Occupational Injuries Among Workers With Diabetes: The National Health Interview Survey, 1997–2005

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Objective: *To assess associations between diabetes and occupational injury.* ***Methods:*** *Data from the 1997 to 2005 National Health Interview Survey comprised a sample of 195,284 adult workers. Multivariate logistic regression analysis assessed associations between diabetes and occupational injuries, adjusting for age, sex, race, and education. Additional logistic regression analysis examined the effect of medical therapy and duration of diabetes with occupational injury.* ***Results:*** *There was no significant association between diabetes and occupational injury (adjusted OR = 1.18; 95% CI = 0.86 to 1.61). Subgroups of diabetics who reported no current diabetes therapy (OR = 1.87; 95% CI = 1.01 to 3.47) or duration of diabetes longer than 12 years (OR = 1.83; 95% CI = 1.05 to 3.18) were at increased risk for occupational injury.* ***Conclusion:*** *The finding of no overall increased risk for occupational injury among workers with diabetes provides nationally representative results that may be useful to policymakers. Increased risk for occupational injury among untreated diabetics or those with long duration of disease may lead to focused efforts to prevent occupational injuries.* (J Occup Environ Med. *2008;50:804–808*)

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In 1997, the US incidence rate of diagnosed diabetes in people 18 to 79 years of age was 4.9 per 1000. By 2004, the incidence rose 43% to 7.0 per 1000.[1] In the United States during the years 2001 to 2004, it is estimated that 10% of noninstitutionalized adults 20 years and older had diabetes.[2] Once thought to be a disease of an aging population, diabetes is now appearing at younger ages. The National Center for Health Statistics has estimated that diabetes prevalence increased from 1.6% to 2.3% of the population age 20 to 39 over the time periods 1988 to 1994 compared with 2001 to 2004.[3]

Workplace policies have limited employment opportunities for people with diabetes. For many years before recent changes in the law, no insulin-requiring diabetics were allowed to hold commercial drivers' licenses for interstate commerce. Diabetics requiring insulin cannot receive first and second class medical certification as pilots, barring them from airline transport and commercial pilot employment.[4] In addition to existing policies, growing anecdotes identify diabetes as the reason for job termination or decisions not to hire.[5] Concerns about workplace discrimination against individuals with diabetes have reached a forum for public discussion.[5]

Part of the rationale for restricting insulin-requiring diabetics from certain employment includes issues of workplace safety for the employee, coworkers, and the public. With regard to employee safety and protection of the diabetic worker from injury, there

are few available data that address a link between diabetes and occupational injury. This study aims to assess the association of diabetes with occupational injury, using data from the National Health Interview Survey (NHIS) from 1997 to 2005.

Materials and Methods

Study Population

The study population was drawn from the NHIS, an annual, nationally representative household survey of the noninstitutionalized civilian population of the United States conducted by the National Center for Health Statistics.[6] Trained interviewers from the US Census Bureau conduct computer-assisted face-to-face personal interviews of household members. The NHIS collects information on demographic characteristics, health conditions, injuries and other variables (not used in the present study) including health insurance, access to health care, limitation in activity, and health behaviors. An adult household member is identified to answer questions on all medically attended injury events in the 3 months before the household interview.

We pooled the available NHIS data from 1997 to 2005. We defined workers as adults aged 18 years or older who reported working for pay as their major activity in the period before the interview and who reported no limitations in their ability to work. To identify subjects with occupational injuries, we chose workers reporting injury while working and compared them to workers reporting no injury. This selection process resulted in data for slightly more than 20,000 workers each year, resulting in a total sample size of 195,284 US workers over the 9-year period.

Variables

Dependent Variable. An injury was defined as a positive response to the following NHIS question: "During the last 3 months, were you or anyone in your family injured seriously enough that you or they got medical advice or treatment?"[7] An occupational injury was defined as a response of "working at a paid job" to the NHIS question: "What was the (person) doing when the injury happened?"

Independent Variables. We selected demographic variables that have been associated with occupational injury, including age, sex, race, ethnicity, and education. The major independent variable, diagnosed diabetes, was defined as a "yes" response to the NHIS question: "(If female: Other than during pregnancy), have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" To calculate the duration of diabetes, we used responses to the NHIS question: "How old were you when a doctor first told you that you had diabetes or sugar diabetes?" Use of insulin or oral agents or both for diabetes was determined by responses to the following two questions: "Are you now taking insulin" and "Are you now taking diabetic pills to lower your blood sugar?"

Analysis

Because the NHIS is a multistage, stratified and weighted data set, we used SUDAAN software for estimation and calculation of correct standard errors.[8] We first examined the unadjusted bivariate relationships between each of the independent variables (age, sex, race, education, and diagnosed diabetes) in relation to the dependent variable, occupational injury. We then included all of these independent variables in a multivariable logistic regression model to assess their adjusted associations with occupational injury.

To assess for effect modification by job type, we first categorized occupations as professional or nonprofessional. Those whose job had been coded as executive, professional, technician, sales, and administrative support were placed in the professional category. Those whose job had been coded as service, farming, forestry, fishing, production, operator or assembler, transportation, or handler or laborer were placed in the nonprofessional category. To assess for effect modification by job type, we limited the sample to those participating in the years 1997 to 2003 because the job classification and coding system for the years 2004 and 2005 was not comparable to the uniform system used from 1997 through 2003. We then added this job type variable (professional vs nonprofessional) as an independent variable in the multivariable logistic regression model with diagnosed diabetes, adjusted for age, sex, race, and education.

To examine the association of medical therapy and duration of diabetes with occupational injury, we performed logistic regression analysis on two multivariable models, both of which had the independent variables for age, sex, race, and education (called the base model). To this base model, we added an independent variable for medication type (any insulin, oral hypoglycemic pills only, and no insulin or pills). In another model, we added to the base model an independent variable for diabetes duration (1 to 4, 5 to 12, and 13+ years).

Results

The 195,284 employed adults in this study were about evenly divided by sex (Table 1). These subjects were predominantly white, non-Hispanic and had education beyond high school. The 7704 who had been diagnosed with diabetes tended to be older, but otherwise appeared similar to the total study group. More males than females reported occupational injury. Although about 4% of the total subjects had diabetes, the number of subjects with both diabetes and occupational injury was small at 67.

Occupational injury was significantly associated with age younger than 30, male sex, white race, and less education in the unadjusted analysis. In a multivariable model, younger age, male sex, and white

TABLE 1
Description of the Study Population of Workers, Workers With Diabetes, and Workers With Occupational Injury; Employed Adults From the United States National Health Interview Survey, 1997–2005

	Total Workers		Workers With Diabetes		Workers With Occupational Injury	
Characteristics	Number	Percent	Number	(Row %)	Number	(Row %)
Total	195,284	100.0	7,704	4.0	1,469	0.8
Age (yr)						
≤39	96,816	49.6	1,301	1.3	769	0.8
>39	98,468	50.4	6,403	6.5	700	0.7
Age quartiles						
<31	51,030	26.1	476	0.9	436	0.9
31–39	45,786	23.5	825	1.8	333	0.7
40–49	47,964	24.6	1,836	3.8	365	0.8
50+	50,504	25.9	4,567	9.0	335	0.7
Gender						
Male	94,756	48.5	3,938	4.2	944	1.0
Female	100,528	51.5	3,766	3.8	525	0.5
Race						
Black	27,220	14.1	1,504	5.5	152	0.6
White	153,440	79.4	5,486	3.6	1,215	0.8
Other race	12,503	6.5	508	4.1	69	0.6
Ethnicity						
Hispanic	33,025	17.1	1,357	4.1	186	0.6
Non Hispanic	160,082	82.9	6,138	3.8	1,250	0.8
Education						
High school or less	27,267	14.3	1,457	5.3	235	0.9
College or more	164,094	85.8	5,974	3.6	1,195	0.7
Diagnosed diabetes	7,704	4.0			67	0.9

TABLE 2
Unadjusted and Adjusted Odds Ratios and 95% CI for Occupational Injury Associations With Characteristics of Adult Workers in the United States National Health Interview Survey, 1997–2005

Characteristic	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)*
Age		
≤39 vs >39	1.21 (1.07–1.37)	1.23 (1.08–1.40)
<30	1.45 (1.21–1.73)	
30–39	1.15 (0.97–1.38)	
40–49	1.17 (0.98–1.40)	
50 or greater	Reference	
Sex = male	1.96 (1.71–2.24)	1.92 (1.67–2.20)
Race		
Black	1.02 (0.70–1.49)	1.08 (0.74–1.57)
White	1.53 (1.10–2.14)	1.58 (1.13–2.21)
Education = high school or less	1.23 (1.03–1.46)	1.18 (0.99–1.41)
Diagnosed diabetes = yes	1.08 (0.80–1.45)	1.18 (0.86–1.61)

*Each variable was adjusted for the other variables in the table.

race remained significantly associated with occupational injury (Table 2). Diagnosed diabetes was not significantly associated with occupational injury in either the unadjusted or adjusted analysis (Table 2).

In assessing the three medication subgroups among those with both diabetes and occupational injury, only those taking no insulin or oral agents showed an association with increased injury risk (Table 3). In assessing subgroups with regard to duration of diabetes, we found that the only significant association with occupational injury was among those diabetics whose disease had been diagnosed at least 13 years previously.

We found no effect modification by job type (professional vs nonprofessional) (results not shown). Including job type in the model did not change the relationship between diagnosed diabetes and occupational injury, nor was job type significantly associated with occupational injury.

Discussion

In this study, we did not find a statistically significant association between diabetes and occupational injury. However, we found subgroups of those with diabetes who did have an increased risk of occupational injury, ie, those taking no medications for diabetes and those who had diabetes for at least 13 years. A study of 3394 members of a large health maintenance organization showed an elevated risk of occupational injury in users of diabetes medications (OR = 1.3 95% CI = 0.9 to 1.9) although the increase was

TABLE 3
Unadjusted and Adjusted Odds Ratios and 95% CI for Occupational Injury Associations With Medication Group and With Duration of Diabetes Among Adult Workers in the United States National Health Interview Survey, 1997–2005

	Total Number (%)	Occupational Injury Number (Row %)	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)*
Medication				
Any insulin	1,971 (25.84)	23 (1.17)	1.49 (0.93–2.39)	1.61 (1.00–2.60)
Pill only	4,297 (55.78)	27 (0.63)	0.70 (0.44–1.12)	0.75 (0.46–1.21)
No insulin or pill	1,436 (18.64)	17 (1.18)	1.67 (0.92–3.02)	1.87 (1.01–3.47)
Duration of diagnosed diabetes (yr)				
1–4	3,260 (43.01)	27 (0.83)	0.88 (0.58–1.33)	0.91 (0.59–1.42)
5–12	2,461 (32.47)	17 (0.69)	0.99 (0.57–1.71)	1.08 (0.63–1.88)
13+	1,859 (24.53)	23 (1.24)	1.64 (0.95–2.84)	1.83 (1.05–3.18)

*Adjusted for age, sex, race, and education.

not statistically significant.[9] A yearlong prospective study of 243 employed people with diabetes on insulin therapy found that 27 people had severe hypoglycemia in the workplace during the year, resulting in six episodes of minor soft tissue injury.[10] No comparison group was included in that study to assess workplace injuries among nondiabetics or among diabetics on oral medication or no medication.

Our finding of an association between duration of diabetes and occupational injury is of interest. Potential explanations include proposed causal pathways to injury, including impaired consciousness due to hypoglycemia, and long-term diabetes complications that lead to impaired vision and peripheral nerve sensory impairments. In a prospective, population-based study of 267 diabetics older than 16 taking insulin therapy, Donnelly et al[11] found that taking insulin for more than 10 years was associated with an increased frequency of hypoglycemic episodes in type 2 diabetics. The authors postulated impaired hormonal regulation as an explanation.

Although our study showed no significant association between diabetes and occupational injury, it is possible that the injuries sustained by diabetics are more severe or result in longer disability compared with nondiabetics. However, when we assessed the only available measure of severity in this study, days lost from work as a result of the injury, we found no difference between diabetics and nondiabetics (data not shown).

Our finding of an association between currently untreated diabetes and occupational injury was unexpected. We had postulated that the group currently taking insulin would have a higher risk of occupational injury, based on risk of hypoglycemic episodes and severity of the disease and its complications. Poor glycemic control can lead to microvascular complications such as visual and peripheral nerve impairment. It is possible that this untreated subgroup has developed these diabetes complications that place them at increased risk for occupational injury. Future studies will be needed to explore possible explanations for this finding in the current study.

We had postulated that, among workers with diabetes, nonprofessional workers would be at higher risk for occupational injury than professionals because of job exposure factors such as physical labor and working with machines. However, we found no such association. It is possible that selective job modification for workers with diabetes may reduce injury hazards for nonprofessional workers.

A strength of the current study is that the data are from a population-based nationally representative sample of US adults, improving the generalizability of results in comparison with other study designs. Few databases collect information on both chronic disease and traumatic injury, and even fewer allow identification of injuries that occur during work. The outcome variable, occupational injury, is likely to reflect a larger scope of occupational injuries compared with studies limited to occupational injuries reported through the worker compensation system.[9] In addition, the 3-month time window for recall of occupational injury events is likely to minimize recall bias for the outcome variable.

A limitation of this study is the small number of participants with diabetes who reported occupational injury. Because of this small number, our result, showing no significant association between diabetes and occupational injury, should be interpreted cautiously. If this study had an increased number of diabetics with occupational injury, the effect on the odds ratio and confidence interval would likely be to decrease the confidence interval around a new, "true", odds ratio somewhere between 0.86 and 1.61. A new "true" odds ratio around 1.00 would confirm this negative study, whereas a new "true" odds ratio closer to 1.5 would suggest an elevated risk of occupational injury for diabetics. It is very unlikely that a true odds ratio would be higher than the upper confidence limit found here. Although it is possible that larger numbers of diabetic subjects with occupational injury could be obtained from clinical populations, generalizability of those results would be limited compared with our study.

Our findings may help inform workplace policy, and future research. These results, showing no overall increased risk for occupational injury among workers with diabetes, provide nationally representative results that can be taken into account by policymakers. Increased risk for occupational injury among the subgroups with untreated diabetes and those with long duration of disease may lead to focused ef-

forts to prevent occupational injuries. These results help to support current secondary preventive health guidelines for early screening and treatment of diabetes and add useful information for consideration of policy-makers with regard to employment of people with diabetes.

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