

BRIEF REPORT

Brief Report: State-Level Number of Physically Inactive US Adults With Arthritis Who can Improve Their Anxiety and Depression by Exercising

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Objective. Provide state-level estimates of the number of physically inactive adults in the United States with arthritis and other rheumatic and musculoskeletal diseases (RMDs) who could improve their anxiety and depression by exercising.

Methods. Utilizing 1) number-needed-to treat (NNT) data from two prior meta-analyses of randomized controlled trials addressing the effects of exercise on anxiety and depression in adults with arthritis and other RMDs, 2) recent state-level prevalence estimates on arthritis and physical inactivity in adults with arthritis and other RMDs, and 3) state-level 2010 US Census population data, the number of physically inactive adults with arthritis and other RMDs who could improve their anxiety and depression by exercising was estimated.

Results. Across all states and the District of Columbia, the number of adults with arthritis and other RMDs who could improve their anxiety and depression by starting an exercise program was estimated at 3 433 167 (95% confidence interval [CI] = 3 171 000-3 703 522) for anxiety and 2 942 706 (95% CI = 2 718 000-3 174 438) for depression. For anxiety, numbers ranged from 3677 (95% CI = 3235-4154) in the District of Columbia to 271 253 (95% CI = 243 998-298 508) in Texas. For depression, numbers ranged from 3151 (95% CI = 2773-3561) in the District of Columbia to 232 502 (95% CI = 209 140-255 863) in Texas.

Conclusion. These state-specific data suggest that a large number of physically inactive US adults with arthritis and other RMDs could improve their anxiety and depression by starting and maintaining a regular exercise program.

INTRODUCTION

Arthritis and other rheumatic and musculoskeletal diseases (RMDs), a diverse group of diseases that commonly affect the joints (1), are a major public health problem in the United States, affecting an estimated 54.4 million (22.7%) adults 18 years of age or older (2). At the state level, including the District of Columbia, the age-adjusted prevalence of arthritis and other RMDs has been reported to be lowest in the District of Columbia (15.7%, 95% confidence interval [CI], 14.7%-16.9%) and highest in West Virginia (34.6%, 95% CI, 33.1%-36.0%) (3). In terms of costs, the total arthritis-attributable medical care expenditures and earnings losses among adults with arthritis and other RMDs in the United States were estimated to be \$303.5 billion in 2013 (4). Two major conditions associated with arthritis are anxiety and depression. For example, the prevalence of anxiety and

depression in US adults 45 years of age or older with arthritis and other RMDs has been estimated to be 30.5% and 17.5%, respectively (5). One potential nonpharmacological intervention for improving anxiety and depression in adults with arthritis and other RMDs is exercise (6,7). Recent meta-analytic research by the authors found both statistically and practically important standardized mean difference (SMD) reductions in both anxiety (-0.40) (6) and depression (-0.42) (7), regardless of exercise type, in adults with arthritis and other RMDs. In addition to the magnitude of effect observed, the number-needed to treat (NNT) was estimated to be 6 for anxiety (6) and 7 for depression (7). The NNT is an important metric because it provides practical information on the number of people who need to be exposed to an intervention such as exercise in order for one to benefit.

Despite the potential benefits of exercise and physical activity, the prevalence of physical inactivity among US adults with

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SIGNIFICANCE & INNOVATION

- This brief report is significant because it demonstrates that a large number of physically inactive US adults with arthritis and other RMDs could improve their anxiety and depression by starting and maintaining a regular exercise program and that the absolute number varies substantially between states.
- This study is innovative because it takes advantage of existing number-needed-to-treat data from previous meta-analyses, state-level data on the prevalence of arthritis and other RMDs as well as physical inactivity, and US Census population data to derive state-level estimates regarding the number of physically inactive adults in the United States with arthritis and other RMDs who could improve their anxiety and depression by exercising.

arthritis and other RMDs is substantial, with a recent age-adjusted overall prevalence estimate of 33.7% (3). At the state level, the age-adjusted prevalence of physical inactivity was lowest in Colorado (23.2%, 95% CI, 19.7%-27.2%) and highest in Kentucky (44.4%, 95% CI, 40.0%-48.8%) (3).

State-level estimates of the number of people with a certain condition who may benefit from an intervention are important because nationwide data may not be appropriate for the circumstances observed in each state. For example, although the overall prevalence of RMDs in US adults 18 years of age or older is 22.7% (2), the reported prevalence ranges from 15.7% in the District of Columbia to 34.6% in West Virginia (3). Knowledge of this data is important for prioritizing, planning, starting, supporting, and assessing health promotion and disease prevention programs at the state level. To the best of the authors' knowledge, no study has provided state-level estimates regarding the number of physically inactive adults with arthritis and other RMDs who may reduce their anxiety and depression by starting and maintaining a regular exercise program. The purpose of this brief report is to address that gap.

MATERIALS AND METHODS

Data for the current study were derived from the following sources: 1) NNT data from two previous systematic reviews with meta-analyses of randomized controlled trials that examined the effects of exercise (aerobic, strength training, or both) on anxiety and depression in adults with osteoarthritis, rheumatoid arthritis, or fibromyalgia (6,7), 2) recent state-level estimates of the prevalence of arthritis and other RMDs as well as physical inactivity in adults with arthritis and other RMDs (3), and 3) state-level population data from the US Census Bureau for the year 2010 (8). The meta-analysis on exercise and anxiety included 14 studies representing 926 participants (539 exercise, 387 control) that were 18 years of age or older (6), whereas the meta-analysis on exercise and depression included 29 studies representing 2449 participants (1470 exercise, 979 control) that were 18 years of age or older (7).

For both meta-analyses (6,7), exercise was defined according to the US Physical Activity Guidelines for Americans, that is, "a form of physical activity that is planned, structured, repetitive, and performed with the goal of improving health or fitness" (9).

State-level estimates of the number of physically inactive adults 18 years of age and older with arthritis and other RMDs who could improve their anxiety and depression by exercising were derived by multiplying the reciprocal of the NNT by the number of physically inactive adults with arthritis and other RMDs in each state.

The NNT data from the two meta-analyses (6,7) were derived using the formula of Furukawa (10). This consisted of converting the SMD into a log odds ratio and combining it with a control group risk to obtain the absolute risk reduction (10). For both anxiety and depression, the SMD was transformed to a natural log odds ratio, odds ratio, an assumed control risk of 30%, and finally, the NNT (10). The 30% control group risk for anxiety was based on previous research on anxiolytics (11), whereas the 30% control group risk for depression was based on a previous review by Sonawalla and Rosenbaum in which it was reported that mean placebo response rates in antidepressant clinical trials were 30% to 40% (12). The NNT values used were 6 for anxiety (6) and 7 for depression (7). These values were previously calculated from a SMD reduction of -0.40 for anxiety (6) and -0.42 for depression (7). As an example of these state estimates and with a focus on the state of West Virginia (WV) and anxiety as an outcome, the reciprocal of the NNT for anxiety (0.167) was multiplied by the estimated number of physically inactive WV adults with arthritis (237845), derived from the product of the number of adults in WV with arthritis (574506) and percentage of physically inactive WV adults with arthritis (41.4%) to arrive at a number to benefit of 39640. The lower and upper 95% CI were generated following the same approach but now using the lower and upper 95% CI for both the number of people in each state with arthritis and the state-level prevalence of physically inactive adults with arthritis.

Exercise (aerobic, strength training, both) in the anxiety meta-analysis took place over a mean \pm standard deviation of 16 ± 7 weeks, 3 ± 1 times per week, for 29 ± 14 minutes per session (6), whereas studies in the depression meta-analysis lasted 19 ± 16 weeks, 3 ± 1 times per week, for 34 ± 17 minutes per session (7). Overall, exercise was performed at a moderate intensity (13) for the studies included in both meta-analyses (6,7).

State-level estimates of the prevalence of arthritis and other RMDs as well as physical inactivity in adults with arthritis and other RMDs were derived from 2017 Behavioral Risk Factor Surveillance System (BRFSS) data reported in a recent study in which participants were asked whether they had ever been told by a doctor or other health care professional that they had arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia (3). Of the 435331 respondents to the question about arthritis, 144099 (33.1%) reported having arthritis (3). Physical inactivity was defined as a response of "no" to the question, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" (3).

Data for the absolute number of adults 18 years of age and older in each state were obtained from tables based on 2010 US Census Bureau data (8) and used to derive state-level estimates of the prevalence of arthritis and other RMDs as well as physical inactivity in adults with arthritis and other RMDs (3). Although both unadjusted and age-standardized state-level estimates were presented in the Guglielmo et al report (3), crude versus adjusted estimates were used in the current study, given that age-standardized estimates are weighted to a standard population and thus do not typically represent the percentage of individuals that one would

observe in the population when one is interested in calculating the number of individuals, as is the case in the current study. Unless otherwise noted, results are reported using absolute values for each state. All data were analyzed using Microsoft Excel 2016.

RESULTS

State-level estimates of the number of physically inactive adults in the United States with arthritis and other RMDs who could improve their anxiety and depression by starting an exer-

Table 1. State-level estimates of the number of physically inactive adults with arthritis and other RMDs who could improve their anxiety and depression by exercising

State	Anxiety (number, 95% CI)	Depression (number, 95% CI)
Alabama	90 281 (85 220-95 544)	77 383 (73 046-81 894)
Alaska	5 686 (4744-6725)	4 873 (4067-5764)
Arizona	66 551 (63 078-70 023)	57 043 (54 067-60 019)
Arkansas	46 092 (41 892-50 293)	39 507 (35 907-43 108)
California	241 705 (216 262-268 056)	207 175 (185 367-229 762)
Colorado	33 237 (30 388-36 221)	28 488 (26 046-31 047)
Connecticut	33 861 (31 525-36 302)	29 023 (27 022-31 116)
Delaware	11 236 (10 127-12 404)	9 631 (8 680-10 632)
District of Columbia	3 677 (3 235-4 154)	3 151 (2 773-3 561)
Florida	241 010 (224 494-257 526)	206 579 (192 423-220 736)
Georgia	116 878 (108 586-125 436)	100 180 (93 074-107 516)
Hawaii	11 130 (9 909-12 424)	9 540 (8 494-10 649)
Idaho	14 969 (13 454-16 531)	12 831 (11 532-14 169)
Illinois	120 823 (109 731-132 311)	103 562 (94 055-113 409)
Indiana	91 155 (87 001-95 540)	78 133 (74 572-81 891)
Iowa	31 082 (28 991-33 363)	26 641 (24 849-28 597)
Kansas	31 598 (30 232-32 879)	27 084 (25 913-28 182)
Kentucky	82 829 (77 652-88 006)	70 996 (66 559-75 433)
Louisiana	66 267 (61 157-71 376)	56 800 (52 420-61 179)
Maine	16 824 (15 622-18 080)	14 420 (13 390-15 497)
Maryland	64 576 (60 540-68 795)	55 350 (51 891-58 967)
Massachusetts	65 029 (57 736-72 727)	55 739 (49 488-62 337)
Michigan	134 908 (127 243-142 573)	115 635 (109 065-122 205)
Minnesota	43 378 (40 990-45 898)	37 181 (35 134-39 341)
Mississippi	46 550 (42 986-50 115)	39 900 (36 845-42 955)
Missouri	79 713 (74 216-85 211)	68 325 (63 613-73 037)
Montana	11 066 (10 090-12 108)	9 485 (8 648-10 378)
Nebraska	17 553 (16 460-18 702)	15 046 (14 108-16 030)
Nevada	23 346 (20 178-26 721)	20 011 (17 295-22 903)
New Hampshire	14 091 (12 819-15 501)	12 078 (10 987-13 286)
New Jersey	102 437 (95 248-109 626)	87 803 (81 641-93 964)
New Mexico	19 617 (17 798-21 501)	16 814 (15 255-18 429)
New York	197 317 (184 276-211 492)	169 128 (157 950-181 278)
North Carolina	106 196 (96 461-116 521)	91 025 (82 681-99 875)
North Dakota	7 409 (6 837-8 023)	6 351 (5 861-6 877)
Ohio	162 717 (153 748-172 113)	139 471 (131 784-147 525)
Oklahoma	54 125 (50 726-57 524)	46 393 (43 479-49 306)
Oregon	39 560 (35 880-43 372)	33 909 (30 754-37 176)
Pennsylvania	168 322 (154 817-182 308)	144 275 (132 700-156 264)
Rhode Island	13 281 (12 146-14 417)	11 384 (10 411-12 357)
South Carolina	59 719 (56 245-63 193)	51 188 (48 210-54 165)
South Dakota	7 465 (6 605-8 369)	6 398 (5 661-7 174)
Tennessee	98 542 (91 242-105 841)	84 464 (78 207-90 721)
Texas	271 253 (243 998-298 508)	232 502 (209 140-255 863)
Utah	16 804 (15 465-18 266)	14 404 (13 255-15 656)
Vermont	6 486 (5 913-7 105)	5 560 (5 069-6 090)
Virginia	94 122 (88 207-100 551)	80 675 (75 606-86 186)
Washington	52 679 (49 167-56 604)	45 153 (42 143-48 517)
West Virginia	39 640 (37 438-41 939)	33 977 (32 090-35 947)
Wisconsin	51 752 (46 187-57 502)	44 359 (39 589-49 288)
Wyoming	6 598 (6 018-7 178)	5 655 (5 158-6 153)

Abbreviation: CI, confidence interval; RMDs, rheumatic and musculoskeletal diseases.

cise program are shown in Table 1. Across all states, the number of adults with arthritis and other RMDs who could improve their anxiety and depression by starting an exercise program was estimated at 3 433 167 (95% CI = 3 171 000-3 703 522) for anxiety and 2 942 706 (95% CI = 2 718 000-3 174 438) for depression. For anxiety, numbers ranged from a low of 3677 (95% CI = 3235-4154) in the District of Columbia to a high of 271 253 (95% CI = 243 998-298 508) in Texas. For depression, numbers also ranged from a low of 3151 (95% CI = 2773-3561) in the District of Columbia to a high of 232 502 (95% CI = 209 140-255 863) in Texas.

DISCUSSION

The results of the current brief report that include state-level data suggest that a large number of physically inactive US adults with arthritis and other RMDs can improve their anxiety and depression by starting and maintaining a regular exercise program. From the authors' perspective, these findings are important for interventionists as it provides them with data to help support studies regarding the potential benefits of exercise and physical activity on anxiety and depression in adults with arthritis and other RMDs. In addition, it is believed that the current findings are also important for funding agencies and other decision makers, for example, state legislators, as it provides them with information that will be helpful in making decisions regarding the allocation of resources, for example, program funding, as it pertains to the promotion of exercise for improving anxiety and depression, as well as other outcomes, in adults with arthritis and other RMDs. Programs such as Fit and Strong, Walk with Ease, EnhanceFitness, the Arthritis Foundation Exercise Program, and Active Living Every Day may be appropriate (3).

Although these findings are important, they should be considered in concert with the percentage of adults in each state with arthritis and other RMDs as well as the percentage of adults with arthritis and other RMDs that are physically inactive. For example, it has been reported that the state with the lowest age-adjusted prevalence of arthritis and other RMDs is the District of Columbia (15.7%, 95% CI = 14.7%-16.9%) whereas the highest is in West Virginia (34.6%, 95% CI = 33.1%-36.0%) (3). For physical inactivity, the lowest age-adjusted prevalence was reported to be in Colorado (23.2%, 95% CI = 19.7%-27.2%), whereas the highest was in Kentucky (44.4%, 95% CI = 40.0%-48.8%) (3). Finally, given that the focus was on anxiety and depression, and assuming necessary data are available, future researchers should consider generating similar state-level information based on other outcomes considered important in adults with arthritis and other RMDs (physical function, pain, quality of life, fatigue, etc).

The major strength of the current study is the use of different sources of information to arrive at state-level estimates of the number of US adults with arthritis and other RMDs who could improve their anxiety and depression by starting an exercise program. However, the results of these estimates should be interpreted with respect to

several potential limitations. First, given that NNT data were derived from aggregate data meta-analyses (6,7), the potential for ecological fallacy exists (14). Second, because of a lack of data, the impact of the uncertainty in the process of the calculation of the NNT from the mean differences of the previously published meta-analyses via sensitivity analyses could not be conducted (6,7). Third, given the availability of data, the two meta-analyses were limited to adults with osteoarthritis, rheumatoid arthritis, and fibromyalgia (6,7), whereas the BRFSS question included those who responded affirmatively to whether they had ever been told by a doctor that they had arthritis, or rheumatoid arthritis, gout, lupus, or fibromyalgia (3). Fourth, and as previously reported by Guglielmo et al (3), the BRFSS data may have been limited by self-report bias (recall, social desirability, etc), low response rates for some states, and the exclusion of institutionalized populations. Fifth, given that separate state-level estimates were not available for variables such as sex, race/ethnicity, education, and income, data partitioned according to these variables were not possible. Sixth, studies in the two meta-analyses were limited to exercise (6,7), a subset of physical activity, whereas the BRFSS data focused on the assessment of physical activity (3), a more inclusive definition that consists of activities such as gardening and housework (9). However, the investigators believe that these differences had minimal or no impact on the estimates that were derived.

In conclusion, these state-specific data suggest that a large number of physically inactive US adults with arthritis and other RMDs could improve their anxiety and depression by starting and maintaining a regular exercise program. State-level efforts to support participation in exercise programs in adults with arthritis and other RMDs should be encouraged.

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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. G. Kelley had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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