

Determinants of willingness to pay for hip and knee joint replacement surgery for osteoarthritis

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Objectives. To determine whether patients with osteoarthritis (OA) would be willing to pay for joint replacement and whether patient characteristics or health outcomes, including pain, physical function and health-related quality of life, were related to willingness to pay (WTP).

Methods. Patients who had undergone primary total hip replacement (THR) or total knee replacement (TKR) for OA completed a disease-specific questionnaire (Western Ontario and McMaster: WOMAC index), a generic measure of health status (Medical Outcome Study Short Form-36: SF-36) and an Evaluation Questionnaire to measure WTP and satisfaction with the replacement.

Results. Responses were obtained from 109 (77%) THR patients and 129 (72%) TKR patients. Mean age of respondents was 67 yr for THR (47% female) and 73 yr for TKR (60% female). Overall, 85% of patients responded to the WTP question. Of the THR patients, 71% were willing to pay something, 11% were not willing to pay anything and 18% did not answer the question. For TKR patients these figures were 70, 16 and 14% respectively. However, of those who responded to the WTP question, only 25% of the THR patients and 18% of the TKR patients indicated they would be willing to pay the actual current average cost of the operation in Australia (\geq A\$15 000). A lower postoperative pain score (as measured by the WOMAC index) was a significant predictor of WTP for both THR and TKR patients. Income also significantly predicted WTP in THR patients but not in TKR patients. The other significant predictors for TKR patients were older age, having private health insurance and willingness to recommend joint replacement to others.

Conclusions. Willingness to pay was a measure that was understandable and acceptable to patients, most of whom were willing to pay something. There was a high correlation between WTP, good health outcomes and patient satisfaction, pain relief being the dominant determinant.

KEY WORDS: Willingness to pay, Osteoarthritis, Hip replacement, Knee replacement.

Introduction:

Joint replacement is among the most commonly performed operations in the developed world, and numbers are expected to increase as the population ages. In the Australian health-care system, the main cost of joint replacement surgery is covered by the Commonwealth Government Medicare universal health-care scheme, Veteran's Affairs or private health insurance. In the financial year 1997–98, joint replacement was estimated to cost in excess of A\$13.5 million. While joint replacement is known to be cost-effective, difficult resource allocation decisions must be made in the context of limited health-care funding. For example, relative cost–effectiveness ratios of a range of interventions may be required in order to inform policy decisions relating to the expansion of programmes. Assessing patients' willingness to pay (WTP) for joint replacement may provide further information to contribute to these decisions. WTP can be used to assess the value to society of a range of services.

WTP studies have been used mainly in the environmental field [1] and have been used recently to value changes in health status [2, 3]. It is commonly argued that the best way to value human life is by the WTP approach [4]. Thompson [5] assessed WTP for a hypothetical cure for arthritis and found that WTP was strongly correlated with functional impairment.

No gold standard exists for the measurement of WTP. Methods include the 'bidding game', in which respondents are offered an amount and the bid is raised or lowered until the amount they are willing to pay is reached; the 'binary response' method, in which only one bid is presented and respondents indicate whether or not they accept that amount; and the 'checklist' method, in which a range of prices is presented and respondents indicate in which category within this range the amount they are willing to pay falls. This last method is suitable for self-completed questionnaires and does not suffer from the possibility of starting-point bias.

The aim of this study was to investigate WTP for joint replacement for osteoarthritis in terms of whether patients who had undergone the procedure would be willing to pay something or nothing. In addition, patient-centred outcomes [Western Ontario and McMaster (WOMAC) Osteoarthritis Index, Medical Outcome Study Short Form-36 (SF-36) Health Survey, and satisfaction with the outcome of the procedure] were investigated to explore their inter-relationships with WTP and to identify the determinants of WTP.

Methods:

Patients

Patients undergoing primary total hip replacement (THR) or total knee replacement (TKR) surgery for osteoarthritis at three Sydney hospitals between April 1994 and December 1995 were eligible. Patients covered by Government-funded Medicare, Veteran's Affairs and private health insurance funds were included.

Questionnaires

Questionnaires were mailed to eligible patients approximately 2–3 yr after their TKR or THR. These questionnaires consisted of a disease-specific questionnaire (WOMAC Osteoarthritis Index), a generic measure of health status (SF-36) and an Evaluation Questionnaire developed specifically for this study to measure WTP and satisfaction with the replacement.

WTP was determined by the checklist method. Respondents were then asked to indicate in which category the amount they would pay falls. Eight categories, starting with 'nothing', then 'up to A\$4999' and 'A\$5000 to A\$9999', then in A\$5000 increments to 'more than A\$30 000'. The question asked respondents to consider how much they would realistically be willing to pay out of their own pocket for their THR or TKR, assuming there was no coverage from Medicare or private health insurance.

Satisfaction with the replacement was asked directly ('How do you feel about the results of your hip/knee replacement?') and indirectly. The indirect method aimed to determine whether the behaviour reported by the respondents indicated satisfaction. The questions included whether they would still have the joint replacement if they could go back in time, whether they would be willing to have another joint replaced if it was warranted, and whether they would recommend joint replacement to others.

As income is commonly thought to affect WTP, respondents were asked their annual household income. Eight categories were given and, in order to minimize offence to the respondents, the respondents were instructed that this question was optional.

The Evaluation Questionnaire also included questions to obtain general information such as employment status and the effect of the joint replacement on family relationships.

Statistical analyses

For the analyses reported here, there were two categories of WTP: willing to pay something and willing to pay nothing. Similarly, there were two categories of income: <A\$20 000 and \geq A\$20 000. These categories correspond to the income of a couple receiving the pension.

For the continuous variables measured in the WOMAC index and the SF-36 questionnaire, independent samples *t*-tests were conducted to compare the means of the groups. For the categorical variables in the Evaluation Questionnaire, χ^2 tests were conducted.

Using the results of the univariate analyses, logistic regression analyses were performed with WTP as the dependent variable. Logistic regression analyses were performed separately for THR and TKR patients. At each stage, non-significant variables were removed in a stepdown fashion.

Regression analyses with WTP as the dependent variable and the eight scales of the SF-36 as the independent variables were also performed. Only General Health and Social Function remained as significant predictors of WTP, so they were used in subsequent models. A similar analysis was performed with the three WOMAC index scales, Pain remaining as the only significant independent predictor.

As they were related, Income (<A\$20 000 and \geq A\$20,000) and Employed (yes/no) were included as independent variables in the regression analysis. Income remained as the significant predictor of WTP, so it was used in the full model.

For all analyses, a significance level of 0.05 was used to assess differences between groups. Analyses were conducted using Statistical Packages for the Social Sciences (SPSS) version 8.0 for Windows.

Results:

Questionnaires were mailed to 142 people who had had THR and 179 people who had had TKR. Responses were obtained from 109 people who had had THR (77%) and 129 people who had had TKR (72%). The mean follow-up time since the joint replacement was 2.8 yr (range 2–4 yr). Due to administrative changes, responses were obtained both 2 and 3 yr after surgery from 29 TKR and 23 THR patients. Responses at these two times were compared, and no significant differences were found in terms of WTP, WOMAC and SF-36 scores, satisfaction, income or private health insurance. Therefore, the responses 3 yr after surgery were included in the analyses for these patients.

The research team was notified of the deaths of 12 people who were eligible to complete the questionnaires; another 25 had moved and no forwarding address was available. Four people indicated that their English was too poor to complete the questionnaires. The remaining non-respondents were those who did not return the questionnaires despite attempts to contact them by both mail (reminder letters) and telephone. It is not known whether these people had moved and did not receive the questionnaires, whether they had died, or whether they simply did not wish to participate in the study.

As shown in Table 1*, there was considerable difference between the characteristics of the THR and TKR groups. Respondents undergoing TKR were significantly older than those undergoing THR, were more likely to be receiving benefits or a pension, less likely to have private health insurance, more likely to report that they suffered from another medical condition, and less likely to be employed.

TABLE 1. Demographic characteristics of respondents

Characteristic	THR	TKR	Significance
No. of respondents	109	129	
Response rate (%)	77	72	
Females (%)	46.8	59.7	$\chi^2 = 3.956, P = 0.047$
Mean age (yr)	67.23	73.48	$t_{234} = -4.839, P = 0.000$
Mean time since replacement (yr)	2.89	2.84	$t_{236} = 0.935, P = 0.351$
Employed (FT/PT ^a /casual) (%)	33.3	8.1	$\chi^2 = 23.186, P = 0.000$
Receive pension (%)	38.0	68.5	$\chi^2 = 21.761, P = 0.000$
Have private health insurance (%)	76.1	58.7	$\chi^2 = 7.995, P = 0.005$

Report having other medical condition (%)	51.0	71.0	$\chi^2 = 11.187, P = 0.004$
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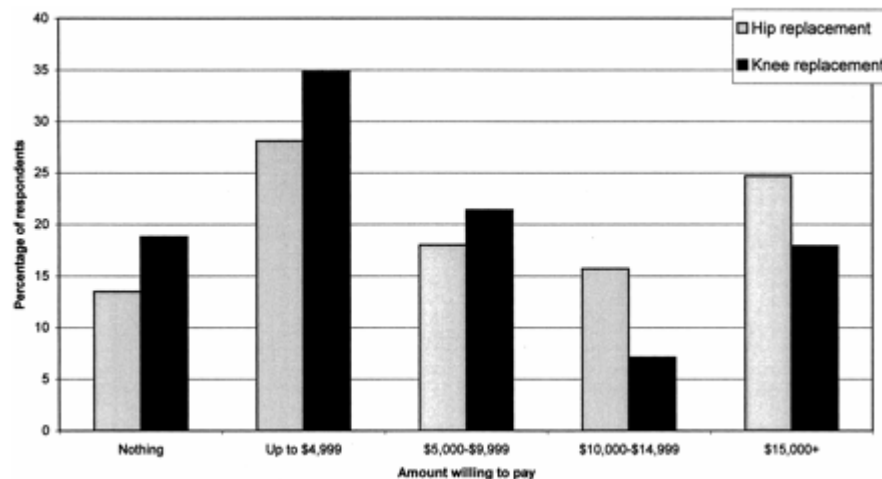
^aFT, full-time; PT, part-time.

For both THR and TKR, the mean overall age of non-respondents did not differ significantly from that of respondents, nor did the proportion of females differ significantly between responders and non-responders. The preoperative health status (WOMAC index and SF-36 questionnaire) was available for 70 non-respondents to the postoperative questionnaires. The only significant difference between respondents and non-respondents in terms of preoperative health status was for TKR patients in the SF-36 scale of General Health, for which non-respondents reported significantly worse scores than respondents.

Responses to WTP question

Responses to the optional question on WTP for joint replacement were obtained from 82% of the THR patients and 86% of the TKR patients. No significant differences were found between those who completed the question and those who did not, in terms of age, sex, income or responses to the Evaluation Questionnaire, WOMAC index or SF-36 questionnaire.

Seventy-one per cent of the THR patients were willing to pay something for a joint replacement and 11% were not willing to pay. Eighteen per cent did not answer the question. Twenty-five per cent of those who responded to the question were willing to pay in excess of A\$15 000, which is the current Australian hospitalization cost of joint replacement [6] (Fig. 1+).



Of the TKR patients, 70% were willing to pay something and 16% were not willing to pay. Fourteen per cent did not answer the question. Eighteen per cent of those who responded to the question were willing to pay in excess of A\$15 000 (Fig. 1+).

WOMAC and SF-36

Preoperative WOMAC and SF-36 scores were available for approximately 74% of the TKR patients and 61% of the THR patients. Analyses of the preoperative scores for these patients showed no significant difference between the THR and TKR groups in

any of the WOMAC or SF-36 scales (data not shown). However, comparison of postoperative WOMAC scores between the THR and TKR patients showed that, at the postoperative follow-up, the THR patients reported better health status than the TKR patients in all three scales. A similar comparison of SF-36 scores showed that the THR patients were significantly better in all scales except General Health and Mental Health (data not shown).

For both the THR and the TKR patients, significant improvements were seen in all WOMAC scales. For the TKR patients, significant improvements from before to after surgery were found in all SF-36 scales except General Health, Role Emotional and Mental Health (no significant difference was found in these scales). For the THR patients, significant improvement was shown in all SF-36 scales except General Health (no difference was found in this scale) (data not shown).

Relationships between WOMAC scores, SF-36 scores and WTP Knee replacements.

Difference scores between before and after surgery were calculated and compared for those who were willing to pay something and those who were willing to pay nothing. A significant difference in improvement was found between the two groups in General Health ($P = 0.025$) and Role Emotional ($P = 0.018$), those who were willing to pay something showing greater improvement from their presurgical state. No significant difference was found in the remaining six scales. Similarly, no significant difference was found in WOMAC improvement scores for any of the three scales.

At the postoperative follow-up, in all scales of the SF-36, respondents who indicated they would be willing to pay something scored significantly higher than those not willing to pay, indicating that those who were willing to pay were in a better health state 2–3 yr after surgery than those not willing to pay. On the WOMAC index, those willing to pay something reported significantly better values for pain, stiffness and physical function than those not willing to pay.

Hip replacements.

Again, difference scores between before and after surgery were calculated and a comparison of SF-36 and WOMAC improvement scores was made between those willing to pay something and those willing to pay nothing. No significant difference in improvement was seen in any of the scales of the SF-36 or WOMAC between the two groups.

Postoperatively, respondents who indicated they would be willing to pay something for their THR scored significantly higher on the SF-36 scales of Physical Function, Bodily Pain, General Health, Vitality and Social Function, and the three WOMAC scales of Pain, Stiffness and Physical Function.

Relationships between other variables and WTP

Results of bivariate analyses with WTP for THR and TKR are shown in Table 2+ and correlations between WTP and the variables are shown in Tables 3+ and 4+. For both TKR and THR, significant correlations were found between WTP and income, having private health insurance, satisfaction and a lower current WOMAC Pain score.

TABLE 2. Hip and knee replacements: relationship with WTP

		TKR		THR	
		No. patients willing to pay something (%)	<i>P</i> value	No. patients willing to pay something (%)	<i>P</i> value
Satisfied	Yes	88.0	<i>P</i> = 0.000	89.5	<i>P</i> = 0.035
	No	46.7		33.3	
Rating now	Better	84.8	<i>P</i> = 0.007	89.7	<i>P</i> = 0.006
	Same/worse	53.8		25.0	
Have over ^a	Yes	86.5	<i>P</i> = 0.000	88.6	<i>P</i> = 0.016
	No	41.7		0 (<i>n</i> = 2)	
Have another joint replaced	Yes	85.6	<i>P</i> = 0.017	91.4	<i>P</i> = 0.017
	No	60.0		33.3	
Recommend to others	Yes	85.9	<i>P</i> = 0.003	87.8	
	No	42.9		(<i>n</i> = 0)	
Income	< A\$20 000	72.3	<i>P</i> = 0.008	71.1	<i>P</i> = 0.000
	≥ A\$20 000	94.4		98.0	
Employed	Yes	90.0	<i>P</i> = 0.482	87.1	<i>P</i> = 0.931
	No	81.0		86.4	
Private health insurance	Yes	88.9	<i>P</i> = 0.014	92.6	<i>P</i> = 0.005
	No	70.2		69.6	

^aIn reply to the question ‘If you could go back in time, do you think you would have had this joint replacement?’.

TABLE 3. Correlations with WTP: knee replacement

	WTP	Income	Insurance	Employed	Satisfaction	Pain
WTP						
Income	0.266 ^b					
Insurance	0.238 ^a	0.368 ^b				
Employed	0.067	0.290 ^b	0.245 ^b			
Satisfaction	0.375 ^b	- 0.009	- 0.021	0.041		
Pain	- 0.336 ^b	- 0.161 ^a	- 0.011	- 0.023	- 0.422 ^b	

^aSignificant at 0.05 level.

^bSignificant at 0.01 level.

TABLE 4. Correlations with willingness to pay: hip replacement

	WTP	Income	Insurance	Employed	Satisfaction	Pain
WTP						
Income	0.396 ^b					
Insurance	0.295 ^b	0.393 ^b				
Employed	0.009	0.355 ^b	0.219 ^a			
Satisfaction	0.308 ^b	0.091	0.167	0.003		
Pain	- 0.428 ^b	- 0.177	- 0.085	- 0.144	- 0.384 ^b	

^aSignificant at 0.05 level.

^bSignificant at 0.01 level.

Regression analyses

To explore multivariate relationships, a series of logistic regressions were performed with WTP as the dependent variable.

Regression analysis: knee replacement.

As they were related, satisfaction and willingness to recommend joint replacement to others were entered into a model with only willingness to recommend replacement remaining as a significant independent predictor of WTP. Willingness to recommend replacement was therefore used in the full model for TKR responses. The results of the regression analysis of TKR respondents are shown in Table 5

. TABLE 5. Predictors of WTP (independent variable) for TKR patients

Variables entered in full model (<i>n</i> = 102)	Final model odds ratio	95% confidence interval	<i>P</i>
Age	1.14	1.03–1.25	0.009
Private health insurance ^a	12.61	2.43–65.31	0.003
Recommend replacement ^a	42.88	3.05–602.50	0.005
Pain	0.80	0.68–0.94	0.007
Income ^b			
Sex ^c			
General Health			
Social Function			

^a0 = no; 1 = yes.

^b0 = < A\$20 000; 1 = > A\$20 000.

^c0 = female; 1 = male.

As shown in Table 5+, the strongest predictor of WTP for a TKR was a willingness to recommend replacement to others, followed by having private health insurance, older age and lower WOMAC pain score at the time of completing the questionnaires. The model fitted the data well, using the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 5.53$, 8 d.f., *P* = 0.70)

Regression analysis: hip replacement.

As with the TKR model, satisfaction and willingness to recommend replacement to others were entered into a model. Satisfaction remained as a significant independent predictor of WTP so was used in the full model for THR responses. The results of the regression analysis of THR responses are shown in Table 6+.

TABLE 6. Predictors of WTP (independent variable) for THR patients

Variables entered in full model (<i>n</i> = 102)	Final model odds ratio	95% confidence interval	<i>P</i>
Income ^a	19.87	2.20–179.30	0.008
Pain	0.75	0.62–0.92	0.005
Satisfaction ^b			

Private health insurance^b

Age

Sex^c

General Health

Social Function

^a0 = < A\$20 000; 1 = > A\$20 000.

^b0 = no; 1 = yes.

^c0 = female; 1 = male.

As shown in Table 6*, income was the strongest predictor of WTP, followed by pain (measured on the WOMAC index; a higher score corresponds to a worse health state). The model fitted the data well using the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 10.35$, 8 d.f., $P = 0.17$).

Discussion:

Total joint replacement has been shown in numerous studies to be beneficial for patients and successful in restoring function and relieving pain [7, 8], but no published studies have investigated WTP for joint replacement. The results of this study are in accordance with published outcome studies showing that both THR and TKR patients improved significantly from before to after surgery. The THR patients showed a better outcome than TKR patients in terms of pain and function, a result similar to that found in previous studies of joint replacement [9, 10].

The state of the operative joint at follow-up was the determining factor for WTP, not the change from preoperative to postoperative status. The only SF-36 improvement scores that showed a significant association with WTP were for TKR respondents in the scales of General Health and Role Emotional. Similarly, improvement in the operative joint from before to after operation, as measured by the WOMAC index, was not significantly associated with WTP for the THR and TKR respondents.

Pain in the operated joint at the postsurgery follow-up (scored on the WOMAC index) was the only outcome measure that consistently remained significant in logistic regression models. When valuing the benefit of joint replacement, pain relief was a major consideration.

For the THR group, only pain and income were significant predictors of WTP. These were both in the expected direction: people with more pain were less likely to be willing to pay and those with a higher income were more likely to be willing to pay. A positive relationship between the amount people are willing to pay and their level of income has been documented [11].

For the TKR group, postoperative pain, willingness to recommend replacement to others, having private health insurance and age were significant predictors. It is interesting to note that for this group income was not a significant predictor of WTP. This may be due to the fact that almost 70% of this group were pensioners and had limited income. An unexpected finding was that older respondents undergoing TKR were more likely to be willing to pay. The reason for this is unknown, but may be related to the overall good health of this group. This highlights the view that older age should not be a barrier to joint replacement. Recommending a replacement to others was a significant predictor of WTP for TKR patients, rather than satisfaction, as found in the THR model.

Pain scores for the affected joint were significantly better after surgery for both TKR and THR respondents and contributed significantly to WTP. Thompson [5], in his study of WTP for a hypothetical cure for rheumatoid arthritis, found that pain was an important consideration in estimating the maximum risk people would take, but impairment in function was the main concern in estimating WTP.

For both THR and TKR, univariate analyses with WTP were all in the expected direction. People who were satisfied, who would recommend replacement and who would have another joint replaced were more likely to be willing to pay. This suggests that WTP is a sound measure of the benefits of joint replacement.

Underlying expectations of the health-care system may play a role in the value respondents give for their WTP. This study did not obtain information as to what respondents' expectations were. The inclusion of a question asking their view on, for example, whether the government should pay for health care, may have provided a clue to the reasons behind the response of those not willing to pay for joint replacement.

One of the main objections to valuing benefits by the WTP method is that the amount stated is thought to be dependent on income. This study confirms that income was significantly associated with WTP both on univariate analysis and in combination with other variables in logistic regression models. This study analysed WTP simply as 'something' or 'nothing'. Further analyses are warranted to determine whether the amount respondents are willing to pay for joint replacement increases with increasing income, or varies with prior knowledge of real costs. Although the majority were willing to pay something, only approximately 20% would be willing to pay the current average cost of the operation in Australia.

The respondents in this study did not pay the full cost of their replacement—it was covered by health insurance (either publicly funded Medicare or private health funds). Almost 85% of the respondents completed the WTP question, suggesting that these respondents were able to think in terms of WTP as a measure of benefit, even though they had no experience with paying for the procedure. It would be of interest to combine the level of acceptance of WTP with a health utility measure such as EuroQol-5 Domains, as such a study would provide information on the relationship between quality of life and WTP.

Conclusions:

Further evaluation would be required before WTP could be used as an outcome measure; it may be too closely linked to ability to pay to become a universal measure. In this study WTP was an acceptable means of measuring the benefit of joint replacement and most were willing to pay something. There was a high correlation between WTP, good health outcomes and patient satisfaction, pain relief being the dominant determinant.

Acknowledgements:

This study was funded by grants from the National Health and Medical Research Council. We are grateful to the secretarial staff of the orthopaedic surgeons for their assistance with recruitment to this study, and to the patients, who have been so cooperative.

Notes:

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Submitted 4 October 1999; revised version accepted 9 June 2000