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Original Article

Work-related psychosocial stress and glycemic control among working adults with diabetes mellitus

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ABSTRACT

Objective: To examine the association between glycosylated hemoglobin (HbA1c) and four subscales of work-related psychosocial stress at study baseline and over time.

Materials and methods: We used survey data from a major HMO located in the Southeastern part of the US on health and healthy behaviors linked with patients' clinical, pharmacy and laboratory records for the period between 2005 and 2009. Study participants ($n = 537$) consisted of working adults aged 25–59 years, diagnosed with diabetes mellitus (DM) but without advanced micro or macrovascular complications at the time of the survey. We estimated the baseline (2005) association between HbA1c and work-related psychosocial stress and their interactions using linear regression analysis. Using individual growth model approach, we estimated the association between HbA1c over time and work-related psychosocial stress. Each of the models controlled for socio-demographic variables, diet and physical activity factor, laboratory factor, physical examinations variables and medication use in a hierarchical fashion.

Results: After adjusting for all study covariates, we did not find a significant association between work-related psychosocial stress and glycemic control either at baseline or over time.

Conclusion: Among fairly healthy middle aged working adults with DM, work-related psychosocial stress was not directly associated with glycemic control.

1. Introduction

Diabetes mellitus (DM) is a major public health problem. It significantly increases the risk of micro-vascular complications such as retinopathy, nephropathy and neuropathy, and macro-vascular damages including myocardial infarction and stroke [1–3]. Currently, an estimated 8.3% American adults have overt DM while about 35% have pre-diabetes [4]. In the past three decades, DM prevalence has more than doubled and related complications have significantly increased [5–7]. Although a strong connection exists between genetic factors and DM etiology [8–10], recent increase in DM prevalence and its related complications have mostly been attributed to internal environmental factors such as stress [11,12] and the external environmental factors such as diet and sedentary behaviors [13–15]. Long term complications from DM are primarily due to chronic elevation and/or fluctuations of blood glucose level, which in turn damage blood vessels resulting in micro and macro-vascular complications [16,17]. With increasing life expectancy but reduced age of DM onset in the US [18], the importance of good glycemic control to prevent and or delay the onset and progression of long term DM related complications cannot be overemphasized.

Proper DM management is demanding and involves adherence to multiple activities including diet, physical activity, medication use, and self-monitoring of blood glucose level [19]. Each of these activities is impacted by multiple factors including: socio-demographic characteristics such as age, race, and socio-economic status [20,21]; the presence of other chronic conditions such as obesity and hypertension [22]; and psychosocial stress [23,24].

The relationship between general measures of psychosocial stress and glycemic control is well established [25–29]. Laboratory studies demonstrated that stressful situations such as unpleasant interviews or impending examinations destabilized blood glucose levels [30,31]. Studies in real life settings, including meta-analysis

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corroborated the initial laboratory findings [5,6,23,24,26,27,32]. Although the exact mechanism through which psychosocial stress impacts diabetes management is not very well understood, the underlying pathway has been hypothesized to involve physiological and/or behavioral mechanisms [26,33–35]. Physiologically, psychosocial stress has been proposed to impact glycemic control through series of processes involving the hypothalamic-pituitary-adrenal axis (HPA) that leads to accumulation of visceral fat due to altered energy homeostasis and increased insulin resistance due to persistently higher level of cortisol [33,36]. The HPA has been identified as the major controller of hormones involved in the regulation of peripheral insulin sensitivity [37]. The behavioral evidence comes from increased engagement in risky lifestyle behaviors (such as smoking, excessive alcohol use), decreased capacity to make modifications to lifestyle behaviors (such as healthy eating and physical activity), medication adherence, and difficulties in self-care among individuals with higher levels of psychosocial stress [35,38–40].

Despite several studies investigating the relationship between general measures of psychosocial stress and glycemic control, limited studies have examined the relationship between psychosocial stress from specific sources, particularly at the work environment, and glycemic control although work-related psychosocial stress has been associated with general ill health [41,42]. The job strain model has been used to explain the association. Individuals working in jobs that have high demand and low control are at greater risk of stress-related ill health and diseases [43]. The American Institute of Stress has noted that job stress is by far the major source of stress among American adults [44]. A report by the National Institute for Occupational Safety and Health (NIOSH) included finding from a prior study that has identified stress at the work environment to be strongly associated with health complaints than any other life stressors including financial and family problems [45]. Working eight or more hours a day and five or more days a week, several American adults spend more time at their work environment than they do with family and or friends. It is therefore important to understand stress at the work environment and how it relates to health, particularly, DM and its control. Research on stress at the work environment and glycemic control appears to be limited to the work by Trief and colleagues [43]. Trief and colleagues did not find a significant association between psychosocial stress at the workplace and glycemic control [43]. The current study was therefore designed to further examine this relationship while addressing the limitations of the unique study; cross-sectional study design, small sample size, and inclusion of only insulin requiring DM patients. Given that 64.5% of American adults are in the work force [46], 8.3% diabetes prevalence [4], and the work environment has an impact on overall health, we conducted a study of both cross-sectional and longitudinal analysis of the association between work related psychosocial stress and glycemic control. The study had two objectives: (1) to examine the association between HbA1c and four subscales of work-related psychosocial stress and their two-way interactions at study baseline, and (2) to examine the association between baseline measures of work-related psychosocial stress subscales and glycemic control over time; while adjusting for socio-demographic variables, diet and physical activity, laboratory and physical examinations variables, and medication use in a hierarchical fashion.

2. Methods

2.1. Study population

We utilized a survey data from a major HMO located in the Southeastern part of the US on Health and Healthy Behaviors. Study participants consisted of working adults who at the time of the data collection in 2005 met the following inclusion criteria: (1) aged 25–59 years; (2) diagnosed with diabetes but without advanced micro or macrovascular complications; (3) employed by one of the 100 largest private or public employer groups offering the HMO as an insurance option; (4) enrollee of the HMO; and (5) subscriber within the enrolled family. Only individuals who reported their race as African American (black) or white were included in the current study due to the small sample size of other races. The HMO's IRB reviewed and approved the study protocol.

2.2. Data and measures

The survey instrument included items and scales that had previously been used in other studies and which had demonstrated reliability and validity. The survey was administered via mail and web. Data obtained from the participants' survey was linked to their clinical information including pharmacy and laboratory records for 2005 through 2009.

2.2.1. The dependent variable

The dependent variable was glycemic control assessed using HbA1c measures from participants' laboratory results from 2005 through to 2009. HbA1c measures within a calendar year were summarized into an annual measure and where a respondent had more than one result within a calendar year, the median was retained. Since most respondents had one or two results on HbA1c per year, the mean and median were equivalent for most respondents.

2.2.2. The main independent variable

The main independent variable was work-related psychosocial stress assessed using 4 stress subscales from the Midlife in the United States (MIDUS) study [47]; work decision authority (6 items), job demands (5 items), coworker support (2 items), and supervisor support (3 items). Each item was assessed using a 5-response Likert scale: "All of the time", "Most of the time", "Sometimes", "Rarely", "Never". Each subscale was scored from 0 (most strained, least supportive work climate) to 100 (least strained, most supportive work climate) by transforming each item response from 0–100 (and reverse coding where necessary). An overall work-related psychosocial stress score was computed as the mean of the 4 subscales. The Cronbach's alpha for the decision authority, job demands, coworker support and supervisor support subscales were 0.88, 0.78, 0.73, and 0.89 respectively.

2.2.3. Covariates

Physical examinations: Data on height, weight, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were obtained from medical records associated with participants' primary care visits. Height and weight were used to compute body mass index (BMI) using the formula BMI = weight (kg)/height (m^2). SBP and DBP were used to compute mean arterial pressure (MAP) using the formula MAP = {(2 × mean diastolic) + mean systolic}/3.

Laboratory factor: The following baseline measures were obtained from participants' laboratory records; low density lipoprotein (LDL), high density lipoprotein (HDL) and cholesterol. Using the lab measures and BMI values, we created a *laboratory factor* using principal component analysis to reduce the number of parameters to be estimated in the model. The reciprocal of HDL was taken to make the direction of all the factors consistent before performing principal component analysis. We retained the first factor which explained more than 50% the variance among the variables.

Dietary intake and physical activity factor: Percent calories from fat, the number of fruit and vegetable (F/V) servings per day, and daily fiber intake (grams per day) were derived from responses to