Prevalence of diabetes, impaired fasting glucose and metabolic syndrome among female Orang Asli community in Peninsular Malaysia

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Background: Orang Asli (OA) are the indigenous people of Peninsular Malaysia. Although majority of the people still live in remote and rural areas, others have been relocated, have undergone acculturation and have adopted urbanized lifestyle and unhealthy dietary habits. As a result, there has been an increasing prevalence of obesity, hypertension and diabetes seen among the OA. The crude prevalence rate of diabetes and impaired glucose tolerance determined in 1993 among the resettled OA were reported to be 1.3 and 10.7%, respectively. **Aim:** This study was undertaken to determine the current status of diabetes, impaired fasting glucose (IFG) and metabolic syndrome (MetS) among the OA living in four rural resettlement areas. **Materials and Methods:** A total of 119 female OA, aged ≥18 years were studied. The subjects underwent physical examination, and fasting blood samples were collected for plasma glucose and lipid profile. A cohort of 76 subjects was followed up for 2 years. **Results:** Prevalence of diabetes, IFG and MetS was 8.4, 16.8 and 22.7%, respectively, where a significant number of people were below 40 years old and were either overweight or obese. **Statistical Analysis:** Statistical analysis was done using SPSS software. Mann-Whitney U and paired t-test were used to compare the differences between groups and between visits, respectively. Results were reported as percentages and mean ± SD. **Conclusions:** Prevalence of diabetes and IFG among the OA has increased significantly over the last decade. Unless immediate steps are taken to contain the increasing prevalence of obesity, diabetes, IFG and MetS, the health care costs for OA with chronic diseases will pose an enormous financial burden to the country.

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Introduction

Diabetes mellitus (DM) is a major global public health problem and the incidence and prevalence of diabetes is escalating not only in highly developed but also in many developing and newly industrialized countries.[1,2] In Malaysia, the prevalence of diabetes among adults of age ≥30 years was 6.2% in the 1986 National Health Morbidity Survey (NHMS),[3] and it rose to 8.2% in NHMS II (1996)[4] and 14.9% in NHMS III (2006).[5] In all the three surveys, the prevalence was found to be higher among the urbanites and those who were socioeconomically disadvantaged.

Metabolic syndrome (MetS) is a clustering of risk factors for cardiovascular diseases[6] and type 2 DM.[7,8] While there have been several clinical definitions of MetS, the International Diabetes Federation (IDF) consensus definition for MetS identified central adiposity (waist circumference, WC) as an essential component for the diagnosis.[9] A South Asian would therefore be diagnosed with MetS if the WC is ≥85.0 cm (for a male) or ≥80.0 cm (for a female), and if the person has any two of the four factors: fasting plasma glucose (FPG) of ≥5.6 mmol/l or previously diagnosed with diabetes, triglycerides (TG) of ≥1.7 mmol/l, high density lipoprotein cholesterol (HDL) of <1.03 mmol/l (for men) or <1.29 mmol/l (for women) and systolic blood pressure of ≥130 mm Hg or diastolic blood pressure ≥85 mm Hg.

The Orang Asli (OA) are the indigenous people of Peninsular Malaysia. Majority of the OA still lived in

remote and rural areas but over the past three decades, many had to undergo relocation programs when their inhabited land and the land where they forage and grow their crops were acquired by the state authority for development. They are given new homes with basic amenities, special schools for the children, free health care services and various programs implemented to ensure employment and improvement in their quality of life. The Department of OA Affairs (JHEOA) was established to look after the socioeconomic well-being of these indigenous populations.

There have been many health surveys and studies conducted on the OA but the focus has been mainly on communicable diseases and nutritional status. While problems such as intestinal parasitic infections, anemia and malnutrition still persist,[10] adoption of urbanized lifestyle and unhealthy dietary habits have resulted in increasing number of OA affected with lifestyle-associated chronic diseases such as hypertension and diabetes. A study conducted in 1993[11] reported the crude prevalence rate of diabetes and impaired glucose tolerance (IGT) to be 1.3 and 10.7%, respectively, among the OA living in rural, resettlement areas, which was significantly higher when compared to that of those who were still living in the jungle (0.0 and 3.3%, respectively). In another study, it was also shown that overweight and obesity were also prevalent especially among the female OA.[12]

Therefore, the objective of this study is to determine the current status of diabetes, FPG and MetS among this indigenous population. Four small rural settlements (villages) in the state of Selangor were selected for the study. Since most of the males were employed outside the villages and returned to the family only on weekends, we only chose to study the female population.

Materials and Methods

The subjects of age ≥18 years were of the Temuan tribe from four small villages: Kampung Kuala Kerling, Kampung Gerachi, Kampung Sungai Jang and Kampung Pertak, which are about 60–90 km from Kuala Lumpur, the capital city of Malaysia. The approximate total adult female population (age ≥ 15 years) in these four villages was 172, out of which, 145 were of ≥18 years old. All eligible adults were invited to participate but only 119 (82.1%) turned up for the baseline visit whereby a cohort of 76 subjects agreed to be followed-up for 2 years.

Ethical approval to conduct the study was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia. Written permission to conduct the study was also obtained from the JHEOA and the head of each village. Cooperation was also sought from the local health authority. The subjects were preinformed to fast for 8–10 hours, and upon obtaining written consent, venous blood samples were obtained from each subject for biochemical analysis. The subjects were also required to undergo anthropometric measurements and with the help of the research team, answered a set of health questionnaires.

About 12 ml fasting venous blood sample were collected from each subject. Blood samples were processed on the same day and sera/plasma samples were stored frozen at –20°C until analysis. FPG, TG, HDL, low density lipoprotein cholesterol (LDL) and total cholesterol (TC) were analyzed on Vitalab Selectra E chemistry analyzer (Vital Scientific N.V., NL 6950 AC Dieren, The Netherlands), using reagents purchased from Randox Laboratories Ltd., Crumlin, Co. Antrim, United Kingdom. The interassay coefficient of variation (CV) for glucose was 3.9% and for lipids it ranged between 0.7 and 2.1%.

Statistical analysis was done using SPSS software version 15.0. Results were reported as percentages and mean ± SD. Mann-Whitney U and paired *t*-test were used to compare differences between groups and between visits. Significant value was assumed when $P < 0.05$.

Results

Using World Health Organization (WHO) criteria,[13] a subject was diagnosed with diabetes if the FPG was ≥7.0 mmol/l, and a subject was diagnosed with IFG, if the FPG fell between ≥6.1 and <7.0 mmol/l. The subject was diagnosed with MetS based on IDF consensus worldwide definition,[9] if his/her WC ≥ 80.0 cm with two of the risk factors: FPG ≥ 5.6 mmol/l or having diagnosed with diabetes, HDL 1.29 mmol/l, TG ≥ 1.7 mmol/l or being treated with lipid-lowering drug.

The prevalence of diabetes, IFG and MetS among the adult female OA was 8.4% (10/119), 16.8% (20/119) and 22.7% (27/119), respectively. When analyzed according to age groups, 50% (5/10) of the subjects diagnosed with diabetes were below the age of 40 years and the highest number of subjects with IFG and MetS was in the age group of 20–39 years [Figure 1].

The baseline anthropometric and biochemical characteristics of subjects grouped as normal, with

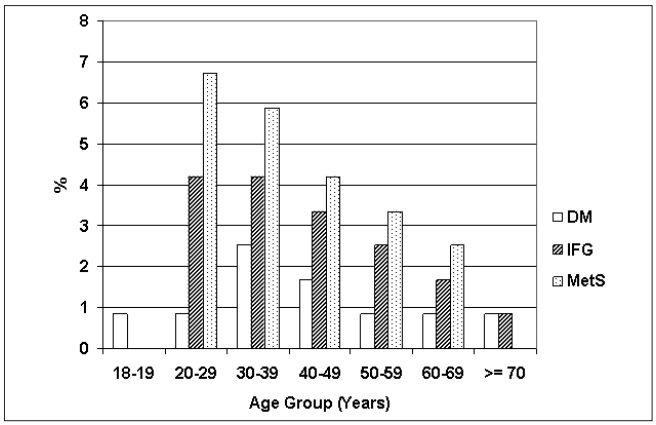

Figure 1: Percentage of subjects with DM, IFG and MetS as per the age groups

IFG and with diabetes are as shown in Table 1 and those according to the MetS status are shown in Table 2. Compared to the ideal body mass index (BMI) of 18.5–22.9 kg/m^2 for adult Asians proposed by the WHO western Pacific region,[14] all the subjects were found to be significantly either overweight or obese. Even amongst the non-MetS subjects, only 23.9% (22/92) was without any risk factor for MetS while the remaining 70 subjects (76.1%) were found to have at least one risk factor. Low HDL was the most prevalent metabolic abnormality (44.6%), followed by elevated FPG (34.8%), WC ≥ 80.0 cm (19.6%) and elevated TG values (9.8%).

A cohort of 76 subjects was followed-up for 2 years. At baseline, 22 subjects (28.9%) had MetS and the remaining 54 (71%) were non-MetS. Diabetes was present in both the groups: five (22.7%) subjects from the MetS group and two (3.7%) subjects from the non-MetS group. Another five subjects were diagnosed with diabetes after 12 months, where three (60%) were below the age of 40 years. At the end of 24 months (final visit), another 33-year-old OA presented with an FPG of 9.4 mmol/l.

Retrospectively, there were a total of 50 subjects who remained as non-diabetes and non-MetS throughout the study period. Despite significant improvement seen in the levels of FPG, HDL, LDL and T-chol at the end of the study, BMI and WC showed significant increase ($P < 0.001$) compared to baseline [Table 3].

Discussion

With the assumption that similar findings would have been obtained if this study had included the

Table 1: Anthropometric and biochemical characteristics of study subjects grouped as normal, with IFG and with diabetes

Parameters (mean ± SD)	Normal (n = 89)	IFG (n = 20)	DM (n = 10)
Age (years old)	33.7 ± 13.6	42.0 ± 14.4	42.4 ± 15.4
Weight (kg)	59.2 ± 12.8	63.5 ± 14.4	65.4 ± 9.8
WC (cm)	75.9 ± 9.8	81.8 ± 9.2*	84.6 ± 9.0*
BMI (kg/m^2)	25.5 ± 4.8	28.1 ± 5.4	28.6 ± 3.8
FPG (mmol/l)	5.2 ± 0.5	6.4 ± 0.3**	9.9 ± 3.8**
TG (mmol/l)	1.1 ± 0.6	1.3 ± 0.4	1.5 ± 0.7
HDL-C (mmol/l)	1.3 ± 0.3	1.2 ± 0.2	1.3 ± 0.3
LDL-C (mmol/l)	3.4 ± 1.0	3.7 ± 0.8	3.6 ± 0.9
T-chol (mmol/l)	5.7 ± 1.1	5.8 ± 1.1	5.9 ± 1.1

*$P < 0.05$; **$P < 0.001$ versus normal

Table 2: Anthropometric and biochemical characteristics of subjects grouped according to with MetS and without MetS (non-MetS)

Parameters (mean ± SD)	Non-MetS (n = 92)	MetS (n = 27)
Age (years)	34.9 ± 14.8	39.2 ± 12.0
Weight (cm)	57.5 ± 12.2	70.8 ± 9.7*
WC (mmol/l)	74.5 ± 8.9	88.4 ± 5.5*
BMI (kg/m^2)	24.9 ± 4.6	30.6 ± 3.1*
FPG (mmol/l)	5.4 ± 0.7	6.8 ± 2.8*
TG (mmol/l)	1.1 ± 0.5	1.6 ± 0.7*
HDL-C (mmol/l)	1.3 ± 0.3	1.1 ± 0.2*
LDL-C (mmol/l)	3.4 ± 0.9	3.7 ± 0.9
T.chol (mmol/l)	5.7 ± 1.1	5.81 ± 1.1

*$P < 0.001$ versus non-MetS

Table 3: Anthropometric and biochemical profiles of subjects (n = 50, 18–77 years old) who remained non-diabetic and without MetS throughout the study duration

Parameters (mean ± SD)	Baseline	At month 24
Weight (cm)	56.7 ± 11.8	59.4 ± 12.5*
WC (mmol/l)	74.7 ± 8.1	76.4 ± 8.8*
BMI (kg/m^2)	25.0 ± 4.2	26.2 ± 4.4*
FPG (mmol/l)	5.2 ± 0.6	4.7 ± 0.9*
TG (mmol/l)	1.1 ± 0.5	1.1 ± 0.6
HDL-C (mmol/l)	1.2 ± 0.2	1.6 ± 0.3*
LDL-C (mmol/l)	3.2 ± 0.9	2.4 ± 0.7*
T.chol (mmol/l)	5.5 ± 1.1	5.3 ± 1.1

*$P < 0.001$ versus baseline

male population and acknowledging the small sample size, the crude prevalence of diabetes among the OA population has increased to an alarming 8.4% from 1.3% reported in 1993 by Osman *et al*.[12] Changing the lifestyle from shifting cultivation, fishing and hunting for their source of proteins to sedentary living and 'westernized' diets has proven to be detrimental to the health of this indigenous population. This is not surprising, as similar findings have been reported in other indigenous populations also. While there is a possible link to genetic susceptibility (the 'thrifty gene' hypothesis)[15,16] reduced physical activity, high-calorie, high-fat diets in addition to the psychological stress associated with living in the new environment, have been found to be the main contributing factors to the epidemic of diabetes among the indigenous Australian aborigines,[17] the Tokelauans in New Zealand,[18] the Micronesians Nauru[19] and the Arizona Pimas.[20]

The younger onset of diabetes in the OA is consistent with that seen among other indigenous groups such as the indigenous Australians,[21] and the American Indian and Alaska natives.[22] The reason for such an observation has not been completely elucidated but is proposed to be associated with obesity which is highly prevalent in the indigenous populations worldwide.[23] As seen in this study, majority of the female OA were either overweight or obese. Even among the cohort group, for those who remained non-diabetic and with non-MetS during the study period, despite showing remarkable improvement in the FPG level and lipids profile, the mean body weight and WC increased significantly at the end of 24 months. Since obesity is closely linked to increased insulin resistance and decreased insulin sensitivity[24] and higher risk of diabetes,[25,26] arresting the obesity pandemic among the OA should be a priority. Special, culturally oriented community-based intervention programs need to be implemented. As shown in this study, the persistent effort by the health workers during each study visit to personally advise the subjects on the importance of healthy eating and physical activity had actually paid off with a significant improvement seen in the levels of FPG, HDL, LDL and T.chol after 24 months.

The prevalence of IFG in 16.8% of the female OA in this study was four times higher than the national prevalence, estimated to be 4.2% in 2006.[5] Even after taking into account the fact that the indigenous populations are more at risk of developing IFG and type 2 diabetes,[27] this study recorded a higher IFG prevalence compared to the DRUID study which reported a prevalence of 3–4.9% among urban female indigenous Australians.[28] Due to our small sample size, this is inconclusive and needs to be verified by extending our study to more OA communities. Nevertheless, our findings warrant special attention from the health and JHEOA authorities since although IFG is not as sensitive as IGT test, it has consistently been shown to be a good predictor of increased risk for cardiovascular diseases[29] and diabetes[30] in many populations around the world.

MetS is a growing epidemic worldwide and is associated with an increased incidence of atherosclerotic cardiovascular disease[6] and type 2 diabetes[7] In the NHANES III study, the prevalence of MetS was shown to increase with age, reaching the peak at around the age of 60 years and above.[31] On the contrary, our study showed that MetS was already present among young female OA, the largest number being between 20 and 39 years. At a prevalence of 22.7%, this was comparable to that seen among adult females (≥20 years old) in the United States, where the unadjusted and age-adjusted MetS prevalence was reported to be 21.8 and 23.8%, respectively.[31] This is alarming and implies that the acculturation and adoption of an 'urbanized' lifestyle has resulted in a high proportion of young female OA becoming either overweight or obese, where a significant number also had cardiovascular risk factors and diabetes. Before the resettlement program, the OA led a simple lifestyle in the jungle, growing their own crops, fishing and hunting to feed the family. As shown in previous studies,[32,33] other than the dietary factors, urbanized living and lack of physical activity have very likely increased the prevalence of MetS in this indigenous community.

Clearly, despite the small sample size, this study has posed important public health issues that require immediate attention from the health authority and the JHEOA. The adoption of urbanized lifestyle and unhealthy diets has significantly increased the risk factors for chronic diseases among the OA. Unless immediate steps are taken to contain the increasing prevalence of obesity, diabetes, IFG and MetS, the health care costs for OA with chronic diseases will pose an enormous financial burden to the country.

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