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## Original research

# Accumulated exposure to unemployment is related to impaired glucose metabolism in middle-aged men: A follow-up of the Northern Finland Birth Cohort 1966

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## ABSTRACT

**Aims:** We explored whether registered unemployment is associated with impaired glucose metabolism in general population.

**Methods:** Based on Northern Finland Birth Cohort 1966 at 46 years, we analyzed the oral glucose tolerance tests of 1970 men and 2544 women in relation to their preceding three-year employment records in three categories of unemployment exposure: no (employed), low ( $\leq 1$ -year) and high exposure ( $> 1$ -year).

**Results:** Among men, pre-diabetes was found in 19.2% of those with no unemployment, 23.0% with low and 27.0% with high exposure, the corresponding figures for screen-detected type 2 diabetes were 3.8%, 3.8% and 9.2% ( $p < 0.01$ ). Among women, analogous figures for pre-diabetes were 10.0%, 12.6% and 16.2% and for screen-detected type 2 diabetes 1.7%, 3.4%

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and 3.6% ( $p < 0.01$ ). Men with high exposure to unemployment had a higher risk for pre-diabetes (OR 1.61, CI 95% 1.03–2.51) and screen-detected type 2 diabetes (OR 2.58 95% CI 1.23–5.44) than employed men, after adjustment for education, smoking, alcohol intake, physical activity and body mass index. Among women, associations were attenuated in the adjusted models.

**Conclusions:** High exposure to unemployment may predispose to type 2 diabetes in middle-aged men. For clinicians, awareness of the patient's unemployment status may be helpful in recognizing undiagnosed cases.

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## 1. Introduction

Type 2 diabetes is a growing global epidemic with a large adverse economic impact [1]. Etiologically, the current knowledge posits a complex interplay between biological, psychological and social factors during the life-course [2–4]. The disease develops through a long-term process characterized by asymptomatic pre-diabetic states with heightened glycaemia [2]. Intervention studies have however shown, that the progression towards type 2 diabetes can be prevented or delayed by lifestyle interventions in high-risk individuals [5,6]. In a 45–74 year-old general population sample, high prevalences were found for asymptomatic pre-diabetes (26% of men and 22% of women) and test-detected type 2 diabetes (9% of men and 7% of women) in oral glucose tolerance tests (OGTT) [7]. Therefore, feasible practices are needed for clinicians to recognize high risk individuals for timely diagnostics and treatment.

Prolonged stress is suggested to be causally linked to the onset of type 2 diabetes [8–10] through overactivity of the hypothalamo–pituitary–adrenal (HPA) axis and cortisol production, as well as behavioral factors [11]. Type 2 diabetes typically occurs in the working age with incidence peaking between 40–64 years [12]. It is hypothesized that employment-related stressors could underlie the development of type 2 diabetes. Stressors such as job strain [13–15] and shift work [13,16] have been shown to predict type 2 diabetes independently of health behaviors [13,15,16]. Some of these results have shown gender-specificity. For instance, work-related stress and shift work have increased the risk of type 2 diabetes in women, whereas high demands and high strain have reduced this risk in men [13,15]. In a large pooled analysis however, job strain increased the risk for type 2 diabetes irrespective of gender [14]. Whilst there are biological and social backgrounds to support sex-specific variations in the etiology of type 2 diabetes in relation to employment patterns, more analysis in both men and women is needed to explore the association between working life and type 2 diabetes.

Unemployment is a common stressor in the working life [17] and a known risk factor for poor health [18]. Nevertheless, only few studies have studied its relation to the development of diabetes, and only based on self-reported unemployment [19–21]. One of these linked type 2 diabetes to individually reported unemployment in women, and to neighbourhood-level aggregates in men [19]. Recently, a systematic review on

the effects of employment on health concluded that although employment appears generally beneficial for health, in particular mental health, further research is needed in relation to specific physical effects of public health relevance [22]. Diabetes is one of the most relevant public health concerns warranting further study in relation to working life.

The present study, based on of the Northern Finland Birth Cohort 1966 (NFBC1966), explores the relation between varying lengths of unemployment with the risk of pre-diabetes and type 2 diabetes in the general population. To our best knowledge, this is the first study to test for the association with objective data for both the exposure to unemployment (national registers) and the outcome of glucose metabolism (OGTT) in men and women.

## 2. Methods

This study is part of the NFBC 1966 study, based on 12,058 live-born children, whose expected dates of birth were in 1966 (96.3% of all births in the region) in the provinces of Oulu and Lapland (Fig. 1) [23]. The prospective data comprises data from questionnaires, clinical examinations and national registers.

The latest 46-year follow-up was conducted between April 2012 and February 2014. The target population consisted of 10,331 eligible individuals, who were alive and living in Finland (84.5% of the original birth cohort, Fig. 1), whereof 65.3% completed the questionnaire concerning education and lifestyle factors. In the clinical examination, 4925 individuals without previously diagnosed diabetes and consenting to the study participated in the OGTT (Fig. 1).

### 2.1. Glucose metabolism

Previous diabetes was defined according to self-reported diagnoses and medications, hospital registers and medication registers from Social Insurance Institution of Finland. For those without previous diabetes, OGTT was conducted in the morning after an overnight fast with 0, 0.5, 1 and 2-h blood samples with glucose determinations from plasma (mmol/L) (Advia 1800, Siemens Healthcare Diagnostics Inc., Tarrytown, Ny, USA Country). Before the OGTT, capillary fingertip blood glucose was measured (Ascensia Contour, Bayer Inc., Canada) and if greater than 8.0 mmol/L, only a fasting glucose sample was taken ( $n = 28$ ). For others, the OGTT was performed by standardized protocol i.e. ingestion of a bolus providing 75 g

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