Published in final edited form as:

Arthritis Care Res (Hoboken). 2020 October ; 72(10): 1349–1357. doi:10.1002/acr.24035.

Quality-Adjusted Life-Years Lost Due to Physical Inactivity in the United States Osteoarthritis Population

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Abstract

Objective: Half of the 14 million persons in the US with knee osteoarthritis (OA) are not physically active, despite evidence that physical activity (PA) is associated with improved health. We estimated both the quality-adjusted life-year (QALY) losses in the US knee OA population due to physical inactivity and the health benefits associated with higher PA levels.

Methods: We used data from the Osteoarthritis Initiative and CDC to estimate the proportions of the US knee OA population aged 45+ that are inactive, insufficiently active, and active and their

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Conflicts of interest: EL is involved in research projects with Pfizer, Samumed, Flexion, and Genentech and is a consultant for Regeneron (all <\$10,000). JNK is involved in research projects with Flexion and Samumed and is President of OARSI (all <\$10,000). DJH is a consultant for Flexion, Merck Serono, Tissuegene, and TLCBio (all <\$10,000).

likelihoods of shifting PA level. We used the Osteoarthritis Policy (OAPol) Model, a computer simulation of knee OA, to determine QALYs lost due to inactivity and to measure potential benefits (comorbidities averted and QALYs saved) of increased PA.

Results: Among 13.7 million persons living with knee OA, 7.5 million total QALYs, or 0.55 QALYs/person, were lost due to inactivity or insufficient PA relative to activity over their remaining lifetimes. Black Hispanic women experienced the highest losses, 0.76 QALYs/person. Females of all races/ethnicities had ~20% higher loss burdens than males. According to our model, if 20% of the inactive population were instead active, 95,920, 222,413, and 214,725 potential cases of cancer, cardiovascular disease, and diabetes would be averted, and 871,541 potential QALYs would be saved.

Conclusion: Physical inactivity leads to substantial QALY losses in the US knee OA population. Increasing activity level in even a fraction of this population may have considerable collateral health benefits, potentially averting cases of cancer, cardiovascular disease, and diabetes.

Physical inactivity was named a global pandemic in 2012(1), with 31% of adults physically inactive worldwide.(2) The United States population is particularly inactive; about 10% of adults met the US Department of Health and Human Services' Physical Activity Guidelines for Americans, according to accelerometry data.(3) Even by self-report, 47% of US adults met neither the CDC's aerobic activity nor muscle-strengthening guidelines.(4, 5) Inactivity is a complex public health hazard, as low levels of physical activity (PA) are associated with the development of obesity, cancer, cardiovascular disease (CVD), and diabetes mellitus (DM), which contribute to mortality in the US.(6–10)

As both life expectancy and average body-mass index (BMI) in the US increase, the population with knee osteoarthritis (OA) is rising to >14 million adults.(11) PA has documented benefits in reducing pain and improving mental health in the OA population, specifically.(12–18) It decreases incidence of CVD and DM,(6, 7) which, in a mutually reinforcing cycle, have themselves been shown to exacerbate knee pain(18, 19) and reduce quality of life (QoL) in patients with OA.(20) PA has therefore become a key element of health promotion for persons with OA.(21) Despite this, almost 50% of individuals with knee OA are inactive,(22) and very little funding and infrastructure exist(23) to implement exercise programs for that population.

We sought to quantify both individual and population losses in health-related QoL due to physical inactivity in persons with OA. We describe how population-level estimates of disease burden and losses in QoL would change if various proportions of the OA population increased PA level. This information may help physicians frame the benefits of activity modification and consider those benefits when planning healthcare with OA patients. It may also allow policy-makers to design and fund public health exercise interventions targeting populations that may gain the most health benefits from increasing PA.

Materials and Methods

Analytic Overview

We used the Osteoarthritis Policy (OAPol) Model to estimate health-related QoL losses due to inactivity and insufficient levels of PA in the US population with knee OA, ages 45 and older. We estimated losses both at the individual level and across the entire population of interest, stratified by sex and race/ethnicity.

The PA levels were defined as follows: inactive (0 or 0–10 min/week of moderate-to-vigorous PA (MVPA), based on Osteoarthritis Initiative (OAI)(24) or NHANES derivations(25)), insufficiently active (1–149 or 10–149 min/week of MVPA), and active (> 150 min/week of MVPA), which are consistent with the CDC's Physical Activity Guidelines for Americans.(4) We derived changes in PA due to age from accelerometry data from the OAI, a large longitudinal knee OA cohort.(24)

Health-related QoL losses were estimated using the quality-adjusted life-year (QALY), a metric that accounts for risk aversion and preferences for quantity and quality of life.(26, 27) It is assumed that a decisionmaker would be indifferent between a survival gain of 1 QALY and an additional year of perfect health. QALYs are designed to allow for standardized comparison across a variety of health states and interventions.

Average per-person QALYs lost were calculated for each sex and race/ethnicity stratum as the difference in quality-adjusted life expectancy (QALE) for: 1) an active compared to inactive population, 2) an insufficiently active compared to inactive population, and 3) an active compared to insufficiently active population. Population-level QALYs lost were calculated by multiplying the corresponding per-person QALYs lost by the number of persons with symptomatic knee OA in each demographic stratum. We also calculated the QALYs lost in each stratum relative to its weight (proportion of stratum's size in the knee OA population), yielding a ratio for each stratum to represent QALY-loss burden. This is graphically depicted and described in Technical Appendix (TA) Figure 2.

We conducted analyses to determine potential life-years saved and cases of disease averted if 5%, 10%, and 20% of the inactive and insufficiently active populations were instead at a higher activity level. Finally, we performed sensitivity analyses to examine the robustness of our findings under variation in our underlying data assumptions and in our QoL and PA transition parameters. We discounted QALYs at 3% annually.(28)

Sensitivity analyses and results without discounting and quality-adjustment, as well as detailed inputs, assumptions, and sample calculations, are presented in the TA.

The OAPol Model

The OAPol Model is a validated, widely published state-transition Monte Carlo computer simulation model that can be used to estimate QALE in persons with knee OA at different activity levels.(12, 29, 30) The model generates cohorts of individuals using pre-specified demographic and clinical characteristics; transition probabilities govern the progression of subjects among various health states. The model distinguishes between three PA levels

(inactive, insufficiently active, active), among which subjects can transition based on annual probabilities (TA Figure 1). Comorbid conditions in this analysis are cancer, CVD, and DM, each described by prevalence and incidence. Presence of comorbidities has an impact on QoL and mortality, but comorbidities do not directly impact OA pain. In turn, level of PA influences risk of comorbidity incidence. The model also evaluates QoL, which is independently impacted by number of comorbidities, obesity, OA pain, and PA level. Further details are described in “Model Inputs and Analytic Details” in the TA and have been previously published.(12, 29, 30)

Cohort Characteristics and Key Input Parameters

Cohort Characteristics—We generated all-male and all-female cohorts, with subjects beginning as either inactive, insufficiently active, or active in different runs (TA Table 1). All cohorts had symptomatic knee OA at baseline. These groupings were further stratified by race/ethnicity: White Non-Hispanic, White Hispanic, Black Non-Hispanic, and Black Hispanic, the races for which we had sufficient data across all sources to evaluate proportions of the OA population at various PA levels. We derived the population’s BMI distribution from the 2012 National Health Interview Survey (NHIS).(31)

PA Progression—The model permits annual transitions between or maintenance of the three PA levels. We estimated the probabilities governing these transitions using OAI accelerometry data(24) and, in base analyses, applied the assumption that individuals would not increase PA with age (annual probability for PA increase = 0).

QoL Utility—We derived initial QoL values from the OAI.(32) The OAI collected descriptive, ordinal measures of health-related QoL using SF-12 measures. To convert these to utility values to assess the strength of preference for one health state over another, we used the transformation proposed by Brazier et al.,(33) yielding QoL utility values for an inactive population, stratified by comorbidities, pain, obesity, and age (TA Table 1).

Level of PA also influences QoL in the model: an insufficiently active state has an annual utility 0.01845 higher than for an inactive state; the annual utility for an active state is 0.04826 greater (TA Table 1). These values were derived from the 2007–08 OAI accelerometry data(24); differences between QoL values were measured cross-sectionally with PA levels, adjusted for age, sex, pain, BMI, and comorbidities.

Pain—We define pain by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)(34) classifications; all subjects with OA have some level of pain. Distributions of initial OA pain level and pain progression over time were derived using OAI data.(32) Greater pain is associated with lower annual QoL, described previously.(12, 35)

Comorbidities—We estimated the prevalence of comorbidities for physically active and insufficiently active individuals using NHANES 2005–06 accelerometry data(25) and risk reduction values (TA Table 1) from a meta-analysis of prospective studies of cardiorespiratory fitness (a proxy measure for PA(36)) and the risk of developing cancer, CVD, and DM. Methodology is outlined in the TA.

Mortality—Background mortality rates, stratified by age, sex, and race/ethnicity, were derived using 2011 CDC Life Tables(37), adjusted to reflect mortality for a population without chronic conditions. Cancer, CVD, and obesity increase mortality in the model. These adjustments were derived from NHIS and National Vital Statistics System 2011–2013 data(31, 38, 39) for cancer and CVD and from Berrington de Gonzales et al.(40) for obesity.

Analytic Details

Throughout this analysis, QALYs lost encompass QALE decrements due to all factors that influence QoL: obesity, OA pain, PA level, and number of comorbidities. We calculated the per-person QALYs lost in each age, sex, and race/ethnicity stratum using the differences between PA levels in average individual life expectancy. To convert these to QALYs lost in our entire population of interest, we used 2012 population count data from CDC Wonder (a CDC public health information system),(41) 2008 accelerometry data from the Osteoarthritis Initiative (OAI),(24) and 2011–12 OA prevalence data from Deshpande et al.(11) These variables were used in a series of calculations delineated in the TA (“Sample Calculation: QALYs Lost and Saved”) that allowed us to translate per-person to population-level life-years.

We calculated the difference between QALYs lost with no change in PA and if 5%, 10%, or 20% of the inactive or insufficiently active population were instead active to estimate potential QALYs saved (details in TA). The persons in active and insufficiently active states in the model could decrease to a lower PA level over time based on the annual transition probabilities derived from the OAI. To calculate potential cases of disease averted, we used a similar methodology as for QALYs saved, taking the difference in cases of cancer, CVD, and DM between each PA condition.

We calculated the (1) proportion of total population QALYs lost attributable to each demographic stratum and (2) size of each stratum relative to size of the total OA population. To evaluate disproportionate burden of overall QALY losses across strata, we created a ratio of these two values (“QALY metric”/“size metric”) for each stratum.

Sensitivity Analyses

In our primary analysis, we were required to condense some less populous race/ethnicity stratifications from our CDC Wonder source(41). We had classified those as “Black,” (see “Key Assumption #1” in TA), and, in a sensitivity analysis, we examined the impact on our primary results of instead classifying those stratifications as “White.”

In a second sensitivity analysis, we varied the QoL increments associated with being insufficiently active and active as the upper and lower 95% confidence interval (CI) bounds for the base case parameters. We calculated the resulting average per-person and population level discounted QALYs.

An additional sensitivity analysis varied the probabilities of decreasing PA level from physically active and insufficiently active to be the upper and lower 95% CI bounds for the base case probabilities. We calculated per-person and population-level QALYs lost under these conditions, as well as QALYs saved if 5%, 10%, and 20% of the inactive and

insufficiently active populations were instead at a higher PA level. In an additional analysis, we considered the ‘most conservative scenario’ by incorporating probabilities of increasing PA from inactive to insufficiently active (11.04%) and insufficiently active to active (9.57%), derived using short-term (2-year) OAI data(24).

Our final sensitivity analysis examined the best- and worst-case scenarios in terms of the QoL increments associated with PA and the probability of decreasing PA. The best-case scenario used the upper boundary of the 95% CI for QoL increment and the lower

Results

Description of the Population

Forty-eight percent of the OA population aged 45+ was inactive, while 41% was insufficiently active, and 11% was active (Table 1). For all race/ethnicity strata, women were less active than men (Table 1). Figure 1 portrays the longitudinal trajectory of PA profiles.

Per-Person and Population-Based QALYs Lost

Table 2 presents the discounted QALYs lost at the individual and population levels, stratified by sex and race/ethnicity. Results without quality-adjusting and discounting are in TA Tables 8–10.

On average, for each person with OA, 0.66 QALYs were lost due to inactivity relative to activity, 0.20 were lost from inactivity relative to insufficient activity, and 0.57 were lost from insufficient activity. Per-person QALYs lost across all sex and race/ethnicity strata ranged from 0.58 – 0.81 for inactivity relative to activity, 0.17 – 0.25 for inactivity relative to insufficient activity, and 0.52 – 0.69 for insufficient activity relative to activity. Black Hispanic and Non-Hispanic women had the highest per-person QALYs lost, while White Non-Hispanic men had the lowest.

Overall, 4.4 million total QALYs were lost due to physical inactivity relative to activity, 1.3 million were lost due to physical inactivity relative to insufficient activity, and 3.2 million were lost due to insufficient activity relative to activity. Considering only losses relative to activity, 7.5 million QALYs were lost in the population, an average of 0.55/person.

Impact of Differing Activity Levels in the OA Population

As shown in Table 3, if 20% of the inactive OA population were instead active, 871,541 potential QALYs would be saved; if 5% were instead active, 217,885 QALYs would potentially be saved. If 20% or 5% of the inactive population were insufficiently active, 266,942 or 66,736 potential QALYs would be saved. If 20% or 5% of the insufficiently active population were active, 631,249 or 157,812 potential QALYs would be saved.

Table 3 also reports cases of cancer, CVD, and DM potentially averted over the remaining course of subjects’ lifetimes with these changes in PA level. If 20% of the inactive OA population were instead active, 95,920, 222,413, and 214,725 potential cases of cancer, CVD, and DM would be averted, corresponding to 2.5%, 5.1%, and 5.8% reductions in disease incidence from a 100% inactive population, respectively. This is compared to

23,980; 55,603; and 53,681 potential cases averted if only 5% of the inactive population were instead active, corresponding to 0.6%, 1.3%, and 1.5% reductions in disease incidence. Twenty percent of the inactive population being at the insufficiently active level would avert 56,399; 91,665; and 96,897 potential cases, corresponding to 1.5%, 2.1%, and 2.6% reductions in disease incidence. In addition, 37,886, 108,115, and 103,152 potential cases would be averted if 20% of the insufficiently active population were active, resulting in 1.2%, 3.2%, and 3.6% reductions in cancer, CVD, and DM incidence.

Burden of QALY Losses on Sex and Race/Ethnicity Strata

TA Figure 2 shows, for each sex and race/ethnicity stratum, the ratio of “QALYs lost from inactivity, relative to activity, attributable to the stratum” to “size of the stratum relative to the total OA population aged 45+.”

Black Hispanic women bore the largest relative burden of lowered QALE due to lack of activity, followed closely by Black Non-Hispanic women. Black Hispanic women comprised 0.5% of the OA population but accounted for 0.8% of the QALYs lost in the population due to inactivity. Black Non-Hispanic women were 11.1% of the OA population and accounted for 18.0% of the QALYs lost. Considering both inactivity and insufficient activity, relative to activity, Black Hispanic women had the highest per-person QALY loss of 0.76. Within all race/ethnicity groupings, women bore a relatively greater proportion (~20%) of the QALYs lost than men.

Sensitivity Analyses

In TA Tables 11–13, we report the same outcomes as in Tables 1–3 under the conditions of the sensitivity analysis reclassifying sociodemographic groupings. All results were similar between the base case and this sensitivity analysis, with slightly greater QALYs lost and comorbidities averted in the base case.

Figure 2 depicts the results of the sensitivity analyses varying annual QoL increments associated with PA and likelihood of changing PA over time. These analyses are presented in greater numerical detail in TA Tables 14–18.

TA Table 14 contains the results of the sensitivity analysis varying annual QoL increments associated with insufficiently active or active states. Figure 2, Panel 1 depicts the average population-level QALYs lost due to being physically inactive, relative to active, which ranged from 3,095,202 – 5,610,815 (average per-person QALYs lost ranged from 0.47 – 0.85). Considering inactivity relative to insufficient activity (Figure 2, Panel 2), QALY losses ranged from 867,841 – 1,784,376 (per-person QALYs lost: 0.13 – 0.27). For insufficient activity relative to activity (Figure 2, Panel 3), the population-level QALYs lost ranged from 2,296,832 – 4,014,751 (per-person QALYs lost: 0.41 – 0.72).

The results were robust in the sensitivity analyses varying annual probability of decreasing PA level (TA Table 15). The population-level QALY losses in the inactive population relative to the active population (Figure 2, Panel 1) ranged from 4,313,856 – 4,400,685 (per-person QALYs lost: 0.65 – 0.67). Considering the inactive population relative to insufficiently active (Figure 2, Panel 2), population-level QALY losses ranged from 1,307,160 – 1,353,503

(per-person QALYs lost all equaled 0.20). For the insufficiently active population relative to active (Figure 2, Panel 3), population QALY losses ranged from 3,139,325 – 3,180,720 (per-person QALYs lost: 0.56 – 0.57).

If 20% of the inactive population were to instead be active, potential QALYs saved varying annual probability of decreasing PA level ranged from 862,771 – 880,137 (TA Table 16). Twenty percent of the inactive population being insufficiently active saved 261,432 – 270,701 potential QALYs; 20% of the insufficiently active population being active saved 627,865 – 636,144 potential QALYs.

In the most conservative scenario incorporating a likelihood of increasing PA over time, 3,238,687 QALYs were lost in the population due to inactivity relative to activity; 1,636,218 were lost due to insufficient activity (TA Table 17).

Per-person and population QALYs lost due to inactivity relative to activity were 0.86 and 5,662,237 under the worst-case scenario sensitivity analysis and 0.46 and 3,053,999 under the best-case scenario (TA Table 18).

Discussion

We estimated QALYs lost due to low levels of PA in the US knee OA population. We assessed potential QALYs gained and cases of cancer, CVD, and DM averted if 5%, 10%, or 20% of the OA population was at an increased PA level. Finally, we described the burden of QALYs lost in each sex and race/ethnicity stratum relative to its size in the overall OA population of interest.

4.4 million QALYs were lost in the OA population due to inactivity (relative to activity), and 3.2 million QALYs were lost due to insufficient inactivity (relative to activity). The burden of QALYs lost due to lack of PA fell disproportionately on women across all race/ethnicity strata, with an emphasis on Black Hispanic and Black Non-Hispanic women. Increasing PA by modest levels could save substantial QALYs in the OA population. Improvement from inactive to active yielded the most potential QALY gains across population strata. However, even smaller improvements from being inactive to insufficiently active and from insufficiently active to active resulted in sizable improvements in QALE.

Our findings illustrate the implications of a previous observational study showing that QoL in knee OA populations can be improved with PA.(42) A randomized controlled trial of individuals with knee OA by Ettinger et al. found that both aerobic and resistance exercise training decreased disability and pain compared to controls.(43) Cross-sectional studies have also observed decreased physical and mental health-related QoL with failure to meet recommended levels of PA, either 150 minutes of moderate or 60 minutes of intense PA/week.(44) Data from another trial showed that moving from the lowest to middle PA tertile was associated with significant QoL gains, while moving from the middle to the highest PA tertile was not associated with further QoL increases.(45) This differs from our finding that insufficient activity relative to activity resulted in greater per-person QALY losses than inactivity relative to insufficient activity. This is due to our input derivations, which yielded a smaller QoL difference between insufficient activity and inactivity than between insufficient

activity and activity, along with a lower likelihood of PA sustainability for insufficient activity than for activity.

We note several limitations to the analysis. We attempted to harmonize our metric for the three PA levels across all OAPol Model inputs, although there were slight discrepancies due to the use of multiple data sources. The meta-analysis from which we derived our PA-related risks of cancer, CVD, and DM used standardized cutoffs for cardiorespiratory fitness measures to determine relative risks for three fitness levels, which we linked to our three PA levels.(46) Our other PA-related model input values were derived using only objectively-measured PA, so this consistency in objectively-measured activity metrics confers a level of agreement across our data. However, using accelerometry data to derive estimates of PA based on short-term wear has the potential to underestimate activity decreases over time, as wearing accelerometers may incentivize PA adherence. In addition, due to the nature of the data we required, the most recent data on OA prevalence in the population, stratified by age, sex, and race/ethnicity, was derived for 2012, while the most recent accelerometry data from OAI and NHANES were available from 2008 and 2005–2006, respectively.(11, 24, 25) While the time frames of our data sources were not perfectly aligned, fluctuations in OA prevalence and population demographics did not change meaningfully between 2005 and 2012. We acknowledge that the OAI may have been subject to healthy volunteer bias in which people with less severe OA and likely higher PA were recruited, leading to underestimated true QALYs lost due to low PA in the OA population. However, the OAI is well-suited to our analysis in that it provides a large, accessible database of objective, longitudinal accelerometry data from individuals with clinically-confirmed knee OA.

As OA is often concomitant with elevated BMI, future analyses could investigate the influence of obesity level on PA uptake and the QALYs to be gained from increased PA stratified by obesity status. Higher average BMI and comorbidity prevalence and incidence may contribute to the elevated QALY loss burden we found among Black women.

The knee OA population is uniquely disadvantaged due to knee pain that limits mobility, and we report that only around 10% of the US OA population aged 45+ completes 150 minutes of MVPA/week. Our results, which evaluate the quantifiable benefits of PA for those with symptomatic knee OA, may be useful for promoting PA in this population. Clinically, physicians can better promote change in patient behavior when equipped with metrics describing the benefits to be gained from increased PA in terms of life expectancy and QoL utility.

From a public health perspective, our projections of potential QALYs saved and comorbidities averted when various proportions of the OA population are at higher activity levels are useful in setting realistic goals for activity promotion programs among OA patients. Published reviews of PA interventions(47) and a CDC report(48) suggest that it is possible to effectively increase PA at the population level through community campaigns and partnerships between health agencies and organizations like schools and city government. Framing outcomes in terms of gains rather than losses, as we do for QALYs saved and comorbidities averted, has been shown to be most effective when promoting behaviors to prevent disease incidence,(49) as is the case with PA interventions. The fact that

even improvement from inactivity to insufficient activity can produce meaningful life expectancy gains may be a motivating factor, as may be the reductions in incidence of cancer, CVD, and DM. Tailoring gains to a specific population or sociodemographic group has been found to be maximally effective in health promotion programs.(50) The observation that women, particularly Black women, bear most of the relative burden of QALYs lost due to lack of PA can help to target future PA interventions in the OA population that will produce the greatest QoL gains.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: Supported by NIH grants R01 AR064320, R01 AR074290K24, R01 AR057827, and P30 AR072577.

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Significance and Innovations

- We evaluated the impact of physical inactivity in the US knee osteoarthritis (OA) population in terms of cases of associated chronic disease and quality-adjusted life-years (QALYs), key metrics for evaluating physical activity from a public health policy standpoint.
- The US knee OA population loses 4,357,707 QALYs due to inactivity and 3,156,244 QALYs due to insufficient physical activity.
- If 20% of the inactive knee OA population were to instead be active (150+ minutes of moderate-to-vigorous activity/week), 871,541 QALYs would potentially be saved, and 95,920 cases of cancer, 222,413 cases of cardiovascular disease, and 214,725 cases of diabetes would potentially be averted.
- Black Hispanic women and Black Non-Hispanic women bear the largest burden of QALYs lost due to lack of physical activity relative to their proportions within the population of interest.

Figure 1. Proportion of US OA Population at Activity States or Dead over Time.

Figure 1 depicts the proportion of the living population with knee OA in each PA state (inactive, insufficiently active, or active) and the cumulative proportion of the population that has died (depicted by the red curve). The green lines depict the three levels of PA, with darker color corresponding to higher PA level. The units of the x-axis are years following start of the simulation (one model cycle = one year), and subjects began at a mean (SD) age of 61 (11).

Figure 2. Sensitivity Analyses of Population QALYs Lost.

Figure 2 depicts the sensitivity of our primary outcome (QALYs lost in the US OA population) in the face of uncertainty. We considered alternative values for two categories of parameters. (1) We varied the annual probabilities of decreasing physical activity (both from *active* to *insufficiently active* and *insufficiently active* to *inactive*) across the range of their respective 95% CIs. (2) We varied the annual increments to health-related QoL (both for *active* and *insufficiently active*) across the range of their respective 95% CIs. The three panels (referred to as Panels 1–3 moving from left to right) of Figure 2 depict the results of these analyses for each of the three PA level comparisons: *inactive* relative to *active* (Panel 1), *inactive* relative to *insufficiently active* (Panel 2), and *insufficiently active* relative to *active* (Panel 3), *Ranges for annual probability of decreasing PA [from active: 0.021 to 0.025; from insufficiently active: 0.088 to 0.096], + Ranges for annual QoL increment associated with PA level [active: 0.031 to 0.065; insufficiently active: 0.006 to 0.030]

Table 1.
US Knee Osteoarthritis Population, Aged 45+, by Race/Ethnicity, Sex, and Level of Physical Activity

Race/Ethnicity and Sex	OA Population (n)	Percent of OA Population Inactive (%)	Percent of OA Population Insufficiently Active (%)	Percent of OA Population Active (%)
White Hispanic				
Men	432,570	35.1%	47.6%	17.3%
Women	753,700	46.7%	42.6%	10.7%
White Non-Hispanic				
Men	3,997,873	38.2%	44.6%	17.1%
Women	6,137,972	52.4%	37.6%	10.1%
Black Hispanic				
Men	38,678	33.6%	60.1%	6.3%
Women	69,125	64.2%	35.2%	0.6%
Black Non-Hispanic				
Men	772,826	37.2%	56.2%	6.6%
Women	1,526,076	67.5%	31.9%	0.6%
Total; Weighted Average	13,728,820	48.2%	40.7%	11.1%

Percent of OA population at each activity level was derived from the OAI.(24)

Table 2. QALYs Lost at the Per-Person and Population Levels Due to Physical Inactivity in the US Knee OA Population Aged 45+

Race/Ethnicity and Sex	OA and Inactive, Relative to Active		OA and Inactive, Relative to Insufficiently Active		OA and Insufficiently Active, Relative to Active	
	Per-Person	Population *	Per-Person	Population	Per-Person	Population
White Hispanic	Men	0.74	112,276	0.23	35,184	0.61
	Women	0.77	269,407	0.23	79,333	0.65
White Non-Hispanic	Men	0.58	890,932	0.17	262,169	0.52
	Women	0.64	2,066,795	0.20	630,338	0.57
Black Hispanic	Men	0.71	9,264	0.21	2,718	0.65
	Women	0.81	36,094	0.23	10,201	0.69
Black Non-Hispanic	Men	0.66	190,372	0.21	61,436	0.59
	Women	0.76	782,566	0.25	253,333	0.62
Population Average (per-person); Total (population)		0.66	4,357,707	0.20	1,334,712	0.57
						3,156,244

* Population QALYs lost may be calculated by multiplying the per-person QALYs lost for each stratum by the number of individuals in that stratum at the corresponding PA level, as reported in Table 1.

Table 3.

Discounted, Quality-Adjusted Life-Years Saved and Comorbidities Averted in the Inactive and Insufficiently Active US Knee OA Populations with Increased Activity*

	% Inactive Population to Active				% Inactive Population to Insufficiently Active				% Insufficiently Active Population to Active			
	5%	10%	20%		5%	10%	20%		5%	10%	20%	
QALYs	217,885	435,771	871,541		66,736	133,471	266,942		157,812	315,624	631,249	
Cancer	23,980	47,960	95,920		14,100	28,200	56,399		9,471	18,943	37,886	
CVD	55,603	111,207	222,413		22,916	45,832	91,665		27,029	54,058	108,115	
DM	53,681	107,362	214,725		24,224	48,449	96,897		25,788	51,576	103,152	

*Note, QALYs lost include losses deriving from prevalent and incident comorbid conditions, while cases of comorbidities averted include incident cases only.