BRIEF REPORT

Perceived Impact of the COVID-19 Pandemic on Physical Activity Among Adult Patients With Rheumatologic Disease

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Objective. The objective of this cross-sectional study was to investigate the impact of the COVID-19 pandemic on physical activity (PA) levels of patients with rheumatic and musculoskeletal diseases (RMDs) and to examine factors associated with decreased PA.

Methods. A sample of adult patients with RMDs (n = 7,776) was identified through electronic medical records from an academic health care system in North Carolina. Invitations to participate in an online survey were sent between July 2020 and September 2020 to assess self-reported changes in PA during the COVID-19 pandemic. Descriptive statistics, age-adjusted prevalence odds ratios (PORs), and 95% confidence intervals (CIs) were computed to examine patient characteristics associated with decreased PA.

Results. A total of 893 eligible participants completed the survey (mean age 57.8 ± 14.9 years, 75.8% female). The most common primary diagnoses reported among participants included rheumatoid arthritis (27.3%), osteoarthritis (16.0%), and systemic lupus erythematosus (SLE) (13.0%). More than half of participants (56.8%) reported engaging in less PA since the pandemic began. Factors associated with engaging in less PA included lower self-reported general health (POR, 2.21; CI, 1.64-2.97) and a diagnosis of SLE (POR, 1.57; CI, 1.03-2.38). Comorbidities associated with decreased PA included chronic pain (POR, 1.38; CI, 1.04-1.82), depression (POR, 1.48; CI, 1.09-2.01), and hypertension (POR, 1.44; CI, 1.10-1.90).

Conclusion. The COVID-19 pandemic has exacerbated barriers to PA in patients with RMDs. There is a critical need to provide resources, support, and multifaceted programs to encourage PA in patients with RMDs during the COVID-19 pandemic.
barriers such as limited time, motivation, and support for and access to PA opportunities as well as disease-specific barriers (eg, fatigue, pain, fear of exacerbating disease) (15–17). Patients with RMDs also experienced unique additional stressors due to the COVID-19 pandemic, including barriers to medication access and concern for increased risk of infection (18–21). In the spring of 2020, actions were taken to mitigate the spread of COVID-19 in the United States, including the closure of nonessential businesses, indoor exercise facilities, and other recreational areas (22). This resulted in limited opportunities of patients to engage in PA as part of their RMD management. Engaging in PA during the COVID-19 pandemic has been associated with lower reported stress, anxiety, and depressive symptoms in the general population (23,24) and among patients with RMDs (25). Additionally, recent research has underscored the importance of PA to support mental health during the COVID-19 pandemic (23,26).

To our knowledge, association of the COVID-19 pandemic on health behaviors, such as PA, across a wide range of RMDs has not been reported in the United States. The objectives of this study were to 1) assess how the COVID-19 pandemic affected self-reported PA behaviors in patients with RMDs, 2) identify patient characteristics (eg, demographics, RMD type, and comorbid diagnoses) associated with decreased PA during the pandemic, and 3) describe patient-reported barriers to PA and opportunities for encouraging PA in patients with RMDs.

MATERIALS AND METHODS

Study design. The Institutional Review Board at the University of North Carolina (UNC) at Chapel Hill approved this study, including a waiver for informed consent for the anonymous survey design. All participants were provided with a description of the purpose, length of the study, eligibility criteria, and privacy information at the beginning of the survey. The 10-minute survey (Supplementary Material 1), available in English and Spanish, was distributed and hosted through UNC’s version of Research Electronic Data Capture (REDCap), an online, secure web application for research data capture (27).

Participants. Eligible patients were identified through the Carolina Data Warehouse for Health (CDW-H), a central data repository containing administrative, clinical, and research data sourced from the UNC Health Care System through Epic electronic medical record (EMR). The patient information collected from the CDW-H included demographics (eg, age, sex, race, ethnicity, and primary language), contact information (eg, email and phone number), and select primary diagnoses for RMDs and concurrent diagnoses queried by International Classification of Diseases codes (see Supplementary Tables 1 and 2).

Patients with RMD diagnoses who were identified through the CDW-H were contacted to participate in the study if they had an encounter at the UNC Rheumatology Clinic from May 2018 to May 2020, had English or Spanish as their primary language, and were 18 years or older. Invitation and reminder emails to complete the survey were sent out five times spanning from July 24, 2020, to September 15, 2020, to all eligible patients. Respondents who preferred not to identify their RMD or indicated that they did not have a diagnosed RMD (including suspected or unconfirmed diagnoses) were excluded from the analyses.

Variables of interest. Change in Physical Activity since the COVID-19 pandemic. Participants were asked to select which best described their level of activity since the beginning of the COVID-19 pandemic: less, about the same, or more activity than before, in which “before” was defined as “the 6 months before the COVID-19 pandemic.” In analyses, individuals who responded with “less activity” were compared with those who responded “about the same” or “more.” Participants also selected the type of activities they engaged in before and since the start of the pandemic, such as walking, running, hiking, and bike riding (Supplementary Material 1).

Physical Activity (PA) goals, opportunities, and barriers. Participants were asked if they were currently meeting their exercise goals and if they were interested in learning about interventions to encourage PA. Additionally, participants identified barriers that impacted their PA since the start of the COVID-19 pandemic (Supplementary Material 1).

General health-related quality of life. Health-related quality of life (HRQOL) was assessed through self-rated general health from the Centers for Disease Control and Prevention Healthy Days Measures, (28) which has been shown to be a useful tool in evaluating HRQOL in a variety of subpopulations, including patients with RMDs (29). The general health item asks participants to rate their general health as excellent, very good, good, fair, and poor (28). Use of the single general health item, rather than the four-question module, has been identified as an efficient summary measure of HRQOL (30).

Participant demographics. Demographic survey questions included age, sex, race, ethnicity, education, and income. Participants’ primary RMD and concurrent diagnoses were self-reported from a limited list. Participants who selected “other” RMD diagnosis provided a written response; these responses were reviewed and collapsed into existing RMD categories, if applicable. We excluded any responses that were blank, non-RMDs, or still being evaluated for formal diagnosis. Patient population characteristics obtained from the CDW-H and survey participant responses are listed in Table 1.

Statistical analysis. Descriptive characteristics were calculated for all participants and were computed overall and stratified by post-COVID-19 activity level. Continuous variables were expressed as means and standard deviations (±SD), and categorical variables were expressed as frequencies and percentages. Prevalence odds ratios (PORs) and 95% confidence
intervals (CIs) were estimated using logistic regression models to assess the cross-sectional association between decreased PA levels since the start of the pandemic and demographic and disease-related characteristics as well as barriers to PA and concerns about the COVID-19 pandemic. PORs were initially adjusted for age (Model 1) and then additionally adjusted (Model 2) for other covariates (ie, sex, race, ethnicity, change in income since the COVID-19 pandemic, and self-reported and current health). All tests were two-sided and considered statistically significant at the 0.05 level. All analyses were conducted using the statistical software package SAS version 9.4 (SAS Institute Inc.).

RESULTS

Participants. Of the 8,631 patients who met the eligibility criteria and were invited via email to participate in the study (Figure 1), 893 eligible participants completed the survey (mean age 57.8 ± 14.9 years; 75.8% female, 83.9% White, and 12.6% African American). The most commonly self-reported RMD diagnoses among participants included rheumatoid arthritis (RA) (27.3%), osteoarthritis (OA) (16.0%), and systemic lupus erythematosus (SLE) (13.1%), and the most frequently self-reported comorbidities were hypertension, chronic pain, anxiety, and depression (Table 1).

Changes in Physical Activity (PA) in the context of the COVID-19 pandemic. The majority of respondents reported not meeting their exercise goals (67.4%). More than half of participants (56.8%) reported engaging in less PA since the start of the COVID-19 pandemic, 27.4% reported unchanged PA, and 15.3% reported increased PA. Participants reported engaging in various forms of PA (eg, walking, running, hiking, and biking) less often since the beginning of the pandemic. The only activity reported more frequently during the pandemic was home workouts (see Supplementary Table 3).

In age-adjusted models (Table 2), factors significantly associated with reporting less PA since the start of the pandemic were self-reported fair or poor general health (POR, 2.21; CI, 1.64-2.97) and a diagnosis of SLE (POR, 1.57; CI, 1.03-2.38). Comorbidities associated with decreased PA included depression (POR, 1.48; CI, 1.09-2.01), hypertension (POR, 1.44; CI, 1.10-1.90), and chronic pain (POR, 1.38; CI, 1.04-1.82). After adjusting for age, sex, race, ethnicity, and change in income (Table 2), the only factor that remained significantly associated with reporting less PA since the start of the pandemic was fair or poor self-reported current health (POR, 1.97; CI 1.43-2.70).

Barriers to engaging in Physical Activity (PA). The most reported PA barriers (Table 3) during the COVID-19 pandemic included increased overall fear or anxiety (33.5%), lack of motivation (32.4%), and risk of contracting coronavirus infection (32.1%). The most frequently identified resources of interest to promote exercise included self-directed home-based programs for individuals (26.9%) or with a partner or guide (21.6%), online resources (23.9%), and in-person programs (22.8%).

DISCUSSION

This study found that patients with RMDs reported numerous impacts of the COVID-19 pandemic on PA. We found that more than half (56.8%) of respondents reported engaging in less PA since the start of the COVID-19 pandemic, which is concerning given the importance of PA for patients with RMDs (8,11). Our figures are in line with a recent survey of patients with RMDs (n = 703) in the United Kingdom that found that more than two-thirds of respondents (68%) reported that their normal levels of PA had decreased since the start of COVID-19 self-isolation (20). Additionally, a systematic review and meta-analysis that assessed changes in PA before and during the COVID-19 pandemic found that a majority of included studies (32 of 57) displayed a significant decline in PA during the COVID-19 pandemic (31).

Multiple factors were associated with reported decreases in PA, including diagnoses of SLE, depression, hypertension, and chronic pain as well as a lower self-reported HRQOL. These are important findings given the associations between PA and reduced risk of RMD activity and damage, cardiovascular disease (32), depression, and QoL (8–13). Additional research is needed to understand the temporal relationships between reduced PA and the burden of RMDs and comorbidities.

Other studies have found that a majority of patients with SLE reported being less physically active since the COVID-19 pandemic began (33,34). It is unclear why patients with SLE were more likely to report a decline in PA than patients with other RMDs, though the complications associated with SLE give some potential insight. There were severe disruptions and stressors specifically experienced by patients with SLE, particularly early in the pandemic (35). Additionally, Black and Hispanic individuals in the United States have reported significant reductions in PA during the COVID-19 pandemic (36), which is important given that SLE prevalence is higher among Black and Hispanic populations in the United States (37). Thus, factors contributing to racial and ethnic disparities in PA may have intersected with and compounded the already heavy burden and unique stressors experienced by patients with SLE during the pandemic. Our findings that associate depression with decreased PA are in line with previous research conducted both prior to and during the pandemic (11,13,25). The association of low PA with diagnoses of both SLE and hypertension is particularly concerning because cardiovascular disease risk is already elevated in SLE (38,39). Additionally, we observed a negative association between decreased PA and a diagnosis of RA, suggesting potential existing strategies of successful PA management that can be used as models in other RMDs.
Table 1. Respondent sociodemographic characteristics, primary rheumatic diagnosis, and self-reported changes in physical activity since the COVID-19 pandemic began (n = 893) compared with the cohort of all identified patients from the CDW-H data query (n = 10,781)

| Characteristics | All respondents | Overall | More activity | Stable activity | Less activity | All eligible Participants identified |
|----------------|----------------|---------|---------------|----------------|---------------|--------------------------------------|
| n = 893 | | 140 (15.8%) | 243 (27.4%) | 503 (56.8%) | N = 10,781 |
| Age, y, mean (SD) | 57.8 (14.9) | 54.3 (14.5) | 60.6 (13.7) | 57.5 (15.3) | 55.1 (16.1) |
| Sex, n (%) | | | | | |
| Female | 673 (75.8) | 110 (79.1) | 169 (69.8) | 388 (77.6) | 7,982 (74.0) |
| Race, n (%) | | | | | |
| White | 719 (83.9) | 114 (83.2) | 204 (87.2) | 397 (82.7) | 6,031 (67.2) |
| Black or African American | 108 (12.6) | 18 (13.1) | 20 (8.5) | 69 (14.4) | 2,682 (29.9) |
| Asian | 21 (2.5) | 3 (2.2) | 7 (3.0) | 10 (2.1) | 173 (1.9) |
| Native American | 9 (1.1) | 2 (1.5) | 3 (1.3) | 4 (0.8) | 96 (1.1) |
| Ethnicity, n (%) | | | | | |
| Hispanic or Latino | 41 (4.8) | 1 (0.7) | 12 (5.1) | 27 (5.6) | 1,137 (11.3) |
| Rheumatologic diagnosis, n (%) | | | | | |
| Rheumatoid arthritis | 242 (27.3) | 36 (25.7) | 87 (35.8) | 119 (23.7) | 1,439 (13.4) |
| Osteoarthritis | 142 (16.0) | 20 (14.3) | 34 (14.0) | 88 (17.5) | 4,897 (45.4) |
| Systemic lupus erythematosus | 116 (13.1) | 18 (12.9) | 21 (8.6) | 77 (15.3) | 1,252 (11.6) |
| Psoriatic arthritis | 87 (9.8) | 15 (10.7) | 26 (10.7) | 46 (9.1) | 470 (4.4) |
| Sjögren syndrome | 44 (5.0) | 9 (6.4) | 14 (5.8) | 21 (4.2) | 470 (4.4) |
| Ankylosing spondylitis | 37 (4.2) | 5 (3.6) | 4 (1.6) | 16 (3.2) | 193 (1.8) |
| Mixed connective tissue disease | 25 (2.8) | 3 (2.1) | 6 (2.5) | 11 (2.2) | 217 (2.0) |
| Scleroderma | 9 (1.0) | — | 2 (0.8) | 7 (1.4) | 280 (2.6) |
| Vasculitis | 9 (1.0) | 1 (0.7) | 2 (0.8) | 6 (1.2) | 107 (1.0) |
| Inflammatory myositis | 147 (16.6) | 35 (19.3) | 27 (14.4) | 85 (16.9) | 4,280 (39.7) |
| Concurrent diagnosis, n (%) | | | | | |
| Hypertension | 251 (28.1) | 30 (21.4) | 60 (24.7) | 158 (31.4) | 4,517 (41.9) |
| Chronic pain | 224 (25.1) | 24 (17.1) | 64 (26.3) | 135 (26.8) | 3,054 (28.3) |
| Anxiety | 196 (21.9) | 30 (21.4) | 49 (20.2) | 115 (22.9) | 2,413 (22.4) |
| Depression | 186 (20.8) | 25 (17.9) | 49 (20.2) | 115 (22.9) | 2,413 (22.4) |
| Thyroid disease | 161 (18.0) | 20 (14.3) | 50 (20.6) | 88 (17.5) | 2,094 (19.4) |
| Asthma or COPD | 138 (15.5) | 27 (19.3) | 34 (14.0) | 63 (12.5) | 1,124 (10.4) |
| Fibromyalgia | 109 (12.2) | 10 (7.1) | 34 (14.0) | 63 (12.5) | 1,124 (10.4) |
| Osteoporosis | 124 (14.0) | 18 (12.9) | 35 (14.4) | 72 (14.3) | 1,124 (10.4) |
| Irritable bowel syndrome | 106 (11.9) | 12 (8.6) | 31 (12.8) | 62 (12.3) | 444 (4.1) |
| Diabetes | 88 (9.9) | 6 (4.3) | 27 (11.1) | 53 (10.5) | 1,832 (17.0) |
| Heart disease | 76 (8.5) | 8 (5.7) | 21 (8.6) | 47 (9.3) | 1,258 (11.7) |
| Self-reported current health, n (%) | | | | | |
| Excellent | 30 (3.4) | 9 (6.4) | 12 (4.9) | 9 (1.8) | |
| Very good | 233 (26.1) | 56 (40.0) | 81 (33.3) | 94 (18.7) | |
| Good | 341 (38.2) | 52 (37.1) | 86 (35.4) | 201 (40.0) | |
| Fair | 234 (26.2) | 18 (12.9) | 51 (21.0) | 162 (32.3) | |
| Poor | 54 (6.1) | 5 (3.6) | 13 (5.3) | 36 (7.2) | |
| Highest level of education, n (%) | | | | | |
| Less than high school (grades 1-12) | 350 (39.6) | 69 (49.3) | 101 (41.6) | 180 (36.0) | |
| Graduated high school or GED | 420 (47.6) | 61 (43.6) | 110 (45.3) | 249 (49.8) | |
| College (1-4 y college, junior college, or technical school) | 100 (11.3) | 10 (7.1) | 28 (11.5) | 62 (12.4) | |
| Graduate school (master’s, doctorate, or professional degree) | 13 (1.5) | — | 4 (1.6) | 9 (1.8) | |
| Income change pre- and post-COVID-19, n (%) | | | | | |
| No change | 611 (71.0) | 91 (66.9) | 184 (77.3) | 331 (69.1) | |
| Make less | 219 (25.5) | 36 (26.5) | 49 (20.6) | 132 (27.6) | |
| Make more | 30 (3.5) | 9 (6.6) | 5 (2.1) | 16 (3.3) | |
| Annual gross income, n (%) | | | | | |
| <$25,000 | 105 (14.0) | 6 (5.0) | 32 (15.6) | 67 (16.0) | |
| $25,000-$49,999 | 130 (17.4) | 18 (15.0) | 31 (15.1) | 78 (18.7) | |
| $50,000-$74,999 | 124 (16.6) | 17 (14.2) | 37 (18.0) | 70 (16.7) | |
| $75,000-$99,999 | 94 (12.6) | 17 (14.2) | 23 (11.2) | 54 (12.9) | |
| $100,000-$150,000 | 139 (18.6) | 25 (20.8) | 39 (19.0) | 75 (17.9) | |
| >$150,000 | 156 (20.9) | 37 (30.8) | 43 (21.0) | 74 (17.7) | |

Abbreviations: CDW-H, Carolina Data Warehouse for Health; COPD, chronic obstructive pulmonary disease; GED, general equivalency diploma.

*Rheumatologic diagnoses are not reported in the CDW-H as “primary.”*
Taken together, this work highlights a longstanding need for improved support of the interrelated aspects of PA and psychological health among patients with RMDs. Recognizing the role that PA has in improving function, pain, and fatigue (8), as well as reduction of anxiety and depressive symptoms (12,13), future efforts are needed to understand and address barriers to PA. Increasing and maintaining PA should be emphasized for patients with RMDs, especially during the COVID-19 pandemic or other periods of increased stress to counteract negative impacts on mental health (25).

The most commonly reported barriers to PA during the COVID-19 pandemic were increased fear or anxiety and a lack of motivation. Prior research has emphasized the importance of providing appropriate PA support to improve mental health and well-being among at-risk populations, such as those with RMDs, who may be self-isolating during the pandemic (25). With widespread availability of COVID-19 vaccines and improved understanding of the disease, fear and anxiety around the pandemic may abate, though efforts are still needed to address patient-specific concerns and barriers to PA likely to extend beyond the pandemic (eg, lack of motivation).

Nearly two-thirds of respondents reported not meeting their exercise goals, and most respondents indicated interest in resources to encourage PA during the COVID-19 pandemic (eg, self-directed online PA programs). Previous research found that patients with RMDs reported a lack of guidance on exercise from health care providers and that patients expressed a desire for such discussions (9). These findings highlight an opportunity for providers to recommend and refer patients to resources that support PA among high-risk patients with RMDs, thereby improving health outcomes and QoL (9). As health care infrastructure adapts to implement low-contact and online services during the pandemic, health care providers must ensure that they emphasize the importance of PA for patients with RMDs and emphasize safe, appropriate, and accessible PA opportunities to patients.

A strength of this study is the large sample size, which generally reflected the demographic characteristics (eg, age, sex) of the patient population sampled. Although this was encouraging, the
reporting less physical activity since the start of the COVID-19 pandemic. Increased overall fear and/or anxiety increased responsibilities, such as working, caring for kids, caring for older adults.

**Table 2.** PORs and 95% CIs of patient characteristics associated with reporting less physical activity since the start of the COVID-19 pandemic.

| Characteristics                                    | Model 1 POR (95% CI) | Model 2 POR (95% CI) |
|---------------------------------------------------|----------------------|----------------------|
| **Demographics**                                  |                      |                      |
| Sex                                               |                      |                      |
| Female vs male                                     | 1.24 (0.91-1.70)     | 1.18 (0.85-1.64)     |
| Race                                              |                      |                      |
| Non-white vs. white                               | 1.23 (0.84-1.80)     | 1.16 (0.77-1.73)     |
| Ethnicity                                         |                      |                      |
| Hispanic/Latino vs. not Hispanic/Latino           | 1.58 (0.80-3.14)     | 1.59 (0.70-3.62)     |
| Highest level of education                        |                      |                      |
| Less than high school (grades 1-12) vs. more       | 1.33 (0.88-2.00)     | 1.10 (0.70-1.75)     |
| Annual gross income                               |                      |                      |
| Lower income after COVID-19 vs. the same or more   | 1.28 (0.93-1.76)     | 1.10 (0.78-1.54)     |
| **Diagnoses and comorbidities**                   |                      |                      |
| Primary rheumatologic diagnosis                   | 1.57 (1.03-2.38)     | 1.24 (0.79-1.94)     |
| Systemic lupus                                    | 1.36 (0.93-1.99)     | 1.47 (0.98-2.19)     |
| Erythematous or lupus                             | 0.83 (0.53-1.29)     | 0.89 (0.55-1.43)     |
| Psoriatic arthritis                               | 0.66 (0.49-0.89)     | 0.68 (0.49-0.93)     |
| Rheumatoid arthritis                              | 0.68 (0.37-1.26)     | 0.72 (0.39-1.36)     |
| Sjögren syndrome                                  | 1.09 (0.55-2.14)     | 1.11 (0.55-2.22)     |
| Ankylosing spondylitis                            | 2.62 (1.54-12.7)     | 2.16 (0.42-11.1)     |
| Vasculitis                                        | 0.95 (0.39-2.31)     | 0.94 (0.37-2.41)     |
| Scleroderma                                       | 1.48 (1.37-5.99)     | 1.38 (0.32-5.94)     |
| Inflammatory myositis                             | 1.34 (0.59-3.08)     | 1.21 (0.51-2.89)     |
| Mixed connective tissue disease                   |                      |                      |
| Other                                             | 1.09 (0.69-1.72)     | 1.17 (0.72-1.91)     |
| **Concurrent diagnosis**                          |                      |                      |
| Depression                                        | 1.48 (1.09-2.01)     | 1.09 (0.77-1.55)     |
| Hypertension                                      | 1.44 (1.10-1.90)     | 1.20 (0.89-1.63)     |
| Chronic pain                                      | 1.38 (1.04-1.82)     | 0.92 (0.66-1.27)     |
| Diabetes                                          | 1.38 (1.93-2.05)     | 1.28 (0.82-2.00)     |
| Heart disease                                     | 1.38 (0.89-2.16)     | 1.17 (0.71-1.91)     |
| Stroke                                            | 1.82 (0.64-7.46)     | 1.53 (0.57-4.14)     |
| Fibromyalgia                                      | 1.21 (0.84-1.73)     | 0.73 (0.48-1.11)     |
| Anxiety                                           | 1.20 (0.89-1.62)     | 0.89 (0.64-1.25)     |
| Irritable bowel syndrome                          | 1.17 (0.80-1.71)     | 1.00 (0.66-1.51)     |
| Thyroid disease                                   | 1.17 (0.85-1.62)     | 1.09 (0.77-1.54)     |
| Osteoporosis                                      | 1.09 (0.76-1.56)     | 0.90 (0.60-1.34)     |
| Asthma or COPD                                     | 0.91 (0.65-1.27)     | 0.79 (0.55-1.14)     |
| No comorbidities                                  | 0.79 (0.58-1.08)     | 0.95 (0.68-1.33)     |
| Self-reported current health                      |                      |                      |
| Fair or poor vs. excellent, very good, or good    | 2.21 (1.64-2.97)     | 1.97 (1.43-2.70)     |

**Table 3.** PORs and 95% CIs of barriers to physical activity and concerns specific to the COVID-19 pandemic that were associated with reporting less physical activity since the start of the COVID-19 pandemic.

| Characteristics                                    | Model 1 POR (95% CI) | Model 2 POR (95% CI) |
|---------------------------------------------------|----------------------|----------------------|
| **Barriers**                                       |                      |                      |
| Contracting the disease (COVID-19)                 | 2.38 (1.76-3.21)     | 2.14 (1.56-2.94)     |
| Lack of good place to exercise                     | 5.46 (3.82-7.79)     | 6.44 (4.39-9.43)     |
| Lack of motivation                                 | 5.67 (4.03-8.00)     | 5.71 (3.96-8.24)     |
| Increased responsibilities, such as working, caring for kids, caring for older adults | 3.70 (2.70-5.08) | 3.28 (2.35-4.58) |
| Increased responsibilities, such as working, caring for kids, caring for older adults | 1.61 (1.14-2.28) | 1.58 (1.10-2.28) |
| **Concerns**                                       |                      |                      |
| Not having enough reliable information             | 1.06 (0.79-1.42)     | 0.99 (0.73-1.35)     |
| Not getting needed help                            | 1.25 (0.81-1.92)     | 0.79 (0.48-1.29)     |
| Not being able to get medications                 | 1.14 (0.72-1.80)     | 0.86 (0.53-1.41)     |
| Not being able to get groceries                   | 1.16 (0.76-1.78)     | 0.88 (0.55-1.40)     |
| Contracting the disease                           | 1.54 (1.15-2.06)     | 1.52 (1.11-2.07)     |
| Not getting timely medical attention              | 1.50 (1.05-2.13)     | 1.35 (0.92-1.99)     |

Abbreviations: CI, confidence interval; POR, prevalence odds ratio.

*Adjusted for age.

*Adjusted for age, sex, race, ethnicity, change in income, and self-reported current health.

**selection bias. Our study also has several limitations, including the use of newly developed measures for perceptions of PA change during the COVID-19 pandemic that have not been validated, potential bias from self-reported data [40], and an inability to assess temporal or causal relationships because of the cross-sectional design.** Additionally, the survey questions assessing barriers to PA only addressed COVID-19-related concerns and may have excluded important disease or other related barriers unrelated to the pandemic. Moreover, the online survey distribution may have restricted participation for those with limited digital literacy or internet access. Despite specific efforts to include Spanish-speaking patients, only 5.2% of those contacted participated in this study (Figure 1). In addition, the generalizability of these results may be limited by the single health care system and lack of geographic variability of the participant sample.

In this study, we have described reported pandemic-related impacts on PA among patients with RMDs and identified several comorbid diagnoses and patient-reported characteristics associated with decreases in PA levels. Further research is needed to assess self-reported and objective PA over time and in relation to clinical and patient-reported outcomes (eg, pain, fatigue) in diverse patient populations. Future research should also expand the focus of RMDs studied, which has largely been concentrated...
on OA and RA, with limited research available on PA in other RMDs, such as SLE, psoriatic arthritis, scleroderma, and gout (4).

Enhanced monitoring and evaluation of PA in RMD care is critical to improve PA and health and QoL outcomes, particularly among patients with relevant comorbidities (eg, depression) who may be more likely to benefit from increasing PA. These findings underscore the need to provide diverse resources, support, and multifaceted programs to encourage PA in patients with RMDs during the COVID-19 pandemic and beyond.

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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 published. Dr. Saira Sheikh, MD had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Dickson, Englund, Cleveland, Allen, Sheikh.

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Analysis and interpretation of data. Saxena-Beem, Dickson, Englund, Cleveland, McCormick, Santana, Walker, Allen, Sheikh.

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