Letter to the Editor

Ethnic Differences in Preoperative Patient Characteristics and Postoperative Functional Outcomes after Total Knee Arthroplasty among Chinese, Malays and Indians

Dear Editor,

Osteoarthritis (OA) of the knee is a common condition and increases in occurrence and severity with advancing age.[1] Total knee arthroplasty (TKA) can significantly improve patient function and quality of life in cases of severe disease.[2-4]

However, preoperative and postoperative patient-reported outcomes may be influenced by physical characteristics—a well known example being body mass index (BMI).[5] In addition, ethnic differences in knee OA have been suggested in some large studies showing that African Americans in the general population had poorer preoperative functional scores, greater prevalence of valgus malalignment and greater severity of radiographic knee OA compared to Caucasians.[6-9] Joshy et al revealed that Indian and Pakistani patients had poorer preoperative Knee Society Scores compared to Caucasians in Birmingham, United Kingdom[10] while Gandhi et al found that Asians in Toronto, Canada had poorer preoperative function than their Caucasian counterparts.[5] Differences between different Asian ethnicities have not been well established.

Singapore has a multiracial community of Chinese (74.2%), Indians (9.5%) and Malays (13.3%)[11] and is therefore a suitable location to study differences among these Asian ethnic groups. In this study, we evaluated differences among Chinese, Indians and Malays undergoing TKA in our institution, in terms of preoperative scores and postoperative outcomes at the end of 1- and 2-years.

Materials and Methods

Study Population

With ethical approval from the National Healthcare Group Domain Specific Review Board, this retrospective observational study was conducted at the National University Hospital (a 1000-bed tertiary care institution of Singapore). From the hospital's joint arthroplasty registry, we identified all Chinese, Malay and Indian patients with primary knee OA who underwent TKA from January 2009 to June 2011. Patients with secondary knee OA (i.e. traumatic, infectious, inflammatory, metabolic) were excluded from this study.

Demographic Variables

Patients' clinical characteristics such as age, gender, ethnicity, BMI, presence of comorbidities (diabetes mellitus [DM], hypertension [HTN] and ischaemic heart disease [IHD]), were recorded. Preoperative knee range of motion (ROM) and deformity (valgus/varus) were also assessed.

Functional Assessments

All patients agreeable for TKA were asked to complete preoperative questionnaires and their knee function was objectively measured. These assessments were repeated during the follow-up visits at 1- and 2-years postoperatively. The following functional scores were measured: 1) The Knee Society Score (KSS) with its 2 components: KSS Knee Score is determined through patient's reported knee pain and the physical examination of the knee, and a KSS Function Score rates the patient's ability to walk and climb stairs. Each score ranges from 0 (worst) to 100 (best); 2) Short Form-36 Health Survey of Mental Component Score (SF 36-MCS) and Physical Component Score (SF 36-PCS) measure functional health and well-being scores that are computed to provide a physical and mental summary component. Each score ranges from 0% (worst) to 100% (best); and 3) The Western Ontario and McMaster Universities OA Index (WOMAC) Score assesses the burden of knee OA in terms of pain, stiffness and physical ability to perform various daily activities. As done by other authors,[12-14] the scoring system was transformed and normalised from the original to give a range from 0 (worst) to 100 (best).

All the above functional scores were administered by a trained research nurse blinded to our study. Knee ROM and fixed flexion deformity were objectively measured with a goniometer by the same research nurse.

Statistical Analysis

We tabulated the demographics and dependent variables of our patients and presented them in frequency tables with appropriate descriptive statistics. Categorical variables were presented as proportions and continuous variables were presented as means with standard deviation. To analyse for ethnic differences in demographics, the chi-squared test was used for comparing categorical variables (comorbidities), while student's t-test and analysis of variance (ANOVA) were used to compare continuous variables (age and BMI). In assessing for ethnic differences in our dependent variables, the chi-squared test was used to analyse categorical variables (such as gender or comorbidities), while student's t-test and

ANOVA were used to compare the means of continuous dependent variables (preoperative functional scores and knee ROM). Statistical significance was accepted with *P* value <0.05. Data analysis was performed using SPSS (SPSS Inc., Chicago IL, Version 18.)

Results

Out of 737 patients identified from the database, 229 were excluded with incomplete preoperative or postoperative functional outcome data, to avoid reporting bias. The remaining 508 patients with complete data who fulfilled the inclusion criteria were reviewed and their demographics (Table 1) and outcome scores were analysed (Table 2).

Demographic Variables (Table 1)

The ethnic breakdown revealed 388 Chinese (76.4%), 47 Malay (9.3%), and 73 Indian (14.4%) patients. The average age of Chinese patients (65.6) and Indian patients (64.3) was higher than the average age of the Malay group (60.3) (*P* <0.001). BMI was similar between Malays and Indians (with both more than the Chinese patients [*P* <0.001]). The prevalence of HTN and IHD was similar but DM was more common in Indians, which almost reached statistical significance (*P* = 0.05).

Preoperative knee ROM and knee joint alignment angle did not show statistically significant difference amongst the 3 groups.

Preoperative and Postoperative Scores (Table 2)

SF36 Physical Component Score

Preoperatively, all 3 ethnic groups had similar scores, but Chinese scored more than Malays and this was shown to be statistically significant (*P* = 0.017). At 1-year postoperatively, all 3 ethnic groups improved in this scoring, but Indians improved the least and scored less than both the Chinese and Malays, with statistical significance, (*P* = 0.002 and *P* = 0.013, respectively). At 2-years postoperatively, there was no difference between Malays and Indians. However, the Chinese still scored higher than the Indians (*P* = 0.013).

SF36 Mental Component Score

At all measured time-points, there was no significant difference in scores between the groups.

KSS Knee Score

Preoperatively, there was no significant difference in scores recorded in Chinese, Malays and Indians. At 1-year postoperatively, there was a large improvement in KSS Knee Scores seen in all 3 ethnic groups. However, statistical significant difference (*P* = 0.033) was seen when comparing postoperative scores between the Chinese (93.3) and Indians (90.3). At 2-years postoperatively, all 3 ethnic groups maintained similar scores as the previous year, and again the Chinese scored more than the Indians (*P* = 0.038).

Table 1. Demographics and Preoperative Knee Range of Motion and Alignment

Demographics	**Chinese, n = 388 (SD)**	**Malay, n = 47 (SD)**	**Indian, n = 73 (SD)**	**ANOVA (*P* Value)**	**Chinese vs Malay (*P* Value)**	**Malay vs Indian (*P* Value)**	**Chinese vs Indian (*P* Value)**
Age	65.6 (7.8)	60.3 (9)	64.3 (9.7)	0.000 or <0.001*	0.000 or <0.001*	0.031*	0.549
BMI	26.8 (4.4)	30.2 (4.8)	29.5 (5.6)	0.000 or <0.001*	0.000 or <0.001*	1.000	0.000 or <0.001*
Preoperative FFD	5.2 (6.2)	4.7 (5.4)	4.1 (7.2)	0.360	1.000	1.000	0.491
Preoperative Flexion	107.1 (16.0)	107.6 (13.1)	108.5 (18.6)	0.796	1.000	1.000	1.000
Preoperative alignment	3.8 (6.4)	3.4 (5.2)	2.4 (7.8)	0.205	1.000	1.000	0.232
Demographics	**Chinese, n = 388**	**Malay, n = 47**	**Indian, n = 73**	**Chi-squared (*P* Value)**			
Gender, male:female	28.1:71.9	21.3:78.7	35.6:64.4	0.218			
Preoperative varus/valgus deformity, varus:valgus	79.1:20.9	80.9:19.1	67.1:32.9	0.067			
DM	97 (25%)	15 (31.9%)	28 (38.4%)	0.05			
HTN	248 (63.9%)	28 (59.6%)	38 (52.1%)	0.152			
IHD	45 (11.6%)	5 (10.6%)	12 (16.4%)	0.481			

ANOVA: Analysis of variance; BMI: Body mass index; DM: Diabetes mellitus; FFD: Fixed flexion deformity; HTN: Hypertension; IHD: Ischaemic heart disease; ROM: Range of motion; SD: Standard deviation

*Statistically significant.

Table 2. Functional Scores Preoperatively and at 1- and 2-Years Postoperatively

Parameters	Chinese, n = 388 (SD)	Malay, n = 47 (SD)	Indian, n = 73 (SD)	ANOVA (*P* Value)	Chinese vs Malay (*P* Value)	Malay vs Indian (*P* Value)	Chinese vs Indian (*P* Value)
SF-36 PCS							
Preoperation	31.7 (6.6)	28.9 (6.1)	29.8 (7.1)	0.004*	0.017*	1.000	0.078
1-year postoperation	49.8 (6.5)	50.4 (5.4)	46.9 (8.2)	0.001*	1.000	0.013*	0.002*
Change at 1-year	18.1 (7.9)	21.6 (8.2)	17.0 (9.5)	0.010*	0.021*	0.010*	0.893
2-years postoperation	49.5 (6.6)	48.8 (8.2)	47.0 (7.1)	0.016*	1.000	0.517	0.013*
Change at 2-years	17.8 (8.3)	19.9 (9.8)	17.2 (8.1)	0.202	0.326	0.258	1.000
SF-36 MCS							
Preoperation	51.2 (7.4)	50.3 (10.6)	52.4 (9.1)	0.339	1.000	0.497	0.693
1-year postoperation	56.0 (5.2)	57.0 (4.2)	56.0 (5.2)	0.435	0.603	0.867	1.000
Change at 1-year	4.9 (8.1)	6.7 (10)	3.6 (8.7)	0.145	0.453	0.149	0.760
2-years postoperation	57.1 (3.9)	57.1 (6.1)	57.0 (5.9)	0.985	1.000	1.000	1.000
Change at 2-years	5.9 (7.7)	6.8 (11.7)	4.6 (9.3)	0.328	1.000	0.488	0.651
KSS knee							
Preoperation	38.4 (14.6)	33.6 (12.1)	37.2 (11.9)	0.089	0.091	0.541	1.000
1-year postoperation	93.3 (8.9)	94.0 (8.3)	90.3 (9.4)	0.028*	1.000	0.099	0.033*
Change at 1-year	54.9 (16.5)	60.4 (14.3)	53.1 (18.9)	0.053	0.097	0.056	1.000
2-years postoperation	93.9 (9.1)	93.8 (10.0)	90.9 (12.3)	0.044*	1.000	0.324	0.038*
Change at 2-years	55.5 (16.5)	60.2 (15.9)	53.6 (19.5)	0.111	0.225	0.118	1.000
KSS function							
Preoperation	50.0 (17.0)	44.5 (18.5)	49.5 (19.0)	0.130	0.131	0.366	1.000
1-year postoperation	77.5 (16.0)	79.6 (15.4)	70.4 (19.8)	0.002*	1.000	0.009*	0.002*
Change at 1-year	27.6 (19.7)	35.1 (23.3)	20.9 (19.9)	0.001*	0.048*	0.001*	0.027*
2-years postoperation	80.1 (17.5)	80.0 (15.5)	75.7 (14.8)	0.120	1.000	0.525	0.123
Change at 2-years	30.2 (19.4)	35.5. (24.1)	26.2 (20.0)	0.043*	0.254	0.037*	0.336
WOMAC							
Preoperation	62.5 (13.5)	60.1 (11.7)	59.8 (15.0)	0.193	0.764	1.000	0.764
1-year postoperation	89.5 (7.2)	90.3 (7.7)	86.8 (9.4)	0.012*	1.000	0.043*	0.017*
Change at 1-year	27.0 (13.5)	30.2 (13.5)	27.0 (15.8)	0.322	0.408	0.654	1.000
2-years postoperation	91.4 (6.9)	92.0 (5.2)	89.6 (7.6)	0.077	1.000	0.166	0.110
Change at 2-years	28.9 (13.7)	31.9 (12.5)	29.7 (14.8)	0.365	0.491	1.000	1.000

ANOVA: Analysis of variance; KSS function: Knee Society Score of knee function; KSS knee: Knee Society Score of knee symptoms; SD: Standard deviation; SF-36 MCS: Short Form-36 Health Survey of Mental Component Score; SF-36 PCS: Short Form-36 Health Survey of Physical Component Score; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index
*Statistically significant.

KSS Function Score

Preoperatively, there was no significant difference in scores recorded in Chinese, Malays, and Indians. At 1-year postoperatively, all ethnic groups improved, but the Malays improved the most and the Indians improved the least. Statistical significance was seen with Malays scoring more than Indians ($P = 0.009$) and Chinese scoring more than Indians ($P = 0.002$). At 2-years postoperatively, while the Malays did not record any further improvement in scores, the Indians improved further over the year and the final postoperative scores at 2-years showed no significant differences between the 3 ethnic groups.

WOMAC

Preoperatively, there was no significant difference in scores recorded in Chinese, Malays, and Indians. At 1-year postoperatively, all ethnic groups improved, but the Indians again failed to improve as much. Differences of statistical significance was seen with Malays scoring more than Indians ($P = 0.043$) and Chinese scoring more than Indians ($P = 0.017$). At 2-years postoperatively, the Indians improved further over the year and the final postoperative scores at 2-years showed no significant differences between the 3 ethnic groups.

Discussion

Preoperative and postoperative outcomes of OA knee may vary among patients from the 3 ethnic groups in Singapore.

Malays undergoing TKA were on average 5 years younger than Chinese and Indians. They generally had the poorest preoperative scores (although only statistically significant for SF-36 PCS versus Chinese). They also improved the most and all their postoperative scores matched those of the Chinese at both 1- and 2-years. Poorer initial scores may partly relate to physical characteristics and social/occupational practices. Obesity was common amongst Malays and is known to aggravate knee OA symptoms especially with frequent kneeling.[15,16] Amongst Malays, kneeling is commonly practiced during Muslim prayers. Malays in Singapore are also more likely to undertake moderate-to-high intensity occupations in Singapore[17,18] and such occupations are known aggravators of knee OA symptoms.[19] However, we are unable to confirm the above factors, as data on occupational and religious practices was not collected.

Indians improved less in the first year, and had lower postoperative scores (SF36 PCS, KSS Function and WOMAC) compared to both Malays and Chinese. However, they continued to improve and at 2-years, reduced this difference.

In a similar Singaporean study,[20] Chinese had better preoperative scores for KSS Knee, KSS Function and SF36. Malays showed the most improvement at 2-years for all outcome scores and showed no difference in scores from Chinese at 2-years except for SF36 Physical Function and KSS Function. Indians scored the worst at 2-years for all outcomes and this was statistically significant when compared to Chinese but not Malays.

The findings of our study and those of Siow et al[20] indicate that Malays present with the worst preoperative scores but show the most improvement after TKA, such that their postoperative scores are comparable to Chinese patients. Although Siow et al[20] found that Indians do not show as much improvement in outcome scores after TKA as Chinese and Malays (and end up with the worst outcome scores), we found that while this is the case for 1-year postoperatively, Indians continue to improve and eventually "catch up" with Chinese and Malays at 2-years.

The strength of our study lies in the relatively large sample size with similar ethnic composition to the Singapore population.[11] In addition, our patients' preoperative scores were taken from a prospectively-kept functional scoring database maintained by research nurses blinded to our study. To our knowledge, this is one of the first and largest studies to examine the evolution of preoperative and postoperative outcomes (at both 1- and 2-years) amongst Asian patients with knee OA undergoing TKA.

There are, however, several limitations in our study. Firstly, the sourcing of patients from a single tertiary referral centre might be a potential source of selection bias, as the study sample may not match the national population demographics in all respects.

Secondly, we had to exclude 229 out of 737 patients, due to incomplete data sets. Although the ethnic distribution of the exclusions (79% Chinese, 8.7% Malays and 12.3% Indians) was similar to the analysed population, the large dropout may have influenced study findings.

Thirdly, the SF-36 scoring systems were not available in the Malay and Tamil languages. Using them to assess functional scores in Malay and Indian patients with poor command of the English language might introduce some observational bias. However, we reduced this risk by engaging our hospital's translator services.

Lastly, as this was a retrospective study, our results cannot be used to establish causality between ethnicity and our dependent variables. Differences in TKA outcomes are multifactorial, and socioeconomic factors should also be assessed to explain differences between the ethnic groups. However, socioeconomic data was not part of the registry data collection. As a result, we were unable to assess the influence of socioeconomic factors on our results. Nonetheless, the findings of our study indicate that differences in preoperative function and postoperative outcomes after TKA exist among the ethnic groups in Singapore. Further research should therefore be carried out to determine if indeed socioeconomic and occupational factors account for these differences.

Conclusion

In conclusion, TKA results in significant improvements in postoperative functional outcomes in patients from the 3 major ethnic groups in Singapore. The following patterns were observed: Malays appear to present with worse preoperative scores and undergo surgery at a younger age, compared to Chinese and Indians. However, at 1-year postoperatively, Malays improve the most while Indians improve the least. Indians improve further over the second year to eventually match the Malays and Chinese. Further research is needed to determine the underlying reasons for these interethnic differences.

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Nadir Zahir Shah, [1]*MS (Orth)*, Rishi Malhotra,[1]*BMBS, MRCS-Eng*, Choon Chiet Hong,[1]*MBBS, MRCS-Ed*, Jonathan BY Sng,[1]*MBBS*, Chee Hoe Kong, [1]*MBBS*, Liang Shen, [2]*PhD*, Nazrul Nashi,[1]*MBBS*, Lingaraj Krishna, [1]*MBBS, MRCSEd, FRCSEd (Orth)*

[1]University Orthopaedics, Hand and Reconstructive Microsurgery Cluster, National University Health System, Singapore
[2]Department of Biostatistics, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Address for Correspondence: Dr Rishi Malhotra, University Orthopaedics, Hand and Reconstructive Microsurgery Cluster, National University Health System, 5 Lower Kent Ridge Road, Singapore 119228.
Email: rishi_malhotra@nuhs.edu.sg