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Relationships between stressful life events and impaired fasting glucose among left-behind farmers in rural China

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ABSTRACT

Objective: This study aims at examining the effects of stressful life events on risk of impaired fasting glucose among left-behind farmers in rural China.
Methods: The study collected data about stressful life events, family history of diabetes, lifestyle, demographics and minimum anthropometrics from left-behind famers aged 40–70 years. Calculated life event index was applied to assess the combined effects of stressful life events experienced by the left-behind farmers and its association with impaired fasting glucose was estimated using binary logistic regression models.
Results: The prevalence of abnormal fasting glucose was 61.4% by American Diabetes Association (ADA) standard and 32.4% by World Health Organization (WHO) standard. Binary logistic regression analysis revealed a coefficient of 0.033 ($P < .001$) by ADA standard or 0.028 ($P < .001$) by WHO standard between impaired fasting glucose and life event index. The overall odds ratios of impaired glucose for the second, third and fourth (highest) versus the first (lowest) quartile of life event index were 1.419 [95% CI = (1.173, 1.717)], 1.711 [95% CI = (1.413, 2.071)] and 1.957 [95% CI = (1.606, 2.385)] respectively by ADA standard. When more and more confounding factors were controlled for, these odds ratios remained statistically significant though decreased to a small extent.
Conclusions: The left-behind farmers showed over two-fold prevalence rate of pre-diabetes than that of the nation's average and their risk of impaired fasting glucose was positively associated with stressful life events in a dose-dependent way. Both the population studied and their life events merit special attention.

Introduction

The prevalence of diabetes is growing rapidly, with the total number of cases worldwide projected to increase from 382 million in 2013 to nearly 592 million by 2035 [1]. In China, age-standardized prevalence of diabetes and prediabetes was estimated as 9.7% and 15.5% respectively [2]. Considerable researches have confirmed biological and behavioral variables as risk factors for the development of type 2 diabetes [3–7]. However, the role of psychosocial risk factors in the development of diabetes or prediabetes has received much less attention. Some previous work in this area has shown that psychological characteristics (e.g. depression and psychological distress) may predict the development of abnormal glucose metabolism independently [8,9]. Yet studies exploring the role of stressful life events on the development of diabetes or prediabetes have been quite limited.

Several studies have reported that stressful life events can be one of the factors related to the development of diabetes or prediabetes. Mooy et al. found an association between stressful experiences in people with previously undetected diabetes and the diagnosis of type 2 diabetes after controlling for alcohol consumption, physical activity level and education [10]. A longitudinal survey by Renzaho et al. pointed that personal, work-related and family-related stressful life events may contribute to the development of chronic diseases including depression or anxiety, heart disease, circulatory disease and type 2 diabetes [11]. Also, according to the Coronary Artery Risk Development in Young Adults study, financial strain demonstrated a prospective effect on impaired fasting glucose over a 20-year follow-up period [12]. However, other studies which have used specific population have documented the contradictory. For example, Williams et al. found that stressful life

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events showed almost no significant relationship with abnormal glucose metabolism in a survey of adults aged 25 years [13]. In addition, lots of researches have explored the relationship between work-related stress and diabetes and the results have also been inconsistent [14,15].

Although limited evidence has supported the relationship between stressful life events and diabetes/prediabetes with conflicting findings, a variety of theoretical pathways between them have been proposed, comprising psychological, behavioral as well as physiological components. Firstly, stress may be directly related to glucose metabolism through its effect on the neuroendocrine system. Stressful life events are thought to activate the sympathetic nervous system which leads to release of stress hormones (i.e., epinephrine, cortisol). These hormones increase glucose production in the liver, inhibit insulin secretion in the pancreas and/or decrease the insulin response to glucose [16,17]. Secondly, stressful life events may influence glucose metabolism indirectly by behavioral path. In other words, stress induces abnormal glucose metabolism via influencing lifestyle behaviors such as smoking [18], excessive alcohol drinking [19], internet addiction [20], low compliance with curative and preventive interventions etc. It is also possible that the two pathways interact with each other.

Given the discrepancies between wide recognition of pathways linking stressful life events to diabetes/prediabetes and inconsistent survey findings, there is a clear need for efforts to further explore the associations of stressful life events with abnormal fasting glucose in different aspects and population groups. This study tries to provide additional evidences for more understandings about the issue. It researches stressful life events and their relations to abnormal fasting glucose among left-behind farmers in China using a tailored life event instrument. Left-behind farmers represent a newly emerged weak group in vast rural China. Along with the nation's rapid socioeconomic reformation and urbanization, the majority of young farmers flow to urban areas for temporary jobs leaving the elderly and less capable at home. Then left-behind farmers merit special attention since long-term separation from family members, lack of help and care from their youngsters etc. may all cause profound negative feelings and aggravate the effects of commonly researched life events.

Methods

Study content and subjects

Content of the study included demographics (e.g. age, gender and education), lifestyle (e.g. smoking, drinking and physical activity), stressful life events (14 stressful events believed to occur frequently among left-behind farmers, see Appendix A), family history of diabetes and a few easily observable anthropometric indicators (i.e. fasting plasma glucose, waist circumference and systolic/diastolic blood pressure). This study formed an integral part of the first wave baseline assessment of eCROPS, a randomized control trial using an evolutionary intervention package in preventing diabetes and pre-diabetes. A detailed description of the trial had been published elsewhere [21]. The first batch of eCROPS study has started in three counties of Lu'an, one of the largest prefectures in Anhui province, China. Its baseline assessment involved 18 villages selected randomly from the 3 counties. Eligible farmers in all the selected villages were invited to participate and the inclusion criteria were farmers: a) with rural residence and at least one family member who had left for jobs in cities; b) who had lived at the sampled villages for over six months during the past year and were living at the villages when this survey was conducted; c) willing to participate; d) able to answer the survey questions; and e) without a previous diabetes. A total of 4040 left-behind farmers were invited to participate and survey of the participants started from early November 2013 and ended in late December 2013.

Data collection

All participants were required to have a fasting (≥8 h) capillary plasma glucose (FCG) test using Sannuo glucose meters (Changsha, China). Waist circumference was measured at the mid-point between the rib cage and iliac crest. Blood pressure was measured by a standard mercury sphygmomanometer, in a seated position after participants had rested for at least 5 min. Then two consecutive blood pressure readings, at least 10 min apart, were taken from the right arm of seated participants, and the mean of the two readings was used in subsequent data analysis. Demographics, lifestyle, stressful life events and family history of diabetes were collected by an interviewer-administered questionnaire. All the measurements and interviews used webpage-assisted data entry and took place at the village clinics.

Variable assignment

The study utilized both simple classification and formula-based calculation for assigning variable values. Simple classification applied to education (1 = illiteracy, 2 = primary school, 3 = middle school or above) and family history of diabetes (0 = no, 1 = yes). Smoking index equaled number of cigarettes smoked per day multiplied by total years of smoking; while alcohol consumption, grams of daily alcohol intake. Physical activity (PA) summarized four grades of daily physical activities using the following formula: $PA = (\sum_{i=1}^{4} w_i x_i)/24$, here i = ith grade of physical activities (1 = sleeping, 2 = sitting, 3 = activities equivalent to walking, 4 = activities equivalent to or heavier than jogging); x_i = the time (hours) spent on the ith grade of activity; w_i = metabolism equivalents (METs) of the ith grade activities ($w_1 = 0.9$, $w_2 = 1.5$, $w_3 = 3.0$, $w_4 = 8.0$) [22,23]. Life event index adopted a simple sum (without any weighing) of the Likert ratings of all the items (N = 14) included in our life event instrument. Each of the items solicited ratings against a 4-point Likert scale ranging from 0 (never experienced the event) to 4 (severely affected by the event).

Statistical analysis

Data analysis used Excel version 2007 and SPSS version 16.0 software and comprised four parts: (1) description of the characteristics of the study population and comparisons of characteristics in different glucose levels using Chi-square test or one-way ANOVA as appropriate; (2) correlations of life event index or fasting plasma glucose with ten variables; (3) binary logistic regression analysis of relationships between impaired fasting glucose and quartiles of life event index adjusted for common influencing factors; and (4) multivariate binary logistic regression analysis of impaired fasting glucose with life event index (as continuous variable) and ten other variables. Here, impaired fasting glucose was defined by 5.6–6.9 mmol/L according to American Diabetes Association [24] and 6.1–6.9 mmol/L according to World Health Organization [25] respectively.

Human subject protection

The study protocol had been reviewed and approved by the Biomedical Ethics Committee of Anhui Medical University. Participation of subjects was voluntary and verbal or written consent was obtained from all participants prior to data collection.

Results

Descriptive characteristics of the study population

For the 4040 eligible farmers, 3546 completed the fasting capillary plasma glucose test, giving a response rate of 87.8%. The characteristics of the participating left-behind farmers are shown in Table 1. They featured female dominance (65.7% females vs. 34.3% males) and low