HHS Public Access

Author manuscript

Arthritis Care Res (Hoboken). Author manuscript; available in PMC 2019 August 01.

Published in final edited form as:

Arthritis Care Res (Hoboken). 2018 August ; 70(8): 1141–1149. doi:10.1002/acr.23466.

Demographic and Clinical Factors Associated with Non-Surgical Osteoarthritis Treatment Use Among Patients in Outpatient Clinics

Lauren M. Abbate, MD, PhD[1,2], **Amy S. Jeffreys, MStat**[3], **Cynthia J. Coffman, PhD**[3,4], **Todd A. Schwartz, DrPH**[5,6], **Liubov Arbeeva, MS**[5], **Leigh F. Callahan, PhD5**[5,7], **Nicole A. Negbenebor, BS**[8], **Wendy M. Kohrt, PhD**[1,9], **Robert S. Schwartz, MD**[1,9], **Ernest Vina, MD, MS**[10], and **Kelli D. Allen, PhD**[3,5,7]

[1]Geriatric Research, Education, and Clinical Center, VA Eastern Colorado Healthcare System, Denver, CO

[2]Department of Emergency Medicine, University of Colorado School of Medicine, Aurora CO

[3]Center for Health Services Research in Primary Care, VA Medical Center, Durham, NC

[4]Department of Biostatistics and Bioinformatics, Duke University Medical Center, Durham, NC

[5]Thurston Arthritis Research Center, University of North Carolina, Chapel Hill, NC

[6]Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina, Chapel Hill, NC

[7]Division of Rheumatology, Allergy, and Immunology, Department of Medicine, University of North Carolina, Chapel Hill, NC

[8]Warren Alpert Medical School at Brown University, Providence, RI

[9]Division of Geriatric Medicine, Department of Medicine, University of Colorado School of Medicine, Aurora CO

[10]Division of Rheumatology, Department of Medicine, University of Arizona College of Medicine Tucson, AZ

Abstract

Objective—To identify patient demographic and clinical characteristics associated with osteoarthritis (OA) treatment use.

Methods—This was a secondary data analysis of three clinical trials among patients with hip or knee OA conducted in 1) Duke Primary Care practices, 2) the Durham Veterans Affairs Health Care System (DVAHCS), and 3) the University of North Carolina-Chapel Hill (UNC). At baseline, participants reported socio-demographic characteristics, OA-related pain and function, and OA treatment use including oral analgesia, topical creams, joint injections and physical therapy. Separate, multivariable logistic models (adjusted for clustering of clinics and providers for Duke

Address for Correspondence: Lauren M. Abbate, MD, PhD; Leprino Building, Campus Box B215, 12401 East 17th Ave, Aurora, CO 80045, Telephone: 303-724-8741, Fax: 303-724-7898, lauren.abbate@ucdenver.edu.

and VA cohorts) were used to estimate odds ratios and 95% confidence intervals (OR, 95% CI) for the associations between participant characteristics and each type of OA treatment.

Results—Oral analgesic use was reported by 70–82% of participants across the three cohorts. Physical therapy, knee injections, and topical creams were used by 39%-52%, 55-60%, and 25-39% of participants, respectively. In multivariable models, worse pain, stiffness, and function, per 5-unit increase, were associated with greater odds of using any oral analgesic for the Duke (OR=1.18 (1.08, 1.28)) and UNC (OR=1.14 (1.05, 1.24)) cohorts but not for the VA cohort (OR=1.04 (0.95, 1.14)). For all three cohorts, Non-Whites had higher odds of use of topical creams compared to Whites.

Conclusion—Results suggest potential under-utilization of therapies other than oral analgesia. Patient characteristics may affect OA treatment use, and understanding the relationship between these factors and OA treatment preferences may improve adherence to OA treatment guidelines.

INTRODUCTION

Osteoarthritis (OA) is a common condition, with a lifetime risk of nearly 50% for symptomatic knee OA (1) and 25% for symptomatic hip OA (2) in the US. As the US population increases in age, the prevalence is expected to rise (1, 3), and there will be a greater demand for high-quality, effective OA-related healthcare. In the absence of curative treatment, current guidelines for OA management recommend a combination of non-surgical treatments and lifestyle modification, with joint replacement recommended in some cases (4, 5). Many individuals with knee OA obtain treatment through their primary care providers, and we previously reported that there was substantial between-clinic variability in the use of some pharmacological and non-pharmacological OA treatments across primary care sites even within one healthcare system (6). Although studies have examined sex, racial/ethnic, and geographical differences in joint replacement (7-9), little is known regarding patient-level factors associated with use of other guideline-based OA treatments, though some variation in treatment may be related to age and duration of symptoms (10) or socio-economic factors (11). Furthermore, these studies have focused on one aspect of OA treatment (i.e. pharmacological or non-pharmacological treatment), whereas examining use of both pharmacological and non-pharmacological treatments across patient groups would provide a comprehensive picture of patterns of OA treatment management.

Current treatment guidelines for the management of OA recommend initial non-pharmacological treatments such as self-management education, weight-loss, and physical activity, along with pharmacological therapy when tolerated and safe (4), yet studies suggest that gaps exist between guideline recommendations and treatments (12, 13). Furthermore, evaluation of use of specific OA treatments is limited to a few studies (10, 14, 15). Assessing patterns of OA treatment use among individuals in different outpatient settings is critical for identifying gaps in recommended care, which, in turn, could lead to interventional approaches to mitigate these gaps that would be applicable to individuals of diverse backgrounds, including those with varying access to care. Therefore, the objectives of this study were to evaluate the frequency of patient use of various OA treatments across several different health care systems and to identify the associations between patient characteristics,

including demographic and health-related factors, and OA treatment use within each health care system.

PATIENTS AND METHODS

Study design and setting

This is a secondary data analysis of baseline data from three clinical trials of behavioral and health services interventions among individuals with symptomatic hip or knee OA in North Carolina. Two studies examined Patient and PRovider Interventions for Managing Osteoarthritis in Primary Care; one was conducted among ten Duke Primary Care Research Consortium practices (PRIMO-Duke) and one was conducted in the Ambulatory Care Service at the Durham Veterans Affairs (DVAHCS) Health Care System (PRIMO-VA). The third study examined PhysicAl THerapy vs INternet Based Exercise Training for Patients with Knee OA (PATH-IN); this study primarily involved patients receiving care within the University of North Carolina (UNC) healthcare system, with 2% enrolled from the surrounding community with various sources of healthcare. Details of the study protocols have been described previously (16, 17). Briefly, in the PRIMO-Duke cluster randomized trial, the clinics were randomized to Provider Intervention or Control, and then study participants within those clinics were assigned to Patient Intervention or Control. The PRIMO-VA cohort was a cluster randomized controlled trial design with primary care providers (PCPs) and their enrolled patients randomized to the Patient + Provider OA intervention or usual care. The PRIMO sites incorporate a diverse range of primary care clinics in terms of urban/rural locations, type and amount of providers, and patient cohort size. The PATH-IN cohort was a randomized controlled trial with three arms where participants were randomized to standard physical therapy (PT) for knee OA, an internet-based exercise training program, or control (Figure 1). These studies were approved by the Duke University Medical Center, DVAHCS, and UNC Institutional Review Boards.

Participants

Individuals were included in the studies if they had: a diagnosis of hip OA (PRIMO-Duke and PRIMO-VA) or knee OA (PRIMO-Duke, PRIMO-VA, and PATH-IN), based on either radiographic evidence in the electronic medical record or American College of Rheumatology clinical criteria (18), along with current symptoms in the joint(s) with OA(16, 17). Participants in all studies were not meeting US Department of Health and Human Services physical activity recommendations(19), and participants in the PRIMO-Duke and PRIMO-VA studies also had a body mass index (BMI) ≥ 25. Exclusion criteria for the three studies included:

PRIMO-Duke, PRIMO-VA, and PATH-IN:

- Presence of other rheumatologic conditions
- Hip or knee surgery or acute meniscus or anterior cruciate ligament tear in the past six months
- Recent hospitalization for cardiovascular/cerebrovascular event
- Serious mental health conditions

- On waiting list for hip or knee arthroplasty
- Motor neuron diseases
- Quadriplegia or paraplegia
- Terminal illness
- Severely impaired hearing, vision, or speech
- Nursing home residents
- Pregnancy or planning to become pregnant
- Non-English speaking
- No access to telephone
- Current participation in another OA intervention or lifestyle changes study
- Other self-reported or study team/primary care physician deemed health condition that would prohibit participation in the study

Additional exclusion criteria for PRIMO-Duke:

- No primary care physician visit in past 18 months

Additional exclusion criteria for PRIMO-VA:

- No primary care physician visit in past 12 months

Additional exclusion criteria for PATH-IN:

- No regular internet access
- Currently receiving physical therapy
- Fall history deemed by study physical therapist to impose risk for potential injury through participation in home-based exercise program

Measures

Participant characteristics—These analyses included demographic and clinical characteristics, assessed at baseline, which were hypothesized to be related to differential use of OA treatments. These included age, sex, race (White vs. Non-White), self-reported income status (low income defined as “just meet basic expenses” or “don’t have enough to meet basic expenses”), self-reported general health (categorized as excellent/very good/good vs. fair/poor), body mass index (BMI), lower extremity pain, stiffness, and physical function as measured by the total score on Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (20), and self-reported duration of OA symptoms.

OA Treatments (Outcomes)—OA treatments were assessed at baseline via self-report for the following: 1) current use of any oral analgesic for OA, 2) non-steroidal anti-inflammatory drugs (NSAIDs) for OA, 3) opioids for OA, and 4) non-opioid analgesics (excluding NSAIDs) for OA; 5) current use of a topical cream for OA, 6) ever having a knee joint injection, and 7) ever having seen a physical therapist for knee OA. Dichotomous response variables indicating use or not for each of these seven OA treatments were created for each participant. Information on use of hip joint injection or physical therapy for hip OA were not included as these are less common interventions with weaker evidence for symptom control(4).

Statistical analyses

Descriptive statistics, including means and standard deviations (SD) for continuous variables, and percentages for categorical variables, were calculated. All analyses were performed using SAS version 9.4.

For the cluster-randomized trials, PRIMO-Duke and PRIMO-VA, generalized linear mixed models (GLMM) (21) with a logit link and binomial distribution were fit to the dichotomous OA treatment response variables to account for correlation due to clustering of patients within clinics or provider. For the UNC study, standard logistic regression models were fit. Multivariable logistic models (adjusted for clustering of clinics and providers for PRIMO-Duke and PRIMO-VA trials) including all of the patient characteristics were used for each of the three cohorts and five of the OA treatment dichotomous outcomes (for a total of fifteen multivariable models). Multivariable models for the OA treatments of non-opioid analgesics and opioids use were not fit due to low prevalence for all three cohorts. Estimated odds ratios and 95% confidence intervals (OR, 95% CI) for the associations between participant characteristics and each OA treatment were calculated. Additionally, models for the PRIMO-Duke and PRIMO-VA cohorts also included whether a participant had knee OA and hip OA except for those models evaluating knee injection and PT for knee OA. Model estimates were used to compute odds ratios for the continuous patient characteristics of age and OA symptoms for a 1-unit increase, and, for BMI and WOMAC scores, for a 5-unit increase.

RESULTS

The PRIMO-Duke cohort included 537 individuals who were mostly female and White and reported having OA symptoms, on average, for a decade (Table 1). The PATH-IN cohort included 350 individuals who were also mostly female and White, and reported having OA symptoms for about 13 years (Table 1). Finally, the PRIMO-VA cohort included 300 individuals who were mostly male and about half Non-White, with over one-half reporting fair or poor self-rated health and over one-third reporting low income (Table 1). Knee OA was nearly twice as common as hip OA in the PRIMO-Duke and PRIMO-VA cohorts. For the PATH-IN cohort all participants had knee OA, as this was an inclusion criterion; hip OA was evaluated by self-report of arthritis by joint, and 38% reported hip OA.

OA treatments were common among all three cohorts (Figure 2). Current use of any oral analgesic was reported most commonly, used by 82.2%, 77.3%, and 70.0% of the PRIMO-Duke, PRIMO-VA, and PATH-IN cohorts, respectively. NSAIDs were more commonly used than non-opioid analgesics or opioid analgesics in all three cohorts (Figure 2). However 29.3% of the PRIMO-VA cohort was currently using opioids, while 13.0% of the PRIMO-Duke participants and 10.3% of the PATH-IN participants were currently using opioids (Figure 2). Over one-half of all participants had ever had a knee injection, and proportions were similar across the three cohorts (Figure 2). Use of PT for knee OA was moderate among participants, with 38.8%, 47.4% and 52.0% of the PRIMO-Duke, PRIMO-VA and PATH-IN cohorts, respectively, reporting ever using physical therapy for knee OA.

In multivariable models, higher WOMAC scores were associated with increased odds of any oral analgesic use, and this was statistically significant for the PRIMO-Duke (OR= 1.18

(1.08, 1.28) per 5 unit increase) and PATH-IN (OR=1.14 (1.05, 1.24) per 5 unit increase) cohorts but not for the PRIMO-VA cohort (OR=1.04 (0.95, 1.14) per 5 unit increase) (Table 2). Women had higher odds of use of any oral analgesic compared to men in the PRIMO-Duke cohort but not in the PRIMO-VA or PATH-IN cohorts (Table 2). Compared to high income, individuals reporting low income had lower odds of use of any oral analgesic for the PRIMO-Duke cohort (OR=0.34 (0.19, 0.63)) but not the PRIMO-VA (OR=0.95 (0.49, 1.84)) or PATH-IN (OR=1.87 (0.80, 4.36)) cohorts. There was no association between fair/poor self-rated health and use of any oral analgesic in any of cohorts; however, individuals reporting low income had lower odds of use of NSAIDs in the PRIMO-Duke cohort only (Table 2).

Table 3 shows the estimates for the associations between participant characteristics and other OA treatments (i.e. topical creams, knee injection, and physical therapy) adjusted for all other participant characteristics. As with oral analgesics, higher WOMAC scores were associated with the use of some of the other OA treatments, including topical creams for the PRIMO-Duke and PATH-IN cohorts and with knee injection and PT for the PRIMO-VA cohort. In the PATH-IN cohort, women had higher odds of use of topical creams (OR=2.19 (1.18, 4.03)), knee injection (OR=1.75 (1.05, 2.92)) and PT (OR=2.75 (1.64, 4.60)) compared to men (Table 3). Non-Whites had higher odds of use of topical creams for all three cohorts, and for use of PT for knee OA in the PRIMO-VA cohort (OR=2.41 (1.38, 4.18)), compared to Whites. Those reporting low income had lower odds of use of knee injection in the PRIMO-VA cohort (OR=0.51 (0.27, 0.95)).

DISCUSSION

This study evaluated the use of various OA treatments in cohorts sampled from three separate outpatient settings and suggests that individuals with OA use a variety of OA treatments to alleviate their symptoms; the use of oral analgesics was very common, while use of topical creams, knee injections, and PT for knee OA were less commonly used. Due to the significant pain and disability associated with OA (3, 22), it is not surprising that the use of different treatments for managing OA is high, and that most individuals use or have used several treatments. Other than the association between Non-White race and topical creams, we found that no single clinical or socio-demographic participant characteristic was consistently associated with any specific OA treatment, but other characteristics associated with increased odds of use of one or more treatments included female sex, Non-White Race, higher BMI, and increased WOMAC scores, while low income was associated with lower odds of use of some treatments.

Our finding that oral analgesics were more commonly used than other treatments aligns with data from a rheumatology setting, suggesting that pharmacologic treatments are more often prescribed than non-pharmacological interventions, such as weight loss and exercise (23), and similar to primary settings in studies from Denmark (24) and Australia (25). Approximately one-half of the participants reported current use of NSAIDs compared to approximately 25% for any non-opioid analgesic and even less for opioids, which is consistent with OA treatment guidelines (4) and similar to other studies of OA oral analgesics in UK (14) and the US (10).

Opioid treatment is recommended for those unable to tolerate NSAIDs or who have failed other medical therapies (4), and our study indicates that opioid use was higher among veterans than in the other two cohorts. Though we could not comprehensively examine reasons for this difference, veterans tend to report more severe pain and more co-morbid pain conditions (26), and may be more likely to have contraindications to NSAIDs such as chronic kidney disease (27) or gastrointestinal bleeding (28). Indeed, high rates of opioid use for chronic pain among veterans have been previously reported and shown to be associated with mental health and substance abuse disorders (29). Opioids have recently been estimated to be involved in over 16,500 or 75% of prescription drug overdose deaths in a single year (30). These data recently resulted in recommendations from the Centers for Disease Control and Prevention to use non-pharmacologic interventions and non-opioid analgesic for chronic pain and to minimize the amount and duration of opioid analgesics (31). In addition, the US Department of Veterans Affairs, recognizing the high prevalence of opioid use for chronic pain, has also established guidelines to reduce opioid use for chronic pain (32). In our study, we asked specifically about use of opioids for OA-related pain. Some (29, 33), but not all (34) studies of veterans, have evaluated opioid use for OA-related chronic pain, and our data on opioid use for OA suggest that there may be a gap in OA treatment guidelines and opioid use for OA among veterans. However, we only asked about current use of medications for OA-related pain; thus, we are unable to assess prior therapies, such as NSAIDs, that veterans may have tried and failed or were unable to continue secondary to medication side effects.

Compared to oral analgesics, use of other OA treatments (i.e. knee injection, topical creams, PT) was less common in our study. Approximately 50% of participants had ever had a knee injection, which is similar to U.S. Medicare data (35); in contrast, 16.9% (15) and 27.5% (14) of patients received knee injections in two studies from the UK, suggesting that joint injections may be more commonly used in the US. Thirty-two to fifty-seven percent of our participants reported current use of topical creams, which is consistent with Conaghan et al., who reported 46.5% and 4.3% of individuals with OA had used an anti-inflammatory gel and capsaicin gel, respectively (14), and with Porcheret et al., who reported 38.8% for topical NSAIDs (15), both among UK populations. Our study provides current US estimates. As topical agents and joint injections are recommended in the treatment of OA pain (4), and may have fewer side effects than oral analgesics, these findings suggest that utilization of these therapies could be improved.

Although PT has been shown to decrease pain and function among individuals with OA (36), it still remains an under-utilized modality (23). PT use was moderate in our study (39%-52%), and higher than in other previously published estimates of PT for OA (13%) (11, 25). This may be because prior studies examined provider referral, and we examined whether the patient had ever used PT based on self-report. Since patients may have more than one provider, it is possible that individual provider referral estimates for PT are low and more patients are utilizing PT during the course of their OA than previously recognized. Caution is advised when interpreting these estimates as it is impossible to determine from these data when, in the course of OA treatment, the participant used PT, the relationship between analgesics and PT, or duration and frequency of PT use, all of which are likely to vary widely among individuals. Still, as PT is recommended in various OA treatment

guidelines (4), and about half of participants in this study had never tried this treatment, this is likely a key area for improvement in OA treatment.

In multivariable models, increasing WOMAC score was associated with use of several OA treatments, and this is not surprising since more symptomatic individuals may have tried more than one treatment modality, though we did not specifically ask about concurrent use or use of multiple treatments over time. On the other hand, duration of OA symptoms was not associated with any of the OA treatments. It is possible that there was no association between duration of OA symptoms and medications because only current medications were assessed (and OA symptoms vary over time) or because duration of OA symptoms may be a poor marker of disease severity.

Individuals with low income compared to high income had lower odds of use of NSAIDs in the PRIMO-Duke cohort and of knee injections in the PRIMO-VA cohort. The reasons for these associations are unclear. Much of the OA treatment research related to socio-economic status has centered on decision to undergo joint replacement; extrapolating from those data (37), individuals with low income have differing treatment preferences and more limited resources compared to individuals with higher income. Improved understanding of OA treatments by socio-economic status is critical in addressing the discrepancies between OA treatment guidelines and adherence to these guidelines.

Female sex was associated with use of topical creams, joint injection, and PT in the PATH-IN cohort and also any oral analgesic in the PRIMO-Duke cohort. Findings for differences in OA treatment by sex have been inconsistent (10, 11) in prior studies. Our finding that women had higher odds of use of these treatments compared to men may be related to more severe OA symptoms among women (38), and understanding this observation could improve use of these treatments.

Likewise, Non-Whites had higher odds than Whites of use of some other OA treatments, including topical creams and PT. While reasons for this observation are unclear, it is possible that Non-Whites are delaying surgical management, as data suggest that Whites compared to other race/ethnic groups are more likely to undergo joint arthroplasty (9, 39). Alternately, this may reflect Non-Whites' preferences for non-invasive therapies (40). Finally, though obesity is a risk factor for OA (41), BMI was not associated with any of the oral analgesics or PT and was only associated with knee injection among the PATH-IN cohort. This may because most of our study participants were overweight or obese. However, data from the Osteoarthritis Initiative also indicated no association between overweight and obesity and oral analgesics, and this sample was not restricted to overweight or obese individuals (10).

Limitations

This study was limited to individuals in three outpatient settings in North Carolina and may not be generalizable to the US population, as regional differences in OA treatment patterns may exist. However, the study included data from three very different health care systems, which is useful for exploring variability across different clinical settings. In addition, we asked only about current use of oral medications, and we did not explore duration of treatment use in this cross-sectional study. Though availability of specific pain medications

may have varied for patients in the VA, based on the current formulary, all classes of medications examined in the study were available to patients in the VA. Nonetheless, we were able to obtain data from three cohorts representing over 1,000 individuals with OA, providing a foundation for further in-depth study and longitudinal studies evaluating all current and previous OA oral medications that would provide a more comprehensive picture of OA treatments. While our data were all self-reported, which may have lead to misclassification, especially for categories of oral analgesics, they may provide a better representation of OA treatment than prescription databases or provider referrals because individuals may not always comply with provider recommendations. We were not able to control for other variables that could significantly affect treatment use, including treatment preferences. Finally the results were not adjusted for multiple comparisons; however, this study was designed as an exploratory analysis to inform future studies of OA treatment use.

This study provides valuable information regarding the use of OA treatment in outpatient settings and suggests potential adherence to OA treatment guidelines for oral analgesics, specifically NSAIDs, but also indicates areas for improvement in opioid use, PT, and joint injections. Moreover, these data suggest that patient characteristics including WOMAC score, sex, race/ethnicity, and socio-economic status may affect OA treatment use. Because OA is a prevalent, chronic condition, it is imperative that we understand not only how to best manage OA but also how to implement evidence-based guidelines for OA management in the community considering individual demographic and clinical characteristics to reduce the burden of OA pain and disability.

Acknowledgments

These studies were funded by the Patient-Centered Outcomes Research Institute (CER-1306-02043), National Institute of Arthritis and Musculoskeletal and Skin Diseases (1R01 AR059673), and the Department of Veterans Affairs Health Services Research and Development Service (IIR 10-126). All statements in this report, including its findings and conclusions, are solely those of the authors and do not necessarily represent the views of the Patient-Centered Outcomes Research Institute (PCORI) or its Board of Governors or Methodology Committee, the Department of Veterans Affairs or the National Institutes of Health. Drs. Allen, Coffman and Jeffreys were supported by the Center for Health Services Research in Primary Care at the Durham VA Healthcare System (CIN 13-410). Dr. Abbate was supported by NIH T32AG000279. Drs. Allen, Callahan, and T. Schwartz were supported in part by National Institute of Arthritis and Musculoskeletal and Skin Diseases Multidisciplinary Clinical Research Center P60 AR062760. Dr. Vina was supported by the National Institute of Arthritis and Musculoskeletal and Skin Diseases K23AR067226.

There has been no financial support or other benefits from commercial sources for this work, and there are no other author financial interests which could create a potential conflict of interest or the appearance of a conflict of interest with regard to this work.

References

1. Murphy L, Schwartz TA, Helmick CG, Renner JB, Tudor G, Koch G, et al. Lifetime risk of symptomatic knee osteoarthritis. Arthritis Rheum. 2008; 59:1207–13. [PubMed: 18759314]
2. Murphy LB, Helmick CG, Schwartz TA, Renner JB, Tudor G, Koch GG, et al. One in four people may develop symptomatic hip osteoarthritis in his or her lifetime. Osteoarthritis and cartilage. 2010; 18:1372–9. [PubMed: 20713163]
3. Hootman JM, Helmick CG. Projections of US prevalence of arthritis and associated activity limitations. Arthritis Rheum. 2006; 54:226–9. [PubMed: 16385518]
4. Nelson AE, Allen KD, Golightly YM, Goode AP, Jordan JM. Seminars in arthritis and rheumatism. Elsevier; 2014. A systematic review of recommendations and guidelines for the management of

osteoarthritis: The chronic osteoarthritis management initiative of the US bone and joint initiative; 701–12.

5. Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, et al. American college of rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. Arthritis care & research. 2012; 64:465–74.
6. Allen KD, Bosworth HB, Chatterjee R, Coffman CJ, Corsino L, Jeffreys AS, et al. Clinic variation in recruitment metrics, patient characteristics and treatment use in a randomized clinical trial of osteoarthritis management. BMC musculoskeletal disorders. 2014; 15:1. [PubMed: 24387196]
7. Hawker GA, Wright JG, Coyte PC, Williams JI, Harvey B, Glazier R, et al. Differences between men and women in the rate of use of hip and knee arthroplasty. N Engl J Med. 2000; 342:1016–22. [PubMed: 10749964]
8. Skinner J, Weinstein JN, Sporer SM, Wennberg JE. Racial, ethnic, and geographic disparities in rates of knee arthroplasty among medicare patients. N Engl J Med. 2003; 349:1350–9. [PubMed: 14523144]
9. Zhang W, Lyman S, Boutin-Foster C, Parks ML, Pan TJ, Lan A, et al. Racial and ethnic disparities in utilization rate, hospital volume, and perioperative outcomes after total knee arthroplasty. J Bone Joint Surg Am. 2016; 98:1243–52. [PubMed: 27489314]
10. Kingsbury SR, Hensor EM, Walsh CA, Hochberg MC, Conaghan PG. How do people with knee osteoarthritis use osteoarthritis pain medications and does this change over time? data from the osteoarthritis initiative. Arthritis research & therapy. 2013; 15:1.
11. Jordan KM, Sawyer S, Coakley P, Smith HE, Cooper C, Arden NK. The use of conventional and complementary treatments for knee osteoarthritis in the community. Rheumatology (Oxford). 2004; 43:381–4. [PubMed: 14623948]
12. Hunter DJ. Quality of osteoarthritis care for community-dwelling older adults. Clin Geriatr Med. 2010; 26:401–17. [PubMed: 20699162]
13. Allen KD, Choong PF, Davis AM, Dowsey MM, Dziedzic KS, Emery C, et al. Osteoarthritis: Models for appropriate care across the disease continuum. Best practice & research Clinical rheumatology. 2016; 30:503–35. [PubMed: 27886944]
14. Conaghan PG, Porcheret M, Kingsbury SR, Gammon A, Soni A, Hurley M, et al. Impact and therapy of osteoarthritis: The arthritis care OA nation 2012 survey. Clin Rheumatol. 2015; 34:1581–8. [PubMed: 24889403]
15. Porcheret M, Jordan K, Jinks C, Croft P, Primary Care Rheumatology Society. Primary care treatment of knee pain–a survey in older adults. Rheumatology (Oxford). 2007; 46:1694–700. [PubMed: 17938135]
16. Allen KD, Bosworth HB, Brock DS, Chapman JG, Chatterjee R, Coffman CJ, et al. Patient and provider interventions for managing osteoarthritis in primary care: Protocols for two randomized controlled trials. BMC musculoskeletal disorders. 2012; 13:1. [PubMed: 22236253]
17. Williams QI, Gunn AH, Beaulieu JE, Benas BC, Buley B, Callahan LF, et al. Physical therapy vs. internet-based exercise training (PATH-IN) for patients with knee osteoarthritis: Study protocol of a randomized controlled trial. BMC musculoskeletal disorders. 2015; 16:264. [PubMed: 26416025]
18. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis. classification of osteoarthritis of the knee. diagnostic and therapeutic criteria committee of the american rheumatism association. Arthritis Rheum. 1986; 29:1039–49. [PubMed: 3741515]
19. US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Physical activity guidelines for americans. Washington, DC: US Department of Health and Human Services; 2008.
20. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988; 15:1833–40. [PubMed: 3068365]
21. Hedeker D, Gibbons R. Longitudinal data analysis. Hoboken, NJ: J Wiley & Sons; 2009.

22. Prevalence and most common causes of disability among adults--united states, 2005. MMWR Morb Mortal Wkly Rep. 2009; 58:421–6. [PubMed: 19407734]
23. DeHaan MN, Guzman J, Bayley MT, Bell MJ. Knee osteoarthritis clinical practice guidelines -- how are we doing? J Rheumatol. 2007; 34:2099–105. [PubMed: 17722223]
24. Barten DJ, Dorsman SA, Dekker J, Veenhof C, Bakker DH. Treatment of hip/knee osteoarthritis in dutch general practice and physical therapy practice: An observational study. BMC family practice. 2015; 16:1. [PubMed: 25608667]
25. Brand CA, Harrison C, Tropea J, Hinman RS, Britt H, Bennell K. Management of osteoarthritis in general practice in australia. Arthritis care & research. 2014; 66:551–8. [PubMed: 24127305]
26. Zullig LL, Bosworth HB, Jeffreys AS, Corsino L, Coffman CJ, Oddone EZ, et al. The association of comorbid conditions with patient-reported outcomes in veterans with hip and knee osteoarthritis. Clin Rheumatol. 2015; 34:1435–41. [PubMed: 24916605]
27. Agha Z, Lofgren RP, VanRuiswyk JV, Layde PM. Are patients at veterans affairs medical centers sicker?: A comparative analysis of health status and medical resource use. Arch Intern Med. 2000; 160:3252–7. [PubMed: 11088086]
28. Abraham NS, Hartman C, Richardson P, Castillo D, Street RL Jr, Naik AD. Risk of lower and upper gastrointestinal bleeding, transfusions, and hospitalizations with complex antithrombotic therapy in elderly patients. Circulation. 2013; 128:1869–77. [PubMed: 24025594]
29. Edlund MJ, Martin BC, Devries A, Fan MY, Braden JB, Sullivan MD. Trends in use of opioids for chronic noncancer pain among individuals with mental health and substance use disorders: The TROUP study. Clin J Pain. 2010; 26:1–8. [PubMed: 20026946]
30. Centers for Disease Control and Prevention (CDC). Vital signs: Overdoses of prescription opioid pain relievers---united states, 1999--2008. MMWR Morb Mortal Wkly Rep. 2011; 60:1487–92. [PubMed: 22048730]
31. Rep MR. Announcing publication of the CDC guideline for prescribing opioids for chronic pain. MMWR Recomm Rep. 2016; 65:1–49.
32. Buscaglia AC, Paik MC, Lewis E, Trafton JA. Baseline variation in use of VA/DOD clinical practice guideline recommended opioid prescribing practices across VA health care systems. Clin J Pain. 2015; 31:803–12. [PubMed: 29498628]
33. Dobscha SK, Morasco BJ, Duckart JP, Macey T, Deyo RA. Correlates of prescription opioid initiation and long-term opioid use in veterans with persistent pain. Clin J Pain. 2013; 29:102–8. [PubMed: 23269280]
34. Dominick KL, Bosworth HB, Dudley TK, Waters SJ, Campbell LC, Keefe FJ. Patterns of opioid analgesic prescription among patients with osteoarthritis. Journal of pain & palliative care pharmacotherapy. 2004; 18:31–46.
35. Koenig KM, Ong KL, Lau EC, Vail TP, Berry DJ, Rubash HE, et al. The use of hyaluronic acid and corticosteroid injections among medicare patients with knee osteoarthritis. J Arthroplasty. 2016; 31:351–5. [PubMed: 26421601]
36. Deyle GD, Henderson NE, Matekel RL, Ryder MG, Garber MB, Allison SC. Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee: A randomized, controlled trial. Ann Intern Med. 2000; 132:173–81. [PubMed: 10651597]
37. Youm J, Chan V, Belkora J, Bozic KJ. Impact of socioeconomic factors on informed decision making and treatment choice in patients with hip and knee OA. J Arthroplasty. 2015; 30:171–5. [PubMed: 25301018]
38. Jordan JM, Helmick CG, Renner JB, Luta G, Dragomir AD, Woodard J, et al. Prevalence of knee symptoms and radiographic and symptomatic knee osteoarthritis in african americans and caucasians: The johnston county osteoarthritis project. J Rheumatol. 2007; 34:172–80. [PubMed: 17216685]
39. Hausmann LR, Brandt CA, Carroll CM, Fenton BT, Ibrahim SA, Becker WC, et al. Racial and ethnic differences in total knee arthroplasty in the veterans affairs healthcare system 2001–2013. Arthritis Care & Research. 2016
40. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Variation in perceptions of treatment and self-care practices in elderly with osteoarthritis: A comparison between african american and white patients. Arthritis Care & Research. 2001; 45:340–5. [PubMed: 11501721]

41. Felson DT, Zhang Y, Hannan MT, Naimark A, Weissman BN, Aliabadi P, et al. The incidence and natural history of knee osteoarthritis in the elderly. the framingham osteoarthritis study. Arthritis Rheum. 1995; 38:1500–5. [PubMed: 7575700]

Significance and Innovation

- Understanding the gaps between OA treatment guidelines and OA treatment use is critical to improving the quality of OA care
- Patient characteristics associated with OA treatment use include WOMAC score, sex, and race
- Use of NSAIDs for OA treatment in the outpatient setting appears to align with OA treatment guidelines; however, a better understanding of opioid use is needed

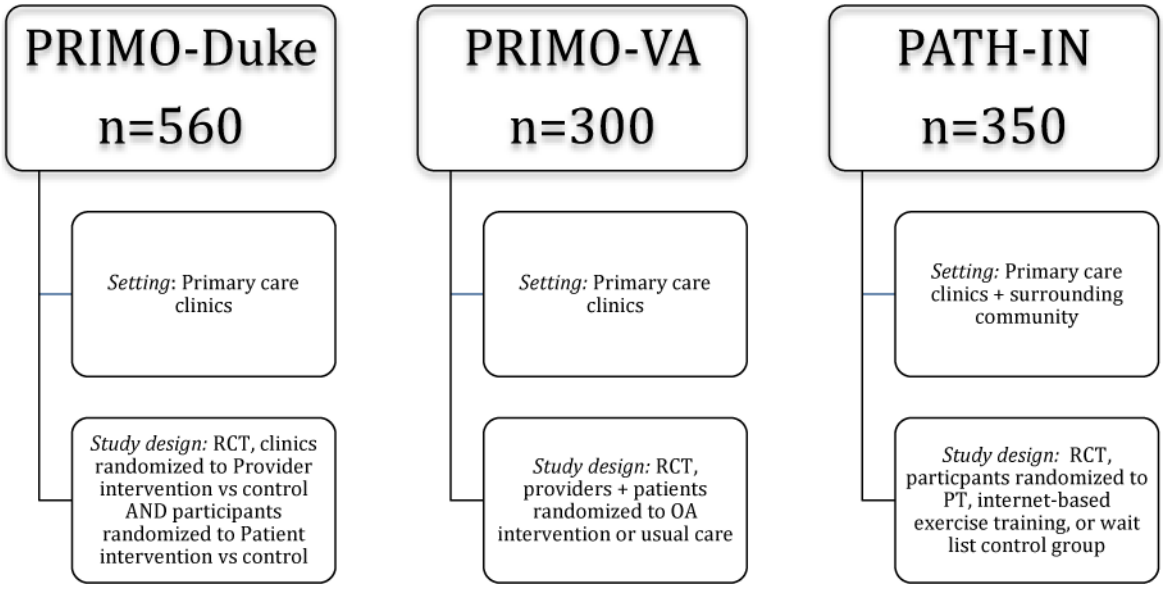

Figure 1. Description of the three separate cohorts used for the study analysis

PRIMO=Patient and Provider Interventions for Managing Osteoarthritis in Primary Care

PATH-IN=Physical Therapy vs Internet-based exercise training for Patients with Knee Osteoarthritis

VA=Ambulatory Care Service at the Durham Veterans Affairs Health Care System (DVAHCS)

RCT=Randomized Controlled Trial

PT=Physical therapy

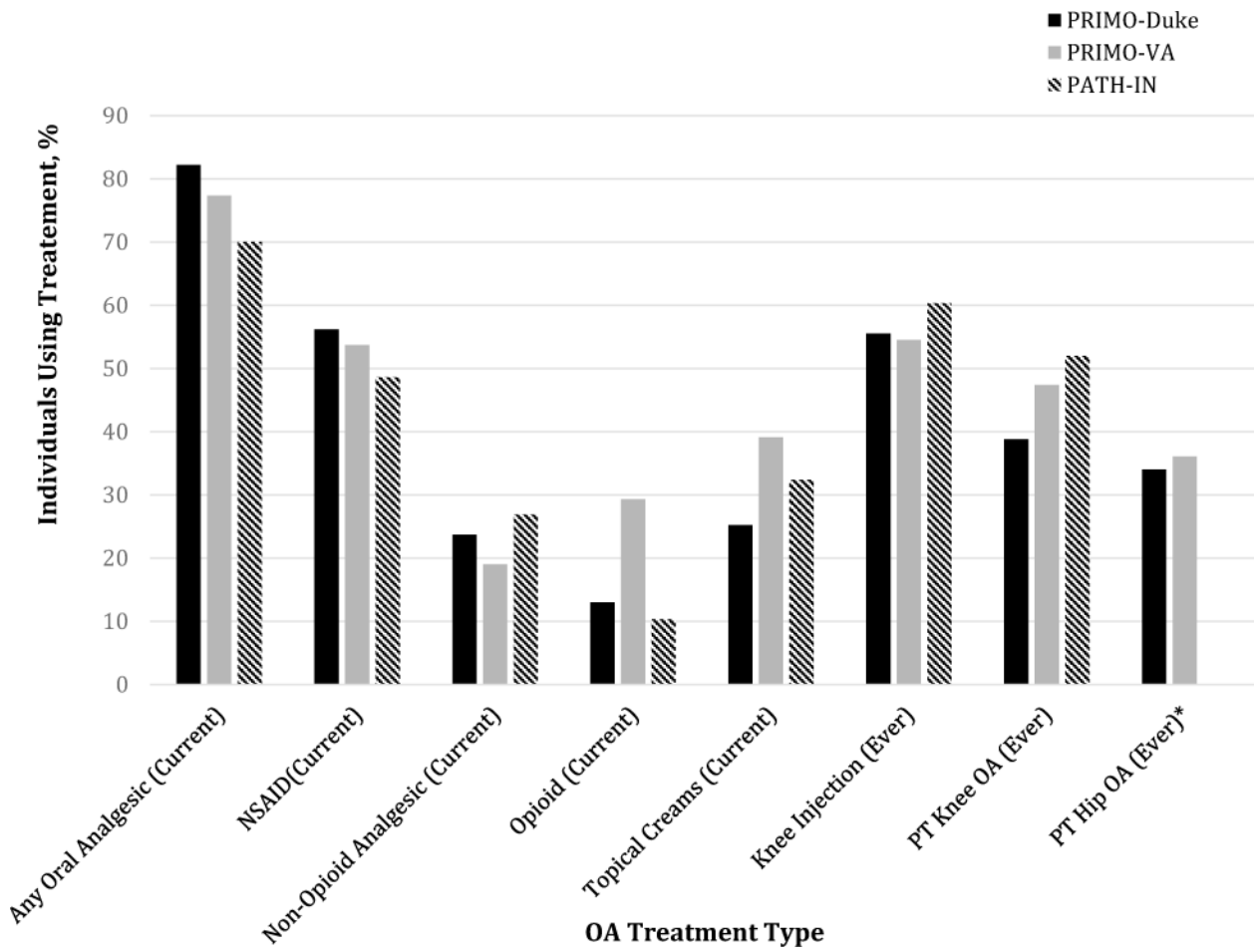

Figure 2. Self-Reported Use of OA Treatments by Cohort*

*Data not collected on hip OA for PATH-IN cohort

PT=Physical Therapy

Missing data: PRIMO-Duke: Topical Creams n=2, Knee Injection n=21, PT for knee OA n=22; PATH-IN: Knee Injection n=1; PRIMO-VA: Topical Creams n=1, Knee Injection n=2, PT for knee OA n=2, PT for hip OA n=1

Table 1

Participant baseline characteristics for each of the three cohorts: PRIMO-Duke, PRIMO-VA, and PATH-IN studies *

	PRIMO-Duke (n=537)	PRIMO-VA (n= 300)	PATH-IN (n=350)
Age, mean (SD)	63.2 (9.6)	61.1 (9.2)	65.3 (11.1)
Female, %	73.9	9.3	71.7
Non-White Race, %	39.6	52.9	26.3
Low Income, %	17.7	34.3	17.8
Fair/Poor Self-Rated Health, %	19.9	61.7	13.7
BMI **, mean (SD)	35.6 (7.4)	33.8 (5.8)	31.4 (8.0)
WOMAC score, mean (SD)	38.6 (17.0)	48.4 (17.5)	32.0 (17.9)
Years with Symptoms, mean (SD)	10.4 (9.2)	14.2 (11.6)	13.1 (11.7)
Knee OA, %	95.2	93.0	100
Hip OA, %	49.5	55.3	N/A

* Missing data: PRIMO-Duke: Non-white race n=2, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) n=1, Years with Symptoms n=1; PATH-IN: Non-White Race n=12, Low Income n=1, WOMAC n=2; PRIMO-VA: Non-White Race n=3, WOMAC n=1, Years with Symptoms n=1

** Body Mass Index

Table 2

Odds ratios (95% CI) from multivariable logistic regression models for the association between participant characteristics and use of any oral analgesics or NSAIDs for each of the three cohorts*

	Any Oral Analgesic Use			NSAID		
	PRIMO-Duke (n=533)	**PRIMO-VA (n=295)**	**PATH-IN (n=335)**	**PRIMO-Duke (n=533)**	**PRIMO-VA (n=295)**	**PATH-IN (n=335)**
Age, year	0.99 (0.96, 1.02)	1.00 (0.97, 1.03)	1.01 (0.98, 1.03)	**0.97 (0.95, 0.99)**	0.98 (0.95, 1.01)	0.98 (0.96, 1.01)
Female	**1.87 (1.10, 3.17)**	2.50 (0.69, 9.06)	1.11 (0.65, 1.89)	1.31 (0.87, 1.99)	0.88 (0.39, 1.98)	1.07 (0.65, 1.74)
Non-White Race	0.65 (0.39, 1.10)	1.03 (0.56, 1.89)	0.66 (0.35, 1.27)	0.87 (0.59, 1.27)	1.13 (0.69, 1.85)	0.77 (0.44, 1.37)
Low Income	**0.34 (0.19, 0.63)**	0.95 (0.49, 1.84)	1.87 (0.80, 4.36)	**0.42 (0.26, 0.68)**	0.68 (0.40, 1.16)	0.76 (0.39, 1.46)
Fair/Poor Self Rated Health	0.80 (0.39, 1.66)	1.74 (0.86, 3.50)	1.12 (0.47, 2.66)	1.44 (0.88, 2.34)	0.74 (0.42, 1.27)	0.72 (0.36, 1.47)
BMI**	1.22 (0.99, 1.49)	1.11 (0.84, 1.48)	1.21 (0.99, 1.47)	1.11 (0.96, 1.27)	0.99 (0.80, 1.24)	1.10 (0.94, 1.29)
WOMAC**	**1.18 (1.08, 1.28)**	1.04 (0.95, 1.14)	**1.14 (1.05, 1.24)**	1.04 (0.98, 1.10)	1.03 (0.95, 1.11)	1.04 (0.96, 1.11)
OA Symptoms, year	1.02 (0.99, 1.04)	1.00 (0.98, 1.03)	1.00 (0.98, 1.02)	1.01 (0.99, 1.03)	0.99 (0.97, 1.01)	1.01 (0.99, 1.03)
Hip OA	0.93 (0.56, 1.55)	1.65 (0.89, 3.05)	—	1.01 (0.70, 1.47)	1.29 (0.79, 2.12)	—
Knee OA	1.11 (0.40, 3.05)	2.83 (0.97, 8.28)	—	1.18 (0.51, 2.75)	2.07 (0.76, 5.62)	—

*Adjusted for all other variables listed, sample size (n) based on participants with complete data for all variables listed

**Body Mass Index, Western Ontario and McMaster Universities Osteoarthritis Index, Per 5-unit increase

Table 3

Odds ratios (95% CI) from multivariable logistic regression models for the association between participant characteristics and use of topical creams, knee injection, and physical therapy for knee OA for each of the three cohorts *

	Topical Creams			Knee Injection			PT for Knee OA		
	PRIMO-Duke (n=531)	**PRIMO-VA (n=294)**	**PATH-IN (n=335)**	**PRIMO-Duke** ** **(n=489)**	**PRIMO-VA** ** **(n=261)**	**PATH-IN (n=334)**	**PRIMO-Duke** ** **(n=488)**	**PRIMO-VA** ** **(n=261)**	**PATH-IN (n=335)**
Age, year	1.02 (1.00, 1.05)	1.00 (0.97, 1.03)	1.01 (0.99, 1.04)	1.02 (0.99, 1.04)	1.00 (0.97, 1.03)	1.01 (0.99, 1.04)	1.02 (0.99, 1.04)	**0.95 (0.92, 0.98)**	1.01 (0.99, 1.03)
Female	1.47 (0.86, 2.52)	1.53 (0.66, 3.53)	**2.19 (1.18, 4.03)**	0.95 (0.62, 1.47)	0.44 (0.17, 1.18)	**1.75 (1.05, 2.92)**	1.39 (0.87, 2.22)	1.02 (0.42, 2.46)	**2.75 (1.64, 4.60)**
Non-White Race	**1.60 (1.04, 2.47)**	**2.55 (1.51, 4.32)**	**1.90 (1.04, 3.48)**	0.82 (0.55, 1.22)	1.03 (0.59, 1.80)	1.23 (0.66, 2.29)	1.12 (0.74, 1.70)	**2.41 (1.38, 4.18)**	1.14 (0.64, 2.03)
Low Income	0.92 (0.53, 1.59)	1.44 (0.83, 2.50)	1.29 (0.65, 2.56)	0.96 (0.59, 1.57)	**0.51 (0.27, 0.95)**	0.88 (0.43, 1.81)	1.06 (0.63, 1.78)	0.80 (0.44, 1.48)	0.73 (0.37, 1.41)
Fair/Poor Self Rated Health	0.81 (0.48, 1.36)	0.92 (0.52, 1.63)	1.36 (0.64, 2.90)	0.88 (0.53, 1.47)	0.88 (0.47, 1.66)	0.93 (0.42, 2.03)	1.02 (0.60, 1.71)	0.75 (0.40, 1.41)	1.98 (0.95, 4.14)
BMI†	1.00 (0.86, 1.16)	0.97 (0.77, 1.22)	1.19 (1.00, 1.42)	1.06 (0.92, 1.21)	1.06 (0.83, 1.36)	**1.41 (1.16, 1.71)**	1.01 (0.87, 1.17)	0.81 (0.63, 1.02)	1.14 (0.97, 1.35)
WOMAC†	**1.15 (1.07, 1.23)**	1.07 (0.99, 1.16)	**1.11 (1.02, 1.20)**	1.07 (1.00, 1.13)	**1.20 (1.09, 1.31)**	1.08 (1.00, 1.17)	1.06 (0.99, 1.13)	**1.11 (1.02, 1.21)**	0.97 (0.90, 1.04)
OA Symptoms, year	0.99 (0.96, 1.01)	0.98 (0.52 1.63)	1.02 (1.00, 1.04)	1.00 (0.99, 1.02)	1.01 (0.99, 1.04)	1.02 (1.00, 1.04)	**1.03 (1.01, 1.05)**	1.03 (1.00, 1.06)	1.02 (1.00, 1.04)
Hip OA	0.90 (0.59, 1.39)	1.26 (0.75, 2.12)	—	—	—	—	—	—	—
Knee OA	2.08 (0.58, 7.49)	1.95 (0.67, 5.70)	—	—	—	—	—	—	—

* Adjusted for all other variables listed, sample size (n) based on participants with complete data for all variables listed

** Sample size included only those with knee OA for PRIMO-Duke, n=496 and PRIMO-VA, n=268

† Body Mass Index, Western Ontario and McMaster Universities Osteoarthritis Index, Per 5-unit increase