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Change in prevalence and 6-year incidence of diabetes and impaired fasting glucose in Korean subjects living in a rural area

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Abstract

Aims: To determine the change in prevalence, incidence and risk factors associated with diabetes and impaired fasting glucose (IFG) in a rural Korean area.
Methods: Initially a total of 1119 subjects (424 men and 695 women) aged 31–99 years were recruited in 1997. Baseline clinical data and various laboratory values were obtained. Six years later, we visited the same area and measured similar parameters in 814 subjects (316 men and 498 women) of which 558 were original participants and 256 subjects were new. Incidence and risk factors of diabetes were analyzed in 518 subjects. Diabetes and IFG were defined according to American Diabetes Association criteria.
Results: Age- and sex-adjusted prevalence of diabetes in 1997 was 6.9%, increasing to 11.7% in 2003. The prevalence of IFG increased alarmingly from 21.9% in 1997 to 38.8% in 2003. The age- and sex-adjusted incidence rate of diabetes was 16.3 per 1000 person-years. Baseline fasting plasma glucose, 2 h post-load glucose, abdominal circumference and urinary albumin excretion rate (UAER) acted as independent risk factors for diabetes in a multivariate logistic regression analysis.
Conclusions: The prevalence of diabetes and IFG increased markedly from 1997 to 2003, indicating the need for urgent preventive measures. Fasting and 2 h post-load glucose, abdominal circumference and UAER independently predicted the development of diabetes in this rural Korean population.

Keywords: Prevalence; Risk factor; Diabetes mellitus; Impaired fasting glucose; Rural Korean

1. Introduction

Diabetes mellitus and its associated complications are major causes of illness and death worldwide and contribute substantially to health-care costs. The prevalence of diabetes has been increasing enormously; the number of adults with diabetes in the world is expected to rise from 135 million in 1995 to 300 million

Abbreviations: IGT, impaired glucose tolerance; IFG, impaired fasting glucose; BMI, body mass index; UAER, urine albumin excretion rate; HOMA, homeostasis model assessment; OR, odd ratio; NGT, normal glucose tolerance

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by 2025 [1]. Apart from the heightened genetic susceptibility of certain ethnic groups, pronounced changes in the human environment, behavior and lifestyle may be responsible for this epidemic [2]. Current recommendations for the detection of diabetes rely mainly on measurement of fasting plasma glucose alone. Impaired glucose tolerance (IGT) has been replaced by impaired fasting glucose (IFG) as a marker of prediabetes or glucose dysregulation. IFG, while not as strong as IGT, consistently predicts an increased risk for diabetes [3–6] and cardiovascular diseases [7] in many populations. As a result, the detection of IFG can be used to both identify groups at risk for the development of diabetes and predict impending epidemics of diabetes.

Previously, we reported that the prevalence of diabetes in a rural population of Korean adult aged 40–99 years was 7.7%, when adjusted for world population [8]. In this study, we estimated the change of prevalence and the incidence of diabetes in the same rural Korean population after 6 years and assessed risk factors for the development of diabetes.

2. Subjects and methods

2.1. Study population and methods

The study population and methods have been described elsewhere [9]. Briefly, the initial population-based cross-sectional study was conducted in February 1997. At the time of the baseline examination in 1997, a total of 1119 subjects (424 men and 695 women) aged 31–99 years were recruited from the Chongup district in southwestern Korea. A personal interview was conducted to obtain demographic data, personal medical history, socio-economic status and physical activity information. Anthropometric measurements (height, weight, waist circumference and hip circumference) and physical examinations (including blood pressure) were done in a standard manner. Body mass index (BMI) was calculated as the ratio of weight (kg) to standing height (m) squared (kg/m^2). A fasting blood sample was collected for measurement of glucose, lipids, insulin and proinsulin. A 2-h glucose tolerance test was performed with 75 g of oral glucose. The albumin concentration of a timed overnight urine sample was determined. The homeostasis model assessment (HOMA) was calculated as the product of fasting insulin (μU/ml) and fasting glucose (μmol/l) divided by 22.5 [10]. Laboratory evaluation methods have been previously detailed [9]. We determined plasma glucose level with the same instrument (Hitachi 736-40 automatic analyzer, Hitachi, Tokyo) in both surveys to minimize precision error.

The second survey was performed in February 2003. In addition to the surviving participants enrolled in the first survey ($n = 1119$), residents aged 30 years or more that did not participate in the first survey ($n = 259$) were invited to a personal interview and clinical examination. During the 6 years since the initial assessment, 81 subjects died (7.2%) and 63 moved out of the Chongup district (5.5%), leaving 975 subjects eligible for the follow-up study. Among them, 558 subjects participated, so the follow-up rate was 57%. A total of 817 subjects were interviewed. Three were not venipunctured, and so complete data were available in 814 subjects for the analysis of prevalence of diabetes and impaired fasting glucose in 2003. The prevalence of diabetes and impaired fasting glucose in 1997 were calculated from the data of 1119 subjects using fasting glucose level only. There was no difference between original participants and new participant in age, sex, clinical and metabolic parameters.

Forty of 558 subjects who participated in both the first and the second survey were excluded from incidence estimates due to previously diagnosed diabetes mellitus. The remaining 518 subjects were available for the analysis of the 6-year cumulative incidence of diabetes. No significant differences were observed in age, sex, BMI, glucose tolerance status, urine albumin excretion rate (UAER), lipid profiles, insulin and proinsulin levels at baseline in 1997 between non-participants and participants of the follow-up survey. Type 2 diabetes was defined according to American Diabetes Association criteria [11] as any of the following: a fasting serum glucose level of 7 mmol/l, a nonfasting glucose level $\geq$11.1 mmol/l, self-reported use of medications for diabetes, or a self-reported previous physician diagnosis. This study was approved by the Institutional Review Board and all subjects gave informed consent.

2.2. Statistical analysis

Age- and sex-standardized estimates of prevalence were calculated by direct methods using the Korean population aged 30–99 from the year 2000 as the standard population, with age categories of 30–49, 50–59, 60–69, 70–79, and $\geq$80 years. The 6-year cumulative incidence was obtained by dividing the number of incident diabetes cases by the number of participants at risk for diabetes at baseline. Baseline characteristics in 1997 considered as possible risk factors included age, sex, BMI, waist circumference, physical activity level, smoking status, blood pressure, fasting plasma glucose, 2-h glucose, fasting insulin, proinsulin, HOMA index, total cholesterol, HDL cholesterol, LDL cholesterol, total triglyceride and UAER. Statistical methods included the χ^2 test, the Student's t test, and stepwise linear logistic regression methods as appropriate. Statistical significance was defined as a value of $P < 0.05$. All analyses were performed using Statistical Package for Social Science (SPSS), Version 9.0 (SPSS Inc., Chicago, IL, USA).

3. Results

3.1. Increased prevalence of diabetes and impaired fasting glucose from 1997 to 2003

The age- and sex-adjusted prevalence of diabetes in 2003 was 11.7%, which was 71% higher than the