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**Arthritis Impact on Employment Participation among U.S. Adults: A Population-based
Perspective**

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ABSTRACT

Background: Arthritis is a large and growing problem, affecting 53 million U.S. adults, more than two-thirds of whom are younger than age 65. Approximately 1/3 of working-age (18-64 years) U.S adults with arthritis report arthritis-attributable work limitation (5% of the total working-age population).

Objectives: The primary goal of this research was to take a population-based perspective to evaluate the association of arthritis with employment participation among U.S. adults. A secondary goal was to examine whether this association differs by sex, age, or other potentially modifiable and non-modifiable characteristics. A tertiary goal was to investigate the effects of the Great Recession (December 2007 to June 2009) on employment among U.S. adults and to determine if arthritis status moderated its effects.

Methods: All three studies were conducted using the National Health Interview Survey (NHIS). The third study also used longitudinal data from the Medical Expenditures Panel Survey (MEPS) linked to NHIS.

Results: Selected findings (these manuscripts are under peer-review for publication, so limited results and conclusions are presented here):

Study 1- Employment participation was always statistically significantly and substantially lower (e.g., >10 percentage points) among adults with arthritis compared with those without arthritis; this gap widened from the first year studied, 2002, compared with the last year studied, 2012. Work disability was significantly higher (≥ 2 -4 times) among adults with arthritis compared with those without for all age and sex groups (range: 12-24% vs. 2.7-10%).

Study 2- Overall, 20.1 million adults (10.4% [95% CI=10.1-10.8] of the working-age population) reported work disability. Prevalence of self-reported work disability was virtually identical among men and women in each age group. The top three most commonly reported causes of work disability overall were back/neck problems 30.3% (95% CI=29.1-31.5), depression/anxiety/emotional problems 21.0% (19.9-22.0), and arthritis/rheumatism 18.6 (17.6-19.6). Musculoskeletal conditions (i.e., back/neck problems and arthritis/rheumatism in our study) were among the three most common causes of work disability overall, regardless of sex, and by age- and sex-specific respondents with a variety of underlying chronic conditions. Recognizing the predominance of musculoskeletal -related work disability, even among those with other primary conditions, should prioritize the identification and treatment of musculoskeletal conditions in adults of working-age.

Study 3- Employment was substantially and significantly lower among adults with arthritis compared with those without arthritis at all time points. By the end of the study period, 16.8% (95% CI = 14.9-18.9) of those without arthritis and 27.0% (95% CI = 21.8-32.9) of those with arthritis stopped work. By the end of the study period, 38.7% (95% CI = 33.8-43.8) of those without arthritis and 24.8% (95% CI = 18.6-32.3) of those with arthritis started work. During the period of the Great Recession, people with arthritis stopped work at higher rates and started work

at lower rates than those without arthritis, suggesting that there was at least some differential effect among those with arthritis.

Conclusion: Findings of each study, and the whole body of work, are robust and contribute novel results to the literature. Importantly, potential intervention opportunities were identified to reduce negative impacts of arthritis on employment participation. The work presented in this dissertation contributes new knowledge by establishing long-term patterns and benchmark information for employment participation, work disability, transitions, and macro economic effects among adults with and without arthritis in the United States. A population-based, non-condition-specific approach of this type has not been previously reported in the literature.

Chapter 1: INTRODUCTION

Background—Arthritis and Employment

Arthritis is a large and growing problem throughout the world (1-3), and musculoskeletal and rheumatic diseases are recognized as the most common cause of morbidity globally (1). In addition to personal impacts, arthritis has negative societal consequences, notably from decreased workforce participation, which results in lost income on an individual and societal level. For arthritis, annual estimated direct and indirect costs exceeded \$128 billion (USD) in 2003, of which \$47 billion were lost earnings (4). People with work limitations/disabilities due to health conditions are less likely to be employed, contribute to payroll taxes, or add to national productivity and are more likely to draw on the social support system (5, 6).

Workforce participation provides opportunities to contribute to society and to remain financially independent (7). As described by Armstrong and Wilkie, workforce participation is necessary for individual prosperity and full participation in society, as well as being “central to identity, social roles, and social status” (8). In contrast, being outside the labor force may have a negative impact on a person’s social status and health (7). In recent years there has been a growing interest in measuring social and economic outcomes of health conditions and giving more value to patient-reported outcomes beyond clinical disease measures (9).

A major concern of arthritis patients is employment. Arthritis is the most common cause of disability among U.S. adults (10), and musculoskeletal conditions are the most common causes of work disability overall (11). Findings from one population-based study indicate that approximately 1/3 of working-age (18-64 years) U.S adults with arthritis report arthritis-

attributable work limitation (5% of the total working-age population), with the highest reported limitations among pre-retirement age adults (45-64 years), women, non-Hispanic blacks, those with lower education and lower income, and those with higher activity limitations (12).

The term “arthritis” describes more than 100 conditions; most of these are characterized by pain, aching, stiffness, and/or swelling in or around the joints or elsewhere in the musculoskeletal system (13). Until very recently, most studies of arthritis and employment were specific to rheumatoid arthritis and reported work cessation between 20 and 70% (6, 14). The adverse consequences of rheumatoid arthritis are changing somewhat due to advances in disease-modifying anti-rheumatic drugs and biologics (15). While there are a few condition-specific treatments that are relevant to workforce participation among adults with arthritis (e.g., biologics for rheumatoid arthritis; joint replacement in certain types of osteoarthritis (both when clinically indicated)), most currently available effective or promising interventions are applicable and effective regardless of the underlying arthropathy. These include self-management education, appropriate physical activity, use of assistive devices, maintaining a healthy weight, vocational rehabilitation, use of legal protections (e.g., the Americans with Disabilities Act), and ergonomic evaluation and adjustments to the job itself (16-25).

In spite of advances in therapeutic approaches to address the adverse social and person consequences of arthritis conditions among working-age adults, work disability among people with a range of arthritis conditions remains substantial and has tremendous negative economic effects, e.g., household incomes of ~\$20,000 less compared with those who remained employed

(6, 14). From a public health perspective, it makes sense to gain a renewed, broader perspective on work disability among adults with arthritis.

In summary, the prevalence of arthritis outstrips that of most chronic conditions and is on the rise via at least two mechanisms—the aging of the population and increased incidence, sometimes due to potentially modifiable risk factors (e.g., obesity) (26-28). Next, arthritis is the most common cause of disability, responsible for a large proportion of morbidity in working-age adults (1, 10-12). Third, arthritis and musculoskeletal conditions cost the health care system billions of dollars each year as well as additional billions of dollars in lost earnings (4). Fourth, arthritis is directly responsible for lost personal and national productivity; arthritis is associated with decreased labor force participation (29-32). Fifth, arthritis has negative social and mental health consequences both individually and on a population level (33-35). Moreover, there is evidence that certain groups (e.g., women) are disproportionately affected by arthritis and may experience additional employment barriers (36-38). Yet, because it is amenable to a variety of public health, medical, and policy-based interventions (39), arthritis is clearly a prime area for major gains in population health, productivity, and quality of life—both directly and through enhanced workforce participation (7, 40).

Research Goals

1. The primary goal of the proposed research was to take a population-based perspective to explore the association of arthritis with labor force participation among U.S. adults.
2. The secondary goal was to examine whether this relationship differs by sex, age, or other potentially modifiable and non-modifiable characteristics.

3. The tertiary goal was to investigate the effects of the Great Recession on employment participation, entry, and exit among U.S. adults with and without arthritis.

Approach

I conducted three studies based on secondary data analysis of National Health Interview Survey (NHIS). NHIS is an ongoing population-based (U.S.) health survey of people of all ages; survey data are released annually as publicly available de-identified cross-sectional datasets. It uses a complex sample design to select a sample representing the U.S. civilian, noninstitutionalized population (41). Data are collected through in-home interview by trained interviewers. Questions on arthritis and labor force participation have been collected regularly since 2002, allowing these key variables to be defined consistently across all studies.

The third study also used data from the Medical Expenditures Panel Survey (MEPS). MEPS is a publicly available de-identified dataset derived from a subset of participants in each year of the NHIS. MEPS participants are followed for 2 calendar years and interviewed at multiple time points. My work used the MEPS Household Component, which gathers information on demographic characteristics, health conditions and status, use of medical services, access to care, satisfaction with care, health insurance coverage, income, and employment (42). The main years of MEPS data were 2008-2009 (Panel 13) with comparisons made to limited analyses from MEPS years 2005-2006 (Panel 10). The longitudinal nature of MEPS allowed conclusions about the effects of arthritis over time, including impacts of the Great Recession.

To maximize the usefulness of our study and to account for the complex sample survey design, we applied sampling weights which make findings from both NHIS and MEPS nationally representative of the civilian, non-institutionalized U.S. population. Participation in both NHIS and MEPS is voluntary, data are de-identified, and sample sizes were sufficient to produce estimates to answer our research questions.

Arthritis definition and justification for self-report:

Respondents were considered to have arthritis if they answered “yes” to: *“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?”*

This is the case-finding question used by the Arthritis Program at the Centers for Disease Control and Prevention and is considered valid for public health surveillance purposes (43, 44). Due to the complexities of gathering and tracking arthritis data as well as time and resource constraints, most population-based studies of arthritis prevalence and impact (e.g., national surveys) must rely on the efficiency of self-report. While clinical and population-based studies suggest that individuals often have limited knowledge of their specific rheumatic condition and frequently cannot report their diagnosis accurately (45-47), self-report of a medical diagnosis of an arthritis condition (without information on sub-type) has been demonstrated to have adequate sensitivity (66-76%) and specificity (75-96%) compared to a clinically assessed diagnosis (48, 49).

Although self-reports often lack diagnostic specificity, they are meaningful from a population perspective in that they frequently capture symptomatic disease; and, because of unequal access to and use of health care providers to treat arthritis symptoms, likely capture burden more

completely. Ascertaining arthritis prevalence by self-report is consistent with the reporting for many other diseases and conditions (e.g., asthma, heart disease, cancer), and case-finding questions that ask respondents to self-report a doctor-diagnosis of arthritis likely increase accuracy of the reports (50).

Chapter 2: Study 1- Labor Force Participation by Arthritis Status: Repeated Cross-Sectional Studies, 2002-2012, NHIS

Background: Most reports of arthritis and employment are limited to condition-specific (usually rheumatoid arthritis), individual cross-sectional, or pharmaceutical registry studies. While these studies are useful and provide information in the context of the condition or outcome under investigation, a thorough, systematic, population-based examination of labor force participation by adults with and without arthritis is lacking.

Questions:

1. What proportion of U.S. adults with arthritis are employed; what proportion report work disability?
2. Are these proportions significantly different from those for U.S. adults without arthritis?
 - 2a. Are there differential effects by age and/or sex?
 - 2b. Are there differential effects of the Great Recession for U.S. adults without arthritis?

Approach: I conducted a series of 11 cross-sectional studies using data from years 2002-2012 of the NHIS. This time period includes the Great Recession (officially December 2007 to June 2009), which served as a natural experiment to examine whether macro economic forces have differential effects for U.S. adults with and without arthritis. I expected to find that individuals with arthritis would report lower proportions of employment and higher proportions of work disability at all time points and for this pattern to be exaggerated during and in the years following the Great Recession compared with their non-arthritis peers.

NOTE: This manuscript is currently under peer-review for publication, so additional details are not presented here.

Chapter 3: Study 2- Prevalence and Causes of Work Disability among Working-Age U.S. Adults, 2011-2013, NHIS

Background: Arthritis is established as the most common cause of disability among U.S. adults (10). Recently, many stakeholders are interested in quantifying the impact of arthritis and other chronic conditions on employment. There are important societal outcomes, especially related to economic impacts, as well as meaningful individual consequences, for compromised employment participation, and chronic conditions are among the major causes of work limitation (11). Quantifying the magnitude (in number and proportion) of arthritis impact on work disability in the context of other chronic conditions has not been done.

Questions:

1. What are the number and proportion of working-age (18-64 years) U.S. adults who say they are limited in work due to a health condition?

1a. Among people who report work limitation, what is the proportion who say arthritis is the cause?

2. Among working-age (18-64 years) U.S. adults who report work limitation, what are the most common causes of work limitation among those with selected chronic conditions?

Approach: I used pooled data from years 2011-2013 of the National Health Interview Survey (NHIS) to estimate the most common causes of work limitation among working-age U.S. adults. In addition to identifying the most common causes of work limitation overall, I examined the most frequently reported causes of work limitation among respondents with selected chronic

conditions. I expected that musculoskeletal conditions in general and arthritis specifically would be among the most common causes of work limitation overall and regardless of other underlying chronic conditions (for example, I expected arthritis to be a top cause of work limitation among respondents with diabetes, asthma, heart disease, etc.).

Work limitation was defined as a “yes” response to one or both of: “Does a physical, mental, or emotional problem NOW keep you from working at a job or business?” and “Are you limited in the kind OR amount of work you can do because of a physical, mental or emotional problem?” Respondents who said yes to either were also asked the question “What conditions or health problems cause your limitations?” Answers to this question allowed the respondent to attribute their limitations to the condition(s) that causes their work limitation.

The case-finding question for arthritis is described above on page 8. Eleven other included conditions were: cancer (excluding non-melanoma skin cancer), diabetes (non-gestational), hypertension, heart conditions (coronary heart disease, angina, heart attack, and any other kind of heart condition or disease), stroke, current asthma, chronic bronchitis, low back and/or neck pain (these last two were queried separately but combined for analysis), serious psychological distress (SPD) as determined by the Kessler-6 (K6) scale (51), obesity, and vision trouble.

Causes of work limitation were examined among individuals with these conditions by frequency of reported condition in order to identify the condition or conditions with the greatest work limitation impact among working-age adults.

No specific effects of the Great Recession were expected in relation to the pattern of conditions causing work limitation.

NOTE: This manuscript is currently under peer-review for publication, so additional details are not presented here.

Chapter 4-Study 3: Employment Exit and Entry among U.S. Adults With and Without Arthritis During the Great Recession, A Longitudinal Study: 2007-2009, NHIS/MEPS

Background: Studies regarding employment transitions among people with arthritis from longitudinal studies are limited. A recent condition-specific study of lupus by Yelin et al. found that low work entry and high work loss both contribute to low employment among adult women with lupus (52); these findings suggest that a broader examination of work entry behaviors among people with arthritis is warranted, in addition to exits, and also indicates that a variety of different employment-related interventions, including policy interventions, are required.

The purpose of Study 3 was to examine the association of arthritis status with employment status over time among U.S. adults who were ages 30-64 at baseline. I estimated the association of arthritis with employment during the Great Recession with some data points from the 3 years immediately prior (2004-2006) for comparison. I anticipated that employment entry would be lower among people with arthritis and that this pattern would be exacerbated by the Great Recession. I also anticipated that employment exit would be greater among people with arthritis and similarly exaggerated by the Great Recession.

An important goal of this work is to identify and describe employment transitions among working-age U.S. adults with arthritis, along with potential risk factors, to be able to tailor effective public health interventions far enough upstream to reduce and delay negative employment consequences for adults with arthritis.

Questions:

1. What are the rates of employment entry (among those not employed at baseline) and employment exit (among those employed at baseline) among U.S. adults ages 30-64 with and without arthritis over the time period of the Great Recession?

1a. What are the predictors of employment entry and employment exit?

1b. Are these predictors modifiable and/or do they present potential targets for intervention?

2. Are the rates of work entry and exit changed, minimized, or magnified by the macro economic environment of the Great Recession?

Approach: I linked baseline 2007 NHIS data to 2-year follow up in MEPS (2008-2009) to examine work entry and work exit among U.S. adults ages 30-64 (at baseline) with and without arthritis. Arthritis status, initial employment status, and potential predictors of work entry and exit were ascertained from the baseline NHIS year. I expected that people with arthritis would have lower employment overall, lower employment entry, and higher employment exit compared with non-arthritis peers. Given that workforce patterns traditionally differ between men and women due to childrearing and other social forces, I anticipated that the predictors of employment entry and exit among people with arthritis could be different for men compared with women. Additionally, insurance status and marital status could be confounders of the employment entry/exit relationship and were tested during analysis.

NOTE: This manuscript is currently under peer-review for publication, so additional details are not presented here.

Chapter 5: CONCLUSION

Selected summary of results:

As mentioned above, these manuscripts are in peer-review for publication, so not all details are reported here.

Study 1

The objectives of this study were to estimate the proportion of employment and work disability among U.S. adults with and without arthritis and to determine if these differ by arthritis status and by age group and sex. Our secondary objective was to examine whether effects of the Great Recession (December 2007-June 2009) differed by arthritis status.

Employment participation was always statistically significantly and substantially lower (e.g., >10 percentage points) among adults with arthritis compared with those without arthritis; this gap widened from the first year studied (2002) compared with the last year studied (2012). Women with arthritis ages 55-64 (range 45-48%) had the lowest employment participation for all examined age and sex groups.

Work disability was statistically significantly and substantially higher (≥ 2 -4 times) among adults with arthritis compared with those without for all age and sex groups (range: 12-24% vs. 2.7-10%). For women ages 30-44, the work disability gap between women with and without arthritis ranged from 11-17 percentage points, and was ≥ 4 times higher for women with arthritis at every time point.

Arthritis was consistently associated with low employment participation and high work disability among U.S. adults. Longitudinal analyses may be better suited to examining the impact of the Great Recession on employment among adults with and without arthritis.

Study 2

We undertook to answer two sets of research questions. The first objective was to estimate the overall prevalence and causes of work disability among working-age (18-64 years) U.S. adults and the most common causes of work disability overall and by sex. The second objective was to estimate the prevalence and most common causes of work disability among adults with 11 specific common chronic conditions by sex and two age groups.

Overall, 20.1 million adults (10.4% [95% CI=10.1-10.8] of the working-age population) reported work disability. Prevalence of self-reported work disability was virtually identical among men and women in each age group. The top three most commonly reported causes of work disability overall were back/neck problems 30.3% (95% CI=29.1-31.5), depression/anxiety/emotional problems 21.0% (19.9-22.0), and arthritis/rheumatism 18.6 (17.6-19.6). Reports of other chronic conditions causing work disability were significantly less common overall. For example, reports of hearing, cancer, stroke, vision, heart problems, lung/breathing problems, hypertension, or diabetes causing work disability ranged from 3.4%-11.7%.

In terms of population prevalence, working-age adults with back or neck pain and arthritis had the highest work disability (13 and 9.9 million, respectively). These conditions were followed

most closely by hypertension (9.7 million) and obesity (8.4 million), with work disability among each of the remaining 13 chronic conditions reported by 5 million or less people.

Musculoskeletal conditions (i.e., back/neck problems and arthritis/rheumatism in our study) were among the three most common causes of work disability overall, regardless of sex, and by age- and sex-specific respondents with a variety of underlying chronic conditions. While the appearance of musculoskeletal conditions as causes of work disability among respondents who reported other primary conditions underscores the issue of multimorbidity among U.S. adults (53, 54). In summary, the consistency of musculoskeletal conditions causing work disability across numerous conditions and age and sex groups provides robust evidence of the consequence of musculoskeletal conditions on work disability among U.S. adults. Recognizing the predominance of musculoskeletal -related work disability, even among those with other primary conditions, should prioritize the identification and treatment of musculoskeletal conditions in adults of working-age.

Study 3

The objective of this study was to examine the association of arthritis status with employment (proportion working and not working) during the Great Recession among U.S. adults with and without arthritis. We also identified predictors of employment entry and exit among both groups.

Overall, employment during the Great Recession (December 2007-June 2009) was substantially and significantly lower among adults with arthritis compared with those without arthritis at all

time points. Employment for both groups declined, particularly in mid- to late-2009, dropping 3.3% percentage points for those without arthritis (baseline = 79.9%, 95% CI = 78.0-81.9; T5 = 76.6%, 95% CI = 74.7-78.6) and 6.0% percentage points for those with arthritis (baseline = 61.4%, 95% CI = 56.4-66.5; T5 = 55.4%, 95% CI = 50.5-60.4) over the study period. Despite these dramatic declines in employment, these losses were not statistically significant for either group.

By the end of the study period (December 2009), 16.8% (95% CI = 14.9-18.9) of those without arthritis and 27.0% (95% CI = 21.8-32.9) of those with arthritis stopped work. Rate of work loss was significantly greater for those with arthritis compared with those without arthritis starting at month 30 and continuing through the remainder of the study period.

By the end of the study period, 38.7% (95% CI = 33.8-43.8) of those without arthritis and 24.8% (95% CI = 18.6-32.3) of those with arthritis started work. Rate of work entry was significantly lower for those with arthritis compared with those without arthritis for most of the study period, from month 11 until month 30.

In summary, during the period of the Great Recession, people with arthritis had a greater number of employment transitions, stopped work at higher rates, and started work at lower rates than those without arthritis. These findings suggest that there was at least some differential effect among those with arthritis.

Significance of the body of work:

As described in the introduction, arthritis is highly prevalent, has significant negative impacts on employment and productivity, and commonly occurs with other chronic conditions. The work represented by the three studies for this dissertation represents substantial contributions to the literature. First, the association of arthritis status with employment participation and work disability among U.S. adults over a period of 11 years and in the context of a global macroeconomic event was established. The inclusion of more than a decade of data and the consideration of a macro economic event represent characteristics which have not been previously studied on a population-level in the context of arthritis. While the design was somewhat ecological in nature, documenting differential effects of the Great Recession on those with and without arthritis reflects a quasi-experimental approach that at least provided suggestive evidence of arthritis impact.

We also advanced current understanding of the prevalence and proportion of work limitation among U.S. adults, particularly by identifying and quantifying underlying causes. By describing the magnitude of the problem, our findings help identify important target groups for intervention. Because chronic conditions are so often the cause of work limitation, it is useful to know which and to what extent these conditions result in work limitation. Our results provide evidence that work limitation interventions should address musculoskeletal conditions regardless of other primary conditions of interest.

Novel findings from this body of work will inform the targeting, tailoring, design, and implementation of existing and new interventions to prevent job-loss/increase employment

retention among adults with arthritis and minimize the substantial personal and societal effects of arthritis among working-age adults. The literature will be enhanced by our identification of the unique predictors (including age, minority status, education, functional status, among others) of employment entry and exit among adults with arthritis, and these findings will be the first step in identifying and applying approaches to address the consequences of arthritis on employment. Different interventions are relevant for employment retention compared with employment entry, and our findings further characterize subgroups in need of a variety of approaches to gain and retain employment. The findings from the third study suggest that the appropriate use of public health, policy, clinical, and other interventions need to be targeted to certain groups and would best be used in combination (e.g., clinical management of pain, public health interventions to teach self-management education, and use of vocational rehabilitation resources to ensure better job fit) to have the greatest effects on employment.

Innovations of the body of work:

Most of what is currently known about arthritis and employment comes from cross-sectional studies or a few condition-specific prospective studies examining arthritis and employment (15, 55). The body of research represented in this dissertation offers innovation in both theoretical approach and in methodology. Specifically, linking NHIS and MEPS to study a macroeconomic event among people with and without arthritis is novel. The examination of employment entry and exit from a population-based perspective is also a unique contribution.

First, this research presented a nationally representative, population-based perspective of employment participation, work disability, and employment entry and exit among working-age

adults with arthritis using both cross-sectional and longitudinal data. These features resulted in robust findings that contribute to our knowledge and understanding of the relationship between arthritis and employment.

Next, we specifically examined potential sex differences in the associations between arthritis and employment based on the fact that men and women have traditionally had different workforce patterns—due to social structure, childrearing, and differences in chronic disease distribution—and took these features into account in analyses in all three studies. Sufficient sample size to examine men and women separately has been a limitation in previous arthritis and employment studies, so our data sources and study designs represent an advancement in this area.

Third, the sequentially building methodological approaches used demonstrated thorough understanding of the strengths and limitations of each study design and resulted in consistent and meaningful findings. For example, in Study 1, taking advantage of 11 years of survey data and describing effects of the Great Recession were both advances over previous individual cross-sectional study designs. One critique of cross-sectional study designs is their often uncertain temporal sequencing. Questions that require respondents to attribute a cause to their reported limitations overcome this uncertainty to some degree and allow for increased confidence in reporting estimates of probable causative effects. Study 2 took advantage of the attribution in the NHIS survey to identify causes of work limitations among working-age adults. Finally, movements into employment among those not employed at Time-1 are mostly missing in the literature and patterns or triggers related to these movements were unexplored on a population level. In Study 3, we not only examined rates and predictors of entry into employment among

those not employed at baseline, we also performed analogous analyses for those employed at baseline who exited employment and described the effects of the Great Recession on these patterns. As a result of these innovations, our findings point to a variety of interventions to address specific needs of individuals at different life stages and on different paths regarding arthritis and employment.

Future directions: Establishing the lower population prevalence of employment among adults with arthritis compared with those without, quantifying the magnitude of musculoskeletal conditions as causes of work limitation among working-age adults with a variety of conditions, and reporting the first-ever longitudinal, population-based estimates of work entry and exit among those with and without arthritis were all important contributions to the literature and public health. These findings do, however, raise several avenues for additional research and, perhaps more importantly, for policy and practice. In terms of additional research, following the trajectory of employment entry and exit among those with and without arthritis during the prolonged recovery period of the Great Recession would provide additional information on the differential effects of arthritis during non-optimal economic events. An additional wave of MEPS data will be available in the coming months that would allow for examination of employment entry and exit for the next panel of participants covering years 2010-2012. Alternatively, the Panel Study of Income Dynamics (PSID) began asking respondents to report arthritis status in 1999, eight years prior to the Great Recession and follows the same participants from inception, providing a more stable group of people with longer term follow-up potential (56). The PSID may be an ideal data source for continuing the work described here that

identifies differences between those with and without arthritis in terms of employment and work disability over time.

In terms of policy and practice, people with arthritis would clearly benefit from policy reform to enhance the ability of individuals with arthritis and work disability to gain and retain employment. Tax credits, legal protections and provisions, and employment programs, in addition to individual workplace accommodations, have all been recommended as promising areas to address limited employment participation and associated poverty in U.S. adults (57, 58). In addition to reforming existing policies, there may also be considerable value expanding the use of these programs to those who could benefit most from them. Furthermore, an important goal should be to create more synergy across the medical, public health, and social systems to assist the employment efforts of those with arthritis and limitations. Prior work has shown that a health care provider's recommendation to attend a self-management education course increases the odds of doing so by 18 times (59). Linking best-practice medical management of the pain and functional limitations that limit work among some of those with arthritis along with evidence-based public health physical activity and self-management interventions proven to result in improvements in aerobic exercise, cognitive symptom management, self-efficacy, pain, social role limitation and physical function (17, 60) and stronger environmental context in terms of education and functioning social support programs may be the best way to improve employment situations for people with arthritis. Finally, additional research to evaluate the relative successes and impacts of these approaches is needed to establish the optimal combination of interventions.

Conclusion: The dissertation work described here represents three rigorously conducted studies examining the association of arthritis with employment participation and work disability in multiple population-based studies of U.S. adults. Examination of this relationship included taking advantage of a natural experiment (the Great Recession) to study the effects of a global macro economic effect on the relationship between arthritis and employment participation, entry, and exits. The body of work built in design, complexity, and rigor over the course of the three studies. Findings of each study, and as a whole body of work, are robust and contribute novel results to the literature. Importantly, potential intervention targets (e.g., age, sex, education, function, among others) were identified to reduce negative impacts of arthritis on employment participation. The work presented in this dissertation contributes new knowledge by establishing long-term patterns and benchmark information for employment participation, work disability, transitions, and macro economic effects among adults with and without arthritis in the United States. A population-based, non-condition-specific approach of this type has not been previously reported in the literature.

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