

TRENDS IN OBESITY AND ABDOMINAL OBESITY AMONG MALAYSIAN ADULTS: FINDINGS FROM THE NATIONAL HEALTH AND MORBIDITY SURVEYS OF 2006, 2011 AND 2015

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Abstract. The prevalence of obesity has increased dramatically and is now a global public health concern. This study examined trends in mean body mass index (BMI), mean waist circumference (WC) and prevalence of overweight, obesity and abdominal obesity (AO) among Malaysian adults obtained from the National Health and Morbidity Surveys (NHMS) in 2006, 2011 and 2015. These cross-sectional population based survey applied a two-stage stratified sampling design provided data on household members aged 18 years and above. Face-to-face interviewed and anthropometric measurements, including weight, height and waist circumference (WC) were collected. Age-adjusted mean BMI is significantly increased from 24.6 kg/m² in 2006 to 25.7 kg/m² in 2015 ($p < 0.001$), while age-adjusted mean WC increased from 81.9 cm to 85.7 cm during the same period of time. Prevalence of overweight significantly increases from 28.3% to 31.3% ($p < 0.001$), that of obesity from 13.2% to 19.1% ($p < 0.001$) and that of AO, the largest, from 39.1% to 51.0% ($p < 0.001$). The prevalence of obesity and, in particular, abdominal obesity among Malaysian adults has increased in all age groups over the past 10 years. Thus, there is an urgent need to determine the factors associated with obesity and abdominal obesity towards developing a national program to prevent deleterious obesity-related health outcomes.

Keywords: abdominal obesity, national survey, obesity, overweight, waist circumference, Malaysia

INTRODUCTION

Obesity and abdominal obesity are justifiably a global public health concern,

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and are an important risk factors for many metabolic syndromes. Abdominal obesity as measured by waist circumference (WC) appears to be more strongly correlated than body mass index (BMI) with high morbidity and mortality and increased risk of cardiovascular disease (CVD) and diabetes mellitus (Lee *et al*, 2008; Casanueva *et al*, 2010). The rise in prevalence of obesity and abdominal obesity (AO) among adults has been reported worldwide (Ladabaum *et al*, 2014; Twells

et al, 2014). Global estimates by the World Health Organization in 2014 reported more than 1.9 billion overweight adults aged 18 years old and above, with over 600 million obese adults (WHO, 2016).

Data from the US National Health and Nutrition Examination Survey (NHANES) showed an increase in obesity from 30.2% to 33.6% and AO prevalence from 46.9% to 52.9% in 1999-2000 to 2007-2008 among American adults aged 20 years and above (Ford *et al*, 2010). Similarly, such increases have been reported in European countries (Howel, 2011; Gutiérrez-Fisac *et al*, 2012). In middle income countries, lifestyle changes concomitant with rapid socioeconomic transition have contributed to increase in obesity prevalence (Ramachandran *et al*, 2012). Although the nutritional status of middle income populations has improved generally with economic growth and social development, there has also been an increased reliance on processed foods, greater use of edible oils and sugar-sweetened beverages and wide availability of fast foods, all of which lead to energy overconsumption (Swinburn *et al*, 2011; Khor, 2012). In the developing world, increases have also been reported, with dramatic increases in prevalence of overweight and obesity in Asian countries. For instance, in China obesity prevalence rose from 4.0% in 1993 to 10.7% in 2009, with an even higher increase in AO from 18.6% to 37.4% in the same period (Xi *et al*, 2012).

This global nutrition transition seems to be the major cause of the obesity epidemic. Other factors that have been identified to be associated with obesity epidemic are genetics, dietary behavior, physical inactivity, and environment (Malik *et al*, 2013). The magnitude is diverse among developing countries, influenced by their different stages of development (Ramachandran and Snehalatha, 2010).

A previous review on trends in overweight and obese adults in Malaysia from 1996 to 2006 showed overweight prevalence has increased from 20.7% to 29.1% and an even larger increase in obesity level, 5.5% to 14.0%, with women having a greater risk for both compared to men (Khambalia and Seen, 2010). This study examined the latest trends in mean body mass index (BMI), mean waist circumference (WC) and prevalence of overweight, obesity and AO among Malaysian adults from 2006 to 2015.

MATERIALS AND METHODS

Study design

We obtained data from the 2006, 2011 and 2015 cycle of the National and Health Morbidity Survey (NHMS), a nationwide cross-sectional survey conducted at periodic intervals to measure and assess the health status and health care services in Malaysia. The nationally representative samples were selected using a two-stage stratified sampling method. Respondents were interviewed at home using structured questionnaires based on the scope of the survey and underwent anthropometry measurement and provided voluntarily a blood sample. Additional details of the methodology of this study have been published elsewhere (IPH, 2008; *ibid*, 2011; *ibid*, 2015). Secondary data from NHMS 2006, 2011 and 2015 were used in this study with response rate of 90.0%, 88.2% and 86.4% in 2006, 2011 and 2015, respectively. Only non-institutionalized respondents aged 18 years old and above and non-pregnant women were included in the analysis.

The studies were approved by Medical Research and Ethics Committee, Ministry of Health, Malaysia (NHMS 2006;P42-251-17000-00500), (NHMS 2011; NMRR 10-757-6837), (NHMS 2015; NMRR 14-1064-21877).

All respondents were provided with written study information sheet and informed consent form prior to enrolment.

Anthropometric measurements

Measurements of body weight (using a Tanita Personal scale HD 319 (Tanita, Tokyo, Japan) to the nearest 0.1 kg wearing light weight clothing), body height (using a SECA measuring tape 206 (SECA, Hamburg, Germany) in NHMS 2006 and 2011, and SECA Stadiometer 213 in NHMS 2015 to the nearest 0.1 cm) and WC were conducted by trained data collectors. Tools were calibrated and validated before data collection. Body mass index (BMI) is calculated as weight (kg)/height (m)². Overweight and obesity is defined as BMI ≥ 25 - 29.9 kg/m², and ≥ 30 kg/m², respectively (WHO, 1998). WC was measured using SECA 201 measuring tape to the nearest 0.1 cm at the bottom of the rib cage and the top of the lateral border of the iliac crest during minimal aspiration. AO is defined as WC >90 cm for men and >80 cm for women (IDF, 2006). All measurements were taken in duplicate and the average value was used for data analysis.

Statistical analysis

Complex sample analysis was employed to determine trends with time of mean BMI and WC and prevalence of overweight, obesity and AO from 2006 to 2015. Age was standardized using the standard population estimated in the 2015 Malaysian Census population (DOSM, 2017). All data were analyzed using IBM SPSS software package version 22.0 (IBM, Armonk, NY). All tests for statistical significant are two-tailed and a $p < 0.05$ is considered significant.

among Malaysian adult men and women in the 10-year study period ($p < 0.001$) (Table 1). Age-adjusted mean BMI and WC is significantly increased from 24.6 kg/m² and 81.9 cm in 2006 to 25.7 kg/m² and 85.7 cm in 2015, respectively ($p < 0.001$). The increase over time in age-adjusted mean BMI is significantly higher in women (1.2 kg/m²) than men (1.0 kg/m²) ($p < 0.001$) (Fig 1). On the other hand, the increase in age-adjusted mean WC is significantly greater among men than women (4.3 cm in 2006 and 3.4 cm in 2015; $p < 0.001$), but with a decreasing trend with time (Fig 2). When the data were stratified by age group and locality, individuals 18-39 years of age living in rural compared to urban areas had the highest increase in mean BMI and WC values compared to other age groups.

There are significant increases in overweight, obesity and AO in men and women ($p < 0.001$) from 2006 to 2015 (Table 2). Overall prevalence of overweight increased by 3.0% and obesity by 5.9%. The prevalence of overweight increased by 3.5% among men and 2.4% among women, but was comparable for obesity (5.9% and 6.0%, respectively). In the past 10 years, age-adjusted overall prevalence of AO has a significant trend to increase, from 39.1% in 2006 to 51.0% in 2015 ($p < 0.001$), with men displaying an increment from 31.3% to 40.5% ($p < 0.001$) and women from 47.2% to 62.1% ($p < 0.001$). The prevalence of AO increased the most among males aged 60 years old and above and among women aged 18 to 39 years old. Those living in rural areas showed the largest increment in AO prevalence (23.5% to 24.9%) than those in urban areas (24.5% to 25.5%).

RESULTS

There is a significant linear increase in age-adjusted mean BMI and WC values

DISCUSSION

The results of this trend analysis reveal significant increments in mean BMI

Table 1
Age-adjusted mean body mass index and waist circumference among Malaysian adults.

	2006		2011		2015		<i>p</i> -value	Change
	<i>n</i>	Mean (SE)	<i>n</i>	Mean (SE)	<i>n</i>	Mean (SE)		
Body mass index (kg/m²)								
National	33,055	24.6 (0.0)	16,810	25.1 (0.1)	18,499	25.7 (0.1)	<0.001	1.1
Men								
Overall	15,092	24.3 (0.1)	8,030	24.8 (0.1)	8,918	25.3 (0.1)	<0.001	1.0
Age group (years)								
18 - 39	7,188	23.7 (0.1)	3,933	24.4 (0.1)	4,126	25.0 (0.1)	<0.001	1.3
40 - 59	5,740	25.4 (0.1)	2,967	25.7 (0.1)	3,188	26.2 (0.1)	<0.001	0.8
≥60	2,164	23.9 (0.1)	1,130	24.5 (0.1)	1,604	25.0 (0.1)	<0.001	1.1
Locality								
Urban	8,661	24.5 (0.1)	4,583	25.0 (0.1)	5,131	25.5 (0.1)	<0.001	1.0
Rural	6,431	23.5 (0.1)	3,447	24.3 (0.1)	3,787	24.9 (0.1)	<0.001	1.4
Women								
Overall	17,963	24.9 (0.1)	8,780	25.4 (0.1)	9,581	26.1 (0.1)	<0.001	1.2
Age group (years)								
18 - 39	8,473	24.1 (0.1)	4,028	24.6 (0.1)	4,047	25.5 (0.1)	<0.001	1.4
40 - 59	7,023	26.5 (0.1)	3,514	26.8 (0.1)	3,732	27.3 (0.1)	<0.001	0.8
≥60	2,468	24.7 (0.1)	1,238	25.2 (0.2)	1,802	26.1 (0.2)	<0.001	1.4
Locality								
Urban	10,917	24.9 (0.1)	5,210	25.3 (0.1)	5,510	26.0 (0.1)	<0.001	1.1
Rural	7,046	25.1 (0.1)	3,570	25.6 (0.1)	4,071	26.5 (0.1)	<0.001	1.4
Waist circumference (cm)								
National	32,900	81.9 (0.1)	16,371	84.2 (0.2)	18,435	85.7 (0.2)	<0.001	3.8
Men								
Overall	15,092	83.9 (0.2)	7,811	86.1 (0.2)	8,894	87.3 (0.2)	<0.001	3.4
Age group (years)								
18 - 39	7,176	81.2 (0.2)	3,808	84.0 (0.3)	4,102	85.1 (0.3)	<0.001	3.9
40 - 59	5,724	87.8 (0.2)	2,856	89.2 (0.3)	3,186	90.2 (0.2)	<0.001	2.4
≥60	2,139	86.3 (0.3)	1,147	88.2 (0.4)	1,606	89.8 (0.3)	<0.001	3.5
Locality								
Urban	8,630	84.8 (0.2)	4,469	86.7 (0.3)	5,118	87.8 (0.3)	<0.001	3.0
Rural	6,401	81.1 (0.2)	3,342	84.2 (0.4)	3,776	85.8 (0.3)	<0.001	4.7
Women								
Overall	17,861	79.8 (0.1)	8,560	82.1 (0.3)	9,541	84.1 (0.2)	<0.001	4.3
Age group (years)								
18 - 39	8,409	76.5 (0.2)	3,885	78.9 (0.3)	4,021	81.3 (0.3)	<0.001	4.8
40 - 59	7,008	84.0 (0.2)	3,398	86.3 (0.3)	3,717	87.2 (0.2)	<0.001	3.2
≥60	2,444	83.3 (0.3)	1,277	85.4 (0.4)	1,803	88.0 (0.4)	<0.001	4.7
Locality								
Urban	10,864	79.8 (0.2)	5,074	82.2 (0.3)	5,480	83.8 (0.2)	<0.001	4.0
Rural	6,997	79.6 (0.2)	3,486	82.5 (0.4)	4,061	84.7 (0.3)	<0.001	5.1

SE, standard error.

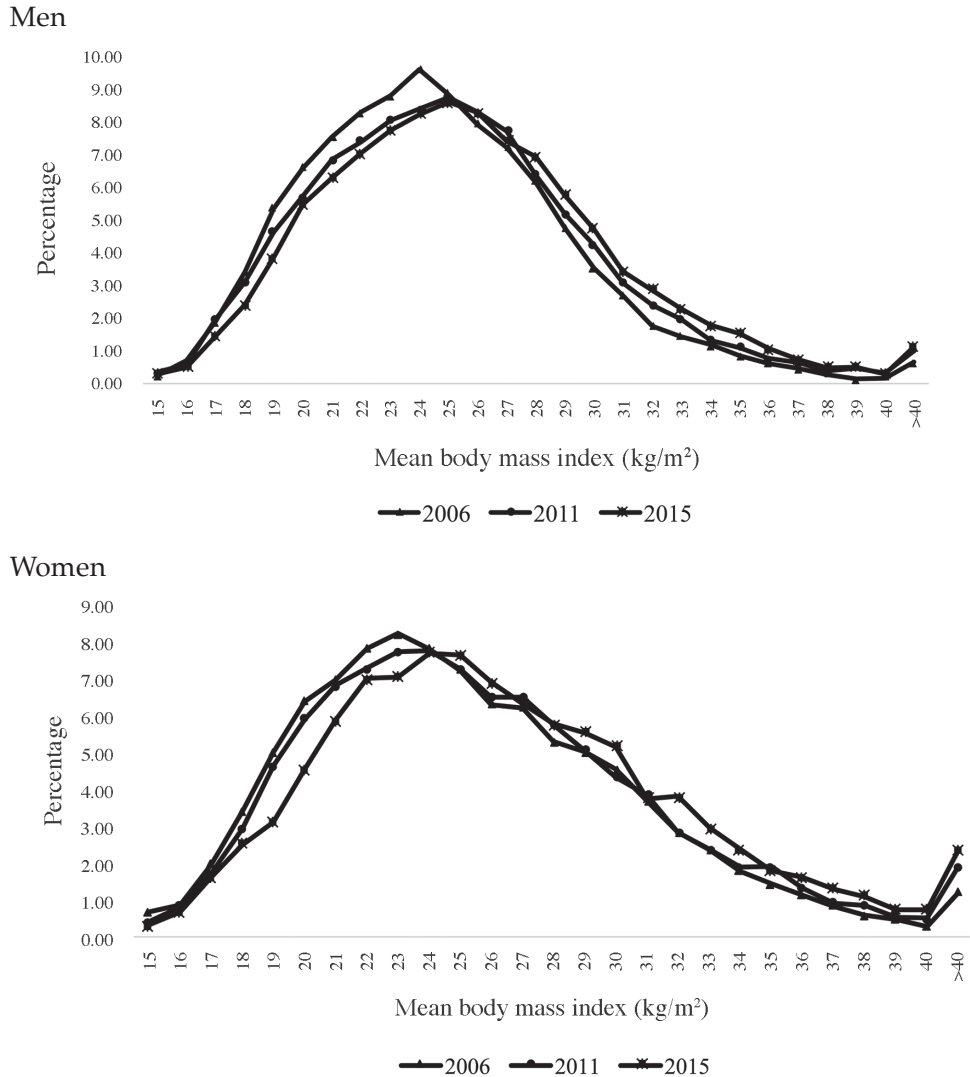


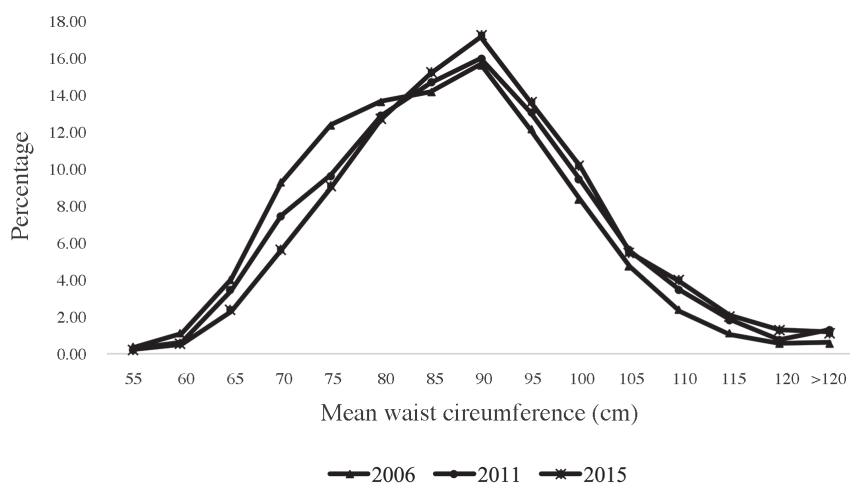
Fig 1-Distribution of mean body mass index among Malaysian men and women in 2006, 2011 and 2015.

and WC, and correspondingly, in the prevalence of overweight, obesity and AO among Malaysian adults between 2006 and 2015. Our analysis provides evidence of continued increases of these parameters since the previous study of 2006 with no signs of levelling among Malaysian adults. In addition, highest increment in mean BMI and WC, prevalence of obesity and AO were seen in women and the test

population residing in rural areas, the latter also having the highest increase in overweight prevalence. The highest increment in prevalence of overweight also was found among men and the older age groups.

A recent study involving 1,698 population-based data sources from 186 countries from 1975 to 2014 reported global age-standardized mean BMI has increased by 2.5

Men



Women

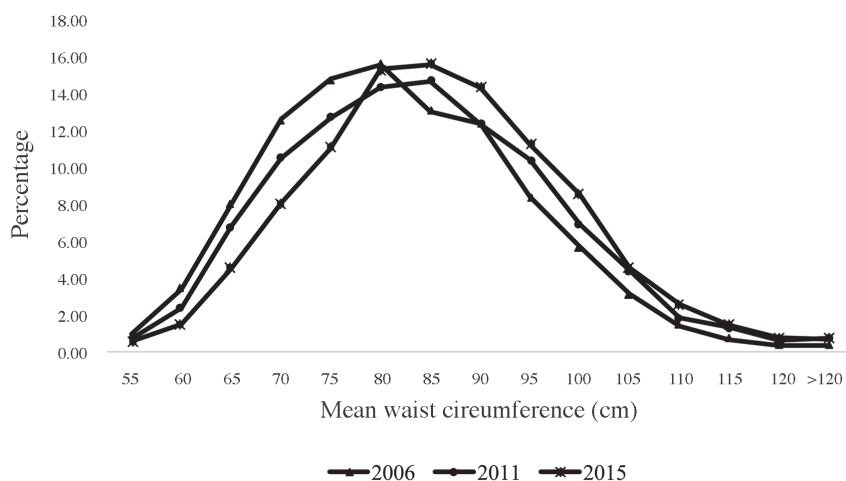


Fig 2-Distribution of mean waist circumference among Malaysian men and women in 2006, 2011 and 2015.

kg/m² among men and 2.3 kg/m² among women (NCD Rick Factor Collaboration, 2016). Furthermore, a computed average increase per decade is 0.63 kg/m² for men and 0.59 kg/m² for women (Finucane *et al*, 2011). Our results for one decade were markedly higher in comparison. The average increase in age-adjusted BMI value was also higher than that (0.95 kg/m²) reported

in Thailand (Aekplakorn *et al*, 2014). However, the increments for Malaysia were lower than data from the US NHANES between 1988 - 1994 and 2005 - 2006 showing an average BMI and WC increase of 1.8 kg/m² and 4.7 cm, respectively after adjusting for sex, age, race-ethnicity, and education (Walls *et al*, 2011).

Our finding on increasing obesity

Table 2
Age-adjusted prevalence of overweight, obesity and abdominal obesity among Malaysian adults.

	2006		2011		2015		p-value	Change
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)		
Overweight								
National	9,554	28.3 (27.8-28.9)	5,149	29.9 (29.1-30.7)	5,950	31.3 (30.5-32.1)	<0.001	3.0
Men								
Overall	4,405	29.3 (28.3-30.2)	2,536	31.6 (30.4-32.7)	2,952	32.8 (31.7-33.9)	<0.001	3.5
Age group (years)								
18 - 39	1,667	24.2 (23.1-25.4)	1,039	26.9 (25.4-28.4)	1,130	27.9 (26.4-29.4)	<0.001	3.7
40 - 59	2,117	38.1 (36.7-39.4)	1,137	39.5 (37.5-41.6)	1,263	40.3 (38.5-42.1)	<0.001	2.2
≥60	621	30.8 (28.6-33.1)	360	33.2 (30.1-36.4)	559	36.7 (34.0-39.4)	<0.001	5.9
Locality								
Urban	2,764	31.0 (29.9-32.1)	1,519	32.6 (31.2-34.6)	1,782	33.8 (32.5-35.3)	<0.001	2.8
Rural	1,641	24.3 (23.2-25.5)	1,017	28.5 (26.8-30.3)	1,170	29.7 (28.0-31.4)	<0.001	5.4
Women								
Overall	5,149	27.3 (26.6-28.0)	2,613	28.1 (27.0-29.2)	2,998	29.7 (28.7-30.7)	<0.001	2.4
Age group (years)								
18 - 39	1,840	21.3 (20.4-22.3)	927	22.9 (21.4-24.4)	973	24.2 (22.8-25.6)	<0.001	2.9
40 - 59	2,572	36.1 (34.9-37.3)	1,288	35.6 (34.0-37.3)	1,410	37.6 (35.9-39.3)	<0.001	1.5
≥60	737	31.3 (29.4-33.3)	398	32.0 (29.2-34.9)	615	33.8 (31.4-36.4)	<0.001	2.5
Locality								
Urban	3,019	26.8 (25.9-27.7)	1,472	27.4 (26.1-28.7)	1,699	29.6 (28.3-30.8)	<0.001	2.8
Rural	2,130	28.9 (27.8-30.0)	1,141	30.3 (28.8-31.9)	1,299	30.0 (28.5-31.5)	<0.001	1.1
Obesity								
National	4,608	13.2 (12.8-13.7)	2,750	16.0 (15.3-16.8)	3,646	19.1 (18.4-19.9)	<0.001	5.9

Table 2 (Continued)

	2006		2011		2015		p-value	Change
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)		
Men								
Overall	1,488	10.1 (9.5-10.7)	1,021	13.3 (12.4-14.2)	1,387	16.0 (15.0-16.9)	<0.001	5.9
Age group (years)								
18 - 39	649	9.4 (8.6-10.2)	541	13.6 (12.4-14.9)	644	15.9 (14.6-17.2)	<0.001	6.5
40 - 59	683	12.3 (11.4-13.3)	413	14.3 (13.6-15.7)	566	18.1 (16.7-19.5)	<0.001	5.8
≥60	156	7.5 (6.4-8.8)	94	9.3 (7.5-11.4)	177	11.3 (9.7-13.1)	<0.001	3.8
Locality								
Urban	935	10.6 (9.9-11.4)	643	14.1 (13.0-15.2)	841	16.4 (15.3-17.6)	<0.001	5.8
Rural	553	8.4 (7.7-9.2)	378	11.0 (9.8-12.2)	546	14.6 (13.3-16.1)	<0.001	6.2
Women								
Overall	3,120	16.5 (15.9-17.2)	1,729	18.8 (17.8-19.9)	2,259	22.5 (21.5-23.5)	<0.001	6.0
Age group (years)								
18 - 39	1,208	13.9 (13.1-14.8)	693	16.6 (15.3-18.1)	877	20.9 (19.6-22.4)	<0.001	7.0
40 - 59	1,574	22.2 (21.2-23.3)	835	23.7 (22.0-25.4)	1,019	26.1 (24.5-27.7)	<0.001	3.9
≥60	338	14.1 (12.6-15.6)	201	16.5 (14.3-18.9)	363	20.5 (18.4-22.7)	<0.001	6.6
Locality								
Urban	1,826	16.1 (15.4-16.9)	988	18.4 (17.1-19.7)	1,205	21.5 (20.2-22.8)	<0.001	5.4
Rural	1,294	17.7 (16.7-18.8)	741	20.4 (18.8-22.0)	1,054	25.6 (24.1-27.2)	<0.001	7.9
Abdominal obesity								
National	13,515	39.1 (38.3-39.8)	7,902	46.2 (44.9-47.4)	9,930	51.0 (49.9-52.1)	<0.001	11.9

Table 2 (Continued)

	2006		2011		2015		p-value	Change
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)		
Men								
Overall	4,688	31.3 (30.4-32.3)	2,955	37.7 (36.2-39.2)	3,679	40.5 (39.1-42.0)	<0.001	9.2
Age group (years)								
18 - 39	1,551	23.0 (21.9-24.3)	1,129	30.7 (28.9-32.4)	1,323	32.8 (31.0-34.6)	<0.001	9.8
40 - 59	2,361	43.2 (41.7-44.6)	1,322	47.4 (45.2-49.7)	1,580	50.7 (48.6-52.7)	<0.001	7.5
≥60	776	39.7 (37.4-42.0)	504	45.5 (42.3-48.8)	776	50.3 (47.3-53.2)	<0.001	10.6
Locality								
Urban	3,065	34.0 (32.8-35.2)	1,797	39.4 (37.5-41.2)	2,211	41.8 (40.0-43.6)	<0.001	7.8
Rural	1,623	23.5 (22.3-24.7)	1,158	32.8 (30.6-35.0)	1,468	36.8 (34.7-38.9)	<0.001	13.3
Women								
Overall	8,827	47.2 (46.3-48.3)	4,947	55.1 (53.5-56.7)	6,251	62.1 (60.8-63.3)	<0.001	14.9
Age group (years)								
18 - 39	1,961	34.9 (33.7-36.1)	1,701	43.6 (41.5-45.7)	2,081	51.3 (49.4-53.2)	<0.001	16.4
40 - 59	4,429	63.1 (61.8-64.4)	2,382	69.4 (67.4- 71.3)	2,807	74.7 (73.0-76.3)	<0.001	11.6
≥60	1,437	60.8 (58.7-62.9)	864	68.3 (65.5-77.0)	1,363	76.3 (73.9-78.5)	<0.001	15.5
Locality								
Urban	5,300	47.0 (45.9-48.2)	2,871	54.6 (52.7-56.5)	3,500	61.3 (59.7-62.9)	<0.001	14.3
Rural	3,527	47.9 (46.5-49.3)	2,076	56.7 (54.3-59.1)	2,751	64.5 (62.5-66.4)	<0.001	16.6

CI, confidence interval.

prevalence agrees with data from other Asian countries. Data from Thailand National Health Examination Survey between 1991 and 2009 reveal age-adjusted prevalence of obesity increases from 1.7% to 6.8% among men and 5.9% to 12.1% among women (Aekplakorn *et al*, 2014). The prevalence of obesity rate reported in Indonesia increases from 4.1% to 8.9% among males and 9.7% to 19.6% among females between 1993 and 2007 (Roemling and Qaim, 2012). The prevalence of obesity reported among Singaporean adults is 5.1% in 1992 and increases to 10.8% in 2010 (Foo *et al*, 2013). A recent review of adult obesity in Malaysia highlighted the driving forces behind rising obesity are the increase in the quantity and type of food available and inadequate physical activity (Ghee, 2016).

In agreement with other studies, our findings show that the prevalence of obesity and AO in women was higher than men (Sardinha *et al*, 2012; Jayawardena *et al*, 2013). Although women have a greater biological tendency to store fat, some countries have reported larger increase among men, notably, the increases in obesity and AO among men but not women in Korean (Yoo *et al*, 2010; Rhee *et al*, 2013). However, in the US changes in obesity prevalence do not differ significantly between adult men and women during 2009-2010 compared with 2003-2008 (Flegal *et al*, 2012). The transition in nutrition taking place in many developing countries, including changes in occupation type and socio-cultural factors, which affect physical activity, particularly among women, may have a greater impact on weight gain among women compared to men (Kanter and Caballero, 2012).

This study shows a greater increment in the prevalence of obesity and AO among individuals living in rural

compared to urban areas. This finding is in line with a study by Befort *et al* (2012) in the US showing a significantly higher prevalence of obesity among adults in rural areas as compared to adults in urban areas. On the other hand, among the South Asia population the rise in prevalence of obesity and AO are more pronounced among urban residents (Jayawardena *et al*, 2013). Similarly, Roemling and Qaim (2012) reported in Indonesia rural location has a negative effect on BMI for both males and females. Globalization has resulted in a higher accessibility of, and cheaper priced, processed foods and beverages that are energy-dense and high in sugar content (Popkin *et al*, 2012), and improvements in the socioeconomic status and adoption of a more sedentary lifestyle may explain the rise in obesity among the rural communities in this and other studies.

There are several strengths in the present study. Firstly, this is a nationally representative study with high response rate. All the parameters for nutritional status evaluation of the respondents were measured by trained research members. Training of data collectors was also conducted to ensure standardized data collection and quality control. However, the limitations in the study should be acknowledged. Others causal factors of obesity or AO, such as education level, household income, dietary intake and physical activity were not considered. Thus, further studies that include the abovementioned factors are recommended to provide additional information on the etiology of obesity in Malaysia. As the data from NHMS surveys comprise different groups of respondents, it is possible that variations between surveys cannot be identified or predicted.

In conclusion, the prevalence of

obesity and abdominal obesity among Malaysian adults clearly shows a progressively increasing trend in all age groups. This has continued unabated since 1996 despite public health interventions. A further focused evaluation of public health prevention strategies are urgently needed to identify the shortcomings and modify current strategies to reduce the prevalence of obesity and abdominal obesity, thereby preventing future deleterious obesity-related health outcomes.

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CONFLICTS OF INTEREST

The author declare no conflicts of interest.

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