability, thereby improving intrinsic muscle activity and thus facilitating better finger activities (Kase et al., 2003; Chitaria et al., 2015). Also, taping the dorsal face of the wrist can cause increased stimulation of cutaneous afferents in the underlying skin. The sensorial system provides preliminary information about limb positions and muscle forces to the central nervous system to monitor and control limb movements, plan actions, and provide smooth motion (McGlone & Reilly, 2010).

In this study, we think that this technique provides improved stability since Kinesio Taping starts from the hand phalanx and metacarpal bones extends over the forearm and arm muscles and extends to the middle of the scapula behind the shoulder. It can be suggested that this method contributes to the clinical changes in the fine motor functions of the hands. This view is supported by Hsu et al. (2009), who reported that neuromuscular taping, in addition to therapeutic procedures, will lead to improvement in strength, functional activities, proprioception and control. Kinesio Taping improves blood circulation in the taped area (Kase & Hashimoto, 1998), and this physiological change can affect muscle and myofascial functions following the application of taping and helps children build the strength required for function. In the studies of Roy et al. (2018) in which they evaluated the effect of Kinesio Taping in children with spastic diplegic cerebral palsy, Kinesio Taping has been shown to have a positive effect on enhancing and developing fine motor skills. The conclusion reached by Roy et al. (2018) supports this study.

In a study, it has been reported that muscle patterns can improve due to better proprioception due to stimulation of Kinesio taping mechanoreceptors (Semple et al., 2012). In a study by Demirel and Bayrakcı (2014) with children with CP, the effect of Kinesio Taping applied to the wrist extensor muscles on the joint range of motion was investigated, and they found an increase in the range of wrist extension, ulnar and radial deviation motion. As a result of this study, it was suggested that Kinesio Taping affects the antagonist muscle of the spastic muscle and may increase the range of motion by removing the fascia. In another study that supports our study; In the studies of Yasukawa et al. (2006) evaluating the application of Kinesio Taping to the upper extremity in children who were admitted to the acute rehabilitation program due to encephalitis, brain tumor, cerebral vascular trauma, traumatic brain and spinal cord injury, the extension and comprehension of the Kinesio Taping, including object manipulation found that functional motor skills increased.

Kinesio Taping stimulates sensory receptors and cutaneous mechanoreceptors in the taped area. Activation of cutaneous mechanoreceptors with a sufficient level of stimulus causes local depolarizations that trigger nerve impulses along the afferent fiber that travels towards the central nervous system (Halseth et al., 2004; Murray & Husk, 2001). The Kinesio Taping application can exert pressure on the skin or stretch the skin and stimulate cutaneous mechanoreceptors that cause physiological changes in this external load-taped area. Previous studies to determine the effects of neuromuscular taping on cutaneous mechanoreceptors have been shown to increase muscle excitability by taping applied on specific muscles and joints (Halseth et al., 2004; Murray & Husk, 2001). Effective use of the hand depends on the complex interaction between fine motor skills and visual perception. In the studies of Mohamed (2016) investigating the effect of Kinesio Taping on upper extremity functions in children with hemiplegic CP, it was concluded that this application had a positive effect on wrist motion, grip and visual motor integration. In this study, it was determined that the values obtained as a result of Frenchay Arm Test in children in the study group in which the Kinesio Taping was applied had a significant change in time compared to the initial stage, and this effect showed that the effect size value of this change had a high level of improvement.

Having different ages and disability levels is a limitation of this study. Also including more participants should be considered in future studies. As a result of this study, it has been shown that the application of Kinesio Taping can increase and improve fine motor skills in children with CP, thereby increasing their functional independence to meet the demands of daily life. It can be predicted that this situation will have a positive effect on parents' quality of life. However, Kinesio Taping should be applied by experienced physiotherapists to achieve the desired effectiveness. It can be argued that with the emergence of positive effects of Kinesio Taping application on extremity functionality, the trust of the child and family in the physiotherapist and willingness to work together will increase. Due to its effectiveness, relatively inexpensive cost and easy application, we think that the use of Kinesio Taping application in addition to traditional treatment can help target functional therapy strategies to improve and improve upper extremity functionality in children with CP. However, more comprehensive studies are needed to support its use in clinical practice.

Conflict of interests

The authors have no conflict of interests to declare. No financial support was received for this study.

Ethics Statement

The studies involving human participants were reviewed and approved by the Başkent University Ethical Research Ethics Committee (Date: 3/03/2020; Decision / Protocol number: KA20/46, The clinical trial number for this study is NCT04529486). Written informed consent to participate in this study was provided by the patients/participants.

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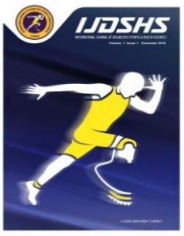

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CASE REPORT

The Effectiveness of Telerehabilitation-Based Occupational Therapy Interventions on Sensory Processing and Functional Independence in the COVID-19 Pandemic: A Case Series

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Abstract

Our study aimed to determine the effectiveness of telerehabilitation-based occupational therapy interventions on the level of sensory processing and functional independence during the pandemic period. Five children between the ages of 5 and 7 with sensory integration disorders were included in our study. A total of 16 sessions of telerehabilitation, 8 weeks, 2 sessions per week, were carried out via online channels (Zoom/Skype). Dunn Sensory Profile and WeeFIM Functional Independence Measure were applied before and after treatment. Data before and after the session were compared with SPSS 23.00. As a result, positive effects of telerehabilitation interventions on visual, vestibular, tactile and multi-sensory processing and functional activity level were determined in children ($p<0.05$). In conditions that negatively affect face-to-face rehabilitation, such as a pandemic, telerehabilitation interventions can be safe and alternative approaches. More telerehabilitation researchs are needed in the field of occupational therapy.

Keywords
Telerehabilitation, Sensory İntegration, Pandemic, Functional İndependence, Occupational Therapy

INTRODUCTION

Telerehabilitation is a new and developing area of telehealth (Cason, Hartmann, & Richmond, 2018). Telerehabilitation is a service model that provides remote treatment services using various telecommunication technologies and is an alternative to face-to-face rehabilitation (Sarsak, 2020). Telerehabilitation services include monitoring, intervention, supervision, education, training, and counseling (Schmeler et al., 2010). The telerehabilitation practices used by occupational therapists can be used to develop skills, change work, home or school environments, and create health-enhancing habits and routines (Torpil & Kaya, 2021; Önal, Güney, Gün & Huri, 2021).

Among the alternative service delivery methods, telerehabilitation applications are frequently used in occupational therapy. Occupational therapists use telerehabilitation to develop skills; include assistive technology and adaptive techniques; change work, home or school environments and to create health-improving habits and routines. Telerehabilitation is useful because it improves accessibility of services and access to specialists, increases flexibility of treatment times for patients and therapists, reduces travel time and reduces delays in service by allowing online consultation (Johnston, 2019).

Access to rehabilitation centers is not always easy for children with special needs living in rural areas, r there may not be permanent occupational therapy in every school with children with special needs. Telehealth technologies are an alternative

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when access to face-to-face rehabilitation is limited. The requirements for telerehabilitation applications have become clearer, especially with the introduction of special conditions such as pandemics into our lives (Önal, Güney, Gün, & Huri, 2021).

Ayres (Roley, Mailloux, Miller-Kuhaneck, & Glennon, 2007) defines sensory integration as a neurological process that organizes sensory stimuli from the body and the environment so that the body can be used more effectively. Sensory processing disorder affects the person's participation in activities of daily living (Bodison & Parham, 2018). It is important to increase participation in order to maintain the well-being of the person. In order to maintain participation, occupational therapists frequently apply sensory integration-based approaches (Kashefimehr, 2014).

With the entry of COVID-19 into our lives, rehabilitation processes have been interrupted. However, the support needs of children with special needs continue to increase (Önal, Güney, & Huri, 2021).

This study aimed to investigate the effects of telerehabilitation-based occupational therapy interventions on sensory processing and functional independence level in children who had disruptions in rehabilitation processes during the pandemic process.

MATERIALS AND METHODS

Participants:

The necessary permission and approval were obtained from the Ministry of Health of the Republic of Turkey for the study to be performed (File no: 29T16_18_46). In addition, informed consent was obtained from the families of the children with special needs participating in the study.

A study invitation was prepared to inform families about telerehabilitation and sensory integration-based occupational therapy; It has been stated that the children will be evaluated through Google forms or e-mail and the interviews will be held over Zoom/Skype. The families were clearly informed that they could leave the study if they wanted to and that their personal data would be kept confidential. The invitation containing the research content, purpose and method was shared through online channels. Informed consent forms were signed by parents and sent to the researchers via online channels. Five children with sensory integration disorder between the ages of 5-7 were included in our study. Three of these children were diagnosed with autism spectrum disorder, one with attention deficit and one with attention deficit and hyperactivity disorder. A total of 16 sessions of telerehabilitation, 8 weeks, 2 sessions per week, were carried out via online channels (Zoom/Skype). Dunn Sensory Profile and WeeFIM Functional Independence Measure were applied before and after treatment. Evaluation forms were sent to families as Google Forms. Data before and after the session were compared with SPSS 23.00 (Wilcoxon Signed Ranked Test).

The Functional Independence Measurement for Children (WeeFIM)

The WeeFIM is used to evaluate functional independence in children aged 6 months to 7 years, regardless of disability level (Wong, Au-Yeung, & Law, 2005). It consists of 18 items divided into 6 subsections (self-care, sphincter control, transfer, locomotion, communication, social cognition). In the scale filled out by the parents, the child scores between 1 (full help) and 7 (completely independent) from each sub-item (Ottenbacher et al., 2000). The scores that can be obtained from the scale vary between 18 and 126. A high score indicates that functional independence is high in daily life (Chan, & Wong, 2002). In a study conducted to translate the WeeFIM into Turkish Cronbach's α value was 0.99 for motor WeeFIM rating and 0.99 for cognitive WeeFIM rating. ICC was 0.81 for motor WeeFIM rating and 0.92 for cognitive WeeFIM rating. The internal construct validity of the Turkish translation of the WeeFIM instrument was confirmed by excellent fit to the Rasch measurement model (Aybay et al., 2007).

The Sensory Profile

This scale can be used for all children between the ages of 3 and 10, regardless of disability group and degree of exposure. It is evaluated by the occupational therapist together with the person with whom the child has the most communication in daily life. Each item is scored between 1 and 5 on a Likert scale. The sensory profile consists of three parts as sensory processing, processing, behavioral-emotional responses and 14 parameters. Parents or caregivers are asked to answer the 125 questions of the SP that draw up their child's sensory profile in three main domains, including sensory processing, behavioral, and emotional responses and

processing, and also nine factors, including endurance/tone, oral sensory sensitivity, inattention/distractibility, poor registration, sensory sensitivity, sedentary, and fine motor/perceptual (Dunn, 1999). In a study conducted to translate the SP into Turkish (Kayihan et al., 2015), Cronbach's α values ranged from .63 to .97, and a high one-week test-retest reliability was found [ICC] > .90).

Intervention

The contents and materials of the sessions, which were individually prepared within the scope of the intervention program, were sent to the families via e-mail. Phone calls were made before each session so that the families could obtain the necessary materials and apply the sensory activities in the session correctly. The contents of the sessions were planned considering the individual needs of the children and the family's access to resources. In the intervention program, the individual needs of the children were taken into account. For example, it was supported by visual-sensory-based activities in children with visual seeking. Each session lasted approximately 45-60 minutes. Occupational therapy practices were carried out with the cooperation of family-therapist and child, with therapist guidance through online interviews (Zoom/Skype) during the sessions. If the child was distracted, the session was interrupted.

Data Analysis

Statistical analyses were performed using SPSS software version 23.00. Descriptive statistics were used for demographic data. Descriptive analyses were presented using the mean and standard deviation and frequencies. Data before and after the session were compared with SPSS 23.00 (Wilcoxon Signed Ranked Test).

RESULTS

Findings of Functional Independence

According to the results of the Functional Independence Measure for Children (the WeeFIM), it was determined that the children had improvements in the areas of self-care, transfer from one place to another, social cognition and total functional independence after telerehabilitation-based occupational therapy intervention (Table 1).

Table 1: The changes in functional independence

WEEFIM	**BR**	**AR**		
	X ± SD	X ± SD	p	Z
Selfcare	13.2±2.16	28.80±9.09	0.043*	-2.023
Sphincter Control	11.8±1.48	12.40±1.67	0.180	-1.342
Transfers	14.8±2.38	17.20±2.67	0.039*	-2.060
Locomotion	11.80±2. 38	12.40±2.63	0.083	-1.732
Communication	8.80±1.92	10.00±2	0.063	-1.857
Social Cognition	6.60±2.19	12.60±2.70	0.042*	-2.032
Total Score	67±7.38	96.2±9.23	0.043*	-2.022

p<0.05*; AR:After Telerehabilitation; BR: Before Telerehabilitation; X ± SD: Mean± Standard Deviation;

Findings on Sensory Processing

According to Dunn Sensory Profile results, visual, vestibular, tactile and multisensorial processes were improved before and after the intervention. While children's visual, vestibular, tactile and multisensory processing processes definitely different before the intervention compared to their peers, their visual, tactile and multisensory processing levels approached the level of their peers after the intervention. Vestibular processing levels were still at the level of definite difference compared to their peers. The changes in the sensory processing processes of the cases after the occupational therapy intervention are shown in Table 2.

Table 2: Changes in sensory processing processes of cases

Sensory Processing	Before Telerehabilitation X ± SD	After Telerehabilitation X ± SD	p	Z
Visual	23.40±2.40	30.80±2.38	0.041*	-2,032
Vestibular	13.80±1.48	32.60±7.26	0.032*	-2,021
Tactile	30±7.21	65.40±5.54	0.043*	-2,023
Multisensorial	10.60±2.79	25.80±1.78	0.039*	-2,013

p<0.05*; X ± SD: Mean± Standard Deviation; Gray: Typical Performance; Yellow: Probable difference; Orange: Definite difference

DISCUSSION

In the current study, which investigated the effects of telerehabilitation-based occupational therapy interventions on sensory processing and functional independence during the pandemic process, significant changes were determined in children's visual, vestibular, tactile and multi-sensory processing and functional ındependence levels.

One of the most important factors affecting participation in activities of daily living is sensory processing skills. Sensory processing disorders affect individuals' participation in activities of daily living. Occupational therapists use specific sensory modalities for self-regulation, attention and behavioral control (Önal, & Güney Yılmaz , 2021). In the current study, positive gains were obtained in both sensory processing processes and performance levels in activities of daily living. Well-regulated and properly functioning sensory systems contribute to important outcomes in the development and maintenance of social-emotional, motor, communication, cognitive and self-care skills (AOTA, 2015). The achievements of children in sensory processing processes through telerehabilitation may also have positively affected their level of independence in functional activities. Similarly, it has been shown that sensory-based telerehabilitation studies applied to children with special needs lead to improvements in adaptive skills, social interaction skills and activity participation (Hung & Fong, 2019; Önal, Güney, Gün& Huri, 2021).

Telerehabilitation provides the therapist with the opportunity to observe parent-child interaction in the home environment and provide meaningful and real-time feedback (Gibbs & Toth-Cohen, 2011). Home programs are often used by occupational therapists to support rehabilitation processes (Novak et al., 2013). The use of telerehabilitation revealed that parents needed constant support. Therapists should not assume that in-clinical training will automatically result in appropriate transfer to demonstrate appropriate techniques and strategies in the natural setting. Thus, it can provide much-needed guidance without requiring additional clinic visits (Marshall, Shaw, Honles, & Sparks, 2008). The therapist-supervised sessions also ensured that the errors that may arise during the application are intervened at the right time. Families often complain about the inability to ensure continuity in implementing home programs. In pandemic conditions where access to face-to-face rehabilitation is limited, children have gained the opportunity to attend regular therapist-supervised sessions through telerehabilitation.

Correct motor movement and good function emerge with a meaningful-purpose sensory activity specific to each child (Niutanen, Harra, Lano, & Metsäranta, 2020). The sensory enriched environment and materials organized by occupational therapists help improve children's activity performance (Cheung, & Lau, 2020; Piwinski, Hoss, Velasco, & Jess, 2021). The session materials, which are created specifically for the individual and developed every week according to the child's progress level, revealed positive results in providing the sensory regulation of the children in the home environment. In addition, it is thought that the progress of children's sensory processing processes is associated with positive developments, especially in self-care activities and social communication levels. On the other hand, although statistically positive developments were achieved regarding the level of vestibular processing, clinical significance was still not achieved. At this point, it should be investigated whether session times or non-clinical

session environments are insufficient to support the vestibular system.

Telerehabilitation applications are quite new areas in rehabilitation in our country (Ceylan, 2020). Therefore, discussions about its applicability and effectiveness still continue (Önal, Güney, Gün, & Huri, 2021). Some limitations emerged ın the current study as well. Some families with limited Internet access have had difficulty participating in telerehabilitation. At the same time, families who needed financial resources to access the sensory materials required for rehabilitation were not included in the study. During the sessions with the families, the parents had difficulty in understanding some of the instructions. As a result, in the current study carried out with sensory-based occupational therapy telerehabilitation interventions in the COVID-19 pandemic, it has been an alternative and useful method for disrupted rehabilitation processes. Further randomized controlled trials involving more children may contribute to the literature.

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Conflict of interests

The authors have no conflict of interests to declare. No financial support was received for this study.

Ethics Statement

The necessary permission and approval were obtained from the Ministry of Health of the Republic of Turkey for the study to be performed (File no: 29T16_18_46). In addition, informed consent was obtained from the families of the children with special needs participating in the study.

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