Contents available at ScienceDirect

Diabetes Research and Clinical Practice

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

International Diabetes Federation

Risk factors of incident type 2-diabetes mellitus over a 3-year follow-up: Results from a large Australian sample

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ARTICLE INFO

Article history:
Received 15 October 2014
Received in revised form
11 November 2014
Accepted 5 February 2015
Available online 14 February 2015

Keywords:
Diabetes
Incidence
Risk prediction
Risk factor
Lifestyle
Behavior

ABSTRACT

Aims: To describe the incidence of type 2 diabetes mellitus (T2DM) among middle-aged and older Australian adults and to examine a broad range of risk factors of T2DM.

Methods: A large cohort of Australian adults aged 45 and up was sampled from the general population and was followed up for approximately 3 years (n = 60,404). Physician-diagnosed T2DM was self-reported at baseline (2006–2008) and follow-up (2010). Incident T2DM was determined as not reporting T2DM at baseline, but reporting T2DM at follow-up. A broad range of risk factors, including socio-demographic characteristics, health status, family history, and lifestyle behaviors were examined at baseline. Multiple logistic regression was used for selecting potential predictors of incident T2DM, and age and reported family history of T2DM were tested as potential effect modifiers.

Results: Of the 54,997 without T2DM at baseline, 888 reported T2DM at follow-up (cumulative incidence 1.6% over 3.4 years, annual incidence rate 0.44%). Adjusted for other risk factors, being male, older age, higher relative socio-economic disadvantage, being born in Asia, lower educational attainment, medical history of hypertension and dyslipidemia, family history of T2DM, overweight/obese, smoking, long sleeping hours, and psychological distress were significantly associated with higher odds of developing T2DM. Particularly, hypertension, dyslipidemia, and overweight/obesity were stronger predictors of T2DM among middle-aged than older adults (≥60 years).

Conclusions: Understanding risk factors for incident T2DM could help identify at-risk populations and develop upstream preventive strategies to combat the epidemic of diabetes.

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http://dx.doi.org/10.1016/j.diabres.2015.02.002
0168-8227/

1. Introduction

Diabetes is a rapidly growing epidemic worldwide and the World Health Organization predicts that unless appropriate action is taken, by 2030 there will be at least 350 million people with type 2 diabetes mellitus (T2DM) in the world [1]. Diabetes is associated with cardiovascular and renal disease, leading to further morbidity, disability, and premature mortality [1,2]. In Australia, the age-standardized prevalence of diabetes has increased from 1.5% in 1989–1990 to 4.2% in 2011–2012 [3]. Based on current trends, the prevalence of diabetes among adult Australians aged ≥25 years is projected to rise to 17% in 2025 [4]. Diabetes poses a substantial economic burden. The total estimated annual costs of diabetes for Australian adults aged ≥30 years was $10.6 billion in 2005, which equated to $14.6 billion in 2010 [5].

Given the health and economic burden and the importance of early interventions in improving disease outcomes, it is important to identify individuals at risk for developing T2DM. Risk prediction models could potentially help classify those who are at increased risk of having an undiagnosed condition, which could help with early diagnosis and management of diabetes. Identifying modifiable risk factors could also guide lifestyle interventions for diabetes prevention [6]. A recent systematic review concluded that the most commonly identified risk predictors of type 2 diabetes are demographic characteristics (i.e., age, sex, ethnicity), family history of diabetes, and cardio-metabolic health indicators (e.g., body mass index, hypertension, waist circumference). Some prediction models also examined lifestyle behaviors, such as physical activity and smoking [6]. Few studies, however, have considered emerging lifestyle risk factors, such as sedentary behavior and sleep [7,8]. Some studies have suggested a potential link between psychological stress and incident diabetes, but this evidence warrants additional investigation [9,10]. Furthermore, only a small number of studies included social determinants of health, such as social deprivation, which may be associated with diabetes incidence [11,12].

Using data from a large Australian cohort, the current study describes the incidence of T2DM among a large cohort of middle-aged and older Australian adults without a diagnosis of diabetes who were followed up for around three years. Further, this study examined a broad range of risk factors, including socio-demographic characteristics, health status, family history, and lifestyle behaviors. In particular we hypothesized that family history and age would act as effect modifiers for some of these risk factors.

2. Methods

2.1. Study population

The analyses are based on the Sax Institute's 45 and Up study, a large cohort study of men and women 45 years and older from the general population of New South Wales (NSW), Australia. Participants were randomly sampled from the Medicare Australia (national health insurance) database, which included information on all Australian citizens and permanent residents, and some temporary residents and refugees who were residents of NSW. Eligible individuals were mailed an invitation to participate, an information leaflet, the study questionnaire, a consent form and a prepaid envelope. A total of 267,153 participants joined the 45 and Up study by returning a completed questionnaire and consent form for long-term follow-up, representing 18% of those invited to participate and 11% of the NSW population aged 45 or older. In 2010, the Social, Economic and Environmental Factors (SEEF) study was conducted as a follow-up of a subsample of the 45 and Up study. The SEEF questionnaire was distributed to the first 100,000 of the 45 and Up study participants, of whom 60,404 returned the completed questionnaire (response rate: 60.4%). The average follow-up time was 3.4 (SD = 0.95) years. The 45 and Up Study was granted ethical approval by the University of New South Wales Human Research Ethics Committee (HREC 05035/HREC 10186) and the SEEF Study by the University of Sydney Human Research Ethics Committee (ref no. 10-2009/12187).

2.2. Measures

2.2.1. Outcome variable

Respondents were asked whether they had ever been told by a doctor that they had diabetes and, if so, their age or year of diagnosis. Incident T2DM was defined as not having diabetes at baseline and a diagnosis of T2DM between baseline and follow-up. A previous study from the same cohort validated the self-report of diabetes against linked administrative data on hospitalization, medical services, and pharmaceuticals and found that reported diagnosis of diabetes in the 45 and Up study had high sensitivity and specificity [13].

2.2.2. Independent variables

All independent risk factors were drawn from the baseline 45 and Up study. These variables included socio-demographic characteristics, self-reported lifestyle risk factors, personal medical history and family medical history.

Socio-demographic characteristics. Socio-demographic characteristics included age, sex, country of birth, highest level of education completed and area-level disadvantage. Country of birth was divided into 5 categories: English speaking countries (Australia, New Zealand, United Kingdom, Ireland, Canada and USA), Europe, Middle East, Asia and other. The 2006 Index of Relative Socio-Economic Disadvantage (IRSED) quintiles at the postcode level were used as a measure of area deprivation. The index was derived from 2006 Australian Census variables such as low income and educational attainment, high unemployment, and people working in unskilled occupations [14]. IRSED scores were grouped into quintiles based on distribution within NSW.

Personal and family medical history. Participants reported family medical history of high blood pressure, heart disease, and T2DM and personal history of high blood pressure, high cholesterol level, and cardiovascular disease. History of cardiovascular disease was ascertained if respondents had ever been told by a doctor that they had a heart attack, heart disease, or blood clots at age 30 years or older or if they had taken aspirin or *Norvasc* (a calcium channel blocker) for most