Original Article

The relationship between culture, food liking, and body mass index in Australian and Thai young adults

Uracha Wanich MSc[1], Lynn Riddell PhD[2], Sara Cicerale PhD[1], Mohammadreza Mohebbi PhD[3], Dhoungsiri Sayompark PhD[4], Djin Gie Liem PhD[1], Russell SJ Keast PhD[1]

[1]*Centre for Advanced Sensory Science, Deakin University, Geelong, Australia*
[2]*Institute for Nutrition and Physical Activity Research, Deakin University, Geelong, Australia*
[3]*Biostatistics Unit, Faculty of Health, Deakin University, Geelong, Australia*
[4]*Faculty of Science and Technology, Rajamangala University of Technology Tawan-ok, Chonburi, Thailand*

Background and Objectives: An individual's liking of food may be associated with Body Mass Index (BMI) due to its subsequent impact on food consumption. This study investigates the association between food liking and BMI in young adults from Australia and Thailand. **Methods and Study Design:** Food liking data were collected via a validated online Food Liking Questionnaire (FLQ). Food liking scores were calculated for overall liking of groupings of foods: grains, vegetables, fruits, dairy, animal protein, plant-based protein, fat and oil, sweet food, salty food, and alcohol. The relationship between food liking and BMI (calculated from self-reported height and weight) was assessed using linear regression models including country and gender, and mean differences were assessed using independent sample t-test. **Results:** Data were available from n=4,173 participants (BMI=22.25 (SD 4.18), age=20.6 (SD 4.22) years, female=71.6%, Thai=52.5%). There were significant differences of food liking between countries for all of food groups (p<0.01) except for animal-based protein and plant-based protein liking. BMI was positively, but weakly, associated with liking of animal-based protein (β=0.20 [0.12, 0.28], p<0.001), and alcohol (β=0.08 [0.02, 0.13], p<0.01) and negatively associated with plant-based protein (β=-0.09 [-0.18, -0.01], p<0.05). There was significant difference of food liking between weight status for all of food groups. **Conclusions:** This study supports only minor associations between food liking and BMI, but cultural and gender variation in liking was evident.

Key Words: food liking, cross-culture, BMI

INTRODUCTION

An individual's response to food is multi-dimensional and dynamic. Environment, experience, and a person's physical state are all factors that may influence liking decisions at any point in time.[1] It is the liking or prospective liking of a food that is one of the key drivers of consumption.[1-4] The impact of taste and food liking on food intake is influenced by age and gender, as well as specific attitudes and beliefs[2,5-7] Individuals who have health concerns and positive attitudes towards healthy food may not consume the food that they like the taste of.[8-10] For example, an individual may have a strong positive liking for chocolate, however does not consume chocolate due to concerns for their potential weight gain or for other health reasons.[4,11-13]

Food flavour has an important influence on food choice.[3,4,14,15] The liking of a food's flavour is an important driver of short-term food consumption, as those who enjoy the food they are consuming tend to eat more of it.[1,4,16] Energy imbalances due to overconsumption of food is common, especially given discretionary foods high in palatable fat, sugar and salt are increasing in abundance in both economically developed and developing nations.[17-21] Obesity represents the largest preventable disease worldwide and is a contributor to ill-health out comes including cardiovascular disease, stroke, type 2 diabetes, hypertension, arthritis, respiratory disorders and certain cancers.[22] Whilst the causes of obesity are multifactorial and complex, they are embedded within energy imbalances brought about by psychological, cultural, personal, environmental, lifestyle, and dietary factors which favour excessive energy intake coupled with sedentary behaviour.[23] Food liking may has been observed to be a driver for food consumption and may in part be responsible for excessive energy intakes. A study by Duffy et al[24] demonstrated that the liking of fatty foods was positively correlated with fat intake. Further, a positive relationship between the liking for fatty foods, body weight and systolic blood pressure was found. This relationship between

Corresponding Author: Dr Russell SJ Keast, Centre for Advanced Sensory Science, Deakin University, Geelong, Australia.
Tel: +61 3 924 46944
Email: russell.keast@deakin.edu.au
Manuscript received 20 April 2019. Initial review completed 15 May 2019. Revision accepted 02 June 2019.
doi:

food liking and dietary intake was also observed in a large study by Mejean et al. The study found that those with a higher liking for fatty foods had an increased intake of total energy, fat and certain foods (high in fat) such as meat, butter, desserts and pastries, and a positive relationship between the liking for fatty foods and obesity risk was observed.[25]

The liking of a specific food, or set of foods, primarily reflects the cultural environment in which an individual is brought up in, and their individual experiences with such food.[4,12,16,26,27] The impact of culture, social, and economic factors additionally contribute to the development, maintenance and change of an individual's dietary pattern. For example, in Thailand the traditional food culture was based on a foundation of rice accompanied with fish and vegetables. However, economic and westernisation transition has transformed the lifestyle and dietary pattern of Thai culture, which affected the diet pattern of Thai population.[18,28-30] Intra-individual determinants such as psychology and psychological factors, and acquired food preferences and knowledge, can be distinguished from interpersonal or social factors. Such interpersonal or social factors could include family and group influences, where such cultures may influence eating behaviours directly.[11,31,32] In different cultures individuals tend to eat different foods whilst maintaining a preference for the food which is more closely aligned with their own cuisines than the cuisines of other cultures.[33,34] However, there are few studies which investigate the relationship between food liking and culture. Of the limited studies available on cultural influences and individual experiences with food, the study by Wanich et al observed differences in food liking between Australian and Thai individuals using laboratory based food taste testing methodologies.[35] Another study looked at the cultural difference in liking of coffee in four difference ethic groups via questionnaires.[36] They found cultural differences in the practice of adding sugar to coffee, but didn't find overall differences in liking for hot coffee. This suggests that individuals can adapt food flavours to suit their cultural preferences.

The transition into a young adult involves major changes in an individual's environment. This constitutes a time of transition during which, the young adult may become more independent from their family which could encompass a change to living arrangements, a difference in food choice, and the amount of food consumed.[37,38] The health behaviours of young adults during this time have been shown to dramatically decline which in turn may influence the long-term health of the individual.[39-41] These changes in health behaviours for young adults include modifications to their way of eating which results in decreased food variety, decreased intake of fruit and vegetables, increased consumption of food high in energy, increased consumption of alcoholic drinks, ready meals, frozen meals, raw and cold meals.[42-47]

Exploring the relationship between food liking and BMI in two cultures, during a period of lifestyle transition has not been widely studied, but as indicated in the aforementioned studies, liking of a food appears as one of the key factors influencing intake. The aim of this study was therefore to investigate the association between food liking and BMI in young adults from Australia and Thailand.

METHODS

This study used an online survey to investigate the relationship between culture, food liking, and BMI in Australian and Thai participants. All participants were over 18 years old. A Food Liking Questionnaire (FLQs) was used to collect the food liking data,[35] additional questions were included to record participants self-reported height and weight.

Participants and procedures

Australian participants (who were undergraduate students enrolled in a Food and Nutrition subject at Deakin University), were invited to take part during 2015-2017. Students completed the data collection as part of their assessment tasks for HSN101 Foundations of Food, Nutrition and Health. After completion of their assignments they were invited to provide consent to allow the data to be used for research purposes. Ethics approval was obtained from the Human Research Ethics Committee at Deakin University (HEAG-H 163_2009) and all participants who agreed to participate in the study provided written informed consent.

Thai participants were first year undergraduate students enrolled at the start of the 2016 and 2017 Thai academic year from eight universities, and were not necessarily studying a health-related course or subject. The following universities were invited to participate: Rajamangala University of Technology Tawan-ok (Eastern of Thailand), Kasetsart University (Central of Thailand), Phetchabun Rajabhat University (Northern of Thailand), Rambhaibarni Rajabhat University (Eastern of Thailand), Chiang Mai Rajabhat University (Northern of Thailand), Rajabhat Maha Sarakham University (Northeast of Thailand), Phranakhon Si Ayutthaya Rajabhat University (Central of Thailand), Mahidol University (Central of Thailand). There were no further screening processes used in the selection of participants for Thai participants. The recruitment strategy included an invitation email containing a link to the survey with up to three repeat emails. The e-mail explained the purpose of the survey, described the importance of the students' participation, assured anonymity of responses, informed participants that by linking to the survey they would provide consent, and stated that they would be entered a random draw upon completion of the survey. If the participant was selected from the random draw, they would receive a gift card. In addition, brief presentations were made in classes and a hand out containing the QR code to the survey questions were given to the students. Ethics approval was obtained from the Human Research Ethics Committee at Deakin University (HEAG-H 18_2016), and Mahidol University in Thailand required their own ethical approval which was granted by Centre of Ethical Reinforcement for Human Research (MU-CIRB 2016/167.1710). Figure 1 outlines participant recruitment.

Food liking questionnaire (FLQ)

A modified version of a FLQ from Duffy et.al[24] was adapted for culturally relevant Australian and Thai

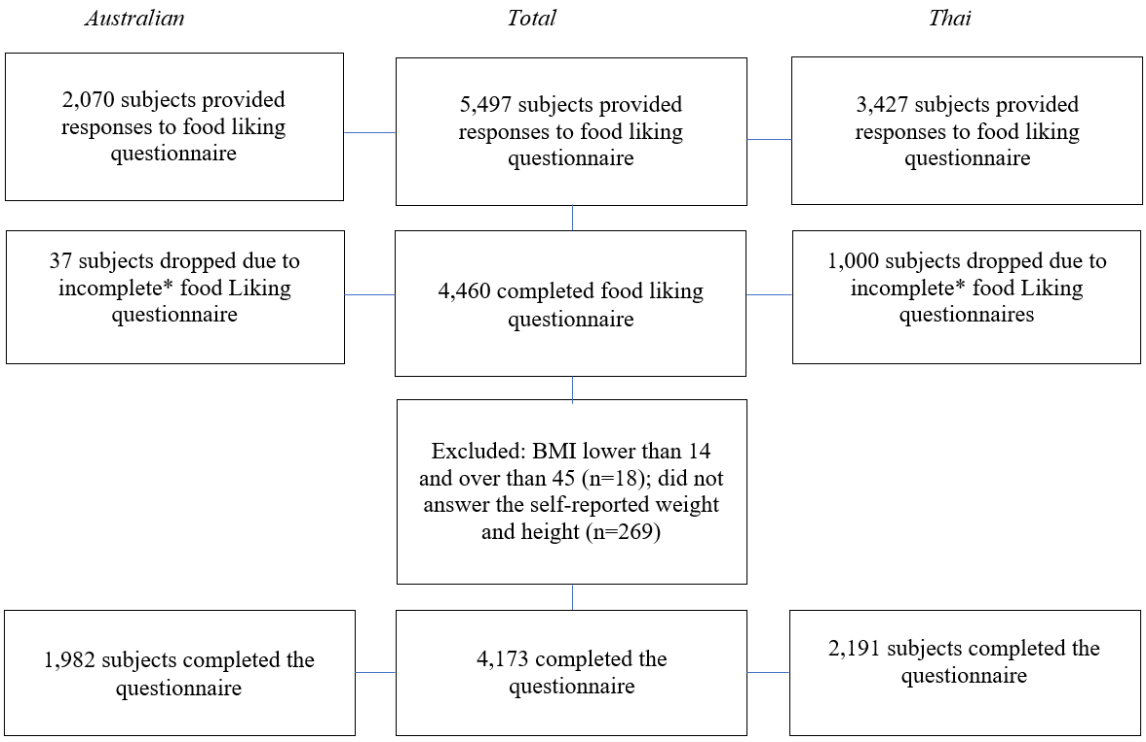

Figure 1. Participant recruitment (100% complete FLQ). * Incomplete FLQ – defined as missing any liking rating for any food or beverage item

foods.[35] The Australian version of the questionnaire contained 73 food items, and the Thai questionnaire contained 89 food items. As many foods as possible were kept consistent between the Australian and Thai questionnaires to allow direct comparison. Examples of foods used in both questionnaires included: beef, cornflakes, potato chips, strawberries, pizza, and chocolate. The Australian questionnaire included the following culturally specific foods: Kentucky Fried Chicken (KFC) and rotisserie chicken. The Thai questionnaire included the following culturally specific foods: chilli dip, fermented fish, foods that have coconut milk/oil, spicy curry, Tom yum, sticky rice, a Thai dessert made from egg yolk and sugar, fruit in thick syrup, and sweet test fruits. The FLQ used a nine-point hedonic scale for rating liking of items. This scale consists of a series of nine verbal categories representing degrees of liking from 'dislike extremely' to 'like extremely'. For subsequent quantitative and statistical analysis, and all verbal categories were converted to numerical values: 'like extremely' was coded as '9', 'dislike extremely' as '1'. Both FLQs contained the instruction "if you have never eaten a food, or never experienced one of the listed items, please rate the item as 'neither like or dislike'". The Thai questionnaire was translated directly into Thai by the lead author, a Thai researcher based in Australia and was reviewed by one co-author, a Thai researcher based in Thailand to ensure cultural appropriateness and accuracy. All data were collected using online survey tools. For the Australian cohort, Qualtrics software (Provo, Utah, USA) was used, and for the Thai cohort, Survey Monkey Audience (San Mateo, California, USA) was used. The foods were classified into ten main categories following the Australian and Thai dietary guidelines: grains, vegetables, fruits, dairy, animal-based protein, plant-based protein, fat and oil, sweet food, salty food, and alcohol.

Statistical analysis

Statistical analyses were carried out using SPSS version 25.0 (IBM Corporation, Armonk, NY, USA). Cronbach's Alpha was used to determine internal consistency of each food group. The Cronbach's alpha values were interpreted as unacceptable (<0.50), poor (0.51-0.60), questionable (0.61-0.70), acceptable (0.71-0.80), good (0.81-0.90), and excellent (0.91-1).[48] Relationships between food liking and BMI (calculated from a self-reported height and weight) was assessed using linear regression models accounting for country and gender. Eta-square effect size ($\eta 2$) was calculated for multiple regression to determine magnitude of the associations. η^2 was interpreted as small (<0.02), medium (0.02-0.13), and large (>0.26).[49] Independent sample t-test was used to compare the food liking groups between countries and genders, a value of $p<0.05$ was considered statistically significant. One-way ANOVA was performed to compare food liking with BMI categories followed by Post-Hoc comparison, Bonferroni method was used to account for multiple comparison.

RESULTS

Participant characteristics

From the n=4,460 participants that were initially available, n=287 participants were excluded because they did not answer the self-reported weight and height or provided unusual data (BMI lower than 14 and over than 50) leaving the total number of participant n=4,173. The mean age was 20.6 (4.22) years. The majority (71.6%) of the participants in this study were female. The average of BMI was 22.25 (4.18). Twenty-four percent (n=1,037)

were overweight. See Table 1 for the complete demographics.

The overall reliability coefficient for the internal consistency of food liking group

In total N=5,497 subjects provided responses to the FLQ, and n=1,037 subjects were excluded from the final analysis due to incomplete liking questionnaires. This left 4,460 subjects available to determine the reliability coefficient. Internal consistency was measured with Cronbach's alpha and is documented in Table 2.

Validity for each of the food liking groups ranged from 0.54 to 0.85, as shown in Table 2. Validity was good (0.81-0.90) for animal-based protein and salty food group, acceptable (0.71-0.80) for vegetables, fruits, sweet food and alcohol group, questionable (0.61-0.70) for dairy group, and poor (0.51-0.60) for grains, plant-based protein and fat and oil group.

Associations between food liking and BMI

Linear regression analysis was used to investigate the association between food liking groups and BMI. The effect size estimates for multiple regression for the association between food liking groups and BMI were small for all of food groups (<0.02) (Table 3).

The liking score of animal-based protein and alcohol showed statistically significant positive associations with BMI. Thus, an increased liking of animal-based protein (β=0.20, CI [0.12, 0.28]) and alcohol (β=0.08, CI [-0.03, 0.28]), was associated with an increase in BMI. For plant-based protein, an increased liking was associated with a lower BMI (β=-0.09, CI [-0.18, -0.01]) (Table 3).

Linear association was used to examined food liking and BMI in Australian participants. An increased liking for diary (β=0.13, CI [0.04, 0.21]), animal-based protein (β=0.16, CI [0.08, 0.24]), fat and oil (β=0.22, CI [0.11, 0.32]), sweet food (β=0.23, CI [0.13, 0.34]), salty food (β=0.23, CI [0.12, 0.34]), and alcohol (β=0.07, CI [-0.00, 0.14] was associated with an increase in BMI. Liking scores of plant-based protein had a negative association with BMI with an increase liking associated with a lower BMI (β=-0.14, CI [-0.24, -0.04]).

Linear association was used to examine food liking and BMI in Thai participants. An increase in liking for ani-

Table 1. Characteristics of study participants (n=4,173)

Characteristic	Total participants M (SD)	Australia (n=1982) M (SD)	Thai (n=2191) M (SD)	Male† (n=1183) M (SD)	Female† (n=2975) M (SD)
Age (years),	20.6 (4.22)	22.3 (5.53)	19.0 (1.14)	20.3 (3.19)	20.7 (4.55)
Height (cm)	166.7 (9.30)	169.4 (9.32)	164.3 (8.59)	175.7 (7.72)	163.1 (7.25)
Weight (kg)	62.2 (14.43)	65.9 (12.82)	59.8 (14.97)	71.8 (15.24)	58.4 (12.15)
BMI (kg/m^2)	22.25 (4.18)	22.88 (3.52)	21.67 (4.62)	23.2 (4.31)	21.9 (4.07)
Weight status (BMI) % (*n*)‡					
Underweight	15.5 (645)	5.3 (105)	24.6 (540)	11.0 (130)	17.2 (513)
Healthy weight	59.7 (2487)	73.9 (1464)	46.9 (1027)	54.5 (645)	61.8 (1840)
Overweight	13.3 (553)	16.3 (323)	10.6 (232)	18.5 (219)	11.2 (332)
Obese	11.6 (482)	4.5 (90)	17.9 (392)	16.0 (190)	9.8 (290)

M: mean; SD: standard deviation; BMI: body mass index.
†Fifteen participants did not identify gender.
‡Australian weight status: underweight ≤18.5: healthy weight BMI 18.5-24.9 (kg/m^2): overweight BMI 25-29.9 (kg/m^2): obese BMI ≥30 (kg/m^2).[50] Thai weight status: underweight BMI ≤18.5: healthy weight BMI 18.5-22.9 (kg/m^2): overweight BMI 23-24.9 (kg/m^2): obese BMI ≥25 (kg/m^2).[51,52]

Table 2. Examining internal consistency of conceptual groups generated from a food liking survey using Cronbach's alpha in Australian and Thai young adults (n=4,460)

Groups (58 items)	Cronbach's alpha†	M (SD)
Grains – plain porridge, wholegrain bread, spaghetti, rice, grains	0.54	6.6 (1.04)
Vegetables – tomato, greens, broccoli, carrot, cabbage, mushrooms, potato (not deep-fried chips), vegetable soup	0.79	6.6 (1.35)
Fruits – apple, pineapple, melon, berries, banana, orange, grapes	0.78	7.4 (1.07)
Dairy - milk, yoghurt, cheese	0.70	6.9 (1.59)
Animal-based protein – beef steak, lamb, pork products, chicken, duck, white fish, pink fish, eggs	0.81	6.4 (1.56)
Plant – based protein - beans and beans products (not include beverage), tofu, nuts	0.56	6.2 (1.51)
Fat and oil – butter, margarine, olive oil	0.59	5.5 (1.49)
Sweet food – ice cream, sweet biscuits, chocolate, lollies, cake, cola soft drinks, citrus soft drinks, fruit juice	0.80	6.7 (1.27)
Salty food – cornflakes, white bread, potato chips (crisps), corn chips, savoury biscuits, ham burgers, hot chips, Asian takeaway, pizza, toasted sandwich, KFC/Red Rooster/rotisserie chicken	0.85	6.4 (1.26)
Alcohol – red wine, white wine, beer e.g. lager/bitter	0.80	4.71 (2.24)

M: mean; SD: standard deviation.
†Classification of Cronbach's alpha value: <0.50 = unacceptable; 0.51-0.60 = poor; 0.61-0.70 = questionable; 0.71-0.80 = acceptable; 0.81-0.90 = good; 0.91-1 = excellent. [48]

Table 3. Bivariate linear regression analysis investigating the association between food liking groups and BMI as reported by FLQ

Variable	Liking score											
	Total participants				Australian				Thai			
	M (SD)	β†	95% CI	η^2	M (SD)	β[1]	95% CI	η^2	M (SD)	β [1]	95% CI	η^2
Grains	6.6 (1.04)	-0.07	-0.19, 0.05	0.00	6.8 (1.09)	-0.04	-0.18, 0.12	0.00	6.5 (0.98)	-0.11	-0.31, 0.08	0.00
Vegetables	6.6 (1.35)	-0.01	-0.11, 0.08	0.00	7.0 (1.12)	-0.03	-0.18, 0.11	0.00	6.3(1.45)	0.00	-0.13, 0.13	0.00
Fruits	7.4 (1.06)	-0.09	-0.20, 0.03	0.00	7.6 (0.92)	-0.03	-0.20, 0.14	0.00	7.2 (1.15)	-0.12	-0.28, 0.05	0.00
Dairy	6.9 (1.61)	0.07	-0.01, 0.15	0.00	6.7 (1.87)	0.13**	0.04, 0.21	0.01	7.0 (1.32)	-0.03	-0.17, 0.12	0.00
Animal-based protein	6.4 (1.57)	0.20***	0.12, 0.28	0.01	6.4 (1.93)	0.16***	0.08, 0.24	0.01	6.4 (1.18)	0.31***	0.14, 0.47	0.01
Plant-based protein	6.2 (1.51)	-0.09*	-0.18, -0.01	0.00	6.2 (1.57)	-0.14**	-0.24, -0.04	0.00	6.2 (1.46)	-0.05	-0.18, 0.09	0.00
Fat and oil	5.5 (1.48)	0.07	-0.01, 0.12	0.00	5.8 (1.45)	0.22***	0.11, 0.32	0.01	5.4 (1.50)	-0.05	-0.18, 0.07	0.00
Sweet food	6.7 (1.27)	-0.02	-0.12, 0.08	0.00	6.5 (1.42)	0.23***	0.13, 0.34	0.01	6.9 (1.08)	-0.40***	-0.58, -0.23	0.01
Salty food	6.4 (1.26)	0.04	-0.06, 0.14	0.00	6.5 (1.37)	0.23***	0.12, 0.34	0.01	6.3 (1.16)	-0.20*	-0.36, -0.03	0.00
Alcohol	4.7 (2.23)	0.08**	0.02, 0.13	0.00	4.3 (2.15)	0.07*	-0.00, 0.14	0.00	5.1 (2.26)	0.09*	-0.00, 0.17	0.00
Overall	6.5 (0.79)	0.12	-0.03, 0.28	0.00	6.5 (0.49)	0.40***	0.21, 0.59	0.01	6.4 (0.80)	-0.12	-0.36, 0.12	0.00

M: mean; SD: standard deviation; n: number of participants in each group; CI: confidence interval.
B: Standardised beta coefficient (countries, gender).
B[1]: Standardised beta coefficient (gender).
η2: Eta-square effect size estimates for multiple regression small (<0.02), medium (0.02-0.13), and large (>0.26).[49]
Significance indicated the ** $p<0.01$, *** $p<0.001$.

mal-based protein (β=0.31, CI [0.14, 0.47]) and alcohol (β=0.09, CI [-0.00, 0.17]) was associated with an increase in BMI. Liking for sweet food (β=-0.40, CI [-0.36, -0.03]) and salty food (β=-0.20, CI [-0.36, -0.03]) was associated with a lower BMI.

Comparing food liking between weight status

One-way ANOVA were used to compare the mean differences of food liking between BMI categories (Table 4). Bonferroni method was used for accounting in Post-Hoc comparisons. Significant mean (Bonferroni adjusted alpha =0.008) were observed for Post-Hoc comparison across BMI categories for all food groups.

The mean difference of food liking between BMI categories in Australian participants was statistically significant in six food groups: dairy, animal-based protein, plant-based protein, fat and oil, sweet food, and salty food. There was difference between participants of a healthy weight and those overweight, in the liking of plant-based protein (p<0.0001) with healthy weight participants rating liking higher than overweight. There was significant difference liking of dairy (p<0.001), animal-based protein (p<0.0001), fat and oil (p<0.0001), sweet food (p<0.0001) and salty food (p<0.001) groups with overweight participants rating liking higher than healthy weight participants

The mean difference of food liking between BMI categories in Thai participants was statistically significant in two food groups: animal-based, and sweet food. Participants in the underweight category rated liking of animal-based protein significantly lower than other BMI categories (p<0.0001). Underweight participants have significant higher liking of sweet food than obese participants (p<0.0001).

Comparing food liking between Australian and Thai participants

Independent sample t-tests were used to compare the mean differences of liking of food groups between Australian and Thai participants (Table 5).

Statistically significant mean differences between Australian and Thai samples of food liking were observed for seven food liking groups: grains (mean difference (MD)=0.28, CI [0.22, 0.34]) Australian vs Thai), vegetables (MD=0.71, CI [0.64, 0.79]), fruits (MD=0.38, CI [0.32, 0.44]), dairy (MD=-0.26, CI [-0.36, -0.16]), fat and oil (MD=0.39, CI [0.30, 0.48]), sweet food (MD=-0.47, CI [-0.55, -0.39]), and alcohol (MD=-0.76, CI [-0.89, 0.63]) (all p<0.001). Statistically significant differences (p<0.01) were also found in salty food liking (MD=0.13, CI [0.05, 0.20]).

Comparing food liking between gender

Independent sample t-tests were used to compare the mean differences of food liking between genders (Table 6). Statistically significant mean differences between genders (p<0.001) were observed in all food groups except for plant-based protein liking.

The mean differences of food liking scores between genders was statistically significant (p<0.001) in nine food groups (all Mean Differences are male-female, respectively): grains (MD=-0.20, CI [-0.27, -0.13]), vegetables (MD=-0.32, CI [-0.41, -0.23]), fruits (MD=-0.20, CI [-0.27, -0.12]), dairy (MD=0.37, CI [0.27, 0.47]), Animal-based protein (MD=0.79, CI [0.69, 0.88]) fat and oil (MD=0.26, CI [0.16, 0.36]), sweet food (MD=0.16, CI [0.07, 0.24]), salty food (MD=0.23, CI [0.15, 0.32]), and alcohol (MD=0.87, CI [0.72, 1.01]).

The mean differences of food liking scores between genders in Australian participants was statistically significant (p<0.001) for all food groups: grain (MD=-0.40, CI [-0.52, -0.28]), vegetables (MD=-0.73, CI [-0.85, -0.61]), fruits (MD=-0.22, CI [-0.32, -0.10]), dairy (MD=0.65, CI [0.49, 0.82]), animal-based protein (MD=1.09, CI [0.93, 1.25]), plant-based protein (MD=-0.52, CI [-0.68, -0.37]), fat and oil (MD=0.30, CI [0.16, 0.45]), sweet food (MD=0.37, CI [0.22, 0.51]), salty food (MD=0.35, CI [0.21, 0.49]), and alcohol (MD=0.50, CI [0.27, 0.70]).

The mean differences of food liking scores between genders in Thai participants was statistically significant (p<0.001 and p<0.05) for seven food groups: fruits (MD=-0.11, CI [-0.22 -0.01]), dairy (MD=0.12, CI [0.00, 0.24]), animal-based protein (MD=0.58, CI [0.47, 0.68]), plant-based protein (MD=0.32, CI [0.20, 0.45]), fat and oil (MD=0.30, CI [0.17, 0.44]), salty food (MD=0.17, CI [0.07, 0.28]), and alcohol (MD=1.01, CI [0.81, 1.21]).

DISCUSSION

The objective of this study was to investigate the association between food liking and BMI in young adults from Australia and Thailand.

One of our primary findings was that those participants who reported a high liking of animal-based protein and alcohol had higher BMI. This observation occurred in both the Australian and Thai participants. Similar results have been observed in previous studies where the liking for animal-based protein has been observed to have positive associations with BMI. A study by Pallister et al[53] reported on the trends of food preference patterns and BMI in a UK twin cohort with higher liking for an animal-based protein pattern associated with a higher BMI. Appleton noted that frequency of consumption of animal-based protein was also associated with the liking of animal-based protein and a higher BMI in a cohort from the UK.[54] As liking of a food is an important driver of food consumption, increased liking for animal based protein is likely to result in increased consumption of this food group.[1,55] Supporting this hypothesis, Mela, Frehlich et al, and Maskarinec et al[55-57] have observed that individuals who have a higher intake of animal-based protein have a higher BMI. This higher intake is at least in part likely to be driven by increased liking of this food group.

There was higher liking of alcohol in overweight and obese participants in both countries. A higher liking of alcohol may lead to higher intake which has been shown to be positively associated with BMI as alcohol is a source of high energy.[58-61] In addition, students living independently have been shown to have increased alcohol consumption compared with students living at home,[44,62] the increased liking for alcohol combined with the transition into independent living may increase the risk of further weight gain in both Australian and Thai young adults.

Table 4. Comparing food liking between weight status

Variable	Liking Score													
	Total participants (n = 4,173)				F (df1, df2)	Australian† (n = 1,982)				F (df1, df2)	Thai‡ (n = 2,191)				F (df1, df2)
	UWt M (SD)	Healthy M (SD)	OWt M (SD)	Obese M (SD)		UWt M (SD)	Healthy M (SD)	OWt M (SD)	Obese M (SD)		UWt M (SD)	Healthy M (SD)	OWt M (SD)	Obese M (SD)	
Grains	6.5 (1.03)	6.7 (1.04)	6.6 (1.10)	6.5 (0.99)	9.16 * (3, 4169)	6.7 (1.20)	6.8 (1.07)	6.7 (1.13)	6.6 (1.09)	1.78 (3, 1972)	6.5 (1.00)	6.5 (0.97)	6.5 (1.04)	6.4 (0.97)	1.18 (3, 2187)
Vegetables	6.3 (1.46)	6.7 (1.31)	6.6 (1.28)	6.3 (1.41)	21.58 * (3, 4169)	7.0 (1.13)	7.0 (1.12)	6.8 (1.16)	6.9 (1.01)	3.35 (3, 1972)	6.2 (1.48)	6.3 (1.43)	6.4 (1.40)	6.2 (1.46)	1.29 (3, 2187)
Fruits	7.3 (1.03)	7.5 (1.05)	7.3 (1.07)	7.2 (1.17)	10.90 * (3, 4169)	7.5 (0.80)	7.6 (0.93)	7.5 (0.96)	7.5 (0.88)	2.43 (3, 1972)	7.3 (1.07)	7.2 (1.15)	7.2 (1.19)	7.1 (1.21)	1.36 (3, 2187)
Dairy	6.9 (1.45)	6.8 (1.71)	7.1 (1.44)	6.9 (1.43)	4.18 * (3, 4169)	6.3 (2.05)	6.7 (1.93)	7.0 (1.60)	6.8 (1.57)	5.29 * (3, 1972)	7.0 (1.28)	7.0 (1.34)	7.1 (1.19)	7.0 (1.40)	0.55 (3, 2187)
Animal-based protein	6.2 (1.35)	6.3 (1.72)	6.7 (1.34)	6.5 (1.25)	16.02 * (3, 4169)	6.0 (2.15)	6.3 (2.01)	6.9 (1.41)	6.5 (1.48)	10.79 * (3, 1972)	6.2 (1.13)	6.4 (1.17)	6.5 (1.20)	6.6 (1.20)	8.41* (3, 2187)
Plant-based protein	6.1 (1.48)	6.2 (1.53)	6.2 (1.47)	6.0 (1.52)	3.48 (3, 4169)	6.0 (1.57)	6.3 (1.57)	6.0 (1.49)	5.7 (1.72)	7.18 * (3, 1972)	6.1 (1.46)	6.2 (1.47)	6.4 (1.41)	6.1 (1.47)	2.41 (3, 2187)
Fat and oil	5.5 (1.47)	5.5 (1.51)	5.8 (1.42)	5.5 (1.49)	4.21 * (3, 4169)	5.7 (1.42)	5.7 (1.49)	6.0 (1.30)	6.0 (1.25)	7.01* (3, 1972)	5.5 (1.48)	5.3 (1.51)	5.3 (1.48)	5.3 (1.51)	1.16 (3, 2187)
Sweet food	6.7 (1.13)	6.6 (1.35)	6.8 (1.12)	6.8 (1.11)	16.24 * (3, 4169)	6.3 (1.46)	6.4 (1.47)	6.2 (1.18)	6.8 (1.14)	6.52 * (3, 1972)	7.1 (1.00)	6.9 (1.11)	6.9 (1.04)	6.8 (1.10)	8.20 * (3, 2187)
Salty food	6.4 (1.20)	6.4 (1.32)	6.6 (1.10)	6.4 (1.19)	3.4 (3, 4169)	6.3 (1.37)	6.4 (1.44)	6.7 (1.09)	6.8 (1.05)	5.86 * (3, 1972)	6.4 (1.17)	6.3 (1.15)	6.4 (1.10)	6.2 (1.20)	1.62 (3, 2187)
Alcohol	4.8 (2.24)	4.6 (2.23)	4.7 (2.18)	4.7 (2.25)	10.91* (3, 4169)	4.0 (2.28)	4.3 (2.15)	4.4 (2.05)	4.7 (2.12)	1.88 (3, 1972)	4.9 (2.20)	5.0 (2.26)	5.1 (2.29)	5.3 (2.26)	2.70 (3, 2187)
Overall	6.4 (0.81)	6.5 (0.81)	6.6 (0.72)	6.5 (0.80)	4.89 * (3, 4169)	6.6 (0.68)	6.7 (0.68)	6.5 (0.81)	6.3 (0.90)	4.94 * (3, 1972)	6.4 (0.80)	6.4 (0.81)	6.5 (0.76)	6.4 (0.81)	0.63 (3, 2187)

UWt: underweight; OWt: overweight; M: mean; SD: standard deviation; n: number of participants in each group.
†Australian weight status, underweight ≤18.5, healthy weight BMI 18.5-24.9 (kg/m^2), overweight BMI 25-29.9 (kg/m^2), obese BMI ≥30 (kg/m^2).[50]
‡Thai weight status, underweight BMI ≤18.5, healthy weight BMI 18.5-22.9 (kg/m^2), overweight BMI 23-24.9 (kg/m^2), obese BMI ≥25 (kg/m^2).[51,52]
p values are for the comparison food liking rating between Australian and Thai samples were determined using One- way ANOVA.
*Bonferroni adjusted significance level=0.008.

Table 5. Comparing food liking between countries

Variable	Liking score, M (SD)				
	Total participants n=4,173	Australian n=1,982	Thai n=2,191	MD	95% CI of the difference
Grains	6.6 (1.04)	6.8 (1.09)	6.5 (0.98)	0.28	0.22, 0.34***
Vegetables	6.6 (1.35)	7.0 (1.12)	6.3 (1.45)	0.71	0.64, 0.79***
Fruits	7.4 (1.06)	7.6 (0.92)	7.2 (1.15)	0.38	0.32, 0.44***
Dairy	6.9 (1.61)	6.7 (1.87)	7.0 (1.32)	-0.26	-0.36, -0.16***.
Animal-based protein	6.4 (1.57)	6.4 (1.93)	6.4 (1.18)	0.39	-0.09, 0.09
Plant-based protein	6.2 (1.51)	6.2 (1.57)	6.2 (1.46)	-0.04	-0.05, 0.13
Fat and oil	5.5 (1.48)	5.8 (1.45)	5.4 (1.50)	0.39	0.30, 0.48***
Sweet Food	6.7 (1.27)	6.5 (1.42)	6.9 (1.08)	-0.47	-0.55, -0.39***
Salty Food	6.4 (1.26)	6.5 (1.37)	6.3 (1.16)	0.13	0.05, 0.20**
Alcohol	4.7 (2.23)	4.3 (2.15)	5.1 (2.26)	-0.76	-0.89, 0.63***
Overall	6.5 (0.79)	6.5 (0.49)	6.4 (0.80)	-0.05	0.05, 0.14***

M: mean; SD: standard deviation; n: number of participants in each group; MD: mean difference.
p values are for the comparison food liking rating between Australian and Thai samples were determined using independent sample t-tests.
Significance indicated the ** $p<0.01$, *** $p<0.001$.

Table 6. Comparing food liking between gender

Variable	Total				Australian				Thai			
	Male (n=1,183) M (SD)	Female (n=2,975) M (SD)	MD	95% CI of the difference	Male (n=468) M (SD)	Female (n=1500) M (SD)	MD	95% CI of the difference	Male (n=715) M (SD)	Female (n=1475) M (SD)	MD	95% CI of the difference
Grains	6.5 (1.06)	6.7 (1.03)	-0.20	-0.27, -0.13***	6.5 (1.14)	6.9 (1.06)	-0.40	-0.52, -0.28***	6.5 (1.01)	6.5 (0.97)	-0.01	-0.09, 0.08
Vegetables	6.4 (1.39)	6.7 (1.32)	-0.32	-0.41, -0.23***	6.4 (1.20)	7.1 (1.04)	-0.73	-0.85, -0.61***	6.3 (1.50)	6.2 (1.42)	0.11	-0.02, 0.24
Fruits	7.3 (1.12)	7.5 (1.03)	-0.20	-0.27, -0.12***	7.4 (0.99)	7.7 (0.90)	-0.22	-0.32, -0.10***	7.2 (1.19)	7.3 (1.13)	-0.11	-0.22, -0.01*
Dairy	7.1 (1.37)	6.8 (1.69)	0.37	0.27, 0.47***	7.2 (1.47)	6.6 (1.96)	0.65	0.49, 0.82***	7.1 (1.29)	7.0 (1.33)	0.12	0.00, 0.24*
Animal-based protein	6.9 (1.27)	6.2 (1.63)	0.79	0.69, 0.88***	7.2 (1.34)	6.1 (2.01)	1.09	0.93, 1.25***	6.8 (1.19)	6.2 (1.12)	0.58	0.47, 0.68***
Plant-based protein	6.2 (1.45)	6.2 (1.54)	-0.04	-0.14, 0.06	5.8 (1.49)	6.3 (1.57)	-0.52	-0.68, -0.37***	6.4 (1.38)	6.1 (1.49)	0.32	0.20, 0.45***
Fat and oil	5.7 (1.50)	5.5 (1.48)	0.26	0.16, 0.36***	6.0 (1.36)	5.7 (1.47)	0.31	0.16, 0.45***	5.6 (1.57)	5.3 (1.46)	0.30	0.17, 0.44***
Sweet food	6.8 (1.22)	6.7 (1.29)	0.16	0.07, 0.24***	6.7 (1.38)	6.4 (1.42)	0.37	0.22, 0.51***	6.9 (1.09)	7.0 (1.07)	-0.09	-0.19, 0.01
Salty food	6.6 (1.25)	6.3 (1.27)	0.23	0.15, 0.32***	6.7 (1.32)	6.4 (1.37)	0.35	0.21, 0.49***	6.5 (1.19)	6.3 (1.14)	0.17	0.07, 0.28***
Alcohol	5.3 (2.21)	4.4 (2.19)	0.87	0.72, 1.01***	4.7 (2.02)	4.2 (2.17)	0.50	0.27, 0.70***	5.7 (2.23)	4.7 (2.19)	1.01	0.81, 1.21***
Overall	6.6 (0.81)	6.5 (0.79)	0.16	0.12, 0.21***	6.7 (0.79)	6.5 (0.79)	0.15	0.07, 0.23***	6.7 (0.83)	6.4 (0.78)	0.19	0.12, 0.26***

M: mean; SD: standard deviation; n: number of participants in each group; MD: mean difference.
p values are for the comparison food liking rating between Australian and Thai samples were determined using independent sample t-tests.
Significance indicated the *** $p<0.001$.

Overall there were differences in food liking of four food groups when comparing weight status and culture: dairy, plant-based protein, fat and oil, and salty food. Post hoc analysis observed no difference in liking of those food groups between BMI categories for Thai participants while there was a difference for Australian participants, with higher liking for dairy, salty and fat and oil linked with higher BMI. This is an interesting finding as the large French study by Deglaire et al reported a positive association between weight status and liking of salt and fat in adult cohort, which suggests participants who have a high liking for salt and fat have a higher BMI.[25] The commonality between French and Australian data regarding liking of salty and fatty foods with BMI may be due to the notion that Australian food has more similarities to French style food than Thai food. Those two food groups are likely to be more culturally accepted and commonplace within those cultures. Furthermore, the association between liking of sweet food and BMI category differed across cultures with Australian overweight participants recording a higher liking of sweet food while a higher liking for sweet food was recorded by underweight Thai participants. Individuals have been shown to have a preference for the food which is more closely aligned with their own cuisines than the cuisines of other cultures.[33,34,63]

As hypothesized this study observed cultural differences in food liking in Australian and Thai similarly aged sample populations. The study found that there was significant difference in food liking between Australian and Thai subjects for eight food groups, which included: grains, vegetables, fruits, dairy, fat and oil, sweet food, salty food, and alcohol. The difference in the liking of these food group was expected due to the culturally different foods of each nation, which according to Furst et al[64] is largely due to cultural norms, values and rituals. A prior study by the current research team reported there was a difference in liking between countries in food items when participants participated in taste testing of food in both a laboratory setting indicating that these differences are robust as they are observed using differing methodologies.[35]

Differences in food liking observed within the current study was expected based on other cross-cultural comparison studies of Australian or Thai populations. However, it is also important to note that the differences observed in the current study may be due to other, non-cultural differences between the two study populations. In the current student, the Australian participants were students who studied in health science whereas the Thai students were recruited more generally from the first-year student cohort. By studying a subject in nutrition, the Australian students may have had a greater overall interest in and awareness of the relationship between food intake and health. Thus, observations that the Australian participants had a higher liking of healthy food compared with Thai participants needs to be confirmed in further studies across these population groups. Several studies have shown that individuals who have education in nutrition and health are likely to have healthier dietary behaviours. For example, a study of Wardle Parmenter and Waller showed that knowledge of nutrition was strongly related to food intake and explained variation in food choice.65 These results, combined with those of Dallongeville et al, Spronk et al, and Kolodinsky et al[66-68] indicate that the knowledge of nutrition was associated with dietary healthy intake and food choice. Our results indicate that cultural differences in food liking occurred however we are unable to determine if this difference is due to cultural factors alone or due the impact of nutrition and health education on self-reported food liking.

Gender differences in food liking were observed in the current study. Females reported a higher liking of healthy food groups compared with males. Female participants were found to have a higher food liking score than the male participants in the following food groups: grains, vegetables, fruits, and plant-based protein. This observation is consistent with previous publications. A study of Cooke and Wardle reported that young UK female participants had significantly higher liking for fruit and vegetables in comparison to young male participants.[69] In contrast the young male participants had significantly higher liking preference for fatty and sugary foods, meats, processed meat products, and eggs. The differences in liking across food groups was observed for both Australian and Thai participants in the current study and when compared with the outcomes from the UK based study by Cooke et, would indicate that this observation of gender differences is robust across cultural groups. It is potentially unsurprising as females have also been found to be more likely to have concerns about health than men and this may drive an increase liking for foods associated with health.[70]

The present study had a number of limitations that should be noted. The study populations are restricted to young adults attending university and may not be representative of the broader young adult population of either country. Although the validity of the FLQ has been previously established there was variability in the reliability of food liking across the food groups, in particular dairy, fats and oils, grain and plant-based protein, due to the low number of food items within. However, the large sample size and the consistency with the observations from the current study and those available within the literature provide confidence in the outcomes from this study.

Conclusions

This study demonstrates little evidence of an association between food liking and BMI, but cultural and gender variation in liking was evident. The findings from this study could inform the health promotion and obesity diseases prevention strategies.

ACKNOWLEDGEMENTS

The authors express their gratitude to the participants and staff at the University at which this research was conducted, Thai researchers from eight universities for their contributions to the study, and Tom Latimer for editing assistance.

AUTHOR DISCLOSURES

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

REFERENCES

1. Yeomans MR. Understanding individual differences in acquired flavour liking in humans. Chemosens Percept. 2010;3:34-41; doi:10.1007/s12078-009-9052-6.
2. Raghunathan R, Naylor RW, Hoyer WD. The unhealthy tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. J Mark. 2006;70:170-84.doi: 10.1509/jmkg.70.4.170
3. Solheim R, Lawless HT. Consumer purchase probability affected by attitude towards low-fat foods, liking, private body consciousness and information on fat and price. Food Qual Prefer. 1996;7:137-43;doi: 10.1016/0950-3293(95)00045-3.
4. Eertmans A, Baeyens F, Van den Bergh O. Food likes and their relative importance in human eating behavior: review and preliminary suggestions for health promotion. Health Educ Res. 2001;16:443-56;doi: 10.1093/her/16.4.443.
5. Clark JE. Taste and flavour: their importance in food choice and acceptance. Proc Nutr Soc. 1998;57:639-43; doi: 10.1079/PNS19980093.
6. Drewnowski A. Taste preferences and food intake. Annu Rev Nutr. 1997;17:237-53; doi: 10.1146/annurev.nutr.17.1.237.
7. Hebden L, Chan HN, Louie JC, Rangan A, Allman-Farinelli M. You are what you choose to eat: factors influencing young adults' food selection behaviour. J Hum Nutr Diet. 2015;28:401-8;doi: 10.1111/jhn.12312.
8. Zhi R, Wan J, Zhang D, Li W. Correlation between hedonic liking and facial expression measurement using dynamic affective response representation. Food Res Int. 2018;108: 237-45;doi: 10.1016/j.foodres.2018.03.042.
9. Zandstra E, De Graaf C, Van Staveren W. Influence of health and taste attitudes on consumption of low-and high-fat foods. Food Qual Prefer. 2001;12:75-82;doi: 10.1016/S0950-3293(00)00032-X.
10. Roininen K, Tuorila H, Zandstra E, de Graaf C, Vehkalahti K, Stubenitsky K et al. Differences in health and taste attitudes and reported behaviour among Finnish, Dutch and British consumers: a cross-national validation of the Health and Taste Attitude Scales (HTAS). Appetite. 2001;37:33-45;doi: 10.1006/appe.2001.0414.
11. Glanz K, Mullis RM. Environmental interventions to promote healthy eating: a review of models, programs, and evidence. Health Educ Q. 1988;15:395-415;doi: 10.1177/109019818801500403.
12. Axelson M. The impact of culture on food-related behavior. Annu Rev Nutr. 1986;6:345-63;doi: 10.1146/annurev.nu.06.070186.002021.
13. Engell D, Bordi P, Borja M, Lambert C, Rolls B. Effects of information about fat content on food preferences in pre-adolescent children. Appetite. 1998;30:269-82;doi: 10.1006/appe.1997.0106.
14. Prescott J. Multisensory processes in flavour perception and their influence on food choice. Curr Opin Food Sci. 2015;3: 47-52;doi: 10.1016/j.cofs.2015.02.007.
15. Kubberød E, Ueland Ø, Tronstad Å, Risvik E. Attitudes towards meat and meat-eating among adolescents in Norway: A qualitative study. Appetite. 2002;38:53-62;doi: 10.1006/appe.2002.0458.
16. Keast RSJ. Sensory systems guide our acceptance of food and beverages. VJHE; 2007;46:21-22.
17. Popkin BM. Technology, transport, globalization and the nutrition transition food policy. Food Policy. 2006;31:554-69;doi: 10.1016/j.foodpol.2006.02.008.
18. Kosulwat V. The nutrition and health transition in Thailand. Public Health Nutr. 2002;5:183-9; doi:10.1079/PHN2001292.
19. Hawks SR, Merrill RM, Madanat HN, Miyagawa T, Suwanteerangkul J, Guarin CM et al. Intuitive eating and the nutrition transition in Asia. Asia Pac J Clin Nutr. 2004;13: 194-203.
20. Chaput JP, Klingenberg L, Astrup A, Sjödin AM. Modern sedentary activities promote overconsumption of food in our current obesogenic environment. Obes Rev. 2011;12:12-20; doi: 10.1111/j.1467-789X.2010.00772.x.
21. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev. 2012;70:3-21;doi: 10.1111/j.1753-4887.2011.00456.x.
22. Haslam D, James W. Obesity Lancet. 2005;366:197-1209.
23. Robertson A, Lobstein T, Knai C. Obesity and socio-economic groups in Europe: Evidence review and implications for action. Brussels: European Commission. 2007; p.1-41.
24. Duffy VB, Hayes JE, Sullivan BS, Faghri P. Surveying food and beverage liking: a tool for epidemiological studies to connect chemosensation with health outcomes. Ann N Y Acad Sci. 2009;1170:558-68;doi:10.1111/j.1749-6632.2009.04593.x.
25. Deglaire A, Méjean C, Castetbon K, Kesse-Guyot E, Hercberg S, Schlich P. Associations between weight status and liking scores for sweet, salt and fat according to the gender in adults (The Nutrinet-Sante study). Eur J Clin Nutr. 2015;69:40; doi:10.1038/ejcn.2014.139.
26. Frewer LJ, Risvik E, Schifferstein H. Food, people and society: a European perspective of consumers' food choices. New York, US: Springer Science & Business Media; 2013.
27. Keast R, Lau J. Culture-specific variation in the flavor profile of soymilks. J Food Sci. 2006;71:S567-S72;doi: 10.1111/j.1750-3841.2006.00146.x.
28. Seubsman Sa, Kelly M, Yuthapornpinit P, Sleigh A. Cultural resistance to fast-food consumption? A study of youth in North Eastern Thailand. Int J Consumer Stud. 2009; 33:669-75;doi: 10.1111/j.1470-6431.2009.00795.x.
29. Jitnarin N, Kosulwat V, Rojroongwasinkul N, Boonpraderm A, Haddock C, Poston W. Prevalence of overweight and obesity in Thai population: results of the National Thai Food Consumption Survey. Eating Weight Disord. 2011;16:e242-e9.
30. Bell B, Adhikari K, Chambers IV E, Cherdchu P, Suwonsichon T. Ethnic food awareness and perceptions of consumers in Thailand and the United States. Nutr Food Sci. 2011;41:268-77;doi: 10.1108/00346651111151401.
31. Rozin P. Cultural approaches to human food preferences. Nutritional modulation of neural function. 1988:137-53.
32. Rozin P. Socioiocultural influences on human food selection. Washington, DC, US: American Psychological Association;1996:233-263.
33. Revel J-F. Culture and cuisine. Cooking, Eating, Thinking: Transformative Philosophies of Food. US; Indiana University Press. 1992:145-52.
34. Einstein MA, Hornstein I. Food preferences of college students and nutritional implications. J Food Sci. 1970;35: 429-36;doi: 10.1111/j.1365-2621.1970.tb00950.x.
35. Wanich U, Sayompark D, Riddell L, Cicerale S, Liem D, Mohebbi M et al. Assessing food liking: comparison of food liking questionnaires and direct food tasting in two cultures. Nutrients. 2018;10:1957;doi: 10.3390/nu10121957.
36. Rozin P, Cines BM. Ethnic differences in coffee use and attitudes to coffee. Ecol Food Nutr. 1982;12:79-88;doi: 10.1080/03670244.1982.9990699.
37. Brevard PB, Ricketts CD. Residence of college students affects dietary intake, physical activity, and serum lipid levels. J Am Diet Assoc. 1996;96:35-8 4p;doi10.1016/S0002-8223(96)00011-9.

38. Edwards JS, Meiselman HL. Changes in dietary habits during the first year at university. Nutr Bull. 2003;28:21-34.
39. Kuh D, Shlomo YB. A life course approach to chronic disease epidemiology: Oxford University Press; 2004.
40. Johansen A, Rasmussen S, Madsen M. Health behaviour among adolescents in Denmark: influence of school class and individual risk factors. Scand J Public Health. 2006;34: 32-40 9p;doi: 10.1080/14034940510032158.
41. Frech A. Healthy behavior trajectories between adolescence and young adulthood. Adv Life Course Res. 2012;17:59-68;doi: 10.1016/j.alcr.2012.01.003.
42. Riddell LJ, Ang BX, Keast RSJ, Hunter W. Impact of living arrangements and nationality on food habits and nutrient intakes in young adults. Appetite. 2011;56:726-31;doi 10.1016/j.appet.2011.02.010.
43. El Ansari W, Stock C, Mikolajczyk RT. Relationships between food consumption and living arrangements among university students in four European countries -- A cross-sectional study. Nutr J. 2012;11:28-34;doi:10.1186/1475-2891-11-28.
44. Bagordo F, Grassi T, Serio F, Idolo A, De Donno A. Dietary habits and health among university students living at or away from home in southern Italy. J Food Nutr Res. 2013;52: 164-71.
45. Pierce EF, Butterworth SW, Lynn TD, O'Shea J, Hammer WG. Fitness profiles and activity patterns of entering college students. J Am Coll Health. 1992;41:59-62;doi:10.1080/07448481.1992.10392819.
46. Castro JMd, Bellisle F, Feunekes GIJ, Dalix AM, Graaf Cd. Culture and meal patterns: a comparison of the food intake of free-living American, Dutch, and French students. Nutr Res. 1997;17:807-29;doi: 10.1016/S0271-5317(97)00050-X.
47. Beasley LJ, Hackett AF, Maxwell SM. The dietary and health behaviour of young people aged 18–25 years living independently or in the family home in Liverpool, UK. Int J Consumer Stud. 2004;28:355-63;doi: 10.1111/j.1470-6431.2004.00394.x.
48. Gliem JA, Gliem RR, editors. Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education; 2003 October 8-10; The Ohio State University, Columbus, OH.
49. Miles J, Shevlin M. Applying regression and correlation: A guide for students and researchers. Gateshead, UK: Sage; 2001.
50. Department of Health Ag. About Overweight and Obesity [cited 2019/01/04]; Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-hlthwt-obesity.htm.
51. Aekplakorn W, Inthawong R, Kessomboon P, Sangthong R, Chariyalertsak S, Putwatana P et al. Prevalence and trends of obesity and association with socioeconomic status in Thai adults: national health examination surveys, 1991–2009. J Obes. 2014;2014;doi:10.1155/2014/410259.
52. Organization WH. The Asia-Pacific perspective: redefining obesity and its treatment. Sydney: Health Communications Australia; 2000.
53. Pallister T, Sharafi M, Lachance G, Pirastu N, Mohney RP, MacGregor A et al. Food preference patterns in a UK twin cohort. Twin Research and Human Genetics. 2015;18:793-805;doi: 10.1017/thg.2015.69.
54. Appleton KM. Barriers to and facilitators of the consumption of animal-based protein-rich foods in older adults. Nutrients. 2016;8:184;doi: 10.3390/nu8040187.
55. Mela DJ. Determinants of food choice: relationships with obesity and weight control. Obes Res. 2001;9(Suppl 11): 249S-55S;doi: 10.1038/oby.2001.127.
56. Frehlich LC, Eller LK, Parnell JA, Fung TS, Reimer RA. Dietary intake and associated body weight in Canadian undergraduate students enrolled in nutrition education. Ecol Food Nutr. 2017;56:205-17;doi: 10.1080/03670244.2017.1284066.
57. Maskarinec G, Novotny R, Tasaki K. Dietary patterns are associated with body mass index in multiethnic women. J Nutr. 2000;130:3068-72;doi: 10.1093/jn/130.12.3068.
58. Rhodes DG, Baer DJ, Seale JL, Conway JM, Rumpler WV. Energy value of moderate alcohol consumption by humans. Am J Clin Nutr. 1996;64:108-14;doi: 10.1093/ajcn/64.1.108.
59. Atwater WO, Rosa EB. A new respiration calorimeter and experiments on the conservation of energy in the human body, II. Physical Review (Series I). 1899;9:214-51;doi: 10.1103/PhysRevSeriesI.9.214.
60. Breslow RA, Smothers BA. Drinking Patterns and Body Mass Index in Never Smokers: National Health Interview Survey, 1997–2001. Am J Epidemiol. 2005;161:368-76;doi: 10.1093/aje/kwi061.
61. Tolstrup JS, Heitmann BL, Tjønneland AM, Overvad OK, Sørensen TIA, Grønbæk MN. The relation between drinking pattern and body mass index and waist and hip circumference. Int J Obes. 2005;29:490;doi: 10.1038/sj.ijo.0802874.
62. Papadaki A, Hondros G, Scott JA, Kapsokefalou M. Eating habits of University students living at, or away from home in Greece. Appetite. 2007;49(1):169-76.
63. Schumaker JF, Small L, Ward DS. Eating behavior among Thais and Americans. J Psychol. 1985;119:469-74;doi: 10.1080/00223980.1985.10542917.
64. Furst T, Connors M, Bisogni CA, Sobal J, Falk LW. Food choice: a conceptual model of the process. Appetite. 1996; 26:247-66.
65. Wardle J, Parmenter K, Waller J. Nutrition knowledge and food intake. Appetite. 2000;34:269-75;doi: 10.1006/appe.1999.0311.
66. Dallongeville J, Marécaux N, Cottel D, Bingham A, Amouyel P. Association between nutrition knowledge and nutritional intake in middle-aged men from Northern France. Public Health Nutr. 2001;4:27-33; doi:10.1079/PHN200052.
67. Spronk I, Kullen C, Burdon C, O'Connor H. Relationship between nutrition knowledge and dietary intake. Br J Nutr. 2014;111:1713-26;doi: 10.1017/S0007114514000087.
68. Kolodinsky J, Harvey-Berino JR, Berlin L, Johnson RK, Reynolds TW. Knowledge of current dietary guidelines and food choice by college students: better eaters have higher knowledge of dietary guidance. J Am Diet Assoc. 2007;107: 1409-13;doi: 10.1016/j.jada.2007.05.016.
69. Cooke LJ, Wardle J. Age and gender differences in children's food preferences. Br J Nutr. 2005;93:741-6;doi: 10.1079/BJN20051389.
70. Girois SB, Kumanyika SK, Morabia A, Mauger E. A comparison of knowledge and attitudes about diet and health among 35- to 75-year-old adults in the United States and Geneva, Switzerland. Am J Public Health. 2001;91:418-24.