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Eating patterns and prevalence of obesity. Lessons learned from the Malaysian Food Barometer

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ABSTRACT

The Malaysian society is experiencing and coping with a fast modernization process, which is characterized by a rapid urbanization and rural exodus, an important reduction of the size of households, and the emergence of a new middle class. The Malaysian Food Barometer launched in 2013 has provided better understanding how these macro issues have affected the lifestyles and especially the food habits of the Malaysians. The country has indeed undergone a transition period from under-nutrition to over-nutrition in a few decades, with the prevalence of overweight and obesity having markedly and rapidly increased. A quantitative survey (n = 2000), elaborated from a qualitative preliminary phase, was carried out with the aim of analyzing the transformation of food habits at the national level. The present article focuses on the BMI issue in Malaysia, and investigates its relationships with the socio-demographic variables of the population, as well as their eating patterns. The mean BMI is 23.64 kg/m^2, with 9.5% of the sample being obese, and 22% overweight. Strong statistical associations have been identified between BMI and independent variables such as size of the living area, ethnicity, level of education, gender, and age. Contrary to general believe, overweight and obesity were neither associated with the number of food intakes taken per day (including snacks) nor with the frequency of eating out. Nonetheless, obesity is over-represented in people who have dissonant eating behaviors, i.e. who declare having fewer food intakes a day (food norms) than they do actually (food practices). This process testifies that the Malaysians are experiencing a "food transition", which is linked with socio-economic development.

1. Introduction

The Malaysian society is coping with a fast modernization process, in which several complementary issues are involved. Firstly, and through a process of rapid urbanization and rural exodus, which accompanied the industrialization of the New Economic Policy Era (1971–1990) (Aziz, 2012) and the development of the services economy from 1970 onwards (Hutton, 2003), the urban population rose from 11% in 1951, to 51% in 1991, 62% in 2000 and 72.7% in 2012 (BMCE Trade, 2013; Jaafar, 2004). Secondly, the structure of the society has changed dramatically in which the fertility rate has dropped from 3.29 children per woman in 2000 to 2.64 in 2012 (Index Mundi, 2013; Leete, 1996) and the size of the average household has reduced from 5.2 persons in 1980 to 4.3 in 2010 (Hirschman & Guest, 1990; Hirschman, 2011; Mahari, Othman, Khalili, Esa, & Miskiman, 2011; Sudha, 1997). As a consequence, the increase in the purchasing power of newly salaried employees combined with the reduction in the family size has heralded the emergence of a new middle class (Embong, 2007; Shamsul, 1999) that has a greater ability to participate in the consumption economy.

All these macro issues have affected the lifestyles and especially the food habits of the Malaysians. In the words of Shamsul (2012: 5), "what a contrast between the student demonstration over the plight of peasants in Baling suffering from 'hunger and poverty' in 1974 and the establishment twenty years later of the Malaysian

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Association of the Study of Obesity (MASO) in 1994". The country is now characterized by the transformation of eating patterns and by some new consumer expectations regarding food. Indeed, the prevalence of overweight and obesity in the adult population has markedly and rapidly increased in Malaysia, from 17% and 4% (NHMS II) in 1996 to 29% and 14% (NHMS III) in 2006 (IPH, 1999; 2008), respectively. Therefore, the current obesity epidemic in Malaysia stimulates us to focus research on identifying those factors in the food cultures and lifestyles that may lead to the development of this problem.

The complex associations between social changes and the transformation of lifestyles and eating patterns have been analyzed in the middle-income countries as a system of transitions "with socio-economic, physical activity, dietary, nutrition and body weight transitions operating in relationship with each other" (Lee & Sobal, 2003, p. 665). In the context of the Malaysian food consumption pattern there are two major distinct characteristics. The first is linked with the multiculturalism as the Malaysian society officially consists of three main ethnic groups (Malay, Chinese, and Indian) plus a few minority groups. Despite the fact that some common dishes, food components and habits are generally shared among Malaysians, each of the main ethnic groups has its own food culture with its typical dishes and ingredients, dietary taboos and restrictions, dining rituals, form and structure of meals, and symbolic dimensions regarding food, health and the body (Duruz & Khoo, 2014; Hsin-Huang & Khay-Thiong, 2015). The second characteristic is the high frequency of food consumed outside the home by the urban population. The two latest population studies led by the Ministry of Health Malaysia – Malaysian Adult Nutrition Survey (MANS, 2008; 2014) – highlight this high frequency of eating out and the strong positive association with the level of urbanization: for example, 55% of urbanites have lunch outside compared to only 30% in rural population (MANS, 2014). Opportunities for the Malaysians to eat out have increased tremendously, and the prices are sometimes lower than the cost of a homemade meal. The idea that increasing urbanization has resulted in a rise in eating out leads to the assumption that the prevalence of eating out is now of much greater significance within Malaysian food culture and its outcomes to health. Although eating out could not be globally linked with the rise of obesity, one could assume that there is a typology based on a cluster of practices that make up the ethnic food lifestyles in Malaysia, and that some of them could be more or less connected with obesity.

The Malaysian Food Barometer (MFB) launched in 2013 is a survey that produces a set of indicators that link cultural patterns, food consumption and demographic data to health issues (Poulain et al., 2015). It complements the classical nutritional survey for developing better prevention programs against health problems, especially non-communicable diseases. The main aim of the MFB is to study eating patterns using the nutritional approach and, in doing so, develop an interdisciplinary dialogue between socio-anthropology and nutrition for the benefit of public health. Ultimately, the purpose is to draw a picture of the Malaysian food habits and to analyze their diversity based on socio-cultural determinants, as well as their link with body mass index (BMI), hence obesity.

The objectives of this article are 1) to describe the BMI issue in Malaysia, and its potential associations with the socio-demographic variables (including ethnicity), and 2) to analyze the associations of BMI with the eating patterns of the Malaysians.

2. Material and methods

The MFB uses a quantitative instrument that is developed at the national level to study the transformation of food habits (n = 2000). This macro tool is then mobilized every two or three years. Data presented in this article are based on a baseline survey carried out from January to May 2013.

2.1. A qualitative exploratory phase

The questionnaire was developed from the data collected within a qualitative exploratory phase (face-to-face interviews and a focus group) that aimed at identifying the main trends in the Malaysian food practices and representations. The interview guide, based on local studies (Aziz, 2012; Khambalia & Seen, 2011; Shamsul, 2012) as well as on food studies methodology (Poulain, Guignard, Michaud, & Escalon, 2010), consisted of four parts: food habits, eating at home, eating out, and social representations. Nine (9) face-to-face interviews were conducted within two rounds: the first one consisted of 3 h-long discussions with a Malay, a Chinese and an Indian to become familiar with the social discourses and representations about food in Malaysia. We then conducted a second round of qualitative data collection for additional information on food practices (shopping, cooking, and number, type and place of food intakes). As such, a shortened version of the interview guide was used and lasted 30 min. After carrying out these qualitative interviews, we conducted one focus group (n = 10) of 3 h duration. A power-point presentation was used to show images, visual media and tools. The participants were all from Kuala Lumpur, the capital of Malaysia. The majority of them were recruited on varying profiles based on their occupation and income level. The different aspects that the focus group looked at included food composition and consumption in a day, structure of the food intake, invitations and eating out, home cooking practices, and food modernity and its avatars.

2.2. The questionnaire design

The questionnaire has six main parts encompassing the socio-demographics and ethnic indicators, food norms, food intake in the last 24 h, cooking practices, social representations regarding food, and the perception of food and health-related risks. The questionnaire comprises of 66 items and more than 1400 variables, including BMI.[1] There are 46 closed and multiple-choice questions, consisting of standard questions used in sociology to describe the socio-demographics of a population (Desrosières, 1998), as well as questions that have been used in previous food studies (Poulain, 2002; Poulain et al., 2010) and then adapted to the Malaysian context. The questionnaire was translated in four languages (Malay, Chinese, Indian, and English), and then retro-translated to ensure the right meaning of the questions (Temple, 1997).

The data collection for the food intake used in the MFB was based on the "recall of the last 24 h" approach. This method, developed by Wiehl (1942), asks the interviewees to list out all the food and drink intakes of the day that include before, during and in between meals.[2] It is a common method used to investigate the individual's food intake. It has been used mainly in nutrition surveys, but we adapted the method to take into account the socio-cultural dimensions that were being investigated, as well as to try to collect more representative data.

[1] The BMI for a person is defined as their body mass (in kg) divided by the square of their height (in m), with the value universally being given in units of kg/m^2. According to the World Health Organization (WHO, 1998), the BMI categories are the following: "underweight" (<18.5 kg/m^2), "normal" (18.5–24.9 kg/m^2), "overweight" (25–29.9 kg/m^2), and "obese" (≥30 kg/m^2).

[2] Food intakes include the meals (socially structured and standardized intakes) and the snacks (extra-prandial intakes i.e. the consumption of any solid or liquid nutriment with caloric content that is not part of a meal) (Poulain, 2002).

Indeed, when individuals are asked to describe the meals they ate the day before and if they have not eaten "as usual", or if they have eaten differently from their "normal" pattern (that is, what they think they normally should have done, according to prevailing social norms), then they might feel uncomfortable and be placed in a dilemma. What should their answer be? What they had actually eaten yesterday, or what they usually ate or what they believe should have been eaten? In an attempt to resolve this ambiguity, some studies (Poulain, 2002) have developed a collection method that facilitates the distinction between practices and norms. This is done by first inviting the participants to describe what they consider to be a "proper meal". This is then presented to them as taking place in an ideal setting, without influence with regard to the organization of the preparation and consumption of these meals. This method is an extension of Douglas (1972)' work on "deciphering a meal" Through this process, the social norms are collected for the meals under consideration. In the second step, when the interviewee is "liberated" from the normative pressures by his or her statements, another series of questions is asked in order to help the individual rebuild his or her actual food consumption of the day before. The interviewer begins by specifying that, now, what interests the research team is what actually happened or what has actually been eaten. The interviewer then explains that working at the level of the total population, it is not a problem if the meals eaten by the interviewee differs from what has been said in the first part of the questionnaire, where the respondent informed them of what she/he thinks should be done, or what she/he usually does. The first type of data corresponds to the social norms, i.e. provides an aggregate of the guidelines for food consumption that are rooted in the cultural, social and family traditions. They result from the specific socialization of an individual. However, these norms are also influenced by the prevailing discourse of public health, or pressure from prevailing models of the desirable body shape. The second type of data remains declarative data, but is much closer to the actual practices of the individuals. Using such a method allows the data collected be more accurate and it becomes possible to distinguish the norms and practices, and their relationships with each other, particularly for the understanding of the transformation of eating patterns.

2.3. Training of the interviewers

All the interviewers that were employed for administering the questionnaire were fluent in the language used for training as well as at least one (other) language into which the questionnaires had been translated into (Malay, Chinese, Indian, and English). As the questionnaire had been translated into another language, the trainers have been trained in different languages (2 days). The main purpose of this was to present the structure of the questionnaire and to validate the data collection method. It was a very important step to match the different points of view and methods regarding the cultural influence.

2.4. Sample size and power calculations

In social sciences as well as in food studies (Poulain et al. 2010), the sample size used for national surveys is usually set at n = 1600 to allow cross-tabulation. However, and since the Malaysian population may present varying characteristics (especially due to the multi-ethnic dimension), we decided to work on 2000 subjects.

Our calculation is based on the theoretical sample size (Cohen, 1988) using the following formula:

$$n = \frac{t^2 p(1-p)}{e^2}$$

With:

- p = 50%
- s = 99% (t = 2.575)
- e (estimated) = 3%

Then n = 1842.

We enlarged it to n = 2000 for the reason explained above (multi-ethnicity).

Then we used the following formula to calculate e:

$$e = t\sqrt{\frac{p(1-p)}{n}}$$

With:

- N (parent population) = 30.000.000

Then e (margin of error) = 2.88%.

2.5. Recruitment strategies

The MFB studied the social, ethnic and cultural diversification of the food habits in Malaysia using a macro data collection approach. It was based on a national representative sample (n = 2000) of respondents of 15 years old and above. The methodology for sampling used a semi-randomized approach, based on the regions within Malaysia and their degree of urbanization. A quota system based on age and ethnicity was also applied. Quantitative data were collected between January and May 2013.

The sample used is the population distribution used by the Ministry of Health in the Malaysian Adult Nutrition Survey (MANS) done in 2002 and 2003, involving 6928 adults selected by stratified random sampling from all the households by zone in Peninsular Malaysia, Sabah and Sarawak. We followed this stratification to build our sample. We then built randomized sampling for the states, level of urbanization, gender, and ethnicity, and it was redressed in order to fit to the national population.

2.6. Statistical analysis

Categorical variables including both socio-demographic variables (i.e. region, size of urban area, ethnicity, level of education, gender, and age) and eating patterns (i.e. number of food intakes per day, number of snacks per day, number of food intakes taken outside per day, and the gap between norms and practices regarding the number of meals per day) were presented as frequencies and percentages. The gap between norms and practices was built to explore the potential differences between food norms and food practices regarding the number of meals per day (Poulain, 2002). It comprises three classes: (i) norm < practice (when individuals declare having fewer meals a day than they do actually), (ii) norm > practice (when individuals declare having more meals a day than they do actually), and (iii) norm = practice (when individuals declare having as many meals a day as they do actually).

The mean and standard deviation of participants' BMI in each group of the categorical variables were reported as well. BMI of the participants was computed by dividing their weight (kg) with height squared (m^2). Then, by following WHO (1998), BMI was grouped into four categories including underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obesity (≥30 kg/m^2). The relationship between the categorical BMI

Table 1
BMI accross different socio-demographic characteristics of the subjects (N = 2000).[a]

Socio-demographic characteristics	n (%)	M ± SD	Bonferroni adjusted *p*-value
Regional distribution	$F(5, 1994) = 6.340$, $p < 0.001$		
Peninsular Malaysia			[1] − [2] ($p = 1.000$), **[1] − [3] ($p < 0.001$)**, [1] − [4] ($p = 1.000$), [1] − [5] ($p = 1.000$), [1] − [6] ($p = 1.000$), **[2] − [3] ($p < 0.001$)**, [2] − [4] ($p = 1.000$), [2] − [5] ($p = 1.000$), [2] − [6] ($p = 1.000$), **[3] − [4] ($p < 0.05$)**, **[3] − [5] ($p < 0.01$)**, [3] − [6] ($p = 0.054$), [4] − [5] ($p = 1.000$), [4] − [6] ($p = 1.000$), [5] − [6] ($p = 1.000$)
[1] Northern region	264 (13.2)	23.02 ± 3.04	
[2] Central region	675 (33.7)	23.47 ± 4.59	
[3] Southern region	366 (10.6)	24.74 ± 4.95	
[4] East coast region	288 (18.3)	23.54 ± 4.37	
East Malaysia			
[5] Sabah	226 (11.3)	23.52 ± 4.95	
[6] Sarawak	174 (8.7)	23.64 ± 4.53	
Size of urban area[b]	$F(2, 1997) = 2.060$, $p = 0.128$		
[1] Rural	379 (19.0)	23.73 ± 4.95	[1] − [2] ($p = 0.263$), [1] − [3] ($p = 1.000$), [2] − [3] ($p = 0.145$).
[2] Suburban	270 (13.5)	23.12 ± 3.73	
[3] Urban	1351 (67.5)	23.71 ± 4.54	
Ethnicity	$F(3, 1996) = 9.145$, $p < 0.001$		
[1] Malay	1176 (58.8)	23.92 ± 4.61	**[1] − [2] ($p < 0.001$)**, [1] − [3] ($p = 0.403$), [1] − [4] ($p = 0.229$), **[2] − [3] ($p < 0.001$)**, [2] − [4] ($p = 1.000$), **[3] − [4] ($p = 0.021$)**
[2] Chinese	498 (24.9)	22.88 ± 3.77	
[3] Indian	133 (6.7)	24.67 ± 5.38	
[4] Non-Malay Bumiputra	193 (9.7)	23.19 ± 4.85	
Level of education	$F(3, 1996) = 6.692$, $p < 0.001$		
[1] Primary school or lower	215 (10.8)	24.47 ± 4.93	[1] − [2] ($p = 0.896$), **[1] − [3] ($p < 0.048$)**, **[1] − [4] ($p < 0.001$)**, [2] − [3] ($p = 0.700$), **[2] − [4] ($p < 0.01$)**, [3] − [4] ($p = 0.111$)
[2] Lower secondary school	543 (27.2)	23.94 ± 4.88	
[3] Upper secondary school	869 (43.4)	23.56 ± 4.35	
[4] College/University	373 (18.6)	22.90 ± 4.03	
Gender	$t(1926.51) = -0.303$, $p = 0.762$		
[1] Male	1016 (50.8)	23.61 ± 4.15	[1] − [2] ($p = 0.762$)
[2] Female	984 (49.2)	23.67 ± 4.88	
Age, years	$F(3, 1996) = 6.692$, $p < 0.001$		
[1] 15–19	309 (15.4)	21.13 ± 3.89	**[1] − [2] ($p < 0.001$)**, **[1] − [3] ($p < 0.001$)**, **[1] − [4] ($p < 0.001$)**, **[1] − [5] ($p < 0.001$)**, **[1] − [6] ($p < 0.001$)**, **[2] − [3] ($p < 0.001$)**, **[2] − [4] ($p < 0.001$)**, **[2] − [5] ($p < 0.001$)**, **[2] − [6] ($p < 0.001$)**, **[3] − [4] ($p < 0.05$)**, [3] − [5] ($p = 0.338$), [3] − [6] ($p = 0.217$), [4] − [5] ($p = 1.000$), [4] − [6] ($p = 1.000$), [5] − [6] ($p = 1.000$)
[2] 20–29	578 (28.9)	22.86 ± 4.25	
[3] 30–39	419 (21)	24.17 ± 4.49	
[4] 40–49	346 (17.3)	25.12 ± 4.46	
[5] 50–59	266 (13.3)	24.92 ± 4.37	
[6] ≥60	82 (4.1)	25.44 ± 4.52	

M: Mean. SD: Standard deviation. ANOVA with Bonferroni correction for pair-wise comparisons was used to test the significance of group differences between variables with more than two groups. All tests were two-tailed. *p*-value < 0.05 are shown in bold. Independent sample *t*-test was used to test the significance difference between male and female subjects. All tests were two-tailed. Adjusted *p*-value < 0.05 are shown in bold.

[a] Quotas were applied.

[b] Rural: Open space, village area without tall buildings. Far from the main and secondary city, 50 km from the main city and a minimum of 20 km from the secondary city. Suburban: Town or city that can be accessed by the highway. Some tall buildings and is normally 30 km from the main city. Urban: Built-up city or large town with large buildings and houses. These three categories (rural, suburban, and urban) have been built from Jaafar (2004) and Masron, Yaakob, Ayob, and Mokhtar (2012).

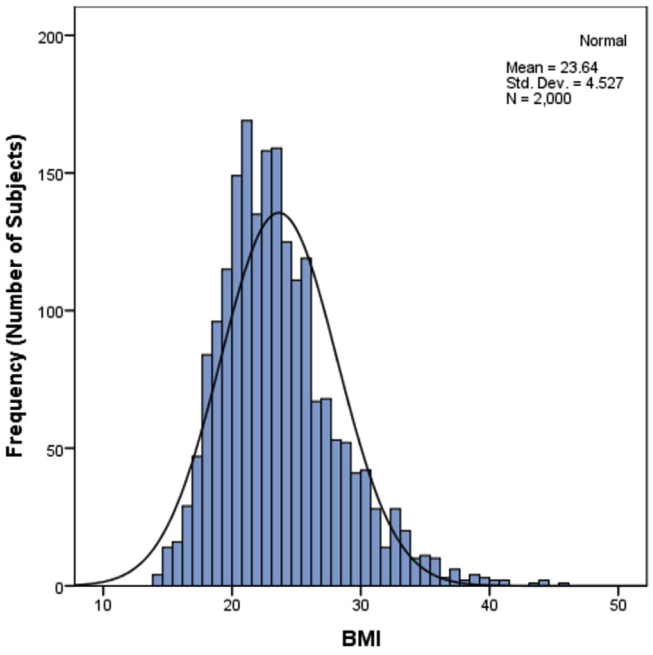

Fig. 1. Distribution of BMI. Mean = 23.64. Standard deviation = 4.527. N = 2000.

with socio-demographic and eating patterns were assessed using the Chi-squared test.

One-way ANOVA was performed to compare the mean of BMI among socio-demographic and eating patterns factors. The interaction effect of education level and ethnicity, gender and ethnicity, as well as education level and gender on BMI was analyzed using two-way ANOVA. A Bonferroni post hoc test was used on all possible pair-wise comparisons when significant F ratios were found. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), version 23.0. All statistical tests were two-tailed, and a *p*-value of equal to or less than 0.05 was considered significant.

3. Results

Table 1 shows the participants' socio-demographic characteristics. The dataset consisted of 2000 male (n = 1016) and female (n = 984) Malaysians. The participants were mainly (67.5%) from urban areas. In total, 58.8% of the participants were Malays, 24.9% Chinese, 6.7% Indians and 9.7% non-Malay Bumiputra.

3.1. BMI and sociodemographic variables

The mean BMI of the participants was 23.64 kg/m^2 (all participants including a small number of adolescents aged between 15 and 19 years) and 24.0 kg/m^2 for the adult participants (Fig. 1). The

Table 2
BMI accross different eating patterns of the subjects (N = 2000).[a]

Eating patterns	n (%)	M ± SD	Bonferroni adjusted *p*-value
BMI			
[1] Underweight (<18.5 kg/m^2)	196 (9.8)	N.A.	N.A.
[2] Normal (18.5 −24.9 kg/m^2)	1174 (58.7)	N.A.	
[3] Overweight (25 −29.9 kg/m^2)	440 (22)	N.A.	
[4] Obesity (≥30 kg/m^2)	190 (9.5)	N.A.	
No. of food intakes/day	*F*(5, 1994) = 0.771, *p* = 0.571		
[1] 1 meal	7 (0.4)	24.19 ± 5.1	[1] − [2] (*p* = 1.000), [1] − [3] (*p* = 1.000), [1] − [4] (*p* = 1.000), [1] − [5] (*p* = 1.000), [1] − [6] (*p* = 1.000), [2] − [3] (*p* = 1.000), [2] − [4] (*p* = 1.000), [2] − [5] (*p* = 1.000), [2] − [6] (*p* = 1.000), [3] − [4] (*p* = 1.000), [3] − [5] (*p* = 1.000), [3] − [6] (*p* = 1.000), [4] − [5] (*p* = 1.000), [4] − [6] (*p* = 1.000), [5] − [6] (*p* = 1.000)
[2] 2 meals	139 (7.0)	23.66 ± 4.33	
[3] 3 meals	624 (31.2)	23.45 ± 4.57	
[4] 1 meal and snack	23 (1.2)	24.78 ± 3.52	
[5] 2 meals and snacks	308 (15.4)	23.50 ± 4.23	
[6] 3 meals and snacks	899 (45.0)	23.78 ± 4.64	
Norms practices meal	*F*(2, 1997) = 5.589, *p* < 0.01		
[1] Norm = Practice	1349 (67.5)	23.55 ± 4.44	[1] − [2] (*p* = 1.000), **[1] − [3] (*p* < 0.01)**, **[2] − [3] (*p* < 0.01)**
[2] Norm > Practice	340 (17.0)	23.30 ± 4.57	
[3] Norm < Practice	311 (15.5)	24.40 ± 4.77	
No. of food intakes taken outside/day	*F*(2, 1997) = 0.148, *p* = 0.862		
[1] 1 meal outside	575 (28.7)	23.43 ± 4.30	[1] − [2] (*p* = 1.000), [1] − [3] (*p* = 1.000), [2] − [3] (*p* = 1.000)
[2] 2 meals outside	562 (28.1)	23.38 ± 4.14	
[3] 3 meals outside	145 (7.2)	23.60 ± 5.02	

M: Mean. SD: Standard deviation. ANOVA with Bonferroni correction for pair-wise comparisons was used to test the significance of group differences between variables with more than two groups. All tests were two-tailed. Adjusted *p*-value < 0.05 are shown in bold.

[a] Quotas were applied.

Table 3
Associations between BMI with socio-demographic and eating patterns variables.

Socio-demographic variables	Pearson χ^2	Eating patterns variables	Pearson χ^2
Size of living area	27.117***	No. of food intakes/day	7.588^{ns}
Ethnicity	46.165***	No. of snacks/day	8.316^{ns}
Level of education	37.398***	No. of food intakes taken outside/day	5.054^{ns}
Gender	9.546*	Gap between norms and practices regarding the No. of meals/day	14.239*
Age	206.145***		

All tests were two-tailed. ^{ns} non-significant. *$p < 0.05$. ***$p < 0.001$.

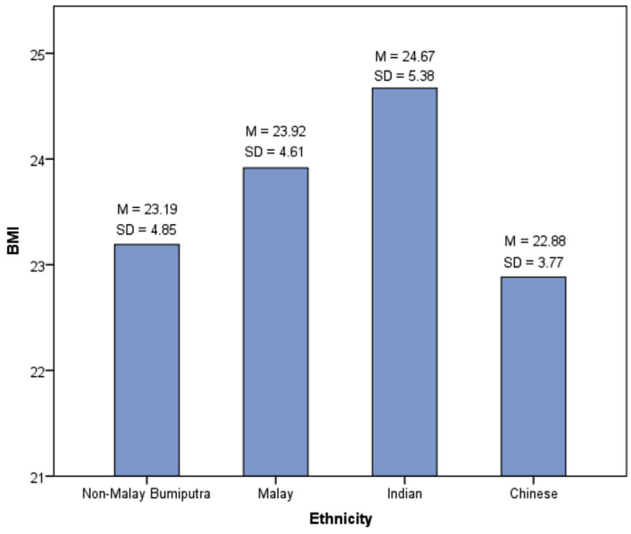

Fig. 2. Mean BMI across ethnicity. M: Mean. SD: Standard deviation. F(3, 1996) = 9.145, $p < 0.001$, two-tailed. N = 2000.

BMI distribution showed that percentage of obese people (9.5%) was similar to the underweight people (9.8%), and that more than half of the population (58.7%) was in the "normal weight" category (Table 2).

Strong statistical association was found between BMI and the socio-demographic variables of the participants (Tables 1 and 3). As far as the size of living area is concerned ($p < 0.001$), underweight people appeared to be over-represented in the "rural" category although the ones living in suburban area tend not to be obese. No direct association was found between the "obesity" and "urban" modalities. The results also showed a strong association between BMI and ethnicity, $p < 0.001$ (Table 3, Fig. 2) where Chinese participants (M = 22.88, SD = 3.77) had significantly lower BMI than Indians (M = 24.67, SD = 5.38) and Malays (M = 23.92, SD = 4.61). Moreover, as it is shown in Fig. 3, while 16.5% of the Indian participants were obese, only 4.6% of Chinese fell into the obese group. As reported in Table 3, the BMI tends to be lower when the level of education increases, $p < 0.001$. More specifically, participants with college/university degree (M = 22.90, SD = 4.03) had significantly lower BMI than those with primary school or lower (M = 24.47, SD = 4.93) and also those with lower secondary school (M = 23.94, SD = 4.88). Crossing this statistical association between BMI and ethnicity with other independent variables allows a more accurate understanding of the situation. Although the interaction effect of ethnicity and education level on BMI was not significant, $p = 0.137$, the results of one-way ANOVA on each ethnic group showed that in Chinese the mean BMI of those with college/university degree

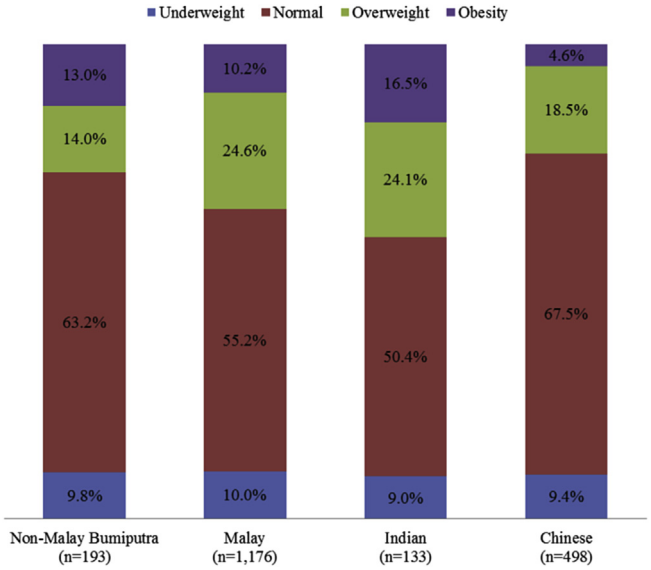

Fig. 3. BMI and ethnicity. $\chi(9) = 46.165$, $p < 0.001$, two-tailed. N = 2000.

(M = 21.78, SD = 3.681) was significantly lower than those in the primary school (M = 23.83, SD = 3.908) and in the lower secondary school (M = 23.36, SD = 3.871), $p < 0.05$ (Fig. 4). Furthermore, the results did not provide support for the interaction effect of ethnicity and gender on BMI, $p = 0.061$. However, conducting independent sample *t*-test on each ethnic group showed that in Chinese participants, males (M = 23.30, SD = 3.552) had a significant higher BMI than females (M = 22.43, SD = 3.953), $p < 0.05$ (Fig. 5). As it is shown in Fig. 6, the interaction between gender and level of education in relation to BMI was significant ($p < 0.05$). The results showed that while there was a significant negative relationship between the BMI of females and their education level, this study failed to support the link between BMI and education level among male respondents. More specifically female participants with college/university degree (M = 22.53, SD = 4.044) had significantly lower BMI than females with primary school or lower (M = 25.15, SD = 5.435) and females with lower secondary school (M = 24.15, SD = 5.078), $p < 0.01$. Lastly, BMI was positively associated with age ($p < 0.001$) (Table 2), with the youngest ones (those under 29) having significantly lower BMI than the other age groups, $p < 0.001$ (Table 3).

3.2. BMI and eating patterns

A 3-meals a day model has been identified within the Malaysian eating patterns (breakfast, lunch, and dinner), with a quite important synchronization of the food intakes (Fig. 7). However, all the subjects do not eat 3 meals a day (Table 2). According to the "recall of the last 24 h", near half of the population (45%) eats 3 meals a day + in-between food intakes, a third (31.2%) eats 3 meals a days only, and a quarter (22.4%) eats 2 meals a day (when adding those having only 2 meals and those having 2 meals + in-between food intakes).

Statistical associations between BMI and eating patterns variables are shown in Tables 2 and 3. Contrary to general assumptions, no association was found between BMI and the frequency of food intakes per day which indicated that overweight and obese subjects did not have more food intakes than the "normal weight" counterparts, $p = 0.703$. Similarly, BMI appeared being neither correlated with the number of snacks per day ($p = 0.503$), nor with the frequency of eating out ($p = 0.537$). Yet a statistical association was found between BMI and the variable we built for identifying the

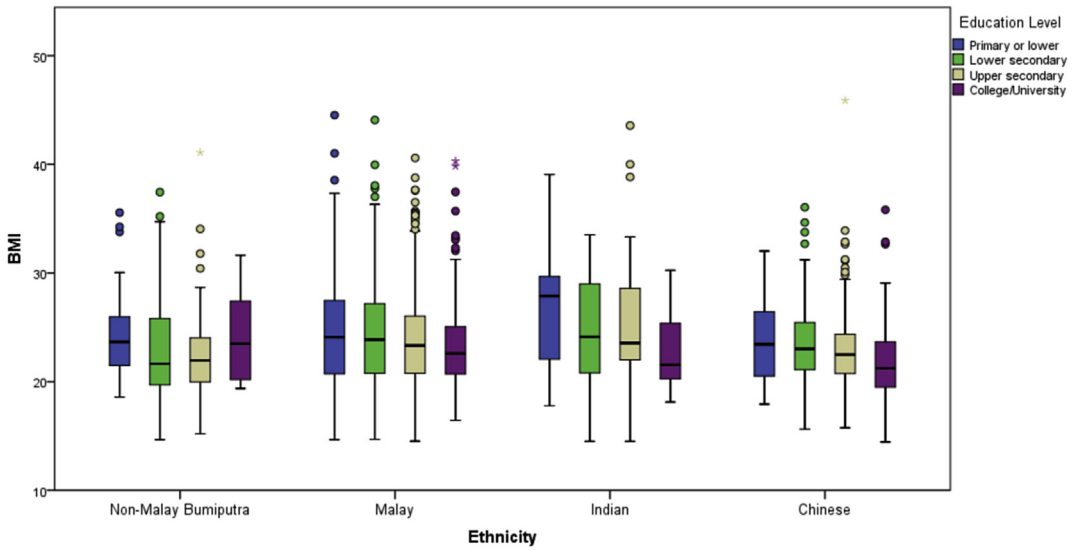

Fig. 4. Average of BMI across education level and ethnicity. Interaction effect of ethnicity and education level on BMI: F (9, 1984) = 1.514, $p = 0.137$, two-tailed, N = 2000.

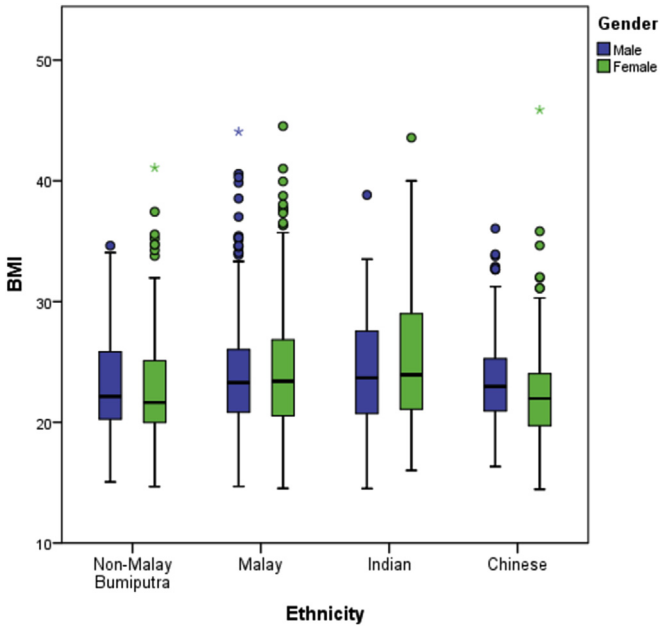

Fig. 5. BMI across ethnicity and gender. Interaction effect of ethnicity and gender on BMI: F(3, 1992) = 2.465, $p = 0.061$, two-tailed, N = 2000.

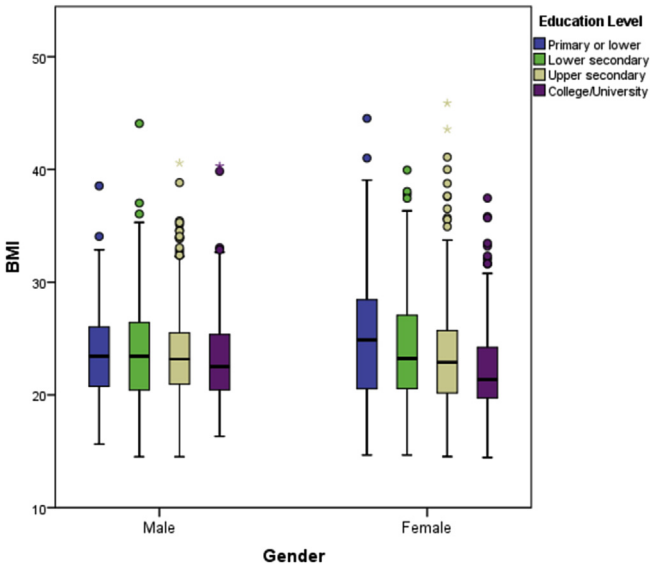

Fig. 6. BMI across gender and education level. Interaction effect of gender and education level on BMI: F(3, 1992) = 3.364, $p < 0.05$, two-tailed, N = 2000.

potential gap between the norms and the practices regarding the number of meals taken per day ($p < 0.05$). Indeed, the proportion of people who declare having fewer meals per day than they actually do increased with BMI, $p < 0.05$ (Fig. 8). A typology was then been built by crossing this variable with BMI and socio-demographic variables (Fig. 9). It demonstrates that obesity was over-represented in the 14% of people having dissonant food behaviors (declaring 2 meals a day and having actually 3). This is also the case of the Malays, the mid-aged people (40–49 years) and those having upper secondary education.

4. Discussion

The MFB investigates the Malaysian food habits and their socio-cultural determinants, and tries to understand the reasons of the rapid increase of obesity. Most of the results from the statistical analysis are in line with data coming from other studies, including those carried out in Malaysia.

Indeed, no direct association was found between the “obesity” and “urban” modalities although one could have expected that the urbanization process would have been involved in the spread of obesity (increase of the food supply, decrease of the physical activity, etc.). This process, that had formerly been highlighted (Davey, Allotey, & Reidpath, 2013; MANS, 2008), appeared as more complex as it seemed to be linked with the socio-cultural dimensions of food and eating operating in a multi-cultural context.

The negative association that linked BMI and the level of education in Malaysia was also in line with Sobal and Stunkard (1989) and Poulain (2009) studies. Data from the MFB helped explain more accurately this association by crossing it with gender. Data revealed that the association worked mainly for women, the BMI

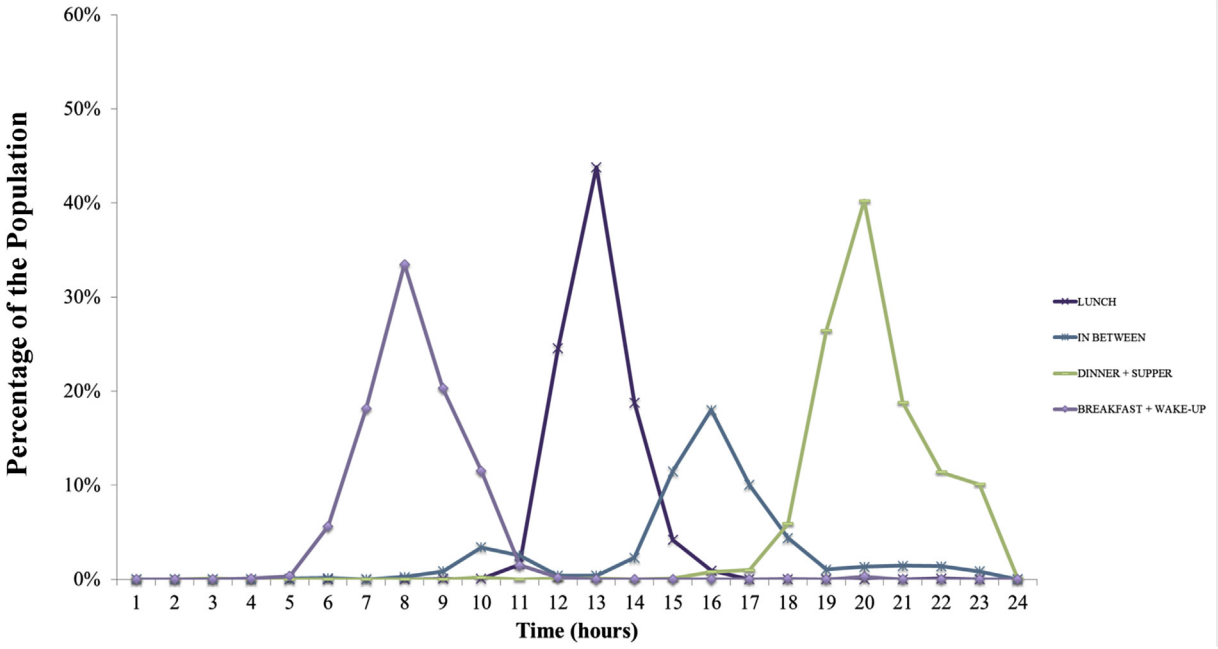

Fig. 7. Food intakes timing in Malaysia. N = 2000.

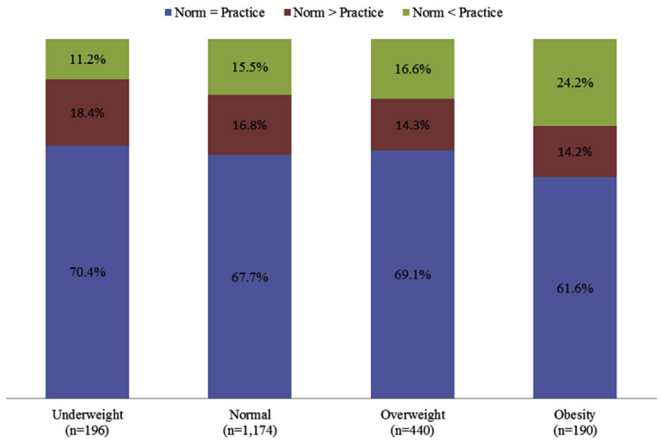

Fig. 8. Comparison of the number of food intakes in norms and practices and BMI. $\chi(6) = 14.239$, $p < 0.05$, two-tailed, N = 2000.

distribution remaining quite stable for the men, irrespective of their education level. This process testified to a gender relationship with food and the body: on the one hand, it worked as a relic of the time when being overweight or obese for a man was a symbol of prosperity and power (Sobal & Stunkard, 1989); on the other hand, it was in line with studies that had demonstrated that women are more likely to comply with the nutritional recommendations than men, and to obey to the normative pressure on their body (Beardsworth et al., 2002; Counihan & Kaplan, 1998; Fournier, Jarty, Lapeyre, & Touraille, 2015; Gough, 2007). In Malaysia, this gender differentiation worked for the Chinese (Ismail et al., 2002), with the hypothesis that females developed a strong reflexivity on food and the body. Indeed, the fact that it was a multi-ethnic society had to be carefully considered, as each ethnic group had its own eating patterns and body representations, and their social regulation. Thus data from the MFB highlighted that "the associations of obesity with gender, age, ethnicity, and socioeconomic status are complex and dynamic" (Wang & Beydoun, 2007).

The rise of food reflexivity could also help explain a methodological issue that stood in the difference of obesity prevalence between the MFB (9.5%) and some epidemiological studies (up to 14%) (IPH, 2008; Khambalia & Seen, 2011; Rampal et al., 2007). Except the smaller sample of our study, the main difference was the way to collect the BMI information: declared height and weight in the MFB, versus measurement in the others. Here we could hypothesize that under-reported weight may contribute to this difference in the BMI prevalence, and may attest to a transition situation in Malaysia in which reflexivity on food and the body was increasing, as well as obesity was getting perceived as a social and medical issue.

This transition situation was also visible in the fact that the prevalence of obesity and underweight was near the same in the Malaysians, respectively 9.8% and 9.5%. The concept of "nutrition transition" was proposed to describe the transformation of diets: some view "shifts in diet" as a predictable consequence of "modernization", urbanization, economic development, and increased purchasing power (Popkin, 1993). It was classically divided into five patterns (collecting food, early agriculture and famine, receding famine, overeating and nutrition-related non-communicable diseases, and behavioral change) and, currently, most low- and middle-income countries are rapidly moving from pattern 3 (end of famine) to pattern 4 (consuming more energy-dense diets), this shift being considered as a key contributor to the obesity epidemic (Misra & Khurana, 2008; Popkin, 2006; Popkin, Adair, & Ng, 2012).

There was no statistical association found between BMI and the number of food intakes per day (meals and snacks), nor between BMI and eating out, although one could have expected that these variables symbolizing a "modernization" process (especially regarding the transformation of food supply) could have had an important incidence (Sobal, 2001). At the same time, data from the MFB stressed on the fact that obesity was over-represented in people who had dissonant eating behaviors, i.e. who declared having fewer meals a day than they did actually. This result was in line with a previous study led on the socio-cultural determinants of obesity in French Polynesia (Poulain,

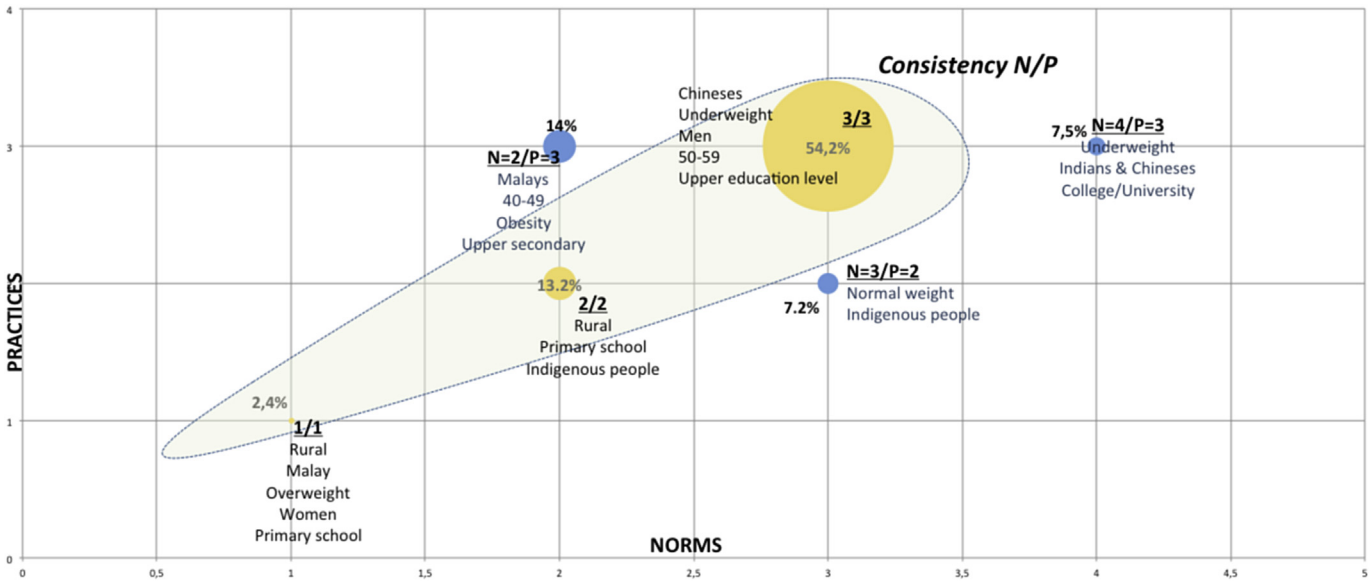

Fig. 9. Norms (N) versus Practices (P) regarding the number of meals per day: A typology. N = 2000.

2006). The latter aimed at identifying the rapid changes operating in eating norms and their potential consequences on BMI. It emphasized the important gap standing between the cultural and the medical norms regarding the number of meals a day: the French Polynesians had 2 meals a day "traditionally", but the 3 meals a day model appeared with the diffusion of nutritional standards by the public health sector. As a consequence, some declared having 2 meals a day while having 3 in practice; here lied the most important rate of obese people. Like in French Polynesia, obesity in Malaysia seemed to be associated with anomic[3] contexts and erosion of the eating patterns.

5. Conclusion

This paper investigates the BMI issue in Malaysia, and aims at identifying its associations with the socio-demographic variables of the MFB participants, as well as their eating patterns. The size of the living area, the level of education, gender, and age are all correlated with the BMI. At the same time, most of these "classical" variables are framed by the ethnicity since the different ethnic groups have their own food practices and body representations. Contrary to general assumptions, overweight and obesity are neither associated with the number of food intakes taken per day (including snacks) nor with the frequency of eating out. In view of the rising trend in prevalence of obesity in Malaysia, these findings must be treated with cautions since no attempt was made in assessment of habitual food intake in term of total calories and the contribution of fats, carbohydrates and protein to total caloric intake of the population studied. Nonetheless, obesity is over-represented in people who have dissonant eating behaviors, i.e. who declare having fewer food intakes a day than they do actually. This process testifies that Malaysia is experiencing a "food transition", which is linked with socio-economic development. Public health recommendations should take into account this process, as well as the specific food related-context of Malaysia such as multi-ethnicity and high frequency of eating out.

[3] The concept of "anomie", introduced by French sociologist Emile Durkheim, refers to the lack of social norms and values, and more precisely to the mismatch between an individual's actions and a system of social norms, thus resulting in moral deregulation.

Conflict of interest

The authors declare having no conflict of interest to report.

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