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Employment Characteristics and Risk of Hospitalization Among Older Adults Participating in the Mayo Clinic Biobank

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Abstract

Objective: To determine the relationship between characteristics of employment and future hospitalization in older adults.

Patients and Methods: We conducted a survey of adults aged 65 years or older participating in the Mayo Clinic Biobank. Using a frequency-matched, case-control design, we compared patients who were hospitalized within 5 years of biobank enrollment (cases) with those who were not hospitalized (controls). We assessed the duration of work, age at first job, number of jobs, disability, retirement, and reasons for leaving work. We performed logistic regression analysis to assess the association of these factors with hospitalization, accounting for age, sex, comorbid conditions, and education level.

Results: Among 3536 participants (1600 cases and 1936 controls; median age, 68.5 years; interquartile range, 63.4-73.9 years), cases were older, more likely to be male, and had lower education levels. Comorbid illnesses had the largest association with hospitalization (odds ratio [OR], 4.09; 95% CI, 3.37-4.97 [highest vs lowest quartile]). On adjusted analyses, odds of hospitalization increased with the presence of disability (OR, 1.31; 95% CI, 1.01-1.69) and decreased with having 1 or 2 lifetime jobs vs no employment (OR, 0.77; 95% CI, 0.60-1.00). The length of work, furlough, age of retirement, childcare issues, and reasons for leaving a job were not associated with hospitalization.

Conclusion: This study reports an association between disability during work and hospitalization. On the basis of our findings, it may be important to obtain a more detailed work history from patients because it may provide further insight into their future health.

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Hospitalization as a measure of health can be influenced by many aspects of psychosocial history, such as educational attainment,[1] marital status,[2] and socioeconomic status (SES).[3] Previous studies have determined common risk factors for hospitalization such as age, previous hospital utilization, and comorbid conditions.[2,4-9] Work history and life experiences also can affect ongoing health and wellness immediately and potentially into the future; however, longitudinal work history experiences, including unemployment, disability, furlough, duration of work, and age at retirement, as predictors of health and hospitalization, have been understudied. Work history may affect the risk of hospitalization directly, from injuries at work (eg, by doing heavy manual labor), and indirectly, from socioeconomic issues.[10]

Work factors such as unemployment and retirement can affect health. For example, persons who experience unemployment may have increased rates of future alcohol-related hospitalization[11] and death,[12] and some studies have shown a 35% higher rate of acute myocardial infarction with any episode of unemployment.[13] The association between retirement age and health is multifaceted because people retire for different reasons, which may be voluntary or involuntary. In 1 study, Swedish military personnel who opted for early retirement had decreased rates of

death and inpatient care compared with those who retired later.[14] In contrast, multiple chronic conditions are associated with a lower retirement age,[15] and in retirement, people can have more depressive symptoms if they are not socially engaged.[16] The relationship between work with cognitive complexity and potential protection against cognitive decline is potentially important. A recent systematic review shows mixed evidence[17]; however, this remains an area of research.

Socioeconomic status and other social variables are complex factors associated with health. We have previously reported that lower SES was associated with an increased risk of hospitalization.[3] Marriage may have a protective effect against hospitalization, with a previous study showing that married persons have lower rates of hospitalization than unmarried persons.[2]

Previously, for purposes of obtaining patients' work history, we used cross-sectional clinical questionnaires from the patient history or a research questionnaire for a biobank.[18] These questionnaires, however, do not address a person's longitudinal life experience that occurred before a clinical visit or research enrollment, such as work histories, including times of unemployment and retirement,[14,15] and that may be associated with different risks for adverse health outcomes. We believe that obtaining longitudinal work history is important because work involves occupational exposure (including possible injury), some assessment of the severity of chronic illness (such as cognitive decline), health literacy, and some SES issues such as access to insurance and income.

The primary aim of this study was to assess for any association between longitudinal work history and risk of hospitalization in older patients. Biobanks can be an important resource for addressing longitudinal research questions, as evidenced by the use of a UK biobank to investigate associations between job history and chronic obstructive pulmonary disease.[19] Thus, we surveyed participants of a biobank to approach our study aim. Specifically, we examined differences in the long-term patterns of work history between biobank participants with hospitalization and age- and sex-matched controls without hospitalization.

PATIENTS AND METHODS

Study Design and Setting

This was a frequency-matched, case-control study of participants enrolled in the Mayo Clinic Biobank (MCB). The specific design, population, and recruitment for the MCB have been previously reported.[18] This study was reviewed and approved by the Mayo Clinic and Olmsted Medical Center institutional review boards, the MCB Access Committee,[20] and the Mayo Clinic COVID-19 access committee. The study was conducted within the ethical framework of the Declaration of Helsinki.[21]

Data Resource

The MCB is an institutional resource and comprises specimens and data from volunteers who consented to donate biological specimens, complete health questionnaires, and provide consent to participate in any approved MCB study.[18] Based on recruitment into the greater MCB, the MCB population is older, with less racial diversity than that of the local population.[22] We used data collected at the time of MCB enrollment for demographic characteristics (age, sex, and race), socioeconomic factors (area deprivation index [ADI]), and comorbid conditions (Department of Health and Human Services comorbid conditions).[23,24]

Identification of Cases and Controls

Cases (persons who were hospitalized) and controls (persons who were not hospitalized) included participants from the MCB who were aged 65 years or older at the time of the study invitation and lived in the 27-county region in Minnesota, Iowa, and Wisconsin, where their data are encompassed by the Rochester Epidemiology Project (REP).[25] Before mailing the surveys, we assessed possible participants for exclusion criteria and death. Among participants who consented to the MCB, we excluded for this study those who had a diagnosis of dementia or lived in a nursing home at the time of survey mailing, those who did not complete the MCB enrollment questionnaire, and those who did not indicate their birthplace on the questionnaire. We also excluded completed surveys with uninterpretable data or missing work

information. Cases were patients who had any hospitalization within 5 years after MCB enrollment. Hospitalization was defined as at least 1 overnight hospital stay. We determined hospitalization using billing data from the hospitals within the REP, which had integrated electronic health records. Controls were selected from participants in the MCB who had not been hospitalized in any of the hospital systems. The original recruitment goal was to invite 3000 cases and 3000 controls. All eligible cases (n=2569) were invited to the study. Among the 4161 potential controls identified, 3000 were frequency matched to have similar distributions of age (65-74, 75-84, and 85 years or older) and sex at the time of survey invitation. We also attempted to match cases and controls on the basis of the 9 most commonly represented Minnesota counties in the REP because of the electronic health record data characteristics.

Survey

The primary data collection method was a mailed survey sent by the MCB (Appendix, available online at http://www.mcpiqojournal.org). The survey asked about detailed work, educational, and life stressor histories. We used questions related to work from the Health and Retirement Survey.[26] The Mayo Clinic Survey Research Center managed all aspects of the data collection, including designing the survey using optical mark recognition, mailing survey packets, and scanning returned surveys.[27] The authors reviewed the survey content for clarity. The mailed survey packets included a cover letter, optical mark recognition survey, and postage-paid return envelope. The US Postal Service delivered the survey packets in November 2020 (after US elections). Nonresponders to the initial survey were sent a reminder 4 weeks later. We concluded the receipt of mailed surveys on February 5, 2021, and reviewed the completed surveys for quality and completeness. Participants were allowed help from family members or friends to complete the survey and were allowed to consult records as needed.

Primary Covariates

The primary covariates (exposures) assessed were work experiences over the adult life course. We used work experience until the time of MCB enrollment. Work-related variables included age, the living situation (eg, living alone vs living with others [eg, family members], and residential type [single-family house vs other types]), when participants started their first full-time job after leaving school or college. These factors give some initial idea of socioeconomic factors. The participants reported whether they ever experienced changes in job situation, including stopping work to stay home and care for children, reducing the number of hours to care for children, and working longer hours to meet the added expenses of having children. Assuming that jobs after the age of 30 years would be relatively mature and stable, we also assessed several characteristics of the jobs that the participants had between the age of 30 years and the time of MCB enrollment. These characteristics included total years of employment, total number of different jobs, any physical or mental illness or disability, and whether the participant had been furloughed or laid off. The participants also reported retirement-related variables, including age, complete or partial retirement, and reason for retirement (forced or voluntary).

Other Covariates

Because work-related variables may be associated with the highest educational attainment level, we collected educational attainment through the survey (less than high school graduate, high school graduate, associate degree, vocational/technical/business school, bachelor's degree, or graduate/professional school). We used existing data in the electronic health records to collect information on established risk factors, such as age group at MCB enrollment (younger than 60 years, 60 years, 70 years, and 80 years or older), sex, and comorbid conditions. For comorbid conditions, we used 21 conditions that are used by the Department of Health and Human Services for calculation of multimorbidity by identifying the *International Classification of Diseases, Ninth Revision, and International Classification of Diseases, Tenth Revision, Clinical Modification,* billing codes that occurred before the MCB enrollment.[24,28,29] We applied methods previously used in the REP to obtain

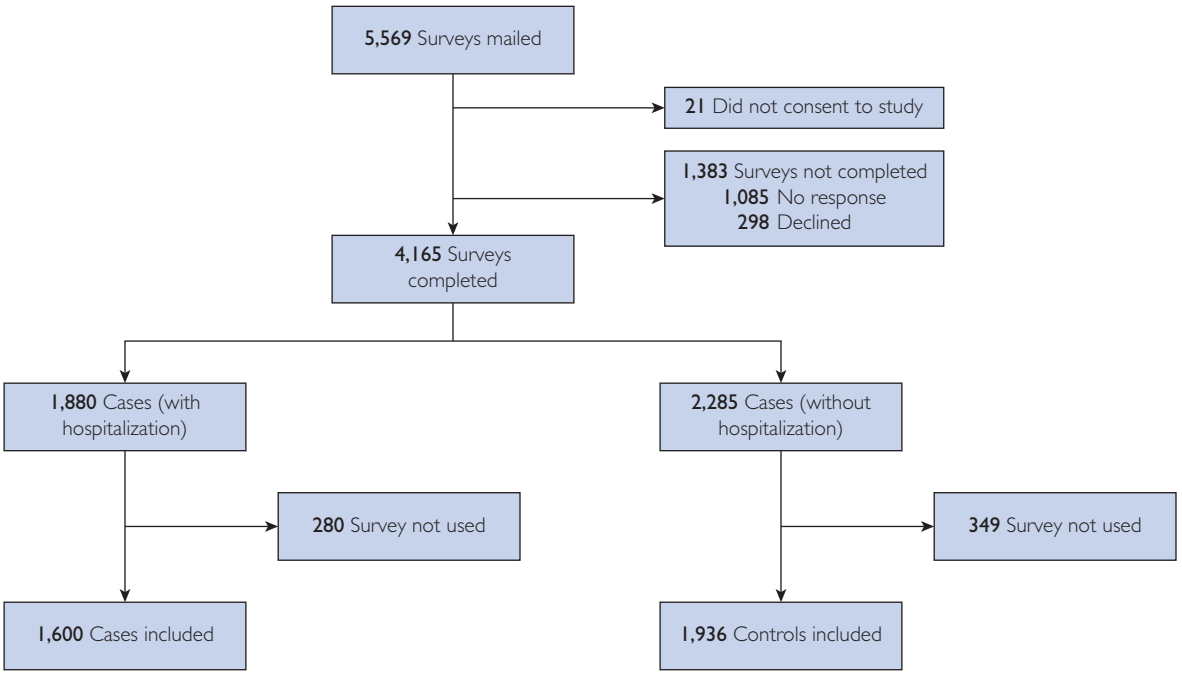

FIGURE. Development of the final cohort from participants of the Mayo Clinic Biobank.

the billing codes.[30] The data on the following conditions were collected: alcohol use disorder, Alzheimer disease and related dementia, arthritis, asthma, atrial fibrillation, autism, cancer (breast, colorectal, lung, and prostate), chronic kidney disease, chronic obstructive pulmonary disease, depression, diabetes, substance use disorder, heart failure, hepatitis, HIV infection, hyperlipidemia, hypertension, ischemic heart disease, osteoporosis, schizophrenia and other psychotic illness, and stroke. The ADI is a multidimensional indicator of social economic conditions of the census block group, as a measure of SES, with a higher score indicating greater deprivation. The ADI combines 17 socioeconomic indicators of education, employment, income, poverty, housing, and housing characteristics.[31] We calculated the ADI using address information at the time of enrollment in the MCB.

Statistical Analyses

We summarized the basic characteristics of persons who were invited to the study, stratified by response status (yes vs no) and reported as medians (interquartile range [IQR]) for continuous variables and as counts (percentages) for categorical variables. A similar summary was generated stratified by case-control status. We first assessed for the association of basic personal characteristics with whether they completed the survey or not, using logistic regression models. Second, we tested for association between sociodemographic characteristics and hospitalization status within 5 years of biobank enrollment, adjusting for age during biobank enrollment and sex. Similar analyses were performed to test the association between work-related characteristics. Additionally, we fitted logistic regression models testing for the association of each work characteristic and hospitalization status, adjusting for age, sex, and comorbid conditions (a well-known risk factor for hospitalization; model 1). To assess for effects of educational attainment on the association results from model 1, we fitted another model by adding educational attainment (model 2). We based these risk adjustment variables on our previous work on risk of hospitalization.[2] We also stratified model 2 by sex to evaluate

TABLE 1. Comparison of 5548 Biobank Participants who did and did not Complete the Survey[a]

Variable	Did not complete survey (n=1383)	Completed survey (n=4165)	*P* value
Age (y)[b]	71.1 (63.9-76.3)	68.0 (62.9-73.5)	<.001
Age (y) categories			<.001
50-59	175 (12.7)	559 (13.4)	
60-69	483 (34.9)	1798 (43.2)	
70-79	537 (38.8)	1518 (36.4)	
80-89	181 (13.1)	286 (6.9)	
90-99	7 (0.5)	4 (0.1)	
Sex			.07
Male	641 (46.3)	2050 (49.2)	
Female	742 (53.7)	2115 (50.8)	
No. of comorbid conditions	6 (4-8)	5 (4-7)	<.001
Area deprivation index quartile[c]	(n=1289)	(n=3893)	<.001
Q1	283 (22.0)	1005 (25.8)	
Q2	574 (44.5)	1834 (47.1)	
Q3	352 (27.3)	915 (23.5)	
Q4	80 (6.2)	139 (3.6)	

[a]Values are median (interquartile range) or number of persons (%).
[b]At Biobank enrollment.
[c]Higher score quartiles indicate greater deprivation.

any potential differences between men and women. We reported comparisons as odds ratios (ORs) and corresponding 95% CIs. A *P* value of <.05 was considered statistically significant. Analyses were performed using R v4.0.3 and SAS v.9.4 (SAS Institute Inc).

RESULTS

Cohort Development and Nonresponders

Among the 5569 persons invited to participate through the mailed survey, 4165 (75.1%) completed the survey. A total of 21 persons had not provided consent for study participation and were not considered further. Of the 1383 who did not complete the survey, 298 (21.5%) declined to participate and the rest did not respond. Sufficient data with clear information and available work history were available to support the planned analyses for 1600 of 1880 surveys (85.1%) returned by cases and 1936 of 2285 surveys (84.7%) returned by controls (Figure). The median age was 71.1 years (IQR, 63.9-76.3 years) for nonresponders and 68.0 years (IQR, 62.9-73.5 years) for responders (*P*<.001). Within the 9-county region, the proportion responding who were cases and controls was similar (84% vs 83%, not shown). The median number of chronic illnesses was 6 (IQR, 4-8) in nonresponders and 5 (IQR, 4-7) in responders (*P*<.001). Overall, the responder group was younger, had a higher percentage of men, and had lower ADI (higher SES) than the nonresponder group (Table 1).

Case and Control Characteristics

Cases were older (median age, 69.1 vs 68.1 years in controls; *P*<.001), with 8.9% aged 80 years or older in cases vs 6.4% in controls (OR, 1.74; 95% CI, 1.27-2.38; *P*=.004) (Table 2). The percentage of men among cases was higher than among controls (50.4% vs 46.6%; *P*=.03). The race was White in 95.2% of the cases, compared with 96.6% of the control group (*P*=.07). Cases were less likely to have a bachelor's degree than controls (20.1% vs 23.9%; OR, 0.66; 95% CI, 0.46-0.94). Cases also had more comorbid conditions, with more than 31% in the top quartile for comorbid health conditions in the cohort, compared with 15.3% of controls (OR, 4.09; 95% CI, 3.37-4.97). There were no differences in ethnicity or marital status (Table 2).

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TABLE 2. Sociodemographic Characteristics of Study Responders: Cases vs Controls[a]

Variable	Group[b]		OR (95% CI)[c]	*P* value
	Controls (n=1936)	Cases (n=1600)		
Age, (y)[d]	68.1 (63.2-73.5)	69.1 (63.8-74.4)	1.02 (1.01-1.03)	<.001
Age (y)[d] categories				
54-59	246 (12.7)	162 (10.1)	Ref	.004
60-69	844 (43.6)	659 (41.2)	1.17 (0.94-1.47)	
70-79	723 (37.3)	636 (39.8)	1.32 (1.06-1.66)	
≥80	123 (6.4)	143 (8.9)	1.74 (1.27-2.38)	
Sex				
Male	903 (46.6)	807 (50.4)	Ref	.03
Female	1033 (53.4)	793 (49.6)	0.86 (0.75-0.98)	
Race				
White	1871 (96.6)	1524 (95.2)	Ref	.07
Other than White	65 (3.4)	76 (4.8)	1.37 (0.98-1.93)	
Ethnicity	(n=1924)	(n=1590)		
Not Hispanic	1913 (99.4)	1581 (99.4)	Ref	.97
Hispanic	11 (0.6)	9 (0.6)	0.98 (0.39-2.38)	
Marital status	(n=1896)	(n=1558)		
Married	1356 (71.5)	1082 (69.4)	Ref	.29
In marriage-like relationship	25 (1.3)	18 (1.2)	0.90 (0.48-1.66)	
Divorced	98 (5.2)	106 (6.8)	1.45 (1.09-1.94)	
Widowed	337 (17.8)	290 (18.6)	1.04 (0.85-1.26)	
Separated	6 (0.3)	3 (0.2)	0.63 (0.13-2.39)	
Never been married	62 (3.3)	51 (3.3)	1.07 (0.73-1.57)	
Other	12 (0.6)	8 (0.5)	0.82 (0.32-2.00)	
Education	(n=1905)	(n=1565)		
Less than high school	68 (3.6)	77 (4.9)	Ref	.01
High school	496 (26.0)	478 (30.5)	0.90 (0.63-1.28)	
Vocational/technical/business school	284 (14.9)	238 (15.2)	0.81 (0.56-1.18)	
Associate degree	165 (8.7)	133 (8.5)	0.80 (0.53-1.19)	
Bachelor's degree	456 (23.9)	314 (20.1)	0.66 (0.46-0.94)	
Graduate/professional school	436 (22.9)	325 (20.8)	0.69 (0.48-0.99)	
No. of comorbid conditions	5 (3-7)	6 (5-8) (n=1596)	1.26 (1.23-1.30)	<.001
No. of comorbid conditions, categories		(n=1596)		
0-4	916 (47.3)	389 (24.4)	Ref	<.001
4-5	292 (15.1)	219 (13.7)	1.78 (1.44-2.20)	
5-7	432 (22.3)	493 (30.9)	2.74 (2.29-3.28)	
7-15	296 (15.3)	495 (31.0)	4.09 (3.37-4.97)	
Current smoker				
No	833 (43)	703 (43.9)	Ref	.06
Yes	46 (2.4)	57 (3.6)	1.58 (1.05-2.37)	
Missing	1057 (54.6)	840 (52.5)	0.97 (0.85-1.12)	
ADI quartile[e]	(n=1811)	(n=1497)		
Q1	497 (27.4)	365 (24.4)	Ref	.17
Q2	837 (46.2)	706 (47.2)	1.14 (0.96-1.35)	
Q3	419 (23.1)	362 (24.2)	1.15 (0.94-1.40)	
Q4	58 (3.2)	64 (4.3)	1.47 (1.01-2.16)	

[a]ADI, area deprivation index; OR, odds ratio; Ref, reference group.
[b]Values are median (interquartile range) or number of responders (%).
[c]Adjusted for age at Biobank enrollment and sex, except for age (adjusted for sex) and sex (adjusted for age).
[d]At Biobank enrollment.
[e]Higher score quartiles indicate greater deprivation.

Comparison of Work Characteristics

For age- and sex-adjusted work characteristics, cases had a slightly lower median (IQR) age of starting work than controls (19 [18-22] years vs 20 [18-22] years; P=.007) (Table 3). Greater percentages of cases than controls had to work longer hours to support children (31% vs 26%; P=.004), never had a job (10% vs 7.7%; P=.004), and had illness or disability during work (9.9% vs 6.4%; P<.001). There was no difference between cases and controls in first work living situation (living alone, living in a single-family home) or cutting back on work hours because of children. The other work characteristics, including total years of employment, total number of jobs, being furloughed, type of employment, retirement, age of retirement, and reason for retirement, were not different between cases and controls (Table 3).

Final Adjusted Models

In the 2 models adjusting for age, sex, and comorbid conditions, without (model 1) or with (model 2) education level, the age at the first job was associated with hospitalization in model 1 but became nonsignificant in model 2 including the education level (Table 4). In model 2, persons who had a total number of jobs up to 2 had a lower chance of hospitalization than those having no job (OR, 0.77; 95% CI, 0.60-1.00; P=.03); there was no difference between those with no job and those with 3 or more jobs. Persons who ever had an illness or disability during employment also were more likely to be hospitalized (OR, 1.31; 95% CI, 1.01-1.69; P=.04). There were no effects of retirement characteristics on hospitalization, including age of retirement, reason for retirement, or partial retirement. Type of employment, ever being furloughed, total number of jobs, total years employed, work related to children, or any first job characteristics also were not associated with hospitalization (Table 4). When data were stratified by sex, number of jobs was not associated with hospitalization in men or women (Supplemental Table, available online at http://www.mcpiqojournal.org). However, the effect of disability during working was driven by male disability, with an OR of 1.48 (95% CI, 1.01-2.20; P=.047) in men and no association with hospitalization in women.

DISCUSSION

In this study of 3536 biobank participants, we found a protective effect for hospitalization of having 1 or 2 jobs over the working lifetime compared with having no job. Not having a job can place a person at risk for lack of health insurance, which affects access to preventive health care.[32] Occupation has traditionally and consistently been used as an indicator of SES, along with education and income, and not having a job also can have deleterious effects on the SES.[33] The protective effect of having a job, however, becomes less prominent once a person has 3 or more jobs. We also found that illness and/or disability during work was a predictor of hospitalization in later life, even after adjusting for comorbid conditions and SES.

Our study found that being furloughed or laid off from a job was not associated with future hospitalization. In an Australian study, patients receiving disability pension or unemployment benefits had no differences in hospital use compared with wage-earning patients.[34] A Danish study reported that job loss from plant closure was not associated with an increase in all-cause hospitalization, but there was an increase in hospitalization from alcohol-related diseases.[35] International studies are often difficult to compare, however, because unemployment laws and medical benefits can be markedly different from country to country.

Many of the work characteristics we examined, including the duration of work and total number of jobs, were not associated with hospitalization. Age at the first job was associated with hospitalization, with a younger age during work associated with hospitalization in unadjusted analysis, but after adjustment for education, the relationship was no longer significant. Socioeconomic status, as measured with the ADI, was not different between cases and controls. In a previous study of 271 patients after hospitalization for trauma, noninsurance status and low SES were predictors of hospitalization.[36] In a study from Israel among patients who had a traumatic injury and missed work, patients in the lowest income quartile had a higher risk of not

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TABLE 3. Association Between Work-Related Variables and Hospitalization Status[a]

Variable	Group[b]		OR (95% CI)[c]	*P* value
	Controls (n=1936)	Cases (n=1600)		
Age at the first job (y)	20 (18-22) (n=1884)	19 (18-22) (n=1533)	0.97 (0.95-0.99)	.007
Age at the first job (y), categories	(n=1884)	(n=1533)		
≤18	676 (35.9)	634 (41.4)	Ref	.001
18 to <20	376 (20.0)	316 (20.6)	0.93 (0.77-1.12)	
20 to <22	520 (27.6)	334 (21.8)	0.71 (0.59-0.84)	
22 to 70	312 (16.6)	249 (16.2)	0.83 (0.68-1.02)	
Living alone during the first job[d]	229 (11.8)	172 (10.8)	0.90 (0.73-1.12)	.35
Living in a single-family house during the first job[d]	880 (48.0) (n=1833)	765 (51.3) (n=1491)	1.11 (0.97-1.28)	.13
Stopped working for children[e]	496 (30.5) (n=1626)	339 (25.6) (n=1323)	0.83 (0.68-1.02)	.08
Cut back hours for children[e]	308 (20.2) (n=1524)	216 (17.1) (n=1263)	0.89 (0.72-1.11)	.30
Working longer hours for children[e]	391 (25.9) (n=1509)	393 (31.1) (n=1263)	1.28 (1.08-1.52)	.004
Total years of employment	34 (28-40) (n=1786)	34 (28-40) (n=1440)	1.00 (0.99-1.00)	.51
Total years of employment, categories	(n=1786)	(n=1440)		
0 to <28	450 (25.2)	388 (26.9)	Ref	.14
28 to <34	473 (26.5)	336 (23.3)	0.78 (0.64-0.96)	
34 to <40	467 (26.1)	376 (26.1)	0.88 (0.72-1.08)	
40 to 66	396 (22.2)	340 (23.6)	0.88 (0.71-1.08)	
Total jobs	2 (1-3)	2 (1-3)	1.02 (0.99-1.06)	.17
Total jobs, categories				
No job	150 (7.7)	160 (10.0)	Ref	.004
1-2	1155 (59.7)	866 (54.1)	0.73 (0.57-0.93)	
3-10	631 (32.6)	574 (35.9)	0.89 (0.69-1.14)	
Illness/disability during employment[e]	124 (6.4)	159 (9.9)	1.63 (1.27-2.08)	<.001
Furloughed or laid off[e]	200 (10.3)	186 (11.6)	1.15 (0.93-1.43)	.19
Type of employment for the longest job	(n=1732)	(n=1402)		
Only full-time	1258 (72.6)	1052 (75.0)	Ref	.16
Most full/some part-time	231 (13.3)	164 (11.7)	0.89 (0.71-1.11)	
Equal full/part-time	46 (2.7)	29 (2.1)	0.80 (0.49-1.28)	
Mostly part/some full-time	93 (5.4)	91 (6.5)	1.23 (0.90-1.69)	
Only part-time	104 (6)	66 (4.7)	0.77 (0.55-1.08)	
Retirement	(n=1802)	(n=1472)		
Not retired	22 (1.2)	18 (1.2)	Ref	.16
Partial retirement	133 (7.4)	138 (9.4)	1.27 (0.65-2.50)	
Complete retirement	1647 (91.4)	1316 (89.4)	0.99 (0.53-1.88)	
Age at partial retirement (y)	62 (57-65) (n=340)	62 (59-66) (n=313)	1.02 (1.00-1.04)	.12
Reason for partial retirement	(n=343)	(n=302)		
Wanted	261 (76.1)	226 (74.8)	Ref	.62
Forced	33 (9.6)	25 (8.3)	0.88 (0.50-1.53)	
Part wanted/forced	49 (14.3)	51 (16.9)	1.19 (0.77-1.84)	
Age at complete retirement (y)	63 (60-67) (n=1665)	63 (60-67) (n=1333)	1.00 (1.00-1.01)	.34
Age at complete retirement (y), categories	(n=1665)	(n=1333)		
≤62	779 (46.8)	588 (44.1)	Ref	.30
62 to <65	370 (22.2)	317 (23.8)	1.16 (0.96-1.39)	
65 to 96	516 (31)	428 (32.1)	1.06 (0.90-1.26)	

Continued on next page

TABLE 3. Continued

Variable	Group[b]		OR (95% CI)[c]	*P* value
	Controls (n=1936)	Cases (n=1600)		
Reason for complete retirement	(n=1593)	(n=1282)		
Wanted	1328 (83.4)	1031 (80.4)	Ref	.02
Forced	91 (5.7)	104 (8.1)	1.51 (1.13-2.03)	
Partial wanted/forced	174 (10.9)	147 (11.5)	1.1 (0.87-1.39)	

[a]OR, odds ratio; Ref, reference group.
[b]Values are median (interquartile range) or number of responders (%).
[c]Adjusted for age at Biobank enrollment and sex, except for age (adjusted for sex) and sex (adjusted for age).
[d]Yes vs no.
[e]Ever vs never.

returning to work than those in the highest quartile.[37] Thus, the findings of other studies differ from those of our study.

In terms of characteristics related to retirement, none of the characteristics we studied, including age and reason for retirement, were predictive of hospitalization. Common reasons for early retirement include poor health, good health, defined benefit plans, financial independence, workplace issues, work itself, and potentially ageism.[38] For some, the physical demands of work require retirement at an earlier age. Adults older than 65 years with higher education can expect an additional 2 to 3 years of disability-free life expectancy compared with older adults with lower education.[39] The length of time in retirement can affect some measures of cardiovascular health, including adiposity; however, no net effect on cardiovascular disease has been shown in the United States.[40]

Our study has some limitations. The study population generalizes to the upper midwest of the United States,[41] but it may not generalize to other countries or parts of the United States with regard to ethnic diversity or educational level. Of particular note, patterns of work may be regional, and the study area has a 2-fold higher rate of health care jobs than the average US region.[42] Although we collected self-reported information on work, we did not collect where the work occurred. In addition, it is possible that missing data, including that related to hospitalization, may have influenced our results. Specifically, misclassifications could have occurred if hospitalizations were not captured. Conversely, the strengths of our study include a large cohort and use of a survey mainly consisting of validated questions used in other studies from the Health and Retirement Survey.[43] The use of questions from that survey also facilitates the comparison of our findings with those from other studies. The cohort was drawn from the MCB, which includes clinical information, prior survey data, and genomic information. The response rate of 75% was excellent, and we also conducted a nonresponse bias analysis, which revealed that responders were younger, with fewer comorbid conditions and higher SES. There is also a potential for recall bias regarding work history with a survey. It is important to recognize that the study reflects this active cohort, and future cohorts and workers may have different experiences such as multiple jobs or working from home, which may change future outcomes.

CONCLUSION

We found that persons with disability during a working lifetime have an increased risk of hospitalization in the future. In addition, having 1 or 2 jobs is protective for hospitalization compared with no jobs. Hospitalization may be an indicator of decreased health, and hospitalization itself can lead to functional decline[44] and increased health care costs.[45] On the basis of our findings, it may be important to obtain a more detailed work history from patients, with attention to disability. We additionally found that retirement and age of work cessation were not associated with hospitalization. This information can

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TABLE 4. Adjusted Models for Association Between Work-Related Variables and Hospitalization Status[a]

Variable	Model 1 (adjusted for age, sex, comorbid conditions)		Model 2 (adjusted for age, sex, comorbid conditions, education)	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age at the first job (y), per 1-y increment	0.98 (0.96-1.00)	.047	0.99 (0.97-1.01)	.23
Age at the first job (y), categories				
≤18	Ref	.03	Ref	.22
18 to <20	0.99 (0.81-1.20)		0.98 (0.8-1.20)	
20 to <22	0.77 (0.64-0.92)		0.80 (0.65-1.00)	
22 to <70	0.88 (0.72-1.09)		0.92 (0.72-1.17)	
Living alone during the first job[b]	0.95 (0.76-1.18)	.61	1.03 (0.82-1.29)	.80
Living in a single-family house during the first job[b]	1.05 (0.91-1.21)	.54	0.98 (0.85-1.14)	.81
Stopped working for children[c]	0.83 (0.67-1.03)	.10	0.85 (0.69-1.06)	.16
Cut back hours for children[c]	0.85 (0.68-1.07)	.17	0.88 (0.69-1.10)	.26
Working longer hours for children[c]	1.22 (1.02-1.45)	.03	1.16 (0.97-1.40)	.10
Total years employed, per 1-y increment	1.00 (0.99-1.01)	.81	1.00 (0.99-1.01)	.78
Total years employed, categories				
0 to <28	Ref	.29	Ref	.40
28 to <34	0.82 (0.66-1.01)		0.84 (0.68-1.03)	
34 to <40	0.93 (0.75-1.14)		0.95 (0.77-1.18)	
40 to 66	0.92 (0.74-1.14)		0.92 (0.74-1.15)	
No. of jobs, per 1-job increment	1.02 (0.98-1.06)	.31	1.02 (0.98-1.06)	.25
No.of jobs, categories				
No job	Ref	.03	Ref	.03
1-2	0.77 (0.59-0.99)		0.77 (0.60-1.00)	
3-10	0.90 (0.69-1.17)		0.91 (0.70-1.19)	
Illness/disability during employment[c]	1.35 (1.04-1.74)	.02	1.31 (1.01-1.69)	.04
Furloughed or laid off[c]	1.15 (0.92-1.44)	.21	1.11 (0.88-1.38)	.38
Type of employment (longest job)				
Full-time	Ref	.35	Ref	.31
Most full/some part	0.89 (0.70-1.12)		0.89 (0.70-1.13)	
Equal full/part	0.80 (0.48-1.32)		0.79 (0.47-1.32)	
Most part/some full	1.20 (0.86-1.66)		1.22 (0.88-1.70)	
Part-time	0.82 (0.58-1.16)		0.81 (0.57-1.15)	
Retirement				
Not retired	Ref	.09	Ref	.17
Partial retirement	1.13 (0.57-2.30)		1.15 (0.57-2.35)	
Complete retirement	0.85 (0.44-1.65)		0.89 (0.46-1.75)	
Age at partial retirement, per 1-y increment	1.02 (1.00-1.04)	.06	1.02 (1.00-1.04)	.09
Partial retirement reason				
Wanted	Ref	.44	Ref	.47
Forced	0.75 (0.42-1.33)		0.78 (0.43-1.39)	
Wanted/forced	1.17 (0.75-1.83)		1.19 (0.75-1.87)	
Age at complete retirement, per 1-y increment	1.00 (1.00-1.01)	.32	1.00 (0.99-1.01)	.39
Age at complete retirement (y), categories				
≤62	Ref	.30	Ref	.39
>62-65	1.16 (0.96-1.41)		1.15 (0.94-1.39)	
>65	1.06 (0.89-1.27)		1.05 (0.88-1.26)	

Continued on next page

TABLE 4. Continued

Variable	Model 1 (adjusted for age, sex, comorbid conditions) OR (95% CI)	*P* value	Model 2 (adjusted for age, sex, comorbid conditions, education) OR (95% CI)	*P* value
Complete retirement reason				
Wanted	Ref	.27	Ref	.41
Forced	1.27 (0.93-1.73)		1.22 (0.89-1.68)	
Wanted/forced	1.09 (0.85-1.39)		1.07 (0.83-1.37)	

[a]OR, odds ratio; Ref, reference group.
[b]Yes vs no.
[c]Ever vs never.

better help clinicians make an accurate assessment of their patients.

POTENTIAL COMPETING INTERESTS

Dr Cerhan reports grants from Genentech, NanoString, and Genmab; reports grant and consulting fee from BMS; and participates on a Data Safety Monitoring Board or Advisory Board for Protagonist, all unrelated to the present study. Other authors report no competing interests.

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SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://www.mcpiqojournal.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **ADI,** area deprivation index; **IQR,** interquartile range; **MCB,** Mayo Clinic Biobank; **OR,** odds ratio; **REP,** Rochester Epidemiology Project; **SES,** socioeconomic status

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