主論文の要旨

Factors Associated With Prediabetes and Diabetes Among Public Employees in Northern Ethiopia

（エチオピア北部の公務員における前糖尿病および糖尿病に関連する要因）

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【Introduction】

Diabetes is an emerging public health challenge in African countries, including Ethiopia. The prevalence of diabetes in Ethiopia, the second populous country in Africa, was estimated at 7.5% in 2017, nearly twice as high as the average prevalence of the African region (4.2%, in 2007). The increasing burden of diabetes in Ethiopia might be related to the urbanization and lifestyle changes during the rapid economic growth in the last decade. Epidemiological studies of known risk factors of raised blood glucose, such as obesity and dyslipidaemia, were still limited in number in African countries including Ethiopia.

We conducted a cross-sectional survey targeting public employees in Mekelle, a regional capital city in northern Ethiopia. Although it is one of the most populous cities in Ethiopia, its urban population had not been included in other previous epidemiological studies related to diabetes. We measured both fasting blood glucose (FBG) and glycated hemoglobin (HbA1c) and found that the prevalence of diabetes was 13.0% in men and 5.9% in women, much higher than those of the 2015 nationwide survey. We have published a profile paper reporting the descriptive statistics of diabetes and other common risk factors of non-communicable diseases. However, associations of prediabetes and diabetes with other factors have not been elucidated. The current study aimed to examine factors associated with prediabetes and diabetes or their potential factors among public employees living in an urban area in northern Ethiopia.

【Methods】

We used the data from our previous epidemiological study conducted between October 2015 and February 2016 in a regional capital city in northern Ethiopia. The study was designed to cover a wide range of government employees aged 25-64 years working in offices of various public services. We mostly followed the World Health Organization (WHO) standard procedure for the data collection with slight modifications. In brief, face-to-face interviews were conducted using the standard questionnaire translated into the local language, Tigrina, and added some questions such as religious fasting practice. Anthropometric measurements were taken following the WHO guideline. Blood samples were taken from a fingertip after at least eight-hour fasting, and portable analysers were used to measure FBG, total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, and HbA1c. Excluding pregnant women, those aged under 25 years or over 64 years, and 5 subjects missing both FBG and HbA1c data, valid data of 1372 subjects (817 men and 555 women) were statistically analysed.

Glycaemic status of the subjects was categorised into three groups using combined diagnosis criteria defined by American Diabetes Association. Diabetes was defined as FBG $\geq$ 7.0 mmol/L (126 mg/dL) or HbA1c $\geq$ 6.5% or currently on treatment. Prediabetes was defined as FBG =5.6-6.9 mmol/L (100-125 mg/dL) or HbA1c =5.7-6.5% subsequently. Normal blood glucose was defined as FBG < 5.6 mmol/L (100 mg/dL) and HbA1c < 5.7%. Religious fasting was categorised by participants' responses (yes/no) to question item of "Do you routinely observe

fasting as part of your religious practice?"

Multinomial logistic regression models were used to analyse the association between various factors and the outcome variable of glycaemic status, namely normal (reference), prediabetes, and diabetes. Factors of age, education, annual income, religious fasting, smoking, alcohol drinking, fruit and vegetable intake, physical activity, degree of hypertension, and obesity indices (body mass index (BMI) or waist circumference) were included in the models as independent variables (classifications of variables were shown in Table 1). Linear trend in the associations of each independent variable with prediabetes and diabetes were assessed by assigning ordinal numbers to each level of the categorical variables, and treating them as continuous variables in the regression models. All statistical tests were two-sided, and $p < 0.05$ were considered statistically significant.

【Results】

The prevalence of prediabetes and diabetes was 37.5% (men: 40.8%; women: 32.5%) and 10.2% (men: 13.1%; women: 5.9%), respectively. BMI increase was significantly associated with prediabetes and diabetes both in men and women (p for trend < 0.001) (Table 1). Increased waist circumference was significantly associated with prediabetes in both men and women (men, OR: 2.60, 1.70-4.00; women, OR: 2.61, 1.50-4.54), and with diabetes only in men (OR: 3.41, 1.89-6.11). Increased waist to hip ratio was significantly associated with prediabetes in both men and women (men, OR: 1.74, 1.19-2.55; women, OR: 2.78, 1.66-4.67), and with diabetes only in men (OR: 2.48, 1.32-4.69). The increase of degree of hypertension was significantly associated with prediabetes and diabetes only in women (p for trend < 0.05). Not observing religious fasting was significantly associated with diabetes in men (OR: 1.88, 1.07-1.15). Low educational levels, low annual income, and low physical activities showed insignificant associations with prediabetes and diabetes both in men and women. Raised triglycerides were significantly associated with prediabetes (OR: 1.33, 1.11-1.58) and diabetes (OR: 1.61, 1.22-2.13) in men but not in women. The increase of total cholesterol was significantly associated with prediabetes (men, OR: 1.28, 1.07-1.53; women, OR: 1.34, 1.11-1.64) and diabetes (men, OR: 1.28, 1.07-1.53; women, OR: 1.34, 1.11-1.64). Non-HDL cholesterol increase was significantly associated with prediabetes (men, OR: 1.30, 1.08-1.56; women, OR: 1.47, 1.19-1.82) and diabetes (men, OR: 1.71, 1.29-2.26; women, OR: 3.28, 1.77-6.10). HDL cholesterol increase was negatively associated with prediabetes and diabetes in men and women when adjusted for age, but the negative association was attenuated when BMI and other factors were adjusted.

【Discussion】

This is the first study to identify factors associated with prediabetes and diabetes defined by both FBG and HbA1c among Ethiopian adults. This study showed that total cholesterol and

non-HDL cholesterol were positively associated with prediabetes and diabetes. As far as we know, non-HDL cholesterol was examined for the first time among Ethiopians for the associations with prediabetes and diabetes. The associations of low HDL cholesterol with prediabetes and diabetes were explained by BMI in both men and women.

The significant association of not observing religious fasting with diabetes was found only in men. This may be due to the fact that women were more likely to observe religious fasting (71%) than men (46%, $p < 0.001$). The significant association of high triglycerides with diabetes was not found in women. We cannot really think of the reason, but the variability of triglycerides as well as the absolute levels were higher in women than in men, which might be related to our finding less significant association in women. This study also confirmed that abdominal obesity was associated with the increased probability of prediabetes and diabetes, which were consistent with previous studies from other Ethiopian population.

This study has several limitations. First, this is a cross-sectional study so that causation cannot be determined. Second, information on the position or type of employment was not available in the data. However, variables of annual income and physical activity levels were included instead to alleviate the shortage.

【Conclusion】

We reported for the first time that non-HDL cholesterol was associated with prediabetes and diabetes. We also confirmed that abdominal obesity was associated with prediabetes and diabetes. The associations of high triglycerides and not observing religious fasting with diabetes were found only in men, and that of high blood pressure was found only in women, the reason for which requires further studies.