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Demographic Differences of Preference, Intake Frequency and Craving Hedonic Ratings of Sweet Foods Among Malaysian Subjects in Kuala Lumpur

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ABSTRACT

As the sugar intake of Malaysians is one of the highest in the Asia Pacific region, we wanted to investigate how this high prevalence of 'sweet tooth' is influenced by biological determinants like age, gender, ethnicity and Body Mass Index (BMI). Therefore, this study was to determine the demographic and BMI differences of preference, intake frequency and craving of a list of sweet beverages and food among Malaysian subjects. Convenience sampling was performed around Kuala Lumpur, with informed consents, involving 367 multi-ethnic subjects (163 males, 204 females; 83 Malays, 201 Chinese, 83 Indians; 209 lean, 158 overweight). Demographics and anthropometric measurements were taken and questionnaire on the preference/frequency/craving of a list of 22 sweet food and beverages with a 7 point hedonic scale (from 1= very unpleasant/never/never crave to 7 = very pleasant/at least once a day/ always crave) was performed. Females significantly preferred more, took less frequently but had equal craving of sweet foods compared to males. Lean subjects and those <25 years showed significantly higher preference, intake frequency and craving of sweet foods. The ethnic differences in rating the preference, intake frequency and cravings seemed to be food-specific and culturally-related, where overall, ethnic Chinese had significantly higher intake frequency but lesser craving of sweet foods compared to Malays and Indians. Understanding the demographic and anthropometric factors that may affect the preference, intake frequency and craving of certain sweet foods can help to plan for strategies to prevent the detrimental health burden of high sugar intake among Malaysians.

Keywords: Food preference, diet records, addictive behavior, Body Mass Index, Malaysia

INTRODUCTION

People who have a persistent desire to eat sweet products are said to have a 'sweet tooth'[1]. The 2007 Food Supply Quantity for sugar and sweeteners revealed that Malaysians have one of the 'sweetest teeth' in the Asia Pacific region, with 40.7 kg/capita/year – way higher than China (8.7) and India (19.8), and ranked second among Southeast Asian countries after Brunei (47.4)[2]. In the same survey, sugar and sweeteners account 13.5% (395 kcal/day) of the total energy intake of Malaysians[2]. According to the Malaysian Adults Nutrition Survey (MANS) 2003, highly-sweetened food like local desserts known as *kuih*, and drinks like tea, coffee, chocolate-flavoured drink (all likely to be sweetened with condensed milk) and cordial are among the top ten daily consumed food and beverages in Malaysia among all ethnicities[3]. The mean sugar intake was about 4 teaspoons/day or around 21g, which was under-represented by only sugar added to beverages like tea, coffee and chocolate-based drinks[3]. If the sugars from the commonly consumed very sweet snacks and desserts (like the Malaysian kuih) and beverages (like soft drinks, cordials) were to be taken into consideration in the study, the dietary energy proportion would be substantially more.

There are few methods that are designed to measure 'sweet tooth'. As reviewed by Reed & McDaniel (2006)[1], hedonic assessment such as intake frequency, preference and craving and assessment of sensitivity as in perceived intensity and quality/pleasantness are examples of methods used to measure 'sweet tooth'. Intake frequency measurement is defined as how often the sweet foods and beverages are consumed, while sweet preference is the desire and acceptance of sweet products that are chosen due to pleasure and satisfaction[1]. The term "sweet craving" is defined as a consuming desire or yearning of sweet foods and beverages[4]. The preference, intake frequency and craving for sweet products vary not only between individuals, but also between different groups of age, gender, ethnicity, and Body Mass Index (BMI) status. For instance, African Americans prefer higher concentrations and Pima Indians prefer lower concentrations of sugar compared with those of European ancestry[5]. However, ethnic differences may generalize only to specific food types. For instance, Taiwanese students rate sucrose solutions as more pleasant,

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but sweetened cookies as less pleasant, than do students of European descent[6]. Studies of sex differences suggest that male and female infants do not differ in sweet preference[7], but that older boys and men prefer higher concentrations of sweet compared with women[8]. Food cravings are also extremely common, particularly among women and are frequently reported for specific type of foods, including chocolate and foods high in both sugar and fat[9].

High sugar intake poses a serious public health threat to Malaysians, which is thought to contribute to the current high prevalence of diabetes at 14.9% for adults ≥30 years and overweight/obesity at 43.1%[10]. To date, there is limited research on understanding how the reported high prevalence of 'sweet tooth' among Malaysians is influenced by biological determinants like age, gender, ethnicity and BMI status. Therefore, the main objective of this study was to perform a questionnaire survey of hedonic assessment on the preference, intake frequency and craving of a list of 22 commonly consumed Malaysian sweet food and beverages. Demographic data and anthropometric measurements such as Body Mass Index (BMI), Waist-to-Hip Ratio (WHR) and Total Body Fat (TBF) were taken to associate how different age, gender, ethnicity and body compositions may affect the hedonic ratings of the sweet food list.

MATERIALS AND METHODS

Subjects

Convenience sampling was performed in this study from October 2009 to February 2010 to recruit student, staff and faculty populations of Kolej Tunku Abdul Rahman and Universiti Tunku Abdul Rahman campuses, two major private institutions of higher learning in Setapak, Kuala Lumpur, and from the local Setapak community. The ideal sample size for this study with a 5% margin error, 95% confidence level and 50% response distribution in the Setapak population of around 66,000 people[11] is 382 subjects. In this study, we recruited 367 healthy and unrelated subjects, consisting of three major Malaysian ethnicities - Malays, Chinese and Indians with the median age of 21.0 ± SD 14.5 years (range 17 - 77). The institutional board approved this study, all individuals participating in this study signed informed consent forms and all samples were taken in accordance with the Declaration of Helsinki (as revised in Seoul 2008).

Demographic data and anthropometric measurements

Demographic data such as age, gender and ethnicity were collected. The height of the subjects was measured to the nearest 0.1 cm using a meterstick affixed to a flat wall. Besides, waist and hip circumferences were determined to the nearest 0.1 cm with the subjects in standing position using a measuring tape. Waist-to-Hip Ratio (WHR) was calculated by dividing the waist circumference by hip circumference. A bio-impedence body fat weighing scale (Salter Body Analyser and Scale, UK) was used to determine the weight (in nearest 0.25 kg), Body Mass Index (BMI - Weight (kg) / [Height (m) x Height (m)]; calculated to the nearest 0.1 kg/m^2) and Total Body Fat (TBF; to the nearest 0.1%). Subjects with the BMI cut-off point of ≥ 23 kg/m2 were considered as overweight[12].

Hedonic assessment of sweet food preference, intake frequency and craving

A self-administered questionnaire on the preference, intake frequency and craving of a list of 22 types of commonly available Malaysian sweet food and beverages (according to the Malaysian Dietary Guidelines)[13] was presented. These included *ais kacang* (a syrup-sweetened shaved ice dessert with condiments such as *attap chee* (palm seed), red beans, sweet corn and grass jelly), *cendol*, (a palm sugar-sweetened shaved ice dessert with condiments such as coconut milk, a worm-like jelly made from rice flour with green food coloring), *cincau* drink (a grass jelly or *Mesona chinensis* drink sweetened with syrup), cola/carbonated drink, cordial/rose syrup/Ribena®, fruit juice, Milo®/ Horlicks®/Vico® (malt-based chocolate drinks), packet drinks (like Yeo's®/Drinho®), sweet dessert soup (like red or mung bean dessert), apam balik (pancake, normally with coarse sugar and peanut fillings), apple pie, brownies, cake, candy/sweets, chocolate, doughnuts, egg/fruit tart, ice-cream, jelly/jam/*kaya* (a coconut egg jam) on bread, *pisang goreng* (fried banana fritters), pudding and sweet *kuih* (bite-sized snack or dessert foods usually made from rice or glutinous rice flour like *bingka ubi kayu, kuih talam, kuih seri muka,* etc.). In order to aid a better recall of the preference, intake frequency and craving of the foods, subjects were also presented with images of the foods, with appropriate serving sizes to reflect high sugar content. Subjects were required to rate the sweet foods and beverages based on how much they like the item (preference), how frequently they consume the item (intake frequency), and how often they experience a craving for the item over the past month (craving) using a 7-point hedonic scale[14]. The response alternatives for preference were 1 = very unpleasant, 2 = fairly unpleasant, 3 = slightly unpleasant, 4 = neither pleasant nor unpleasant, 5 = slightly pleasant, 6 = fairly pleasant and 7 = very pleasant; frequency were 1 = never, 2 = once a month or less often, 3 = 1-2 times a month, 4 = once a week, 5 = a couple of times a week, 6 = almost everyday and 7 = at least once a day and for craving, 1 = never, 2 = very rarely, 3 = rarely, 4 = sometimes, 5 = often, 6 = very often and 7 = always/almost everyday.

Statistical Analysis

The data obtained was statistically analyzed by the Statistical Package for Social Sciences, SPSS® for Windows® Version 16.0 software (SPSS, Chicago, IL). Descriptive statistics was used to compute frequencies and percentages for demographic data. The results for preference, intake frequency and craving are given as means ± standard error (SE). The differences between two or more groups were assessed by Mann-Whitney *U* test or Kruskal-Wallis test for continuous variables. The *p* value of < 0.05 was considered as statistically significant.

RESULTS

Demographic and anthropometric characteristics of subjects

Table 1 represents the demographic information and anthropometric measurements of the subjects involved in this study. A total amount of 367 subjects were recruited and among these subjects, 44.4% of them were males while 55.6% were females. Subjects were categorized into two different age groups in this study - < 25 years were considered as the 'younger' group, while subjects ≥ 25 years old were considered as the 'older' group. The majority of the subjects in this study were aged < 25 with females more than males. This phenomenon is due to the study being conducted primarily in university campuses comprising of young students. In this study, the largest ethnic group was Chinese (n = 201, 54.8%) of which the majority of them were females. An equivalent number of Malay and Indian subjects participated in this study. The majority of the subjects were lean (56.9%), with lean and overweight subjects well-balanced for males. WHR, BMI and TBF were all significantly different among gender, with males having higher WHR and BMI (mean was in the overweight category).

Table 1. Demographic and anthropometric characteristics of the subjects

Variables	Male (n = 163)	Female (n = 204)
Ethnicity		
Malay	36 (22.1)	47 (23.0)
Chinese	91 (55.8)	110 (54.0)
Indian	36 (22.1)	47 (23.0)
Age groups (year)		
<25	125 (76.7)	131 (64.2)
≥25	38 (23.3)	73 (35.8)
BMI status		
Lean	80 (49.1)	129 (63.2)
Overweight	83 (50.9)	75 (36.8)
Anthropometric measurements (Mean ± SD)		
WHR	0.86 ± 0.07	0.80 ± 0.07
p	<0.001	
BMI (kg/m^2)	25.62 ± 15.82	22.74 ± 5.46
p	0.016	
TBF (%)	22.16 ± 10.83	25.75 ± 12.01
p	0.003	

WHR – waist-to-hip ratio, BMI – body mass index, TBF – total body fat; Numbers in brackets are percentage of total variable of the same column; p values by Mann-Whitney U test, significant at <0.05

Preference, intake frequency and craving hedonic ratings

Gender

For sweet beverages, females significantly preferred fruit juice and sweet dessert soup more; drank or ate less frequently ais kacang, cola/carbonated, chocolate malt and packet drinks but had equal craving of sweet foods compared to

males (Figure 1A). As for sweet food, females significantly preferred brownies, cake, chocolate and pudding; ate less frequently apple pie, ice cream, jam on bread and pisang goreng, but had equal craving for sweet food compared to males (except for cake) (Figure 1B).

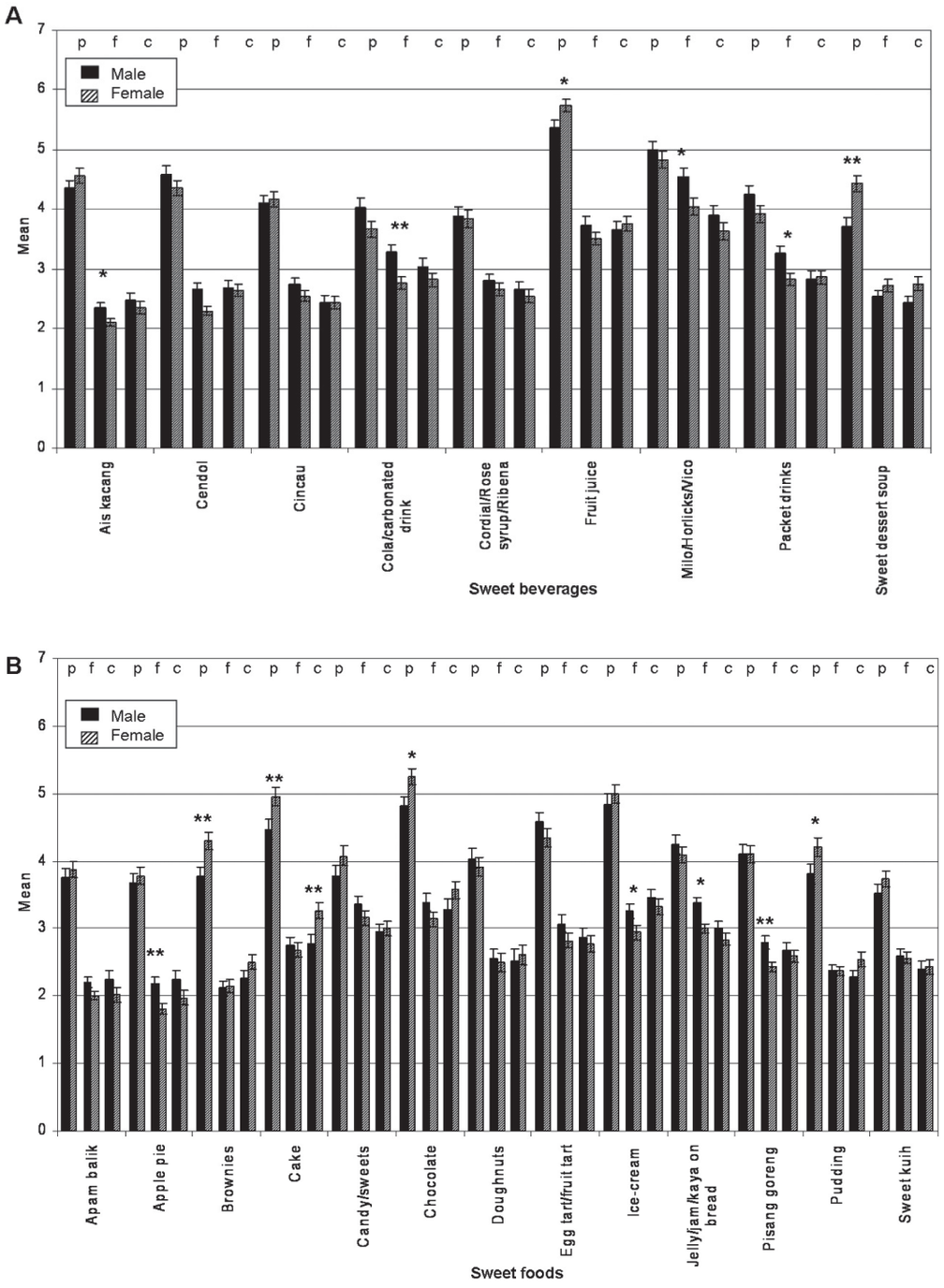

Figure 1. Means of hedonic ratings of preference (p), intake frequency (f) and craving (c) of (A) sweet beverages and (B) sweet foods among genders. Significant difference of means between genders was compared by Mann-Whitney *U* test, with levels of significance, *$p<0.05$ and **$p<0.01$ as indicated. Error bars are standard errors

Age group

The age group of <25 significantly preferred cola/carbonated, malt and packet drinks more; drank cincau, cola/carbonated, fruit juice, malt and packet drinks and sweet dessert soup more frequently; and craved cola/carbonated, fruit juice, malt and packet drinks and sweet dessert soup more than the 25 age group (Figure 2A). Furthermore, they also significantly preferred, ate and craved more brownies, cake, candy, chocolate, doughnuts, tart and ice cream more than the 25 age group (Figure 2B).

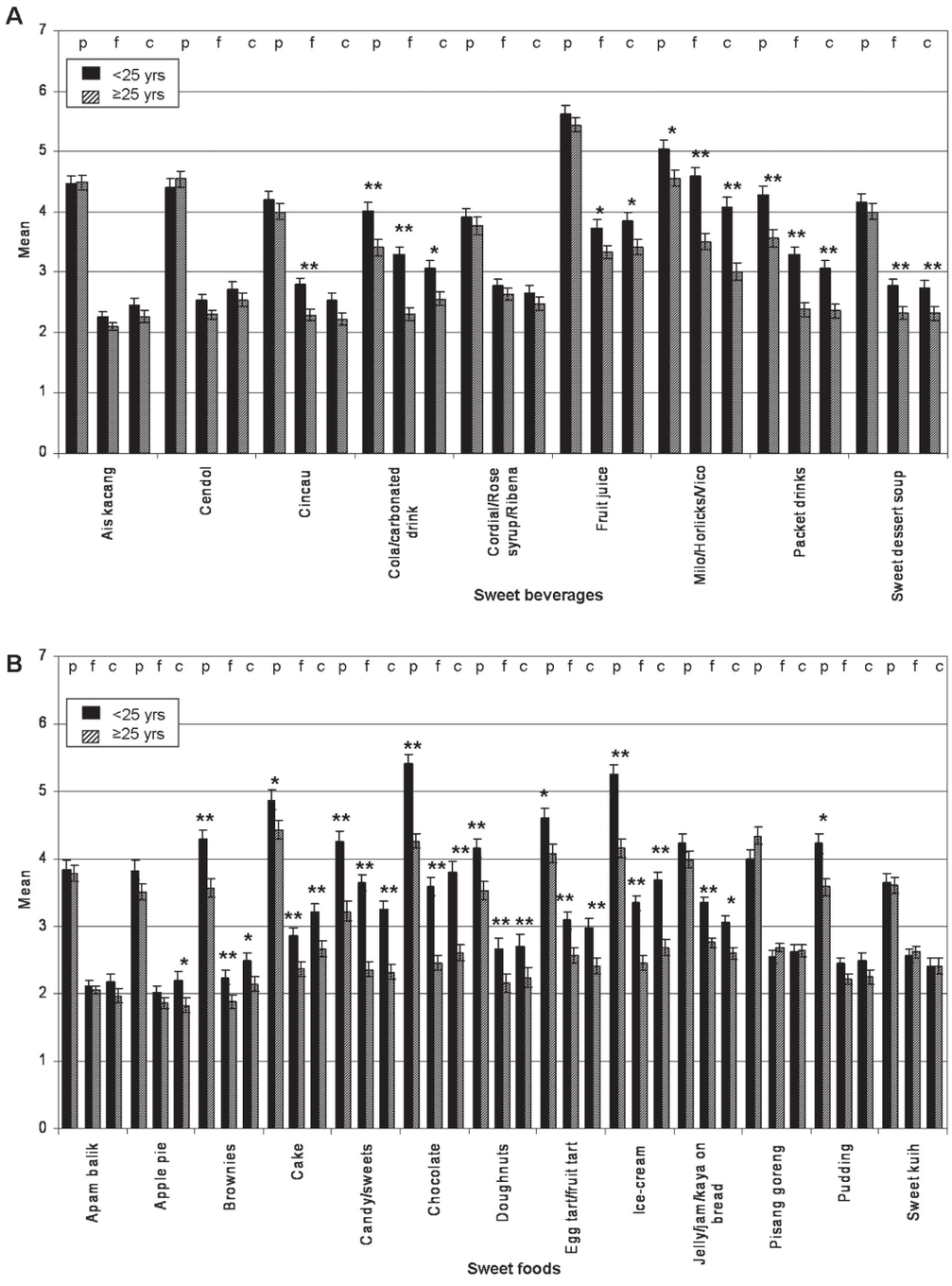

Figure 2. Means of hedonic ratings of preference (p), intake frequency (f) and craving (c) of (A) sweet beverages and (B) sweet foods among age groups. Significant difference of means between age groups was compared by Mann-Whitney *U* test, with levels of significance, **p*<0.05 and ***p*<0.01 as indicated. Error bars are standard errors

Ethnicity

Ethnic Malays had significantly higher preference, intake frequency and craving of cordial drinks and pisang goreng compared to other ethnicities (Figure 3). Ethnic Chinese had significantly higher intake frequency of cola/carbonated and chocolate malt drinks, candy, chocolate and ice-cream, and significantly higher preference and craving for sweet dessert soup and tarts. Of note, ethnic Indians tend to have a significantly higher preference of sweet kuih compared to Malays or Chinese (Figure 3B).

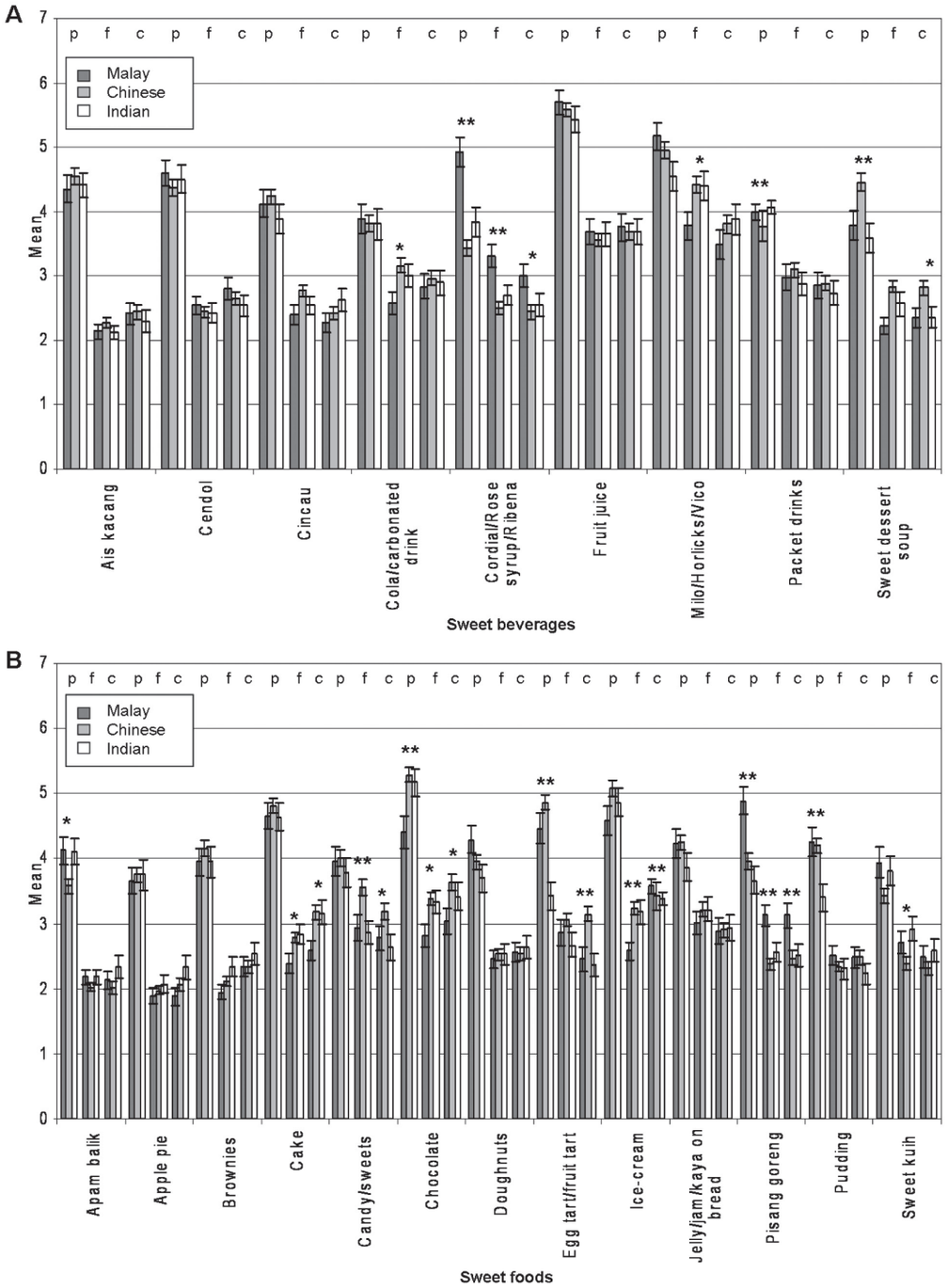

Figure 3. Means of hedonic ratings of preference (p), intake frequency (f) and craving (c) of (A) sweet beverages and (B) sweet foods among Malaysian ethnicities. Significant difference of means between ethnicities was compared by Kruskal-Wallis test, with levels of significance, *$p<0.05$ and **$p<0.01$ as indicated. Error bars are standard errors.

BMI status

Lean subjects significantly ate or drank and craved cincau, chocolate malt, packet drinks and sweet dessert soup more compared to the overweight group (Figure 4A). As well, they significantly preferred, ate and craved cake, candy, chocolate and pudding more compared to the overweight group (Figure 4B).

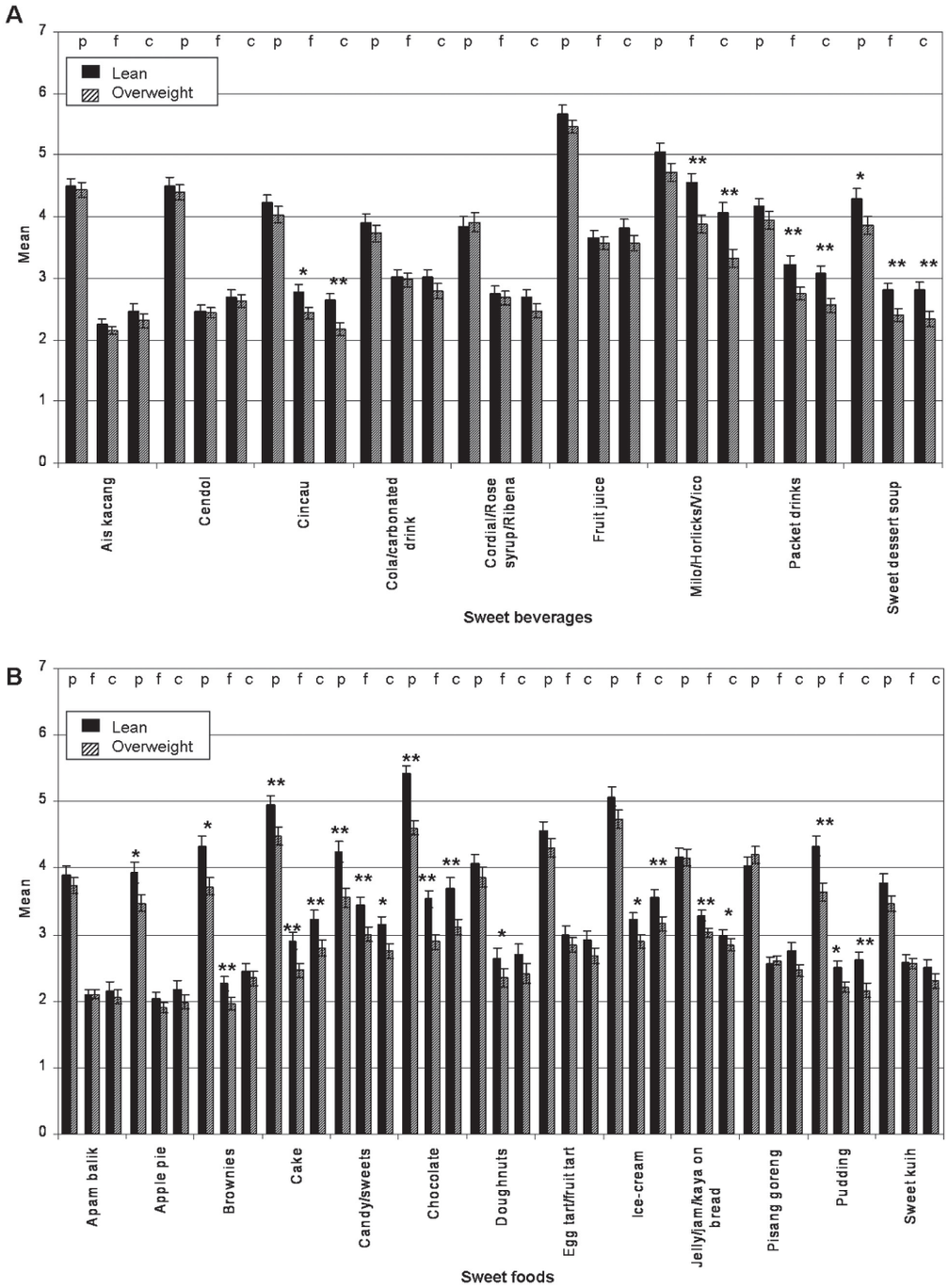

Figure 4. Means of hedonic ratings of preference (p), intake frequency (f) and craving (c) of (A) sweet beverages and (B) sweet foods among BMI status (lean and overweight). Significant difference of means between BMI groups was compared by Mann-Whitney *U* test, with levels of significance, **p*<0.05 and ***p*<0.01 as indicated. Error bars are standard errors

DISCUSSION

Consumption of sweet foods is influenced by a variety of biological, psychological, sociological, and environmental factors and on an individual level, taste preference for sweetness has been shown to have an influence on sugar consumption[15]. Sweet food intake is hard to measure accurately because of memory issues and disinclination of subjects to correctly report the food they eat. Individuals might under- or over-report intakes[16]. For instance, a person who is attempting to lose weight may tend to report smaller portions than were actually eaten. In this study, we investigated the determining patterns of the reported high prevalence of 'sweet tooth' among Malaysians of different ethnicities, by using a 7-point hedonic scale to estimate the preference, intake frequency and craving of a list of 22 commonly consumed Malaysian sweet food and beverages. Demographic (gender, age groups and ethnicity) and anthropometric (BMI status) differences were also compared.

The current study shows that Malaysian women significantly preferred more, ate or drank less frequently but had equal craving of sweet foods compared to men. Pertaining to preference, in contrast with our study, previous studies on sex differences revealed that although male and female infants do not differ in sweet preference[7], older boys and men prefer higher concentration of sweets as compared to women[8]. The higher mean of intake frequency of sweet foods in men compared to women supports the finding of earlier research at Italy which found that male ate food rich in saturated fats such as fried food, meat and sugar drinks more frequently than female did[17]. This is because female seemed to be more concerned about their weight and diet by eating healthy food, such as vegetables, more frequently than men did[17]. Meanwhile, studies on sweet craving suggest that women, more often than men, experience food cravings in general[18]. It has been reported that oestrogen may play a role in changes of sweet craving during the menstrual cycle[19]. However, our study found no evidence of gender difference in sweet food craving.

As for age, the group <25 years showed significantly higher preference, intake frequency and craving of sweet foods than 25 years, as expected. Preference for sweetness is affected by ageing as demonstrated by some studies[20]. Young people also had higher frequency of sweet intake than do elderly people in Japan[21]. Also, the investigation conducted by Drewnowski *et al.* (1997) [16] agreed with this finding. This phenomenon can be explained by changes in caloric requirements for growth, or the onset of puberty[16]. Meanwhile, sweet craving changes over the life span, and older women report less craving for sweet foods compared with younger women[9].

The ethnic differences in rating the preference, intake frequency and cravings seemed to be food-specific and culturally-related, as expected. For Malays, they seemed to have higher affinity towards cordial drinks and pisang goreng, Chinese - sweet dessert soup and tarts and Indians – sweet kuih. A pilot study among Malaysian children[22] found that although the difference in sweet preference between boys and girls was not statistically significant, the ethnic variation was. They suggested that diet and sugar eating habits, in particular sweet preference levels, are gradually nurtured over time by culturally accepted dietary norms[22]. This ethnic variability in the hedonic ratings of preference, intake frequency and craving is also supported by previous studies in other populations. For example, in Australia, Malaysian students (mainly ethnic Malays) had significantly higher sweetness perception but lower sweetness preference for high-sucrose orange juice samples, compared to their Caucasian counterparts[23].

It is commonly assumed that people with a sweet tooth will over-consume sweet foods, consequently causing a proportional rise in obesity (reviewed in [24]). Our study showed that the lean subjects showed significantly higher preference, intake frequency and craving of sweet foods than the overweight subjects. This result is supported by some studies which demonstrate that lean people prefer sweet food or drinks and consume more calories, as sugar, compared with obese people[25]. The reason for lean subjects to have a stronger craving for sweet foods could be explained by their high temptation in controlling the intake of high sugar-content-foods, while overweight subjects who might be less concerned about the consequences of sweet food intake, appear to have less craving for sweet items[26].

There were several limitations in this study. Firstly, the age of the subjects was more skewed towards young university and college students, although elderly subjects were included in this study. We are also aware of the small sample size, therefore limiting the power for statistical analysis and could not be generalized to reflect the entire Malaysian population. A larger sample size may prevent sampling bias. There may be also under-reporting of the sweet food preference, intake frequency and craving due to responder fatigue, memory recall and interviewer and subject bias. Sweet food preference, intake frequency and craving could also be associated with sweet genetic markers, like the sweet taste receptor genes TAS1R2 and TAS1R3, and leptin and leptin receptor genes, LEP and LEPR (reviewed in [27]). Studies in mice have indicated that the exchange of Ile to Thr at amino acid codon 60 of T1R3 (encoded by Tas1R3 gene; homologue for human TAS1R3) is attributed to lower sweetness preference[28], while studied in humans have indicated that single nucleotide polymorphisms rs307355 and rs35744813 of the TAS1R3 gene[29] and LEP A19G and LEPR K109R[30] are associated with sucrose sensitivity and sweet preference.

CONCLUSIONS

All in all, Malaysian females in this study significantly preferred more, ate or drank less frequently but had equal craving of sweet foods compared to males, whereas lean subjects and those <25 years showed significantly higher preference,

intake frequency and craving of sweet foods. Among ethnic groups, Chinese had significantly higher intake frequency but lesser craving of sweet foods compared to Malays and Indians. The Malaysian Dietary Guidelines generally recommend eating food and drinking beverages that are low in sugar (NCC, 2010). In addition to that, understanding the demographic and anthropometric factors that may affect the preference, intake frequency and craving of certain sweet foods can help to plan for more strategies in preventing the detrimental health effects of high sugar intake among Malaysians.

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