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Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Sleep disturbances and low psychological well-being are associated with an increased risk of autoimmune diabetes in adults. Results from the Nord-Trøndelag Health Study

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ARTICLE INFO

Article history:
Received 22 May 2012
Received in revised form
26 August 2012
Accepted 4 September 2012
Published on line 23 September 2012

Keywords:
Autoimmune diabetes in adults
LADA
Type 2 diabetes
Insulin resistance
Psychosocial factors

ABSTRACT

Aims: To investigate whether sleep disturbances and low psychological well-being are associated with an increased risk of autoimmune diabetes in adults (including LADA and type 1 diabetes) and type 2 diabetes.

Methods: We used data from the Norwegian HUNT Study ($n = 53{,}394$) and estimated the risk of developing autoimmune diabetes in adults ($n = 138$) and type 2 diabetes ($n = 1895$) between 1984 and 2008 in relation to baseline self-reported psychological well-being and sleep problems.

Results: Sleep disturbances and low psychological well-being were associated with an increased risk of autoimmune diabetes (hazard ratio 1.84, 95% confidence interval 1.10–3.09), primarily linked to poor sleep in men (1.83, 1.05–3.20) and low well-being in women (2.50, 1.03–6.54). Similar associations were seen with type 2 diabetes in relation to sleep problems (1.25, 1.08–1.44) in men and low well-being (1.34, 1.16–1.54), in both men and women. In autoimmune diabetes, these factors were associated with lower anti-GAD levels (177 vs. 306 WHO units/ml, $p = 0.04$).

Conclusions: Our findings indicate that psychosocial factors influence the risk of autoimmune diabetes in adults, possibly through mechanisms related to insulin resistance. This supports the notion that the aetiology of autoimmune diabetes with adult onset in some respects is similar to that of type 2 diabetes.

1. Introduction

There is an emerging body of evidence suggesting that psychosocial factors, such as psychosocial work stress [1,2], psychological distress [3], depression [4] and sleep disturbances [5], in addition to traditional risk factors, are important for the development of type 2 diabetes. These associations have been attributed mainly to increased insulin resistance [6,7]. Whether psychosocial factors are associated with autoimmune diabetes with adult onset has not been investigated previously.

Autoimmune diabetes with adult onset includes Latent Autoimmune Diabetes in Adults (LADA) as well as ''classical'' type 1 diabetes. LADA is a common form of diabetes

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0168-8227/$ – see front matter
http://dx.doi.org/10.1016/j.diabres.2012.09.011

that is estimated to account for approximately 10% of all cases of diabetes in Nordic countries [8], and is by far the most common form of adult-onset autoimmune diabetes. Risk factors for this form of diabetes are, however, poorly understood. Previous findings based on the Norwegian Nord-Trøndelag Health Study (HUNT) indicate that traditional risk factors such as obesity and physical inactivity are associated with an increased risk of LADA [9]. This implies that the aetiology of autoimmune diabetes in adults in some respects may be similar to that of type 2 diabetes. In line with this it has been shown that LADA patients, in addition to autoimmunity, also display insulin resistance [10].

Against this background we hypothesised that psychosocial factors may influence the risk of autoimmune diabetes in the same way as type 2 diabetes, through increased insulin resistance. It also seems possible that psychosocial factors could influence the risk of autoimmune diabetes through mechanisms related to the autoimmune process. Psychological stress has been linked to type 1 diabetes in children, and stress may affect the immune system and contribute to diabetes-related autoimmunity [11,12]. Furthermore, sleep is hypothesised to have a restorative function that is important for the immune system [13]. As far as we know, the influence of sleep disturbances and psychological well-being in relation to the risk of adult onset autoimmune diabetes has not been investigated previously.

The aim of this study was to investigate the influence of sleep disturbances and low psychological well-being on the risk of autoimmune diabetes in adults, and to compare the risk to that of type 2 diabetes. We used data from a 22-year follow-up of the population-based HUNT Study, to date the largest prospective study where incident cases of autoimmune diabetes in adults can be separated from cases of type 2 diabetes.

2. Subjects, material and methods

2.1. The Nord-Trøndelag Health Study (HUNT)

In the Norwegian county of Nord-Trøndelag, the entire population aged ≥20 years have been invited to participate in an extensive health study consisting of questionnaires and clinical investigations, on three occasions between 1984 and 2008 (Fig. 1). The first HUNT survey (HUNT1) was conducted in 1984–1986 and 90.3% (n = 76,885) of those invited participated [14]. The survey included clinical examinations such as measurements of height, weight and blood pressure and questionnaires with questions on health, lifestyle factors, psychosocial and socioeconomic factors.

In 1995–1997, a second, similar investigation of the inhabitants of Nord-Trøndelag was conducted (HUNT2). The clinical investigations were more extensive this time, including measurements of height, weight, blood pressure waist and hip circumference, total cholesterol, HDL-cholesterol and triglycerides. The response rate was 71.2% (n = 66,140) [15]. Among those participating in HUNT1, 61% (n = 47,150) also participated in HUNT2, whereas 15% had died before HUNT2.

In 2006–2008, a third survey (HUNT3) was conducted. The response rate was 54% (n = 50,839) among the 94,194 individuals who had been invited to participate. Among those participating in HUNT2, 56% (n = 37,004) participated in HUNT3. Of participants in HUNT2 11% had died before HUNT3. Among those participating in HUNT1 40% (n = 30,754) also participated in HUNT3.

2.2. Study population

Based on the three HUNT surveys we formed a cohort consisting of 53,394 individuals who could be followed

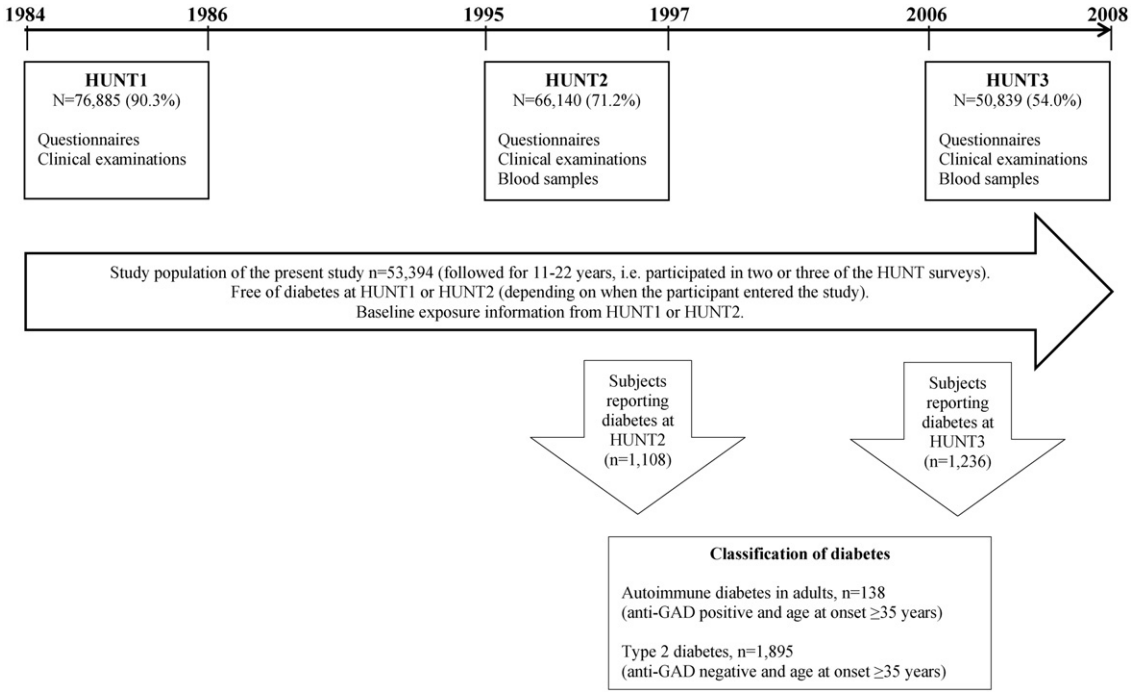

Fig. 1 – The Nord-Trøndelag Health Study (HUNT), 1984–2006.