

ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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# Effect of Spirometry Use in the Pre-Op Period on Stress and Anxiety Levels in the Post-Op Period in Total Hip Replacement and Knee Replacement Surgeries: A Quantitative Quasi-Experimental Study

## Total Kalça Protezi ve Diz Protezi Ameliyatlarında Pre-Op Dönemde Spirometre Kullanımının Post-Op Döneminde Stres ve Anksiyete Düzeyine Etkisi: Nicel Yarı Deneysel Çalışma

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This study was prepared based on the findings of Münevver ARAS KARAKAŞ's thesis study titled "tez adı" (İstanbul: Haliç University; yıl)

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**ABSTRACT Objective:** This research aimed to determine the effect of preoperative use of spirometer on stress and anxiety levels in the postoperative period in total hip replacement and knee replacement surgeries. **Material and Methods:** The study was carried out in a quasi-experimental design. The study was conducted in the orthopaedic clinic of İstanbul Gaziosmanpaşa Training and Research Hospital in June 2022, in İstanbul, with 30 patients with hip prostheses (n=17) and knee prostheses (n=13). Spirometry was used after the Perceived Stress Scale (PSS), and the Beck Anxiety Inventory (BAI) was applied preoperatively, and the PSS, and the BAI was applied again postoperatively. **Results:** In intra-group comparisons, a decrease was observed in the anxiety scores of patients with hip and knee prostheses (p=0.000). In inter-group comparisons, there was a difference in the postoperative BAI scores, while there was a difference in the preoperative and postoperative PSS scores (p<0.01). A positive relationship was detected between postoperative PSS and the BAI of those in the hip replacement group (r=0.493; p=0.044). **Conclusions:** The results demonstrated that preoperative use of spirometer can reduce patients' stress and anxiety levels. Providing education to patients and their families before and after surgery can be recommended to enable them to resume their daily life activities.

**Keywords:** Anxiety; knee replacement; spirometer; stress; hip replacement

**ÖZET Amaç:** Bu çalışma, total kalça protezi ve diz protezi ameliyatlarında ameliyat öncesi spirometre kullanımının ameliyat sonrası dönemdeki stres ve anksiyete düzeylerine etkisinin belirlenmesi amacıyla gerçekleştirildi. **Gereç ve Yöntemler:** Çalışma yarı deneysel tasarımda yürütülmüştür. Çalışma, Haziran 2022 tarihinde İstanbul Gaziosmanpaşa Eğitim ve Araştırma Hastanesi Ortopedi Kliniği'nde, kalça protezi (n=17) ve diz protezi (n=13) olan 30 hasta ile yürütülmüştür. Ameliyat öncesinde Algılanan Stres Ölçeği [Perceived Stress Scale (PSS)] ve Beck Anksiyete Envanteri [Beck Anxiety Inventory (BAI)] uygulandıktan sonra spirometre kullanılmış ve ameliyat sonrasında PSS ve BAI tekrar uygulanmıştır. **Bulgular:** Grup içi karşılaştırmalarda kalça ve diz protezi olan hastaların anksiyete puanlarında azalma gözlemlendi (p=0,000). Gruplar arası karşılaştırmalarda BAI ameliyat sonrası puanlarında farklılık görüldü, PSS ameliyat öncesi ve sonrası puanlarında fark görülmüştür (p<0,01). Kalça protezi grubunda ameliyat sonrası PSS ile BAI arasında pozitif bir ilişki saptanmıştır (r=0,493; p=0,044). **Sonuç:** Sonuçlar, spirometrenin ameliyat öncesi kullanımının hastaların stres ve anksiyete düzeylerini azaltabileceğini göstermiştir. Ameliyat öncesi ve sonrası hastalara ve ailelerine günlük yaşam aktivitelerine dönebilmeleri için eğitim verilmesi önerilebilir.

**Anahtar Kelimeler:** Anksiyete; diz protezi; spirometre; stres; kalça protezi

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Surgical procedures impact patients both psychologically and physiologically, as all aspects of the process, including surgery, anaesthesia, and postoperative phases, create stress and anxiety in patients.<sup>1</sup> Higher rates of depression, stress, and anxiety are reported among patients admitted to orthopaedic and traumatology clinics.<sup>2</sup> The success of surgical intervention and treatment depends not only on the surgical technique but also on preparing and informing the patient preoperatively and providing care postoperatively.<sup>3</sup> Reminding patients about the use of spirometers was reported to enhance their adherence to various treatments.<sup>4</sup> It is stated that applications made by changing the depth and frequency of breathing have positive effects on emotional reactions and psychological processes.<sup>5</sup> Besides, it is suggested that respiratory diseases and problems may contribute to or exacerbate panic and anxiety disorders.<sup>6</sup> Depression and anxiety may be observed due to decreased respiratory functions.<sup>7</sup> Respiratory therapy applied to patients, regardless of the technique or equipment used, plays an important role in pulmonary rehabilitation.<sup>8</sup> A significant reduction in postoperative pulmonary and extrapulmonary complications was described with the use of lung protective ventilation.<sup>9</sup> Increased oxidative stress was also linked with major postoperative complications.<sup>10</sup> The insufficient number of studies on the use of spirometry in orthopedic patients, especially those undergoing knee and hip replacement surgery, and its effects on the psychological outcomes of individuals reveals a gap in the literature. For this reason, this study was conducted to determine the effect of spirometry use in the preoperative period on stress and anxiety levels in the postoperative period in total hip replacement and knee replacement surgeries.

## MATERIAL AND METHODS

### STUDY DESIGN

The study was conducted with a quasi-experimental design to determine the effect of the preoperative use of incentive spirometers on postoperative stress and anxiety levels in total hip replacement and knee replacement surgeries. In this context, the following hypotheses were sought:

H<sub>0</sub>: Preoperative use of a spirometer has no effect on postoperative stress or anxiety in patients undergoing total hip or knee replacement surgery.

H<sub>1a</sub>: Preoperative use of a spirometer reduces postoperative stress levels in patients undergoing total hip or knee replacement surgery.

H<sub>1b</sub>: Preoperative use of a spirometer reduces postoperative anxiety levels in patients undergoing total hip or knee replacement surgery.

### STUDY SETTING AND SAMPLING

Following the ethics committee and institutional permission, data were collected from patients in the orthopaedic service of İstanbul Gaziosmanpaşa Training and Research Hospital in June 2022, in İstanbul. Based on the monthly surgery rates in the orthopaedic department, the sample consisted of 30 patients, comprising 17 patients who would receive hip replacement surgery and 13 who would receive knee replacement surgery. The sample calculation was made by taking into account the number of patients admitted to the service for knee or hip replacement surgery. The “post hoc” power analysis using the G\*Power 3.0.10 software showed that the effect size obtained from the preliminary study in the 2 repeated-measures design, with a sample size of 26 (n1:13-n2:13) and a 5% margin of error, indicated an approximate study power of 90%. The inclusion criteria for the sample were i) being scheduled for hip or knee replacement surgery, and ii) being able to respond to questions independently. The exclusion criteria were; i) having any illness that affects breathing, ii) having a diagnosed anxiety-related illness, iii) having any hearing or vision impairment, and iv) having any cognitive impairment.

### DATA COLLECTION TOOLS

**Personal Information Form:** A 20-item questionnaire prepared by the researcher was used to collect patients’ sociodemographic and health status informations.

**The Perceived Stress Scale-14 (PSS-14):** It is a 5-point Likert-type scale developed by Cohen, Kamarck and Mermelstein, and its Turkish validity and reliability were assessed by Eskin et al. In addition to

the 14-item PSS 10 and 4-item versions are available. Scores on the PSS-14 range from 0 to 56.<sup>11</sup> In Eskin's validity and reliability study, the PSS demonstrated a Cronbach alpha value of 0.66.<sup>11</sup> PSS-14 question form was used in this study. In this study, this scale showed a Cronbach alpha value of 0.726 for preoperative and 0.722 for postoperative.

**Beck Anxiety Inventory (BAI):** Developed by Beck et al., the inventory consists of 21 items, and its Turkish validity and reliability were assessed by Ulu-soy et al. The total score ranges from 0 to 63, with higher scores indicating greater severity of depression. The Cronbach alpha coefficient for internal consistency is reported as 0.93.<sup>12</sup> In this study, the BAI demonstrated a Cronbach alpha value of 0.884 for preoperative and 0.855 for postoperative.

## INTERVENTION

After providing information and ensuring correct usage of spirometer through demonstration, individuals were given spirometer and instructed to use it correctly, starting 48 hours before the surgery, practising it 3 times a day for 5 minutes each session. Using respiratory exercise devices 48-72 hours before surgery helps facilitate the completion of the surgical process.<sup>13</sup> A tool containing 3 balls was used as a spirometer, and it is necessary to ensure that all the balls rise to the top by taking a deep breath or exhaling, depending on the stance of the tool. The same model and type of spirometer was provided to all patients. The researcher observed and supported the patient during spirometer exercises. Participants were only administered spirometry before surgery and not after surgery. The results obtained were scored according to the statements made by the patients in the data collection tools they filled out.

## DATA COLLECTION

In the study, face-to-face interviews were conducted with patients before using spirometry in the preoperative period, and participants who volunteered to participate in the study filled out the Personal Information Form, PSS, and BAI Form. After the data collection tools were filled in, patients were told how to use spirometry and the intervention was performed. In the postoperative period, when patients

felt good and could answer the questions independently, the PSS and BAI were collected by the researcher through face-to-face interviews. In cases where patients reported feeling better, data were collected 24 hours after surgery.

## DATA ANALYSIS

Statistical analyses were performed using the SPSS software package (IBM SPSS Statistics 24). Frequency tables and descriptive statistics were used to interpret the findings. "Independent t-test", "Paired test" (t-table value), "Mann-Whitney U test" (Z-table value), "Wilcoxon test" (Z-table value), "Pearson and Spearman" correlation coefficient were used for analyses.

## ETHICAL APPROVAL

The research conforms to the provisions of the Declaration of Helsinki. To implement the study, ethical approval was obtained from Haliç University Non-Interventional Clinical Research Ethics Committee (date: February 23, 2022, no: 39), institutional permission was obtained from İstanbul Gaziosmanpaşa Training and Research Hospital (date: June 08, 2022, no: 41420-2022/11). After the necessary permissions were obtained, written consent was obtained from all participants before the study began.

## RESULTS

There was a statistically significant difference found among participants in terms of having hip or knee replacement, their income level, and their opinion about whether the surgery would limit them presented in Table 1 ( $p < 0.05$ ).

In intra-group comparisons, a statistically significant decrease was observed in the anxiety scores of patients with hip and knee prostheses ( $p = 0.000$ ). In inter-group comparisons, there was a statistically significant difference in the BAI postoperative scores and preoperative and postoperative scores of the PSS presented in Table 2 ( $p < 0.01$ ).

A positive, weak and statistically significant relationship was detected between the postoperative PSS and BAI in the hip replacement group presented in Table 3 ( $r = 0.493$ ;  $p = 0.044$ ).

| <b>Group Variable</b>                                   | <b>Hip replacement (n=17)</b> |          | <b>Knee replacement (n=13)</b> |          | <b>Statistical analysis*probability</b> |
|---------------------------------------------------------|-------------------------------|----------|--------------------------------|----------|-----------------------------------------|
|                                                         | <b>n</b>                      | <b>%</b> | <b>n</b>                       | <b>%</b> |                                         |
| Age groups                                              |                               |          |                                |          |                                         |
| ≤64                                                     | 3                             | 17.6     | 6                              | 46.2     | $\chi^2=5.010$                          |
| 65-74                                                   | 5                             | 29.5     | 5                              | 38.5     | $p=0.082$                               |
| ≥75                                                     | 9                             | 52.9     | 2                              | 15.3     |                                         |
| Gender                                                  |                               |          |                                |          |                                         |
| Female                                                  | 15                            | 88.2     | 11                             | 84.6     | $\chi^2=0.084$                          |
| Male                                                    | 2                             | 11.8     | 2                              | 15.4     | $p=0.773$                               |
| Marital status                                          |                               |          |                                |          |                                         |
| Married                                                 | 16                            | 94.1     | 13                             | 100.0    | $\chi^2=0.791$                          |
| Single                                                  | 1                             | 5.9      | -                              | -        | $p=0.374$                               |
| Income                                                  |                               |          |                                |          |                                         |
| Income is less than expenses                            | 6                             | 35.3     | -                              | -        | $\chi^2=5.735$                          |
| Income is more than expenses                            | 11                            | 64.7     | 13                             | 100.0    | <b><math>p=0.017</math></b>             |
| Education                                               |                               |          |                                |          |                                         |
| Illiterate                                              | 9                             | 52.9     | 4                              | 30.8     | $\chi^2=7.445$                          |
| Literate                                                | 4                             | 23.5     | 9                              | 69.2     | $p=0.059$                               |
| Primary education                                       | 3                             | 17.7     | -                              | -        |                                         |
| High school                                             | 1                             | 5.9      | -                              | -        |                                         |
| Family type                                             |                               |          |                                |          |                                         |
| Nuclear family                                          | 5                             | 29.4     | 9                              | 69.2     | $\chi^2=3.229$                          |
| Extended family                                         | 12                            | 70.6     | 4                              | 30.8     | $p=0.072$                               |
| Presence of a supporter                                 |                               |          |                                |          |                                         |
| Yes                                                     | 17                            | 100.0    | 13                             | 100.0    | #                                       |
| Surgery history                                         |                               |          |                                |          |                                         |
| Yes                                                     | 9                             | 52.9     | 9                              | 69.2     | $\chi^2=0.277$                          |
| No                                                      | 8                             | 47.1     | 4                              | 30.8     | $p=0.599$                               |
| Fear of surgery                                         |                               |          |                                |          |                                         |
| Yes                                                     | 15                            | 88.2     | 11                             | 84.6     | $\chi^2=0.084$                          |
| No                                                      | 2                             | 11.8     | 2                              | 15.4     | $p=0.773$                               |
| Thinking that the surgery will be limiting              |                               |          |                                |          |                                         |
| Yes                                                     | 16                            | 94.1     | 6                              | 46.2     | $\chi^2=8.666$                          |
| No                                                      | 1                             | 5.9      | 7                              | 53.8     | <b><math>p=0.003</math></b>             |
| Thinking that the surgery will cause damage to the body |                               |          |                                |          |                                         |
| Yes                                                     | 8                             | 47.1     | 3                              | 23.1     | $\chi^2=1.824$                          |
| No                                                      | 9                             | 52.9     | 10                             | 76.9     | $p=0.177$                               |

\*Pearson- $\chi^2$  cross tables; #The statistical evaluation could not be performed as there were no subjects in the "no" group.

## DISCUSSION

Breathing exercises have a relaxing and stress-reducing effect on individuals.<sup>14</sup> It is stated that deep breathing has a positive effect on stress, anxiety and negative affect seen in various situations such as diseases and surgical procedures.<sup>15</sup> The use of spirometry is useful in detecting many respiratory-related and non-respiratory-related chronic diseases and that it

should be used throughout infancy, adolescence, early and late adulthood.<sup>16</sup> Spirometry, which is also used to increase lung capacity, allows the patient to take long, deep breaths and hold them for seconds, thus encouraging diaphragmatic breathing, improving tidal volume and basal ventilation, and encouraging the clearance of secretions.<sup>17</sup>

Among the participants, a significant difference was observed in hip and knee replacement patients

**TABLE 2:** Comparison of BAI and the PSS-14 Scores according to groups

| Inventory/scale |                      | Hip replacement (n=17)     |                             | Knee replacement (n=13)   |                             | Statistical analysis*      |
|-----------------|----------------------|----------------------------|-----------------------------|---------------------------|-----------------------------|----------------------------|
|                 |                      | $\bar{X} \pm SD$           | Median<br>[minimum-maximum] | $\bar{X} \pm SD$          | Median<br>[minimum-maximum] |                            |
| BAI             | Preoperative         | 17.12 $\pm$ 9.05           | 16.0<br>[6.0-43.0]          | 11.92 $\pm$ 6.44          | 10.0<br>[3.0-25.0]          | Z=-1.719<br>p=0.086        |
|                 | Postoperative        | 8.12 $\pm$ 5.63            | 6.0<br>[1.0-21.0]           | 3.00 $\pm$ 1.91           | 3.0<br>[0.0-6.0]            | t=3.491<br><b>p=0.002</b>  |
|                 | Analysis probability | Z=-3.625<br><b>p=0.000</b> |                             | t=5.916<br><b>p=0.000</b> |                             |                            |
| PSS-14          | Preoperative         | 27.47 $\pm$ 3.85           | 28.0<br>[20.0-33.0]         | 23.69 $\pm$ 2.78          | 22.0<br>[20.0-28.0]         | Z=-2.751<br><b>p=0.006</b> |
|                 | Postoperative        | 27.35 $\pm$ 3.44           | 28.0<br>[20.0-33.0]         | 23.69 $\pm$ 2.78          | 22.0<br>[20.0-28.0]         | Z=-2.823<br><b>p=0.005</b> |
|                 | Analysis probability | t=0.265<br>p=0.795         |                             | Z=0.000<br>p=1.000        |                             |                            |

\*Independent Sample t-test (t-table value); "Paired Sample" test (t-table value); "Mann-Whitney U" test (Z-table value); the "Wilcoxon" test (Z-table value); SD: Standard deviation; BAI: Beck Anxiety Inventory; PSS: Perceived Stress Scale

**TABLE 3:** Examining scale scores according to groups

| Correlation*  | The PSS-14                |              |                            |         |
|---------------|---------------------------|--------------|----------------------------|---------|
|               | Hip replacement<br>(n=17) |              | Knee replacement<br>(n=13) |         |
|               | r value                   | p value      | r value                    | p value |
| BAI           |                           |              |                            |         |
| Preoperative  | 0.089                     | 0.733        | 0.355                      | 0.233   |
| Postoperative | <b>0.493</b>              | <b>0.044</b> | 0.495                      | 0.085   |

\*The Spearman correlation; PSS: Perceived Stress Scale; BAI: Beck Anxiety Inventory

whose income exceeded their expenses. While hip replacement patients believed that the surgery would limit them, knee replacement patients did not think they would be restricted. According to Jacobson et al, a significant portion of knee replacement patients experiences pain, functional limitations, and dissatisfaction persisting up to 2 years after the surgery.<sup>18</sup> In a study conducted by Fernandes et al. on patients who underwent abdominal surgery, there was a decrease in muscle strength, resulting in limitations in daily functions, and after respiratory therapy, there was an improvement in muscle strength, enhancing functionality in daily life activities.<sup>8</sup> For many people, undergoing surgery is perceived as a stressful life event that often leads to anxiety in the perioperative period, and this intensifies greatly when the patient fears pain and lack of control.<sup>19</sup>

In intra-group comparisons, it was observed that the anxiety scores of hip and knee replacement patients decreased, and the stress scores decreased slightly in hip replacement patients. Restriction or restriction of airflow in individuals may cause anxiety.<sup>20</sup> Dyspnea is common in anxiety, and it has been reported that there is a relationship between respiratory distress and anxiety.<sup>7</sup> Patients with high levels of anxiety, depression, and negative surgery expectations are strongly associated with worse total knee replacement outcomes.<sup>21</sup> For this reason, various interventions are carried out to help patients avoid negative emotions such as stress, anxiety and depression before surgery. In a study by Gudivada et al. with patients who had COVID-19 disease, there was an improvement in respiratory functions with incentive spirometry exercises, and the anxiety and depression scores of the patients decreased compared to those who did not do breathing exercises.<sup>6</sup> According to the study by Eltorai et al, reminding patients about spirometer usage increased adherence to spirometer use, positively impacted various clinical outcomes, shortened fever episodes, reduced intensive care unit stay durations, and decreased the usage rates of non-invasive positive pressure ventilation and the duration of high-flow nasal cannula usage.<sup>4</sup> The study by Demirci et al. on patients undergoing orthopaedic



surgery indicated that showing videos and playing music reduced anxiety.<sup>19</sup> In a study by Zheng et al. on patients undergoing lumbar disc herniation surgery, relaxation therapy was mentioned to distract patients' attention, reduce muscle tension, and simultaneously affect the nervous system, increasing tolerance to external stressors and reducing fatigue caused by muscle tension.<sup>22</sup> In the study conducted by Wang et al, it was observed that psychological techniques such as relaxation exercises in the mobile rehabilitation program applied to patients after total hip or knee arthroplasty were effective in reducing stress, anxiety and depression, and a more effective and supportive intervention plan can be created for individuals by adding activities such as breathing exercises and spirometer use to such mobile applications.<sup>23</sup> These studies suggest that interventions performed before, during surgery or after discharge help reduce stress and anxiety in patients. The small number of studies on this subject in the field of orthopedics also reveals the need to focus on this subject.

A positive relationship was detected between the postoperative PSS and the BAI in the hip replacement group. According to a study by Şavk et al, as anxiety levels increased, diseases had a greater impact on patients' lives, and concerns about their illnesses and their emotional impact also increased.<sup>1</sup> Wrzeciono et al. suggested that as perceived stress increased, respiratory function efficiency decreased.<sup>24</sup> Pulmonary rehabilitation facilitates individuals' desensitisation to shortness of breath, anxiety, and depression.<sup>6</sup> Joint decision-making with the patient and taking time to explain risks and predictions are among the essential elements of preoperative counselling to reduce stress.<sup>19</sup>

When the hypotheses of the study were considered, it was seen that the use of spirometry was not ineffective. In this study, it was seen that it was more effective in reducing anxiety, but its level of effect in reducing stress was very low.

## LIMITATIONS

The study has some limitations. The first is that it was conducted in a single hospital. Therefore it is not gen-

eralizable. Another limitation is that the effect of spirometer use on patients could not be followed for an extended period. The absence of a control group is also among the limitations of the study.

## CONCLUSION

Preoperative spirometer usage has been observed to be effective in reducing the patient's stress and anxiety levels. It has been realized that the number of studies on the use of spirometer and other spirometers in reducing the negative psychological effects of surgical procedures on individuals is insufficient and that more studies are necessary. Lowering patients' stress and anxiety levels by providing spirometer training preoperatively and investigating the effect of the spirometer training on stress and anxiety levels further with different patient groups and randomized controlled studies can be recommended.

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## Conflict of Interest

*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

## Authorship Contributions

**Idea/Concept:** Münevver Aras Karakaş, Gülcan Kendirikiran; **Design:** Gülcan Kendirikiran, Münevver Aras Karakaş; **Control/Supervision:** Gülcan Kendirikiran; **Data Collection and/or Processing:** Münevver Aras Karakaş; **Analysis and/or Interpretation:** Münevver Aras Karakaş, Gülcan Kendirikiran; **Literature Review:** Münevver Aras Karakaş, Gülcan Kendirikiran; **Writing the Article:** Münevver Aras Karakaş, Gülcan Kendirikiran; **Critical Review:** Gülcan Kendirikiran; **References and Fundings:** Münevver Aras Karakaş, Gülcan Kendirikiran; **Materials:** Münevver Aras Karakaş.

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