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ORIGINAL ARTICLE

The effect of educational status on the relationship between obesity and risk of type 2 diabetes

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Summary
Objective: Obesity trends are likely to increase social disparities in diabetes. The magnitude of this effect depends on the strength of the relationship between obesity and diabetes across categories of disadvantage. This study aims to test the hypothesis that education level moderates the association between obesity and fasting plasma glucose (FPG), 2-h plasma glucose (2hPG), HbA1c level, and diabetes prevalence.
Methods: We used the baseline data from the Australian Obesity, Diabetes, and Lifestyle study in 2000 ($n = 8646$). We performed multiple linear regression analysis adjusted for confounding factors and stratified by education level. Body mass index (BMI) and waist circumference (WC) were positively associated with FPG, 2hPG, HbA1c and prevalence of diabetes.
Results: No moderating effect of education on these relationships was observed in the total population. In never smokers free of diagnosed diabetes at baseline the association of WC with 2hPG and HbA1c and of BMI with HbA1c was stronger in those with a lower level of education.
Conclusions: Overall, these results suggest that the association between obesity and diabetes risk is independent of educational status. However, inconsistent results suggest that further analyses of an adequately powered longitudinal study of never smokers free of diabetes would be useful to further explore this hypothesis.

Introduction

Obesity is a global public health problem. According to the World Health Organization (WHO), more

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than 200 million men and nearly 300 million women were obese in 2008 [1]. The prevalence of obesity has been increasing over time [2] and is likely to increase in the future [3]. Obesity is generally known to be socially patterned, with an inverse relationship between socio-economic position (SEP) and obesity shown in a number of studies in developed countries [4—6]. Obesity has been associated with an increased risk of a number of health outcomes [7], particularly diabetes [8].

Similar to obesity, diabetes is socially patterned [9]. The prevalence of diabetes is significantly higher in people with lower SEP [10], particularly among women [11]. This social pattern is not only observed in terms of the prevalence, incidence, and risk factors of diabetes, but also in the diagnosis and control of the disease [12].

Currently, it is assumed that the association between obesity and diabetes is the same across every SEP group. However, this might not be the case. Obese people with a low SEP may have additional risk of diabetes over and above obese people with a high SEP due to differences in the nature of their obesity including duration of obesity and body composition [13], diet [14], lifestyle factors [15], and accessibility to healthcare providers [16]. If indeed the relationship between excess body weight and diabetes is stronger among people with a low SEP, then social inequalities in obesity may lead to even greater social inequalities in diabetes than currently expected. However, to our knowledge, this question has not yet been addressed. Our aim was to investigate whether education moderates the association between excess body weight, using BMI and WC, and the risk of diabetes, using continuous measures of fasting plasma glucose (FPG), 2-hour post-load glucose (2hPG) and glycated haemoglobin (HbA1c) levels, and prevalence of diabetes. As the effect of SEP may act through both primary risk status and treatment we analysed these associations in the total population and those free of diagnosed diabetes at baseline.

Methods

We used the cross-sectional baseline data from the Australian Diabetes, Obesity, and Lifestyle (AusDiab) study. The AusDiab baseline study was a national, population based survey of 11,247 adults aged ≥25 years old in 1999/2000, comprising a household interview and biomedical examination at a testing site. The response rate at baseline was 55% among those completing the household questionnaire. Anthropometric measurements such as height, weight, and WC were collected by trained health professionals. 2hPG was measured from plasma samples collected following a 75 g oral glucose tolerance test (OGTT) for all participants without previously known diabetes. FPG and HbA1c was measured for all participants, however, for those who had not fasted for at least eight hours prior to the fasting blood collection ($n = 3$), FPG result were recorded as missing. HbA1c was measured from whole blood using high performance liquid chromatography. Details of the AusDiab study have been previously described [17]. BMI and WC were used as independent variables, each categorised into three categories according to WHO criteria (BMI: normal weight 18.5—24.9 kg/m^2, overweight 25—29.9 kg/m^2, obese ≥30 kg/m^2; WC: normal < 94.0 cm (men) and < 80.0 cm (women), increased risk 94—101.9 cm (men) and 80.0—87.9 cm (women), very increased risk ≥102.0 cm (men) and ≥88.0 cm (women)) [18]. Education was chosen as the indicator of SEP and classified into secondary school only, diploma, and university degree. Continuous measures of FPG, 2hPG, and HbA1c levels, and the dichotomous presence or absence of diabetes, were used as the dependent variable. For every analysis, participants who had missing data on the specific independent and dependent variables of interest were excluded (final sample size: FPG: $n = 8963$, 2hPG: $n = 8646$, HbA1c: $n = 8882$, diabetes: $n = 8881$).

The association of interest was examined using multivariable linear regression, adjusted for age, sex, country of birth, family history of diabetes, alcohol intake, and smoking status. All analysis were conducted using STATA 11 (StataCorp, College Station, TX). To determine whether the strength of the association between BMI/WC and the continuous measures of FPG, 2hPG, and HbA1c levels differed by education level, a log-likelihood test was performed to determine whether the model with the interaction term with education and BMI or WC predicted the outcome better compared with the model without the interaction term. Due to the higher proportion of smokers in the normal weight group in our study population, and the known increased risk of diabetes associated with smoking, we repeated all analyses in the population of never smokers (FPG: $n = 4986$, 2hPG: $n = 4850$, HbA1c: $n = 4952$, diabetes: $n = 4952$) to remove the possibility of any confounding due to smoking frequency and intensity, as is recommended [19]. We additionally repeated all analyses in a population free of known diabetes at baseline to remove the confounding effect of those on glucose lowering