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Preoperative Patient Characteristics and Outcomes of Total Knee Arthroplasty in a Multiethnic Asian Population Stratified by Ethnicity

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ABSTRACT

We aim to compare the patient profile and outcomes after TKA between the different racial groups in Singapore. Prospective data were collected from 364 patients who underwent TKA in Singapore General Hospital from January 2006 to May 2010. Patients were stratified according to ethnicity and we compared their preoperative demographic data, Short-Form 36 (SF-36), Oxford Knee (OKS) as well as Knee Society Scores (KSS). Malays were younger (62.0 ± 5.3) at time of surgery ($p = 0.05$) and the body mass index of Chinese (27.9 ± 4.7) was lower than Malay (30.4 ± 5.0) and Indian (31.5 ± 4.5) patients ($P < 0.005$). Malay (40.3 ± 11.0) and Indian (39.2 ± 9.3) patients had less favourable preoperative OKS than Chinese (35.9 ± 7.8) patients ($P < 0.05$). All 3 ethnic groups achieved statistically significant improvements in outcome measures but did not differ significantly between the ethnicities.

Osteoarthritis (OA) of the knee is a leading cause of pain and disability worldwide [1] and the percentage of the world population afflicted with this condition is expected to rise. Total knee arthroplasty (TKA) effectively restores function in patients with OA knee [2], but despite the higher rates of OA reported in Asian countries [3], the rate of TKA remains lower compared to Western countries [4]. With the increasing urbanization and affluence of the region coupled with an aging population, the demand and utilization of TKA in Asia are expected to increase. Several studies have demonstrated differences in outcomes after TKA in patients of varying ethnicities. In a study of a Northeastern United States suburban cohort, Kamath et al demonstrated that African-Americans had worse 2-year Knee Society Scores (KSS) [5]. In addition, Ibrahim et al survey of veterans revealed that both non–infection related and infection-related complications after knee arthroplasty were higher among black patients compared with white with a relative risk (RR) of 1.5 and 1.42 respectively [6].

In addition, the varying functional demands of patients with different ethnicities may affect their severity of osteoarthritis. From the cohort study conducted among people aged 60 years or older in Beijing [7], prolonged squatting at 25 years of age (>1 h per day) was a common activity and was found to be a strong risk factor for OA of the tibio-femoral joint of the knee and this activity accounted for a substantial proportion of the difference in knee OA prevalence between Chinese subjects in Beijing and white subjects participating in the Framingham OA study [8].

Despite the growing interest and literature in the role of ethnicity in outcomes after TKA, there is currently limited literature relating to an Asian population. To the best of our knowledge, there are limited studies analysing the role of ethnicity in preoperative and postoperative knee function in an Asian community. Singapore is a developed nation located in South East Asia with a population of 5 million that comprises of three major ethnicities, namely, Chinese (76% of total population in Singapore), Malay (14%), and Indian (8%) [9]. The GDP of Singapore ranks among the highest in Asia with good access provided to quality healthcare, thus enabling meaningful comparisons between their healthcare statistics and those in developed Western nations. We aim to study the effect of ethnicity on outcomes following total knee arthroplasty in a multi-ethnic, developed Asian population and also hope that our study provides a useful model for future comparisons in other Asian populations. The results will be clinically relevant in managing patient expectations in an Asian population and has implications with regards to the interpretation of outcome studies in an Asian population.

Materials and Methods

From January 2006 to May 2009, 368 patients who underwent elective TKA had their preoperative data and functional scores collected prospectively. Patients from a single surgeon, the senior author of the paper, were selected for consistency of surgical technique and postoperative care. Our series of patients were sequential and were referred for symptomatic osteoarthritis from

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the primary healthcare services to the senior surgeon of the study. Surgery was offered when patient had failed conservative therapy which included analgesia, physiotherapy, intra-articular injections and/or arthroscopic debridement. Our institutional review board approved the study.

All patients underwent unilateral TKA by a single surgeon and all patients had tourniquet applied to the operated limb throughout the course of the surgery. TKA was performed in standard fashion for all patients. The medial parapatellar approach was used for patients with varus knees and the lateral parapatellar approach for those with valgus knees. No patellar re-surfacing was performed. Postsurgical drains were inserted for all patients and removed on either postoperative day 2 or when the drainage was less than 70 mL, whichever occurred earlier. We excluded patients of ethnicity other than Chinese, Malay or Indian in our study to focus our analysis.

All patients received standardized postoperative care, which included appropriate analgesia, pneumatic calf pumps, continuous passive motion from first postoperative day and daily physiotherapy assessment. All patients began ambulation on the second postoperative day. None of the patients received oral chemoprophylaxis against VTE. The range of motion of each knee was documented daily by the physiotherapist using a goniometer. The patients were further evaluated with the Knee Society Score [10], SF-36 questionnaire [11] and the Oxford Knee score [12] at six-month and two-year intervals in addition to preoperative demographic data including BMI, CCI, diabetes status, and tobacco use. The Oxford Knee Score is a questionnaire comprising of 12 items on daily activities and each item was scored from 1 to 5, with 1 representing best outcome/least symptoms. Scores from each item were subsequently added so the global score was from 12 to 60 with 12 being the best outcome. Complications, such as infection or need for revision surgery, also were recorded.

The improvement in functional scores over time was analysed via repeated measures ANOVA (analysis of variance), whereas the differences in functional scores between the three different ethnicities were analysed via one-way ANOVA with a *P*-value of less than 0.05 considered significant. All statistics were calculated with SPSS1 Version 17.0 (SPSS Inc, Chicago, IL, USA).

Results

Of the 368 patients included in our study, 89.1% (328) were Chinese, 5.7% (21) were Malay and 4.1% (15) were Indian (Table 1). This ethnic ratio was similar to those found in the study conducted by Joshy et al on the Singaporean population [13]. The proportion of female patients was not significantly different between the 3 races, with females comprising 80.4% (296) of the patients who underwent TKA. The inordinately higher rate in females is likely due to greater utilization and life expectancy on top of higher osteoarthritis prevalence in female patients and is similarly reflected in studies of Asian patients [14]. There was no statistically significant difference between the rates of diabetes between the 3 groups.

Table 1

Preoperative Variables	Chinese (n = 328)	Malay (n = 21)	Indian (n = 15)	*P*-Value
Age	66.1 ± 7.6	62.0 ± 5.3	65.9 ± 8.2	.054
Gender				
Male	60 (18.3%)	7 (33.3%)	4 (26.7%)	
Female	268 (81.7%)	14 (66.7%)	11 (73.3%)	
BMI	27.9 ± 4.7	30.4 ± 5.0	31.5 ± 4.5	<.005
SF-36 PCS	31.4 ± 10.8	24.6 ± 8.7	32.2 ± 10.6	.019
SF-36 MCS	50.1 ± 10.6	51.7 ± 9.6	47.2 ± 7.4	.442
OKS	35.9 ± 7.8	40.3 ± 11.0	39.2 ± 9.3	.015
KSS	34.0 ± 18.5	27.8 ± 18.7	29.0 ± 18.7	.213

Malays tend to be younger (62.0 ± 5.3) at time of surgery compared to Chinese (66.1 ± 7.6) and Indian (65.9 ± 8.2) patients ($P = 0.05$) and the body mass index of Chinese (27.9 ± 4.7) was lower than Malay (30.4 ± 5.0) and Indian (31.5 ± 4.5) patients ($P < 0.005$).

Malays have the lowest preoperative SF-36 physical component score (PCS) (24.6 ± 8.7) compared to Chinese (31.4 ± 10.6) and Indian (32.2 ± 10.6) patients ($P < 0.05$). However, there was no statistically significant difference in SF-36 mental component scores (MCS). Malay (40.3 ± 11.0) and Indian (39.2 ± 9.3) patients had less favourable OKS than Chinese (35.9 ± 7.8) patients ($P < 0.05$).

All 3 ethnic groups achieved statistically significant improvement in OKS at 6 months of follow-up: Chinese from 35.9 ± 7.8 to 21.5 ± 7.2 ($P < 0.0001$), Malays from 40.3 ± 5.6 to 22.8 ± 7.0 ($P < 0.0001$) and Indians from 39.2 ± 9.3 to 21.7 ± 7.8 ($P < 0.0001$). This improvement is sustained at 2 years follow up and reflected in the SF-36 PCS and KSS (Table 2). Chinese patients had statistically significant improvement in SF-36 MCS and although similar improvements in Malay and Indian patients did not reach statistical significance, this is likely due to smaller sample sizes in these groups which we acknowledge as a limitation. The outcomes between the 3 ethnic groups after TKA did not differ significantly. We detected 1 post-operative complication of TKA revision in a Chinese lady within 1 year of surgery and no mortalities.

Discussion

The role of ethnicity in preoperative as well as postoperative outcomes in patients undergoing TKA has been studied in both the US and UK. Lavernia et al demonstrated that Hispanic and Black patients reach arthroplasty surgery with lower preoperative functional and health status [15] and have suggested that cultural and behavioural factors may account in part for a delay in seeking surgical intervention. Joshy et al echoes this trend in their study of Asian and Caucasian patients undergoing TKA in a UK community, demonstrating that the mean preoperative knee function score in Asian patients was 32.5, compared with 45.0 in Caucasians [13]. The differences in preoperative function between ethnicities stimulate further study into both the health seeking behaviour and natural progression of osteoarthritis in different races, and may potentially guide the orthopaedic surgeon in tailoring their management to suit the characteristics of varying ethnicities.

We acknowledge certain limitations in our study. Firstly, although the differences between the gender ratios were not statistically significant, we did not stratify the groups further according to gender to preserve the power of the study, which may have concealed subtle differences in the sub-groups. In addition, the differences in socio-economic status may act as a confounder and should be controlled in

Table 2

	Preoperative	6 months	2 years	*P*-value
Chinese				
PCS	31.4	44.0	48.0	<0.0001
MCS	50.1	53.8	54.0	<0.0001
OKS	35.9	21.5	19.0	<0.0001
KSS	34.0	79.6	84.1	<0.0001
Malay				
PCS	24.6	41.6	46.3	<0.0001
MCS	51.6	55.4	57.1	0.155
OKS	40.3	22.8	20.5	<0.0001
KSS	27.8	77.4	83.1	<0.0001
Indian				
PCS	32.2	39.0	49.5	<0.0001
MCS	47.2	48.3	51.9	0.447
OKS	39.2	21.7	19.9	<0.0001
KSS	29.0	78.7	84.5	<0.0001