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Effect of comorbidity on quality of life of male veterans with prevalent primary total knee arthroplasty

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Abstract

This is a study of the impact of specific and overall comorbidity on health-related quality of life (HRQoL) in men with primary total knee arthroplasty (TKA). In a population-based sample of male veterans who responded to a cross-sectional survey using the validated short-form 36 for veterans (SF-36 V) and had undergone primary TKA prior to survey, eight SF-36 V domain and two summary scores (physical and mental component (PCS and MCS) summary) were compared using multivariable-adjusted multiple linear regressions between patients with and without five comorbidities—chronic obstructive pulmonary disease (COPD)/asthma, diabetes, depression, hypertension, and heart disease. Analyses were adjusted for age, five comorbidities, and time since TKA. Two hundred ninety-three male patients constituted the analytic set with mean (SD) age of 70.3 (8.8) years; 97% were Caucasian and mean (SD) duration since TKA was 2.1 (0.7) years. COPD/asthma was associated with significantly lower adjusted MCS (mean±standard error of mean, 47.1±0.7 vs. 43.1±1.2; $p\leq 0.001$) and PCS (30.1±0.6 vs. 27.7±1.0; $p<0.05$), depression with significantly lower MCS (48.9±0.7 vs. 37.6±1.2; $p\leq 0.001$) but not PCS, hypertension with significantly lower MCS (47.0±0.7 vs. 44.3±1.0; $p<0.05$) but not PCS, and heart disease with significantly lower MCS (47.4±0.8 vs. 44.2±0.9; $p\leq 0.001$) and PCS (30.5±0.7 vs. 28.1±0.8; $p<0.05$). Diabetes was not associated with lower MCS or PCS. The overall number of comorbidities was associated with lower MCS and PCS ($p\leq 0.001$ for both). Medical and psychiatric comorbidity impacts physical and mental/emotional HRQoL in patients with primary TKA. The impact differs by comorbidity. Higher comorbidity load negatively impacts both physical and mental/emotional HRQoL.

Keywords

Comorbidity; Health-related quality of life; HRQoL; Knee arthroplasty; Quality of life; Total knee arthroplasty

Total knee arthroplasty (TKA) is associated with significant improvement in pain, function, and health-related quality of life (HRQoL) [1]. Previous studies (mostly consisting of small samples and often lacking multivariable adjustment) investigating whether medical comorbidity impacts the HRQoL in patients with TKA reported contradictory findings. Higher

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comorbidity was associated with poorer function [2–4] or worse pain outcomes [3,5,6] in some studies but not in others [2,7–13]. Rather than examining the impact of individual comorbidity on TKA outcomes, most previous studies used Charlson Index [7,8], Charnley class [4,5,9], or other additive scores [2,3,8,10–13]. While these additive scores provide a good means for adjusting for common diseases when another predictor is of interest, they do not allow us to examine the impact of specific diseases on TKA outcomes.

Few studies have examined the impact of specific comorbidities on outcomes after TKA. Diabetes was associated with painful or stiff knee 1-year post-TKA in one case–control study [6] but not in another [14]. Diabetes was associated with worse knee and function scores 8 years post-TKA in 51 patients [15], associated with better knee and pain scores 4 years post-TKA in 291 patients [16], but not associated with physical function scores 1-year post-TKA in 165 patients [17], and not associated with knee, pain, and function scores 4.5-year post-TKA in 222 patients [18]. Chronic lung disease was associated with painful or stiff knee [6] but not with function 1-year post-TKA [17]. Depression was associated with more pain 5-years post-TKA [19] but not associated with function 1-year post-TKA [17]. Hypertension and heart disease were not associated with risk of painful or stiff knee after TKA [6] or with function 1-year post-TKA [17]. In summary, the published studies so far suggest that diabetes may or may not impact pain, stiffness, or function post-TKA; chronic lung disease and depression impact pain but not function outcomes post-TKA; and hypertension and heart disease do not impact these outcomes post-TKA. Just how these comorbidities impact the various domains of HRQoL, including physical and mental/emotional HRQoL, has not been studied well.

We recently reported that HRQoL scores are lower and comorbidity scores higher in veterans with knee arthroplasty compared to veterans without arthroplasty [20]. We wanted to examine the effects of specific comorbidities on HRQoL in male veterans living with primary TKA in a population-based sample. Specifically, we evaluated whether (1) pulmonary disease, diabetes, hypertension, and heart disease were each significantly associated with poorer physical HRQoL and (2) depression was significantly associated with poorer mental HRQoL but not physical HRQoL.

Materials and methods

Source population

The source population consisted of all the participants in the VISN-13 Veterans Quality of Life Study [21] (details previously published). Many studies have examined disease subgroups from this dataset [22–24]. This included all veterans that utilized health care services from Veterans Affairs (VA) health care system facilities in three states (Minnesota, North Dakota, and South Dakota) and had a mailing address ($n=70,508$). The study was approved by the Minneapolis VA Institutional Review Board.

Data sources

Survey—The cross-sectional self-administered mailed survey queried demographics (age, gender, race, etc.), self-reported physician-diagnosed comorbidities (chronic obstructive pulmonary disease (COPD)/asthma, diabetes, depression, hypertension, and heart disease), and health-related quality of life (HRQoL) with the validated short-form 36 for veterans (SF-36 V) [25–27]. SF-36 V is a modified version of the validated SF-36® [28–31] with 36 questions, where role physical and role emotional domains were changed from dichotomous to five-choice ordinal scales to avoid floor and ceiling effects, similar to version 2.0 of SF-36®, scored similarly [32]. The 36 questions on SF-36 V are summed into eight domains: physical functioning (PF), role physical (role limitations due to physical problems, RP), bodily pain (BP), general health (GH), energy/vitality (VT), social functioning (SF), role emotional (role

limitations due to emotional problems, RE), and mental health (MH, range from 0 (worst) to 100 (best)). Physical and mental component summary scores are obtained in a standard fashion from the eight subscale scores and represent physical and mental/emotional HRQoL, respectively (mean, 50; standard deviation, 10 for US population).

VA clinical databases—The International Classification of Diseases, ninth version (ICD-9) code, or Common Procedure Terminology (CPT) code for TKA prior to the survey was obtained from the National VA inpatient surgery (available from 1988 to 1998) and outpatient patient care databases (available from 1991 to 1998), shown to be valid for most common [33] and specific diagnoses [34,35].

Study cohort

The study cohort consisting of survey respondents ($n=40,508$; 58% response rate) who had an ICD-9 or CPT code for primary TKA, were men (since 95% of cohort were male subjects) and had complete data on comorbidities and SF-36 V PCS and MCS ($n=293$). Primary TKA patients who also underwent hip arthroplasty or contralateral TKA or revision surgery were excluded from the analyses in order to restrict our analyses to patients with only one primary TKA.

Study outcomes

Outcomes of this current study were the eight SF-36 V domain and two summary scores (PCS and MCS) in veterans with primary TKA.

Clinically meaningful differences were based on definitions for minimal clinically important differences (MCID) of five to ten points in domain and 2.5 to five points in summary component scores of SF-36 derived from published randomized controlled trials in rheumatic conditions [36–39]. The MCID values represent the minimum improvement that patients perceive to be important and thus offer a reasonable method to compare groups of patients.

Statistical analyses

Multivariable-adjusted (age, time since primary TKA, and the five comorbidities) comparisons of SF-36 domain and summary scores between patients with and without comorbidity were performed with linear regression analyses using least-squares means. Another linear regression model adjusted for age, time since primary TKA, and the total number of comorbidities. All analyses were performed using SAS, version 9.0 (Cary, NC, USA). A p value <0.05 was considered statistically significant.

Nonresponders were patients with prevalent primary TKA who did not respond to the survey or did not provide data on all survey variables of interest (comorbidities, age, time since arthroplasty, and SF-36 V summary score; $n=404$). Nonresponders and responders were compared using t test and chi-square test, as appropriate.

Results

Study population

Two hundred ninety-three veterans with prevalent primary TKA constituted the analytic dataset. The mean (standard deviation (SD)) age was 70.3 (8.8) years; 21% had college education or beyond; 21% were employed; 62% were retired; 97% were Caucasian; and 76% were married. Mean (SD) duration since TKA was 2.1 (0.7) years.

Patients who provided these data differed from nonresponders in being slightly younger (69.2 vs. 71.8, $p=0.004$) and more likely to be married (76% vs. 68%, $p=0.017$). There were no

significant differences in race (96% vs. 97% Caucasian, $p=0.23$) or employment status ($p=0.48$).

Effect of comorbidity on physical and mental HRQoL

Presence of COPD/asthma was associated with statistically significantly lower SF-36 physical functioning, role physical, general health, vitality, role emotional, social functioning, and mental health scores (Table 1). Depression was associated with statistically significant lower scores on all eight SF-36 domains (Table 1). Hypertension was associated with statistically significant lower adjusted scores on bodily pain, role physical, vitality, social functioning, and mental health domain. Heart disease was associated with significantly lower scores on bodily pain, role physical, general health, role emotional, vitality, social functioning, and mental health (Table 1). All these statistically significant differences in SF-36 domain scale scores with each of the conditions also exceeded the MCID of five points, except mental health scores in those with and without heart disease. Diabetes was not associated with any statistically significant differences on any SF-36 domain score.

COPD/asthma and heart disease were each associated with statistically significant lower PCS scores that approached the MCID of 2.5 points, while diabetes, depression, and hypertension were not associated (Table 1). COPD/asthma, depression, hypertension, and heart disease (but not diabetes) were each associated with significantly lower MCS; all differences exceeded the MCID of 2.5 points.

Effect of number of comorbidities on HRQoL

Increasing the number of comorbidities was associated with lower scores on each of the eight SF-36 subscale scores and the two summary scales, PCS and MCS; all differences met/exceeded the MCID thresholds (Fig. 1).

Discussion

In this study of male veterans living with primary TKA, higher comorbidity load was associated with poorer physical and mental/emotional HRQoL, which met/exceeded the MCID. Specifically, chronic lung disease and heart disease were each associated with significantly worse physical and mental/emotional HRQoL (PCS and MCS) and depression and hypertension with significantly worse mental/emotional HRQoL. Diabetes was not associated with worse HRQoL. These are important observations and add to the current literature, considering very few studies have examined the impact of specific comorbidity on HRQoL in patients with primary TKA.

Strengths and limitations

This study included a population-based sample, used a validated HRQoL measure, and adjusted for most common comorbidities. The study population was limited to male veterans (95% of our veteran cohort were male subjects), so findings may not be generalizable to women and to non-veterans. Veterans have much higher comorbidity load than the general population [40] and thus constitute one of the best populations to examine the effect of comorbidity on outcomes. Residual confounding is possible due to other comorbidities (chronic kidney disease, cancer, etc.) and surgical factors. Due to the cross-sectional nature of the study, the relationships noted in this study are associations and do not imply causation; these are hypothesis-generating and not hypothesis-proving observations. Longitudinal cohort studies are needed to confirm these findings. Nonresponse may have biased our findings since nonresponders were slightly older (with higher comorbidity), indicating that there have been slight underestimation of the differences.

Many observations from this study deserve further discussion. First, the association of the number of comorbidities with worse physical and mental/emotional HRQoL confirms previous similar findings of association with poorer pain/function [2–6] but is in contrast to others showing no association [2,7–13]. Interestingly, the mental/emotional HRQoL was impacted far more than physical HRQoL, despite the fact that one psychiatric and four medical comorbidities constituted the summative score.

Second, the association of chronic lung disease with both physical and mental/emotional HRQoL confirms previous observations of its association with painful/stiff knee [6] but is in contrast with lack of its association with function [17]. All three studies adjusted for other comorbidities. This study differed from the earlier negative report [17] in sample size (293 patients at mean 2-year post-TKA vs. 165 patients at 1-year post-TKA), outcome assessed (HRQoL vs. function), study group (men vs. men and women), and setting (population-based vs. single-center clinic-based sample). Our observation of the impact of chronic lung disease on MCS in primary TKA patients is similar to that reported for patients with COPD and of a similar magnitude [41].

Third, the association of heart disease with both physical and mental/emotional HRQoL and of hypertension with mental/emotional HRQoL differs from previous reports of lack of associations with risk of painful or stiff knee [6] or with poorer function post-TKA [17]. Differences in patient population (men at mean of 2-year post-TKA in a population-based sample vs. men and women at 1-year in clinic-based sample), outcome (HRQoL vs. pain/function), and sample size (293 vs. 67 and 165 patients) may underlie differences in results. We are unsure of the reason for lower bodily pain scores in hypertension and heart disease, but this is similar to what has been reported in COPD patients previously [6].

Fourth, the association of depression with mental/emotional HRQoL extends the previous findings of association of depression with more pain [19] and of lower preoperative mental health scores with painful/stiff knee [6] and worse function [42] to HRQoL outcomes. A practical application of this finding is that, in patients with high comorbidity load (especially in patients with depression), a discussion regarding expectations with regards to mental/emotional HRQoL (and perhaps physical HRQoL) should be done preoperatively. Since patient expectations can independently impact patient outcomes and satisfaction [43], a clear understanding of realistic outcomes is likely to improve patient satisfaction.

Lastly, the lack of association of diabetes with HRQoL was interesting and confirms previously reported lack of association with pain, function, and stiffness [14,17,18]. Other studies have reported its association with worse knee and function scores [15] or with better knee and pain scores [16]. Thus, studies of larger cohorts of patients with diabetes are needed to improve our understanding of its impact on outcomes.

In summary, this study found that overall comorbidity load is associated with poorer physical and mental/emotional HRQoL and that specific comorbidity impacted HRQoL in men with primary TKA. A detailed discussion of expected outcomes in patients with high comorbidity load may help in reducing the gap between patient expectation and outcomes following primary TKA.

Key messages

1. Higher comorbidity is associated with worse physical and mental/emotional HRQoL in primary TKA patients.
2. COPD/asthma and heart disease impact physical and mental/emotional HRQoL in primary TKA patients.

3. Depression and hypertension impact mental/emotional but not physical HRQoL in primary TKA patients.

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Fig. 1.

Effect of number of comorbidities (none, one, two, three, or more) on SF-36 V domain and summary scores in men with primary TKA. SF-36 V scores were significantly lower in patients with primary TKA that have higher comorbidity for all eight subscales (all p values < 0.001), PCS (p value < 0.001), and MCS (p value < 0.001). These analyses were adjusted for age, duration since TKA, and five common comorbidities (COPD/asthma, diabetes, depression, hypertension, heart disease). Scores for each domain and summary scale range from 0 to 100 with a higher score indicating better health. PCS and MCS are norm-based with a mean of 50 and standard deviation of 10 for the US general population. *Error bars* represent standard error of the mean. *PF* physical functioning, *RP* role physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social functioning, *RE* role emotional, *MH* mental health, *PCS* physical component summary, *MCS* mental component summary

Table 1

Effect of each comorbid condition on adjusted SF-36 V domain and summary scores ($n=293$) in male veterans with prevalent primary TKA

	COPD or asthma		Depression		Diabetes		Hypertension		Heart disease	
	Mean±SE (p value)		Mean±SE (p value)		Mean±SE (p value)		Mean±SE (p value)		Mean±SE (p value)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
PF	36.2±1.6	28.7±2.6*	36.9±1.6	26.5±2.7***	35.6±1.5	29.6±2.9	35.5±1.7	32.1±2.3	35.4±1.8	32.6±2.0
RP	39.8±1.7	32.7±2.8*	39.9±1.6	32.1±2.8*	37.6±1.6	38.9±3.0	40.1±1.8	34.1±2.4*	40.6±1.9	34.3±2.2*
BP	40.9±1.4	36.7±2.3	42.5±1.4	31.9±2.4***	39.4±1.3	40.9±2.5	42.1±1.5	35.7±2.0*	42.4±1.6	36.1±1.9*
GH	50.0±1.3	41.7±2.2**	51.6±1.3	36.7±2.3***	48.0±1.3	47.0±2.4	49.3±1.4	45.2±1.9	52.8±1.5	41.0±1.8***
VT	41.6±1.4	36.1±2.3*	43.8±1.4	29.4±2.4***	39.0±1.3	43.7±2.4	42.7±1.5	35.7±2.0**	43.6±1.6	35.5±1.0.8***
SF	63.7±1.7	48.5±2.9***	64.8±1.7	44.5±3.0***	60.0±1.7	58.4±3.2	63.3±1.9	53.3±2.4**	61.4±2.0	57.3±2.4
RE	60.0±1.9	51.1±3.2*	62.2±1.9	44.4±3.3***	58.5±1.9	54.7±3.5	59.2±2.1	54.9±2.7	61.1±2.2	52.8±2.5*
MH	67.4±1.2	61.7±2.0*	71.5±1.2	49.7±2.1***	65.6±1.2	67.0±2.2	67.7±1.3	62.7±1.7*	67.7±1.4	63.4±1.6*
Summary scales										
PCS	30.1±0.6	27.7±1.0*	30.0±0.6	27.9±1.0	29.5±0.6	29.1±1.0	30.2±0.6	28.2±0.8	30.5±0.7	28.1±0.8*
MCS	47.1±0.7	43.1±1.2**	48.9±0.7	37.6±1.2***	46.0±0.7	46.3±1.3	47.0±0.7	44.3±1.0*	47.4±0.8	44.2±0.9***

Adjusted for all comorbid conditions, duration since arthroplasty, and age simultaneously. All statistically significant results with p value <0.05 are in italic

COPD chronic obstructive pulmonary disease, *PF* physical functioning, *RP* role physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social functioning, *RE* role emotional, *MH* mental health, *PCS* physical component summary, *MCS* mental component summary

* $p<0.05$;

** $p<0.01$;

*** $p\leq 0.001$