The Effects of Race/Ethnicity and Physician Recommendation for Physical Activity on Physical Activity Levels and Arthritis Symptoms Among Adults With Arthritis

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Research article

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Abstract

Background: Among U.S. adults with physician-diagnosed arthritis, we examined the effects of race/ethnicity and receiving physician exercise recommendation on meeting aerobic and strengthening physical activity guidelines, and arthritis symptoms, and whether race/ethnicity moderates the effects of physician recommendation on activity levels and symptoms.

Methods: Retrospective, cross-sectional study of National Health Interview Survey pooled data from 2002, 2006, 2009, and 2014. The study included 27,887 U.S. adults aged $\geq 18$ years with arthritis. Outcomes were meeting aerobic (yes/no) and strengthening guidelines (yes/no), arthritis-associated activity limitations (yes/no) and arthritis-related pain (0-10; higher score=more pain). Predictors were race/ethnicity (White, African American, Latino, and Asian) and receipt of physician recommendation for exercise (yes/no). Covariates included demographic and health characteristics and U.S. region.

Results: Controlling for covariates, physician exercise recommendation was independently associated with meeting aerobic (AOR=1.14; 95% CI 1.06, 1.24) and strengthening (AOR=1.17; 95% CI 1.06, 1.28) guidelines; effects did not differ by race/ethnicity. African Americans were more likely than Whites to meet strengthening guidelines (AOR=1.22; 95% CI 1.07, 1.40) and Asians were less likely to meet aerobic (AOR=0.80; 95% CI 0.65, 0.99) and strengthening (AOR=0.76; 95% CI 0.60, 0.96) guidelines. Compared to Whites, African Americans (B=0.51; 95% CI 0.26, 0.76) and Latinos (B=0.43; 95% CI 0.14, 0.72) reported more severe, while Asians reported less severe (B=-0.60; 95% CI -1.17, -0.04) joint pain.

Conclusions: Disparities in pain exist for African Americans and Latinos with arthritis. Physician exercise recommendation is critical among patients with arthritis to relieve symptom burden.

Background

In 2015, arthritis affected 23% (54.4 million) of U.S. adults, (1) and is estimated to affect 78.4 million by 2040. (2) The prevalence of disability due to arthritis is expected to increase from 22.7 to 34.6 million Americans by 2040, a 52% increase from 2012. (2) Between 2013–2015, the average prevalence of arthritis was similar between Whites and African Americans (22.6% vs 22.2%) but lower among Latinos (15.7%) and Asians (11.8%).(1) However, arthritis-related activity limitations and pain were significantly higher among African Americans, Latinos, mixed-race, and American Indian/Native Alaskan populations compared to Whites.(1) Effective interventions to address racial/ethnic disparities in symptom burden are warranted.

Physical activity (PA) is a safe, non-pharmacologic, evidence-based intervention to reduce arthritis symptoms. PA is effective at reducing pain and improving function among persons with moderate-to-severe arthritis, and compared to the short-term benefits of nonsteroidal anti-inflammatory drugs and opioids, regular exercise provides more durable benefits. (3–8) Also, exercise improves mood and quality of life in those with chronic pain due to arthritis. (9, 10) Although some evidence suggests that strengthening exercise has a larger effect on pain reduction, (11) both aerobic and strengthening exercises...
are efficacious in reducing pain and improving function; (7) offering patients a choice between the two may improve adherence. (7) Musculoskeletal organizations such as the American Academy of Orthopedic Surgeons (AAOS) and the Osteoarthritis Research Society International (OASRI) have issued consistent recommendations for regular PA for persons with arthritis. (12)

Despite strong evidence that PA is beneficial for people with arthritis, almost one-third of persons with arthritis are completely inactive, and only one-quarter adhere to national PA recommendations. (13) The picture is even bleaker for minorities. African Americans and Latino adults with arthritis were less likely than Whites to meet aerobic physical activity guidelines. (14) In one study among persons with or at risk of knee osteoarthritis, African Americans were 72–76% less likely than Whites to meet PA guidelines. (15)

Receiving advice from a physician to exercise is associated with a higher likelihood of meeting aerobic PA guidelines among those with arthritis. (16) In 2011, only 60% of persons with arthritis received a physician recommendation to exercise for relief of arthritis symptoms. (16) Several studies have demonstrated that African Americans and Latinos with arthritis were less likely to receive PA advice from physicians than their White counterparts. (12, 17) Also, patients most likely to benefit (obese/overweight and those with higher pain levels, comorbidities, and activity limitations) were less likely to have received a physician recommendation to exercise. (18) Yet, studies support recommending PA to reduce arthritis symptoms regardless of patient profile, including radiologic severity and pain levels. (18) Disparities in receipt of physician recommendation for PA for arthritis symptoms could help explain disparities in symptom burden.

Studies examining the role of physician recommendation for PA among persons with arthritis have been limited in that they only asked about PA in general, rather than differentiating between aerobic and muscle strengthening activities. It is important for physicians to know if there is systematic variation in patient preferences in type of PA, as this information could be used to increase adherence. (7)

Using data from the National Health Interview Survey (NHIS), the objectives of this study were to assess the independent effects of race/ethnicity and receipt of physician recommendation for PA on: a) meeting physical activity guidelines, and b) arthritis symptoms (pain and activity limitations). Our study expands prior research by examining whether the effects of physician PA recommendation on meeting PA guidelines is moderated by race/ethnicity. Furthermore, we distinguish between meeting PA guidelines for aerobic and strengthening activities. We hypothesize that physician exercise recommendation may be less effective for African Americans and Latinos (e.g., due to less patient engagement), which may explain partially why these groups suffer from more severe arthritis.

**Methods**

**Study design and sample**

This study used NHIS pooled data from 2002, 2006, 2009, and 2014, linking the Adult Core sample file and Person file for each year. The NHIS is an ongoing, multistage probability cross-sectional in-person
A household survey of a nationally representative sample of the U.S. noninstitutionalized population residing in all 50 U.S. states and the District of Columbia. We selected adults (ages 18 years and older) with self-reported arthritis defined by a “yes” response to the item, “Have you EVER been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?” Responses of “no” and those with unknown arthritis status were excluded. For the remainder of the manuscript, the phrase “doctor or other health professional” is referred to as physician. The authors utilized publicly available de-identified data, therefore, this study does not constitute human subjects research.

**Measures**

**Dependent variables**

*Meets Aerobic Physical Activity Guidelines.* The Health and Human Services (HHS) 2008 Physical Activity Guidelines for Americans 2nd edition recommend 150 minutes/week of moderate aerobic PA (e.g., brisk walking) or 75 minutes/week of vigorous aerobic PA (e.g., running) or an equivalent combination for all adults. Individuals reported weekly frequency and duration of moderate and vigorous aerobic PA. Total aerobic PA was assessed by combining moderate and vigorous aerobic PA, where 1 minute of vigorous aerobic PA is equivalent to 2 minutes of moderate aerobic PA. Those reporting ≥ 150 minutes/week of total aerobic PA were considered to have met aerobic PA guidelines.

*Meets Muscle Strengthening Physical Activity Guidelines.* The HHS 2008 guidelines for muscle strengthening PA recommend ≥ 2 strengthening activities per week. Individuals that report lifting weights or doing calisthenics ≥ 2 times/week met muscle strengthening PA guidelines.

*Arthritis-Associated Activity Limitation.* This variable was assessed using the item “Are you now limited in any of your usual activities because of your arthritis or joint symptoms?” Response options were yes/no.

*Severity of arthritis-related pain.* Individuals were asked if they experienced symptoms of pain, aching, or stiffness in or around a joint in the past 30 days. Those responding “yes” were asked to rate their average joint pain during the past 30 days on a scale of 0 to 10; 0 = no pain or aching and 10 = pain and aching as bad as it can be. Those responding “no” to the initial question were considered to have no pain and assigned a value of 0 (no pain); thus scores ranged from 0–10 with a higher score indicating more pain.

**Predictor variables**

*Self-reported race/ethnicity.* The race/ethnicity item used response options of: Hispanic, non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, and Non-Hispanic/all other races. Hereafter, we refer to these groups as Latino, White, African American, and Asian. Respondents reporting non-Hispanic/all other races were dropped from the analyses.

*Receipt of physician recommendation to exercise to help arthritis.* This variable (yes/no) was assessed using the question, “Has a doctor or other health professional EVER suggested physical activity to help your arthritis or joint symptoms?” Those with missing responses were excluded.
Covariates

Demographic covariates included age (18–44, 45–64, 65, or ≥ 65 years), sex (male or female), educational attainment (less than high-school degree, high-school graduate, technical college/some university, four year college degree or higher), marital status (yes/no), employment status (yes/no), annual household income (0–$34,999, $35,000–64,999, and ≥ $65,000), health insurance (yes/no), having a usual source of care (yes/no), and U.S. region (Northeast, Midwest, South, or West).

Health covariates included: smoking status (never, former, or current); body mass index (BMI calculated from self-reported weight and height as a continuous measure (weight in kg/height in m^2) categorized as underweight (< 18.5), normal weight (18.5–24.9), overweight (25.0-29.9), or obese (≥ 30); and self-rated health (excellent/very good/good versus fair/poor); number of comorbidities (0, 1–2, or ≥ 3) as a count of the following conditions: asthma, cancer, chronic obstructive pulmonary disease, heart disease, hepatitis, diabetes, kidney disease, hypertension, psychological distress, and stroke; and psychological distress assessed with the Kessler-6 and categorized into 3 levels based on the sum score: none/mild (0–4), moderate (5–12), and severe (≥ 13). (20, 21)

**Statistical Analysis**

Descriptive statistics were used to examine the distributions of demographic, health characteristics, and outcomes by race/ethnicity.

Multivariate logistic regression was used to analyze the independent effects of race/ethnicity and receipt of physician recommendation on the odds of meeting aerobic and strengthening PA guidelines, and having activity limitations. Additionally, we assessed whether the effects of receipt of physician recommendation to exercise on these outcomes was moderated by race/ethnicity (included an interaction term for race/ethnicity x receipt of physician recommendation) in each model. Covariates included demographic characteristics (age, sex, education, marital status, income, employment, health insurance, having a usual source of care) and health characteristics (smoking status, BMI, self-reported health, comorbidities, psychological distress) and region.

Multivariate linear regression was used to analyze the independent effects of race/ethnicity and receipt of physician recommendation on joint pain severity, and whether these effects were moderated by race/ethnicity. An interaction term for race/ethnicity x receipt of physician recommendation was included. Covariates included demographic characteristics (age, sex, education, marital status, income, employment, health insurance, having a usual source of care) and health characteristics (smoking status, BMI, self-reported health, comorbidities, psychological distress) and region.

The NHIS sampling weights for the Sample Adult Core were used for all analyses to generate nationally representative population estimates. SAS/STAT software PROC SURVEY SELECT was utilized to insure correct estimates and standard errors.

**Results**
Descriptive analysis

The sample consisted of 27,887 adults; mean age was 60.9 years (SD = 15.1) (Table 1). More than half were women. Educational attainment was lowest among Latinos (46% < high school) and highest among Asians (33.2% > college degree).
Table 1
Characteristics of U.S. Adults Aged ≥ 18 years with Arthritis by Race/Ethnicity, National Health Interview Survey, 2002, 2006, 2009, and 2014, N = 27887.

| Characteristics                                      | Total | White | African American | Latino | Asian | p-value |
|------------------------------------------------------|-------|-------|------------------|--------|-------|---------|
| Demographic characteristics                         |       |       |                  |        |       |         |
| Age (in years)                                       |       |       |                  |        |       |         |
| 18–44                                                | 4138 (14.8) | 2793 (13.8) | 674 (15.7) | 581 (20.7) | 90 (14.6) | < .0001 |
| 45–64                                                | 11652 (41.8) | 8288 (41.1) | 1941 (45.3) | 1209 (43.1) | 214 (34.6) |       |
| ≥ 65                                                  | 12097 (43.4) | 9100 (45.1) | 1669 (39.0) | 1014 (36.2) | 314 (50.8) |       |
| Sex                                                   |       |       |                  |        |       |         |
| Female                                               | 17922 (64.3) | 12646 (62.7) | 2990 (69.8) | 1906 (68.0) | 380 (61.5) | < .0001 |
| Male                                                  | 9965 (35.7) | 7535 (37.3) | 1294 (30.2) | 898 (32.0) | 238 (38.5) |       |
| Education                                             |       |       |                  |        |       |         |
| < high school                                        | 5769 (20.8) | 3061 (15.2) | 1294 (30.5) | 1276 (46.0) | 138 (22.5) | < .0001 |
| high school graduate                                  | 8236 (29.7) | 6215 (30.9) | 1242 (29.3) | 642 (23.1) | 137 (22.4) |       |
| Technical or some college                             | 8018 (28.9) | 6123 (30.5) | 1169 (27.5) | 592 (21.3) | 134 (21.9) |       |

1 Count of the following conditions: asthma, cancer, chronic obstructive pulmonary disease, heart disease, hepatitis, diabetes, kidney disease, hypertension, psychological distress, and stroke.

2 Psychological distress was assessed using the Kessler-6 and recommended cutoffs. (20)

3 Using 2008 Physical Activity Guidelines for Americans recommendation of 150 minutes per week of moderate aerobic physical activity, 75 minutes per week of vigorous aerobic physical activity or an equivalent combination of moderate and vigorous aerobic physical activity. (31)

4 Using 2008 Physical Activity Guidelines for Americans recommendation of two or more days per week of calisthenics, resistance training, weightlifting or any activities that require muscle tension against a weight or force (i.e., strengthening physical activity). (31)
|                                | Total | White | African American | Latino | Asian |
|--------------------------------|-------|-------|------------------|--------|-------|
|                                | 5692  | 4685  | 539 (12.7)       | 265    | 203   |
|                                | (20.5)| (23.3)|                  | (9.5)  | (33.2)|

**Health characteristics**

### Smoking Status

| Smoking Status | Total | White | African American | Latino | Asian |
|----------------|-------|-------|------------------|--------|-------|
| Never          | 13449 | 9197  | 2205 (52.0)      | 1634   | 413   |
|                | (48.6)| (45.9)|                  | (58.6) | (67.2)|
| Former         | 8889  | 6941  | 1083 (25.5)      | 719    | 146   |
|                | (32.1)| (34.6)|                  | (25.8) | (23.7)|
| Current        | 5355  | 3911  | 954 (22.5)       | 434    | 56    |
|                | (19.3)| (19.5)|                  | (15.6) | (9.1) |

### Body mass index

| Body mass index                | Total | White | African American | Latino | Asian |
|--------------------------------|-------|-------|------------------|--------|-------|
| < 18.5, underweight            | 395   | 305   | 47 (1.1)         | 21     | 22    |
|                                | (1.5) | (1.6) |                  | (0.8)  | (3.6) |
| 18.5–24.99, normal weight      | 7248  | 5631  | 795 (19.4)       | 527    | 295   |
|                                | (27.1)| (29.1)|                  | (19.7) | (48.8)|
| 25–29.9, overweight            | 9067  | 6667  | 1222 (29.8)      | 974    | 204   |
|                                | (34.0)| (34.5)|                  | (36.4) | (33.8)|
| ≥ 30, obese                    | 9989  | 6716  | 2036 (49.7)      | 1154   | 83    |
|                                | (37.4)| (34.8)|                  | (43.1) | (13.7)|

### Self-rated health

| Self-rated health                | Total | White | African American | Latino | Asian |
|---------------------------------|-------|-------|------------------|--------|-------|
| poor/fair                       | 8555  | 5290  | 1891 (44.2)      | 1200   | 174   |
|                                 | (30.7)| (26.2)|                  | (42.8) | (28.2)|
| good/very good/excellent        | 19308 | 14873 | 2390 (55.8)      | 1602   | 443   |
|                                 | (69.3)| (73.8)|                  | (57.2) | (71.8)|

### Number of co-morbidities

1 Count of the following conditions: asthma, cancer, chronic obstructive pulmonary disease, heart disease, hepatitis, diabetes, kidney disease, hypertension, psychological distress, and stroke.

2 Psychological distress was assessed using the Kessler-6 and recommended cutoffs. (20)

3 Using 2008 Physical Activity Guidelines for Americans recommendation of 150 minutes per week of moderate aerobic physical activity, 75 minutes per week of vigorous aerobic physical activity or an equivalent combination of moderate and vigorous aerobic physical activity. (31)

4 Using 2008 Physical Activity Guidelines for Americans recommendation of two or more days per week of calisthenics, resistance training, weightlifting or any activities that require muscle tension against a weight or force (i.e., strengthening physical activity). (31)
|                | Total  | White  | African American | Latino | Asian  |      |
|----------------|--------|--------|------------------|--------|--------|------|
| 0              | 6686 (24.6) | 5002 (25.4) | 756 (18.1) | 758 (27.9) | 170 (28.8) | <.0001 |
| 1–2            | 15104 (55.5) | 10843 (55.0) | 2456 (58.9) | 1469 (54.0) | 336 (56.9) |
| ≥ 3            | 5419 (19.9) | 3883 (19.7) | 957 (23.0) | 494 (18.2) | 85 (14.4) |

Psychological distress

|                | Total  | White  | African American | Latino | Asian  |      |
|----------------|--------|--------|------------------|--------|--------|------|
| none to mild (0–4) | 19407 (71.3) | 14381 (72.9) | 2868 (68.6) | 1714 (62.9) | 444 (74.9) | <.0001 |
| moderate (5–12) | 6037 (22.2) | 4182 (21.2) | 1000 (23.9) | 734 (26.9) | 121 (20.4) |
| severe (≥ 13) | 1774 (6.5) | 1156 (5.9) | 312 (7.5) | 278 (10.2) | 28 (4.7) |

Outcomes

Received clinician recommendation to exercise to help arthritis

|                | Total  | White  | African American | Latino | Asian  |      |
|----------------|--------|--------|------------------|--------|--------|------|
| Yes            | 15799 (56.9) | 11068 (55.1) | 2645 (62.0) | 1713 (61.3) | 373 (60.4) | <.0001 |
| No             | 11982 (43.1) | 9031 (44.9) | 1623 (38.0) | 1083 (38.7) | 245 (39.6) |

Severity of point Pain

|                | Total  | White  | African American | Latino | Asian  |      |
|----------------|--------|--------|------------------|--------|--------|------|
| Mild (0–3)     | 11503 (41.7) | 8785 (44.0) | 1400 (33.3) | 1013 (36.6) | 305 (50.3) | <.0001 |
| Moderate (4–7) | 10817 (39.2) | 8107 (40.6) | 1494 (35.5) | 991 (35.8) | 225 (37.1) |

1 Count of the following conditions: asthma, cancer, chronic obstructive pulmonary disease, heart disease, hepatitis, diabetes, kidney disease, hypertension, psychological distress, and stroke.

2 Psychological distress was assessed using the Kessler-6 and recommended cutoffs. (20)

3 Using 2008 Physical Activity Guidelines for Americans recommendation of 150 minutes per week of moderate aerobic physical activity, 75 minutes per week of vigorous aerobic physical activity or an equivalent combination of moderate and vigorous aerobic physical activity. (31)

4 Using 2008 Physical Activity Guidelines for Americans recommendation of two or more days per week of calisthenics, resistance training, weightlifting or any activities that require muscle tension against a weight or force (i.e., strengthening physical activity). (31)
### Table

|                               | Total  | White   | African American | Latino | Asian  |
|-------------------------------|--------|---------|------------------|--------|--------|
| Severe (8–10)                 | 5243   | 3086    | 1314             | 767    | 76     |
|                               | (19.0) | (15.4)  | (31.2)           | (27.7) | (12.5) |
| Arthritis-associated activity limitations |        |         |                  |        |        |
| Yes                           | 11487  | 7893    | 2051             | 1312   | 231    |
|                               | (41.3) | (39.2)  | (48.0)           | (46.9) | (37.5) |
| No                            | 16354  | 12257   | 2225             | 1487   | 385    |
|                               | (58.7) | (60.8)  | (52.0)           | (53.1) | (62.5) |
| Met guideline for aerobic physical activity \(^3\) |        |         |                  |        |        |
| Yes                           | 9151   | 7124    | 1092             | 716    | 219    |
|                               | (33.9) | (36.5)  | (26.2)           | (26.1) | (36.0) |
| No                            | 17879  | 12387   | 3076             | 2027   | 389    |
|                               | (66.1) | (63.5)  | (73.8)           | (73.9) | (64.0) |
| Met guideline for strengthening physical activity \(^4\) |        |         |                  |        |        |
| Yes                           | 4500   | 3507    | 572              | 313    | 108    |
|                               | (16.3) | (17.5)  | (13.5)           | (11.2) | (17.6) |
| No                            | 23118  | 16478   | 3666             | 2470   | 504    |
|                               | (83.7) | (82.5)  | (86.5)           | (88.8) | (82.4) |

1 Count of the following conditions: asthma, cancer, chronic obstructive pulmonary disease, heart disease, hepatitis, diabetes, kidney disease, hypertension, psychological distress, and stroke.

2 Psychological distress was assessed using the Kessler-6 and recommended cutoffs. (20)

3 Using 2008 Physical Activity Guidelines for Americans recommendation of 150 minutes per week of moderate aerobic physical activity, 75 minutes per week of vigorous aerobic physical activity or an equivalent combination of moderate and vigorous aerobic physical activity. (31)

4 Using 2008 Physical Activity Guidelines for Americans recommendation of two or more days per week of calisthenics, resistance training, weightlifting or any activities that require muscle tension against a weight or force (i.e., strengthening physical activity). (31)

African Americans had higher rates of current smoking, obesity, poor/fair self-reported health, comorbidities and severe psychological distress than all other groups (Table 1). Latinos had higher rates of obesity, poor/fair self-reported health status and severe psychological distress compared to Whites and Asians (Table 1).

Rates of receipt of physician recommendation were higher among Whites (44.9%) than all other groups (<39.6%). Almost 60% of the sample reported moderate to severe joint pain and 41.3% reported arthritis-
associated activity limitations. African Americans and Latinos were more likely to report moderate to severe joint pain and arthritis-associated activity limitations than other groups. Overall, 34% met aerobic and 16.3% met muscle strengthening PA guidelines, with rates being equal among Whites and Asians but lower among African Americans and Latinos (Table 1).

Multivariate analyses

**Meeting physical activity guidelines**

Controlling for demographic and health-related factors, and region, compared to Whites, African Americans were more likely to meet strengthening activity guidelines (AOR = 1.22; 95% CI 1.07, 1.40) (Table 2). Asians were less likely than Whites to meet aerobic (AOR = 0.80; 95% CI 0.65, 0.99) and muscle strengthening (AOR = 0.76; 95% CI 0.60, 0.96) activity guidelines.
Table 2
Association of Race/Ethnicity and Receipt of Physician Recommendation on Meeting Aerobic and Strengthening Physical Activity Guidelines, and Joint Pain Severity among U.S. Adults Aged ≥ 18 years with Arthritis, National Health Interview Survey, 2002, 2006, 2009, and 2014.

| Race/ethnicity (ref: White) | **Meets Aerobic Physical Activity Guidelines** 1 | **Meets Muscle Strengthening Physical Activity Guidelines** 1 | **Has Arthritis-Associated Activity Limitations** 1 |
|-----------------------------|-----------------------------------------------|-------------------------------------------------|--------------------------------------------------|
|                             | Unadjusted OR (95% CI) | Adjusted OR (95% CI) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
| **Race/ethnicity (ref: White)** | | | | | | |
| African American | 0.81 (0.74–0.89) | 1.08 (0.96–1.20) | 0.91 (0.81–1.03) | 1.22 (1.07–1.40) | 1.24 (1.13–1.36) | 1.03 (0.92–1.14) |
| Latino | 0.83 (0.75–0.93) | 0.93 (0.82–1.05) | 0.77 (0.67–0.89) | 0.98 (0.84–1.14) | 1.14 (1.03–1.26) | 0.96 (0.85–1.08) |
| Asian | 1.12 (0.94–1.35) | 0.80 (0.65–0.99) | 1.18 (0.95–1.45) | 0.76 (0.60–0.96) | 0.84 (0.70–1.01) | 0.998 (0.81–1.23) |
| **Received Physician Recommendation for Exercise to Help Arthritis (ref: No)** | | | | | | |
| Yes | 1.07 (1.03–1.11) | 1.14 (1.06–1.24) | 1.13 (1.08–1.18) | 1.17 (1.06–1.28) | 1.30 (1.26–1.35) | 1.28 (1.18–1.38) |
| **Interaction term for Race (ref: White) x Received Physician Recommendation** | | | | | | |
| African American x Received Physician Recommendation | 0.98 (0.88–1.09) | 1.001 (0.88–1.14) | 0.95 (0.86–1.05) |
| Latino x Received Physician Recommendation | 1.11 (0.98–1.24) | 0.89 (0.76–1.03) | 0.98 (0.88–1.10) |

1 Controlling for demographic factors (age, sex, education, marital status, income, employment, health insurance, having a usual source of care), and region (Northeast, Midwest, South, West)
| Health Characteristics | Meets Aerobic Physical Activity Guidelines<sup>1</sup> | Meets Muscle Strengthening Physical Activity Guidelines<sup>1</sup> | Has Arthritis-Associated Activity Limitations<sup>1</sup> |
|------------------------|-----------------------------|-----------------------------|-----------------------------------------------|
| Asian x Received Physician Recommendation | 0.94 (0.77–1.15) | 1.10 (0.88–1.39) | 1.07 (0.87–1.31) |
| Smoking Status (ref: Never) | | | |
| Former | 1.11 (1.06–1.23) | 1.14 (1.07–1.22) | 0.95 (0.90–1.00) |
| Current | 0.82 (0.77–0.87) | 0.71 (0.66–0.77) | 1.19 (1.12–1.26) |
| BMI (ref: <25, underweight/normal) | | | |
| 25-29.9, overweight | 1.11 (1.06–1.17) | 1.08 (1.03–1.14) | 0.90 (0.85–0.94) |
| ≥ 30, obese | 0.74 (0.71–0.78) | 0.71 (0.67–0.75) | 1.36 (1.30–1.42) |
| Self-reported health status (ref: good, very good, excellent) | | | |
| poor/fair | 0.53 (0.51–0.55) | 0.57 (0.54–0.61) | 2.28 (2.20–2.37) |
| Number of Comorbidities (Ref: 0) | | | |
| 1–2 | 1.06 (1.01–1.11) | 1.01 (0.95–1.07) | 0.90 (0.86–0.95) |
| ≥ 3 | 0.59 (0.55–0.63) | 0.89 (0.81–0.97) | 1.98 (1.87–2.10) |

<sup>1</sup> Controlling for demographic factors (age, sex, education, marital status, income, employment, health insurance, having a usual source of care), and region (Northeast, Midwest, South, West)
Adjusting for covariates, receipt of physician recommendation to exercise was associated independently with meeting aerobic (AOR = 1.14; 95% CI 1.06, 1.24) and muscle strengthening (AOR = 1.17; 95% CI 1.06, 1.28) guidelines (Table 2). The effects of physician recommendation to exercise did not differ by race/ethnicity for meeting either aerobic or muscle strengthening guidelines (i.e., interaction terms for race/ethnicity x physician recommendation were not significant).

Health characteristics associated with lower odds of meeting aerobic PA guidelines were current smoking status (versus never; AOR = 0.84; 95% CI 0.78, 0.90), obesity (versus BMI < 25; AOR = 0.75; 95% CI 0.71, 0.80), poor/fair self-rated health (versus good/very good/excellent; AOR = 0.67; 95% CI 0.63, 0.70), ≥ 3 comorbidities (versus none; AOR = 0.86; 95% CI 0.80, 0.92), and severe psychological distress (versus none-mild; AOR = 0.74; 95% CI 0.66, 0.85). Similarly, current smoking (AOR = 0.73; 95% CI 0.67, 0.80), obesity (AOR = 0.71; 95% CI 0.66, 0.76), poor/fair self-reported health (AOR = 0.73; 95% CI 0.68, 0.78), and ≥ 3 comorbidities (AOR = 0.89; 95% CI 0.81, 0.97) were independently associated with decreased odds of meeting strengthening guidelines.

## Arthritis symptom severity

Although African Americans (OR = 1.24; 95% CI 1.13, 1.36), and Latinos (OR = 1.14; 95% CI 1.03, 1.26) were more likely than Whites to report arthritis-associated activity limitations in unadjusted analyses, racial/ethnic differences were attenuated when controlling for demographic and health-related factors and region (Table 2).

Receipt of physician recommendation to exercise was associated with a higher likelihood of reporting activity limitations (versus no recommendation; AOR = 1.28; 95% CI 1.18, 1.38), controlling for covariates. There were no racial/ethnic differences in the effects of physician exercise recommendation on arthritis-associated activity limitations (i.e., interaction terms for race/ethnicity x physician recommendation were not significant).
Health characteristics independently associated with greater odds of reporting arthritis-associated activity limitations were obesity (AOR = 1.20; 95% CI 1.14, 1.27), poor/fair self-reported health (AOR = 1.73; 95% CI 1.66, 1.81), ≥ 3 comorbidities (AOR = 1.25; 95% CI 1.17, 1.34), and severe psychological distress (AOR = 1.69; 95% CI 1.51, 1.90).

In adjusted analyses, compared to Whites, African Americans (B = 0.51; 95% CI 0.26, 0.76) and Latinos (B = 0.43; 95% CI 0.14, 0.72) reported more severe joint pain (Table 3), while Asians reported less severe pain (B=-0.60; 95% CI -1.17, -0.04). Controlling for covariates, receipt of a physician recommendation to exercise was positively associated with severity of joint pain (B = 0.67; 95% CI 0.56, 0.78) and did not differ by race/ethnicity.
Table 3
Association of Race/Ethnicity and Receipt of Physician Recommendation on Severity of Joint Pain among U.S. Adults Aged ≥ 18 years with Arthritis, National Health Interview Survey, 2002, 2006, 2009, and 2014

| Severity of Joint Pain¹ | Unadjusted Beta Estimate (95% CI) | Adjusted Beta Estimate (95% CI) |
|-------------------------|----------------------------------|-------------------------------|
|                         |                                  | N= 24,107                      |
| Race/ethnicity (ref: Non-Hispanic White) |                                  |                               |
| African American        | 1.09 (0.93, 1.24)                | 0.51 (0.26, 0.76)             |
| Latino                  | 0.79 (0.60, 0.98)                | 0.43 (0.14, 0.72)             |
| Asian                   | -0.61 (-0.96, -0.27)             | -0.60 (-1.17, -0.04)          |
| Received Physician Recommendation to Exercise to Help Arthritis (ref: No) |                                  |                               |
| Yes                     | 0.88 (0.77, 0.98)                | 0.67 (0.56, 0.78)             |
| Interaction term for Race (ref: White) x Received Physician Recommendation |                                  |                               |
| African American x Received Physician Recommendation | -0.09 (-0.39, 0.20) |                               |
| Latino x Received Physician Recommendation | -0.23 (-0.59, 0.13) |                               |
| Asian x Received Physician Recommendation | 0.34 (-0.35, 1.03) |                               |

Health Characteristics

Smoking Status (Ref: Never)

| Current | 0.67 (0.52, 0.81) | 0.24 (0.10, 0.38) |
| Former  | 0.08 (-0.03, 0.20) | 0.04 (-0.07, 0.15) |

BMI (Ref: <25, underweight/normal)

| 25-29.9, overweight | 0.24 (0.11,0.37) | 0.19 (0.06,0.31) |
| 30 or more, obese   | 1.01 (0.88,1.15) | 0.54 (0.41,0.67) |

¹ Controlling for demographic factors (age, sex, education, marital status, income, employment, health insurance, having a usual source of care), and region (Northeast, Midwest, South, West)
Severity of Joint Pain

| Self-reported health status (Ref: good, very good, excellent) |  |
|-------------------------------------------------------------|--|
| Poor/fair                                                   | 2.13 (2.02, 2.24) | 1.15 (1.03, 1.28) |
| Number of comorbidities (Ref: 0)                            |  |
| 1–2                                                        | 0.71 (0.60, 0.83) | 0.30 (0.18, 0.42) |
| ≥ 3                                                        | 1.80 (1.64, 1.95) | 0.68 (0.52, 0.85) |
| Psychological Distress (Ref: none to mild (0–4)             |  |
| Moderate (5–12)                                             | 1.55 (1.42, 1.69) | 0.91 (0.78, 1.04) |
| Severe (≥ 13)                                               | 2.89 (2.68, 3.09) | 1.64 (1.42, 1.86) |

1 Controlling for demographic factors (age, sex, education, marital status, income, employment, health insurance, having a usual source of care), and region (Northeast, Midwest, South, West)

Health characteristics that were associated positively with joint pain severity were current smoking (B = 0.24; 95% CI 0.10, 0.38), being overweight (B = 0.19; 95% CI 0.06, 0.31) or obese (B = 0.54; 95% CI 0.41, 0.67), poor/fair self-reported health (B = 1.15; 95% CI 1.03, 1.28), 1–2 comorbidities (B = 0.30; 95% CI 0.18, 0.42) or ≥ 3 comorbidities (B = 0.68; 95% CI 0.52, 0.85), and moderate (B = 0.91; 95% CI 0.78, 1.04) or severe psychological distress (B = 1.64; 95% CI 1.42, 1.86).

Discussion

In this study, among adults with arthritis, we aimed to assess the independent effect of receipt of physician recommendation to exercise for relief of arthritis symptoms on meeting aerobic and strength training PA guidelines and arthritis symptoms, and whether these effects are moderated by race/ethnicity. Overall, we found that almost 60% of respondents reported at least moderate joint pain and over 40% reported activity limitations, while only 34% and 16% met aerobic and strengthening activity guidelines. Over 40% indicated they had not received a physician recommendation for exercise to relieve symptoms. Controlling for other factors, compared to Whites, African Americans were more likely to meet strengthening activity guidelines, while Asians were less likely to meet aerobic and muscle strengthening guidelines. Receipt of physician recommendation was independently and positively associated with meeting aerobic and strengthening guidelines, having arthritis-associated activity limitations, and more severe arthritis-related pain; these effects did not vary by race/ethnicity.

Our findings are consistent with a 2013 study showing that receipt of physician recommendation to exercise was independently associated with meeting PA guidelines, corroborating the importance of physician advice. (16) Although the proportion of adults with arthritis receiving a physician
recommendation to exercise has improved from 28% between 1999–2000 (22) to nearly 60%, (16, 23) there is still considerable room for improvement.

The proportions of those with arthritis who meet aerobic and strengthening guidelines in our study are similar to those found in a previous study of the U.S. population — approximately 36% and 18%, respectively. (14) In our study, a greater proportion of African Americans and Latinos, compared to Whites, received a physician recommendation to exercise. They were also more likely to report severe joint pain and activity limitations than Whites in absolute terms. In multivariate analyses, both of these symptoms were associated positively with receipt of an exercise recommendation, which could explain the higher rates of physician recommendation to exercise in patients where the need is greatest. However, physician recommendation alone was ineffective in reducing arthritis symptom disparities among African Americans and Latinos.

Asians appear to be at particularly high-risk of not meeting aerobic and strengthening activity guidelines, although their absolute rate of receiving a physician recommendation was comparable to African Americans and Latinos. Murphy et.al., found that Asians were just as likely as Whites to report meeting aerobic PA guidelines but did not address muscle strengthening physical activity guidelines. (14) In our study, Latinos were as likely as Whites to meet guidelines for both types of physical activity, which is consistent with a prior study. (14) African Americans were more likely than Whites to meet muscle strengthening guidelines; this may be due to cultural preferences for weight lifting/strengthening exercises or avoiding over-exertion. (24) (25) This is a novel finding and suggests that physicians should elicit and consider patient preferences for type of exercise.

Controlling for other factors, there were no racial/ethnic differences in arthritis-associated activity limitations. African Americans and Latinos reported more and Asians less severe pain than Whites, controlling for other factors. Our results agree with prior literature on greater pain among African Americans and Latinos but differ in that we found no racial/ethnic differences on activity limitations. (26) However, our analyses controlled for demographic and health characteristics while the referenced study only included demographics.

Smoking and obesity were independent risk factors for not meeting aerobic and strengthening guidelines and worse arthritis symptoms. This finding indicates that advising arthritis patients on smoking cessation and weight loss is indicated and could help relieve arthritis symptoms. Physician and self-management of comorbidities and psychological distress could also reduce the risk of not meeting aerobic and strengthening guidelines and worse arthritis symptoms. The relationship between distress and chronic pain is well-established (27) and less than optimal management of pain could contribute to higher levels of depression, especially among African Americans and Latinos. (28)

As a retrospective cross-sectional study, this study is limited in that directionality and causality cannot be determined.

Conclusions
Our findings suggest that physicians can influence patients’ exercise levels through effective advising. Reiterating the benefits of regular exercise is critical to improve arthritis pain and reduce disability. Patient-centered care that takes into account exercise preferences, environmental characteristics, cultural factors (e.g., attitudes among African American women regarding protecting hairstyles, (29) could motivate healthy lifestyle changes.

With the arthritis population expected to increase by over 30 million in 20 years, it is imperative that we reduce disability among this population, especially among Latinos and African Americans. (30) Barriers to exercise must be better characterized among the arthritis community. Finally, although the importance of PA to reduce arthritis symptoms is clear, social and biological mechanisms that might explain disparities in arthritis-related symptoms need to be better understood.

List Of Abbreviations

- (PA) Physical Activity
- (NHIS) National Health Interview Survey

Declarations

Ethics approval and consent to participate

This study utilized a publicly available de-identified dataset, therefore, does not constitute human subjects research and did not undergo ethics committee review.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated during and/or analyzed during the current study are available in the National Health Interview Survey (NHIS) repository, [https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm]

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

JH made substantial contributions to the conception, analysis, interpretation of data and drafting of the work. AN made substantial contributions to the conception, design of the work, interpretation of data, and substantial revision of the work. RR made substantial contributions to the work through acquisition, analysis of data and revision of the work. FW made substantial contributions to the work through design and revision of the work. All authors have read and approved the manuscript.

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