Malays. Appl. Biol. (2019) 48(2): 9–18

CONSTRUCTION AND RELIABILITY OF LABELED MAGNITUDE SATIETY SCALE FOR MALAY POPULATION

ZALIFAH MOHD KASIM*, ASMA QAMALIAH ABDUL HAMID and RAZALEE SEDEK

Food Science Programme, Centre for Biotechnology and Functional Food,
Faculty of Science and Technology, Universiti Kebangsaan Malaysia,
43000, Bangi, Selangor, Darul Ehsan, Malaysia
**E-mail: zalifah.kasim@ukm.edu.my*

Accepted 9 May 2019, Published online 31 May 2019

ABSTRACT

Satiety is a persistent feeling of fullness after a meal that can prevent further energy consumption until hunger is felt again. This study was conducted to construct and validate the reliability of a labeled magnitude scale (LMS) in the Malay language among Malay adult population in Universiti Kebangsaan Malaysia. A total of 100 subjects rated the semantic meaning of 40 Malay phrases describing different levels of satiety and hunger using magnitude estimation. Eleven anchor phrases were positioned corresponding to their geometric mean magnitude to construct a bipolar LMS satiety scale. Thirty subjects have taken part in food testing (commercial breakfast cereal) for reliability using the LMS scale from this study and reference scale in two occasions, one week apart from one another. Evaluations were made at 0 min, each 15 min for the first 90 min and each 30 min until 180 min. The results showed significant differences ($p<0.05$) between male and female subject for two positive (satiety) and negative (hunger) anchor phrases. During food test evaluation, the male subject showed a shorter time to reach a neutral point (not hungry nor fullness) compared to female subject in both studies. The alpha value between LMS in this research and reference is 0.907. Therefore, the reliability for the label magnitude scale in this study is high which indicated the scale is very suitable and reliable for Malay subjects in Malaysia to evaluate their perception of fullness and hunger after meal consumption.

Key words: Label magnitude scale, satiety, hunger, Malay population, reliability

INTRODUCTION

Overweight and obesity problems are the alarming trend and have become major health problems globally, including Malaysia. In 2013, the Ministry of Health Malaysia had reported one of three Malaysians were obese due to unhealthy eating habit. Findings from the National Health and Morbidity Survey [NHMS], (2015) also estimated that 5.6 million adult aged 18 and above were overweight and 3.3 million was obese.

According to the World Health Organization [WHO], (2014), obese people were said to be at high risk for serious illnesses such as cardiovascular disease, diabetes mellitus, hypertension, stroke and cancer. This is because these people have a low satiety level compared with people who have a normal body mass index (BMI) (Stroebele & de Castro, 2004). Schoeller (2008) had discovered that imbalanced between energy intake and energy expenditure was an ultimate factor while, genetic, behaviour and environment were additional factors that caused increasing body weight (Soenen & Westerterp-Plantenga, 2008).

In addition, Olson (2010) also stated that obese people tend to feel hungry easily but take a long time to feel satiety during eating. This causes them to take a large portion of food to avoid the hunger feeling without noticing their daily energy intake has increased. The knowledge about exact satiety level is still limited and scarce. People would tend to eat more when hungry and only stop when stuffed.

The focus of the present research was on constructing a labeled magnitude scale (LMS) for satiety and hunger in the Malay language among Malay adult population in Universiti Kebangsaan Malaysia. The LMS has been introduced by Cardello *et al*. (2005) among employees of the US Army Natick Soldier Systems Center. The aim for that

* To whom correspondence should be addressed.

research was to quantify the semantic meaning of common English phrases used to describe hunger and fullness, using modulus-free magnitude estimation. Sensory test of food has been evaluated using developed LMS and compared with visual analogue scale (VAS) scale for sensitivity and reliability. For this, satiety was defined as signals or processes that, following the end of consumption, inhibit eating before hunger returns and hunger as a feeling of discomfort or weakness caused by lack of food, coupled with the desire to eat (Chapelot, 2013).

Epidemiological studies reported that regular consumption of breakfast, particularly cereal (Fakhouri *et al*., 2012; Ogden *et al*., 2012) is associated with lower BMI and cardiometabolic risk profile (Fakhouri *et al*., 2012; Deshmukh *et al*., 2013). Both cross-sectional and prospective studies of breakfast habits and body weight have demonstrated inverse associations between breakfast intake and relative body weight (Ogden *et al*., 2012; Wayatt *et al*., 2002). Indeed, obese individuals are more likely to skip breakfast or to consume less energy at breakfast than their lean counterparts (Fakhouri *et al*., 2012; Song *et al*., 2005) which is associated with higher fasting lipids, reduced postprandial insulin sensitivity (Farashchi *et al*., 2005; Ogden *et al*., 2012), and overeating later in the day (Astbury *et al*., 2011).

This study aimed to construct a labeled magnitude scale for satiety and hunger in the Malay language among Malay adult population in Universiti Kebangsaan Malaysia. Secondly, to validate the reliability of the constructed scale by conducting a food test evaluation and comparing it with a reference scale (Zalifah *et al*., 2008). It was hypothesized that; (1) male and the female subject would have a significant difference. Hence, two labeled magnitude scale will be constructed, (2) no significant difference between LMS in this study and reference. Thus, LMS in this study has high reliability.

MATERIALS AND METHODS

This study has been approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia (Ethics approval number: UKM PPI/111/8/JEP-2016-129). All subjects were given a verbal and written explanation about the study and they were requested to fill out a written consent form prior to the commencement of the study.

Modulus-free magnitude estimation

A hundred subjects (50 male and 50 female) from Universiti Kebangsaan Malaysia were randomly selected. To make sure the result was consistent; each subject must meet the inclusion criteria which are Malay subjects between 20-30 years of age (doing undergraduate, masters or doctoral degree) with normal body mass index. The subjects are sedentary, not pregnant or lactating and have no food allergy. Subjects who are smokers, athlete undergoing training, diabetics and non-regular breakfast eaters are refrained from taking part in this study. In this phase, each subject needs to quantify the semantic meaning of 40 Malay phrases used to describe satiety or hunger using modulus-free magnitude estimation.

These phrases were developed by Cardello *et al*. (2005) and translated to the Malay language by focus group discussion (Table 1). Each phrase is randomly arranged in ten sets of the questionnaire with complete written instruction. The subjects were needed to identify each phrase whether it indicates the feeling of satiety, hunger or neutral with positive (+), negative (-) or zero sign (0) respectively. After that, the subjects need to assign a number for each phrase with the maximum value of satiety and hunger were +100 and -100 respectively. This is to indicate the magnitude of satiety and hunger express by phrases. In addition to written instructions, the details of the procedure were explained by the researcher to each subject and all subjects were allowed to ask questions before starting. Each subject rated all 40 Malay phrases for the perceived magnitude of satiety or hunger (or neither) expressed by the phrase. Magnitude estimation given by the subjects was used to calculate the mean of arithmetic and geometric.

In addition, phrases that were wrongly assigned by the subject for more than 10% were eliminated automatically. This is because these phrases are not suitable to be used as a descriptor of satiety or hunger which represents Malay adult population in Universiti Kebangsaan Malaysia. The value of geometric mean was calculated to reduce the range by taking the positive value by using a formula from Ando *et al*. (2004). All the phrases known as anchor phrases were arranged from higher positive value to higher negative value to construct the LMS scale in this study. The eleven anchor phrases were "greatest imaginable fullness", "extremely full", "very full", "moderately full", "slightly full", "neither hungry nor full", "slightly hungry", "moderately hungry", "very hungry", "extremely hungry" and "greatest imaginable hunger" (Cardello *et al*., 2005; Zalifah *et al*., 2008).

Reliability evaluation

Thirty-two subjects from phase one which scores $\leq$10, $\leq$10 and $\leq$7 for restraint, disinhibition and hunger respectively in The Three Factor Eating Questionnaire (TFEQ) took part in the food test evaluation for reliability. They were instructed to

Table 1. The 40 Malay phrases used in modulus-free magnitude estimation

a) Positive phrases (fullness)		b) Negative phrases (hunger)		c) Neutral phrases	
English	Malay	English	Malay	English	Malay
1 **Greatest imaginable fullness***	***Kekenyangan yang sangat tidak dapat digambarkan****	1 **Greatest imaginable hunger***	***Kelaparan yang sangat tidak dapat digambarkan****	1 No appetite	*Tiada selera*
2 Bursting	*Teramat penuh*	2 **Extremely hunger***	***Amat lapar****	2 Neither sated nor unsated	*Tidak muak ataupun tidak kenyang*
3 Stuffed	*Senak*	3 Extremely unsatisfied	*Amat tidak kenyang*	3 No particular feeling	*Tiada perasaan*
4 **Extremely full***	***Amat penuh****	4 Very unsatisfied	*Sangat tidak kenyang*	4 Neither famished nor gorged	*Tidak lapar ataupun tidak penuh*
5 **Very full***	***Sangat penuh****	5 **Very hungry***	***Sangat lapar****	5 Neutral	*Neutral*
6 **Moderately full***	***Sederhana penuh****	6 **Moderately hungry***	***Sederhana lapar****	6 **Neither hunger nor fullness***	***Tidak lapar ataupun tidak kenyang****
7 Extremely sated	*Amat muak*	7 Empty	*Kosong*		
8 Very sated	*Sangat muak*	8 Hungry	*Lapar*		
9 Extremely satisfied	*Amat kenyang*	9 Moderately unsatisfied	*Sederhana tidak kenyang*		
10 Very satisfied	*Sangat kenyang*	10 **Slightly hungry***	***Sedikit lapar****		
11 Extremely content	*Amat puas*	11 Slightly unsatisfied	*Sedikit tidak kenyang*		
12 Satisfied	*Kenyang*	12 Unsated	*Tidak kenyang*		
13 **Slightly full***	***Sedikit penuh****	13 Semi hungry	*Separa lapar*		
14 Very content	*Sangat puas*				
15 Moderately sated	*Sederhana kenyang*				
16 Moderately satisfied	*Sederhana puas kenyang*				
17 Moderately content	*Sederhana puas*				
18 Slightly satisfied	*Sedikit puas kenyang*				
19 Slightly sated	*Sedikit kenyang*				
20 Slightly content	*Sedikit puas*				
21 Semi satisfied	*Separa kenyang*				

***Anchor phrases**

fast overnight (10-12 hours) before coming to the laboratory. The LMS which was constructed in phase one was used to evaluate the breakfast cereal test food. This study uses 50g carbohydrate from a chosen breakfast cereal which was *Kellog's Special K* and 200 mL *Dutch Lady* low-fat milk. Plain water was also given to the subjects at the amount of 250 mL.

In this phase, subjects were instructed to record their degree of hunger/fullness after fasting overnight using the LMS scale given. Next, subjects were served with test meals and were given 15 minutes to finish their food and record their degree of hunger/fullness immediately in the second LMS scale given. A set of questionnaire that consist of eight LMS scales was given. Subjects were required to record their degree of hunger/fullness every 15 minutes for the first 90 minutes and every 30 minutes till 180 min. All subjects were advised to set the time using their mobile phone to alert hunger/fullness evaluation. In addition, subjects were required not to eat or drink anything except for sips of mineral water only. They also were required to do a sedentary activity only for the 3 hours evaluation duration. The same subjects were called back to evaluate their degree of hunger/fullness on the same breakfast cereal a week later but this time evaluations were made on the reference LMS scale by Zalifah *et al*. (2008). The same procedure was applied during the second evaluation.

Data analysis

The modulus-free magnitude estimation and the LMS were calculated using Microsoft Excel 2010. The Statistical Package for Social Sciences (SPSS) version 22.0 was used to calculate all the descriptive test consist of mean, frequency and standard deviation with a significant difference for all test is $p<0.05$. The t-test analysis was used to compare the evaluation for a male and female subject. During the second phase, the subject had recorded and rated their degree of hunger/fullness for 180 minutes. The test-retest-reliability analysis was used to compare between the readings obtained from the two LMS scale using the SPSS software version 22.0.

RESULTS AND DISCUSSION

Modulus-free magnitude estimation

Frequency ratings of each phrase

Twenty-one phrases that represent fullness at various intensities were evaluated by the subjects in this study. Theoretically, these phrases must be assigned as positive (+). But, the result showed only nine phrases were correctly assigned by all subjects (100%) as positive. Most of the positive phrases (57.14%, n=21) were not correctly assigned as fullness phrases (positive) by the subjects in this study.

There were six other phrases (moderately full, very satisfied, bursting, satisfied, very content and slightly content) which were correctly assigned (100%) as positive by female subject as compared to the male subject. Our findings showed that four out of five anchor positive phrases has been correctly assigned by the subjects. Hence, this shows that male and female subjects in this study have similar perception and consistency in their assessment.

Analysis of the neutral phrase showed that all the neutral phrases have been given a '0' or zero value by the subject. This situation clearly shows the subjects of the study are able to make an accurate assessment of the given neutral phrases. Results from Zalifah *et al*. (2008) showed a subject (2%) evaluated neutral phrases as a positive phrase.

Hunger phrases should be evaluated as negative as they illustrate the intensity of hunger. Overall, it was found that varied evaluations (positive, negative and neutral) were also given by the subjects for negative phrases. The negative phrases that were correctly evaluated by the male subjects were four phrases while female subjects correctly evaluated five anchor phrases.

There is only one anchor phrase (very hungry) which was correctly evaluated by all male and female subjects. The only anchor phrase that was correctly evaluated by all male subjects was "slightly hungry". In female subjects, phrases which had 100% correct evaluation were "moderately hungry" and "very hungry". Another phrase such as "hungry" was correctly assessed by all subjects while the phrase "incomplete" was correctly rated by all female subjects only. Evaluation for the phrases "moderately hungry" and "very hungry" found that 98% of the male subjects were able to correctly make negative ratings for each phrase. One male subject (2%) who failed to evaluate the phrases has rated them as positive phrases.

Geometric mean of phrases

Nearly 40% of the geometric mean for positive phrases evaluated by the male subjects was higher compared to the female subjects. The geometric mean values (negative phrases) showed that two phrases were significantly different ($p<0.05$) between the two groups which were "slightly hungry" and "moderately hungry". The difference in geometric mean values obtained from this study, Zalifah *et al*. (2008) and Cardello *et al*. (2005) are shown in Table 2. No positive phrases are removed from the male subjects of this study compared to the female subjects with the phrase "extremely sated"

Table 2. Comparison of geometric means for positive phrases between this study, Zalifah *et al*. (2008) and Cardello *et al*. (2005)

No	Phrases	This study			Zalifah *et al*. (2008)	Cardello *et al*. (2005)
		Male	Female	^p		
1	**Greatest imaginable fullness***	**100**	**100**		**90.7**	**115.2**
2	Bursting	97.10	92.43	0.021	88.3	107.1
3	Stuffed	89.05	87.24		74.1	91.3
4	**Extremely full***	**82.59**	**82.24**		**80.0**	**91.5**
5	**Very full***	**76.15**	**77.79**		**69.3**	**85.6**
6	**Moderately full***	**53.76**	**59.62**	**0.034**	**36.9**	**53.9**
7	Extremely sated	79.93	74.27		70.7	45.9
8	Very sated	69.65	Removed		56.6	50.0
9	Extremely satisfied	76.28	72.68		61.1	47.4
10	Very satisfied	72.43	74.56		50.2	46.6
11	Extremely content	74.08	77.75		61.4	42.0
12	Satisfied	52.97	63.96	0.043	41.4	37.0
13	**Slightly full***	**36.06**	**49.46**	**0.011**	**27.9**	**36.7**
14	Very content	66.58	63.45		50.6	35.2
15	Moderately sated	48.68	48.48		31.7	35.1
16	Moderately satisfied	43.39	48.16	0.044	27.8	31.2
17	Moderately content	38.74	41.89		Removed	26.6
18	Slightly satisfied	23.15	31.78	0.007	Removed	19.7
19	Slightly sated	30.51	36.26	0.039	Removed	19.7
20	Slightly content	23.56	33.12	0.004	Removed	17.4
21	Semi satisfied	23.89	33.27	0.019	Removed	Removed

***Anchor phrases**

Table 3. Comparison of geometric means for negative phrases between this study, Zalifah *et al.* (2008) and Cardello *et al.* (2005)

No	Phrases	This study			Zalifah *et al*. (2008)	Cardello *et al*. (2005)
		Male	Female	^p		
1	Semi hungry	-18.93	-19.14		Removed	-28.3
2	Unsated	Removed	Removed		-24.9	Removed
3	Slightly unsatisfied	-19.58	Removed	0.050	Removed	-21.1
4	**Slightly hungry***	**-20.83**	**-26.17**	**0.006**	**-20.5**	**-23.8**
5	Moderately unsatisfied	Removed	-35.55		-26.5	-27.7
6	Hungry	-41.17	-46.89		-32.0	-47.8
7	Empty	Removed	Removed		Removed	-42.7
8	**Moderately hungry***	**-35.97**	**-43.01**	**0.043**	**-30.3**	**-48.9**
9	**Very hungry***	**-69.90**	**-70.35**		**-50.3**	**-72.0**
10	Very unsatisfied	-60.43	-53.70		-47.0	-36.8
11	Extremely unsatisfied	-74.75	-56.30		-50.2	-43.5
12	**Extremely hunger***	**-90.31**	**-84.93**		**-66.3**	**-86.3**
13	**Greatest imaginable hunger***	**-100**	**-100**		**-78.3**	**-107.1**

***Anchor phrases**

being removed due to ambiguity (Table 2). Cardello *et al*. (2005) have removed "half-filled" phrase while the study of Zalifah *et al*. (2008) have removed five positive phrases (moderately satisfied, slightly satisfied, slightly sated, slightly satisfied and semi-filled) as they were rated as negative phrases by the subjects. However, no anchor phrases were removed from any of these studies.

Meanwhile, the analysis data showed that the negative phrases removed from this study and previous studies due to ambiguous ratings were higher than the positive phrases (Table 3). The same two negative phrases which were incoherently asses by both male and female subjects were "not sated" and "empty". The phrases "moderately unsatisfied" and the phrase "slightly sated" were ambiguously

rated by the male and female subjects. There are similarities between the results of the female subjects in this study and the results from Zalifah *et al*. (2008) where the negative phrases removed due to ambiguity were "slightly unsatisfied" and "empty". The ambiguous phrase "not sated" showed similar ratings between this study and Cardello *et al*. (2005). No negative anchor phrases were ambiguously evaluated. Therefore none of them were removed for this study.

Three out of 11 anchor phrases rated by the female subjects in this study have higher geometric mean values than the geometric mean values in the previous study (Cardello *et al*., 2005; Zalifah *et al*., 2008). The phrases were "moderately full", "slightly full" and "slightly hungry". The geometric mean for male subjects was highest for the phrase "extremely hungry" when compared to previous studies. In short, the geometric mean values obtained from this study was higher than those from Zalifah *et al*. (2008) for all anchor phrases. Some phrases showed lower values than the study of Cardello *et al*. (2005).

Construction of Labeled Magnitude Scale (LMS)

The LMS is built using 11 anchor phrases which have a range between +100 (greatest imaginable fullness) to -100. The selected anchor phrases are a group of phrases that have similar adjectives in different intensities to illustrate the degree of satiety and hunger (Cardello *et al*., 2005; Zalifah *et al*., 2008). A horizontal line of 20 cm bipolar scale was then constructed with intervals based on the geometric means obtained (Table 4).

The neutral phrase "neither hungry nor full" was chosen as the midpoint (10 cm) of the constructed bipolar LMS. The value of the phrase is set at zero. The highest positive value of LMS has been set to +100 (0 cm) for the phrase "greatest imaginable fullness" and the lowest negative value set is -100 (20 cm) for "greatest imaginable hunger". In this study, two LMS were constructed (for female and male subjects) as there were significant differences ($p < 0.05$) for four anchor phrases between the male and female subjects (Figure 1).

Based on the built-in scale, the interval value between the phrase "extremely full" and the phrase "very full" has the smallest difference (male = 6.45%, female = 4.45%) versus the interval values among other phrases arranged in order of intensity. This is likely because the subjects are not able to distinguish the intensity difference and assign the corresponding magnitude between phrases with very close meaning. Therefore, the phrases were evaluated with similar magnitude. The biggest interval magnitude was for phrases such as "slightly full" and the phrase "neither hungry nor full" (male = 36.1%, female = 49.5%).

In this study, we also found that the LMS for male subjects was asymmetrical and the interval gaps between the phrases were also not balanced. The interval gap between the "extremely full" and "very full" is 0.62 cm while the gap between the "moderately full" and "slightly full" is 1.74 cm. The interval gap values are uneven with a distance of almost 3 times. Meanwhile, in the female subjects, the LMS also showed similar results as their male counterparts. The interval gap values between the phrases were also asymmetrical between the anchors phrased. The distinction between the duration of the study did not limit the consistency of the findings of this study.

Second phase: reliability evaluation

Thirty-two subjects (15 male and 17 female) took part in the food testing session for the reliability test of the scale constructed. However, only 30 subjects successfully completed the food testing session. The two subjects failed to finish the

Table 4. Geometric means for eleven anchor phrases

No.	Anchor phrase	Geometric means		
		Male	Female	^p
1	Greatest imaginable fullness	100	100	
2	Extremely full	82.60	82.24	0.948
3	Very full	76.15	77.79	0.178
4	**Moderately full**	**53.76**	**59.62**	**0.034***
5	**Slightly full**	**36.06**	**49.46**	**0.011***
6	Neither hungry nor full	0	0	
7	**Slightly hungry**	**-20.83**	**-26.17**	**0.006***
8	**Moderately hungry**	**-35.58**	**-43.01**	**0.043***
9	Very hungry	-69.43	-70.35	0.996
10	Extremely hungry	-90.30	-84.93	0.089
11	Greatest imaginable hunger	-100	-100	

*Has a significant different ($p<0.05$).

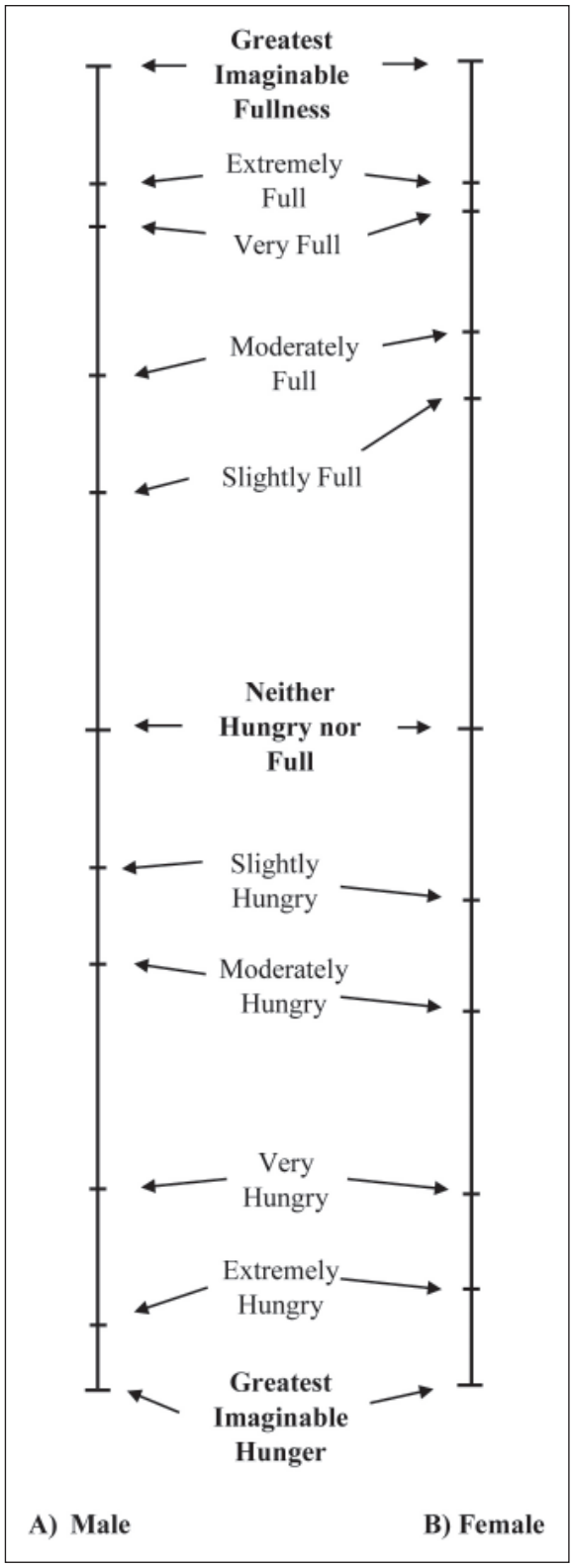

Fig. 1. The LMS for Malay population.

food sample within the time given (15 minutes) and were not included in this study. Studies by Berti *et al*. (2015) and Hlebowicz *et al*. (2008) had used a smaller number of participants during food test evaluation with 13 and 9 participants respectively.

The average fullness and hunger scores evaluated using LMS scale in this study are shown in Figure 2a. All average full and hunger scores for male subjects were lower than female subjects. Significant differences ($p<0.05$) between male and female subjects were found for six intervals which were 15, 30, 45, 60, 120 and 180 minutes. Our findings showed female subjects recorded the highest average satiety score (71.0) at 15 minutes which was significantly different ($p<0.05$) compared to the average satiety scores of male subjects (51.1). These satiety scores for female subjects were at "very full" on the constructed LMS while for male subjects, the average value obtained at 15 minutes coincided with "moderately full". These findings clearly illustrate that the male subjects felt less full with the food samples given and have lower levels of satiety female subjects.

Interestingly, the male and female subjects of this study felt close to "slightly full" throughout the 45th to 75th minutes. In fact, they were also found "neither hungry nor full" at the 90th to 120th minutes respectively. However, at the 150th minute, male subjects were observed to have a faster decline in hunger rate while their female counterparts were still at "neither hungry nor full" mark. It is also observed that the male subjects reached the "neither hungry nor full" point (score 0) faster than female subjects. It was found that males subjects reached "neither-nor full" at 76th minute while female subject similar score at 127th minute. This evidently showed that male subjects are more likely to feel hunger faster for the sample test meal. The satiety score at 180 minutes found that the male subject was at "moderately hungry" while for female subjects, the average score was close to "slightly hungry".

Food testing evaluated on LMS by Zalifah *et al*. (2008) was conducted within seven days of the first evaluation. It is important to ensure that the second assessment is not affected by the decision from the first assessment. The average scores for fullness and hunger evaluated on LMS Zalifah *et al*. (2008) are shown in Figure 2b. The average satiety scores for male subjects were lower than female subjects at all time intervals. This result is consistent and similar to the first evaluation using LMS scale in this study.

The analysis also showed significance difference ($p<0.05$) between male and female subject at all times interval except at 45 and 180 minutes. Female subject recorded the highest satiety value (66.2) which was significantly different ($p<0.05$) compared with the male subject (50.2) 15 minute of food test consumption. The result from the independent t-test between the satiety scores for LMS scale in this study and reference showed no significant difference for female and male subjects respectively. Therefore, the reliability of the LMS scale in this

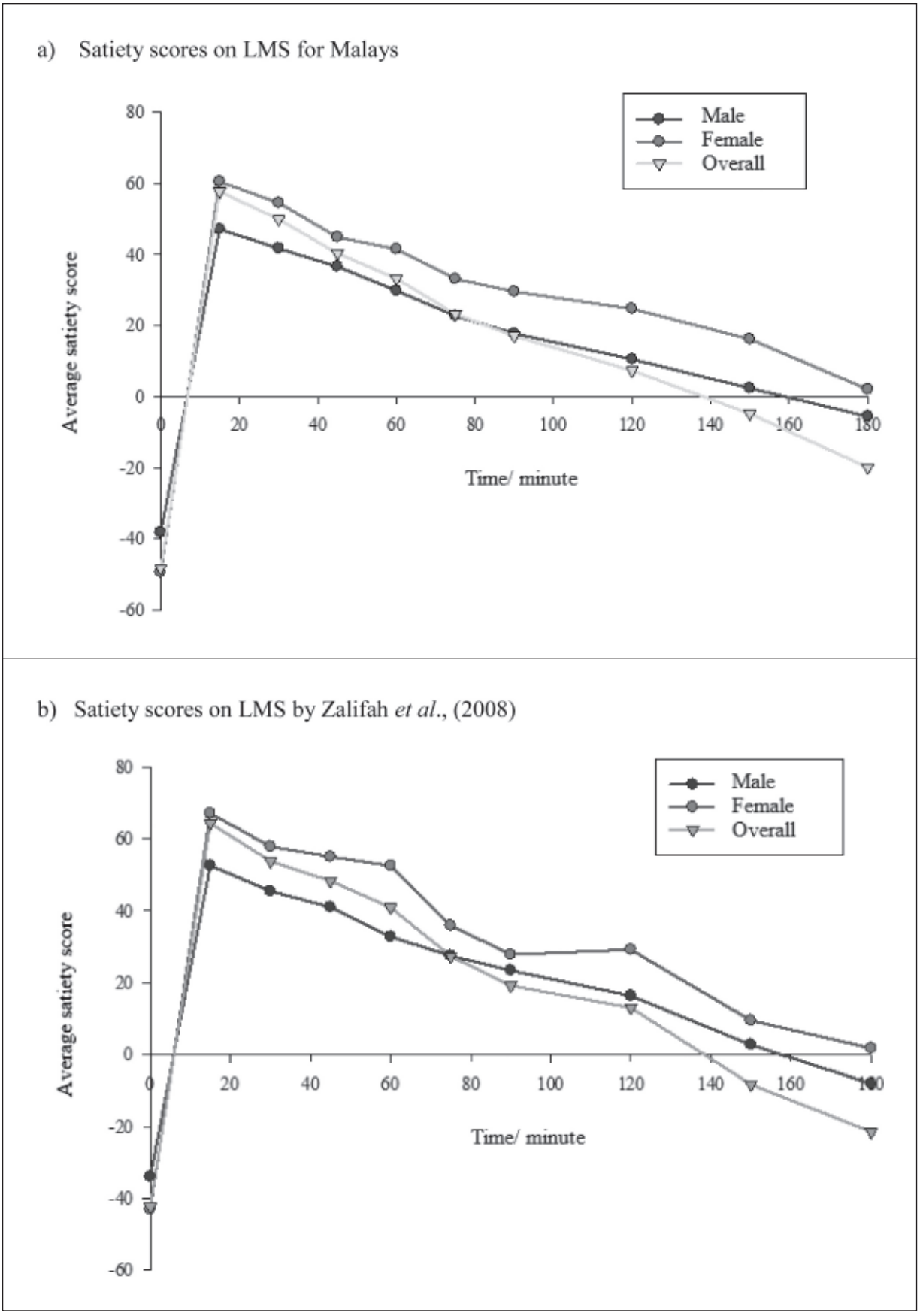

Fig. 2. Average satiety scores recorded on a) LMS from this study, b) LMS from Zalifah *et al*. (2008).

study is high. To strengthen our finding, a test-retest-reliability analysis between LMS scale in this study and reference scale also showed a higher Pearson value for male (0.95) and female (0.97) respectively.

Interestingly, the mean values of male and female subjects' satiety scores on the reference LMS also showed some differences at various time intervals. Prior to the consumption of the test meal, it was found that the male subjects started off with the average score of -38.8 (close to "moderately hungry" while the female subjects were "very hungry" at (-56.9). During the 45th and 60th minutes, the male subjects' assessment was approaching "slightly full" while the female subjects' assessment was found to be close to "moderately full". Close to the 90th minute, male subjects were found to have approached close to the level "neither hungry nor full" while the female subjects were approaching "slightly full". This is supported by Oslon, (2010) which showed that men usually need a higher amount of energy values than women and this causes them to feel hungry quicker than women.

The male subjects were found to have reached the level of "neither hungry nor full" (zero value) at 92 minutes. The female subjects took a longer duration to reach "neither hungry nor full" which was at the 53rd minute. This finding explains that female subjects have higher satiety scores and sustain longer satiation than male subjects in this study. At the 180 minutes, both male and female subjects reached closed to "slightly hungry". The t-independent test between the LMS from this study and the reference scale showed no significant difference ($p > 0.05$) for male subjects and female subjects at every time interval recorded. This shows that the reliability of the constructed LMS is high. However, according to Schifferstein (2012), the use of LMS individually is more effective than any other traditional scale. The reliability of the scale construction from this was very good with Pearson's value of 0.95 and 0.97 respectively for male and female subjects. The overall Pearson's value between this scale and the reference scale was 0.96. This clearly shows that the LMS constructed in this study has a high level of reliability. Solah *et al*. (2015) in their study analysed the effect of training/familiarisation and no training/familiarisation on the correct use of LMS. The accuracy of test-retest reliability after breakfast meal intake has been studied. Their results showed that for subjects with training/familiarisation, the Pearson value was higher ($p=0.95$) than those who did not undergo training/familiarisation ($p=0.70$). This clearly demonstrates that the level of scale reliability increases with the training/familiarisation performed which was done in this study.

CONCLUSION

Two separate LMS for satiety was constructed for male and female Malay subjects. Based on test-retest reliability, it was found that both scales constructions have high-reliability values which are very important in scale construction. This finding is important in food product development especially food which is able to provide longer satiation. Therefore, this scale can be used to assess perceived fullness and hunger after meal consumption for Malay subjects in Malaysia.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants for their time and trouble as well as their support for this study. We would also like to thank grant FRGS/1/2013/STWN04/UKM/02/1 and GUP-2018-059 which has made this research possible.

REFERENCES

Astbury, N.M., Taylor, M.A. & Macdonald, I.A. 2011. Breakfast consumption affects appetite, energy intake, and the metabolic and endocrine responses to foods consumed later in the day in male habitual breakfast eaters. *Journal of Nutrition,* **141**: 1381-1389.

Berti, C., Riso, P., Brusamolino, A. & Porrini, M. 2015. Benefits of breakfast meals and pattern of consumption on satiety-related sensations in women. *International Journal of Food Sciences and Nutrition,* **66(7)**: 837-844.

Cardello, A.V., Schutz, H.G., Lesher, L.L. & Merrill, E. 2005. Development and testing of a labeled magnitude scale of perceived satiety. *Appetite,* **44(1)**: 1-13.

Chapelot, D. 2013. Quantifying Satiation and Satiety. In *Satiation, Satiety and the Control of Food Intake*. Woodhead Publishing. 12-39 pp.

Chung, CE. 2005. Is consumption of breakfast associated with body mass index in US adults? *Journal of American Diet Association,* **105**: 1373-1382.

Deshmukh-Taskar, P., Nicklas, T.A., Radcliffe, J.D., O'Neil, C.E. & Liu, Y. 2013. The relationship of breakfast skipping and type of breakfast consumed with overweight/obesity, abdominal obesity, other cardiometabolic risk factors and the metabolic syndrome in young adults. The National Health and Nutrition Examination Survey (NHANES) 1999–2006. *Public Health Nutrition,* **16**: 2073-2082.

Fakhouri, T.H., Ogden, C.L., Carroll, M.D., Kit, B.K. & Flegal, K.M. 2012. Prevalence of obesity among older adults in the United States, 2007–2010. *National Center for Health Statistics,* 1-8 pp.

Farshchi, H.R., Taylor, M.A. & Macdonald, I.A. 2005. Deleterious effects of omitting breakfast on insulin sensitivity and fasting lipid profiles in healthy lean women. *American Journal of Clinical Nutrition,* **81**: 388-396.

Hlebowicz, J., Lindstedt, S., Björgell, O., Höglund, P., Almér, L.O. & Darwiche, G. 2008. The botanical integrity of wheat products influences the gastric distention and satiety in healthy subjects. *Nutrition Journal,* **7(1)**: 1-6.

National Health and Morbidity Survey. 2015. *Non-Communicable Diseases, Risk Factors & Other Health Problems*. Institute for Public Health, Ministry of Health Malaysia.

Ogden, C.L., Carroll, M.D., Kit, B.K. & Flegal, K.M. 2012. Prevalence of obesity in the United States, 2009-2010. *National Center for Health Statistics* p. 1-8 pp.

Olson, P. 2010. The effects of satiety and hunger on normal, overweight, and obese BMI ranges. *Journal of Obesity,* **25**: 15-29.

Schifferstein, H.N. 2012. Labeled magnitude scales: A critical review. *Food Quality and Preference,* **26(2)**: 151-158.

Schoeller, D. 2008. Insights into energy balance from doubly labeled water. *International Journal of Obesity,* **32**: 72-75.

Solah, V.A., Meng, X., Wood, S., Gahler, R.J., Kerr, D.A., James, A.P., Pal, S., Fenton, H.K. & Johnson, S.K. 2015. Effect of training on the reliability of satiety evaluation and use of trained panelists to determine the satiety effect of dietary fibre: A randomised controlled trial. *Public Library of Science,* **10(5)**: 12-26.

Soenen, S. & Westerterp-Plantenga, M.S. 2008. Proteins and satiety: implications for weight management. *Current Opinion in Clinical Nutrition & Metabolic Care,* **11(6)**: 747-751.

Song, W.O., Chun, O.K., Obayashi, S., Cho, S. & Chung, C.E. 2005. Is consumption of breakfast associated with body mass index in US adults? *Journal of the American Dietetic Association,* **105(9)**: 1373-1382.

Stroebele, N. & de Castro, J.M. 2004. Effect of ambience on food intake and food choice. *Nutrition,* **20(9)**: 821-838.

Wyatt, H.R., Grunwald, G.K., Mosca, C.L., Klem, M.L., Wing, R.R. & Hill, J.O. 2002. Long-term weight loss and breakfast in subjects in the National Weight Control Registry. *Obesity Research,* **10**: 78-82.

World Health Organization 2015. *Obesity and Overweight*. Geneva: World Health Organization.

Zalifah, M.K., Greenway, D.R., Caffin, N.A., D'Arcy, B.R. & Gidley, M.J. 2008. Application of labeled magnitude satiety scale in a linguistically-diverse population. *Food Quality and Preference,* **19(6)**: 574-578.