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Relationship Between Age, Tenure, and Disability Duration in Persons With Compensated Work-Related Conditions

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Objective: The aim of the study was to examine the relationships among age, tenure, and the length of disability following a work-related injury/illness. **Methods:** This study utilized 361,754 administrative workers' compensation claims. The relationships between age, tenure, and disability duration was estimated with random-effects models. **Results:** The age-disability duration relationship was stronger than the tenure-disability duration relationship. An interaction was observed between age and tenure. At younger ages, disability duration varied little based on tenure. In midlife, disability duration was greater for workers with lower tenure than for workers with higher tenure. At the oldest ages, disability duration increased as tenure increased. **Conclusions:** Findings indicate that age is a more important factor in disability duration than tenure; however, the relationship between age and disability duration varies based on tenure, suggesting that both age and tenure are important influences in the work-disability process.

Workplace injury and illness is a serious concern in today's work environment. The estimated annual direct and indirect cost of workplace injury and illness is approximately $250 billion, a total greater than the annual cost of cancer.[1] Most of these costs result from injuries/illnesses that require time away from work or work restriction.[1] Unsurprisingly, workplace injuries/illnesses that require a greater amount of time out of work or limitation while at work tend to be more costly.[2–5] As such, there is interest in better understanding the factors related to the length of disability and how to best manage the work-disability process.

Age has been consistently shown to relate to the experience of workplace injury/illness and the length of disability. Research has found that the length of disability increases with age, as does the likelihood of experiencing work-disability recurrence. In addition, the chances of never achieving a return to work (RTW) increase with age.[6–13] There are several potential reasons for the relationship between age and RTW outcomes that include biological changes associated with aging, which might delay recovery after injury/illness, older workers might sustain more serious injuries/illnesses, and there is a higher incidence of comorbidities with age that might further complicate recovery.[14,15] In addition, it has been suggested that older workers might have reduced access to rehabilitation services, older workers might also be less satisfied with their rehabilitation services, employers might not encourage older workers to RTW, and older workers might be in industries and occupations with fewer opportunities for accommodation that might facilitate RTW.[8,15]

Despite the research on the relationship between age and the length of disability, research also has demonstrated that the length of disability decreases with increasing tenure.[6,9,16–18] The relationship between tenure and the length of disability might be due to several factors including the increase in work experience at a given company that can help workers to better navigate the RTW system at an organization, workers with longer lengths of tenure might also have greater organization attachment and more positive supervisor interactions both of which can make the RTW process easier, and more accommodations might be available to workers with higher tenure.

The reverse directions of the relationships between age and the length of disability and tenure and the length of disability are somewhat surprising as age and tenure have traditionally been very closely related.[19] As such, it might be expected that a positive relationship between age and the length of disability would translate to a positive relationship between tenure and the length of disability; however, this is not the case. These findings raise questions including the following: Are age and tenure independently related to the length of disability? Is one of the relationships stronger than the other? Is there nonlinearity in these relationships? and Do age and tenure interact in their relationship with length of disability?

Few studies have systematically examined models involving age, tenure, and the length of disability. Several studies have, however, included age and tenure in predictive models either as covariates or as variables included in larger multivariate models. Findings indicate that both explain unique variance in work-disability outcomes.[6,9,20,21] In the majority of previous work, age and tenure have been included in models with only linear terms or in some cases as categorical variables, despite speculation about possible nonlinearity in the relationships.[15,22] There has been only one previous study that has considered nonlinearity in both relationships. In this study, the age/work-disability relationship was found to be linear; however, an inverted u-shaped relationship was found between tenure and certified sickness absence. Previous research has not yet examined nonlinearity in the relationships with disability resulting from work-related injury/illness specifically. In addition, research has not examined whether the relationship with the length of disability is stronger for age than tenure, or vice versa.

Regarding the possible interaction between age and tenure, again there is limited research. A few studies have examined the interaction between age and tenure with the risk of experiencing a workplace injury/illness. One study found that in younger railway workers, the risk of injury increased with tenure.[23] Another study found that in older health care workers, the risk of injury was the lowest for new hires.[24] Other research has focused on the interaction in relation to the length of disability. In a study of workers in the fruit and vegetable packing industry, the number of days off work following an accident was found to be similar across tenure levels for middle-aged workers, whereas for older workers the number of days off decreased with tenure.[25] A final study found different patterns for the interaction between age and tenure with the length of certified sickness absence among two groups of workers. For homecare workers with high tenure, age was positively associated with the length of certified absence, whereas there was no association with age for homecare workers with low tenure. In contrast, for

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residential care workers, the positive relationship between age and certified absence was stronger for low- and medium-tenure workers than for high-tenure workers.[15] These studies focused on single industries, raising questions about the generalizability of the findings.

This is an especially important time to examine relationships among age, tenure, and the length of disability. The demographic makeup of the United States workforce has been changing drastically over the last several decades. In 1990, roughly 12% of the workforce was comprised of workers age 55 and older. That number is expected to grow to over 25% by 2020.[26] This has heightened concerns for employers about the potential impact of the aging workforce in regards to the cost and length of disability for older employees.[27]

At the same time that the workforce is aging, the typical career trajectory is also changing. Traditionally, individuals entered the workforce after school and then remained with a single employer for their entire careers. As a result, as age increased, tenure on the job also increased; however, research indicates that this trend might be changing.[28] Individuals now change organizations, and sometimes careers, several times throughout their working years.[29,30] This has led to shorter average lengths of tenure, especially for men at older ages. For example, the median tenure for male workers aged 55 to 64 years fell from 15.3 years in 1983 to 9.5 years in 2006.[31]

Based on previous research, it is unclear whether and how age and tenure might interact in their relationship with the length of disability; however, there are a few potential directions this interaction might take. First, work-related experience generally increases with tenure. As such, this experience might serve as a protective factor against the age-related changes that result in an increase in the length of disability as age increases. If this were the case, the length of disability might be shorter for older workers with higher tenure compared with those with lower tenure. On the contrary, workers who have been with their employer longer might feel increased job security, which could result in individuals taking a longer time to RTW as they do not feel the need to rush back to work to keep their jobs. Accordingly, older workers with higher tenure might have longer disability durations than those with lower tenure. The current study aimed to address these possibilities.

The changing demographic makeup of the US workforce and the changing nature of career trajectories make this an important time to conduct research aimed at gaining an understanding of how age and tenure might interact to influence work disability. The goal of the present study is to explore the relationship between age and tenure with the length of disability following a work-related injury/illness to better understand the complex interplay among these factors.

METHODS

The administrative records from a large, private workers' compensation insurance company in the United States were used in this study. These claims come from various different organizations, industries, company sizes, and geographic locations. All claims with complete data from January 1, 2002 until December 31, 2008 were assessed for inclusion. Only claims with at least 1 day of compensated lost work time were included. Lost work time included both days of temporary partial disability (TPD) and days of temporary total disability (TTD). All claimants were aged 18 to 80 at the time of claim initiation. Claims were followed for 1 year from the date at which lost work time began or until indemnity payments finished if that occurred within a year. This study was approved by the New England Institutional Review Board.

Several restrictions were applied to the claims (initial pool = 427,571). For claimants who had multiple claims within a single calendar year from 2002 to 2008, only the first claim within the calendar year was included in analyses (13,222 excluded). This was done to ensure that we only followed a single claim from a claimant within 1 calendar year. Claimants who received a lump sum payment within 1 year of claim initiation were also excluded (5701 excluded). In several instances, claimants first received compensation for lost work time more than 1 year after claim initiation. The sample was restricted to only include claims wherein lost work time first occurred within 1 year of claim initiation (6038 excluded). Finally, some claimants experienced multiple episodes of lost work for a single claim resulting from the same condition. This occurred in cases wherein an individual went back to work after an injury/illness for some time but then had to go back out of work again as a result of the same condition. For the current study, claimants were considered to have multiple episodes of lost work time when they returned to work for at least 14 days before having to go back off again. Cases wherein the individual returned to work for less than 14 days before going back out were considered a single episode. Multiple episode claims were excluded (40,856 excluded). In total, 361,754 claims were used in analyses.

MEASURES

Predictor Variables

Age and tenure at the time of claim initiation were the main predictor variables for the analyses. Tenure was calculated based on the date of hire. Both age and tenure were measured continuously in years.

Outcome Variable

The outcome variable was the length of disability, calculated based on the date that a claimant first received TPD or TTD until the date at which TPD or TTD ended. TPD or TTD were considered to have ended when no paid disability days were taken for at least 14 calendar days consecutively. When the length of disability exceeded 1 year, which occurred in 28,733 claims, the value for the length of disability was censored at 365 days. To address issues with normality, the natural log of the length of disability was used in the analyses.

Covariates

Several variables that might confound the relationship between age, tenure, and length of disability were included in the analyses. These variables included gender, annual income, litigation status, and year of injury/illness. Gender was coded 1 for female and 0 for male. Annual income was assigned to 1 of 16 categories. The first 15 were in increments of $10,000 (eg, $0 to $9999). A 16 was applied when people earned $150,000 or more. Litigation status was coded 1 if the insurer assigned an attorney to the claim and 0 if not. A series of dichotomous variables was used to represent the year of injury/illness with 2002 as the reference year.

Random-Effects Variables

The crossed effect between industry and the diagnosis chapter was estimated using random effects in the analyses. Industry was categorized into 10 groups including the following: (1) agriculture, forestry & fishing, (2) mining, (3) construction, (4) manufacturing, (5) transportation, communications, electric, gas, & sanitary services, (6) wholesale trade, (7) retail trade, (8) finance, insurance, & real estate, (9) services, and (10) public administration. These industry groupings match the US Department of Labor's Standard Industry Classification groups.[32] The most commonly used International Classification of Diseases, ninth revised edition (ICD-9) diagnosis appearing in the claimant's medical file for the first 15 days of medical bills was used as the primary diagnosis for the claim. Diagnoses were collapsed into the major chapters of the ICD-9 coding scheme. The crossed-effect approach was selected instead of treating diagnosis chapter and industry separately because it is

likely that certain diagnoses are more prevalent in some industries than others. In addition, the impact of specific diagnoses on the length of disability is likely to be dependent on the industry in which an individual works. For example, the length of disability might be shorter following a leg fracture in the finance, insurance, & real estate industry than in the construction industry. By using a crossed-effect approach we are better able to take this into account.

ANALYSES

To analyze the relationship between age, tenure, and the length of disability, random-effects models were utilized instead of ordinary least squared regression models, due to the non-independence of observations across the major diagnosis chapters and industry groupings.[33] Using a crossed-effect approach, random effects for each diagnosis chapter by industry grouping were included in the models.[34,35] Only pairings with at least 20 claims per pairing were included in the analyses.

In the first stage of the analyses, possible nonlinearity in the relationship between age and the length of disability was examined. The linear term for age was added to the first model. In the second model, the squared term for age was added. In the second stage of the analyses, the linearity analyses were replicated for tenure. The linear and nonlinear age and tenure terms reaching statistical significance were then included in a combined model with both age and tenure. In the final stage of the analyses, the interaction terms between age and tenure were added to the model. Continuous variables in the model were mean-centered. Analyses were estimated using Stata 13 (Stata Corporation, College Station, TX). The analyses presented have a large sample size and thus a P value of less than 0.001 was considered statistically significant. Confidence intervals are provided for all estimates. In addition, we present the predicted lengths of disability for the different statistically significant relationships addressed. We did not use a specific cutoff for determining the meaningfulness (clinical significance) of a difference in the predicted lengths of disability, as this number likely varies dependent on the stakeholder group (ie, employers, policy makers, or clinicians).

RESULTS

Of all claims (361,754), 31% were for women, half (50%) had an annual income greater than $30,000, and approximately a quarter (27%) were involved in litigation. The number of claims by year declined from 58,793 claims in 2002 to 47,097 claims in 2008. The largest industries represented in the claims were manufacturing (23%), transportation, communications, electric, gas, & sanitary services (23%), and services (22%). The most common diagnosis chapters were injury and poisoning (53%) and diseases of the musculoskeletal system (29%). Length of disability ranged from 3 days to 365 days, with an average of 88 days. The age of claimants in the sample ranged from 18 to 80 years, with an average of 41 years, and the length of tenure ranged from 0 to 30 years, with an average of 6 years. In our sample, the correlation between age and tenure was 0.38 ($P < 0.001$). The breakdown of claims by age and tenure is presented in Table 1.

For the first stage of the analyses, the relationship between age and the length of disability was estimated. The results are presented in Table 2. In models 1 and 2, we found that the relationship was slightly nonlinear (Figure 1), with both the age and age-squared terms reaching statistical significance. The relationship changes very little when adjusted for tenure (model 5) than when not adjusted for tenure (model 2). The relationship increases until around age 70 at which point it plateaus. When adjusted for tenure, the predicted length of disability varies by approximately 18 days across ages 18 to 80, ranging from 32.3 days at age 18 to 50.9 days at age 80. Regarding the adjustment of the model for tenure, we compared the age coefficients from model 2, with the age coefficients from model 5 using a Wald test. We found that the age coefficients were statistically similar across the models ($\chi^2 = 3.71$, $P > 0.05$).

In the second stage of the analyses, the relationship between tenure and the length of disability was estimated. These results are also shown in Table 2. For tenure, we found a linear relationship with the length of disability, with the tenure-squared term (model 4) not reaching statistical significance. The tenure relationship was estimated unadjusted for age (model 3) and adjusted for age (model 5). We found the relationship to be quite different when the model was adjusted for age. A Wald test comparing the tenure coefficients for the adjusted and unadjusted models revealed a significant difference ($\chi^2 = 49.82$, $P < 0.001$). The adjusted and unadjusted relationships are plotted in Figure 2. When the tenure-length of disability relationship was not adjusted for age, there was a positive relationship with the predicted length of disability increasing as tenure increased. The predicted length of disability ranged from a low of 42.1 days at 1 year of tenure to a high of 43.7 days at 20 years of tenure. In contrast, when the relationship was adjusted for age, the relationship became negative with the predicted length of disability

TABLE 1. Distribution of Claims by Age and Tenure

	Tenure													
	<1 Yr		1–2 Yrs		2–5 Yrs		5–10 Yrs		10–20 Yrs		20 Yrs		Total	
Age Groups	No. of Claims	% of Claims	No. of Claims	% of Claims	No. of Claims	% of Claims	No. of Claims	% of Claims	No. of Claims	% of Claims	No. of Claims	% of Claims	No. of Claims	% of Claims
18–24	26,158	7.23	7,139	1.97	5,653	1.56	565	0.16	0	0.00	0	0.00	39,515	10.92
25–29	17,206	4.76	6,287	1.74	8,088	2.24	5,125	1.42	381	0.11	0	0.00	37,087	10.25
30–34	16,099	4.45	6,325	1.75	8,686	2.40	7,088	1.96	4,563	1.26	0	0.00	42,761	11.82
35–39	15,504	4.29	6,462	1.79	9,306	2.57	7,949	2.20	9,254	2.56	264	0.07	48,739	13.47
40–44	14,831	4.10	6,465	1.79	9,619	2.66	8,207	2.27	10,006	2.77	3,461	0.96	52,589	14.54
45–49	12,262	3.39	5,715	1.58	8,795	2.43	7,740	2.14	8,742	2.42	6,910	1.91	50,164	13.87
50–54	8,327	2.30	4,152	1.15	6,765	1.87	6,235	1.72	6,916	1.91	8,196	2.27	40,591	11.22
55–59	4,944	1.37	2,703	0.75	4,605	1.27	4,567	1.26	5,138	1.42	6,536	1.81	28,493	7.88
60–64	2,096	0.58	1,275	0.35	2,499	0.69	2,644	0.73	2,998	0.83	3,336	0.92	14,848	4.10
65–69	712	0.20	413	0.11	804	0.22	949	0.26	904	0.25	693	0.19	4,475	1.24
70–74	273	0.08	169	0.05	379	0.10	376	0.10	354	0.10	233	0.06	1,784	0.49
75–80	86	0.02	47	0.01	140	0.04	176	0.05	162	0.04	97	0.03	708	0.20
Total	118,498	32.76	47,152	13.03	65,339	18.06	51,621	14.27	49,418	13.66	29,726	8.22	361,754	100.00

TABLE 2. Random Effects Model for Linearity Testing of Age and Tenure Predicting Length of Disability

	Model 1: Age Linear		Model 2: Age Quadratic		Model 3: Tenure Linear		Model 4: Tenure Quadratic		Model 5: Combined Model		Model 6: Interaction	
Predictors	**Coef (SE)**	**95% CI**	**Coef (SE)**	**95% CI**	**Coef (SE)**	**95% CI**	**Coef (SE)**	**95% CI**	**Coef (SE)**	**95% CI**	**Coef (SE)**	**95% CI**
Age[*]	0.09 (0.002)[a]	0.088 : 0.094	0.09 (0.002)[a]	0.091 : 0.097					0.10 (0.002)[a]	0.101 : 0.107	0.09 (0.002)[a]	0.090 : 0.099
Age^2			0.02 (0.001)[a]	−0.017 : −0.012					−0.01 (0.001)[a]	−0.017 : −0.01	−0.01 (0.001)[a]	−0.014 : −0.008
Tenure[†]					0.01 (0.001)[a]	0.007 : 0.012	0.01 (0.002)[a]	0.005 : 0.014	−0.02 (0.001)[a]	−0.02 : −0.019	−0.2 (0.002)[a]	−0.026 : −0.019
Tenure^2							−0.000 (0.001)	−0.001 : 0.001				
Age × Tenure											−0.01 (0.002)[a]	−0.014 : −0.005
Age^2 × Tenure											0.01 (0.001)[a]	0.004 : 0.008
Female[‡]	0.03 (0.004)[a]	0.023 : 0.039	0.03 (0.004)[a]	0.020 : 0.037	0.05 (0.004)[a]	0.043 : 0.060	0.05 (0.004)[a]	0.043 : 0.060	0.03 (0.004)[a]	0.021 : 0.038	0.03 (0.004)[a]	0.021 : 0.037
Income	0.02 (0.006)[a]	0.018 : 0.022	0.02 (0.001)[a]	0.016 : 0.019	0.03 (0.001)[a]	0.026 : 0.030	0.03 (0.001)[a]	0.026 : 0.030	0.02 (0.001)[a]	0.020 : 0.024	0.02 (0.001)[a]	0.020 : 0.024
Claim Litigated	1.18 (0.004)[a]	1.177 : 1.193	1.18 (0.004)[a]	1.174 : 1.190	1.20 (0.004)[a]	1.20 : 1.21	1.20 (0.004)[a]	1.196 : 1.212	1.18 (0.004)[a]	1.172 : 1.187	1.18 (0.004)[a]	1.172 : 1.187
Year of injury[§]												
2003	−0.03 (0.006)[a]	−0.042 : −0.017	−.03 (0.006)[a]	−0.041 : −0.017	−0.03 (0.006)[a]	−0.041 : 0.016	−0.03 (0.006)[a]	−0.041 : −0.016	0.03 (0.006)[a]	−0.041 : −0.017	−0.03 (0.006)[a]	−0.041 : −0.017
2004	−0.05 (0.006)[a]	−0.060 : −0.035	−.05 (0.006)[a]	−0.059 : −0.034	−0.04 (0.006)[a]	−0.056 : −0.030	−0.04 (0.006)[a]	−0.056 : −0.030	−0.05 (0.006)[a]	−0.060 : −0.035	−0.05 (0.006)[a]	−0.060 : −0.035
2005	−0.06 (0.006)[a]	−0.074 : −0.048	−.06 (0.006)[a]	−0.072 : −0.047	−0.06 (0.007)[a]	−0.069 : −0.043	−0.06 (0.007)[a]	−0.069 : −0.043	−0.06 (0.006)[a]	−0.074 : −0.048	−0.06 (0.006)[a]	−0.073 : −0.048
2006	−0.05 (0.007)[a]	−0.059 : −0.033	−0.04 (0.007)[a]	−0.057 : −0.032	−0.04 (0.007)[a]	−0.052 : −0.026	−0.039 (0.007)[a]	−0.052 : −0.026	−0.05 (0.007)[a]	−0.060 : −0.035	−0.05 (0.007)[a]	−0.060 : −0.034
2007	−0.038 (0.007)[a]	−0.051 : 0.025	−0.04 (0.006)[a]	−0.048 : −0.023	−0.03 (0.007)[a]	−0.041 : −0.015	−0.03 (0.007)[a]	−0.041 : −0.015	−0.04 (0.007)[a]	−0.053 : −0.027	−0.04 (0.007)[a]	−0.052–0.027
2008	0.02 (0.007)[a]	0.002 : 0.028	0.02 (0.007)	0.005 : 0.031	0.03 (0.007)[a]	0.015 : 0.041	0.03 (0.007)[a]	0.015 : 0.041	0.01 (0.007)	0.000 : 0.026	0.01 (0.007)	0.000 : 0.026
Intercept[‖]	3.44 (0.020)[a]	3.399 : 3.477	3.46 (0.020)[a]	3.420 : 3.499	3.43 (0.020)[a]	3.392 : 3.470	3.43 (0.020)[a]	3.392 : 3.470	3.46 (0.020)[a]	3.419 : 3.497	3.46 (0.018)[a]	3.428 : 3.497

Random effects for ICD-9 chapter by Industry pairings used.
CI, confidence interval; Coef, coefficient; ICD-9, International Classification of Diseases, ninth revised edition; SE, standard error.
[a] P value < 0.001.
[*] Age is coded in 10s of years (eg, one unit of age is 10 years).
[†] Tenure coded in 5s of years (eg, one unit of tenure is 5 years).
[‡] Male is the reference group.
[§] 2002 is the reference group.
[‖] Natural log of length of disability.

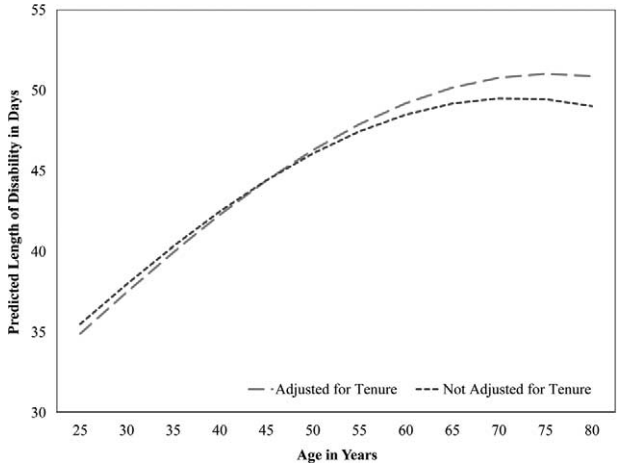

FIGURE 1. Plot of the relationship between age and the length of disability when adjusted and unadjusted for tenure. This figure is based on predicted values for the length of disability at different ages.

decreasing as tenure increased. In this model, the predicted length of disability ranged from a high of 43.8 days at 1 year of tenure to a low of 40.3 days at 20 years of tenure.

In addition to examining the main effect relationships of age and tenure with the length of disability separately, we also investigated differences between the relationships in their relative strength. Using a Wald test, we compared the absolute values of the coefficients for age and tenure in the combined model (model 5). When comparing the coefficients, both age and tenure were measured in years. The results revealed that the age-length of disability relationship was considerably stronger than the tenure-length of disability relationship ($\chi^2 = 526.82$, $P < 0.001$).

In the final stage of analyses, the interaction between age and tenure with the length of disability was estimated. The results are presented in model 6 of Table 2. A significant interaction was found between age and tenure, which is plotted in Figure 3 following the procedure of Aiken and West.[36] The age-length of disability relationship was plotted for various different lengths of tenure so that variation in the relationship across tenure levels might be observed.

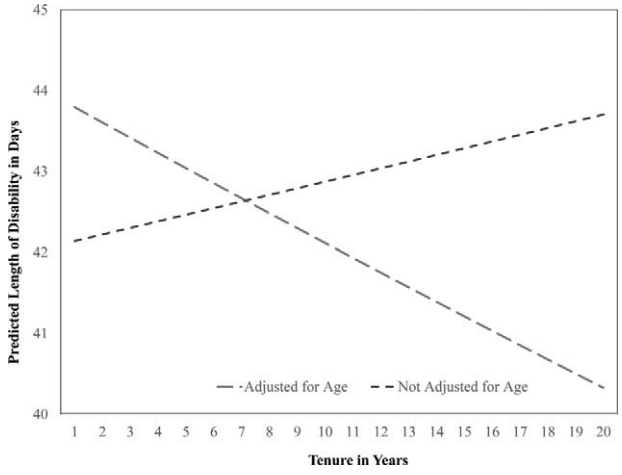

FIGURE 2. Plot of the relationship between tenure and the length of disability when adjusted and unadjusted for age. This figure is based on predicted values for the length of disability at different lengths of tenure.

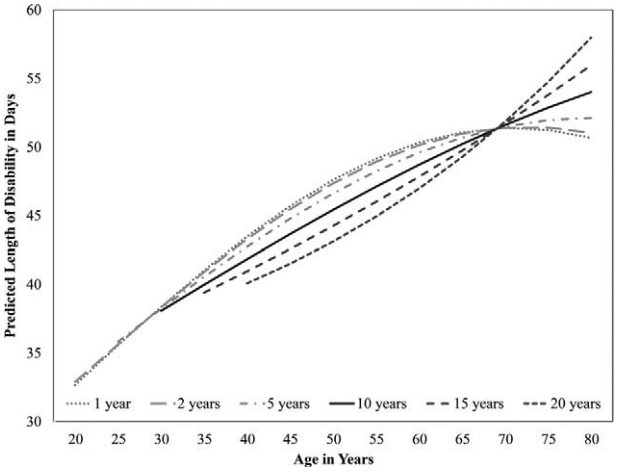

FIGURE 3. Plot of the interaction between age and tenure predicting the length of disability. This figure is based on predicted values for the length of disability at different ages and lengths of tenure.

As seen in Figure 3, at low levels of tenure (less than 5 years), the relationship between age and the length of disability is a slightly inverted u-shaped relationship wherein the length of disability increases with age until around age 70 at which point the length of disability then begins decreasing slightly up to age 80. In contrast, at higher levels of tenure (more than 10 years), the length of disability continuously increases with age. The positive relationship between age and the length of disability is greater as tenure increases. A turning point was observed around age 70. Prior to age 70, as tenure increased, the predicted length of disability decreased; however, after age 70, as tenure increased, the predicted length of disability began to increase. In general, the highest predicted length of disability was for the oldest workers with high tenure, whereas the shortest predicted length of disability was for younger workers with the lowest tenure.

Additional analyses were conducted to further investigate the interaction between age and tenure. The values of tenure might be thought to be conditional on age as certain values of tenure are not possible at younger ages (eg, 20 years of tenure at 30 years of age). A series of analyses were therefore conducted with this conditional relationship in mind by attempting to estimate models wherein the full sample of claimants has the potential to have any of the lengths of tenure regardless of their age. In the first model, we examined the interaction between age and tenure with tenure dichotomized into less than 2 years of tenure compared with 2 or more years of tenure. The results of this model were largely similar to the model with tenure measured continuously (Supplemental Figure 1). In the second model, we restricted the sample to claimants age 30 or older and we also restricted the sample to claimants with less than 10 years of tenure. As seen in Supplemental Figure 2, a similar finding emerged as in the full model.

Due to the large number of claims ($n = 28{,}733$) with a length of disability greater than 365 days, sensitivity analyses assessed whether the study findings varied when those claims were not included in the model. All analyses were replicated on the 333,021 claims with a length of disability of less than a year. The results were found to be consistent within this subsample. As with the full sample, the age-length of disability relationship was found to be nonlinear, whereas the tenure-length of disability relationship was found to be linear. The findings for age did not change when the model was adjusted for tenure. For tenure, the relationship with the length of disability did reverse when adjusted for age. Also, the age-length of disability relationship was found to

be stronger than the tenure-length of disability relationship. Finally, the interaction pattern between age and tenure was similar in the subsample model. Full results from the sensitivity analyses are not shown but are available upon request.

DISCUSSION

This study examined a model of age, tenure, and the length of disability in a large sample of workers' compensation claims from the United States with the goal of better understanding the complexity among these factors. For age and the length of disability, in general there was a positive relationship with the length of disability increasing as age increased and this relationship varied very little based on whether or not it was adjusted for tenure. Over a 2.5 week difference in the predicted length of disability was found going from ages 18 to 80. There was, however, some nonlinearity in this relationship. Specifically, the relationship began to flatten around age 70 and the length of disability increased very little with age from 70 to 80 years. These findings are somewhat in line with previous research. Whereas few studies have explored possible nonlinearity in the age-length of disability relationship, most studies have found a generally positive relationship between the two.[8,9] In the one study that did assess potential nonlinearity, the relationship was still linear, but in this previous study, the age range only extended to 65.[15] In the present study, the observed nonlinearity was primarily for workers over age 65, which might explain the divergence in our results. It is possible that the plateauing of the age-length of disability relationship after age 65 reflects the healthy worker effect, in which as age increases, only ''healthier'' older workers are able to continue working.[37] The lack of variability in the length of disability at older ages could be the result of only healthier workers still being in paid employment and therefore eligible for workers' compensation or it could result from the oldest workers feeling the need to go back to work sooner to keep their jobs secure.

Although the positive relationship between age and the length of disability has been shown in previous studies, there has been little empirical work testing the reasons for this relationship. There are, however, several possible explanations, such as the increasing likelihood of having comorbidities with age that might complicate the recovery process and physical changes that occur with age that might increase recovery time.[14] There might also be aspects of individuals' working conditions that might influence the length of disability. Employers might be more likely to offer accommodations to younger workers or to give more encouragement to younger workers to RTW quickly after injury.

The tenure-length of disability relationship was found to be linear. Interestingly, the relationship differed greatly when it was adjusted for age compared with unadjusted for age. When unadjusted for age, there was a positive relationship such that as tenure increased, the length of disability also increased. Although the reverse was true when adjusted for age—with the length of disability decreasing as tenure increased. This finding suggests that when the model did not include age, tenure was partially acting as a proxy for age. Our finding of a negative relationship when adjusted for age is in line with previous research.[16,18] We found approximately a 3-day decrease in the predicted length of disability going from 1 year to 20 years of tenure. It is important to note that although the relationship was statistically significant, even after the adjustment for age, the predicted length of disability only varied by a relatively small number of days over the range of tenure. From a clinical standpoint, a 3-day difference might not be very meaningful, in which case tenure would not be considered a primary factor in predicting the length of disability; however, for employers and insurers who might be considering the length of disability for thousands of workers, even a 1 day difference in the length of disability can be important.

In terms of the relative strength of the relationship with the length of disability for age and tenure, although both age and tenure remained statistically significant, age was found to be a stronger predictor of the length of disability than tenure. One possible explanation for this finding is that the mechanism behind the relationship between age and the length of disability, which might primarily reflect delayed recovery as a result of physiological changes associated with aging, has a greater impact on duration of disability than the mechanism behind the relationship between tenure and the length of disability. Although open to conjecture, the tenure-length of disability relationship likely involves a desire to RTW quickly because of a stronger organizational attachment; however, despite wanting to RTW quickly, older workers might need to remain out of work longer due to the additional time required for them to recover. This would result in the worker's age having a greater impact on the length of disability than the worker's length of tenure.

We also found an interaction between age and tenure with the length of disability. At the youngest ages, we found very little variability in the length of disability across the tenure groups. This is logical as there is a far smaller range for the lengths of tenure for individuals who recently entered the workforce. In contrast, for midlife workers aged 45 to 50, there was approximately a 4-day difference in the predicted length of disability across the tenure groups. The predicted length of disability was the shortest for midlife workers with high tenure compared with low tenure. This finding might reflect that in comparison to lower tenure midlife workers, workers in midlife that have been with their employers longer are more motivated to RTW quickly and know about the availability of resources at their organization, such as workplace accommodations, which facilitate a faster RTW. For workers in the typical retirement ages of 65 to 70, the predicted length of disability was found to vary very little across the tenure groups, but by age 80, the predicted length of disability varied by approximately a week, with lower tenure workers having a shorter predicted length of disability than high-tenure workers. It is possible that older workers with high tenure feel secure in their positions, and thus might not feel the need to rush back to work after a work-related injury/illness. In contrast, older workers with low tenure might hurry to RTW for fear of losing their jobs and being unable to find other employment due to their age. This might have contributed to differences in the length of disability across lengths of tenure in the oldest workers.

The interaction between age and tenure found in our study is somewhat different from previous studies. In one study, for workers over the age of 53, the number of days off of work following a work-related accident was higher for low-tenure workers than high-tenure workers.[25] In this previous study, individuals 54 and older were categorized in one single group. It is possible that this might contribute to the divergence of the findings as in our study, there was a turning point in the interaction between ages 50 and 80. At age 50, our findings were consistent with this previous study with the predicted length of disability being highest for low-tenure workers, but by age 80 the reverse was true. In another study, for homecare workers where the maximum age of participants was 64 years, the length of disability was found to be greater for the oldest workers with high tenure than those with low tenure, whereas in residential care workers, the oldest workers with medium tenure had the longest length of disability, followed by the high-tenure and then the low-tenure workers.[15] This previous study focused on certified sickness absence as opposed to work-related injury/illness specifically that could account for the differences as certified sickness absence involves a large number of chronic medical conditions.

IMPLICATIONS

There are several implications of the current findings. First, the stronger relationship between age and the length of disability than between tenure and the length of disability has implications for

research focused on the prognostic factors for RTW. By quantifying the magnitude of the relationships in a single model, we were able to show that age might be a more important factor to focus on than tenure. If tenure were to be included in models, the models should also include age, as the relationship between tenure and the length of disability actually reversed when adjusted for age. Further, the age by length of disability relationship varied across tenure levels. From a clinical perspective, our results point to the need to gain a better understanding of the factors leading to the relationship between age and the length of disability. Age-related changes in recovery time after any type of condition are likely to play a major role in this relationship, but to the extent that other factors might also influence this relationship might have the potential to inform interventions and treatment plans. For example, older workers might have a greater length of disability because suitable accommodations in the workplace are not made to facilitate returning to work. Regarding the interaction between age and tenure, as the workforce continues to age and the nature of careers also evolves, it is important to consider the interplay between these two factors on the length of disability. Up until the typical retirement age, for workers over the age of 50, the length of disability was higher for workers with lower tenure. Workers in midlife and those approaching retirement age who are new to their organizations might need additional support in the RTW process. These workers might be less familiar with the resources available to them and might not have strong organizational and supervisor relationships to rely on. From an intervention perspective, it might be important to identify what types of programs and policies would be most helpful in these workers RTW process.

LIMITATIONS

Although our study had strengths including the use of a large number of workers' compensation claims covering a wide range of employees of various ages and lengths of tenure in many different states and industries, there were important limitations to note. The large sample size afforded us the ability to examine the age and tenure interaction, but it also resulted in relationships being statistically significant despite there being relatively small differences in the predicted lengths of disability. When interpreting the results, it is important to consider what differences in the length of the disability are most meaningful to a given stakeholder group. Due to our reliance on already existing administrative data, we were unable to include in our analyses variables such as comorbidities, relationships with coworkers, and availability of job accommodations. Being able to have done so would likely have helped us to better understand the complexity of the age, tenure, and length of disability relationships.

A second limitation was the possible bias among the oldest claimants in the sample. Although it is a study strength that the age ranged from 18 to 80 years, individuals working after the traditional retirement years likely represent select groups of workers who delayed retirement, either due to financial necessity or personal preference. As such, the length of disability for the oldest workers might be influenced by factors beyond those at younger ages. In addition, in comparison with workers of other ages, there were relatively few workers over the age of 70 ($n = 2492$), with workers aged 70 to 80 representing less than 1% of the total sample. With this in mind, findings should be interpreted cautiously.

A third limitation was in the operationalization of the length of disability. The length of disability was calculated based on the beginning and end of indemnity payments. In doing so, we assume that the end of indemnity payments coincides with RTW; however, in the administrative data used in this study, there is no way to verify if this was indeed the case. It is possible that in certain cases, the end of indemnity payments actually signified an individual taking permanent disability or retirement.

A final limitation was that the primary methodology used in this study did not fully account for the conditional relationship between age and tenure. At the youngest ages, the longest lengths of tenure in our sample represent impossible values. For example, a 25-year-old claimant could not have 20 years of tenure. We did supplemental analyses including only distributions of age and tenure that would be possible showing that our findings held under these conditions; however, the results from the main analyses should be interpreted with this limitation in mind.

CONCLUSIONS

The results of the current study pointed to a stronger relationship between age and the length of disability than for tenure and the length of disability. In terms of risk factors for longer work-disability durations, age seems like a more important factor than tenure; however, there was variability in the age-length of disability relationship based on the length of tenure suggesting that tenure might still be an important aspect of the work-disability process. From a case management perspective, older workers might be a group in need of extra support as their RTW process seems to be delayed relative to younger workers. For some older workers, retirement is not an option due to financial necessity or needing to continue to have access to health insurance benefits beyond those provided by the government. Such workers might feel unable to leave their jobs after a workplace injury/illness, and experience extra difficulty getting back to work. With the continued aging of the workforce and the changing nature of career paths, furthering our understanding of how and why age and tenure influence the work-disability process is important. The current study was a first step in examining the interplay between age and tenure with the length of disability, but future research is necessary to uncover the mechanisms behind these relationships.

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