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Functional outcomes and post-rehabilitation quality of life following total knee arthroplasty – a pilot study

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Abstract

Introduction and Objective. Osteoarthritis of the knee leads to pain, reduced functional ability and a decline in quality of life. Knee replacement, combined with rehabilitation, is an effective treatment, but the impact of place of residence on patients' functional status and quality of life remains poorly understood. The aim of the study is to assess the functional status of patients before knee replacement surgery and after completion of rehabilitation, and to analyse their functional status and quality of life at the post-rehabilitation assessment, taking into account their place of residence.

Materials and Method. The study included 60 patients who underwent total knee replacement. Functional status was assessed using the KOOS questionnaire before surgery and after completion of rehabilitation, whereas quality of life was assessed using the WHOQOL-BREF questionnaire after rehabilitation. Statistical analyses were performed using the Wilcoxon signed-rank test and the Mann–Whitney U test, with a significance level of $p < 0.05$. The Holm–Bonferroni correction was applied to adjust for multiple comparisons.

Results. Following rehabilitation, functional status significantly improved across all KOOS domains ($p < 0.001$). Place of residence did not affect functional outcomes. Urban residents had descriptively higher WHOQOL-BREF scores, but no differences remained significant after correction.

Conclusions. Knee replacement surgery, combined with post-operative rehabilitation, was associated with significant improvements in patients' functional status. Place of residence did not affect functional outcomes, and no significant urban–rural differences in quality of life remained after correction. These findings should be interpreted cautiously, as quality of life was assessed only once, after rehabilitation.

Key words

knee osteoarthritis, total knee arthroplasty, rehabilitation, quality of life, patient-reported outcome measures, activities of daily living

INTRODUCTION AND OBJECTIVE

Osteoarthritis is the most common chronic condition affecting the musculoskeletal system and is a leading cause of disability worldwide. The essence of the disease lies in the progressive loss of both the quality and quantity of articular cartilage, the function of which is to cushion loads and ensure smooth movement of the joint surfaces. As the disease progresses, symptoms such as pain, stiffness and instability in the affected joints become more severe. These symptoms lead to limitations in daily, occupational and social activity [1, 2], forcing patients to rely on care providers [3]. This chronic, progressive condition also leads to sleep disturbances, fatigue and a reduced quality of life across all aspects [1, 4]. Osteoarthritis is also associated with high costs to the healthcare system [5]. Given the ageing population and the rising prevalence of obesity and joint injuries, the prevalence of osteoarthritis is expected to continue to rise [5].

One method of treating osteoarthritis of the knee is total knee replacement. This is a commonly used surgical treatment for advanced osteoarthritis of the knee, and is characterised by a high degree of effectiveness as assessed on the basis of objective clinical outcomes [6]. However, studies indicate that a significant proportion of patients report dissatisfaction with the outcomes of treatment following surgery, due to persistent pain, functional limitations and reduced quality of life [7]. The high proportion of adverse outcomes reported by patients suggests that some patients do not experience the expected improvement in their quality of life following surgery. Medical rehabilitation is now a key component of post-operative management, facilitating the recovery of functional ability following knee replacement surgery [8]. However, restoring full functional ability to enable everyday functioning after surgery remains a challenge [9], and many factors can disrupt or hinder the rehabilitation process.

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Place of residence is one of the socio-demographic factors that may influence the course of treatment and the outcomes of rehabilitation in patients following knee replacement surgery. People living in rural areas often have limited access to specialist orthopaedic and rehabilitation care due to the distance from treatment centres or to limited transport options [10]. However, existing research indicates that, despite these differences, patients living in urban and rural areas achieve comparable functional outcomes following knee replacement surgery [11, 12]. At the same time, the impact of place of residence on quality of life following surgery remains poorly understood, and studies of this issue are limited [13]. For this reason, an assessment of the relationship between place of residence and the functional status and quality of life of patients following knee replacement surgery appears justified, and may provide important information for the planning of post-operative care and rehabilitation.

OBJECTIVE

The aim of the study is to assess the functional status of patients before knee replacement surgery and after rehabilitation, and to analyse differences in functional status and quality of life according to place of residence. Answers were sought to the following questions:

1. What was the functional status of the patients, as assessed using the KOOS scale, at the preoperative and post-rehabilitation assessments?
2. Were there any differences in functional status, as assessed using the KOOS scale, between patients living in urban and rural areas at the preoperative and post-rehabilitation assessments?
3. What was the patients' quality of life after knee replacement surgery and rehabilitation, as assessed using the WHOQOL-BREF questionnaire?
4. Were there any differences in quality of life, as assessed using the WHOQOL-BREF questionnaire, between patients living in urban and rural areas after rehabilitation?

MATERIALS AND METHOD

The longitudinal study involved 60 patients aged between 51–82, hospitalised in the Orthopaedics Department and the Rehabilitation Department of the MSWiA Hospital in Lublin. The study participants were patients referred for elective total knee arthroplasty. The study was conducted between 12 December 2022 – 13 April 2023. Prior to commencement of the study, consent was obtained from the Ethics Committee of the Hospital of the Ministry of the Interior and Administration (MSWiA) in Lublin. The study was conducted in accordance with the Declaration of Helsinki and its amendments.

The mean age of the participants was 68.17 ± 7.04 years. Women accounted for 76.67% of the study group (n = 46), and men accounted for 23.33% (n = 14). Most respondents lived in towns (n = 33; 55.0%), while rural residents accounted for 45.0% of the sample (n = 27). The educational background of the respondents varied. The largest group consisted of those with secondary education (n = 15; 25.0%), vocational secondary education (n = 14; 23.33%) and vocational qualifications (n = 12; 20.0%). The majority of respondents were married (n = 36; 60.0%), however, 35.0% were widowers and widows (n = 21).

The study included patients who had been referred for elective knee replacement surgery due to osteoarthritis of the knee. An additional inclusion criterion was that participants were not taking any medication that might affect motor coordination. The exclusion criteria included the occurrence of post-operative complications (local or general) and impairments in verbal-logical communication.

The participants were assessed on two occasions: at the pre-operative and post-rehabilitation assessments.

The following were employed to collect research data: the Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire, and the abbreviated WHOQOL-BREF quality of life questionnaire. The WHOQOL-BREF quality of life questionnaire assesses patients' life circumstances across various domains, comprised of 26 questions covering four domains of life, namely: physical, mental, social and environmental functioning [14,15]. Another tool used was the KOOS Scale, comprising five subscales covering the determination of: (1) pain, (2) symptoms, (3) daily activities, (4) sporting and recreational activities, and (5) quality of life. The assessment focused on the patient's well-being during the week in which the survey was conducted. The standard survey form included response options ranging from 0–4 points on a Likert scale. The total score is calculated separately for each subscale. A score of 100 indicates the absence of symptoms, while a score of zero indicates the presence of symptoms of extreme severity. Part I contains 7 questions concerning actual symptoms; Part II consisted of 9 questions concerning pain; Part III incorporated 17 questions assessing activities of daily living; and Part IV had 5 questions relating to the assessment of sporting and recreational activities. Part V comprised 4 questions that measured quality of life [16–18]. The self-designed questionnaire contained 17 questions, including 2 semi-open-ended questions and 15 single-choice questions. The first section concerned socio-demographic data, such as: gender, age, place of residence, education and marital status.

The internal consistency of both standardized questionnaires was evaluated using Cronbach's alpha coefficient in the study sample (n = 60). For the WHOQOL-BREF, administered after rehabilitation, Cronbach's α coefficients were 0.824 for the physical health domain, 0.814 for the psychological health domain, 0.704 for the social relationships domain, and 0.827 for the environmental domain. The corresponding standardized α coefficients were 0.824, 0.809, 0.724, and 0.820, respectively. For the KOOS, administered before rehabilitation, Cronbach's α coefficients were 0.725 for the Symptoms subscale, 0.853 for the Pain subscale, 0.941 for the Activities of Daily Living subscale, 0.921 for the Sport and Recreation Function subscale, and 0.677 for the Knee-Related Quality of Life subscale. The corresponding standardized α coefficients were 0.747, 0.860, 0.941, 0.928, and 0.692, respectively.

Statistical analysis. Statistical analysis was carried out via Statistica 13.3 (TIBCO Software Inc., 2017, Statistica – data analysis software system, version 13) and Microsoft Excel 365. A significance level of α = 0.05 was adopted for all analyses.

Descriptive statistics were used in the analysis of the results, including frequencies and percentages (%), as well as measures of central tendency and dispersion: the arithmetic

mean (M), standard deviation (SD), median (Me), mode (Mo), and minimum (Min) and maximum (Max) values. Before selecting the appropriate statistical methods, the conformity of the distribution of the analysed variables with the normal distribution was assessed by means of the Shapiro–Wilk test. Due to the non-normal distribution of the variables and the ordinal nature of some of the data, non-parametric tests were employed.

The Wilcoxon signed-rank test was used to compare KOOS scores obtained at the pre-operative and post-rehabilitation assessments. The Mann–Whitney U test was used to compare KOOS scores between patients living in urban and rural areas at both assessment time points. It was also used to compare WHOQOL-BREF scores between urban and rural residents following rehabilitation. To account for multiple comparisons, p-values for the 47 Wilcoxon signed-rank tests were adjusted using the Holm–Bonferroni method. Similarly, p-values for the six WHOQOL-BREF outcomes compared by place of residence were adjusted using the Holm–Bonferroni method. Statistical significance was determined based on the adjusted p-values, with a threshold of $p < 0.05$.

The internal consistency of the WHOQOL-BREF domains and KOOS subscales was assessed using Cronbach's α coefficient, including standardized α coefficients. Reliability analyses were performed using WHOQOL-BREF data collected after rehabilitation and KOOS data collected before rehabilitation.

RESULTS

Assessment of knee function in patients scheduled for total knee arthroplasty before surgery and after rehabilitation using the KOOS questionnaire. At the pre-operative assessment, patients scheduled for total knee arthroplasty exhibited the lowest scores in Sport and Recreation Function (Me = 0.0) and Knee-Related Quality of Life (Me = 18.75). Higher, although still reduced, median scores were observed for Symptoms (Me = 37.50), Pain (Me = 36.11), and Activities of Daily Living (Me = 30.88). Within the Symptoms domain, the greatest impairments were related to knee flexion, swelling, and stiffness. In the Pain domain, the greatest difficulties were reported with twisting and pivoting, full knee flexion, stair climbing, and the frequency of pain episodes. In Activities of Daily Living, the most pronounced limitations concerned heavy domestic duties and mobility. Knee-Related Quality of Life was most impaired in terms of overall knee function, symptom frequency, and the need for lifestyle modifications. In Sport and Recreation Function, all assessed activities had a median score of 0.

Following rehabilitation, statistically significant improvements were observed across all KOOS domains (Holm-adjusted $p < 0.05$). Median scores increased from 37.50–62.50 for Symptoms, from 36.11 to 58.33 for Pain, from 30.88 to 58.82 for Activities of Daily Living, from 0.0–20.0 for Sport and Recreation Function, and from 18.75–43.75 for Knee-Related Quality of Life. Despite these improvements, the lowest post-rehabilitation scores were still observed for pain frequency, heavy domestic duties, and Sport and Recreation Function, particularly jumping and kneeling (Tab. 1).

The change in knee joint function following total knee arthroplasty was not significantly different according to place of residence ($p > 0.05$ for all analyzed domains). Both rural and urban residents experienced comparable improvements in Symptoms, Pain, Activities of Daily Living, Sport and Recreation Function, and Knee-Related Quality of Life (Tab. 2).

Quality of life among patients surveyed following knee replacement surgery and rehabilitation, as assessed using the WHOQOL-BREF questionnaire. Assessment of quality of life using the WHOQOL-BREF indicated that participants generally rated their overall quality of life as good (Me = 4.0) and were satisfied with their health status (Me = 4.0). Median scores were highest in the psychological (Me = 15.33) and social domains (Me = 14.67), slightly lower in the environmental domain (Me = 14.0), and lowest in the physical health domain (Me = 12.57), suggesting that physical health remained the lowest-rated domain (Tab. 3).

No significant differences were observed in satisfaction with health status after total knee arthroplasty and rehabilitation according to place of residence ($p = 0.577$). Overall quality of life was slightly higher among urban residents (Me = 4.0) than among rural residents (Me = 3.0), but this difference was not statistically significant (Mann–Whitney U test; $p = 0.124$).

Assessment of specific WHOQOL-BREF domains revealed descriptively higher scores among urban residents in the physical domain (Me = 13.71 vs. 12.0; raw $p = 0.022$), psychological domain (Me = 16.0 vs. 14.67; raw $p = 0.011$), social domain (Me = 16.0 vs. 14.67; raw $p = 0.048$), and the environmental domain (Me = 15.0 vs. 14.0; raw $p = 0.034$). However, none of these differences remained statistically significant after adjustment for multiple comparisons using the Holm–Bonferroni method (Tab. 4).

DISCUSSION

Osteoarthritis of the knee is one of the main causes of pain and reduced mobility in older people. In the advanced stages of the disease, total knee replacement remains the most effective treatment [19]. Patient-reported outcome measures (PROMs), which enable the assessment of pain, function and quality of life, are being recognised as increasingly important in evaluating the effectiveness of treatment [20].

This study demonstrated a significant enhancement in the functional status of patients following knee replacement surgery and completion of rehabilitation, as determined using the KOOS questionnaire. The greatest improvement was observed in terms of pain symptoms and their frequency. Following completion of rehabilitation, patients reported a significantly lower intensity of pain during everyday activities, which indicates a beneficial effect of surgical treatment and rehabilitation on knee joint function. These findings are consistent with the results of a recent systematic review, which confirmed that total knee arthroplasty combined with post-operative rehabilitation is associated with substantial improvements in pain and physical function [21].

Canovas and Dagneaux [22] emphasised that the ability to walk down stairs is one of the most important factors influencing patient satisfaction following knee replacement surgery. These findings are reflected in the current study, which demonstrated a significant reduction in pain when walking down stairs following the completion of rehabilitation. A recent systematic review by DeFrance et al.

Table 1. KOOS scores before surgery and after rehabilitation in patients scheduled for total knee arthroplasty.

KOOS		Assessment of knee joint function						Wilcoxon test		
		Before surgery			After rehabilitation					
		Me	Q1	Q3	Me	Q1	Q3	Z	p (raw)	p (Holm adjusted)
Symptoms	Swelling of knee joint	1.0	0.0	1.5	2.0	1.0	3.0	3.074	0.002	0.004
	Creaking or grinding noise, skipping sensation, or any other sound while moving	2.0	1.0	4.0	3.0	2.0	4.0	3.559	<0.001	0.002
	Locking the joint during flexion and extension	2.0	1.0	3.0	3.0	2.0	4.0	4.155	<0.001	< 0.001
	No restrictions on knee extension	2.0	1.0	3.0	3.0	3.0	4.0	4.905	<0.001	< 0.001
	No restrictions on knee flexion	0.5	0.0	1.5	3.0	1.0	4.0	5.170	<0.001	< 0.001
	Degree of stiffness in knee on first getting out of bed	1.0	0.0	2.0	2.0	1.0	3.0	4.726	<0.001	< 0.001
	Degree of stiffness in knee after sitting, lying down or resting during the day	1.0	1.0	2.0	2.0	2.0	3.0	4.067	<0.001	< 0.001
	General symptoms	37.50	21.43	48.21	62.50	46.43	78.57	5.808	<0.001	< 0.001
Pain	Frequency of knee pain	1.0	0.0	1.0	1.0	1.0	2.0	4.783	<0.001	< 0.001
	Turning and pivoting on heel/foot with the knee bent	1.0	0.0	1.5	2.0	1.0	3.0	5.277	<0.001	< 0.001
	Full knee extension	1.5	1.0	2.0	2.0	2.0	3.0	4.614	<0.001	< 0.001
	Full knee flexion	1.0	0.0	2.0	2.0	2.0	3.0	3.682	<0.001	0.001
	Walking on level ground	2.0	1.0	3.0	3.0	2.0	3.0	4.916	<0.001	< 0.001
	Climbing stairs	1.0	0.0	1.0	2.5	2.0	3.0	5.690	<0.001	< 0.001
	Lying in bed at night	2.0	1.0	2.0	3.0	2.0	3.0	5.345	<0.001	< 0.001
	Sitting or lying down	2.0	1.0	2.0	3.0	2.0	3.0	5.161	<0.001	< 0.001
	Standing upright	2.0	1.0	2.0	3.0	2.0	3.5	5.714	<0.001	< 0.001
	Pain in general	36.11	25.0	44.44	58.33	50.0	70.83	6.473	<0.001	< 0.001
Daily activities	Going down stairs	1.0	0.0	1.0	2.5	2.0	3.0	6.154	<0.001	< 0.001
	Climbing stairs	1.0	0.0	1.0	3.0	2.0	4.0	6.259	<0.001	< 0.001
	Standing up from a sitting position	1.0	1.0	2.0	2.0	2.0	3.0	5.614	<0.001	< 0.001
	Standing	1.0	1.0	2.0	3.0	2.0	3.0	5.754	<0.001	< 0.001
	Bending down to the floor/picking up something from the floor	1.0	0.0	2.0	2.0	1.5	3.0	4.695	<0.001	< 0.001
	Walking on level ground	2.0	1.0	2.5	3.0	3.0	4.0	5.974	<0.001	< 0.001
	Getting in and out of the car	1.0	0.0	1.5	2.0	1.0	3.0	5.141	<0.001	< 0.001
	Shopping	1.0	0.0	2.0	2.0	1.0	3.0	4.528	<0.001	< 0.001
	Putting on socks/stockings/tights	1.0	0.0	1.5	2.5	2.0	3.0	5.728	<0.001	< 0.001
	Getting out of bed	1.0	1.0	2.0	3.0	2.0	3.0	5.479	<0.001	< 0.001
	Taking off socks/stockings/tights	1.0	1.0	2.0	3.0	2.0	3.0	5.471	<0.001	< 0.001
	Staying in bed	1.0	1.0	2.0	2.0	2.0	3.0	4.683	<0.001	< 0.001
	Using the shower or bath	1.0	1.0	2.0	2.5	2.0	3.0	5.349	<0.001	< 0.001
	Seating	2.0	1.0	2.5	3.0	2.0	3.0	5.108	<0.001	< 0.001
	Using the toilet	2.0	1.0	2.0	3.0	2.0	4.0	5.758	<0.001	< 0.001
	Carrying out heavy household chores	0.0	0.0	1.0	1.0	0.5	2.0	4.969	<0.001	< 0.001
	Carrying out light household chores	2.0	1.0	2.0	3.0	2.0	3.0	4.818	<0.001	< 0.001
	Daily activities in general	30.88	20.59	40.44	58.82	50.0	77.94	6.585	<0.001	< 0.001
Sport and leisure activities	Squats	0.0	0.0	1.0	1.0	0.0	2.0	4.474	<0.001	< 0.001
	Running	0.0	0.0	0.0	1.0	0.0	1.5	3.990	<0.001	< 0.001
	Jumping	0.0	0.0	0.0	0.0	0.0	1.0	3.270	0.001	0.004
	Turning and pivoting on heel/foot with the knee bent	0.0	0.0	1.0	1.5	0.0	2.0	4.590	<0.001	<0.001
	Kneeling	0.0	0.0	0.0	0.0	0.0	1.0	2.502	0.012	0.012
	Sport and leisure activities in general	0.0	0.0	5.0	20.0	5.0	35.0	5.542	<0.001	<0.001
Quality of life	Frequency of symptoms affecting the functioning of the knee joint	1.0	0.0	1.0	1.0	1.0	2.0	4.608	<0.001	< 0.001
	Lifestyle changes aimed at avoiding activities that could be harmful to one's knee	1.0	0.0	2.0	2.0	1.0	3.0	3.294	<0.001	0.004
	Level of confidence in functionality of your knee joint	1.0	0.0	2.0	2.0	2.0	3.0	5.354	<0.001	<0.001
	Severity of the problem in terms of overall knee joint function	0.0	0.0	1.0	2.0	2.0	3.0	6.031	<0.001	< 0.001
	Overall quality of life	18.75	6.25	31.25	43.75	34.38	56.25	6.100	<0.001	< 0.001

Note: Pre- and post-treatment comparisons performed using the Wilcoxon signed-rank test. Raw p-values adjusted for multiple comparisons using the Holm–Bonferroni method across all 47 comparisons. Statistical significance was set at $p < 0.05$

Table 2. Changes in KOOS scores between the preoperative and post-rehabilitation assessments, by place of residence

KOOS	Place of residence						Mann-Whitney U test	
	Village			City				
	Me	Q1	Q3	Me	Q1	Q3	Z	p
Symptoms	25.0	10.71	46.43	25.0	0.0	42.86	0.594	0.552
Pain	27.78	8.33	38.89	27.78	13.89	33.33	0.230	0.818
Activities of daily living	26.47	17.65	39.71	27.94	13.24	51.47	-0.357	0.721
Sport and leisure activities	15.0	5.0	20.0	15.0	5.0	35.0	-0.706	0.480
Quality of life	25.0	12.50	37.50	25.0	12.50	37.50	0.111	0.911

Note: Change scores calculated as the difference between post-rehabilitation and preoperative KOOS scores (post-rehabilitation minus preoperative)

Table 3. Quality of life following total knee arthroplasty and rehabilitation, assessed using the WHOQOL-BREF

WHOQOL-BREF	Descriptive statistics				
	M	SD	Me	Q1	Q3
Overall quality of life	3.45	0.65	4.0	3.0	4.0
Satisfaction with one's health	3.57	0.72	4.0	3.0	4.0
Somatic sphere	12.47	2.47	12.57	10.57	14.29
Psychological sphere	15.14	2.67	15.33	14.00	17.33
Social sphere	14.71	2.98	14.67	13.33	16.00
Environmental sphere	14.25	2.82	14.00	12.50	16.00

Table 4. WHOQOL-BREF quality-of-life scores following total knee arthroplasty and rehabilitation, by place of residence

WHOQOL-BREF	Place of residence						Mann-Whitney U test		
	Village			City					
	Me	Q1	Q3	Me	Q1	Q3	Z	p (raw)	p (Holm-adjusted)
Overall quality of life	3.0	3.0	4.0	4.0	3.0	4.0	-1.538	0.124	0.248
Satisfaction with one's health	4.0	3.0	4.0	4.0	3.0	4.0	-0.557	0.577	0.577
Somatic sphere	12.0	9.71	13.71	13.71	12.0	14.86	-2.288	0.022	0.110
Psychological sphere	14.67	12.67	16.0	16.0	14.67	18.0	-2.556	0.011	0.066
Social sphere	14.67	12.0	16.0	16.0	14.67	17.33	-1.976	0.048	0.144
Environmental sphere	14.0	12.50	15.0	15.0	12.50	17.50	-2.117	0.034	0.136

Note: Between-group comparisons performed using the Mann–Whitney U test. Raw p-values adjusted for multiple comparisons using the Holm–Bonferroni method across the six WHOQOL-BREF outcomes. Statistical significance was set at $p < 0.05$

[7] indicated that the most important factors influencing patient satisfaction following total knee replacement include a reduction in pain, enhanced joint function and the fulfilment of expectations regarding treatment. The authors also emphasise that persistent pain, joint stiffness and post-operative complications are the most common causes of patient dissatisfaction following surgery. Furthermore, Hadlandsmyth et al. [23] observed that between 6 weeks and 6 months after surgery, most patients did not report significant changes in pain intensity or functional ability, whereas improvements were observed in 20% and 31% of participants, respectively.

In contrast to the observations cited, the results obtained in the current study showed a significant boost in patient functioning in terms of activities of daily living following the completion of rehabilitation. The greatest improvement was observed in the performance of basic activities of daily living, such as climbing stairs, standing up from a seated position, bending over, getting dressed and bathing. After completing rehabilitation, however, significant difficulties persisted, particularly when carrying out heavy household chores.

The findings of studies by Hanreich et al. [24] and Ventura et al. [25] indicate that, following knee replacement surgery, the majority of patients resumed physical activity, experiencing less pain and enhanced function compared with their pre-operative condition. The authors emphasise, however, that this return to activity primarily concerns low-impact activities, such as walking, cycling or swimming, while a return to medium- and high-impact sports, such as running, tennis or skiing, is observed much less frequently.

The study demonstrated a significant improvement in patients' functional ability in terms of sporting and recreational activities following the completion of rehabilitation. Despite this, the greatest limitations still concerned activities placing significant stress on the knee joint, such as jumping and kneeling, which may be due both to functional limitations following surgery and to recommendations to avoid activities that place a heavy load on the prosthesis.

The current study demonstrates a significant enhancement in quality of life related to knee joint function following total knee replacement and completion of rehabilitation. Patients reported greater confidence in the function of their operated knee, fewer limitations in daily activities, and a reduced impact of knee-related symptoms on their quality of life. Despite the improvement achieved, many of the patients surveyed still reported experiencing daily discomfort in the operated knee, which suggests that a full return to normal function and a normal subjective assessment of health are not always possible within a relatively short period following the completion of rehabilitation.

Analysis of differences by place of residence showed a comparable improvement in knee function following rehabilitation among both urban and rural residents. No statistically significant differences were found between the groups analysed in terms of symptoms ($p = 0.552$), pain ($p = 0.818$), activities of daily living ($p = 0.721$), sporting and recreational activity ($p = 0.480$) and quality of life related to the knee joint ($p = 0.911$). The results obtained are consistent with the findings of Garlapaty et al. [11], who, using the abbreviated version of the KOOS questionnaire (KOOS-JR), also found no significant differences in functional outcomes

between urban and rural residents. one year after total knee replacement. Similar findings were reported by Taylor et al. [12], who also found no significant differences in patient-reported outcomes following surgery, regardless of place of residence. In contrast, Agrodnia et al. [10], in a systematic review, demonstrated that although rural residents were more likely to encounter difficulties in accessing treatment, their patient-reported outcomes (PROMs), including the KOOS-JR, were generally comparable to those of urban residents.

The use of the WHOQOL-BREF questionnaire to assess the quality of life of patients following knee replacement surgery was justified, as this tool has been shown to possess good psychometric properties and to enable a reliable assessment of quality of life following surgical treatment and rehabilitation [26]. In the current study, respondents rated their overall quality of life as good following the completion of rehabilitation, and reported being satisfied with their state of health. Analysis of the individual domains of the WHOQOL-BREF showed that the highest scores were obtained in the psychological and social domains, while slightly lower scores were recorded in the environmental and somatic domains. Similar findings were reported by Askari et al. [27], who demonstrated that total knee arthroplasty led to a significant improvement in health-related quality of life compared with the pre-operative period. Earlier studies also indicated that a reduction in pain and an improvement in function are among the most important factors determining an improvement in patients' quality of life following surgery [28].

An analysis of quality of life by place of residence revealed no significant differences between urban and rural residents in terms of overall quality of life and satisfaction with their health. At the same time, urban residents showed descriptively higher scores in the physical, psychological, social and environmental domains of the WHOQOL-BREF questionnaire. However, none of these differences remained statistically significant after adjustment for multiple comparisons using the Holm–Bonferroni method.

In the available literature, few studies have analysed the impact of place of residence on the quality of life of patients following knee surgery. Moreira et al. [13], however, investigated the quality of life of patients who had undergone knee surgery and participated in a 4-week rehabilitation programme carried out at centres located in urban and rural areas. The authors demonstrated a significant improvement in quality of life following rehabilitation in both groups, with greater benefits observed in patients who underwent rehabilitation at a rural centre. It was emphasised, however, that a properly planned rehabilitation programme leads to an improvement in quality of life regardless of place of residence.

In contrast, Siripongpan and Sindhupakorn [29], in their analysis of patients with osteoarthritis of the knee, found no significant differences in overall quality of life between urban and rural residents. The authors noted that the severity of degenerative changes, depressive symptoms, and the age of the participants were more significant factors affecting quality of life than place of residence alone.

The results obtained in the current study are partly consistent with the cited reports. As in the study by Siripongpan and Sindhupakorn, no differences were found in the overall assessment of quality of life or satisfaction with health between urban and rural residents. At the same time, urban residents showed descriptively higher scores in the physical, psychological, social and environmental domains of the WHOQOL-BREF; however, none of these differences remained statistically significant after adjustment for multiple comparisons using the Holm–Bonferroni method. The differences observed may be linked to urban residents having easier access to healthcare, rehabilitation and infrastructure that promotes physical activity and social participation. These findings complement previous reports on the impact of place of residence on treatment outcomes following knee replacement surgery, suggesting that the differences may primarily relate to selected aspects of quality of life rather than joint function. Given the limited number of studies examining the impact of place of residence on quality of life following knee replacement surgery, these findings require confirmation in further studies involving larger groups of patients.

Limitations of the study. The study had certain limitations which should be taken into account when interpreting the results. One limitation is the relatively small sample size (n = 60), which may have limited the extent to which the results can be generalised to the entire population of patients undergoing knee replacement surgery. Furthermore, the study was conducted at a single centre, which may limit the generalisability of the findings to other healthcare settings. The lack of a control group also limited the ability to attribute the observed improvements in knee function exclusively to the surgical procedure and post-operative rehabilitation. The study did not include objective methods for assessing knee joint function or physical fitness, such as measurements of range of motion, functional tests or muscle strength assessments, which could have provided a valuable complement to the results obtained. Additionally, the WHOQOL-BREF questionnaire was administered only after surgery and rehabilitation, and no pre-operative assessment of quality of life was performed. Therefore, changes in quality of life over time could not be evaluated.

In future studies, larger, multicentre samples should be considered, together with the inclusion of a control group and the combination of subjective and objective methods of assessing treatment outcomes. The inclusion of a pre-operative WHOQOL-BREF assessment would also enable the analysis of changes in quality of life following surgery and rehabilitation. These measures would allow for a more comprehensive analysis of the effectiveness of knee replacement surgery and post-operative rehabilitation.

CONCLUSIONS

Knee replacement surgery, combined with post-operative rehabilitation, significantly improves KOOS scores, indicating a reduction in pain and an improvement in knee function. These improvements may translate into better functioning in patients' daily lives and may contribute to an improved quality of life.

The study showed no statistically significant differences in the functional status of patients from urban and rural areas following knee arthroplasty and completion of rehabilitation, as evidenced by comparable KOOS scores. Urban residents had descriptively higher scores in the physical, psychological, social and environmental domains of the WHOQOL-BREF questionnaire.

No statistically significant differences were observed in the overall assessment of quality of life or satisfaction with health. The results suggest that place of residence was not significantly associated with functional outcomes following knee replacement surgery and rehabilitation. Given the small sample size, these findings require confirmation in studies involving a larger number of patients.

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