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Long-term diabetes outcomes in multi-ethnic Asians living in Singapore

Serena Low^{a,*}, Lim Su Chi^{a,b}, Lee Ying Yeoh^c, Jian Jun Liu^a, Sharon Fun^b,
Chang Su^a, Xiao Zhang^a, Tavintharan Subramaniam^{a,b}, Chee Fang Sum^b

^a Clinical Research Unit, Khoo Teck Puat Hospital, Singapore, Singapore

^b Diabetes Centre, Khoo Teck Puat Hospital, Singapore, Singapore

^c Department of Medicine, Khoo Teck Puat Hospital, Singapore, Singapore

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ABSTRACT

Aims: This study aims to assess ethnic and gender disparities on long-term complications among multi-ethnic Asians with Diabetes Mellitus (DM) living in Singapore.

Methods: We conducted a retrospective cohort study involving 3006 patients who attended a diabetes centre in a hospital from 2003 to 2011. Demographics and clinical data were obtained from standardised questionnaire and patient's case records. Age at onset of diabetes was calculated as current age minus duration of DM in years. Outcomes on Acute Myocardial Infarction (AMI), End-Stage Renal Failure (ESRF) and all-cause death were ascertained by data linkage with national registries.

Results: The mean duration of diabetes exposure was 15.6 ± 9.1 years for AMI, 15.4 ± 9.0 years for ESRF and 17.0 ± 9.0 years for death. After adjusting for traditional cardiovascular risk factors, Malay and Indian with diabetes remained significantly associated with AMI with HRs 2.81(95%CI, 1.81–4.37) and 2.03 (95%CI, 1.15–3.59), respectively. The effect of Malays on ESRF and death became attenuated post-adjustment. Besides mortality, there was preponderance for other adverse outcomes associated with male.

Conclusions: Ethnic (Malay worse) and gender (male worse) disparities were observed in DM-related outcomes. The results may inform allocation of finite resources and to organize care targeted at high-risk groups.

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1. Introduction

Diabetes Mellitus (DM) has reached epidemic proportions in many parts of the world. According to the International Diabetes Federation, there were 382 million people with DM in

2013. The number of people with DM is expected to increase to 592 million in 2035 [1]. While DM poses a global public health threat, the burden is pronounced in Asia where 60% of the world's population with diabetes is found [2]. The rising prevalence of DM in Asia can be attributed to aging-population, urbanization and socio-economic changes with

* Corresponding author. Tel.: +65 66023340; fax: +65 66023772.

E-mail address: low.serena.km@alexandrahealth.com.sg (S. Low).

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concomitant lifestyle modifications such as reduced physical activity, dietary preference for high-energy foods and unhealthy behaviours [1,2].

The myriad of DM complications such as cardiovascular diseases, renal failure and mortality has been well studied in many western countries [3–15]. Interestingly, there were ethnic [3,4,6,8,9,11] and gender disparities in the development of coronary artery disease and mortality from coronary heart disease (CHD) [12–15]. For example, the United Kingdom (UK) Asian Diabetes Study has demonstrated that the cardiovascular risk was higher in South Asians with Type 2 DM compared to White Europeans in the UK [3]. Some meta-analyses suggest that the effect of diabetes on fatal coronary heart disease (CHD) is gender dependent i.e. among women, presence of diabetes confers greater CHD risk. This risk-burden conferred by diabetes is less pronounced in men [12]. Information on the contribution of ethnicity and gender to DM-related outcomes is however limited in Singapore, a multi-ethnic society in South-East Asia.

Singapore has three major ethnic groups: Chinese 74.2%, Malays 13.3% and Indians 9.1% [14]. The ethnic diversity provided us a unique opportunity to study the impact of ethnicity on DM-related outcomes. There were earlier studies that examined association between DM and ethnicity with mortality and cardiovascular complications in Singapore [15–18]. However, these studies were either cross-sectional in nature [15,16] or involved subjects from previous surveys in general or selected populations with and without DM [17,18]. Most of these studies were published almost a decade ago, between 2003 and 2006 [15,17,18]. More recent epidemiological studies on ethnic and gender dependent diabetes outcomes in Singapore are lacking. With the rapidly increasing prevalence of DM in Singapore, it is timely to examine the long term DM-related outcomes by ethnic groups and gender from a public health perspective. Studying the epidemiology of diabetes-related outcomes may reveal its distribution and determinants thereby informing public health policies and clinical interventions e.g. identifying high-risk group for screening and interventions. These will clarify uncertainties on these potential risk factors and bridge the knowledge gaps on our understanding of the risk profile in our local population with potential translation of findings into clinical practice and prevention strategies.

The aim of this study is to determine whether there are ethnic and gender differences on development of DM-related complications, namely acute myocardial infarction (AMI), end-stage renal failure (ESRF) and death, among patients attending DM centre in a hospital in Singapore.

2. Materials and methods

2.1. Data sources and study population

The study involved adult patients with Type 1 (T1) DM and Type 2 (T2) DM who attended the DM centre of a single health care organization—the Alexandra Health Private Limited (AHPL) from 2003 to 2011. Ethics approval was obtained from National Healthcare Group Domain Specific Review Board in Singapore. All patients who participated gave informed written consent.

Data on age, gender, ethnicity, and medications was extracted from patients' case records upon recruitment by trained staff while information on family history and smoking history were obtained from a standard questionnaire administered to the patients upon recruitment. Age at onset was calculated as the current age minus duration of DM in years. Duration of diabetes was ascertained either from patient's case record or when unavailable, direct questioning with the standard questionnaire. Blood pressure (BP) was measured by trained nurses using a standard electronic sphygmomanometer with an appropriate cuff in the sitting position. Hypertension was present if systolic BP ≥ 140 mmHg and diastolic BP ≥ 80 mmHg. The body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in metre. Spot urine and blood samples were taken and sent to the hospital laboratory accredited by the College of the American Pathologists (CAP). Urinary albumin was measured by immunoturbidimetric assay (Roche cobas[®] c 501); serum creatinine, total cholesterol (TC), low density lipoprotein cholesterol (LDL-cholesterol), high density lipoprotein cholesterol (HDL-cholesterol) and triglycerides (TG) by enzymatic colorimetric test (Roche cobas[®] c 501); and glycated haemoglobin (HbA1c) by Tina-quant HbA1c Gen.3 (Roche cobas[®] c 501). The following lipids level were considered abnormal: LDL-cholesterol ≥ 2.6 mmol/l (high LDL-cholesterol); HDL-cholesterol ≤ 1.0 mmol/l in men or ≤ 1.3 mmol/l in women (low HDL-cholesterol); TC ≥ 5.2 mmol/l (high TC); and TG ≥ 1.7 mmol/l (high TG), taking references from the 2014 ADA recommendations. The above clinical baseline parameters were measured at time of recruitment.

Outcomes on AMI, ESRF and death were obtained by linking our data to records from the following registries maintained at the National Registry of Diseases Office (NRDO): Singapore Myocardial Infarction Registry, Singapore Renal Registry and Registry of Births and Deaths. The study team analysed the anonymised individual level data of the linked dataset. The Singapore Myocardial Infarction Registry and Singapore Renal Registry routinely capture outcome of AMI and ESRF based on reporting from healthcare institutions where individuals were diagnosed or treated for such conditions under legislation that requires mandatory reporting. The registry coordinators also capture the data of these individuals at follow-up. Likewise, the Registry of Births and Deaths collects data on live births, deaths and still-births in Singapore and its territorial waters, and all deaths in Singapore must be reported within 24 h of occurrence under legislation (<http://www.ica.gov.sg>). Data from AHPL were merged with disease registry data the unique National Registry of Identification Card (NRIC) number, identifiables such as name and NRICs were subsequently removed from the merged dataset before analysis could be carried out.

2.2. Statistical analysis

Statistical analysis was performed using STATA Version 13.0 (STATA Corporation, College Station, Texas). Categorical variables were expressed as number (percentage), and continuous variables as means $\pm$ standard deviation (SD) or median (interquartile range) as appropriate. Differences in patient characteristics were compared using Chi-Square test

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