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Research Article

Investigation of the Relationship Between Exercise Barriers, Quality of Life, Physical Performance, and Range of Motion in Patients with Total Hip Arthroplasty

Ismail Uysal[1], Fatih Ozden[2], Ismet Tumturk[3], Mehmet Ozkeskin[4], Fatih Ozyer[5]

[1]Muğla Sıtkı Koçman University, Fethiye Vocational School of Health Services, Department of Health Care Services, Muğla, Türkiye
[2]Muğla Sıtkı Koçman University, Köyceğiz Vocational School of Health Services, Department of Health Care Services, Muğla, Türkiye
[3]Süleyman Demirel University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, Isparta, Türkiye
[4]Ege University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İzmir, Türkiye
[5]Fethiye State Hospital, Department of Orthopaedics and Traumatology, Muğla, Türkiye

Abstract

Aim: This study aimed to demonstrate the relationship between exercise barriers-benefits with joint range of motion (ROM), quality of life, and physical performance in individuals with total hip arthroplasty (THA).
Material and Method: A cross-sectional observational study was conducted with fifty older individuals with THA. Patients were evaluated with the 5-Times Sit and Stand Test (5TSTS), Exercise Benefits and Barriers Scale (EBBS), and EuroQol (EQ-5D-5L) Quality of Life Scale. In addition, the patient's active ROM was measured with a universal goniometer.
Results: There was a significant low correlation between body mass index (BMI) and EBBS-Benefits sub-score (r=-0.286 p<0.05). EQ-5D-5L VAS was weakly correlated with EBBS (r=-0.291, p<0.05). 5TSTS was moderately correlated with EBBS Barriers sub-score, EBBS Benefits sub-score, and EBBS total score, respectively (r_1=0.354, r_2=0.440, r_3=0.444, p_1<0.05, $p_{2,3}$<0.01). EBBS Barriers sub-score strongly correlated with EBBS Benefits sub-score and EBBS total score, respectively (r_1=0.709, r_2=0.826, p<0.01). In addition, the EBBS Benefits sub-score was highly correlated with the EBBS total score (r=0.983, p<0.01). There was a low to moderate correlation between the EBBS Barriers sub-score and all active ROM measures (p<0.05).
Conclusion: Individuals' exercise barriers and benefits were mainly associated with physical performance. Participants with higher exercise benefits from exercise had higher physical performance, ROM, and quality of life.

Keywords: Function, exercise barriers, exercise benefits, joint motion, life quality

INTRODUCTION

Total hip arthroplasty (THA) is a frequent surgical procedure preferred to reduce pain and improve the function of patients with hip osteoarthritis (1,2). The survival rate in the postoperative period is between 98% and 100% due to recent surgical techniques, including cementless prosthesis design and cross-linked polyethylene (3,4). However, despite these advances in surgical practice, patients may experience decreased muscle strength and quality of life (5,6). Recent studies indicate that these deficiencies occur in 10-20% of individuals with THA (7). Therefore, patients should be assessed holistically during the rehabilitation process.

Objective and subjective measurements are used in evaluating individuals with THA. Performance-based clinical tests are commonly used to evaluate patients objectively. These tests demonstrate the individual's functional independence (8). A study has reported that the improvements shown by performance-based clinical tests used in evaluating individuals with THA do not coincide with the results of patient-reported outcomes measures (PROMs) (9). However, it has also been remarked that a causal relationship exists between performance-based and PROMs (10).

Some assessments can only be fulfilled through the subjective interpretation of individuals. One of these is patients' exercise perception. Exercise programs given to individuals with THA in the postoperative period are more effective than other rehabilitation approaches in reducing pain and improving muscle strength, function, and other clinical outcomes (11). A recent study reported

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Corresponding Author: Fatih Ozden, Muğla Sıtkı Koçman University, Köyceğiz Vocational School of Health Services, Department of Health Care Services, Muğla, Türkiye
E-mail: fatihozden@mu.edu.tr

that identifying the benefits and barriers affecting the individual's exercise habit and adaptation to training can enable rehabilitation professionals, especially physiotherapists, to provide practical rehabilitation approaches. In addition, these assessments may enable individuals to develop clinical exercise practice recommendations to accelerate the recovery of individuals and increase their quality of life (12,13).

The literature does not provide adequate evidence to provide exercise facilitators and barriers in individuals with THA (12). In addition, objective and subjective aspects of the measurements are not compared regarding causal relationships in individuals with THA. Exercise barriers, physical performance, and quality of life are not presented with relevant clinical outcomes in individuals with THA. This study aimed to demonstrate the relationship between exercise barriers-benefits with joint range of motion, quality of life, and physical performance in individuals with THA.

MATERIAL AND METHOD

Subjects and Clinical Setting

The cross-sectional observational study was conducted in the Orthopaedics and Traumatology Department of the Muğla Training and Research Hospital between February and June 2022. Fifty patients with THA (71.38±9.91 years, 33 women, and 17 men) participated in the study. The inclusion criteria of the study were; (1) patients at least six months after the THA, (2) patients with primary THA, (3) patients who can understand and respond to verbal commands, (4) patients who do not have hearing, speech, or psychiatric problems that prevent communication. The exclusion criteria of the study were; (1) patients with revision surgery, (2) patients with THA for reasons such as rheumatoid arthritis and traumatic injury, (4) patients with a history of other lower limb surgery or a disease such as stroke that may affect the assessments, (5) patients with post-operative complications such as deep vein thrombosis. The study was carried out in accordance with the ethical principles and the Helsinki Declaration. Informed consent of the patients was obtained. The study protocol was approved by Ege University Medical Research Ethics Committee (No: 22-8.1T/63). G*Power software was used to calculate the effect size. The effect size was based on the medium effect size (0.50) of Cohen's d, with an error probability of 0.05 and a statistical power of 0.95, which were used during the calculation. Finally, a minimum of 34 cases were calculated as required for the research sample (14).

Procedures

Individual characteristics (e.g., age, gender, height, weight, chronic disease status, education level) were recorded. Patients were evaluated with the 5-Times Sit and Stand Test (5TSTS), Exercise Benefits and Barriers Scale (EBBS), and EuroQol (EQ-5D-5L) Quality of Life Scale. In addition, the patient's active range of motion (ROM) was measured with a universal goniometer.

5-Times Sit and Stand Test

Participants stand up and sit down as quickly as possible five times from a 43 cm highchair without armrests. A stopwatch is used to calculate the time (15).

Exercise Benefits and Barriers Scale

The EBBS consists of 43 items. Twenty-nine questions address the benefits of exercise, and 14 questions address the barriers to exercise. The scale was designed according to a 4-point Likert-type scale: “strongly agree (4), agree (3), disagree (2), strongly disagree (1)”. The benefit subscale ranges between 29 and 116, and the barrier subscale ranges between 14 and 56. The total score ranges from 43-172. In this scoring system, a higher score represents a higher perception. The Turkish validity and reliability of the scale were conducted by Ortabağ et al. (16).

EQ5D5L Quality of Life Scale

The EQ-5D-5L consists of 2 parts: EQ-5D descriptive system and EQ visual analog scale (EQ VAS). The descriptive system comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has five levels: no problem, mild problem, moderate problem, severe problem, and extreme problem. The patient is asked to indicate their health status by checking the box next to the most appropriate statement in each of the five dimensions. The EQ VAS records the patient's health status on a vertical visual analog scale, where the endpoints are labeled "best health you can imagine" and "worst health you can imagine". The VAS can be used as a quantitative measure of health outcomes reflecting the patient's judgment (17).

Active Range of Motion Measurements

A universal goniometer was used for all ROM measurements at the functional range of motion limit. The measurement directions were internal rotation, external rotation, flexion, extension, and abduction.

Internal/External Rotation

The patients are instructed to turn their legs outward and inward while sitting. The fulcrum was aligned with the patella, and both arms of the goniometer were within the midline of the tibia. The stationary arm was then hanging freely but should be perpendicular to the floor (18).

Flexion/Extension

The participant was asked to lie supine and prone. The measurement was then performed with the fixed arm positioned along the lateral midline of the abdomen, using the pelvis as a reference, and the goniometer's movable arm along the lateral midline of the femur (18).

Abduction

Hip abduction was measured from the neutral zero position, where the longitudinal axis of the thigh was perpendicular to the transverse line along the anterior superior iliac spines of the pelvis. These last anatomical landmarks were also used to align the fixed arm of the goniometer. The movable arm was aligned on the midline of the femur, pointing to the center of the patella (19).

Statistical Analysis

SPSS for Windows v25.0 software (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. For quantitative variables, mean and standard deviation (SD) were presented. Percent (%) were reported for qualitative variables. The normal distribution of data was analyzed by Shapiro-Wilk or Kolmogorov–Smirnov tests. The skewness and kurtosis coefficients were considered to determine whether the data followed a normal distribution. The relationship between variables was analyzed using Pearson correlation analysis. The Mann-Whitney U test presented the differences in active range of motion between affected sides. A significance level of $p<0.05$ was considered statistically significant.

RESULTS

A total of 50 patients with THA (71.38±9.91 years, 33 women, 17 men) participated in the study. Demographic and clinical characteristics of the participants are detailed in Table 1.

Table 1. The baseline physical and clinical characteristics of the participants

	THA patients (n=50)
Age (years, mean±SD)	71.38±9.91
Gender (women/men, n (%))	33 (66)/17 (34)
BMI (kg/m2, mean±SD)	27.43±4.68
Affected side (right/left, n (%))	24 (48)/26 (52)
Living area (urban/rural, n (%))	31 (62)/19 (38)
Education status (primary/high school and above, n (%))	40 (80)/10 (20)
Smoking (yes/no, n (%))	5 (10)/45 (90)
Duration after THA surgery (months, mean±SD)	23.62±21.76
Presence of chronic disease (present/absent, n (%))	38 (76)/12 (24)

SD: standard deviation, n: number of patients, BMI: body mass index, THA: total hip arthroplasty

Relationship Between Parameters

Pearson correlation analysis was carried out to reveal the relationship between the parameters. Table 2 shows the correlation coefficients between EBBS with 5TSTS, EBBS, and EQ-5D-5L. The correlation between the active ROM measurements and EBBS are summarized in Table 3.

There was a significant low correlation between body mass index (BMI) and EBBS-Benefits sub-score ($r=-0.286$ $p<0.05$). EQ-5D-5L VAS was weakly correlated with EBBS ($r=-0.291$, $p<0.05$). 5TSTS was moderately correlated with EBBS Barriers sub-score, EBBS Benefits sub-score, and EBBS total score, respectively ($r_1=0.354$, $r_2=0.440$, $r_3=0.444$, $p_1<0.05$, $p_{2,3}<0.01$). EBBS Barriers sub-score strongly correlated with EBBS Benefits sub-score and EBBS total score, respectively ($r_1=0.709$, $r_2=0.826$, $p<0.01$). In addition, the EBBS Benefits sub-score was highly correlated with the EBBS total score ($r=0.983$, $p<0.01$) (Table 2). There was a low to moderate correlation between the EBBS Barriers sub-score and all active ROM measures ($p<0.05$) (Table 3).

Table 2. The relationship between clinical test, scale scores and patients' characteristics in THA patients

n: 50	EBBS-Barriers	EBBS-Benefits	EBBS-Total
Age	0.071	0.253	0.221
BMI	-0.171	**-0.286***	-0.272
Duration after THA	0.04	-0.081	-0.054
EQ-5D-5L	-0.175	-0.242	-0.239
EQ-5D-5L VAS	-0.101	**-0.291***	-0.259
5TSTS	**0.354***	**0.440****	**0.444****

THA: total hip arthroplasty, n: number of patients, BMI: body mass index, EQ-5D-5L VAS: EQ-5D-5L quality of life scale visual analog scale, 5TSTS: Five Times Sit to Stand Test, EBBS: Exercise Benefits and Barriers Scale, *: p<0.05, **: p<0.01, Pearson Correlation Test was used in all analyses

Table 3. Relationship between active range of motion measurements and other parameters

n: 50	RHIR	RHER	RHF	RHE	RHABD	LHIR	LHER	LHF	LHE	LHABD
EBBS-barriers	**-0.415****	**-0.367****	-0.233	**-0.309***	**-0.310***	-0.273	**-0.280***	-0.117	-0.265	-0.187
EBBS-benefits	**-0.423****	**-0.479****	**-0.313***	**-0.319***	**-0.371****	**-0.517****	**-0.358***	**-0.345***	**-0.316***	**-0.384****
EBBS-total	**-0.446****	**-0.478****	**-0.310***	**-0.335***	**-0.377****	**-0.475****	**-0.359***	**-0.306***	**-0.322***	**-0.356***

EBBS: Exercise Benefits and Barriers Scale, RHIR: right hip internal rotation, RHER: right hip external rotation, RHF: right hip flexion, RHE: right hip extension, RHABD: right hip abduction, LHIR: left hip internal rotation, LHER: left hip external rotation, LHF: left hip flexion, LHE: left hip extension, LHABD: leftt hip abduction, *: p<0.05, **: p<0.01, Pearson Correlation Test was used in all analyses

DISCUSSION

The results revealed that exercise barriers and benefits were moderately associated with physical performance. However, exercise benefits were poorly associated with body mass index and quality of life. Finally, there was a low-to-moderate association between benefits and barriers of exercise barrier with hip ROM in all directions. The outcomes of this study revealed that individuals' exercise barriers and benefits were mainly associated with physical performance. Participants with higher exercise benefits from exercise had higher physical performance, ROM, and quality of life. Future studies may address exercise barriers and benefits in the context of secondary data from a randomized controlled trial of a standardized exercise program in the postoperative period.

The sample of this study consisted of older people, with an average age of approximately 71. The female population was higher than expected. More comprehensive cohorts in recent years have also shown more women with THA (20). On the other hand, the individuals were overweight according to BMI classification. The sample did not consist of obese patients. Therefore, the sample was homogenous in terms of BMI. Since the individuals were at least six months after surgery (with a mean of approximately 23 months), a stable period of THA can be observed regarding their physical condition (21). In this respect, our sample is also homogeneous regarding physical performance.

The results of the correlational analysis revealed that exercise barriers and benefits were primarily related to the 5TSTS, indicating the physical performance of the individuals. Subjective exercise perceptions of the patients are shown to be associated with their physical status. Numerous studies have demonstrated that post-operative exercise protocols in THA improve patients' physical function (22-24). These results indicate that that high exercise barrier achievement, particularly in this population of older individuals, may have negative consequences in some cases due to exercise compliance or non-performance of exercises. For example, inadequate stretching exercises may result in permanent loss of ROM (25), or in some cases, lack of aerobic exercise may have a negative impact on quality of life (26).

Exercise benefits were found to have a low correlation with quality of life. Many physical and psychological parameters can affect the quality of life in individuals with THA independently or holistically (27,28). The quality of life may also be affected by pain, disability, activities of daily living and psychological status. However, although a low correlation levels, our results may prove that individuals with THA who report more exercise benefits have a higher quality of life. The minimal clinically important difference (MCID) values of the EQ-5D may be helpful to show that increasing exercise benefits more clearly (29). However, since our study did not have a longitudinal design, we could not demonstrate the clinical significance of this change.

Another subclinical result we obtained from our study was the negative relationship between BMI and exercise benefits. As expected, we found that individuals with lower BMI benefited more from exercise. BMI is already known to be a negative indicator for surgical success after THA (30,31). It is comprehended that individuals with hip osteoarthritis are in a vicious circle regarding aerobic exercise and osteoarthritis progression. In clinical practice, some physicians claim that aerobic exercise such as walking combined with increased load on the joint due to high weight may increase osteoarthritis. In contrast, clinical guidelines strongly recommend aerobic exercise to prevent hip osteoarthritis (32,33). Our study found that individuals with high BMI benefited less from exercise. Future studies should address the barriers and benefits of exercise after THA in individuals with high BMI more comprehensively.

The correlation between ROM and the benefits of exercise barriers provided critical clinical outcomes for comparing objective-subjective parameters in our study. The total score of exercise barriers and benefits was moderate to strongly correlated with all angles of hip joint motion. The highest correlation was with the degree of external rotation. According to these results, it was revealed that ROM is also related to the subjective exercise intake of individuals. Some studies have demonstrated flexion-extension ROM losses with neglect of post-operative rehabilitation protocols (34,35). The subjective exercise perception of individuals supported our results.

Limitations

The study has some potential methodological limitations. First, the fact that individuals' exercise perceptions were not addressed within the context of a standardized exercise rehabilitation protocol. Secondly, our study was conducted with a prospective cross-sectional design. In a longitudinal design, the change between two different measurements in terms of MCID value could have facilitated the clinical interpretation of the results. Although we provide an evidence-based power analysis with a sample size, a higher sample may improve the evidence level of the statistical analysis.

CONCLUSION

The results revealed that exercise barriers and benefits were moderately associated with physical performance. However, exercise benefits were poorly associated with body mass index and quality of life. Finally, there was a low-to-moderate association between benefits and barriers of exercise barrier with hip ROM in all directions. The outcomes of this study revealed that individuals' exercise barriers and benefits were mainly associated with physical performance. Participants with higher exercise benefits from exercise had higher physical performance, ROM, and quality of life. Future studies may address exercise barriers and benefits in the context of secondary data from a randomized controlled trial of a standardized exercise program in the postoperative period.

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