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Short communication

Association between effort-reward imbalance and self-reported diabetes mellitus in older U.S. workers

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ABSTRACT

Objective: Studies assessing the effects of work stress on health in older adults in the U.S. labor force are scarce. We examined the longitudinal association between work stress as measured by effort-reward imbalance (ERI) and incident diabetes over a 7-year period in U.S. working adults aged 50 years and older.
Methods: We used longitudinal data from the 2006–2012 waves of the Health and Retirement Study (n = 1932). Cox proportional hazard regression was used to examine whether ERI significantly predicted diabetes incidence in older adults who were diabetes-free at baseline.
Results: High stress level at work (ERI ratio > 1.0) was found in participants who worked 55 h or more a week (37.3%), had no insurance coverage (35.9%), and those working in blue collar jobs (34.4%). Participants with high ERI had a significantly higher risk of diabetes (HR = 1.33, 95%CI = 1.04–1.69) relative to those with low ERI, after adjustment for known predictors of adult-onset diabetes.
Conclusion: Effort-reward imbalance was associated with increased risk of diabetes incidence after controlling for other known predictive factors, which suggests an independent non-mediated effect of work stressors. More research is required to better understand the effects of work stress in aging populations and how psychosocial disequilibrium in the work environment may impact susceptibility to chronic conditions, and in particular how change in self-assessed reward might vary toward the end of a working lifetime.

1. Introduction

Type 2 diabetes mellitus is a leading cause of morbidity and mortality in the U.S. and a great burden on the U.S. healthcare system [1]. Work stress has been documented as a risk factor for incident diabetes [2–9], and there are plausible pathways for this association. For example chronic exposure to stress at work may result in elevated catecholamine secretion, and reduced immune-competence which may impair glucose tolerance [10,11]. Work stress is also associated with unfavorable health behaviors, such as sedentary lifestyle, poor diet, and alcohol misuse [12], which are established diabetes risk factors.

The few prospective studies examining the association between diabetes and work stress have mainly used Karasek's Job-Demand-Control (JDC) model [2–6], and some studies have examined this association using Siegrist's effort-reward imbalance (ERI) model [7–9,13]. The ERI model postulates that stressful working conditions are due to failed reciprocity between high effort and low rewards [13]. While both models examine psychosocial disequilibrium, they are conceptually different [14]. JDC emphasizes the structure of the work environment and task characteristics, while ERI focuses on the principle of reciprocity inherent in the work contract and on macro-social factors (job security, promotions, salary) indicative of the economic labor market environment [14,15]. Work stress research using the ERI model would therefore broaden the scope of knowledge on contributions of different psychosocial work stressors to ill health.

So far, research on ERI and diabetes has been conducted outside of the U.S. [8,9,16], and may not be generalizable to the U.S. population. Americans reportedly work longer hours than Europeans [17]. Long work hours are associated with adverse mental health outcomes, and poor health behaviors which are associated with obesity, a known predictor of diabetes [18]. Americans may therefore be more vulnerable to work stress, and susceptible to diabetes risk factors. Research that takes into account the psychosocial aspects of the U.S. workplace is therefore warranted. Older workers are vulnerable to age-related cognitive and physiological health declines which may greatly impact their work, and work related stress [19]. Studies examining the effects of

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work stress in older U.S. workers are limited but necessary, in particular as the labor force participation rates by older workers is projected to increase [20].

The objective of this study was to partially address these knowledge gaps by examining the temporal association between ERI and incident diabetes over a 7-year period in U.S. working older adults.

2. Methods

2.1. Data source

We used Health and Retirement Study (HRS) data from 2006 to 2012. The HRS is a nationally representative longitudinal study of retirement and health in Americans 50 years and over. Data are collected biennially. Sampling procedures and study design are available elsewhere [21]. Participants gave informed consent prior to participation, and study procedures were approved by the Institutional Review Board (IRB) at the University of Michigan. In 2006 the total HRS sample size was 18,469, and approximately 50% of the sample participated in in-person interviews. ERI measures were obtained from the self-administered *Psychosocial Leave-Behind* questionnaire which was given to participants who completed in-person interview [22]. The overall response rate for the HRS was 88.6%, and 74% for *Psychosocial Leave-Behind* questionnaire. HRS data are de-identified, and publicly available, therefore review and approval was not required from the IRB at the University of Texas Medical Branch.

Participants who were diabetes-free, working in 2006, and completed the HRS *Psychosocial Leave-Behind* questionnaire items on Job Stressors ($n = 2097$) were eligible for inclusion in the current study. The analytic sample for this study consisted of 1932 diabetes-free participants with complete observations after exclusion of those with missing data.

2.2. Variables of interest

First self-report of diabetes after 2006 was the outcome of interest. Diabetes was ascertained by a confirmatory response to the question, "Has a doctor ever told you that you have diabetes or high blood sugar?" Due to the wording of the survey question, self-reported diabetes in this study may include individuals who may have had hyperglycemia, but were not type 2 diabetics.

ERI measured in 2006 was the predictor variable of interest and was defined using items (with responses on a 4-point Likert Scale), from the Psychosocial *Leave-Behind* questionnaire. Two items measured effort, (1) "My job is physically demanding," and (2) "I am under constant time pressure due to a heavy workload." Five items measured reward, (1) "I receive the recognition I deserve for my work," (2) "My salary is adequate," (3) "My job promotion prospects are poor," (4) "My job security is poor," and (5) "I receive adequate support in difficult situations." For both, a sum score of items was calculated, and effort/reward ratio was obtained by dividing effort by reward, weighted by the number of items in each construct. ERI ratio was dichotomized, with an established cut-off of > 1.0 denoting high imbalance, and greater stress [15].

Additional baseline covariates included age, sex, race/ethnicity, education, marital status, body-mass index (BMI), physical activity (moderate or vigorous physical activity at least twice/week), alcohol, hypertension, insurance coverage, work hours, occupational category (blue-collar, white-collar, service industries), and job tenure.

2.3. Analytic strategy

Cox proportional hazards regression analysis was used to determine whether high ERI ratio significantly predicted diabetes risk. Model 1 controlled for demographic variables only (age, sex, race/ethnicity, education, and marital status), and Model 2 was fully adjusted for occupational factors, and all covariates outlined above. Failure was defined as the first self-report of a diabetes diagnosis after 2006. Participants were censored if they were lost to follow-up prior to reporting diabetes, or if they did not develop the disease during the study. All analyses were conducted using Stata/SE 12.0 (Stata, College Station, TX).

Table 1
Baseline study characteristics by ERI for working adults 50 years and older.

Variable	Low ERI (75.05%)		High ERI (24.95%)		X^2	*P*-Value
	n	%	n	%		
ERI ratio (mean, SE)	0.64, 0.01		1.33, 0.20			
Age (mean, SE)	61.43, 0.20		59.47, 0.31			**< 0.01**
Current job tenure (mean, SE)	12.37, 11.77		12.26, 11.55			0.44
Race/ethnicity					1.16	0.76
Hispanic	104	74.3	36	25.7		
Black	159	77.6	46	22.4		
White	1153	74.7	390	25.3		
Other	37	78.7	10	21.3		
Gender					1.18	0.28
Male	661	73.9	233	26.1		
Female	792	76.1	249	23.9		
Education					7.19	0.06
< 12 years	160	73.4	58	26.6		
12 years	419	72.2	161	27.8		
> 12 < 16	380	74.7	129	25.3		
≥ 16	494	78.7	134	21.3		
Physical activity					3.36	0.07
Yes	853	76.6	260	23.4		
No	600	73.0	222	27.0		
Work hours/week					**45.94**	**< 0.01**
< 35	473	83.0	97	17.0		
35–40	557	75.6	180	24.4		
41–54	231	71.7	91	28.3		
≥ 55	192	62.8	114	37.3		
Married					1.58	0.21
Yes	1056	75.9	336	24.1		
No	397	73.1	146	26.9		
Insurance coverage					**8.23**	**0.02**
Fully covered	361	75.1	120	25.0		
Partially covered	1017	76.1	320	23.9		
Not covered	75	64.1	42	35.9		
Hypertension					0.02	0.89
Yes	602	74.9	202	25.1		
No	850	75.2	280	24.8		
Occupational category					**27.95**	**< 0.01**
White collar	994	78.9	266	21.1		
Service	197	70.9	81	29.1		
Blue collar	212	65.6	111	34.4		
BMI category					0.25	0.88
< 24.99	364	75.7	117	24.3		
25–29.99	586	75.1	194	24.9		
> 30	488	74.4	168	25.6		
Alcohol					0.04	0.98
None	800	74.9	268	25.0		
≥ 4 times/week	460	75.0	153	25.0		
5 + times/week	184	75.4	60	24.6		

Bold text indicates a statistically significant difference with a p-value ≤ 0.05.

3. Results

1932 participants met the inclusion criteria. During the 7-year follow-up period, there were 288 (11.8%) self-reported incident diabetes cases. Approximately 25% of the sample had high ERI (Table 1). Of the 288 participants with diabetes, 72.8% had high ERI and 27.2% had low ERI at baseline. Mean age was 61.4 years among participants with low ERI and 59.5 years among those with high ERI. Rates of high ERI were greatest among participants working at least 55 h per week (37.3%), those without insurance (35.9%), and those working blue