# Why Patients Do Not Participate in Sports Activities After Total Knee Arthroplasty

Moon Jong Chang,* MD, Yeon Gwi Kang,† MS, Byung June Chung,‡ MD, Chong Bum Chang,§ MD, PhD, and Tae Kyun Kim,†|| MD, PhD

*Investigation performed at the Joint Reconstruction Center, Seoul National University Bundang Hospital, Seongnam-si, Gyeonggi-do, Korea*

**Background:** It is important to identify the reasons or factors preventing patients from participating in sports activities after total knee arthroplasty (TKA) to improve patient satisfaction and general health that can be gained from regular sports activities.

**Purpose:** To determine the reasons for lack of participation in regular sports activities after TKA as perceived by patients and to identify specific factors involved.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** A total of 369 patients with a follow-up longer than 1 year after TKA were included in this retrospective study. A postal survey regarding sports activities was conducted using a questionnaire gathering information such as sociodemographic data, activity levels, and sports activities after TKA. The reasons perceived by patients for not participating in sports activities were determined. Patients unable to participate in sports activities were compared with patients able to do so in terms of sociodemographic data and pre- and postoperative outcomes.

**Results:** Of the 369 patients, 88 (24%) replied that they could not participate in a sports activity. Among the perceived reasons, reasons not related to the replaced knee were more frequent than those related to the replaced knee (76% vs 24%). Symptoms related to the spine or other joints composed 25% of the total perceived reasons. The presence of medical comorbidities accounted for 16%, while symptoms in the nonreplaced knee represented 8% of the reasons. In terms of patient factors, multivariate logistic regression revealed that male sex, a floor-based (ie, non-Western) lifestyle with greater demands on knee flexion, and worse postoperative University of California at Los Angeles activity scale were associated with nonregular sports activity levels.

**Conclusion:** The perceived reasons and patient factors hindering regular sports activities after TKA were not restricted to problems with the replaced knee. Nonetheless, orthopaedic surgeons may have a substantial role in encouraging patients to participate in sports by resolving joint-related problems. Furthermore, this study supports the notion that a multidisciplinary approach is needed to improve sports participation after surgery.

**Keywords:** preventing factor; sports activity; outcome; total knee arthroplasty

The ultimate goal of total knee arthroplasty (TKA) is to improve quality of life, which is known to be associated with patient satisfaction with a replaced knee. It has been documented that a major factor in patient satisfaction is whether preoperative expectations are fulfilled.[17,18] With the typically successful results of contemporary TKA, patients undergoing TKA expect to resume their sports activities after surgery.[2,14,19,22] Thus, whether patients can participate in sports activities after TKA can affect patient satisfaction after surgery.[2,14] Furthermore, activity levels and participation in sports activities are certainly related to general health issues.[16,20] However, despite successful results of contemporary TKA, several previous studies reported that many patients with TKA fail to participate in sports activities after surgery.[2,3,6,23] A previous study reported that the rate of sports participation

||Address correspondence to Tae Kyun Kim, MD, PhD, Joint Reconstruction Center, Seoul National University Bundang Hospital, 300 Gumidong, Bundangu, Seongnam-si, Gyeonggi-do, 463-707, Republic of Korea (email: osktk@snubh.org).

*Department of Orthopaedic Surgery, Gwangmyeong Saeum Hospital, Gwangmyeong-si, Gyeonggi-do, Korea.

†Joint Reconstruction Center, Seoul National University Bundang Hospital, Seongnam-si, Gyeonggi-do, Korea.

‡Department of Orthopaedic Surgery, Knee and Spine Hospital, Seoul, Korea.

§Department of Orthopaedic Surgery, Seoul National University College of Medicine, Seoul National University Boramae Hospital, Seoul, Korea.

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actually decreased after TKA, even if surgery improved patients' activity levels and functional outcomes.[3]

To improve patient satisfaction and general health status, it is important to identify the reasons or factors preventing patients from participating in sports activities after TKA. However, the current literature lacks research on this issue. Most previous studies related to sports activities after TKA focused on the level of postoperative sports activities, the risk of sports activities for implant failures, or the types of sports allowed for patients after TKA.[2-4,12,13,22] Furthermore, although reasons perceived by patients and factors actually hindering patients from sports activities may differ, few studies have examined separately the perceived reasons and the objective factors.

Therefore, this study was undertaken to determine reasons perceived by patients as to why they could not participate in regular sports activities after TKA and to identify patient factors associated with the inability to participate in sports activities. Our hypotheses were kept general. First, we hypothesized that while some reasons as perceived by patients would relate to the replaced knees, there would be reasons unrelated to the TKA. We also hypothesized that there would be some characteristic features, in terms of demographics and pre- and postoperative outcomes, of patients that did not participate in sports activities after TKA.

## METHODS

This study was approved by the institutional review board of Seoul National University Bundang Hospital. This retrospective study included 369 patients with a follow-up longer than 1 year after TKA. Initially, 745 patients who underwent TKA at the authors' institute from January 2008 to December 2010 were reviewed for eligibility. The inclusion criteria were as follows: a diagnosis of primary osteoarthritis, the absence of systemic disease or perioperative complications that could affect the outcome of TKA, and TKA patients with follow-up from 1 to 3 years. From these criteria, 178 patients were excluded for various reasons: previous surgery on the same lower extremity (n = 14) or spine (n = 8); a diagnosis other than primary osteoarthritis (n = 39); Parkinson disease (n = 5); a previous cerebrovascular accident with neurological deficit (n = 8); cancer (n = 10); death due to diseases unrelated to TKA (n = 8); periprosthetic infection (n = 2); other conditions (n = 58) such as depression, dementia, or problems in the contralateral knee; patients who refused to be involved in this study (n = 11); and patients whose contact information was changed (n = 15). After exclusion of these 178 patients, 567 patients were mailed a postal survey. To maximize the response rate, a follow-up mailing was sent to patients who failed to respond to the initial survey after 3 weeks. A follow-up telephone call was made to patients who failed to respond to the first mailing before mailing the questionnaire a second time. Finally, a telephone survey was performed for patients who did not reply to the second mailing. Of 567 patients who were mailed the questionnaire, 369 (65%) returned the completed questionnaire or responded to a telephone survey (35 patients, 6%) and were included in the data analysis. There were 339 (92%) female patients, and the mean age (±SD) was 68.8 ± 5.7 years (range, 50-83 years). The mean preoperative height and weight were 153.3 ± 6.2 cm (range, 140-179 cm) and 64.5 ± 9.3 kg (range, 42-92 kg), respectively. The mean body mass index (BMI) was 27.4 ± 3.3 kg/m$^2$ (range, 19.3-39.1 kg/m$^2$). Of the 369 patients, 251 (68%) had both knees replaced and 118 (32%) had 1 knee replaced.

The questionnaire consisted of items regarding sociodemographic characteristics, activity levels, and sports activities after TKA. The sociodemographic part of the questionnaire included place of residence (urban vs rural), lifestyle (floor-based [ie, usually sitting on the floor] vs Western), family members (living with vs without), socioeconomic status (low, middle, high), and education level (no regular education, elementary school, middle school, high school, university, or graduate school). Socioeconomic status was subjectively determined by the patients themselves. Other parts of the questionnaire contained items about whether the patient undertook regular sports activities before and after surgery, the preoperative University of California at Los Angeles (UCLA) activity scale, and the postoperative UCLA activity scale. The UCLA activity scale was used to measure patient activity level because it is a validated method for assessing activity levels with good reliability.[16,24] If the patient reported no participation in sports activities, they were asked to provide reasons as to why they could not participate. The survey revealed that a considerable portion of the patients did not participate in sports activities after surgery. Thus, the authors sought to explore the causes behind patients' low levels of exercise after TKA using the relevant data set from the survey. The following reasons were investigated: problems in the replaced knee; problems in the nonreplaced knee; problems in other joints or the spine; medical comorbidities such as cardiovascular diseases, respiratory diseases, endocrine diseases, and others; lack of sports facilities; lack of motivation; and other reasons. Patients were able to choose 1 or more from the given list of reasons. Patients also had the opportunity to name other reasons in an open-ended question (see the Appendix).

All surgeries were performed by a single surgeon (T.K.K.) using a standard medial parapatellar approach, and all patients underwent the same rehabilitation protocol after surgery.[8] Mobile-bearing prostheses (E-motion; B. Braun-Aesculap) were used in 151 (41%) patients, while fixed-bearing prostheses (Genesis II; Smith & Nephew) were used in 218 (59%) patients. All patellae were resurfaced, and all components were fixed using cement.

Clinical data were collected prospectively by a clinical investigator (Y.G.K.) and maintained as a longitudinal research database. Patients were evaluated for demographic data and clinical status preoperatively. Clinical evaluations were also performed postoperatively at 6 months, 1 year, and annually thereafter. Preoperative

TABLE 1
Comparison of Responders and Nonresponders to the Mailed Questionnaire[a]

| Parameter | Responder (n = 369) | Nonresponder (n = 198) | *P* Value |
|---|---|---|---|
| Age, y | 68.8 ± 5.7 | 69.4 ± 6.4 | .278 |
| Female sex | 339 (92) | 185 (94) | .618 |
| Preoperative BMI, kg/m$^2$ | 27.4 ± 3.3 | 27.3 ± 3.6 | .566 |
| Postoperative SF-36 | | | |
| MCS | 40.5 ± 8.3 | 40.1 ± 8.3 | .709 |
| PCS | 46.6 ± 11.2 | 45.3 ± 11.0 | .234 |

[a]Data are presented as mean ± SD or n (%). BMI, body mass index; MCS, mental component summary; PCS, physical component summary; SF-36, Short Form–36.

clinical status and postoperative clinical outcomes were evaluated using range of motion (ROM), American Knee Society (AKS) knee and function scores,[7] the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score,[1] and Short Form–36 (SF-36) scores.[20] The ROM was calculated by subtracting flexion contracture from maximum flexion. Flexion contracture and maximum flexion were measured by the same clinical investigator using a standard 38-cm clinical goniometer with the patient supine.

Statistical analyses were performed using SPSS software (version 18.0 for Windows; SPSS Inc), and $P < .05$ was considered to indicate statistical significance. To confirm the representativeness of the 369 responders, preoperative demographic data and SF-36 scores evaluated at last follow-ups were compared with the data from the 198 nonresponders. No significant differences were found, supporting the representativeness of the study subjects (Table 1).

To determine reasons perceived by patients, the number and proportion of each reason were calculated in patients who reported they could not participate in regular sports activities. To identify demographic features or clinical outcomes associated with the inability to participate in sports activities, sociodemographic data, preoperative clinical status, and outcomes evaluated at last follow-up were compared between patients who did not participate in sports activities and patients who did. To facilitate analysis, sociodemographic data were dichotomized by categorizing the education level and socioeconomic status into 2 groups: elementary school and less versus middle school and above for education level and middle class and above versus low class for socioeconomic class. Statistical significance of the differences between the 2 groups was determined by using the Student *t* test for continuous variables and chi-square tests for categorical variables. Multivariate logistic regression analysis was also run. The dependent variable was whether the patient engaged in regular sports activities after TKA. Sociodemographic data or components of clinical outcome scales with *P* values <.05 determined in the univariate analyses were included as covariates in the backward stepwise regression model. The odds ratios (ORs) with the 95% CI and the *P* value were calculated.

TABLE 2
Reasons for Not Participating in Sports Activities (109 Reasons From 88 Patients)[a]

| Perceived Reason | Total Patients | Unilateral TKA Patients | Bilateral TKA Patients |
|---|---|---|---|
| Symptoms in the replaced knee | 26 (24) | 9 (22.5) | 17 (25) |
| Symptoms in the nonreplaced knee | 9 (8) | 9 (22.5) | NA |
| Symptoms in spine or other joints | 27 (25) | 9 (22.5) | 18 (26) |
| Presence of medical comorbidities | 17 (16)[b] | 2 (5) | 15 (22) |
| Lack of motivation | 9 (8) | 4 (10) | 5 (7) |
| Lack of sports facilities | 19 (17) | 6 (15) | 13 (19) |
| Other | 2 (2) | 1 (2.5) | 1 (1) |

[a]Data are presented as n (%). NA, not applicable; TKA, total knee arthroplasty.
[b]Medical comorbidities cited by patients as reasons for their inability to participate in sports activity were cardiovascular in 8, endocrinal in 5, respiratory in 2, and other in 2.

TABLE 3
Reasons for Not Participating in Sports Activities (42 Reasons From 34 Patients Who Were Involved in Sports Activity Before Surgery)

| Perceived Reason | % (n) |
|---|---|
| Symptoms in the replaced knee | 16 (38) |
| Symptoms in the nonreplaced knee | 4 (9.5) |
| Symptoms in spine or other joints | 14 (33) |
| Presence of medical comorbidities | 4 (9.5)[a] |
| Lack of sports facilities | 2 (5) |
| Other | 2 (5) |

[a]Medical comorbidities cited by patients as reasons for their inability to participate in sports activity were endocrinal in 2, cancer in 1, and other reasons in 2.

## RESULTS

Analysis revealed that reasons unrelated to the replaced knee were more frequent than those related to the replaced knee (76% vs 24%) (Table 2). Among the 369 patients, 88 (24%) undertook no regular sports activities after TKA, while 281 (76%) did. Among the patients who did not participate in regular sports activity after TKA, 34 (39%) had been involved in sports activity before TKA (Table 3). Symptoms related to the spine or other joints represented 25% of the total perceived reasons, while the presence of medical comorbidities accounted for 16%. Symptoms in the nonreplaced knee represented 8% of the reasons; however, this was perceived as the reason for not participating in sports activities by 22.5% (9/40) of the unilateral TKA patients. On the other hand, 27% (lack of sports facilities,

TABLE 4
Demographics of the Groups With and Without Regular Sports Activity[a]

| Variable | Regular Sports Activity (n = 281) | No Regular Sports Activity (n = 88) | *P* Value |
|---|---|---|---|
| Male sex | 18 (6) | 12 (14) | **.030** |
| Age, y | 68.5 ± 5.8 | 69.8 ± 5.3 | .064 |
| Height, cm | 153 ± 6.1 | 153 ± 6.6 | .552 |
| Weight, kg | 65 ± 9.3 | 63 ± 9.3 | .064 |
| BMI, kg/m$^2$ | 27.6 ± 3.3 | 26.9 ± 3.5 | .082 |
| Rural area of residence (vs urban) | 47 (17) | 25 (28) | **.016** |
| Floor-based lifestyle (vs Western) | 31 (11) | 21 (24) | **.003** |
| Living without family member (vs with) | 55 (20) | 19 (22) | .513 |
| Education level ≤elementary school (vs ≥middle school) | 140 (50) | 58 (66) | **.008** |
| Low socioeconomic class (vs ≥middle class) | 82 (29) | 34 (39) | .095 |

[a]Data are presented as n (%) or mean ± SD. Statistically significant values ($P < .05$) are shown in boldface. Only data from area of residence (rural), lifestyle (floor-based), family member (without), education level (≤elementary school), and socioeconomic class (low class) are presented. BMI, body mass index.

TABLE 5
Comparison of Preoperative and Operative Variables Between Groups With and Without Regular Sports Activity[a]

| Variable | Regular Sports Activity (n = 281) | No Regular Sports Activity (n = 88) | *P* Value |
|---|---|---|---|
| UCLA activity scale | 4.6 ± 1.7 | 4.0 ± 1.9 | **.005** |
| AKS | | | |
| Pain | 20.7 ± 4.3 | 20.6 ± 4.1 | .840 |
| Knee | 45.3 ± 9.8 | 45.1 ± 9.4 | .848 |
| Function | 58.5 ± 12.8 | 55.3 ± 12.5 | **.045** |
| WOMAC | | | |
| Pain | 10.5 ± 4.5 | 11.7 ± 4.9 | .052 |
| Stiffness | 4.3 ± 2.1 | 4.9 ± 2.2 | **.033** |
| Function | 37.3 ± 13.4 | 41.1 ± 13.4 | **.032** |
| SF-36 | | | |
| Physical functioning | 28.4 ± 8.3 | 26.1 ± 8.6 | **.038** |
| Role physical | 31.5 ± 10.2 | 29.6 ± 10.2 | .165 |
| Bodily pain | 32.8 ± 8.5 | 29.9 ± 8.1 | **.008** |
| General health | 41.3 ± 8.7 | 40.1 ± 8.3 | .291 |
| Vitality | 43.4 ± 8.7 | 41.5 ± 10.9 | .160 |
| Social functioning | 38.7 ± 11.9 | 32.0 ± 12.5 | **<.001** |
| Role emotional | 34.3 ± 14.7 | 29.8 ± 16.0 | **.026** |
| Mental health | 42.6 ± 10.2 | 40.0 ± 12.4 | **.035** |
| Flexion contracture | 10.8 ± 7.5 | 11.4 ± 6.6 | .517 |
| Maximum flexion | 134.5 ± 14.8 | 136.6 ± 13.7 | .232 |
| Range of motion | 123.7 ± 19.5 | 125.92 ± 16.4 | .500 |
| Unilateral TKA (vs bilateral) | 83 (30) | 35 (40) | .072 |
| Fixed bearing prosthesis (vs mobile bearing) | 165 (59) | 53 (60) | .802 |

[a]Data are presented as mean ± SD or n (%). Statistically significant values ($P < .05$) are shown in boldface. AKS, American Knee Society; SF-36, Short Form–36; TKA, total knee arthroplasty; UCLA, University of California at Los Angeles; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Scale.

19/109; lack of motivation, 9/109; and other, 2/109) were not health related. Among the 88 patients who did not undertake regular sports activities after TKA, 34 (39%) had been involved in sports activities before TKA. In this subset of patients, reasons related to the replaced knee represented 38% (n = 16) of total perceived reasons. In contrast, symptoms related to the spine and other joints represented 33% (n = 14) of reasons.

Male sex, a floor-based lifestyle with greater demands on knee flexion, and worse postoperative UCLA activity scale scores were associated with no regular sports activities after TKA. In the univariate analysis, in terms of demographics, the no regular sports activity group had a larger number of male patients ($P = .030$), patients who lived in rural areas ($P = .016$), patients with a floor-based lifestyle ($P = .003$), and patients with lower levels of education ($P = .008$) compared with the regular sports activity group (Table 4). For preoperative variables, the no regular sports activity group had lower preoperative UCLA activity scale scores ($P = .005$), worse AKS function scores, worse WOMAC stiffness and function scores, and worse scores on several subscales of the SF-36, such as physical and social functioning, compared with the regular sports activity group ($P < .05$) (Table 5). For postoperative variables, the no regular sports activity group had lower postoperative UCLA activity scale scores ($P < .001$), worse AKS function scores and WOMAC function scores, and worse SF-36 scores, except for the subscale of the role emotional ($P < .05$) (Table 6). When demographic factors, preoperative clinical status, and postoperative outcome variables were entered into the multivariate logistic regression analysis, male sex (OR, 4.9; 95% CI, 1.4-18.0; $P = .016$), a floor-based lifestyle (OR, 3.3; 95% CI, 1.3-8.5; $P = .011$), and worse postoperative UCLA scale scores (OR, 0.5; 95% CI, 0.4-0.7; $P < .001$) were associated with the no regular sports activity group (Table 7).

## DISCUSSION

Contemporary TKAs have progressed to assure better functional outcomes and satisfactory durability, reducing concerns over implant survival. As such, many patients undergoing TKA have come to expect active participation in sports activities after surgery.[13,14] However, several previous studies reported that considerable proportions of patients with TKA did not resume their sports activities after surgery.[2,3,6,22] Thus, in this

TABLE 6
Postoperative Clinical Outcomes Between Groups With and Without Regular Sports Activity[a]

| Variable | Regular Sports Activity (n = 281) | No Regular Sports Activity (n = 88) | *P* Value |
|---|---|---|---|
| UCLA activity scale | 5.1 ± 1.3 | 4.1 ± 1.5 | **<.001** |
| AKS | | | |
| Pain | 46.1 ± 3.5 | 45.2 ± 6.0 | .095 |
| Knee | 93.5 ± 6.2 | 93.7 ± 6.9 | .809 |
| Function | 93.3 ± 9.8 | 89.5 ± 12.0 | **.015** |
| WOMAC | | | |
| Pain | 2.8 ± 3.0 | 2.8 ± 3.4 | .996 |
| Stiffness | 2.0 ± 1.6 | 2.2 ± 1.7 | .554 |
| Function | 14.7 ± 10.2 | 17.7 ± 12.0 | **.030** |
| SF-36 | | | |
| Physical functioning | 40.6 ± 7.5 | 37.5 ± 9.3 | **.018** |
| Role physical | 40.7 ± 10.2 | 36.2 ± 11.2 | **.003** |
| Bodily pain | 45.2 ± 9.4 | 41.6 ± 11.8 | **.026** |
| General health | 42.5 ± 8.1 | 39.7 ± 9.0 | **.021** |
| Vitality | 47.4 ± 9.1 | 44.8 ± 9.2 | **.048** |
| Social functioning | 47.8 ± 9.3 | 44.1 ± 12.0 | **.025** |
| Role emotional | 42.2 ± 12.6 | 38.2 ± 15.2 | .059 |
| Mental health | 46.8 ± 10.4 | 42.6 ± 12.5 | **.007** |
| Flexion contracture | 0.1 ± 0.9 | 0.1 ± 1.2 | .800 |
| Maximum flexion | 129.8 ± 11.2 | 130.5 ± 12.2 | .645 |
| Range of motion | 129.7 ± 11.3 | 130.4 ± 12.3 | .665 |

[a]Data are presented as mean ± SD. Statistically significant values ($P < .05$) are shown in boldface. AKS, American Knee Society; SF-36, Short Form–36; UCLA, University of California at Los Angeles; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Scale.

TABLE 7
Multivariate Logistic Regression of Patient Characteristics Associated With No Regular Sports Activity[a]

| Variable | β | SE | Odds Ratio (95% CI) | *P* Value |
|---|---|---|---|---|
| Male sex | 1.598 | 0.662 | 4.9 (1.4-18.0) | **.016** |
| Floor-based lifestyle | 1.205 | 0.475 | 3.3 (1.3-8.5) | **.011** |
| Worse postoperative UCLA scale | –0.647 | 0.159 | 0.5 (0.4-0.7) | **<.001** |

[a]Statistically significant values ($P < .05$) are shown in boldface. Backward stepwise, $R^2 = 0.172$. The variables entered as covariates for the regression were sex, place of residence, lifestyle, education level, and preoperative variables, including UCLA activity scale, AKS function, subscales of WOMAC (stiffness, function), and subscales of SF-36 (physical functioning, bodily pain, social functioning, role emotional, mental health). The postoperative clinical outcomes in terms of UCLA activity scale, AKS pain, WOMAC function, and subscales of SF-36 (except for role emotional) were also included as covariates. AKS, American Knee Society; SE, standard error; SF-36, Short Form–36; UCLA, University of California at Los Angeles; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Scale.

study, we sought to determine reasons perceived by patients as to why they did not participate in regular sports activities and to identify patient characteristics associated with the inability to engage in sports activities.

The study findings support the hypothesis that only some of the reasons are related to symptoms in the replaced knees (24%). Most of the reasons perceived by patients were in fact not related to the replaced knees, but symptoms in joints other than the knee were most common among the surveyed comorbidities (25%). These results are consistent with a previous study in which 53% of TKA patients responded that their activities were limited by other joints.[4] These findings can be explained by the fact that the process of osteoarthritis can involve multiple joints, and TKA is typically performed in the elderly.[15] Furthermore, in the subset of unilateral TKA patients, 22.5% selected symptoms in the nonreplaced knee as the perceived reason for not participating in sports activities. Even if bilateral TKA is not needed at the time of index surgery, contralateral knee status can be aggravated during the follow-up period. Additionally, contralateral nonreplaced knee status has substantial influence on the clinical results of uncomplicated unilateral TKA.[5] Thus, this study suggests that orthopaedic surgeons should encourage patients to participate in sports activities after surgery by tending to problems in other joints, including the nonreplaced knee as well as those in the replaced knee.

Patient factors that inhibit participation in regular sports activities are more complicated than simple functional or physical problems. One finding of this study, that worse postoperative UCLA activity scale was associated with no regular sports activity, is reasonable because the UCLA activity scale reflects sports activity levels. In contrast, it is somewhat strange that male sex was associated with lack of regular sports activities after TKA because male patients have been reported to exhibit higher activity levels than female patients.[21] In a previous study that explicitly examined predictors of participation in sports after arthroplasty, male sex was an independent predictor for being highly active (UCLA scale $\geq$7) after surgery.[21] Furthermore, men also tended to have higher UCLA activity scale scores in this study (data not shown). It is difficult to explain this seemingly contradictory finding. However, it may be due in part to the fact that this study focused on actual sports participation rather than activity level. Thus, it could be associated with factors unrelated to activity level, such as a lack of motivation. In addition, a floor-based lifestyle was also associated with inability to participate in sports activities Furthermore, symptoms not related to the replaced knee represented the majority of the total perceived reasons reported by patients who engaged in sports activities before surgery, even if those reasons may have existed before receiving TKA. Thus, this study demonstrates that patient characteristics preventing regular sports participation after TKA are not limited to merely physical or functional problems. The situation is inherently more complex and may stem partly from cultural backgrounds. Our findings suggest that in addition to improved

functional outcomes and the surgeon's efforts to resolve joint problems, a multidisciplinary approach is needed to increase patients' sports participation after TKA.

The present study has several limitations to be considered. First, 65% of eligible patients responded to the questionnaire, presenting the possibility of selection bias. However, bias was minimized by confirming that there were no differences in demographic data and postoperative health-related quality of life (SF-36) between responders and nonresponders. Second, most study subjects were women (92%); thus, caution is required when generalizing this study's findings to other cohorts with different sex compositions. However, female dominance in TKA patients is common in Asians and Westerners.[9-11,23] suggesting that no selection bias affected our results. Therefore, despite the dominance of female subjects in our population, our study may provide valuable information for clinicians treating Asian and Western patients. Third, patient health and functional status regarding TKA could have changed during the follow-up period.[5] This study provides no information on temporal change patterns because it was of a retrospective design at a single time point. However, we believe that the effect of time elapsed after the index surgery on our results was minimal, as only patients who had undergone TKA 1 to 3 years before the survey were included.

## CONCLUSION

The perceived reasons and patient factors hindering regular sports activities after TKA were not restricted to problems with the replaced knee. Nonetheless, orthopaedic surgeons may have a substantial role in encouraging patients to participate in sports by resolving joint-related problems, while overall, a multidisciplinary approach is needed to improve sports participation after surgery.

## REFERENCES


1. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol*. 1988;15:1833-1840.
2. Bonnin M, Laurent JR, Parratte S, Zadegan F, Badet R, Bissery A. Can patients really do sport after TKA? *Knee Surg Sports Traumatol Arthrosc*. 2010;18:853-862.
3. Chatterji U, Ashworth MJ, Lewis PL, Dobson PJ. Effect of total knee arthroplasty on recreational and sporting activity. *ANZ J Surg*. 2005; 75:405-408.
4. Dahm DL, Barnes SA, Harrington JR, Sayeed SA, Berry DJ. Patient-reported activity level after total knee arthroplasty. *J Arthroplasty*. 2008;23:401-407.
5. Farquhar S, Snyder-Mackler L. The Chitranjan Ranawat Award: the nonoperated knee predicts function 3 years after unilateral total knee arthroplasty. *Clin Orthop Relat Res*. 2010;468:37-44.
6. Huch K, Muller KA, Sturmer T, Brenner H, Puhl W, Gunther KP. Sports activities 5 years after total knee or hip arthroplasty: the Ulm Osteoarthritis Study. *Ann Rheum Dis*. 2005;64:1715-1720.
7. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res*. 1989;(248): 13-14.
8. Kim TK, Park KK, Yoon SW, Kim SJ, Chang CB, Seong SC. Clinical value of regular passive ROM exercise by a physical therapist after total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc*. 2009; 17:1152-1158.
9. Koh IJ, Kim TK, Chang CB, Cho HJ, In Y. Trends in use of total knee arthroplasty in Korea from 2001 to 2010. *Clin Orthop Relat Res*. 2013; 471:1441-1450.
10. Memtsoudis SG, Della Valle AG, Besculides MC, Gaber L, Laskin R. Trends in demographics, comorbidity profiles, in-hospital complications and mortality associated with primary knee arthroplasty. *J Arthroplasty*. 2009;24:518-527.
11. Mitsuyasu S, Hagihara A, Horiguchi H, Nobutomo K. Relationship between total arthroplasty case volume and patient outcome in an acute care payment system in Japan. *J Arthroplasty*. 2006;21:656-663.
12. Mont MA, LaPorte DM, Mullick T, Silberstein CE, Hungerford DS. Tennis after total hip arthroplasty. *Am J Sports Med*. 1999;27:60-64.
13. Mont MA, Marker DR, Seyler TM, Jones LC, Kolisek FR, Hungerford DS. High-impact sports after total knee arthroplasty. *J Arthroplasty*. 2008;23:80-84.
14. Mont MA, Rajadhyaksha AD, Marxen JL, Silberstein CE, Hungerford DS. Tennis after total knee arthroplasty. *Am J Sports Med*. 2002;30: 163-166.
15. Myers VH, McVay MA, Brashear MM, et al. Exercise training and quality of life in individuals with type 2 diabetes: a randomized controlled trial. *Diabetes Care*. 2013;36:1884-1890.
16. Naal FD, Impellizzeri FM, Leunig M. Which is the best activity rating scale for patients undergoing total joint arthroplasty? *Clin Orthop Relat Res*. 2009;467:958-965.
17. Noble PC, Conditt MA, Cook KF, Mathis KB. The John Insall Award: patient expectations affect satisfaction with total knee arthroplasty. *Clin Orthop Relat Res*. 2006;452:35-43.
18. Nyland J, Kanouse Z, Krupp R, Caborn D, Jakob R. Total knee arthroplasty in motivated patients with knee osteoarthritis and athletic activity approach type goals: a conceptual decision-making model. *Disabil Rehabil*. 2011;33:1683-1692.
19. O'Hagan C, De Vito G, Boreham CA. Exercise prescription in the treatment of type 2 diabetes mellitus: current practices, existing guidelines and future directions. *Sports Med*. 2013;43:39-49.
20. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care*. 1992;30:473-483.
21. Williams DH, Greidanus NV, Masri BA, Duncan CP, Garbuz DS. Predictors of participation in sports after hip and knee arthroplasty. *Clin Orthop Relat Res*. 2012;470:555-561.
22. Wylde V, Blom A, Dieppe P, Hewlett S, Learmonth I. Return to sport after joint replacement. *J Bone Joint Surg Br*. 2008;90:920-923.
23. Yan CH, Chiu KY, Ng FY. Total knee arthroplasty for primary knee osteoarthritis: changing pattern over the past 10 years. *Hong Kong Med J*. 2011;17:20-25.
24. Zahiri CA, Schmalzried TP, Szuszczewicz ES, Amstutz HC. Assessing activity in joint replacement patients. *J Arthroplasty*. 1998;13: 890-895.

# APPENDIX

## Study Questionnaire

**Part I**

1. Please check the location in which you live.
   ☐ Urban area ☐ Rural area ☐ Other (specify:_____ )
2. Please check the most appropriate lifestyle provide below.
   ☐ Korean (usually sit on the floor)
   ☐ Western (usually sit on a chair)
3. Please check whether you live with a family member.
   ☐ Yes ☐ No
4. Please check your education level.
   ☐ No formal education
   ☐ Elementary school
   ☐ Middle school
   ☐ High school
   ☐ University or graduate school
5. Please check your subjective income level.
   ☐ Low ☐ Middle ☐ High

**Part II**

Please answer the following questions about your sports activities before and after surgery.

*IIA. Sports activities before surgery*

1. Did you play sports regularly before surgery?
   ☐ Yes ☐ No
2. If you had sports activities before surgery, please check the types of activities.
   ☐ Hiking, ☐ Swimming, ☐ Cycling, ☐ Walking, ☐ Running, ☐ Gymnastics, ☐ Table tennis, ☐ Badminton,
   ☐ Gate ball, ☐ Golf, ☐ Tennis, ☐ Stretching, ☐ Other (specify:_____ )
3. Please check your level of activity before surgery.
   ☐ Regularly participate in impact sports such as jogging, tennis, skiing, acrobatics, ballet, heavy labor, or backpacking
   ☐ Sometimes participate in impact sports
   ☐ Regularly participate in very active events, such as bowling or golf
   ☐ Regularly participate in active events, such as bicycling
   ☐ Regularly participate in moderate activities, such as swimming and unlimited house work or shopping
   ☐ Sometimes participate in moderate activity
   ☐ Regularly participate in mild activities, such as walking, limited house work, and limited shopping
   ☐ Sometimes participate in mild activity
   ☐ Mostly inactive: restricted to minimal activities or daily living
   ☐ Wholly inactive: dependent on others; cannot leave residence
4. If you had sports activities before surgery, were you able to resume your preoperative sports activities after surgery?
   ☐ Yes ☐ No

*IIB. Sports activities after surgery*

1. Do you play sports regularly after the surgery?
   ☐ Yes ☐ No
2. If you have sports activities after the surgery, please check the types of activities.
   ☐ Hiking, ☐ Swimming, ☐ Cycling, ☐ Walking, ☐ Running, ☐ Gymnastics, ☐ Table tennis, ☐ Badminton, ☐ Gate ball,
   ☐ Golf, ☐ Tennis, ☐ Stretching, ☐ Other (specify: )
3. Please check your level of activity after surgery.
   ☐ Regularly participate in impact sports such as jogging, tennis, skiing, acrobatics, ballet, heavy labor, or back packing
   ☐ Sometimes participate in impact sports
   ☐ Regularly participate in very active events, such as bowling or golf
   ☐ Regularly participate in active events, such as bicycling
   ☐ Regularly participate in moderate activities, such as swimming and unlimited house work or shopping
   ☐ Sometimes participate in moderate activity
   ☐ Regularly participate in mild activities, such as walking, limited house work, and limited shopping
   ☐ Sometimes participate in mild activity
   ☐ Mostly inactive: restricted to minimal activities or daily living
   ☐ Wholly inactive: dependent on others; cannot leave residence

*(continued)*

APPENDIX (continued)

4. If you have no sports activities after surgery, please check the causes.
   - ☐ Problems in operated knee
   - ☐ Problems in non-operated knee
   - ☐ Lack of sports facilities
   - ☐ Comorbidities not related to knee joint
     - a. Other joint problems
     - b. Cardiovascular diseases (hypertension, brain infaction, etc)
     - c. Respiratory diseases (asthma, etc)
     - d. Endocrine diseases (diabetes, etc)
     - e. Other (specify: _____)
   - ☐ Other (specify: _____)

**Part III**

Please answer the following questions about level of satisfaction after surgery.

1. Please rate your level of satisfaction with the overall surgical outcome.
   - ☐ Very satisfied
   - ☐ Satisfied
   - ☐ Neither satisfied nor dissatisfied
   - ☐ Dissatisfied
   - ☐ Very dissatisfied

2. Please rate your level of satisfaction with the overall surgical outcome.
   Very dissatisfied 0 1 2 3 4 5 6 7 8 9 10 very satisfied

3. What is your appreciation of your current physical activity as compared with your preoperative expectation?
   ☐ Better than expected ☐ As expected ☐ Poorer than expected

4. What is your appreciation of your current physical activity as compared with peers?
   ☐ Better ☐ The same ☐ Poorer

5. Please rate your level of satisfaction regarding your level of physical activity.
   Very dissatisfied 0 1 2 3 4 5 6 7 8 9 10 very satisfied