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Heterogeneity of social participation in patients three months after total knee arthroplasty: a latent profile analysis

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Abstract

Background Social participation is an important index of rehabilitation and social reintegration in patients after total knee arthroplasty (TKA). However, most existing studies focus on improving patients' functioning and activities, with only a few examining the social participation among patients after TKA. Therefore, the study aims to investigate the heterogeneity of social participation in patients three months after TKA and analyze subgroup influencing factors, to promote functional exercise and postoperative follow-up in specific patients.

Methods This cross-sectional study recruited 255 patients who underwent TKA in a Tertiary Hospital in Jinan City, China, from March to July 2022. Three months after having undergone TKA, participants' data were collected using the Numeric Pain Rating Scale, the Chinese version of the Tampa Scale of Kinesiophobia, the 10-item Kessler Psychological Distress Scale, Hospital for Special Surgery Knee-rating Scale, and Impact on Participation and Autonomy Questionnaire. Latent profile analysis was used to identify categories of patients' social participation. Multiple logistic regression analysis was used to analyze the influencing factors of the different subgroups.

Results Three months after TKA, the patients were divided into three subgroups: low social participation group (17.9%), moderate social participation group (40.8%), and high social participation group (41.3%). The vast majority of patients who underwent TKA exhibited moderate-to-high level of social participation. The multiple logistic regression analysis results showed that age, degree of pain, knee function, and kinesiophobia were the influencing factors of the potential profiles of social participation in patients three months after TKA ($p < 0.05$).

Conclusion These results support a distinct categorical feature of social participation among patients three months after undergoing TKA. Medical staff need to provide targeted guidance according to the potential classification characteristics of social participation to improve the level of social participation and promote rehabilitation of patients.

Keywords Total knee arthroplasty, Social participation, Latent profile analysis

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Introduction

Total knee arthroplasty (TKA) is a safe and effective way to treat end-stage knee osteoarthritis (KOA) [1], it can effectively reduce joint pain, improve dysfunction and improve quality of life. In decades, the number of TKA operations in the U.S. has steadily increased and is expected to reach 3.48 million annually by 2030 [2]. The number of TKA operations in China in 2019 reached nearly 400,000, with the annual growth rate remaining close to 30% [3]. The number of TKA operations has increased globally, a trend that is expected to continue [4].

The World Health Organization has developed the International Classification Framework of Functioning, Disability, and Health, which includes an individual's level of physical function, physical disabilities, activities, and participation [5]. Participation (e.g., social participation) refers to an individual's participation in a variety of life situations, such as socializing, attending meetings, religious activities, volunteering, and social interactions with friends [6], which is associated with human health outcomes. A meta-analysis reported that social participation was associated with physical and mental health, social isolation and long-term quality of life in individuals after a stroke, and that patients who were unable to engage in social activities experienced an increased risk of recurrent stroke, depression, and death during recovery [7]. Furthermore, high social participation has a positive effect on individuals' health level and degree of interpersonal satisfaction [8], whereas low social participation increases disability and mortality [9]. It is worth noting that social participation, as an important indicator of patient rehabilitation and social reintegration, has attracted much attention in patients with chronic diseases, including patients who underwent TKA. A previous qualitative study showed that all participants experienced participation limitations after surgery due to cognition changes, reduced expectations and persistent knee injury [10]. Moreover, prior studies showed that for patients after TKA, the first three months after surgery is critical for postoperative recovery. The recovery achieved during this period largely determines whether "peak recovery" is achieved subsequently [11]. However, only a handful of existing studies have focused on social participation in patients after TKA, with the majority focusing on improving physical function and activity level in patients [12, 13], ignoring the impact of social role and community interaction on them. Furthermore, prior studies only focused on the overall level of social participation of patients after TKA, ignoring potential individual differences. Therefore, to explore whether there are different subgroups of social participation in patients after TKA, which is closer to the actual situation and in line with the management practice idea of "classified management", so as to improve intervention efficiency and conserve medical resources.

Latent profile analysis (LPA) is a person-centered analytic method that identifies the homo-proton subgroups of individuals based on a specific subset of variables and analyzes the relationship between each subgroup and various covariables [14]. LPA can better identify multidimensional social participation and is widely used in a variety of fields, such as psychology and medicine [15, 16]. Therefore, this study aims to use LPA (1) to identify different subgroups of social participation among patients three months after TKA, and (2) to explore the relevant factors of different social participation subgroups, so as to improve the level of social participation in patients and formulate targeted intervention measures.

Methods

Design

A convenience sample was recruited from March to July 2022 for this cross-sectional study conducted at a tertiary hospital in Jinan, Shandong Province, China. This study was conducted in strict accordance with the Declaration of Helsinki and was approved by Ethics Committee of Scientific Research of School (2021-R-152).

Participants

Inclusion criteria for patients in this study were: (1) an age of ≥45 years; (2) having a KOA diagnosis for which primary unilateral TKA surgery was required; and (3) speaking and understanding Chinese without communication disorders and participating voluntarily. Exclusion criteria for this study were as follows: (1) undergoing TKA for indications other than KOA; (2) having a history of TKA; (3) having hearing, visual, or cognitive impairment, or severe mental illness; (4) having lower extremity motor dysfunction or muscle disease; and (5) having American Association of Anesthesiologists (ASA) Body status rating of IV or higher. Patients with ASA IV were excluded as they had a serious systemic disease that limited joint movement and posed a persistent threat to life.

We recruited patients offline in the hospital outpatient clinic. During the recruitment process, three trained investigators introduced the content and purpose of the study to the patients who underwent TKA who met the inclusion criteria to ensure participants' understanding of the study. All patients who volunteered for the survey then signed a paper version of the informed consent form, recruiting a total of 300 participants. If more than 10% of the items were not answered, the questionnaire was considered invalid. The final sample included 255 patients for data analysis (85%).

Yi et al. [17] showed that robust statistical results can be obtained when the average sample size of each profile reaches 50. According to the results of a previous study

on chronic obstructive pulmonary disease [18], there are at least three categories of social participation; thus, the required sample size is at least 150. Considering 10–15% invalid questionnaires, at least 167–176 were required for this study. The actual sample size of this study is 255, which meets the requirement.

Data collection and measures

At the hospital outpatient follow-up, the research assistant collected general socio-demographic information, clinical information, information on pain, kinesiophobia, psychological status, knee function and social participation from each patient. All participants were given a small gift to thank them for their participation.

Sociodemographic variables

The characteristics of the patients after TKA who participated in the study were collected by self-reporting, which included information on gender, age, body mass index (BMI), education level, household registration status, employment status, marital status, and clinical characteristics (comorbidities), such as diabetes, heart disease, and hypertension (answers were presented in a yes or no format).

Numeric Pain Rating Scale (NPRS)

The NPRS was used to assess participants' pain intensity during activities [19]. The scores ranged from 0 to 10, representing different levels of pain. A score of 0 indicated being painless and score of 10 being severe; higher scores indicated a higher degree of pain.

Tampa Scale of Kinesiophobia, Chinese version (TSK-11)

The Chinese version of the Tampa Scale of kinesiophobia (TSK-11) was developed by Woby et al. [20]. It was translated and cross-cultural adapted into the Chinese language by Cai et al. [21]. The scale was used to assess kinesiophobia in this study. The scale included three dimensions and 11 items and used a Likert 4-point scale with scores ranging from 1 to 4. A score of 1 point represented "strongly disagree", with a score of 4 points representing "strongly agree". The total score obtained was the sum of the scores for each item. Higher scores indicated higher levels of fear associated with exercise.

The 10-item Kessler Psychological Distress Scale (Kessler10)

The 10-item Kessler Psychological Distress Scale (K10) was compiled by Kessler and Mroczek [22]. It was translated and cross-cultural adapted into the Chinese language by Zhou et al. [23]. It was used to assess the frequency of symptoms associated with non-specific heart health conditions, such as anxiety and stress levels experienced over the past four weeks. Each item of the scale ranged from 1 to 5, with 1=almost never, 2=sometimes, 3=fairly often, 4=very often, and 5=all time. The total score obtained was the sum of the scores for each item. Higher scores indicated a higher risk of mental illness.

Hospital for Special Surgery knee score (HSS)

The Hospital for Special Surgery knee score (HSS) was developed by Insall et al. [24]. This scale was used to assess knee function in patients after TKA. The scale comprises pain, walking ability, knee flexion, muscle strength, flexion deformity, and joint stability, and subtraction items. The total HSS score ranges from 0 to 100, with higher scores indicating better knee function.

The impact on participation and autonomy questionnaire (IPA)

The Impact on Participation and Autonomy Questionnaire (IPA) was developed by Cardol et al. [25]. It was translated and cross-cultural adapted into the Chinese language by Li et al. [26].The questionnaire comprises four dimensions: indoor participation, family role participation, outdoor participation, and social life participation. It contains 25 items and uses a Likert 5-point scale ranging from 0 to 4 to record the responses to the items. Lower IPA scores indicate a higher self-perceived degree of social participation.

Statistical analysis

First, descriptive statistics were calculated using mean and standard deviations for normal continuous variables and using median and quartile for no-normal continuous variables. Categorical variables, such as gender, education level, household registration status, employment status, marital status, and clinical characteristics, such as diabetes, heart disease, and hypertension were calculated using frequency counts and percentages.

Second, four dimensions of IPA were used as observed variables for the LPA. The Akaike's information criterion (AIC), Bayesian information criterion (BIC), sample-size-adjusted Bayesian information criterion (aBIC), entropy, Lo-Mendell-Rubin adjusted LRT (LMR), and bootstrapped likelihood ratio test (BLRT) were used to compare the model fitting indexes. The entropy ranged from 0 to 1(with >0.8 being acceptable). The closer entropy was to 1, the more accurate was the classification. Furthermore, the smaller the AIC, BIC, and aBIC values, the better the model fitting effect [27]. The LMR is mainly used to compare the fitting differences between models with k-1 and k classes (where k represents the number of classes). A significant LMR p value indicates that a model with class k is superior to a model with class k-1.

Finally, LPA concluded that the 3-profile models were the optimal models. One-way analysis of variance, Kruskal-Wallis H-test, and Chi-square tests were used to

compare differences in demographic and clinical characteristics in 3-profile models. Multinomial logistic regression was conducted for covariables with significant *p*-values in the univariate analysis, and the result was expressed in terms of odds ratio (OR) and 95% confidence interval (CI). Data analysis was conducted using IBM SPSS 26.0 and Mplus 8.3. The significance level was set at $p<0.05$. Percentages are reported to one decimal place and mean and standard deviation are reported to two decimal places. The LPA, one-way analysis of variance, Kruskal-Wallis H-test, Chi-square tests and Multinomial logistic regression are reported to three decimal places.

Results

Characteristics of the participants

Of the 255 participants aged 63.53±7.51, 168 (65.9%) were female and 87 (34.1%) were male. Nearly half (46.7%) have a secondary education or higher and the majority (93.7%) were married. Other relevant information is presented in Table 1 (End of document).

Table 1 Comparison of demographic and clinical characteristics of latent profiles of social participation in patients three months after TKA ($n=255$)

Variables	Total	Social participation profiles			H/F/χ2	*p*
	M ± SD/*N* (%)/ [M(Q1-Q3)]	Group 1	Group 2	Group 3		
Age	63.53 ± 7.51	66.50 ± 8.37	63.09 ± 7.01	62.66 ± 7.36	7.564	**0.001**[c]
Gender						
male	87(34.1%)	18(39.1%)	41(38.7%)	28(27.2%)	3.698	0.157 [b]
female	168(65.9%)	28(60.9%)	65(61.3%)	75(72.8%)		
BMI	26.47 ± 2.88	26.99 ± 2.50	25.99 ± 2.79	26.72 ± 3.08	2.599	0.076 [c]
Education level						
Below primary school	59(23.1%)	14(30.4%)	21(19.8%)	24(23.3%)	6.065	0.416 [b]
primary school	77(30.2%)	11(23.9%)	32(30.2%)	34(33.0%)		
Junior high school	88(34.5%)	17(37.0%)	35(33.0%)	36(35.0%)		
High school and above	31(12.2%)	4(8.7%)	18(17.0%)	9(8.7%)		
Household registration status						
Urban	28(11.0%)	7(15.2%)	11(10.4%)	10(9.7%)	1.829	0.767 [b]
Rural town	59(23.1%)	8(17.4%)	25(23.6%)	26(25.2%)		
City	168(65.9%)	31(67.4%)	70(66.0%)	67(65.0%)		
Employment status						
Work	40(15.7%)	5(10.9%)	18(17.0%)	17(16.5%)	1.524	0.822 [b]
Unemployed	159(62.4%)	32(69.6%)	65(61.3%)	62(60.2%)		
Retire	56(22.0%)	9(19.6%)	23(21.7%)	24(23.3%)		
Marital status						
Married	239(93.7%)	41(89.1%)	100(94.3%)	98(95.1%)	2.070	0.365 [b]
Divorced/Widowed	16(5.3%)	5(10.9%)	6(5.7%)	5(4.9%)		
Heart disease						
Yes	27(10.6%)	8(17.4%)	12(11.3%)	7(6.8%)	3.879	0.142 [b]
No	228(89.4%)	38(82.6%)	94(88.7%)	96(93.2%)		
Diabetes						
Yes	24(9.4%)	7(15.2%)	12(11.3%)	5(4.9%)	5.081	0.074 [b]
No	231(90.6%)	39(84.8%)	94(88.7%)	98(95.1%)		
Hypertension						
Yes	98(38.4%)	17(37.0%)	36(34.0%)	45(43.7%)	2.140	0.343 [b]
No	157(61.6%)	29(63.0%)	70(66.0%)	58(56.3%)		
NPRS	2(1–4)	4(2–4)	3(2–4)	2(1–2)	37.167	**< 0.001**[a]
TSK	19(15–26)	28(22–33)	21(18–26)	16(15–19)	75.242	**< 0.001**[a]
K10	17(14–21)	23(20–25)	17(15–21)	15(14–17)	60.275	**< 0.001**[a]
HSS	81(78–83)	75(73–79)	80(77–82)	82(81–85)	75.341	**< 0.001**[a]

Notes: M, mean; SD, standard deviation; M(Q1-Q3), median(quartile1-quartile3); NPRS, the Numeric Pain Rating Scale, TSK, Tampa Scale of Kinesiophobia; K10, The 10-item Kessler Psychological Distress Scale; HSS, Hospital for special surgery knee score. a Value was calculated by Kruskal-Wallis H-test; b value was calculated by a chi-square test; c Value was calculated by one-way analysis of variance; Bold numbers indicate significant differences ($p<0.05$). Group1: low-level social participation group; Group2: moderate-level social participation group; Group3: high-level social participation group

Table 2 Latent profile analysis of social participation in patients three months after TKA ($n=255$)

Model	AIC	BIC	aBIC	Entropy	LMR *p*-value	BLRT *p*-value
1	5516.212	5544.542	5519.180			
2	5080.742	5126.779	5085.565	0.886	0.0005	< 0.001
3	**4923.578**	**4987.321**	**4930.257**	**0.909**	**0.0246**	**< 0.001**
4	4869.025	4950.475	4877.559	0.889	0.1027	< 0.001
5	4831.024	4930.180	4841.413	0.909	0.2485	< 0.001

Notes: AIC, Akaike's information criterion; BIC, Bayesian information criterion; aBIC, Sample size adjusted Bayesian information criterion; LMR, Lo–Mendell–Rubin; BLRT, bootstrapped likelihood ratio test; bold letters indicate the best-fitting model

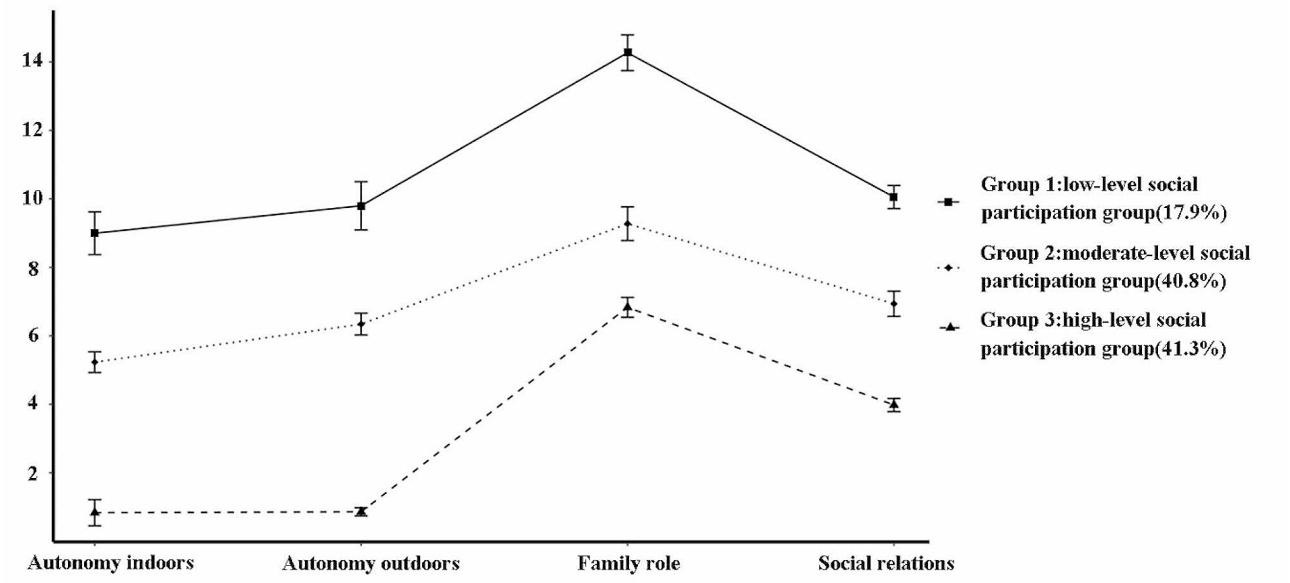

Fig. 1 Analysis of latent profiles of social participation in patients after TKA

Figure Legends: Latent profiles of social participation. The x-axis is the four dimensions of social participation, and the y-axis is the average score of each dimension of the latent profile. The results show the proportion of people in the potential profile of social participation in patients as well as the mean scores and standard errors for each dimension of social participation in each group

Latent profile analysis

Table 2 shows latent profile fitting statistics for social participation. With the number of latent profiles increased, the values of AIC, BIC and aBIC continued to decrease. The LMR test for the 4-profile was not significant, indicating that the 4-profile did not fit the data better than the 3-profile. The entropy value indicated there was higher entropy in a 3-profile model than in a 2-profile model. In addition, the 3-profile model's AIC, BIC, and aBIC were lower than those of the 2-profile models, with 3-profile models subsequently chosen for this study.

Characteristics of the profiles

Group 1 included 17.9% ($n=46$) of participants who exhibited low social participation and were labeled as the low-level social participation group. Group 2 included 40.8% ($n=103$) of participants who exhibited moderate social participation and were labeled as the moderate-level social participation group. Group 3, comprising 41.30% ($n=106$) of participants, exhibited a high level of social participation and was labeled as the high-level social participation group. All three groups scored the highest in the family role dimension. Figure 1 shows the latent groups of social participation.

Influencing factors of social participation groups

A preliminary univariate analysis of different profiles revealed that patients after TKA with different social participation profiles demonstrated significant differences in terms of age, NPRS scores, TSK, K10, and HSS in Table 1. Thereafter, the demographic factors, NPRS, TSK, K10, and HSS were included as independent variables in a multiple logistic regression model, with profile 3 as the reference group. Results found that the age, NPRS, TSK and HSS were influencing factors of the potential profiles of social participation in patients three months after TKA. When comparing the low-level and high-level social participation groups, the higher the HSS scores (OR = 0.758, 95% CI [0.651,0.882], $p<0.001$), the lower the probability of entering the low-level social participation

group, that is, the better the knee function, the less prone to low social participation. Moreover, higher pain scores (OR=1.468, 95% CI [1.020,2.113], $p=0.039$), higher TSK scores (OR=1.186, 95% CI [1.078,1.306], $p<0.001$) and older age (OR=1.069, 95% CI [1.003,1.139], $p=0.040$) were more likely to enter the low-level social participation group. When comparing the moderate-level social participation group with the high-level social participation group, HSS scores and age did not differ significantly between the two groups. However, higher pain scores (OR=1.355, 95% CI [1.079,1.701], $p=0.009$) and higher TSK scores (OR=1.130, 95% CI [1.051,1.216, $p=0.001$) were more likely to enter the moderate-level social participation group (Table 3).

Discussion

In this investigation of social participation among patients three months after undergoing TKA using LPA, three distinct groups were identified: low social participation, moderate social participation, and high social participation, with distribution rates of 17.9%, 40.1%, and 41.3%, respectively. The vast majority of patients who undergo TKA exhibit moderate-to-high level of social participation. Moreover, the latent classification characteristics of social participation were associated with age, pain, knee function, and kinesiophobia. This information can help health practitioners provide targeted guidance for different social participation subgroups, improve the level of social participation, and achieve the purpose of social reintegration.

In this study, approximately 40% of patients after TKA assigned to the high social participation group showed good levels of social participation. This finding is consistent with those of previous studies of working-age patients after TKA [12], which showed greatest improvement in physical and mental impairment and activity restriction and increased participation in social roles three months after the surgery. However, nearly 18% of patients after TKA belonged to the low social participant group. Previous research has shown that approximately one-third of patients experienced limited participation for at least one year after undergoing TKA due to factors such as gender, ethnicity, depressive symptoms, pain, and knee functioning status [10]. Social participation is a modifiable determinant of improved health status [28]. It is vital to identify patient subgroups that require particular emphasis, distinguishing them from patients who have moderate to high levels of social participation after undergoing TKA.

This study found that the older the patients, the greater the probability of patients entering low social participation compared to the high social participation group. This finding is consistent with a previous study by Maxwell et al. [29], which focused on older patients after TKA aged 50–79 years and found that 45% of patients aged 75 years or older still experienced participation restrictions at one year after TKA surgery. Townsend et al. [30] previously reported that age was a strong predictor of social participation, with the older the age, the more limited the social participation. This may also be related to lower participation expectations and aging in older adults. Compared with young patients, older patients experience more severe clinical symptoms and tend to become less active with age [13]. Unlike the results by Wilding [31] and Maxwell [29], one obtained in this study indicated that gender is not associated with social participation. Wilding et al. [31] reported a 3.0% increase in women's social participation across all groups, while Maxwell et al. [29] reported that participation was limited in female patients after TKA. Therefore, gender deserves further investigation as a factor influencing social participation. Moreover, in this study, the patients who underwent TKA had the highest score for autonomous participation in family roles, indicating low social participation. This may be attributed to traditional Chinese culture. After TKA, family members worry that patients may have an accident (such as falling), fix them in the role of the patients, and take the initiative to do more housework, reducing the patients' family responsibilities and resulting in decreased family participation.

This study found that compared with the high social participation group, the higher the pain scores, the greater the probability of patients entering low social participation. Although end-stage KOA was successfully treated in majority of the patients undergoing TKA surgery, some had persistent pain at short follow-up (3 months or more after TKA) [32]. However, persistent pain after surgery can increase the psychological burden

Table 3 Multinomial logistic regression analysis of different social participation profiles in patients three months after TKA ($n=225$)

Variables	Group 1: Low-level social participation			Group 2: Moderate-level social participation		
	p	OR	95%CI	*p*	OR	95%CI
Age	**0.040**	1.069	(1.003,1.139)	0.788	1.006	(0.964,1.049)
NPRS	**0.039**	1.468	(1.020,2.113)	**0.009**	1.355	(1.079,1.701)
TSK	**<0.001**	1.186	(1.078,1.306)	**0.001**	1.130	(1.051,1.216)
K10	0.056	1.130	(0.997,1.280)	0.231	1.061	(0.963,1.169)
HSS	**<0.001**	0.758	(0.651,0.882)	0.273	0.946	(0.857,1.044)

Reference Group 3: High-level social participation group; Bold numbers indicate significant differences ($p<0.05$)

on patients, leading to negative thoughts about the severity of pain. This can reduce patients' compliance with rehabilitation training programs and limit their level of social participation. Some qualitative studies have shown that participants may experience anxiety and fear due to uncontrolled postoperative pain [33], as well as avoiding activities that require prolonged walking due to postoperative pain [10]. Furthermore, a previous study on the relationship between pain and functional scores three months and two years after surgery showed that changes in the first three months after surgery were associated with long-term pain and functional status [11]. Therefore, pain management in the acute postoperative period (<three months) can be used as an important target to improve the health outcomes of patients after undergoing TKA, to improve the level of social participation of patients and promote social reintegration.

Individuals' awareness of social participation also has an impact on their level of social participation [34]. This study found that greater kinesiophobia, the greater the probability of patients entering low social participation compared to the high social participation group. In the early postoperative period, pain is aggravated and muscle strength and function levels are reduced, which makes it difficult for patients to perform activities of daily living, causing kinesiophobia and avoidance, and thus reducing leisure social activities after TKA [1]. Kinesiophobia serves as an influencing factor of patients' long-term recovery. Studies have shown that kinesiophobia predisposes patients to chronic pain, severely affecting functional outcomes and the likelihood of returning to previous activity levels [35]. Furthermore, owing to postoperative walking limitations among patients after undergoing TKA, a lack of confidence in their mobility and an increase in the risk of falls have been noted, leading to patients avoiding participating in activities [36]. Therefore, medical staff should strengthen psychological intervention to improve patients' self-confidence in their mobility and reduce kinesiophobia.

After undergoing TKA, knee rehabilitation is an important step toward restoring daily joint activities and social participation among patients [10, 37]. This study found that better knee function, the lower the probability of patients entering low social participation group compared to the high social participation group. Early postoperative functional and walking limitations may be important risk factors for low social participation [10, 29]. Patients after TKA experience slower walking speed, reduced extension, decreased walking adjustment ability, decreased muscle strength, and a limited walking level [1]. Pua et al. [36] reported that at six months after receiving TKA, approximately 5–20% of patients had flexion contracture of 10°, range of motion of less than 90°, and a maximum walking time of 15 min. Furthermore, participation in social/leisure activities (e.g., volunteering) may not be attributable to TKA. Similarly, many patients with chronic KOA may have already adapted to the limitations brought on by the disease and may not have adopted a more active lifestyle in spite of the improved function provided by TKA [13]. A longitudinal study by Rubio-Morales et al. [13] showed that about 38.6% of patients were still classified as sedentary three years after surgery, and although TKA improved their level of function, it did not promote an increase in their social leisure and activities of daily living.

Limitations

This study has some limitations. First, our sample size is small, and we have no way to increase it to assess the differences in social participation profiles across other variables. Second, we used a convenience sampling method, gathering participants from one hospital in China. The representativeness of the findings for other hospitals or regions needs to be further verified. Multicenter data collection will be conducted in the future to verify the stability of the model. Third, this is a cross-sectional study, which prevents a dynamic understanding of changes in social participation among patients after TKA. In the future, a large sample longitudinal survey will be conducted to investigate the dynamic interaction of social participation over time. Furthermore, environmental factors in this study are confounding factors that cannot be ignored and may affect the final results. Additionally, we did not assess the architectural factors surrounding the patient area or whether there was acceptance policy support. If the patient is surrounded by a park, square, or rehabilitation facility with assistive devices, this can help the patient regain knee function and improve social participation.

Significance for clinical practice

Despite these above limitations, this study provides new information on the social participation of patients after TKA in China. It serves as a guidance for further accurate evaluation and development of targeted interventions to promote greater social participation of patients who underwent TKA in China.

Conclusions

In this study, LPA was used to identify the group heterogeneity of social participation in patients three months after TKA. Three categories were identified: low, moderate, and high social participation groups. The vast majority of patients who undergo TKA exhibit moderate-to-high level of social participation. Age, degree of pain, knee function, and kinesiophobia are important factors influencing different potential profiles of social participation for patients three months after TKA. Based on

the results of this study, medical staff should focus on patients' postoperative pain management, knee functional exercises, and improving mental well-being to enhance social participation and facilitate successful social reintegration.

Abbreviations

TKA	Total knee arthroplasty
LPA	Latent profile analysis
TSK	Tampa Scale of Kinesiophobia
HSS	Hospital for special surgery knee score
NPRS	The Numeric Pain Rating Scale
KOA	Knee osteoarthritis

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Author contributions
WR Q and XR L contributed to the conception and design of the study. WR Q, XR L, ZP Y, HM W, SM Z, XL W, MQ L, JR W contributed to data acquisition and analysis. WR Q performed the statistical analysis, wrote the first draft of the manuscript, and consulted relevant literature. XR L revised the article. All authors contributed to the article and approved the submitted version.

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Data availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent was obtained from all participants. The study was approved by the ethics committee of Shandong University (2021-R-152).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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