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Prevalence rates of arthritis among US older adults with varying degrees of depression: Findings from the 2011 to 2014 National Health and Nutrition Examination Survey

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Abstract

Objective: Arthritis and depressive symptoms often interact and negatively influence one another to worsen mental and physical health outcomes. Better characterization of arthritis rates among older adults with different levels of depressive symptoms is an important step toward informing mental health professionals of the need to detect and respond to arthritis and related mental health complications. The primary objective is to determine arthritis rates among US older adults with varying degrees of depression.

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CONFLICT OF INTEREST

None declared.

Methods: Using National Health and Nutrition Examination Survey 2011 to 2014 data ($N=4792$), we first identified participants aged ≥ 50 years. Measures screened for depressive symptoms and self-reported doctor-diagnosed arthritis. Weighted logistic regression models were conducted.

Results: Prevalence of arthritis was 55.0%, 62.9%, and 67.8% in participants with minor, moderate, and severe depression, respectively. In both unadjusted and adjusted regression models, a significant association between moderate depression and arthritis persisted. There were also significant associations between minor and severe depression with arthritis.

Conclusions: Arthritis is commonly reported in participants with varying degrees of depression. This study highlights the importance of screening for and treating arthritis-related pain in older adults with depressive symptoms and the need for future geriatric psychiatry research on developing integrated biopsychosocial interventions for these common conditions.

Keywords

arthritis; depression; depressive symptoms; elderly; epidemiology; older adults

1 | INTRODUCTION

Arthritis is a highly prevalent, costly, and often disabling chronic condition in older adults. Prevalence of doctor-diagnosed arthritis is more common with older age, rising from 24.3% in adults more than 45 years old to 47.4% in adults ages 65 and older in the United States.¹ Arthritis is among the leading reasons for seeking health care, with total US national health expenditures related to arthritis exceeding \$81 billion per year.² It also remains a major cause of functional disability and rates of arthritis-attributable activity limitation are high and increasing over time. Forty-three percent of adults with arthritis reported arthritis-attributable activity limitation in 2015, an increase of almost 20% from 2002.³ The functional disability related to arthritis can be explained in part by a lack of evidence-based therapies to restore cartilage loss and the limited number of effective and safe therapies for the treatment of the physical components of pain.⁴ In addition, many patients with arthritis have multiple co-morbid medical conditions including obesity, heart disease, kidney disease, and diabetes, which can limit treatment options given the possibility for adverse drug-drug interactions.³

The clinical burden of arthritis is also due, in part, to the lack of effective treatments for the affective-emotional dimensions of chronic pain.⁵ Emotional disturbance such as any depressive symptoms and mild-to-moderate depression are even more prevalent than major depression in later life.⁶ The consequences of less severe depressive symptoms in older adults with arthritis are similar to those of major depression, including increased pain and functional impairment, which in turn, negatively affect treatment outcomes and heighten mortality risk.⁷⁻¹¹ As such, it is important to consider the potential health impacts of different levels of depressive symptoms. Depression is highly prevalent yet one of the most under-treated and poorly understood psychosocial factors related to arthritis,¹² with nearly half of older adults with both chronic pain and depression receiving either inadequate or no mental health care.¹³

Although depression and arthritis are well-documented comorbidities,¹⁴⁻¹⁶ the epidemiology of arthritis among older adults with depression is not established. Furthermore, arthritis rates among older adults with varying levels of depressive symptoms has received little attention.^{17,18} The opposing trends are known, with prevalence rates of depression in US adults aged 45 and older with arthritis estimated to be 18%.¹⁹ However, most previous studies have focused on arthritis patients from small, clinic-based samples,^{13,20-25} limiting knowledge of co-occurring arthritis and depression in the broader population.

The biopsychosocial model of chronic pain conceptualizes the physical as well as psychosocial factors (eg, depressive symptoms) of arthritis,²⁶ which often interact and negatively influence one another to worsen health outcomes.^{27,28} Depressive symptoms, including minor-to-moderate depression, are linked to greater functional disability, higher health care utilization, increased suicidal ideation, and heightened rates of mortality.⁶ Better characterization of arthritis rates among older adults with different degrees of depressive symptoms is an important step toward informing mental health professionals of the need to detect and respond to arthritis and related mental health disorders.

The main purpose of this paper is to describe recent, US national-level estimates of arthritis rates among community-dwelling adults over age 50 with varying levels of depressive symptoms. More specifically, the aims of the current study are to (1) determine the prevalence of arthritis in older adults with minor, moderate, and severe depression (defined below); and (2) examine the rates of arthritis among older adults with varying severity of depression as compared with older adults without depressive symptoms. Given that psychiatry services for older adults are often complicated by various biopsychosocial factors that impact long-term function including treatment outcomes, these estimates of co-occurring arthritis among older adults with varying degrees of depression can inform mental health professionals in primary care and specialty care services and establish priorities for resource allocation.

2 | METHODS

2.1 | Survey description

The National Health and Nutrition Examination Survey (NHANES) data were fielded by the US National Center for Health Statistics, a part of the Centers for Disease Control and Prevention, and surveys have been conducted annually since 1999. The NHANES is a cross-sectional survey representative of the civilian, noninstitutionalized US population. The survey is a complex, multistage, stratified design, and oversamples minorities and older adults. Interviews and examinations were performed by trained staff with automated data collection. Questions were directed to the respondent or if necessary to their proxy. Other information on sampling, study design, and components are described at <http://www.cdc.gov/nchs/nhanes>. To obtain an adequate sample size for the planned cross-sectional analyses, we combined NHANES data from two recent waves, ie, 2011 to 2012 and 2013 to 2014 waves. Ethics approval for this study with de-identified data was not required in accordance with the policy of [blinded].

2.2 | Study population

A total of 11 539 participants 18 years of age and older were sampled and interviewed. Of those interviewed, we excluded participants <50 years of age ($N = 6272$) and any participants who did not have depression scores and arthritis information, which allowed us to examine arthritis rates in older adults with varying degrees of depressive symptoms. We used the cutoff of 50 years as a designation for “older adults” in this study. Previous literature on aging and mental health has defined the threshold for “older” to begin at age 50 or 55 to account for the early development of functional impairment in this population.²⁹ Other exclusions were based on true missing data from either depression or arthritis-related questions, which resulted in a final analytic sample of 4792 participants aged 50 years and older.

2.3 | Primary variables

For the main outcome (self-report of doctor-diagnosed arthritis), we identified participants who answered yes to the question “Has a doctor ever told you have arthritis?” Depressive symptoms were assessed by the Patient Health Questionnaire (PHQ-9). The PHQ-9 is a 9-item screening instrument that asks about the frequency of symptoms of depression over the past 2 weeks.^{30,31} Total PHQ-9 scores range from 0 to 27. We defined PHQ-9 total scores with the ranges of 0 and 4 as *no depression* and 5 and 9 as *minor depression*. *Moderate depression* was classified with the range of 10 and 14,³² which is consistent with clinically relevant depression process and outcome performance measures recommended by the National Quality Forum.³³ In addition, those with PHQ-9 scores 15 were categorized as having *severe depression*, suggesting the presence of major depression for which active treatment with pharmacotherapy and/or psychotherapy is recommended.³¹

2.4 | Sociodemographic and health covariates

Interviewers ascertained participants' birthdates, gender, race/ethnicity status, and educational attainment by self-report through the initial screening questionnaire. Gender was categorized as: 1 = male, 0 = female. Race/ethnicity was classified as a categorical variable with = non-Hispanic white and 0 = non-Hispanic black, Hispanic-American, or other. Educational attainment was categorized as 1 = more than high school education, 0 = less than high school education.

Smoking status was established by responses to: “Do you now smoke cigarettes?” Participants who answered “some days” or “every day” were classified as current smokers (1 = currently smokes, 0 = does not currently smoke). Participants with a current history of drinking were ascertained with the following question: “In the past 12 months, on how many days did you have 4 (female)/5 (male) or more drinks of any alcoholic beverage?” Participants who answered 1 were classified as having a recent binge drinking episode (1 = binge drinking, 0 = no binge drinking). Sedentary behavior time was classified into mean tertile units in minutes. Participants were first prompted with a definition of activities involving sedentary behavior. Participants then answered with time in minutes to: “How much time do you usually spend sitting on a typical day?”

We defined obesity as a BMI ≥ 30 kg/m². Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared. All body measurements and procedures were performed on the right side of the body, except where casts, amputations, or other factors prevented the assessment. Weight was measured on an electronic digital scale calibrated in kilograms. Height was measured with a stadiometer in meters.

Participants were classified as having diabetes mellitus through an affirmative response to the question: “Have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?” Hypertension was identified by asking: “Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?” Heart disease was ascertained by an affirmative response to: “Has a doctor or other health care professional ever told you had congestive heart failure, coronary heart disease, angina, or heart attack?”

2.5 | Statistical analyses

Sociodemographic and health characteristics were analyzed using frequencies, percentages, means, and standard errors. Mobile Examination Center sample weights and the appropriate home-examined sample design variables (strata, primary sampling unit) were used in the analysis to account for the complex survey design (including oversampling) and survey nonresponse, and were post-stratified to obtain nationally representative estimates of the US civilian non-institutionalized population using the R package *survey* (). Prevalence rates were analyzed using frequencies, with statistical testing performed using t-tests with an α -level of <0.05 denoting statistical significance. Adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated using four different multiple logistic regression models for arthritis diagnosis outcome (referent = no arthritis) by minor depression (categorical variable using PHQ-9 score range of 5 to 9), moderate depression (categorical variable using PHQ-9 score range of 10 to 14), and severe depression (categorical variable using PHQ-9 score range of 15). For depression categories, no depression (PHQ-9 score range of 0 to 4) was the reference group. For model adjustment, sociodemographic and health covariates were selected based on prior arthritis and depression research.³⁴⁻³⁸ The first model was unadjusted (Model 1); the second included age and gender (Model 2); the third included Model 2 covariates and race, education, smoking status, binge drinking, and sedentary behavior (Model 3); and the fourth included all the covariates and obesity, diabetes, hypertension, and heart disease (Model 4). Adjusted ORs with a 95% CI not including the value of one were considered statistically significant. Analyses were conducted using R (version 3.3.2; The R Foundation for Statistical Computing).

3 | RESULTS

Our analytic sample included 2483 women and 2309 men aged 50 years and older, as indicated in Table 1. Participant mean age was 64.5 years (SE ± 9.3). Less than half, 2096 (43.7%) participants, identified themselves as non-Hispanic white, and approximately half of the participants (51.1%) reported fewer than 12 years of education. Over one-quarter, 749 (27.0%) participants, reported a recent binge drinking episode, and 799 (33.6%) were

classified as current smokers. The average time spent each day in sedentary behavior was 394 minutes (SE \pm 198.4) or 6.57 hours. With respect to medical co-morbidities, 1896 (39.3%) of participants were classified as having obesity, 1035 participants (22.5%) had diabetes mellitus, 2714 (56.7%) had hypertension, and 339 (7.1%) had heart disease.

Arthritis prevalence rates in the total sample and in the various depression subgroups are shown in Table 2. The prevalence rates are further stratified by age categories. For the total sample, 2094 participants (43.7%) reported doctor-diagnosed arthritis, with arthritis rates increasing with age and highest in the 70 to 79 year (51.5%) and 80+ year (57.1%) categories. Arthritis rates were lowest in participants with no depression, with 1345 (38.2%) non-depressed individuals with self-reported doctor-diagnosed arthritis. For the subgroup with minor depression, 413 out of 754 (55.0%) participants reported having a diagnosis of arthritis. Within the minor depression category, prevalence rates of depression were similar across the various age subgroups (15.5% to 15.9%). However, prevalence rates of arthritis in minor depression increased between 50 to 59 and 60 to 69 years (44.7% to 57.9%) and remained similar across the age categories. In total, 195 out of 310 (62.9%) and 141 out of 208 (67.8%) participants with moderate and severe depression, respectively, reported an arthritis diagnosis. With increasing age categories, moderate-to-severe depression rates showed a progressive decline, from 6.5% and 4.3% to 5.4% and 2.9%, respectively. Across the age categories, arthritis rates among those with moderate-to-severe depression increased between 50 to 59 and 60 to 69 years (from 53.1% and 59.6% to 69.2% and 73.7%, respectively) and stabilized in advancing age categories.

Figures 1 and 2 present the score distribution of depressive symptoms in persons with and without arthritis. There was a significant difference between individuals with (versus those without) arthritis (mean PHQ-9 score = 4.6 vs 2.6; $P < .001$).

As presented in Table 3, all of the unadjusted models for varying degrees of depressive symptoms were significantly associated with arthritis diagnosis as the outcome. After adjusting for sociodemographic and health characteristics, minor depression remained significantly associated with arthritis in Models 1, 2, and 3 (ORs: 1.10-1.12; CIs: 1.02-1.18). Moderate depression was associated with arthritis in all adjusted models (ORs: 1.24-1.27; CIs: 1.12-1.40). Severe depression was associated with arthritis in the Models 1 and 2 (ORs: 1.21-1.22; CIs = 1.08-1.36).

3.1 | Post hoc test

To examine whether there were significant differences between the associations for (1) the minor depression category with arthritis outcome and (2) moderate-to-severe depression categories (clinical depression; PHQ-9 total scores ≥ 10) with arthritis outcome, we performed comparison models. In an unadjusted model, clinical depression (referent: minor depression) had a significant association with arthritis (OR: 1.26; CI: 1.19-1.33). With age and gender adjustments, clinical depression remained significantly associated with arthritis (OR: 1.26; CI: 1.19-1.32). After controlling for age and gender, in addition to race, education, smoking status, binge drinking, and sedentary behavior, clinical depression persisted in the significant association with arthritis (OR: 1.24; CI: 1.11-1.38). Finally, after adjusting for all of the previous covariates and obesity, diabetes, hypertension, and heart

disease, clinical depression remained significantly associated with arthritis (OR: 1.21; CI: 1.09-1.34).

4 | DISCUSSION

This study examined recent, US national-level estimates of arthritis among community-dwelling adults over the age of 50 years with minor depression, moderate depression, and severe depression. A secondary objective was to examine the rates of arthritis among older adults with varying severity of depression as compared with older adults without depressive symptoms. Overall, we found higher arthritis prevalence rates of 55.0%, 62.9%, and 67.8% in participants with minor, moderate, and severe depression, respectively. The findings endorse the importance of considering arthritis and depressive symptoms as frequently co-occurring physical and psychosocial issues for older adults.

Similar to previous research,³⁹ arthritis prevalence was high in adults 50 years (43.7%) and rates increased across age categories and was highest (51.5% to 57.1%) in groups aged 70 years. Arthritis rates were lowest in participants 50 years with no depression (38.2%). For participants with varying depression severity, arthritis rates ranged from 53.1% to 73.7% and demonstrated the largest increase in prevalence between 50 to 59 and 60 to 69 years, remaining similar across advancing age groups. Our findings on arthritis rates in older adults with depressive symptoms are analogous to other cross-sectional, population-based surveys on the higher rates of depression (18%) among US adults 45 years and older with arthritis.¹⁹

Consistent with our expectations, we also found that higher rates of arthritis were reported by older adults with various degrees of depression compared with those without sub-clinical and clinical levels of depressive symptoms. This pattern is consistent with other studies on associations between arthritis and depression in older adults.⁴⁰⁻⁴² Notably, there were significant associations between moderate depression and arthritis, even after adjusting for age, gender, race, education, smoking status, binge drinking, sedentary behavior, obesity, diabetes, hypertension, and heart disease. These findings suggest that moderate depression and arthritis tend to co-occur among older adults, independent of other factors that are known contributors to both depression and arthritis. There were also associations between minor depression and arthritis in all models, with the exception for the model including medical co-morbidities. Finally, there were unadjusted and age-adjusted and gender-adjusted associations between severe depression and arthritis. Interestingly, however, the severe depression-arthritis links did not remain significant after adjusting for other sociodemographic and health characteristics. One possible explanation for the lack of significance after adjustments is that the size of the severe depression subsample may have limited statistical power and reduced the ability to ascertain associations. Another reason may be that this finding suggests that other sociodemographic and health characteristics may be equally or more important than severe depression to the increased likelihood of arthritis diagnosis. For instance, older adults with multiple chronic conditions have been shown to be more likely to also report doctor-diagnosed arthritis.⁴³

A post hoc test indicated there were significant differences between the associations for minor depression with arthritis and the associations for moderate-to-severe depression with

arthritis in both unadjusted and adjusted models. There are several potential reasons for the significantly greater association between higher prevalence of arthritis and increasing severity of depression.⁴⁴ First, arthritis and disability in older adults have been well-established as major risk factors for depression in older adults,⁶ which indicates there may be a bidirectional relationship between these physical and mental health conditions. However, research has also indicated that persons with a history of major depression often report higher levels of pain even prior to the onset of arthritis.⁴⁵ Second, higher arthritis prevalence and depression severity may be associated with greater frequency in cognitive distortions such as catastrophizing about potential treatment and rehabilitation outcomes.⁴⁶ Third, the association between depression and arthritis may be linked to poorer coping strategies including reduced physical activity and behavioral inactivation--both risk factors for depression and arthritis.⁴⁷ Finally, it is possible that a common biological mechanism such as neuroimmune dysregulation resulting in inflammation may be associated with the onset and worsening of both arthritis^{48,49} and depression.^{50,51} Given that the NHANES dataset does not include self-report measures on cognitive-behavioral coping strategies or immune dysfunction biomarkers, future studies would benefit from exploring the shared relationships between these biopsychosocial variables with depressive symptoms and arthritis using other large population-based samples.

Although it is well established that clinicians should screen for depressive symptoms in patients with clinically relevant pain from arthritis, the reverse may not hold true. In light of the current study's findings on high rates of arthritis among older adults with depression and elevated depressive symptoms, it may be important to screen for and treat both common conditions in older adults with or at risk for depression in primary care, specialty pain care, and mental health and behavioral health clinics. Because there are numerous adverse health consequences of depressive symptoms alone and without the added burden of arthritis, the findings from this study imply that it may be critical for mental health care providers to provide regular arthritis-related pain assessments and evidence-based treatments for co-occurring arthritis in older adults with or at risk for depression. Addressing arthritis in mental health treatment and behavioral medicine may also help to reduce the overlapping cognitive, behavioral, and somatic symptoms in older adults with depressive symptoms and arthritis, which may be difficult for providers to disentangle through brief screening procedures and treat through conventional depression care.⁴⁴

While this is one of the few studies to investigate arthritis rates in older adults with varying degrees of depression,^{17,18} there are several limitations to consider. First, we used cross-sectional data, limiting our ability to draw conclusions about the causality or direction of associations. The use of longitudinal data to examine other time points and better understand the trajectories of arthritis and depression in older adults are needed. We were also limited to self-reported measures of depression and arthritis, which may be subject to reporting and measurement bias. The assessment of arthritis did not distinguish between types of arthritis (eg, osteoarthritis, rheumatoid, inflammatory). Survey weights were used with analyses to reduce sampling bias, yet some biases likely remain due to the nature of sampling within difficult-to-reach older populations (eg, persons with severe mental illness). Finally, this study did not address other relevant physical and psychosocial factors related to depression and arthritis, including physical factors like pain severity and functional disability,^{40,41} other

psychological factors such as anxiety, anger, trauma, or psycho-sis,⁴² or social factors including family, friend, and significant other support.^{52,53} Receipt of pharmacological treatments (eg, prescription opioid use) or non-pharmacological interventions (eg, cognitive-behavioral therapy for pain) for arthritis and other chronic pain conditions was also not assessed. Subsequent work should explore how such physical, psychosocial, and treatment factors may interact to shape associations between depression and arthritis in later life.

5 | CONCLUSION

This study works toward building a foundation for a better understanding of the relationship between arthritis and varying levels of depressive symptoms among older adults. Drawing from a nationally representative dataset, these findings shed light on the high prevalence of arthritis among older adults with varying degrees of depression compared with the significantly lower arthritis rates among older adults without depressive symptoms. Understanding that depressive symptoms and arthritis may be interlinked in older adults is critical when making decisions for health care budget allocation to ensure availability and access to appropriate services. To provide streamlined care and cost-effective care, future research in geriatric psychiatry is needed to develop and test pilot integrated biopsychosocial strategies and interventions targeting both arthritis and depressive symptoms for delivery by mental health professionals in primary care and specialty care services.

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REFERENCES

1. Hootman JM, Helmick CG, Barbour KE, Theis KA, Boring MA. Updated projected prevalence of self-reported doctor-diagnosed arthritis and arthritis-attributable activity limitation among US adults, 2015–2040. *Arthritis Rheumatol*. 2016;68(7):1582–1587. [PubMed: 27015600]
2. Yelin E, Murphy L, Cisternas MG, Foreman AJ, Pasta DJ, Helmick CG. Medical care expenditures and earnings losses among persons with arthritis and other rheumatic conditions in 2003, and comparisons with 1997. *Arthritis Rheum*. 2007;56(5):1397–1407. [PubMed: 17469096]
3. Barbour KE. Vital signs: prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation—United States, 2013–2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(9):246–253. [PubMed: 28278145]

4. Chen D, Shen J, Zhao W, et al. Osteoarthritis: toward a comprehensive understanding of pathological mechanism. *Bone Res.* 2017;5:1–13.
5. Stone RC, Baker J. Physical activity, age, and arthritis: exploring the relationships of major risk factors on biopsychosocial symptomology and disease status. *J Aging Phys Act.* 2014;22(3):314–323. [PubMed: 23881509]
6. Meeks TW, Vahia IV, Lavretsky H, Kulkarni G, Jeste DV. A tune in “a minor” can “b major”: a review of epidemiology, illness course, and public health implications of subthreshold depression in older adults. *J Affect Disord.* 2011;129(1):126–142. [PubMed: 20926139]
7. Ang DC, Choi H, Kroenke K, Wolfe F. Comorbid depression is an independent risk factor for mortality in patients with rheumatoid arthritis. *J Rheumatol.* 2005;32(6):1013–1019. [PubMed: 15940760]
8. Gatchel RJ, Peng YB, Peters ML, Fuchs PN, Turk DC. The biopsychosocial approach to chronic pain: scientific advances and future directions. *Psychol Bull.* 2007;133(4):581–624. [PubMed: 17592957]
9. Harrison M, Reeves D, Harkness E, et al. A secondary analysis of the moderating effects of depression and multimorbidity on the effectiveness of a chronic disease self-management programme. *Patient Educ Couns.* 2012;87(1):67–73. [PubMed: 21767927]
10. Matcham F, Scott IC, Rayner L, et al. The impact of rheumatoid arthritis on quality-of-life assessed using the SF-36: a systematic review and meta-analysis. *Semin Arthritis Rheum.* 2014;44(2):123–130. [PubMed: 24973898]
11. Wolfe F, Michaud K. Predicting depression in rheumatoid arthritis: the signal importance of pain extent and fatigue, and comorbidity. *Arthritis Care Res.* 2009;61(5):667–673.
12. Synnott A, O’Keeffe M, Bunzli S, Dankaerts W, O’Sullivan P, O’Sullivan K. Physiotherapists may stigmatise or feel unprepared to treat people with low back pain and psychosocial factors that influence recovery: a systematic review. *J Physiother.* 2015;61(2):68–76. [PubMed: 25812929]
13. Gleicher Y, Croxford R, Hochman J, Hawker G. A prospective study of mental health care for comorbid depressed mood in older adults with painful osteoarthritis. *BMC Psychiatry.* 2011;11(1):1–10. [PubMed: 21194496]
14. Axford J, Butt A, Heron C, et al. Prevalence of anxiety and depression in osteoarthritis: use of the Hospital Anxiety and Depression Scale as a screening tool. *Clin Rheumatol.* 2010;29(11):1277–1283. [PubMed: 20721594]
15. Matcham F, Rayner L, Steer S, Hotopf M. The prevalence of depression in rheumatoid arthritis: a systematic review and meta-analysis. *Rheumatology.* 2013;52(12):2136–2148. [PubMed: 24003249]
16. Ohayon MM, Schatzberg AF. Using chronic pain to predict depressive morbidity in the general population. *Arch Gen Psychiatry.* 2003;60(1):39–47. [PubMed: 12511171]
17. Magni G, Caldieron C, Rigatti-Luchini S, Merskey H. Chronic musculoskeletal pain and depressive symptoms in the general population. An analysis of the 1st National Health and Nutrition Examination Survey data. *Pain.* 1990;43(3):299–307. [PubMed: 2293141]
18. Magni G, Marchetti M, Moreschi C, Merskey H, Luchini SR. Chronic musculoskeletal pain and depressive symptoms in the National Health and Nutrition Examination I. Epidemiologic follow-up study. *Pain.* 1993;53(2):163–168. [PubMed: 8336986]
19. Murphy LB, Sacks JJ, Brady TJ, Hootman JM, Chapman DP. Anxiety and depression among US adults with arthritis: prevalence and correlates. *Arthritis Care Res.* 2012;64(7):968–976.
20. Covic T, Cumming SR, Pallant JF, et al. Depression and anxiety in patients with rheumatoid arthritis: prevalence rates based on a comparison of the Depression, Anxiety and Stress Scale (DASS) and the Hospital, Anxiety and Depression Scale (HADS). *BMC Psychiatry.* 2012;12(1):6. [PubMed: 22269280]
21. El-Miedany YM, El Rasheed AH. Is anxiety a more common disorder than depression in rheumatoid arthritis? *Joint Bone Spine.* 2002; 69(3):300–306. [PubMed: 12102277]
22. Hawley DJ, Wolfe F. Depression is not more common in rheumatoid arthritis: a 10-year longitudinal study of 6,153 patients with rheumatic disease. *J Rheumatol.* 1993;20(12):2025–2031. [PubMed: 8014929]

23. Ødegård S, Finset A, Mowinckel P, Kvien TK, Uhlig T. Pain and psychological health status over a 10-year period in patients with recent onset rheumatoid arthritis. *Ann Rheum Dis.* 2007;66(9):1195–1201. [PubMed: 17392351]
24. Rosemann T, Backenstrass M, Joest K, Rosemann A, Szecsenyi J, Laux G. Predictors of depression in a sample of 1,021 primary care patients with osteoarthritis. *Arthritis Care Res.* 2007;57(3):415–422.
25. Söderlin MK, Hakala M, Nieminen P. Anxiety and depression in a community-based rheumatoid arthritis population. *Scand J Rheumatol.* 2000;29(3):177–183. [PubMed: 10898071]
26. Keefe FJ, Smith SJ, Buffington AL, Gibson J, Studts JL, Caldwell DS. Recent advances and future directions in the biopsychosocial assessment and treatment of arthritis. *J Consult Clin Psychol.* 2002; 70(3):640–655. [PubMed: 12090374]
27. Furner SE, Hootman JM, Helmick CG, Bolen J, Zack MM. Health-related quality of life of US adults with arthritis: analysis of data from the behavioral risk factor surveillance system, 2003, 2005, and 2007. *Arthritis Care Res.* 2011;63(6):788–799.
28. Hootman JM, Helmick CG, Brady TJ. A public health approach to addressing arthritis in older adults: the most common cause of disability. *Am J Public Health.* 2012;102(3):426–433. [PubMed: 22390506]
29. Bartels SJ, Pratt SI, Mueser KT, et al. Integrated IMR for psychiatric and general medical illness for adults aged 50 or older with serious mental illness. *Psychiatr Serv.* 2014;65(3):330–337. [PubMed: 24292559]
30. Kroenke K, Spitzer RL. The PHQ-9: a new depression diagnostic and severity measure. *Psychiatric Annals.* 2002;32(9):509–515.
31. Kroenke K, Spitzer RL, Williams JB. The Phq-9. *J Gen Intern Med.* 2001;16(9):606–613. [PubMed: 11556941]
32. Manea L, Gilbody S, McMillan D. Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): a meta-analysis. *Can Med Assoc J.* 2012;184(3):E191–E196. [PubMed: 22184363]
33. National Quality Measures C Depression: percent of clinically significant depression patients who attain a 5 point or greater reduction in Patient Health Questionnaire (PHQ) score within 6 months after their New Episode PHQ. 2005.
34. An R, Xiang X. Smoking, heavy drinking, and depression among US middle-aged and older adults. *Prev Med.* 2015;81:295–302. [PubMed: 26436684]
35. Fiske A, Wetherell JL, Gatz M. Depression in older adults. *Annu Rev Clin Psychol.* 2009;5(1):363–389. [PubMed: 19327033]
36. Teychenne M, Ball K, Salmon J. Sedentary behavior and depression among adults: a review. *Int J Behav Med.* 2010;17(4):246–254. [PubMed: 20174982]
37. Yoshimura N, Muraki S, Oka H, et al. Mutual associations among musculoskeletal diseases and metabolic syndrome components: a 3-year follow-up of the ROAD study. *Mod Rheumatol.* 2015;25(3):438–448. [PubMed: 25411893]
38. Xiang X, An R. Depression and onset of cardiovascular disease in the US middle-aged and older adults. *Aging Ment Health.* 2015;19(12):1084–1092. [PubMed: 25616725]
39. Patel KV, Guralnik JM, Dansie EJ, Turk DC. Prevalence and impact of pain among older adults in the United States: findings from the 2011 National Health and Aging Trends Study. *Pain.* 2013;154(12):2649–2657. [PubMed: 24287107]
40. Margaretten M, Julian L, Katz P, Yelin E. Depression in patients with rheumatoid arthritis: description, causes and mechanisms. *Int J Clin Rheumatol.* 2011;6(6):617–623.
41. Nicassio PM. The significance of behavioral interventions In: Weisman MH, Weinblatt ME, Louie JS, Van Vollenhoven RF, eds. *Targeted Treatment of the Rheumatic Diseases.* 1st ed. Philadelphia: Elsevier; 2009:397–407.
42. Sturgeon JA, Finan PH, Zautra AJ. Affective disturbance in rheumatoid arthritis: psychological and disease-related pathways. *Nat Rev Rheumatol.* 2016;12(9):532–542. [PubMed: 27411910]
43. Freid VM, Bernstein AB, Bush MA. Multiple chronic conditions among adults aged 45 and over: trends over the past 10 years. *Women.* 2012;45:1–8.

44. Nicassio PM. Arthritis and psychiatric disorders: disentangling the relationship. *J Psychosom Res.* 2010;68(2):183–185. [PubMed: 20105701]
45. Fifield J, Tennen H, Reisine S, McQuillan J. Depression and the long-term risk of pain, fatigue, and disability in patients with rheumatoid arthritis. *Arthritis Rheum.* 1998;41(10):1851–1857. [PubMed: 9778227]
46. Edwards RR, Bingham CO, Bathon J, Haythornthwaite JA. Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. *Arthritis Care Res.* 2006;55(2):325–332.
47. van't Land H, Verdurmen J, ten Have M, van Dorsselaer S, Beekman A, de Graaf R. The association between arthritis and psychiatric disorders; results from a longitudinal population-based study. *J Psychosom Res.* 2010;68(2):187–193. [PubMed: 20105702]
48. Celi ska-Löwenhoff M, Musiał J. Psychiatric manifestations of autoimmune diseases—diagnostic and therapeutic problems. *Psychiatr Pol.* 2012;46(6):1029–1042. [PubMed: 23479944]
49. Gálvez I, Torres-Piles S, Hinchado M, et al. Immune-neuroendocrine dysregulation in patients with osteoarthritis: a revision and a pilot study. *Endocr Metab Immune Disord Drug Targets.* 2017;17(1). 10.2174/1871530317666170320113613
50. Boter Carbonell C, Caceres M, Cabeza EM. Relationship between chronic inflammation and depression. 2016.
51. Miller AH, Raison CL. The role of inflammation in depression: from evolutionary imperative to modern treatment target. *Nat Rev Immunol.* 2016;16(1):22–34. [PubMed: 26711676]
52. Hung M, Bounsanga J, Voss MW, Crum AB, Chen W, Birmingham WC. The relationship between family support; pain and depression in elderly with arthritis. *Psychol Health Med.* 2017;22(1):75–86. [PubMed: 27427504]
53. Lee JE, Kahana B, Kahana E. Social support and cognitive functioning as resources for elderly persons with chronic arthritis pain. *Aging Ment Health.* 2016;20(4):370–379. [PubMed: 25806938]

Key points

- Self-reported doctor-diagnosed arthritis is highly prevalent among older adults with varying severity levels of depression.
- Mental health care providers should provide regular arthritis-related pain assessments and evidence-based treatments for co-occurring arthritis among older adults with or at risk for clinically relevant depression.
- The findings from this study implicate the need to develop and test integrated biopsychosocial interventions for these common conditions.

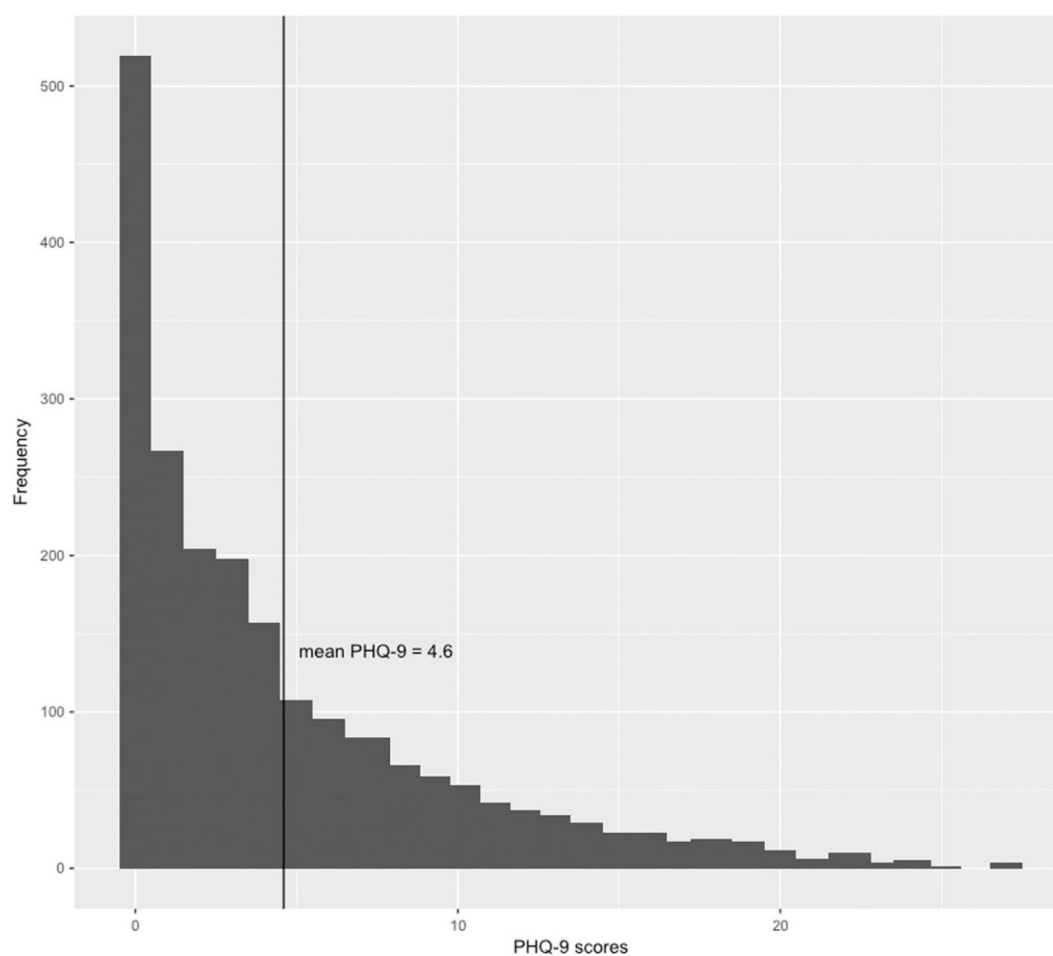


FIGURE 1.

Note. PHQ-9 scores represent the average scores for depression. PHQ-9 scores for no depression = 0-4, minor depression = 5-9, moderate depression = 10-14, and severe depression = 15

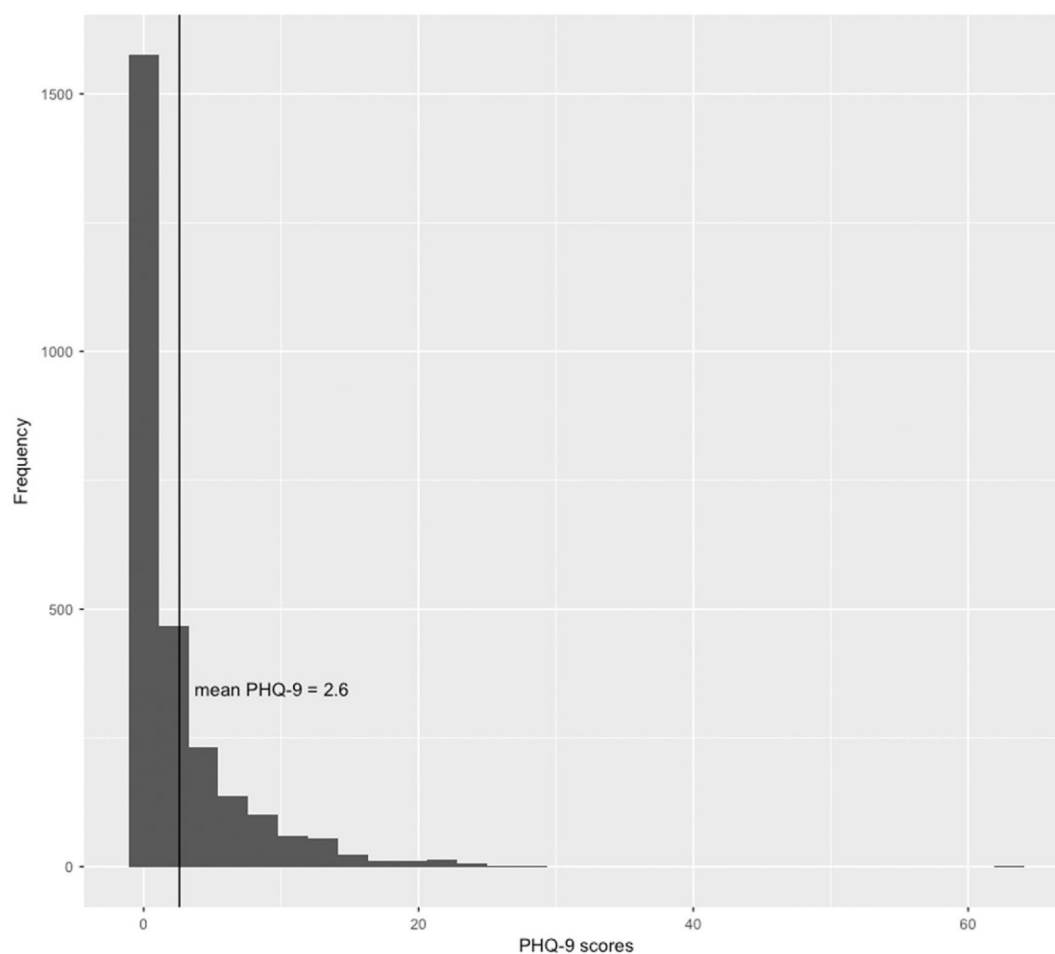


FIGURE 2.

Note. PHQ-9 scores represent the average scores for depression. PHQ-9 scores for no depression = 0-4, minor depression = 5-9, moderate depression = 10-14, and severe depression = 15

TABLE 1

Sociodemographic and health characteristics of cohort

Variable	Total sample (<i>n</i> = 4792)
Mean age (mean years \pm SD)	64.5 \pm 9.3
50-59	1594 (33.3)
60-69	1689 (35.2)
70-79	949 (19.8)
80	560 (11.7)
Female sex	2483 (51.8)
Race	---
Non-Hispanic White	2096 (43.7)
Non-Hispanic Black	1187 (24.8)
Hispanic-American	945 (19.7)
Other	744 (11.8)
Current smoker	799 (33.6)
Recent binge drinking episode	749 (27.0)
Education	---
<12 years	2451 (51.1)
>12 years	2341 (48.9)
Sedentary behavior (mean min. \pm SD)	394.0 \pm 198.4
Obesity	1856 (39.3)
Comorbidities	---
Diabetes mellitus	1035 (22.5)
Hypertension	2714 (56.7)
Heart disease	339 (7.1)

Note. Means \pm standard deviations are presented for continuous variables, counts (weighted percentages) for categorical variables.

Obesity is defined as a BMI ≥ 30 kg/m².

TABLE 2

Arthritis rates in total sample and depression subgroups

Sample Characteristics	Overall Cohort (50 Years)	50-59 Years	60-69 Years	70-79 Years	80+ Years
Number of participants from total sample	4792 (100)	1594 (33.3)	1565 (32.7)	887 (18.5)	560 (11.7)
Arthritis in participants from total sample	2094 (43.7)	520 (32.6)	695 (44.4)	457 (51.5)	320 (57.1)
Number of participants with no depression	3520 (73.5)	1135 (23.7)	1130 (23.6)	682 (14.2)	426 (8.9)
Arthritis in participants with no depression	1345 (38.2)	292 (25.7)	418 (37.0)	324 (47.5)	235 (55.2)
Number of participants with minor depression	754 (15.7)	257 (15.5)	242 (15.5)	141 (15.9)	88 (15.7)
Arthritis in participants with minor depression	413 (55.0)	115 (44.7)	140 (57.9)	88 (62.4)	54 (61.4)
Number of participants with moderate depression	310 (6.5)	113 (7.1)	117 (7.5)	41 (4.6)	30 (5.4)
Arthritis in participants with moderate depression	195 (62.9)	60 (53.1)	81 (69.2)	28 (68.3)	20 (66.7)
Number of participants with severe depression	208 (4.3)	89 (5.6)	76 (4.9)	23 (2.6)	16 (2.9)
Arthritis in participants with severe depression	141 (67.8)	53 (59.6)	56 (73.7)	17 (74.0)	11 (68.8)

Note. Arthritis = self-reported doctor-diagnosed arthritis. PHQ-9 scores for no depression = 0-4, minor depression = 5-9, moderate depression = 10-14, and severe depression = 15-19. Prevalence rates are presented as counts (weighted prevalence).

TABLE 3
Regression models for varying degrees of depression by arthritis outcome, weighted estimates

	Model 1		Model 2	Model 3	Model 4
	No depression	Rate (%) 3520 (73.5)	Odds ratios (95% CI) Referent		
Analysis based on three depression categories	Minor depression	754 (15.7)	OR 1.12 (1.08-1.18)	OR 1.12 (1.07-1.17)	OR 1.10 (1.02-1.18)
	Moderate depression	310 (6.5)	OR 1.26 (1.18-1.36)	OR 1.26 (1.17-1.35)	OR 1.24 (1.14-1.40)
	Severe depression	208 (4.3)	OR 1.21 (1.08-1.36)	OR 1.22 (1.11-1.34)	OR 1.12 (0.97-1.30)

Note. Arthritis outcome = self-reported doctor-diagnosed arthritis (referent = no arthritis diagnosis). PHQ-9 scores for no depression = 0-4, minor depression = 5-9, moderate depression = 10-14, and severe depression = 15. For the logistic regression models, values bolded do not include a value of “one” in the confidence intervals and are considered statistically significant at $P < .05$.

Model 1: Unadjusted.

Model 2: Adjusted for age and gender.

Model 3: Model 2 covariates, race, education, smoking status, binge drinking, sedentary behavior.

Model 4: Model 3 covariates, obesity, diabetes, hypertension, heart disease.