

Nutritional Status of Orang Asli (Che Wong Tribe) Adults in Krau Wildlife Reserve, Pahang

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ABSTRACT

This is a descriptive study on nutritional status of Orang Asli (Che Wong tribe) adults in Krau Wildlife Reserve. Twenty-six households, comprising 29 men and 28 women, participated in the study. Dietary diversity was assessed using food frequency questionnaire with 37 food groups. Weight, height and waist circumference were measured using standard instruments. The mean age for men and women was 39.9 ± 17.1 years and 33.7 ± 16.1 years, respectively. Most (89.5%) of the adults had no formal education and about 89.5% of households were categorised as poor. There were 13.8% underweight, 72.4% normal, 10.3% overweight and 3.3% obese men. For women, 25.0%, 46.4%, and 28.6% were underweight, normal and overweight, respectively. While none of the men had at-risk waist circumference (men ≥ 90 cm), about 21.4% of women had waist circumference of ≥ 80 cm. The mean dietary diversity score was 9.47 ± 4.15 with men (9.48 ± 3.70) and women (9.46 ± 4.63) having similar scores. There was a significant correlation between waist circumference and household income ($r=0.36$, $p<0.01$); however, the association was only significant in women ($r=0.50$, $p<0.01$). Although under-nutrition still prevails, there are emerging cases of overweight and obesity in this rural Orang Asli community undergoing nutrition transition especially among the females.

Keywords: Dietary diversity, obesity, Orang Asli, underweight

INTRODUCTION

Nutrition transition that is occurring worldwide is characterised by populations adopting diets that are high in animal foods, fat and sugar, foods with greater energy density and decreased fibre (Popkin, 2001). In low and middle income countries, nutrition transition appears to accelerate, leading to a situation where communicable diseases exist in parallel with non-communicable chronic diseases, thus creating a double burden of diseases (WHO, 2003). Similarly, rapid and marked socio-

economic development in Malaysia for the past two decades has brought about changes in food habits, food purchasing and consumption patterns and lifestyles. During the same period there has been an increase in the prevalence of diabetes mellitus type II, coronary heart disease, hypertension and cancers (Ismail, 2002).

In Malaysia, the Third National Health and Morbidity Survey (2006) (NHMS III) reported that the prevalence of obesity was three times higher in 2006 (14%) as compared to 1996 (4.4%) whereas the prevalence of overweight almost doubled from year 1996

(16.6%) to 2006 (29.1%). The NHMS III revealed that 29.7% men and 28.6% women were overweight while 10.2% men and 17.5% women were obese. The prevalence of overweight and obesity in the rural population (41.8%) did not differ much from that (43.5%) of the urban population. While overweight and obesity continue to rise, underweight (7.8%) still exists in rural communities of Malaysia although the prevalence was reduced from 25.2% in 1996 to 8.5% in 2006 (NHMS III, 2006).

Many studies have shown that the prevalence of chronic diseases is disturbingly high among indigenous peoples worldwide (Anand *et al.*, 2001; James *et al.*, 2001; Uauy, Albala & Kaine, 2001; Ring & Brown, 2003; Vanasse *et al.*, 2006; Hayati *et al.*, 2007). Most are going through westernisation of lifestyles and diets although some indigenous communities still maintain their isolation (Montenegro & Stephens, 2006). A westernisation of indigenous diets involves reduced consumption of traditional foods obtained from fishing, hunting and home grown fruits and vegetables; occurring in parallel is increased dependence on market foods such as processed foods and beverages that are generally high in refined carbohydrates, sugar and saturated fat (Kuhnlein & Receveur, 1996; Uauy *et al.*, 2001). In addition, the active lifestyle of hunting, fishing, gathering and herding activities of the indigenous peoples is gradually being replaced by a sedentary lifestyle.

Poverty is a risk factor for chronic diseases and it is prevalent among indigenous peoples worldwide (Damman, Eide & Kuhnlein, 2008). In Australia, the socio-economic gap between the indigenous and non-indigenous groups is very wide with 40% of the former living below the poverty line with the unemployment rate (23%) of indigenous people being three times higher than that of non-indigenous population (Altman, 2007). Poverty is also widespread among the indigenous peoples

in Latin America. In Bolivia and Guatemala, almost three-quarters of the indigenous population are poor. About 87% of indigenous people in Ecuador live in poverty while in Mexico, the incidence of extreme poverty in 2002 was 4.5 times higher in indigenous than in the non-indigenous group. Of all poor households in Peru, 43% are indigenous groups (World Bank, 2008). Similarly in Malaysia, the Orang Asli has been identified as one of the poorest groups and with a higher incidence of poverty (50.9%) and hardcore poverty (15.4%) compared to the national figures of 7.5% and 1.4%, respectively (EPU, 2007). Poor and market dependent individuals tend to purchase high energy dense foods which are low in micronutrient content, high in saturated fat and refined carbohydrates. Consumption of low nutritional quality foods is associated with the occurrence of obesity and diabetes (Uauy *et al.*, 2001).

The Che Wong (Orang Asli) of the Senoi sub-group resides mainly in the forest of Pahang, Malaysia and depends substantially on forest resources. The Che Wong population is small compared to the other tribes of Orang Asli. In 1979, there were 246 Che Wong in Krau and 115 in Raub (Howell, 1981). The population increased to only 456 in 2007 with 418, 18, 8 and 4 in Pahang, Perak, Selangor and Terengganu, respectively (JHEOA, 2008). Many of the Che Wong have migrated to other locations due to marriages with members of other Orang Asli tribes. In recent years, the government has resettled Che Wong communities into villages in proximity to the town areas as part of efforts to improve their socio-economic status and quality of life. The Che Wong may experience dietary and lifestyle changes due to the shift from total dependence on forest resources to reliance on the market economy.

Although under-nutrition remains a major health concern among the Orang Asli, there is evidence to show that overweight and obesity is on the rise in this population

(Lim & Chee, 1998; Hayati *et al.*, 2007). This study provides an insight on the nutritional status of Che Wong adults including dietary diversity, body mass index and waist circumference. The study also reports on the association between socio-demography and nutritional status of Che Wong adults.

METHODOLOGY

This cross-sectional descriptive study was carried out in the Krau Wildlife Reserve, Pahang. The reserve is located in the southern part of Pahang and covers approximately 60,338 hectares of land area. There are about 26 Orang Asli village settlements surrounding this reserve with approximately 15,000 to 20,000 residents that include Malays and Orang Asli (Temuan, Jah Hut and Che Wong tribes) (Krau Wildlife Management Plan 2002-2006, 2001).

Purposive sampling method was used in that adults (18 years and above) in all 45 Che Wong households located in Kg. Enggang, Kg. Sungai Enggang, Kg. Bess, Kg. Senel, Kg. Bayek, Kg. Bayek Neram, Kg. Bancal, Kg. Kalau, Kg. Beranti, Kg. Sabut were included as study population. However, only adults in 26 households gave consent to participate in this study. For other households, the adults could not be located (even after several visits) or they refused to be interviewed.

All respondents were interviewed using a pre-tested questionnaire and measured for weight, height, and waist circumference. The questionnaire consisted of two parts – demographic and socio-economic characteristics, and dietary diversity. Dietary diversity was determined using a food frequency questionnaire (FFQ) consisting of 37 food groups commonly consumed by Che Wong. These food groups were identified through in-depth interviews conducted with 5 men and 5 women from the Che Wong tribe prior to this study. The men and women were requested to verbally list the common types

of foods consumed by Che Wong. In many instances, the researchers were shown the foods, especially those hunted or gathered in the forest. The information obtained from these 10 informants was considered adequate as similar patterns of responses (point of saturation) were given by the fifth interview. The 37 food groups represent 7 major groups of cereals and cereal products, meat and meat products, fish, fruits, vegetables, milk and dairy products, and beverages (Table 1). A score of 1 is given if the food group is consumed daily or at least twice a week and 0 for other responses. The possible score range is 0-37 with a higher score indicating a more diverse diet.

Height, weight, and, waist circumference were measured using SECA body meter, Tanita weighing scale, and SECA measuring tape, respectively. Each measurement was taken twice and the average was used for analysis. Classifications for Body Mass Index (BMI) and waist circumference (WC) were according to WHO (1995) and IOTF/WHO/IASO (2000), respectively. The BMI categories used were < 18.5 (underweight), 18.5 – 24.9 (normal weight), 25.0 – 29.9 (overweight) and ≥ 30 (obesity). At risk waist circumference was defined as $WC \geq 90$ cm and $WC \geq 80$ cm for men and women, respectively.

Prior to data collection, ethics approval was obtained from the Medical Research Ethics committee of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Permission to conduct this study on Orang Asli was also obtained from the Department of Orang Asli Affairs and Department of Wildlife and National Parks, Peninsular Malaysia. Before the respondents were interviewed, informed consent (initialised consent form) was obtained from each of them.

Data were analysed using Statistical Package for Social Science (SPSS) version 13.0. All data are presented descriptively as mean, standard deviation, and frequency. Pearson's correlations and point bi-serial

Table 1. Major food groups, food groups and examples

<i>Major food groups</i>	<i>Food groups</i>	<i>Examples</i>
Cereals and cereal products	Cereals	Rice, porridge, hill paddy, Glutinous rice
	Breads and buns	White bread and cream Bread
	Cereal products	Kueh teow, mee hoon, Yellow mee
	Flour products	<i>roti canai</i> , <i>jemput-jemput</i>
	Potatoes and tubers	Sweet potatoes, potatoes, Yam, tapioca
	Cereal breakfast	mixed cereals, ready to eat cereals (nestum, oats)
	Malay pancake	<i>lempeng</i>
Meat and meat products	Meat	Mutton, beef, pork
	Birds	Duck, chicken
	Large mammals	Monkey, deer
	Reptiles, amphibians	Tortoise, frog and snake
	Rodents	Porcupine, squirrel
	Eggs	Preserved egg, duck egg, Chicken egg
	Internal organs	lung, liver, lymph, gall bladder
	Processed meats	burger, sausage, hotdog, nugget
Fish/ seafoods	Fresh water fish	<i>Ikan haruan</i> , <i>ikan keli</i>
	Salt water fish	<i>Ikan kembong</i>
	Seafoods	crab, prawn, squid
	Salted fish/ canned fish	anchovy, sardine
Fruits	Seed fruits	Watermelon, honeydew
	Citrus	Orange
	Wild fruits	<i>Malong</i> , <i>kejijak</i> , <i>taban</i> , <i>tampoi</i>
	Non seasonal fruits	Pineapple, papaya, guava
	Seasonal fruits	durian, sapodilla, mangosteen, rambutan
	Non local fruits	Apple, orange, grape
	Fruit juices	Lime, watermelon
Vegetables	Green vegetables	Swamp cabbage, mustard green, spinach, salad
	Cabbage	cabbage, broccoli, cauliflower
	Beans	French bean, long bean, okra, drumstick

Table 1. Continued

Major food groups	Food groups	Examples
	Red/ orange vegetables Pumpkin/ cucumber	carrot, chilli, tomato pumpkin, bitter gourd, Cucumber, eggplant
	Seeds	<i>Petai, kerdas,</i> <i>hentau</i>
	Fungi Shoots	Fresh/dried mushroom Tapioca shoot, <i>pucuk</i> <i>paku, pucuk cemperai</i>
Milk and milk products	Fresh milk	goat milk, cow milk, powdered milk, Ultra heat treated (UHT) milk
	Other milk	Sweetened condensed milk, evaporated milk
Beverages	Malted drinks Other drinks	Milo, Horlicks, Ovaltine coffee/ tea

Hentau (Archidendron jiringa); Ikan haruan(Channa striata); Ikan keli (Clarias batrachus);Ikan kembong(Rastrelliger kanagurta);Kerdas (Archidendron microcarpum); Malong(Aporosa nervosa); Petai (Parkia speciosa);Pucuk cemperai (Champerea manillana);Pucuk paku (Diplazium esculentum);Taban (Microcos antidesmifolia);Tampoi(Baccaurea griffithii); Durian (Durio zibethinus); Rambutan (Nephelium lappaceum)

were used to determine the associations between socio-demographic factors with dietary diversity and nutritional status. A statistical probability of less than 0.05 ($p < 0.05$) was considered as significant.

RESULTS

Fifty-seven subjects participated in this study with 29 (50.9%) being men and 28 (49.1%) women (Table 2). The mean age of the subjects was 36.84 ± 16.75 years with nearly half in the age range of 16-30 years old. As the majority (89.5%) of Che Wong did not have any formal schooling, the mean years of education was only 0.19 ± 0.64 years. All the women were housewives, while most of the men collect forest resources, cultivate 'hill paddy' or work as rubber tappers; very few of them employed in the government sector. The median household income was RM 200 with 79.3% (n=23) of the households earning below RM500. Using the Poverty

Line Income (PLI) in Peninsular Malaysia as RM543 per month for a household size of 4.6 persons or per capita income of RM 118.04 (EPU, 2007), 68.4% of the Che Wong households could be classified as hardcore poor and 21.1% poor.

The nutritional status of men and women is shown in Table 3. The mean Body Mass Index (BMI) was 21.83 ± 3.40 kg/m² for men and 21.31 ± 4.05 kg/m² for women. For men, about 13.8% of the sample were underweight, 72.4% normal, 10.3% overweight and 3.3% were obese men. For women, 25.0%, 46.4%, and 28.6% were underweight, normal and overweight, respectively. About 19.3% of Che Wong adults were underweight while 21.1% were overweight and obese with more women (28.6%) than men (13.6%) being overweight and obese. The mean waist circumference for men and women was 74.4 ± 6.09 cm and 73.92 ± 6.80 cm, respectively. While none of the men had at-risk waist circumference

Table 2. Sample characteristics (n=57)

Variable	Men (n=29)		Women (n=28)		All respondents	
	n (%)	M ± SD	n (%)	M ± SD	n (%)	M ± SD
Age (years)		39.9 ± 17.09		33.7 ± 16.08		36.84 ± 16.75
16-30	10 (34.5)		17 (60.7)		27 (47.4)	
31-50	13 (44.8)		6 (21.4)		19 (33.3)	
>51	6 (20.7)		5 (17.9)		11 (19.3)	
Years of education		0.14 ± 0.58		0.25 ± 0.70		0.19 ± 0.64
No formal schooling	27 (93.1)		24 (85.7)		51 (89.5)	
Primary	2 (6.9)		4 (14.3)		6 (10.5)	
Employment status						
Work	29 (100.0)		0(0)		29 (100.0)	
Did not work	0(0)		28 (100.0)		28 (100.0)	
Household income (RM)						264.74+253.22
RM 10.00- RM499.90	23 (79.3)		-		(Median – RM200)	
≥ RM500.00	9 (20.7)		-		23 (79.3)	
Income per capita (RM)					9 (20.7)	
< 59.00 ^a	-		-		(Median – RM 25)	
59.00-118.04 ^b	-		-		49.35 ± 47.71	
> 118.04	-		-		39 (68.4)	
					12 (21.1)	
					6 (10.4)	

^a Hard core poor; ^b Poor (Malaysia and Economic Planning Unit (EPU, 2007)

Table 3. Nutritional status of Che Wong men and women

Characteristics	Men (n=29)		Women (n=28)		All respondents	
	n (%)	M ± SD	n (%)	M ± SD	n (%)	M ± SD
Weight (kg)	29 (100)	55.51 ± 8.32	28 (100)	47.85 ± 9.73	57 (100)	51.95 ± 9.84
Height (m)	29 (100)	1.63 ± 0.07	28 (100)	1.50 ± 0.07	57 (100)	1.50 ± 0.07
Body mass index (kg/m ²)		21.83 ± 3.40		21.31 ± 4.05		21.57 ± 3.70
<18.5 (Underweight)	4 (13.8)		7 (25.0)		11 (19.3)	
18.5-24.9 (Normal)	21 (72.4)		13 (46.4)		34 (59.6)	
25.0-29.9 (Overweight)	3 (10.3)		8 (28.6)		11 (19.3)	
≥30.0 (Obese)	1 (3.3)		0 (0.0)		1 (1.8)	
Waist circumference* (cm)		74.40 ± 6.09		73.92 ± 6.80		74.18 ± 6.40
No risk	29 (100.0)		22 (78.6)		51 (89.5)	
At risk	0 (0)		6 (21.4)		6 (10.5)	

* At-risk waist circumference - men ≥90cm and women ≥80 cm (IOTF/ WHO/ IASO, 2000)

Table 4. Dietary diversity score of Che Wong men and women

Food group	Range	Men	Women	Total
		(n=29)	(n=28)	
		← M ± SD →		
Grains and cereals	1-5	2.62 ± 4.11	2.50 ± 1.26	2.56 ± 1.23
Meat/meat products	0-5	1.21 ± 1.35	1.04 ± 1.17	1.12 ± 1.25
Fish	0-4	1.45 ± 1.09	1.21 ± 1.10	1.33 ± 1.09
Fruits	0-2	0.48 ± 0.63	0.54 ± 0.69	0.51 ± 0.66
Vegetables	0-5	1.90 ± 1.32	2.29 ± 1.76	2.09 ± 1.55
Milk and dairy products	0-2	1.20 ± 0.64	0.64 ± 0.62	0.63 ± 0.62
Beverages	0-2	0.60 ± 0.62	1.25 ± 0.59	1.25 ± 0.61
Total score	4-18	9.48 ± 3.70	9.46 ± 4.63	9.47 ± 4.15

^a Minimum and maximum score for each food group – Grains and cereals (0-6); Meat and meat products (0-8); Fish (0-4); Fruits (0-7);Vegetables (0-8); Milk and dairy products (0-2); Beverages (0-2)

(≥ 90 cm), 21.4% of women had at-risk waist-circumference of ≥ 80 cm.

Table 4 demonstrates the dietary diversity score of Che Wong men and women. The mean score for dietary diversity was 9.47 ± 4.15 with men (9.48 ± 3.70) and women (9.46 ± 4.63) having a similar score. Men consumed more milk and milk products (1.2 ± 0.64) as compared to women (0.64 ± 0.62) whereas the women consumed more vegetables (2.29 ± 1.76) and beverages (tea, coffee and Milo (1.25 ± 0.59) than men (1.90 ± 1.32 and 0.60 ± 0.62, respectively). The Che Wong adults, especially men, prefer to add sweetened condensed milk or evaporated milk into beverages. Consumption of ultra heat treated (UHT) milk, powdered and fresh milk is very rare in this community. In general, the diet of the Che Wong was less diverse as indicated by the limited number of food groups consumed within each major food group. The major food groups with the most limited number of sub-food groups were fruits, vegetables and meat/meat products.

The associations between socio-demography and dietary diversity score (DDS) with nutritional status (body mass index and waist circumference) are shown in Tables 5 and 6. There was a significant association between household income and

waist circumference of the Che Wong adults ($r = 0.36, p < 0.01$); however the significant association was only observed for women ($r = 0.50, p < 0.01$). Although income per capita was not significantly associated with waist circumference of either men or women, it was found to be significantly associated with waist circumference of the total sample ($r = 0.32, p < 0.05$).

DISCUSSION

While more than half of the adults had normal weight (59.7%), both underweight (19.3%) and overweight or obesity (21.1%) exist in this Che Wong community. In an earlier study among Jakun women in Pahang, 35.7% were underweight, 7.1% were overweight and 14.3% were obese (Lim & Chee, 1998). Similarly, among Jahai and Temiar adults in Lembah Belum Grik, while underweight still prevailed (26.7%), 10.1% were either overweight or obese (Hayati *et al.*, 2007). Although numerous studies have reported a high prevalence of undernutrition in Orang Asli women and children (Khor, 1988; Osman & Zaleha, 1995; Lim & Chee, 1998), the findings of this present study as well as several other studies (Lim & Chee, 1998; Wendy, 2004; Hayati *et al.*, 2007) tend to support overweight and obesity as a rising

Table 5. Correlation between socio-demography and dietary diversity score (DDS), Body Mass Index (BMI) and Waist Circumference (WC)

Variables	BMI			WC			DDS		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Age ^a	-0.29	0.02	-0.11	-0.23	0.12	-0.05	0.005	-0.17	-0.09
Years of education ^a	-0.30	0.07	-0.09	-0.11	0.09	0.03	0.101	0.10	0.11
Household income ^a	0.10	0.17	0.14	0.21	0.50**	0.36**	-1.24	0.21	0.06
Income per capita ^a	0.11	0.13	0.12	0.28	0.37	0.32*	-0.11	0.23	0.08
Occupation ^b	-	-	0.07	-	-	0.04	-	-	0.00
DDS ^a	0.05	-0.01	0.02	0.08	0.09	0.08	1.00	1.00	1.00

** p < 0.01, * p < 0.05

^a Pearson correlation ^bPoint bi-serial correlation

Table 6. Correlation^a between Body Mass Index (BMI) and Waist Circumference (WC)

Variables	Body Mass Index		
	Men	Women	Total
Waist circumference	0.56*	0.75*	0.67*

* p < 0.01

^a Pearson correlation

nutritional concern in the Orang Asli adult population.

This study also found that the proportion of underweight was similar to overweight with more women (25.0%) than men (13.8%) being underweight. Dietary intake with insufficient energy and nutrients as well as a moderately active lifestyle could explain the relatively high prevalence of underweight among the Orang Asli (Osman & Zaleha, 1995; Lim & Chee, 1998). Worldwide, studies have reported that although prevalence of overweight and obesity are on the rise among indigenous peoples, underweight is still prevalent in some indigenous groups. Among the Savar tribes in India, 38% of men and 49% of the women were underweight (Bose *et al.*, 2006). Wang, Hoy & McDonald (2000) reported that 14% men and 18% women of Australian

aborigines in Tiwi Island were underweight. Although overweight and obesity were prevalent in Taiwanese indigenous groups, 0.6% and 5.9% of the men and women were underweight, respectively (Ho & Tsai, 2007). Underweight among indigenous peoples is associated with poor housing environment, low educational achievement, unemployment, inadequate incomes and overcrowded living conditions (Durie, 2003). Besides increased mortality risk, underweight can contribute to increased risk of women having pre-term births and infants with low birth weights and adults with poor psychological health, lower work capacity and limited social activity (Flegal *et al.*, 2005; Khan & Kraemer, 2009).

Globally, the indigenous people are being affected by rapid epidemiological and socio-economic transition. These transitions

have led to increasing prevalence of lifestyle and diet-related chronic diseases such as obesity, hypertension, diabetes mellitus and cardiovascular diseases in this indigenous population (Durie, 2003). In Canada (Vanasse *et al.*, 2006) and Taiwan (Ho & Tsai, 2007), the proportion of obese indigenous peoples (BMI \geq 30) was estimated at 48% and 25%, respectively. Among the indigenous groups in Siberia, 21.7% were overweight and 9.8% were obese (Snodgrass *et al.*, 2006). Lourenco *et al.* (2008) reported a higher proportion of overweight (42.3%) and obesity (18.2%) among the Surui' Indians in Brazil. There are challenges to address obesity and its related chronic diseases in the indigenous population as the etiologies and required preventive strategies may be far different from those observed in the non-indigenous populations (Ring & Brown, 2003). Socio-economic deprivation, genetic susceptibility to diseases, lack of resource control and political discrimination are important considerations in efforts to address the current health and nutritional status of the indigenous people (Durie, 2003).

In indigenous populations, there is evidence that more women are overweight and obese than men. Among the indigenous Siberians, the prevalence of obesity in women (12%) was higher than that (7%) of men (Snodgrass *et al.*, 2006). Risica *et al.* (2000) reported that in Alaskan indigenous groups, more women (61%) were overweight and obese than men (51%). Similarly, we found that overweight was more prevalent among Che Wong women (28.6%) than men (10.8%). The Third National Health and Morbidity Survey (2006) of Malaysia has reported that slightly more males (29.7%) were overweight than females (28.6%), whereas more females (17.5%) than males (10.2%) were obese. Although the proportions of overweight and obesity in Che Wong women or women of other Orang Asli tribes was lower compared to the proportions reported in other ethnic groups (Malay, Chinese, Indian), there is a high

possibility that the proportions could increase to similar proportions observed in the mainstream population if efforts are not adequately directed to address this nutritional problem. Further clarification on gender differences in overweight and obesity will require further examination into genetic, behavioural and environmental factors in the Orang Asli population.

Abdominal obesity is a risk factor for hypertension, dyslipidemia, diabetes mellitus and metabolic syndrome, even among adults with normal BMI (Janssen, Katmarzyk & Ross, 2002). While none of the Che Wong men had at-risk waist circumference, 21.4% of the women had excess abdominal fat. Shasikala (2004) also reported a similar finding in that 21.7% of Orang Asli women in Sepang had at-risk waist circumference. In contrast, Hayati *et al.*, (2007) found that none of the Orang Asli men and women was at risk of abdominal obesity although they were overweight and obese. However, we further showed that waist circumference was significantly associated with BMI in both Che Wong men ($r=0.56$, $p<0.05$) and women ($r=0.75$, $p<0.05$), indicating that those with high BMI had also increased waist circumference. With excess body weight and intra-abdominal fat distribution, the Che Wong men and women could be at risk of diet-related chronic diseases.

Overall, the score for dietary diversity was very poor indicating lack of variety in food consumption. The main sources of carbohydrate for Che Wong were rice, tapioca, yam and sweet potato and wheat flour. Sweet biscuits (e.g. Mary biscuit) and cream crackers were also frequently consumed as they are less expensive. Breads, margarine and potatoes are only eaten if there is an opportunity to shop in towns. The main protein source is fish which is usually obtained from the nearby rivers. Anchovies were usually purchased and often cooked with chillies or vegetables. Che Wong also hunts wild boar, deer, and lizard

as meat sources. They rarely consumed chicken and beef sold in the market due to the prices. Fruits were infrequently consumed as most of the available fruits in the area were seasonal or because of the high fruit prices for both local and imported fruits at the markets. The most frequently eaten fruits were papaya and banana as these are non-seasonal fruits and grown in their backyards. The daily consumption of vegetables among Che Wong included shoots (cemperai, fern, sweet potatoes, and tapioca), mustard leaves, swamp cabbage and ulam (*petai, jering*) which were locally grown or gathered in the forest. Sweetened condensed milk or evaporated milk is mixed with coffee, tea and malted beverages were taken during breakfast or tea time. Generally, Malaysians tend to consume milk in the form of sweetened condensed milk which is added in hot beverages (Norimah *et al.*, 2008). The poor diet quality among the Orang Asli could be due to lack of food availability and accessibility as well as cultural practices that are limiting their food choices.

In this study, a significant correlation was found between household income and waist circumference among Che Wong women only. Chen & Pedoe, (2004) showed that socio-economic characteristics (e.g. household income) were significantly related to women's waist circumference because when women have their own income, they are perceived to have equal economic contribution as men to the households. Thus, they are more likely favoured in terms of food allocation and this could enhance their nutritional status (Wei *et al.*, 2001). Although all of the Che Wong women were housewives, they also cultivate vegetables and sell to vendors. Perhaps with this additional income, they are able to have better diet and consequently improved nutritional status. However, if the diets of the women are energy dense and they are less physically active, they could be at risk of weight gain and abdominal adiposity.

There are several limitations to this study that need to be highlighted which may have an impact on the study findings. First, as this was a cross-sectional survey, it was not able to determine the direction of the association between socio-demography and dietary diversity as well as nutritional status. In addition, there are many other factors that may be associated with nutritional status but were not investigated in this study. Second, this study was only conducted among the Che Wong tribe and involved only a small number of Che Wong adults. Thus, the findings of this study may not be representative of the Che Wong population and other Orang Asli tribes. Third, as a translator facilitated the interviews, the information obtained was highly dependent on the ability and skill of the translator to convey the right messages to the researchers and respondents. The translator might interpret the information wrongly or researchers might record the information incorrectly. Also, the accuracy of the information obtained depended on the understanding and interpretation of the respondents; there is the possibility that they might understand and interpret the interview questions differently.

CONCLUSION

Regardless of the limitations, this study has been able to provide insights into the nutritional status of Che Wong adults undergoing nutrition transition. The findings warrant the attention of other researchers and health professionals to investigate the prevalence, distribution and risk factors of overweight and obesity in Orang Asli community. As evidence indicates that indigenous peoples are at higher risk of both communicable and non-communicable diseases, efforts should be undertaken to address the double burden of diseases in Orang Asli of Peninsular Malaysia.

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