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Original article

Association between current perceived stress and incident diabetes is dependent on occupational status: Evidence from the IPC cohort study

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Abstract

Aim. – The role of stress in the onset of type 2 diabetes is a widespread lay belief, yet observational studies have produced inconsistent results. This study aimed to test the hypothesis that the association between perceived stress and incident diabetes might depend on occupational status (OS).

Methods. – The four-item Perceived Stress Scale (PSS-4) was completed at baseline by 22,567 participants in the labour force (16,193 men, 6374 women; mean age: 44.5 ± 9.8 years) who had undergone two health checkups subsidized by the French national healthcare system. All subjects were free from diabetes at baseline, defined as a fasting blood glycaemia ≥ 7 mmol/L or the use of antidiabetic drugs.

Results. – After a mean follow-up of 5.3 ± 2.1 years, 527 participants (2.3%) had incident diabetes. After adjusting for sociodemographic, behavioural and biomedical risk factors as well as self-rated health, the association between baseline perceived stress and diabetes at follow-up was non-significant for the total study population. However, perceived stress was significantly associated with incident diabetes in participants of low OS [odds ratio (OR) for a five-point increment: 1.39; 95% confidence interval (CI): 1.02–1.90]. In contrast, there was a negative association between perceived stress and diabetes among those of high OS (OR: 0.60; 95% CI: 0.41–0.88) and no association within other occupational categories. The interaction between perceived stress and OS was significant ($P < 0.01$).

Conclusion. – This study suggests that the association between perceived stress and diabetes onset is dependent on OS. Furthermore, this association does not appear to be explained by the classical risk factors for diabetes.
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Keywords: Diabetes mellitus; Longitudinal studies; Occupational status; Psychological stress; Risk factors

Abbreviations: BMI, body mass index; BP, blood pressure; CI, confidence interval; HDL, high-density lipoprotein; IPC, *Investigations Préventives et Cliniques* (Preventative and Clinical Investigations); OR, odds ratio; OS, occupational status; PSS-4, four-item Perceived Stress Scale; SES, socioeconomic status.

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1. Introduction

Around 382 million people worldwide have diabetes [1] and the prevalence of this disease is increasing. Diabetes is predicted to become the fifth leading cause of death by 2030 [2]. Type 2 diabetes (T2D) represents about 90% of all cases, and its risk factors may be either non-modifiable (for example, age and family history) or modifiable (such as obesity and physical inactivity). The involvement of stress in the onset of T2D is an old hypothesis [3,4] and a widespread lay belief [5]. This belief can influence medical adherence, which is a core issue in diabetes management [6]. Patients may be less likely to persistently adhere to antidiabetic drug treatments or lifestyle changes if they believe that glycaemic control mainly depends on stress [7]. However, epidemiological observational studies of this topic are scarce and have produced inconsistent results [8–12]. One possible reason for these conflicting results is that the role of some factors as effect modifiers has been overlooked. In fact, the hypothesis that the association between stress and diabetes onset might be affected by socioeconomic status (SES) has never been tested.

A growing body of evidence suggests that the association of various psychological variables with cardiovascular diseases might be stronger among individuals of low SES [13–15]. These recent results encourage looking for potential mediators that might explain the greater impact of stress-related variables on cardiovascular disease risk among such individuals. For example, hypertension has been found to be more tightly correlated with perceived stress in low SES individuals [16,17]. As regards incident diabetes, two studies found that the increased risk associated with major depression or depressive symptoms was of greater magnitude among individuals of low SES [18,19]. However, neither of these two studies were specifically examining psychological stress.

Here, our present study aimed to test the hypothesis that the association between perceived stress and incident diabetes might depend on occupational status (OS). OS is a useful proxy for SES as it integrates educational achievements, the skills required to obtain a job, long-term associated rewards (including, but not limited to, income) and several job characteristics, such as working conditions and latitude in decision-making [20]. More specifically, our hypothesis was that perceived stress at baseline would be associated with incident diabetes at follow-up to a greater extent among individuals of low OS.

2. Methods

2.1. Participants

According to the longitudinal design of our study and its objective, the target population comprised all subjects in the labour force (working participants and those seeking employment) who had undergone at least two health checkups at the *Investigations Préventives et Cliniques* (IPC; Preventative and Clinical Investigations) Centre in Paris, France, between October 1998 and December 2011, with a time interval between visits of 1 year or more. This medical centre, which is subsidized by the French national healthcare system, offers all working and retired individuals, and their families, a free medical examination with a minimum interval ranging from 1 to 5 years. It carries out approximately 25,000 examinations per year of people living in the Paris area. All clinical and biological parameters are evaluated on the same examination day. In the case of participants who benefited from more than two examinations, only data from the first and second examinations were considered. Eligibility criteria were: ≥ 18 years of age at the first visit; able to fill out the study questionnaires; no missing data for selected variables (see below); and free from diabetes at the first visit (fasting blood glucose < 7 mmol/L and no use of antidiabetic drugs). To minimize potential biases, individuals who reported using psychotropic drugs were not included.

The IPC Centre received authorization from the *Commission Nationale de l'Informatique et des Libertés* (CNIL; National Data Processing and Liberties Commission) to conduct these analyses. All subjects ($n = 22{,}567$) gave their informed consent at the time of the first examination. Data were rendered anonymous before analysis.

2.2. Blood glucose and diabetes

Fasting blood samples were taken to measure glucose, using an enzymatic method and a fully automated Hitachi 917 analyzer (Hitachi, Ltd., Tokyo, Japan). The outcome for the present study was diabetes at the second visit, defined as blood glucose levels ≥ 7 mmol/L or the use of antidiabetic drugs (see below).

2.3. Perceived stress

Perceived stress was measured with the French version of the four-item Perceived Stress Scale (PSS-4) [21,22]. Each item is rated on a scale of 0 to 4 (Text S1; see supplementary data associated with this article online). The PSS-4 total score ranges from 0 to 16; it has a one-factor structure and satisfactory internal consistency ($\alpha = 0.73$). The scale measures the degree to which situations in a person's life over the past month are appraised as stressful ('In the past month, how often have you felt it was difficult to control the important things in your life?'). To obtain meaningful odds ratios (ORs), the variable was rescaled, using the difference between the 25th and 75th percentiles as the unit of measure.

2.4. Occupational status

Current occupation was self-reported as a free text response, then coded according to the French 'Occupations and Socio-occupational Categories' [*Professions et Categories Socioprofessionnelles* (PCS)] classification system [23]. Current unemployment was also self-reported. Because recruitment at the IPC Centre was mostly restricted to salaried workers, some groups (such as farmers) are not represented. To achieve sufficient statistical power to test the hypothesized interaction, OS was categorized in four broad classes:

- high (such as managers);

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