Arthritis, Occupational Class, and the Aging US Workforce

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In the United States, people aged 65 years and older are the fastest growing demographic group. The percentage of people aged 65 years and older is projected to almost double between the present day and 2050, rising from 6% to 11%, and about 1 in 5 of these elderly are poor.[1,2] Furthermore, the proportion of employed workers aged 65 years and older is increasing.[3] Over this same period, real earnings will continue to decline primarily because of high health insurance costs for households at or below the median income.[4] Increasing health costs are not only reducing retirement savings, they are also placing a financial burden on the elderly.[2] Therefore, although many elderly persons continue to work past retirement because they prefer to, a growing segment of this population will continue to work out of financial necessity.[5–7] Both blue-collar and elderly people are much more likely than are younger or more affluent people to suffer from disabling conditions and to live shorter lives.[8–13] We will therefore see an increasing burden of disease and disability among the American workforce, reducing both the quality of life and productivity of lower-income Americans.

Arthritis provides a lens through which one can view the convergent social phenomena of aging, workforce globalization, skyrocketing health costs, and a falling quality of life among the middle and lower classes. Arthritis is a common disabling condition that would normally force many workers to leave the workforce.[8,14] From 2007 to 2009, approximately 49 million US adults had arthritis, and 21 million suffered activity limitations as a result.[14] The prevalence of arthritis reaches 50% for persons aged 65 years and older compared with 7.9% for persons aged 18 to 44 years. It is estimated that by the year 2030 approximately 67 million adults aged 18 years and older will have arthritis.[14] Although additional longitudinal studies are needed to examine causal pathways, arthritis has been shown to contribute to and arise from poverty[15]; blue-collar and elderly workers are at increased risk of arthritis, and arthritis is a major

risk factor for losing one's job.[7,16] In this study, we present a snapshot of the burden of disease attributable to arthritis among US workers by age and occupational class.

METHODS

We used the quality-adjusted life year (QALY) as an outcome measure.[17] The QALY contains 2 dimensions: the time spent alive and one's health-related quality of life (HRQoL), which is scaled from 0 (death) to 1 (perfect health) and can be used to adjust the amount of time lived in good health to reflect relatively higher or lower morbidity.[17] In this case, we used the EuroQol 5D (EQ-5D), which is an HRQoL measure contained within the Medical Expenditure Panel Survey (MEPS). One QALY represents a year of life lived in perfect health.

We undertook a 3-step process to estimate quality-adjusted life expectancy (QALE) and to calculate incremental QALYs arising from arthritis among employed adults aged 18 years and older relative to employed adults without arthritis. First, we estimated mean EQ-5D scores and mortality probabilities in 1-year age

intervals by occupational class. Second, we used the mortality probabilities and these scores to build life tables for each occupational class.[18] Finally, we subtracted QALE by occupational class at different age intervals. The difference between QALE values yields the incremental QALYs.

Study Databases

We obtained data from 2 publicly available nationally representative samples of the US adult population: the 1997–2004 National Health Interview Survey (NHIS) and the 2001–2003 MEPS. The NHIS is an annual population-based survey of the resident noninstitutionalized US civilian population conducted by the National Center for Health Statistics (NCHS).[19] Interviews are conducted in person by trained interviewers. In the Family Core component, information was collected on sociodemographic characteristics and health conditions for all members of the household. In the Sample Adult Core component, 1 adult household member was randomly selected to provide more detailed personal health information in the NHIS. We used the NHIS database to obtain data

Objectives. The working poor sometimes delay retirement to survive. However, their higher risk of disease and disability threatens both their financial survival and their ability to work through the retirement years. We used the burden of disease attributable to arthritis by occupational class to illustrate the challenges faced by the older poor.

Methods. We merged data from the National Health Interview Survey, Medical Expenditure Panel Survey, and the National Death Index into a single database. We then calculated and compared age- and occupational class–specific quality-adjusted life years (QALYs) between workers with and without arthritis by using unabridged life tables.

Results. White-collar workers have a higher overall health-related quality of life than do other workers, and suffer fewer QALYs lost to arthritis at all ages. For instance, whereas 65-year-old white-collar workers without arthritis look forward to 17 QALYs of future life, blue-collar workers with arthritis experience only 11, and are much less likely to remain in the workforce than are those in service, farming, or white-collar jobs.

Conclusions. To meet the needs of the aging workforce, more extensive health and disability insurance will be needed. (*Am J Public Health.* 2011;101: 1729–1734. doi:10.2105/AJPH.2011.300173)

on a participant's occupation and sociodemographic characteristics. The MEPS is a subsample of NHIS participants that also generates a nationally representative survey of the US civilian noninstitutionalized population with oversampling of Hispanics and Blacks, containing detailed information on demographic characteristics, health conditions, and medical expenditures.[20] We obtained and linked the EQ-5D scores (a health-related quality of life measure) from the NHIS responders that participated in MEPS to their NHIS data. We also linked data from the NHIS to mortality data from the National Death Index to estimate the probability of death.[21,22] We pooled data from multiple survey years across each of the study databases to develop robust variance estimates for selected measures across each occupational class.

Data Sample and Measures

Occupational and arthritis classification. Employed respondents aged 18 years and older reported on their occupation for the week preceding the NHIS interview.[19] Employment status (i.e., employed vs nonemployed) was specified as a dichotomous variable based on the question "What is your correct working status?" Workers were then grouped according to the 2000 Standard Occupational Codes into 4 major occupational groups—white-collar, service, farm, and blue-collar workers.[23] This permitted a classification based on 2000 US Census codes using a standard 4-category occupational status variable commonly used by the NCHS that included the categories of white-collar workers (census codes 003–389); service workers (403–469); farming, fishing, and forestry workers (473–499); and blue-collar workers (503–889).[24]

In the NHIS, arthritis status among adults aged 18 years and older was assessed by response to the question: "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 (fy-bro-my-AL-jee-uh)?" Participants who responded in the affirmative to this question were coded as having arthritis.

Health-related quality of life measure. We derived HRQoL scores from the EQ-5D measure data located in the MEPS. The EQ-5D consists of a 5-item descriptive system that measures 5 dimensions of health status (mobility,

self-care, usual activities, pain or discomfort, and anxiety or depression) with 3 levels per dimension (no problem, some problems, and extreme problems).[25] The combination of all possible dimensions and levels resulted in 243 unique health states. A multiattribute value function was used to map preferences for these health states.[26,27] From this scoring function, an EQ-5D index score based on responses to the 5-item questionnaire is calculated and provided by MEPS in the publicly available data set.[26] These preference scores are measured on a scale from 0 to 1 where 0 represents death and 1 represents perfect health. The construct validity, reliability, and responsiveness of the EQ-5D have been documented extensively in both general and specific disease populations.[27] The scoring algorithm for the EQ-5D index descriptive system used in this research was based on US community preferences.

A total of 17 967 individuals aged 18 years or older with valid (i.e., nonmissing) EQ-5D scores, occupation type, and arthritis status in the 2001–2003 MEPS data were included in this analysis out of a total of 38 473 MEPS participants (e.g., unemployed) with EQ-5D scores in same time period. The sample design of the MEPS Household Component survey includes stratification, clustering, multiple stages of selection, and oversampling of minority populations.[28] Using the MEPS sampling weights and robust standard error estimators, we adjusted for these factors and for survey nonresponse when estimating age- and occupation-specific mean EQ-5D scores.

Estimating probability of death. We calculated age- and occupation-specific probabilities of death by arthritis status by using the NHIS linked with the National Death Index. We pooled the data from the 1997–2004 NHIS for the adults and linked it with pooled 1997–2004 (with follow up through 2006) mortality data from the National Death Index provided by the NCHS.[22] During this time period, there were 16 965 deaths among the 242 223 NHIS-participating adults identified in the probabilistically determined matching process.[21] We calculated the probability of death for all adults aged 18 to 88 years by arthritis status and occupational class by using coefficients from these pooled logistic regression models.[29]

Quality-adjusted life expectancy measure. We constructed a total of 8 life tables in 1-year age

intervals with US mortality data for each of the occupational classes (white-collar, service, farm, and blue-collar workers) by arthritis status.[18] We let q_{icr} denote the mortality probability (discrete hazard of dying) at age i for workers in class c (white-collar, service, farm, and blue-collar workers) with arthritis status r (coded 1 for present and 0 for absent). Similarly, we denoted by N_{icr} the number of population members surviving to age i in worker class c with arthritis status r, and denoted by B_{icr} the corresponding life years lived by these workers between the i-th and $(i + 1)$-th birthdays. Given the schedule of mortality hazards and a specification of N_{acr} for an initial age a, we can estimate B_{acr} and succeeding values of N_{jcr} and B_{jcr} (for $j = a+1, a+2, \ldots, 88$) using standard life table assumptions:

$$(1) \quad B_{icr} = \{1 - (q_{icr}/2)\} \times N_{icr} \text{ and}$$
$$N_{i+1,cr} = N_{icr} \times (1 - q_{icr})^{18}$$

The life expectancy (LE) at age a is the total life years at and beyond age a divided by the population surviving to age a:

$$(2) \quad LE_{acr} = \sum_{j \geq a} B_{jcr}/N_{acr}$$

Denoting the age, worker-group, and arthritis-status specific mean quality of life scores by X_{icr}, the worker-group, total arthritis-specific QALYs at age i is the product:

$$(3) \quad B_{icr} \times X_{icr}$$

and the QALE at age a is:

$$(4) \quad QALE_{acr} = \sum_{j \geq a} B_{jcr} \times X_{jcr}/N_{acr}$$

The incremental QALYs lost because of arthritis at age a for a worker in class c is simply the difference $QALE_{ac0} - QALE_{ac1}$ and represents the expected number of QALYs that a worker with arthritis at age a in class c can expect to lose going forward, compared with a worker without arthritis.

RESULTS

The 1997–2004 NHIS had 242 223 adult participants of which there were 16 965 deaths reported (follow-up mortality through 2006). Reported employment status, occupation type, and arthritis condition for adult participants

during the same time period was available for 19 699 workers, representing an estimated annual 187 090 449 US workers. The HRQoL measure (EQ-5D scores) available in the 2001–2003 MEPS database (a subset of the 1997–2004 NHIS participants) with valid adult data reporting on occupation type and arthritis status included 17 967 participants. To construct the 8 life tables in 1-year age intervals for each of the occupational classes by arthritis status we used the HRQoL experience from the MEPS database and used the mortality experience from the NHIS database to estimate the QALE measure as described previously.

Overall, white-collar workers were only slightly less likely to work beyond age 65 years than were other workers: 14% of all white-collar workers were aged 65 years and older

relative to 17% of service workers and famers, and 16% of blue-collar workers. But blue-collar workers appeared to be much more likely to retire if they developed arthritis (P<.001). Whereas approximately 47% of blue-collar workers aged 65 years and older had arthritis, 58% of service workers, 67% of farm workers, and 51% of white-collar workers had arthritis (Table 1).

Health-Related Quality of Life

Next, using the MEPS database, we examined EQ-5D scores, which capture much of the morbidity among those suffering from arthritis. Overall, workers with arthritis reported EQ-5D scores that were lower (0.69; 95% confidence interval [CI]=0.67, 0.70) than those of workers without arthritis (0.88; 95% CI=0.87,

0.89; Table 2). White-collar workers reported higher mean EQ-5D scores than did corresponding workers in other worker groups, reflecting lower overall morbidity. For instance, white-collar workers with and without arthritis had a mean EQ-5D score of 0.72 (95% CI= 0.71, 0.74) and 0.90 (95% CI=0.89, 0.91), respectively, whereas workers with and without arthritis in other worker categories had lower EQ-5D scores: service workers (0.64 [95% CI=0.61, 0.66] and 0.86 [95% CI=0.85, 0.87], respectively), farm workers (0.68 [95% CI=0.61, 0.75] and 0.84 [95% CI=0.81, 0.87], respectively), and blue-collar workers (0.63 [95% CI=0.60, 0.65] and 0.86 [95% CI=0.85, 0.87], respectively). In all cases, we found that white-collar workers with arthritis suffered considerably less overall

TABLE 1—Occupation- and Age-Stratified Characteristics Among US Workers With Arthritis in the Combined National Health Interview Survey (1997–2004) and Medical Expenditure Panel Survey (2001–2003)

Occupational Groups	Sample No.	Estimated Annual US Worker Population	Workers Aged ≥65 Years, %	In Workforce With Arthritis, %	Aged ≥65 Years in Workforce With Arthritis, %
All workers	19 699	187 090 449	15	22	53
Blue-collar workers	5017	43 174 508	16	22	47
Aged 18–24 y	332	3 174 913		2	
Aged 25–44 y	2215	18 839 984		10	
Aged 45–64 y	1656	14 005 265		29	
Aged 65–74 y	468	3 861 040		42	
Aged ≥75 y	346	3 293 305		53	
White-collar workers	10 804	114 646 129	14	19	51
Aged 18–24 y	725	6 855 730		3	
Aged 25–44 y	4813	52 221 217		8	
Aged 45–64 y	3738	38 651 796		31	
Aged 65–74 y	828	8 734 044		45	
Aged ≥75 y	700	8 183 339		59	
Service workers	3330	25 666 964	17	26	58
Aged 18–24 y	319	2 746 181		2	
Aged 25–44 y	1433	11 173 886		13	
Aged 45–64 y	1024	7 745 301		38	
Aged 65–74 y	296	2 004 775		52	
Aged ≥75 y	258	1 996 818		65	
Farm workers	548	3 602 846	17	20[a]	67[a]
Aged 18–24 y	51	384 279		4[a]	
Aged 25–44 y	231	1 372 693		7[a]	
Aged 45–64 y	174	1 278 450		25[a]	
Aged 65–74 y	43	219 389		55[a]	
Aged ≥75 y	49	348 033		75[a]	

[a]Estimates have a relative standard error ≥30% and should be used with caution, as they do not meet National Center for Health Statistics standards of reliability or precision (NCHS, 2002[19]).

TABLE 2—Occupation- and Age-Stratified Euro-Qol Scores Among US Workers in the Combined National Health Interview Survey (1997–2004) and Medical Expenditure Panel Survey (2001–2003)

Occupational Groups	Respondents With Arthritis, Mean EQ-5D (95% CI)	Respondents Without Arthritis, Mean EQ-5D (95% CI)
All workers	0.69 (0.67, 0.70)	0.88 (0.87, 0.89)
White-collar workers	0.72 (0.71, 0.74)	0.90 (0.89, 0.91)
Aged 18–24 y	0.84 (0.77, 0.92)	0.91 (0.90, 0.93)
Aged 25–44 y	0.74 (0.71, 0.78)	0.91 (0.90, 0.91)
Aged 45–64 y	0.74 (0.72, 0.75)	0.88 (0.87, 0.89)
Aged 65–74 y	0.72 (0.70, 0.75)	0.87 (0.85, 0.88)
Aged ≥75 y	0.67 (0.64, 0.71)	0.79 (0.76, 0.82)
Service workers	0.64 (0.61, 0.66)	0.86 (0.85, 0.87)
Aged 18–24 y	0.88 (0.80, 0.96)	0.90 (0.88, 0.92)
Aged 25–44 y	0.62 (0.56, 0.68)	0.87 (0.86, 0.89)
Aged 45–64 y	0.63 (0.60, 0.68)	0.82 (0.80, 0.85)
Aged 65–74 y	0.65 (0.60, 0.70)	0.81 (0.77, 0.85)
Aged ≥75 y	0.64 (0.58, 0.70)	0.77 (0.69, 0.85)
Farm workers[a]	0.68 (0.61, 0.75)	0.84 (0.81, 0.87)
Aged 18–24 y	0.73 (0.33, 0.98)	0.88 (0.84, 0.93)
Aged 25–44 y	0.96 (0.40, 0.96)	0.87 (0.82, 0.91)
Aged 45–64 y	0.76 (0.70, 0.82)	0.81 (0.75, 0.88)
Aged 65–74 y	0.71 (0.62, 0.79)	0.84 (0.78, 0.91)
Aged ≥75 y	0.53 (0.34, 0.72)	0.60 (0.38, 0.82)
Blue-collar workers	0.63 (0.60, 0.65)	0.86 (0.85, 0.87)
Aged 18–24 y	0.84 (0.71, 0.97)	0.91 (0.89, 0.94)
Aged 25–44 y	0.69 (0.64, 0.74)	0.87 (0.86, 0.89)
Aged 45–64 y	0.58 (0.54, 0.62)	0.83 (0.82, 0.85)
Aged 65–74 y	0.64 (0.59, 0.70)	0.81 (0.77, 0.84)
Aged ≥75 y	0.63 (0.57, 0.70)	0.78 (0.75, 0.83)

Note. CI = confidence interval; EQ-5D = Euro-Qol 5D.
[a]Estimates have a relative standard error ≥30% and should be used with caution, as they do not meet National Center for Health Statistics standards of reliability or precision (NCHS, 2002[19]).

morbidity (relative to those without arthritis) than did other workers. For instance, whereas white-collar workers with arthritis realized a 10% drop in their EQ-5D score (from 0.84 to 0.72), service workers realized more than a 20% drop in their EQ-5D score (0.88 to 0.64).

Incremental Quality-Adjusted Life Years

Although morbidity provides much of the story, it is also informative to explore the remaining healthy life expectancy at age 65 years, or QALE. This is a measure of the quality time remaining for workers of different occupational classes. Figure 1 presents the QALE remaining among white-collar, service,

farm, and blue-collar workers with arthritis at 2 different ages: 25 and 65 years. At age 25 years, blue-collar workers without arthritis can expect to live 44 years of perfect health over their remaining life, and white-collar workers without arthritis can expect to live 50. Among those with arthritis, QALE is 33 and 39 respectively. Said another way, if 25-year-old white collar workers without arthritis represent the ideal standard, then 25-year-old blue collar workers suffer the equivalent of 17 years of perfect health lost. At age 65 years, white-collar workers with arthritis who remain in the workforce can expect to lose just 4 QALYs relative to those without arthritis, whereas blue-collar workers lose nearly 6 of their

remaining years of perfect health measured in QALYs.

DISCUSSION

In the past, youths from lower-income families could often garner blue-collar factory jobs with sizable pension plans and health insurance.[6] As real wages decline for lower-income workers, they will need to work past retirement age because they lack retirement savings or other assets.[30] As a result, the lower-income US worker can easily fall into a downward financial spiral later in life in which productivity declines for health reasons, as the need to put in more hours to meet one's basic survival needs increases.[31] As Social Security and Medicare fail to provide economic protection to the elderly, they must remain in the workforce, but have a difficult time doing so.

Arthritis serves as a powerful lens for looking at these convergent phenomena. Many people can work in pain with this condition if need be.[9–11,32,33] We find that blue-collar workers with arthritis are in much worse health than are all other workers, suggesting that they are struggling to stay in the workforce despite their health condition. Although some blue-collar workers continue to work beyond age 65 years, those with arthritis appear to leave the workforce much earlier than do workers in other sectors (Table 1). Although it is likely that some of the former blue-collar workers were able to retire because of high-paid union jobs in an earlier era, the higher morbidity suffered by those who remain in the workforce suggests that some of these blue-collar workers are forced to work despite significant disability.[34–37]

We found that lower-income workers of older age in the service and farming sectors—2 job types that are unlikely to come with pension plans—are more likely to have arthritis than not, with an arthritis prevalence between 58% and 67%. They are also likely to work with higher morbidity than that of white-collar workers, but lower morbidity than that of blue-collar workers.

Unfortunately, lower-income workers—whether in the farming, service, or blue-collar sector—also have many fewer years of healthy life to look forward to. For example, blue-collar workers aged 65 years with arthritis can only expect to enjoy 11 remaining QALYs, many of
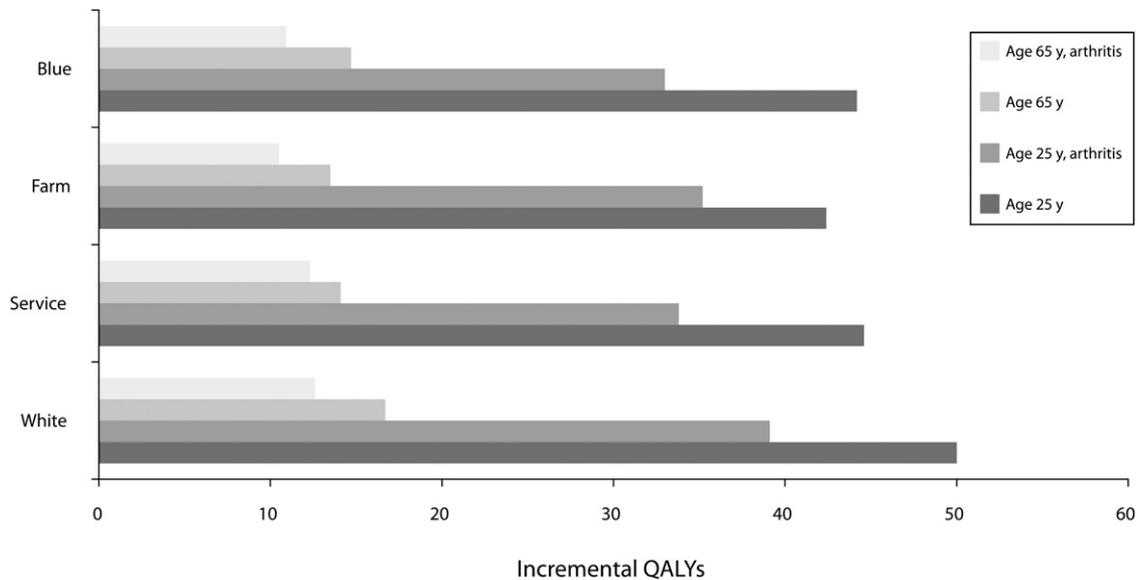
FIGURE 1—Quality-adjusted life expectancy for workers with and without arthritis.

which will be spent on the job. White-collar workers with arthritis who work past retirement age have relatively little morbidity; those white-collar workers without arthritis will enjoy 17 remaining years of perfect health, suggesting that they may be more likely to opt whether to continue to work or to retire.

Our study is subject to a number of important limitations. First, the NHIS and MEPS are based on cross-sectional population survey data that are subject to measurement error and do not allow for causal conclusions. We attempted to minimize this bias and maximize the specificity of our estimates by using regression techniques for mortality and quality of life estimates. In addition, arthritis prevalence was obtained by self-report rather than from medical records; these responses are thus subject to both self-report bias and perceptual bias. However, this case-finding question has been demonstrated to be valid for public health surveillance purposes.[38,39] Moreover, in large nationally representative adult samples (such as the NHIS), moderate-to-high levels of agreement can be observed between current occupation and longest-held job for most occupational subgroups.[40] Further research is needed to examine whether blue-collar workers with arthritis who leave the workforce early have higher disability than do their working counterparts.

The increasing age of the US workforce presents new challenges for government, employers, and working families. For example, health costs are greatly outstripping inflation, increasingly impoverishing even those elderly Americans eligible for Medicare and Social Security benefits.[33] Unreimbursed medical costs can quickly eat into the already meager retirement benefits offered elderly Americans.[33] Moreover, as fewer younger workers are available to pay into Social Security and Medicare, more Americans will be encouraged or required to delay retirement.[13,41] Between 2004 and 2014, the annual growth rate of the group aged 55 years and older is projected to be 4 times the rate of growth of the overall labor force.[42] Taken together, even with seemingly neutral policies aimed at increasing the retirement age for everyone, the "graying" workforce will be disproportionately represented by people from middle and lower occupational classes that also suffer from a higher prevalence of chronic medical conditions and a shorter life expectancy than do wealthier Americans.

As these changes occur, the Patient Protection and Affordable Care Act will play an important role in protecting the US worker and retiree alike.[43] Foremost, it will help protect a family's assets in the event of illness of one of its members, increasing retirement savings and reducing the need to work later in life. However, additional enhancements to federal programs, such as disability and unemployment insurance, will be needed to maintain a higher quality of life for all workers, particularly those with chronic conditions such as arthritis. Educational system enhancements (e.g., evidence-based arthritis health promotion interventions) hold hope for producing cost savings, while making the US workforce more competitive.[44] Still, as the native population ages, new funding for such programs will need to be sought in the face of expanding budget deficits. Politically difficult choices—such as reducing spending, increasing taxation, and developing new programs to attract young, skilled immigrants—will need to be made if the United States is to prevent significant declines in its standard of living. ■

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A.J. Caban-Martinez, P.A. Muennig, D.J. Lee, and L.E. Fleming originated the study, helped with the analysis wrote the first draft of the article. D.J. Tancredi, K.L. Arheart, W.G. LeBlanc, K.E. McCollister, S.L. Christ, and G.H. Louie collaborated on the idea, conducted the analyses, and edited the draft.

Human Participation Protection

The Human Subjects Research Office at the University of Miami, Leonard M. Miller School of Medicine approved the study protocol.

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