

# Chronic back pain among older construction workers in the United States: a longitudinal study

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This study assessed chronic back pain among older construction workers in the United States by analyzing data from the 1992–2008 Health and Retirement Study (HRS), a large-scale longitudinal survey. Fixed-effects methods were applied in the multiple logistic regression model to explore the association between back pain and time-varying factors (e.g., employment, job characteristics, general health status) while controlling for stable variables (e.g., gender, race, ethnicity). Results showed that about 40% of older construction workers over the age of 50 suffered from persistent back pain or problems. Jobs involving a great deal of stress or physical effort significantly increased the risk of back disorders and longest-held jobs in construction increased the odds of back disorders by 32% (95% CI: 1.04–1.67). Furthermore, poor physical and mental health were strongly correlated with back problems. Enhanced interventions for construction workers are urgently needed given the aging workforce and high prevalence of back disorders in this industry.

**Keywords:** Job stress, Physical effort, Perceived physical health, Mental health, Longitudinal study, Fixed-effects

## Introduction

Back pain or back problems affect a large portion of the world.<sup>1</sup> In the United States, an estimated 29% of the adult population reported low back pain at least once in a three-month time frame.<sup>2</sup> Furthermore, back pain is a widespread physical condition for which people often seek medical consultations and treatment. In a given year, between 12% and 15% of the general US population will visit their physician with a complaint of back pain.<sup>2</sup> Among working people, back pain is also a very common health disorder,<sup>3</sup> especially among those with physically demanding jobs, such as construction workers. A US study found that the construction industry comprises a disproportionate share of workers experiencing back pain.<sup>4</sup> Other studies from various nations such as Canada,<sup>5</sup> the Netherlands,<sup>6–8</sup> Ireland,<sup>9</sup> Finland,<sup>10–11</sup> Denmark,<sup>12</sup> Sweden,<sup>13–16</sup> Germany,<sup>17–21</sup> Hong Kong,<sup>22</sup> and Japan,<sup>23–25</sup> agreed that individuals working in the construction trade have a high risk of back disorders. In addition to causing acute and chronic pain, back disorders also bring financial burdens to workers and their families, employers, and society.<sup>26–27</sup> Back disorders are the most common reason for filing workers'

compensation claims and account for almost one-quarter of all claims.<sup>28,29</sup> Compared with other workers, back pain and problems were more severe for construction workers<sup>30</sup> and accounted for the greatest percentage of claims costs and disability days.<sup>4</sup>

Back pain can even afflict young construction apprentices at the beginning of their careers.<sup>31</sup> As time progresses, such ailments are exacerbated and become more severe.<sup>32–33</sup> As the baby boomers (those born from 1946–1964) age, older workers are expected to comprise a large share of the labor force.<sup>34</sup> Following this trend, the average age of US construction workers increased to 41 years in 2009, almost four years older than in 1992.<sup>35</sup> Although occupational exposures that are physical in nature are considered a risk factor for back pain among construction workers and the persistence of back problems tends to be more frequent with increasing age, the compounded effect of aging and long-term exposure on older construction workers remains unclear. Because the construction workforce is generally mobile and chronic back pain develops over time, studies based on cross-sectional data are unable to capture older workers who exit the construction industry due to back pain and subsequently, fail to identify the long-term effects of construction work on back disorders. Some studies on construction workers that are longitudinal in nature, only focus on one construction occupation, a

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small sample, or a short follow-up time frame. Furthermore, such longitudinal studies are not based on US construction workers.

To expand upon existing literature, this study assessed chronic back pain or problems among older construction workers in the United States using a large-scale, longitudinal survey with a 17-year follow-up period. This survey design allowed for retrospective analyses of job histories and health statuses of individual workers even after exiting an industry or the job market.

## Methods

### Data source and study sample

This study utilized the Health and Retirement Study (HRS), a large nationally representative longitudinal survey of US residents over the age of 50 conducted by the University of Michigan since 1992. The initial sample (or the HRS cohort) contained 12,652 people who were born between 1931 and 1941. Several age cohorts have been added to the HRS since 1992 (see the University of Michigan's HRS website for more information regarding the cohorts: <http://hrsonline.isr.umich.edu/>).

To better evaluate long-term effects of job history and job exposures at the individual level, respondents who were once employed or currently employed (see the Terms and Measures section) in Wave 1 (1992), were selected and followed wave by wave from 1992 through 2008, regardless of their occupation or employment status. Other age cohorts post-1992 were excluded from this study as were respondents who were never employed. The respondents in the construction industry were identified from the HRS restricted or confidential dataset obtained through an agreement with the University of Michigan. Table 1 summarizes the sample sizes represented in each wave of the HRS survey from 1992 to 2008 for both construction and non-construction samples.

### Terms and Measures

Back pain or back problems in the HRS survey were self-reported and the wording of this question varied across survey waves. In Waves 1 and 2, the question asked, "Do you have any of the following health problems: Problems with your back?" Beginning in Wave 3, the question asked, "Since we last talked to you (in the previous interview), have you had any of the following persistent or troublesome problems: Back pain or problems?" From Wave 1 to Wave 3, every respondent was asked about back pain. However in subsequent waves, follow-up interviewees were only asked about back pain every other wave. Therefore, the study cohort was asked about back pain or problems in Waves 1, 2, 3, 5, 7, and 9. When the question was skipped, the individual's response in the previous interview was used. A dichotomous variable, "BACKPAIN," was coded as "1" if the answer to the question was "yes," and coded as "0" if the answer was "no."

Perceived physical health was based on the question, "Would you say your health is excellent, very good, good, fair, or poor?" This question is asked for every respondent in each wave in which the categories "very good" and "good" were combined for this study.

Mental health was measured by the Center for Epidemiologic Studies Depression (CES-D) scale. The CES-D score is a sum of six "negative" indicators (i.e., depression, everything was an effort, sleep was restless, felt alone, felt sad, or could not get going) minus two "positive" indicators (i.e., felt happy and enjoyed life), pertaining to how the respondent felt the majority of the time the week prior to the interview.<sup>36</sup> Higher CES-D scores represent greater negative feelings a week prior to the interview.

To track occupations over time, there were a group of questions on respondents' current job, last job, and job history. The respondents were also asked about

**Table 1 Sample size by wave, construction versus non-construction, 1992–2008**

Wave	Year	Construction		Non-Construction		Total		
		Longest	Longest & Current	Current	Longest & Not Current	Longest	Current	Ever Employed
1	1992	616	400	84	94	10,567	7,819	11,459
2	1994	571	305	90	87	9,623	6,518	10,411
3	1996	551	246	86	91	9,130	5,608	9,872
4	1998	504	209	71	74	8,740	4,842	9,397
5	2000	472	175	64	64	8,240	4,055	8,836
6	2002	438	128	60	67	7,926	3,329	8,465
7	2004	406	100	53	60	7,581	2,866	8,059
8	2006	390	55	29	29	7,147	1,741	7,576
9	2008	364	44	16	22	6,794	1,253	7,182
Lost cases	252				3,773		4,277	

#### Notes:

1. Longest=Longest-held job in construction.
2. Longest & Current=Longest-held job in construction and currently working in construction.
3. Current=Currently working in construction, but longest-held job in non-construction.
4. Longest & Not Current=Longest-held job in construction and currently working in non-construction.

starting and ending dates for each job, which allowed the longest-held job to be computed. If the respondent was working at the time of the interview, his/her current industry was identified from the question, “What kind of business or industry do you work in—that is, what do they make or do at the place where you work?” For self-employed interviewees, the question was reworded to read, “What industry do you work in? That is, what does your company do or make?” Similar questions were also asked to ascertain respondents’ last job and job history. When the respondent’s current industry and longest industry were the same, his/her longest and current industry was counted.

Longest occupations were associated with the longest-held job based on the questions, “What is/was the official title of your job?” “What is/was the title that your employer uses/used?” and “What sort of work do/did you do?” Occupations were regrouped into two major categories for the data analyses: blue-collar and white-collar. Blue-collar (or Production) occupations included respondents who reported that their longest-held job was in construction trades, mechanics, or repair personnel, operators (e.g., machine, transport, and handlers), and so on. Workers employed as administrative support, and managerial and professional occupations, were combined as white-collar.

In addition to questions regarding occupations, working respondents were also asked about job characteristics. Job physical effort was assessed through the question, “Thinking of your job, please tell me how often these statements are true: My job requires lots of physical effort. Is this true all or almost all of the time, most of the time, some of the time, or none or almost none of the time?” The categories “most of the time” and “some of the time” were combined when analyzing the data. Job stress was ascertained through the question, “Thinking of your job, please indicate how much you agree or disagree with each statement: My job involves a lot of stress. Do you strongly agree, agree, disagree, or strongly disagree with that statement?” The categories “disagree” and “strongly disagree” were combined in this study.

### Statistical Analyses

Workers’ demographics, employment characteristics, general health status, and back pain were examined for both 1992 (baseline) and 2008 (follow-up) according to the respondent’s longest-held industry. The individual’s characteristics were tracked and repeatedly measured wave by wave for those in the baseline sample surveyed until Wave 9 (2008 survey). That is, the individuals who were included in the bivariate and multivariate analyses were tracked for the same length of time. To better measure the

relationship between the extent of job exposures and back disorders, the dataset was restructured to contain one record per person-year as opposed to one record per person. An identification variable (ID) was assigned for all the records for each individual. Fixed-effects methods<sup>37–38</sup> were employed in the multiple logistic regression model to control for all stable characteristics, such as gender, race, ethnicity, and education (assuming that few individuals in this age cohort changed their educational attainment in the study period). The time-varying variables (e.g., employment characteristics and general health status) were included in the multiple logistic regression model as independent variables. In addition, a dummy variable for survey waves was created to distinguish the observations at different time points for each individual. This variable was included in the regression model with Wave 3 as the reference category because the question on back pain had changed during that wave. Odds ratios and 95% confidence intervals (CIs) were calculated to assess the significance of associations between back pain and the independent variables at the  $\alpha=0.05$  level. The Hosmer-Lemeshow goodness-of-fit test was conducted to measure whether the model fits the data. The HRS sample weights, primary sampling unit markers, and strata markers were applied in all tabulations. In addition, the ID variable was used in stratum (i.e., nine observations for each respondent were counted together in the analyses). SAS-callable SUDAAN (version 10.0.1), which accounted for the complex, multistage sampling design of the HRS, was utilized in conducting the data analyses.

### Results

Table 1 summarizes the sample sizes for construction and non-construction respondents by wave. Overall, the number of respondents in this study’s cohort decreased over time. By Wave 9, about 37% (4,277 of 11,459) of the original cohort at Wave 1 (baseline) had either died or lost contact with the HRS. The percentage of lost cases among those whose longest-held job was in construction was as high as 41% (252 of 616). Across the long follow-up period, respondents whose longest-held job was in construction also worked in non-construction at times, while those who held a longest-job in non-construction would work in construction temporarily.

Tables 2 and 3 provide the sample’s characteristics at baseline in 1992, and during the follow-up period in 2008, according to respondents’ longest-held industry. On average, construction workers were slightly younger than non-construction workers at the baseline period. However, in the 2008 follow-up survey, more than 99% of workers in both groups were 65 years or older. Generally, construction is a “male-dominated” industry;

less than 10% of construction workers were female in 1992 and 2008, compared with more than half in non-construction. Regarding race and ethnicity, fewer black and other minority workers were employed in

construction than in non-construction fields, but no significant differences arose between Hispanic and non-Hispanic workers for this age cohort. There were remarkable differences in educational attainment

**Table 2 Demographic characteristics, job exposures, and health status at baseline (1992), by longest-held industry**

Variable	Construction (n=616)		Non-construction (n=10,567)		p-value <sup>1</sup>
	%	SE	%	SE	
Demographics					
Age					
Mean (Years)	55.46	0.15	55.53	0.04	0.623
50–54	43.30	2.2	41.49	0.61	0.068
55–64	56.70	2.2	58.46	0.62	
65 and up	–	–	0.05	0.03	
Gender					
Male	90.28	1.35	47.29	0.46	0.000*
Female	9.72	1.35	52.71	0.46	
Race					
White	90.49	1.46	85.99	0.69	0.000*
Black/Other	9.51	1.46	14.01	0.69	
Ethnicity					
Hispanic	6.24	1.11	5.9	0.68	0.731
Non-Hispanic	93.76	1.11	94.10	0.68	
Educational Attainment					
High School Diploma or Less	75.97	2	59.51	1.11	0.000*
Some College	16.35	1.83	20.26	0.57	
College Degree or More	7.68	1.14	20.23	1.01	
Geographic Region					
Northeast	19.74	2.98	22	1.88	0.018*
Midwest	18.87	2.76	24.7	1.94	
South	39.66	3.69	33.77	1.82	
West	21.72	2.9	19.53	2.19	
Job Exposures					
Longest Occupation					
Blue-collar	69.13	1.93	27.04	0.8	0.000*
White-collar	30.87	1.93	72.96	0.8	
Employment Type					
Self-employed	26.62	2.07	13.41	0.5	0.000*
Wage-and-salary	73.38	2.07	86.59	0.5	
Employment Status					
Works full-time	64.24	2.3	60.4	0.78	0.007*
Works part-time/Partly retired	14.02	1.8	15.04	0.39	
Disability	4.45	0.76	2.75	0.25	
Retired	10.87	1.47	13.59	0.56	
Other	6.41	1.15	8.23	0.38	
Job Physical Effort <sup>2</sup>					
All/Almost all of the time	34.91	2.69	19.56	0.74	0.000*
Most/Some of the time	45.88	3.1	47.74	0.83	
None/Almost none of the time	19.2	2.14	32.7	0.91	
Job Involves Lots of stress <sup>3</sup>					
Strongly agree	17.03	1.7	20.02	0.63	0.112
Agree	41.3	2.33	42.81	0.76	
Disagree/Strongly disagree	41.68	2.47	37.17	0.72	
Health Status					
CES-D <sup>4</sup> Score (0–8)					
Mean	2.06	0.09	2.11	0.02	0.594 <sup>1</sup>
0	27.56	1.97	25.3	0.62	0.430
1	23.35	2.01	21.64	0.56	
2	15.6	1.66	17.12	0.57	
3 or above	33.48	2.23	35.94	0.75	
Perceived Health Status					
Excellent	21.05	1.77	24.88	0.72	0.093
Very good/Good	56.41	1.8	56.52	0.59	
Fair	13.64	1.5	12.21	0.51	
Poor	8.9	1.31	6.39	0.35	
Back Pain/Problem	39.19	2.1	33.86	0.76	0.034*

**Notes:**

1.  $Pr > |t|$  for t-Test.

2. Percentage for those who reported this information;  $n=489$  for construction;  $n=7,518$  for non-construction.

3. Percentage for those who reported this information;  $n=488$  for construction;  $n=7,488$  for non-construction.

4. CES-D=Center for Epidemiologic Studies Depression scale.

\*  $p < 0.05$  for  $\chi^2$  test.

between construction and non-construction: Less than 8% of construction workers had finished college, while more than 20% in non-construction had a college education or above. As expected, demographic

characteristics such as gender, race, ethnicity, and education were relatively stable over time. In terms of geographic area, construction workers were more likely to reside in the South and West than

**Table 3 Demographic characteristics, job exposures, and health status at follow-up (2008), by longest-held industry**

Variable	Construction (n=364)		Non-construction (n=6,794)		p-value <sup>1</sup>
	%	SE	%	SE	
Demographics					
Age					
Mean (Years)	70.91	0.18	71.06	0.04	0.431
55–64	0.66	0.48	0.07	0.04	0.22
65 and up	99.34	0.48	99.93	0.04	
Gender					
Male	90.41	1.32	43.95	0.70	0.000*
Female	9.59	1.32	56.05	0.70	
Race					
White	91.41	1.71	88.50	0.64	0.068
Black/Other	8.59	1.71	11.50	0.64	
Ethnicity					
Hispanic	4.29	0.86	5.54	0.77	0.076
Non-Hispanic	95.71	0.86	94.46	0.77	
Educational Attainment					
High School Diploma or Less	78.54	2.46	56.91	1.23	0.000*
Some College	12.95	1.92	20.77	0.75	
College Degree or More	8.51	1.78	22.32	1.14	
Geographic Region					
Northeast	15.99	3.39	18.96	1.72	0.625
Midwest	23.16	3.38	24.33	1.95	
South	38.06	4.46	36.34	1.89	
West	22.60	3.44	20.22	2.06	
Job Exposures					
Occupation Type					
Blue-collar	69.43	3.09	24.55	0.81	0.000*
White-collar	30.57	3.09	75.45	0.81	
Employment Type					
Self-employed	19.75	2.73	8.38	0.54	0.000*
Wage-and-salary	80.25	2.73	91.62	0.54	
Employment Status					
Works full-time	12.95	2.36	9.32	0.46	0.033*
Works part-time/Partly retired	20.61	2.08	17.02	0.67	
Disability	0.60	0.37	0.72	0.12	
Retired	63.54	3.01	68.41	0.82	
Other	2.30	0.98	4.51	0.31	
Job Physical Effort <sup>2</sup>					
All/Almost all of the time	23.30	6.01	13.77	1.42	0.010*
Most/Some of the time	52.60	7.02	46.43	1.60	
None/Almost none of the time	24.10	4.49	39.80	1.65	
Job Involves Lots of Stress <sup>3</sup>					
Strongly agree	8.33	3.78	9.19	0.82	0.762
Agree	27.28	6.02	30.78	1.37	
Disagree/Strongly disagree	64.39	5.81	60.03	1.38	
Health Status					
CES-D <sup>4</sup> Score (0–8)					
Mean	1.09	0.09	1.26	0.02	0.055 <sup>1</sup>
0	51.32	2.41	49.94	0.96	0.030*
1	24.24	2.42	21.96	0.81	
2	11.75	1.84	9.87	0.43	
3 or above	12.68	1.59	18.23	0.76	
Perceived Health Status					
Excellent	7.92	1.68	8.76	0.39	0.127
Very good/Good	60.15	2.65	64.68	0.89	
Fair	21.45	2.45	19.21	0.73	
Poor	10.48	1.45	7.36	0.42	
Back Pain/Problem	39.15	3.28	36.77	0.72	0.481

**Notes:**

1.  $P > |t|$  for t-Test.

2. Percentage among those who reported this information;  $n=92$  for construction;  $n=1,244$  for non-construction.

3. Percentage among those who reported this information;  $n=92$  for construction;  $n=1,263$  for non-construction.

4. CES-D=Center for Epidemiologic Studies Depression scale.

\*  $p < 0.05$  for  $\chi^2$  test.

non-construction workers at baseline, but such differences were not found during the follow-up period.

With regard to job exposure, occupational distributions were quite different between the industry groups. Compared with non-construction workers, construction workers were more likely to be in production or blue-collar occupations (69.1% versus 27% at baseline). Self-employment was also more common in the construction industry as 26.6% were self-employed versus 13.4% in non-construction at baseline. Such differences were also found during the follow-up period, although the proportion of self-employed workers in construction declined in later years.

Employment status significantly changed for both groups over time. Only 11% of construction workers and 14% of non-construction workers retired at the baseline period, while the proportion of retirees increased to 64% for construction and 68% for non-construction at the follow-up period. In addition, construction workers were more likely to work full-time than non-construction workers at both the baseline and follow-up periods. Incidentally, construction workers were found to report more disability cases than non-construction workers at baseline (4.5% versus 2.8%). However, the percentage of “disability” decreased to less than 1% for both groups at the follow-up period.

With regard to job demands, construction workers were significantly more likely to be exposed to high physical demands at their jobs compared with non-construction workers over both the baseline and follow-up periods. However, for both groups, job physical efforts declined in their later working life as did job stress. No significant differences were observed with regard to job stress between the industry groups at either the baseline or follow-up periods.

Aging seemed to take its toll as perceived physical health of this study cohort greatly deteriorated from the baseline to the follow-up period. The percent of construction workers who reported “excellent” health declined from 21% in 1992 to less than 8% in 2008. A similar trend was also found among non-construction workers as the percentage of “excellent” health dropped from 25% to 9% during the same period. In contrast to physical health, mental health somehow improved as workers aged. The average CES-D score decreased for both construction and non-construction workers, and workers with a CES-D score of 0, which indicates excellent mental health, nearly doubled at the follow-up period. No significant differences in mental health were found between the two groups at the baseline period, but were found at the follow-up period with the construction cohort showing greater improvement.

When the question on back pain or problems was asked at baseline, more than 39% of construction

workers reported “yes,” compared with less than 34% of non-construction workers. This difference was statistically significant at baseline, but not at the follow-up period. Interestingly, the percentage of back pain remained the same for construction workers and increased for non-construction workers, but wording differences over time for the back pain question was not taken into account in this comparison.

When all nine waves of the study were examined together, a higher percentage of back pain was observed in most of the subgroups in construction than in the corresponding groups in non-construction (Table 4). Within the construction industry, the percentage of back pain varied among workers with different demographics and employment characteristics. Workers with lower educational attainment, production workers, wage earners, or job holders with higher physical efforts or job stress, were more likely to report back pain or problems. Back pain also more frequently occurred among workers with poorer physical and mental health statuses as well as for those with a disability. In addition, back pain was more likely to be reported by female workers (45%), but less likely to be reported by black and other races (32%) and Hispanic workers (26%). However, such racial and ethnic disparities were not found among non-construction workers. (The disparities in construction may not be reliable given the wider confidence intervals reported.)

Table 5 shows the adjusted odds ratios from the multivariate logistic regression analysis of factors associated with back pain. The large *p*-value from the Hosmer-Lemeshow goodness-of-fit test indicates that the fixed-effects model fits the observed data well (H-L Wald *p*-value=0.575; H-L Satterthwaite adjusted *p*-value=0.484). After controlling for the time-invariant and time-varying variables, the results indicate that persistent back pain/problems were more likely to be experienced later in life for this study cohort when using Wave 3 as the reference year. Workers’ job history and job exposures were significantly associated with the risk of chronic back pain or problems in which longest job in construction increased the odds of chronic back pain by 32% (95% CI: 1.04–1.67). Jobs involving a high level of stress also raised the risk of chronic back pain by 36% (95% CI: 1.15–1.6) when compared with jobs without much stress. In addition, jobs demanding physical effort all or almost all of the time increased the odds of back pain by 21% (95% CI: 1.04–1.4) compared with jobs not requiring such effort. After controlling for job characteristics, the difference between occupation and employment type was not significant.

Both perceived physical health and mental health were negatively correlated with back pain in which the better the health, the less the back pain. The odds of

chronic back disorders for workers in poor health were more than four times those in excellent health (OR=4.33; 95% CI: 3.16–5.93). Additionally, regional variation was found in this model. Older workers who resided in the Northeast and West regions were more likely to report back pain than living in the South

(OR=1.20 and 1.32; 95% CI: 1.01–1.41 and 1.09–1.58, respectively).

## Discussion

This longitudinal study provides evidence that employment history and occupational exposures are

**Table 4 Individual characteristics and their bivariate associations with occurrence of back pain by longest-held industry, 1992–2008**

Variable	Construction Person-Year=3,062 <sup>1</sup>			Non-construction Person-Year=55,437 <sup>1</sup>		
	Mean	Lower 95%	Upper 95%	Mean	Lower 95%	Upper 95%
Demographics						
Gender						
Male	0.39	0.34	0.44	0.29	0.28	0.31
Female	0.45	0.3	0.59	0.34	0.33	0.36
Race						
White	0.40	0.35	0.45	0.32	0.31	0.34
Black/Other	0.32	0.21	0.42	0.33	0.30	0.35
Ethnicity						
Hispanic	0.26	0.13	0.39	0.33	0.29	0.36
Non-Hispanic	0.40	0.35	0.45	0.32	0.31	0.34
Educational Attainment						
High School Diploma or Less	0.41	0.36	0.46	0.35	0.33	0.37
Some College	0.34	0.21	0.46	0.32	0.29	0.34
College Degree or More	0.31	0.16	0.46	0.25	0.23	0.27
Geographic Region						
Northeast	0.44	0.34	0.53	0.32	0.29	0.35
Midwest	0.39	0.28	0.49	0.31	0.29	0.33
South	0.42	0.35	0.48	0.31	0.29	0.33
West	0.34	0.24	0.44	0.35	0.31	0.38
Job Exposures						
Longest Occupation						
Blue-collar	0.43	0.37	0.49	0.36	0.33	0.39
White-collar	0.32	0.23	0.41	0.31	0.30	0.32
Employment Type						
Self-employed	0.37	0.30	0.43	0.28	0.25	0.31
Wage-and-salary	0.40	0.35	0.46	0.33	0.31	0.34
Employment Status						
Works full-time	0.36	0.30	0.43	0.26	0.25	0.27
Works part-time/Partly retired	0.32	0.25	0.39	0.30	0.28	0.32
Disability	0.74	0.62	0.86	0.68	0.63	0.72
Retired	0.44	0.38	0.50	0.36	0.34	0.38
Other	0.36	0.27	0.45	0.36	0.32	0.39
Job Physical Effort <sup>2</sup>						
All/Almost all of the time	0.37	0.30	0.45	0.30	0.28	0.33
Most/Some of the time	0.34	0.29	0.40	0.29	0.27	0.31
None/Almost none of the time	0.32	0.20	0.44	0.24	0.22	0.25
Job Involves Lots of Stress <sup>3</sup>						
Strongly agree	0.38	0.30	0.47	0.33	0.31	0.36
Agree	0.36	0.29	0.44	0.28	0.26	0.30
Disagree/Strongly disagree	0.33	0.28	0.38	0.25	0.23	0.27
Health Status						
CES-D <sup>4</sup> Score (0–8)						
0	0.27	0.21	0.32	0.22	0.21	0.23
1	0.39	0.33	0.46	0.34	0.32	0.36
2	0.50	0.42	0.59	0.41	0.38	0.43
3 or above	0.62	0.56	0.68	0.50	0.49	0.52
Health Status						
Excellent	0.28	0.20	0.36	0.16	0.14	0.17
Very good/Good	0.35	0.29	0.41	0.30	0.29	0.31
Fair	0.50	0.43	0.57	0.50	0.48	0.52
Poor	0.73	0.66	0.79	0.67	0.62	0.71

### Notes:

1. Data includes those who participated in both the 1992 and 2008 survey. All variables were repeatedly measured wave to wave for nine total waves. Respondents with invalid responses to back pain questions were excluded.
2. Tabulations among those who reported this information; Person-Year=1,550 for construction; Person-Year=28,503 for non-construction.
3. Tabulations among those who reported this information; Person-Year=1,562 for construction; Person-Year=28,561 for non-construction.
4. CES-D=Center for Epidemiologic Studies Depression scale.

significantly associated with persistent back disorders. The results also confirm previous research findings that construction work puts one at higher odds of experiencing back pain.<sup>39</sup> Longest-held jobs in the construction industry increased the risk of persistent back pain or problems by 32% after controlling for time-invariant and other time-varying factors. Furthermore, high job stress and heavy physically demanding jobs significantly increased the likelihood of back disorders by 36% and 21%, respectively. It was also found that both self-reported mental and physical health statuses were strongly associated with persistent back pain or problems. The experience of back pain may contribute to depression symptoms and overall physical health status, but it is difficult to conclude causality in either direction from the current study. The

finding also indicates that persistent back pain/problems were somewhat more likely to be experienced later in life for the overall cohort. This general trend could be attributed to the effects of aging and/or natural deterioration of the body over time. In addition, the variation of back pain was observed among different geographical areas. It appears that older workers who resided in the Northeast and West were more likely to experience back pain or problems. Perhaps weather differences in those regions might partially account for the variations.<sup>40-41</sup>

This study has several advantages such as a relatively large sample size, nationally representative study cohort, occupational exposure history, repeatedly measured health outcomes, and a long follow-up period. Nevertheless, this research design has some

**Table 5 Multivariate logistic regression: Factors associated with back pain, 1992–2008**

Variable	Odds Ratio (OR)	Lower 95% OR	Upper 95% OR	p-value
Intercept	0.11	0.09	0.14	0.000*
Wave				
1	1.11	1.01	1.21	0.030*
2	1.06	0.96	1.17	0.333
3	1	1	1	–
4	0.86	0.81	0.91	0.000*
5	1.04	0.94	1.16	0.441
6	1.01	0.90	1.13	0.885
7	1.20	1.08	1.35	0.002*
8	1.16	1.00	1.34	0.049*
9	1.16	0.97	1.39	0.100
Industry (Longest job)				
Construction	1.32	1.04	1.67	0.023*
Non-Construction	1.00	1.00	1.00	–
Occupation Type (Longest job)				
Blue-collar	1.08	0.93	1.26	0.302
White-collar	1.00	1.00	1.00	–
Employment Type				
Self-employed	1.12	0.96	1.31	0.143
Wage-and-salary	1.00	1.00	1.00	–
Degree of Physical Work				
All/Almost all of the time	1.21	1.04	1.40	0.014*
Most/Some of the time	1.19	1.07	1.33	0.002*
None/Almost none of the time	1.00	1.00	1.00	–
Job Involves Lots of Stress				
Strongly agree	1.36	1.15	1.60	0.000*
Agree	1.07	0.96	1.20	0.209
Disagree/Strongly disagree	1.00	1.00	1.00	–
Health Status				
Excellent	1.00	1.00	1.00	–
Very good/Good	1.90	1.68	2.16	0.000*
Fair	3.05	2.59	3.60	0.000*
Poor	4.33	3.16	5.93	0.000*
CES-D <sup>1</sup> Score (0–8)				
0	1.00	1.00	1.00	–
1	1.51	1.40	1.64	0.000*
2	1.73	1.53	1.96	0.000*
3 or above	2.19	1.97	2.43	0.000*
Geographic Region				
Northeast	1.20	1.01	1.41	0.035*
Midwest	1.15	0.97	1.36	0.103
West	1.32	1.09	1.58	0.005*
South	1.00	1.00	1.00	–

**Notes:**

1. CES-D=Center for Epidemiologic Studies Depression scale.

2. Hosmer & Lemeshow goodness-of-fit test: Chi-square=6.65, DF=8, Pr>ChiSq=0.575.

3. Total observations (Person-Year) used in this model were 21,661. Invalid responses were excluded.

\* p<0.05.

drawbacks as well. One of the weaknesses of the longitudinal design is that some respondents drop out over time. In this present study, about 37% of the original cohort and 41% of respondents whose longest-held job was in construction lost contact with HRS and were not captured in the 2008 follow-up survey. Because respondents who were less healthy or had severe back problems may be more likely to exit from the cohort earlier, the long-term effects of job exposures on chronic back disorders could be underestimated due to the healthy worker or survivor effect. In addition, the definition of longest job varies for different individuals and may not fully capture respondents' other jobs with greater peak exposures despite shorter exposure periods. Moreover, the changes in the back pain question in terms of wording and query frequency across the study period, could also reduce the study's validity. In addition, some of the respondents had already retired or left the labor force at the baseline survey. Thus, their specific job exposures were not able to be measured over time since the job characteristic questions are only asked to those who are working at the time of the survey. Furthermore, despite the relatively large sample size of the study, it is still too small to be broken down by detailed construction occupations. Finally, the fixed-effects methods used in the regression model focused more on differences within individuals than between individuals. Future studies using random- or mixed-effects approaches should be conducted to better capture between-person variations.

Despite limitations, there are several notable components to highlight from this study. The findings showed that persistent back pain or problems were common (36%, see Table 4) among older full-time construction workers. With the baby-boomer generation aging, the participation rates of older workers in the labor force are expected to increase.<sup>42</sup> Employers can take advantage of the changing demographics in the labor force by acknowledging the value and contributions older workers add to the workplace.<sup>43</sup> Nevertheless, with this perception, employers should strongly consider implementing risk-control measures designed for the needs of older workers to mitigate negative outcomes such as back pain. As per the World Health Organization (WHO), the workplace should be adjusted to accommodate changing physical capacities with aging.<sup>44</sup> For example, ergonomic evaluations and solutions for job tasks assigned to older workers should be encouraged. The finding also reflects the mobile characteristics of the construction industry. The older workers switched jobs and industries frequently during the follow-up period. This study did find that job physical efforts declined among both construction and non-construction workers in their later working years. Yet, such

changes may only reflect the physical limitation or changed job duties of these older workers rather than the changes in the workplace. While reducing extraneous physical effort is essential, the observed association between job stress and back pain confirms that psychological factors increased the odds of chronic back pain.<sup>19</sup> Future research and health interventions should shed more light on the socio-psychological issues in the workplace.

The bivariate analysis found that the occurrence of chronic back pain varied among different occupations in addition to industrial disparities. For example, the percentage of persistent back pain or problems was as high as 43% among blue-collar workers whose longest-job was in the construction industry (see Table 4). Although the occupational difference was not significant after controlling for specific job characteristics in the fixed-effects model, blue-collar occupations in both construction and non-construction were more likely to increase the risk of back pain or problems than white-collar occupations. This finding is in line with previous studies that found that cement and concrete workers,<sup>45-46</sup> painters,<sup>17</sup> carpenters,<sup>47-48</sup> electricians,<sup>49-50</sup> mason tenders,<sup>51</sup> and machine drivers<sup>6,47</sup> are more likely to suffer from back pain due to their occupational duties. Programs to reduce back disorders should be targeted to high-risk occupations for workers of any age.

This longitudinal study not only assessed back pain among people who were still working, but also measured the long-term effects of occupational exposures after discontinuing to work. The higher percentage of chronic back pain for retirees whose longest-held job was in the construction industry (44%, see Table 4) indicates that the effects of occupational exposures could persist even after workers have retired or left the industry and affect them later in life. In addition, the percentage of back pain was found to be extremely high among construction workers who were disabled (74%), which suggests a relationship between back problems and disabilities. However, considering the small sample size of those with disabilities, further studies are needed to test this hypothesis. In addition, the severity of back pain and its impact on workers' physical functionality and work ability should be assessed in future studies.

## Conclusion

Employment history and occupational exposures are significantly associated with chronic back disorders among older construction workers. Occupational exposures can have lasting effects on current and former workers well after they stop working. Given the aging US workforce and increases in the age of retirement,<sup>52</sup> the safety and health of older workers deserves special attention from all public health stakeholders and society.

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