

Research Article

Analysis of the Glycaemic Response and Cultural Appropriateness of Modified Traditional Asian Breakfast Meals

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Abstract

Background: Current dietetic practice in Australia aimed at reducing risk of Type 2 Diabetes Mellitus (T2DM) provides dietary advice to Asian populations which often involves meal suggestions that are culturally inappropriate thus decreasing compliance with dietary advice. The aim of this project was to modify traditional high GI Asian breakfast meals to lower GI versions and to develop culturally acceptable meal options that could help with glycaemic control in South East (SE) Asian and Chinese populations. The cultural appropriateness of the modified test meals was also determined.

Methods: Twenty participants were recruited and placed into either the SE Asian group (n = 12) or the Chinese group (n = 8) based on their self-identified ethnic background. Participants were assigned to the modified traditional breakfast meal (either SE Asian or Chinese) or porridge oats in a randomised crossover design. Each meal was matched for macronutrient composition and provided 50g of available carbohydrate. Measurements of blood glucose, appetite and satiety and cultural appropriateness of the meals were taken over a 3 h postprandial period.

Results: There were no significant differences ($P > 0.05$) in glycaemic response between the modified SE Asian breakfast meal and the porridge oats (173 ± 61 vs 152 ± 61 mmol.min/L, respectively) or between the modified Chinese meal and the porridge oats (163 ± 74 vs 144 ± 67 mmol.min/L, respectively) using repeated measures ANOVA. Qualitative analysis found that preparation time was a key determinant of breakfast choice in both groups.

Conclusion: These results indicate that small modifications to

traditional meals may be a viable alternative option in diabetes prevention.

Keywords

Asian Meals; Blood Glucose; Chinese; South East Asian; Cultural Appropriateness; Glycaemic Response

Introduction

The food choices people make determine their food intake and influence their nutritional status. Food choice is made based on a range of determinants including sensory attributes, cultural habits, lifestyle factors and food trends [1]. While food habits are systematically interrelated with one's traditional cultural behaviour [2], it is also recognised that food habits continually change as people travel, migrate and are exposed to a different environment [3].

Australia contains a large (and growing) Asian population, which is grouped into certain ethnic groups including South East (SE) Asians, North East Asians and Southern and Central Asians [4]. According to Australian Institute of Health and Welfare (AIHW) 35% of people with Type 2 Diabetes Mellitus (T2DM) in 2001 were born overseas, more common among Asians [5]. The introduction of Western culture into Asian lifestyle seems to make them more susceptible to T2DM [6]. The regular consumption of high Glycaemic Index (GI) and/or Glycaemic Load (GL) meal options such as white rice and/or white flour as their main carbohydrate source in Asian diets is thought to be a contributing factor [7-12]. Breakfast meals prepared with white rice and white flour is a common practice in the Asian region [13]. The regular consumption of high GI foods has been shown to increase the ir-

regular fluctuation of blood glucose levels and hence is associated with T2DM and related metabolic diseases [14]. Excessive postprandial glucose excursions are a risk factor for developing T2DM. This may explain why Asians exhibit a 2-3-fold larger postprandial glycaemic response than Caucasians [15-17]. Low GI foods are known to improve glycaemic control in those with or at risk of developing T2DM and are recommended as a dietary strategy in dietetic practice [18-20]. Hence, it is critical for dietitians and other healthcare professionals to gain in-depth knowledge and skills in facilitating healthy and culturally appropriate food choice changes in this population [21]. Like other cultures, many Asians have difficulties in adapting to new diets after migrating to a Western environment such as Australia especially the older generation [22,23]. Thus Australian-trained healthcare professionals face the challenge of promoting food choice change aligned with both theoretical knowledge and cultural appropriateness, which are often conflicting with each other. Since low GI diets have been shown to be effective in managing blood glucose levels in T2DM, many diabetic Asian patients in Australia are currently advised to drastically switch their traditional savoury breakfast choices to Western options such as wholegrain bread or sweet oat porridge, ignoring the patients' needs and cultural preferences. Despite knowledge that culturally tailored intervention has been shown to be more effective [24], medical nutrition prescriptions delivered by dietitians and healthcare professionals are largely based on studies conducted with Caucasians using Western foods, thus limiting applications to Asian counterparts. By incorporating selective low GI Asian food choices, traditional breakfasts can be modified to fit to practice and also accepted culturally. For example, the use of high GI rice, such as Jasmine (GI = 109, GL = 46) or medium grain (GI = 89, GL = 36) can be substituted with low GI rice varieties, such as long grain (GI = 50, GL = 21) or Basmati (GI = 58, GL = 22), or added with legumes without changing the sensory characteristics and at the same time culturally acceptable.

Thus, this unique study sought to carefully select the most commonly consumed breakfast meals by Asians from two different regions (Chinese and SE Asians) and to modify the traditional breakfasts to lower GI versions. The glycaemic response of the modified breakfasts was compared to the recommended (Western) oat breakfast cereal. The perceived satiety, acceptance and cultural appropriateness of the modified breakfast meals were also assessed along with biochemical and physical analysis. We hypothesised that the modified versions of the traditional breakfast meals will have a comparable glycaemic response to the oat breakfast meal and will be culturally appropriate and accepted by the relevant healthy Asian population.

Materials and Methods

Study design

This study employed a mixed methods research approach, with an arm of a randomised, non-blind control trial and an arm of qualitative assessment for exploring cultural appropriateness of the meals. The study was conducted in the Department of Nutrition, Dietetics and Food, at Be Active, Sleep and Eat (BASE) Facility,

Monash University, Melbourne, Victoria, Australia. This study was approved by the Monash University Human Research Ethics Committee (Project Code: CF14/1227-2014000551).

Recruitment

Participants were recruited between May to August 2014 via flyers placed around Monash University campuses (Notting Hill, Clayton, Caulfield and Monash Medical Centre) and local libraries in the City of Monash, online advertisement on the local media of Monash University and group email to all the staff and students of Monash University and to professional networks.

Inclusion criteria

The inclusion criteria were as follows: age 18-65 years, stable body weight in the last 6 months, BMI between 18.5-26.9 kg/m² (criteria set for Asian population), fasting blood glucose value < 6.1 mmol/L, unrestrained eating pattern, non-smokers, no drug or excessive alcohol consumption, normotensive, without chronic diseases and not pregnant or lactating.

Screening

To determine their eligibility, interested individuals were asked to complete health and habitual physical activity questionnaires. Screening appointments were made to potentially eligible participants identified by the questionnaires. Screening appointments involved anthropometric, blood pressure and fasting blood glucose measurements, carried out using standardised methods in the fasting state. Height was measured using a stadiometer (Harpender stadiometer, Holtain, Crymch, UK). Body weight was recorded using Seca scales (Seca 874, Hamburg, Germany). BMI was calculated with the standard formula weight (kg)/height² (m²). Body composition was calculated using Bioelectrical Impedance Analysis (BIA) analyser (QuadScan 400, Bodystat, Douglas, Isle of Man). Blood pressure was measured with an automatic device (Conex ProBP 3400, Welch Allyn, NY, USA). Fasting blood glucose was recorded by obtaining capillary blood using a single-use lancing device (HaB Direct Oceania, Queensland, Australia) and analysed using an Accu-Chek blood glucose analyser (Accu-Chek Performa, Roche Diagnostics, Mannheim, Germany). All measurements were performed with the participants wearing light clothing without shoes. Subjects were given full details of the study protocol and the opportunity to ask questions. All subjects gave written consent prior to participation.

Test meals

The test meals were oat porridge (rolled oats prepared with low fat (1.3%) lactose-free milk, (Zymil, Pauls, South Brisbane, Australia) served with honey and almonds), congee (savory rice porridge containing sweet potato and oats served with peanuts and tofu) and nasi lemak (coconut rice served with chilli sambal, cucumber, peanuts and egg). The two Asian test meals were chosen as commonly eaten breakfast meals in the Chinese and SE Asian populations, respectively [13], compared with a reference meal (oat porridge) used in Western breakfast. The serving size and nutrient values of each meal are given in table 1. The

type of rice (as the main source of carbohydrate) in the Asian test meals were modified from traditional recipes to having ingredients with low GI that are assumed culturally appropriate. Mahatma long grain rice (Riviana Foods, Wetherill Park, NSW, Australia) (GI = 50), Mahatma Basmati rice (Riviana Foods, Wetherill Park, NSW, Australia) (GI = 58) and Uncle Toby's rolled oats (Nestlé Australia Ltd, Sydney, Australia) (GI = 42) were used in the congee, nasi lemak and oat porridge recipes, respectively, instead of their high GI counterparts.

The GI of these grains were tested in previous studies [25]. The ingredients added in the modified recipes are provided in the appendix 1. All meals were analysed using Foodworks analysis (2009; Xyris Software, Queensland, Australia) to ensure they equally contained 50 g available carbohydrates. Energy, macronutrient and fibre contents across the three meals were also matched. All meals were prepared fresh by one researcher in the commercial kitchen of the department, on the mornings of the test and served warm.

Test meal	Weight (g)	avCHO (g)	Energy (kJ)	Protein (g)	Total fat (g)	Dietary fibre (g)
Congee	506.0	50.4	1680.1	14.2	11.7	5.9
Nasi Lemak	279.9	50.1	1705.6	14.2	12.3	6.3
Oats porridge	321.8	50.1	1724.1	14.6	11.9	7.5

Table 1: Nutrient composition of test foods providing approximately 50 g available carbohydrate (avCHO) per serve.

*Nutrient analysis was performed using FoodWorks 7 software (Xyris Software, Queensland, Australia).

Study protocol

The participants were divided into the Chinese and SE Asian groups, according to their self-identified ethnic background. Participants in the Chinese group were assigned the congee as their modified Asian breakfast while those in the SE Asian group were given the nasi lemak. Both groups were given oats porridge as the Western breakfast (reference food). The two meals were provided randomly on two separate mornings, with a washout period of at least two days. Randomisation was performed by flipping an Australian twenty-cent coin. The participants were advised to follow their habitual diet and exercise routine throughout the study period.

Glycaemic response testing

The protocol used to measure glycaemic response was adapted from that described by Wolever et al., [26] and Brouns et al., [27]. The meals were tested in the morning, after a 12 h overnight fast. Prior to the test, the participants were asked to complete a short questionnaire regarding the time and amount of their last meal, consumption of alcohol and caffeine, exercise and level of stress. Fasting blood glucose samples were taken at -5 min and 0 min before consumption of the test meal and the baseline fasting blood glucose level was taken as the mean of these two values. Immediately after the second fasting blood sample was taken at 0 min, the participants were required to consume the test meal at a comfortable pace within 15 min. Further blood samples were obtained at 15, 30, 45, 60, 90 and 120 min after the participants started eating the test meal. The test foods were served with 200 mL water, further 200 mL water was given during the subsequent 120 min. Subjects were asked to maintain minimal physical activity throughout the tests. Blood was obtained by finger-prick as described above.

Calculation of the glycaemic response

For each test food, the Incremental Area Under the Curve (IAUC), ignoring the area beneath the baseline, was calculated geometrically [28]. The glycaemic response for each test meal was expressed as the mean IAUC for the whole group.

Satiety

One-hundred-millimetre continuous line Visual Analogue Scales (VAS) were utilised to measure subjective feelings of hunger, fullness, desire-to-eat and prospective food consumption. The volunteers provided VAS data at baseline (0 min) and at 30, 60, 90, 120, 150, and 180 min after the commencement of eating the test food. The specific questions asked were, 'How hungry do you feel?', 'How full do you feel?', 'How strong is your desire to eat?' and, 'How much food do you think you can eat?'

Cultural appropriateness questionnaire

A 5-item cultural appropriateness questionnaire was designed specifically for the study, to determine participants' usual breakfast choices and the cultural acceptability of the breakfast meals provided. At 60 min after consuming the provided meal, the participants completed a cultural appropriateness questionnaire, as described in the appendix 2. The questionnaire collected information on existing breakfast habits and exploring determinants of breakfast choices.

Food diary

After the completion of each test, the participants were asked to complete a 24 h food diary, indicating their consumption of all the foods and drinks consumed after the blood glucose measurement. They were reminded to follow their usual eating and exercise patterns during the study period.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (version 17.0; SPSS, Chicago, IL, USA) and data and figures were processed in Microsoft Excel 2011 spreadsheet (2006, Reading, UK). The IAUC was determined for GR and satiety using the trapezoidal rule for values above the baseline. The relative increment in the GR at any time point compared with the baseline value was used to assess the differences at each time. The differences were assessed using a three-factor Repeated-Measures Analysis of Variance (RM-ANOVA) with differences between the meal assessed using contrasts within the ANOVA. Significance was set at $P < 0.05$. Values are presented as means \pm Standard

Errors of the Mean (SEM) unless otherwise stated.

Results

A total of 20 subjects (7 male, 13 female) with a mean age of 25 years (± 8) participated in the present study. All participants (mean \pm SD) were within the normal BMI range ($22.2 \text{ kg/m}^2 \pm 2.2$),

body fat percentage ($22.0\% \pm 6.7$) and fasting blood glucose ($4.9 \text{ mmol/L} \pm 0.4$).

Twelve participants (3 male, 9 female) were self-identified as SE Asians and 8 participants (4 male, 4 female) as Chinese. Table 2 indicates the anthropometric criteria for Chinese and SE Asian groups, with no difference in any of the criteria between groups ($P > 0.05$).

Criteria	Chinese	SE Asian	P values
Total number of participants	8	12	-
Total male participants	4	3	-
Total female participants	4	9	-
Age (years)	24.2 ± 3.8	25.9 ± 9.3	0.58
BMI (kg/m^2)	22.0 ± 2.1	22.4 ± 2.3	0.67
Fat mass (%)	19.6 ± 7.4	23.7 ± 6.0	0.21
Blood pressure (systolic)	107 ± 5	110 ± 10	0.38
Blood pressure (diastolic)	69 ± 4	72 ± 8	0.28
Fasting blood glucose (mmol/L)	5.0 ± 0.4	4.9 ± 0.3	0.26

Table 2: Age and anthropometry data of the study participants.

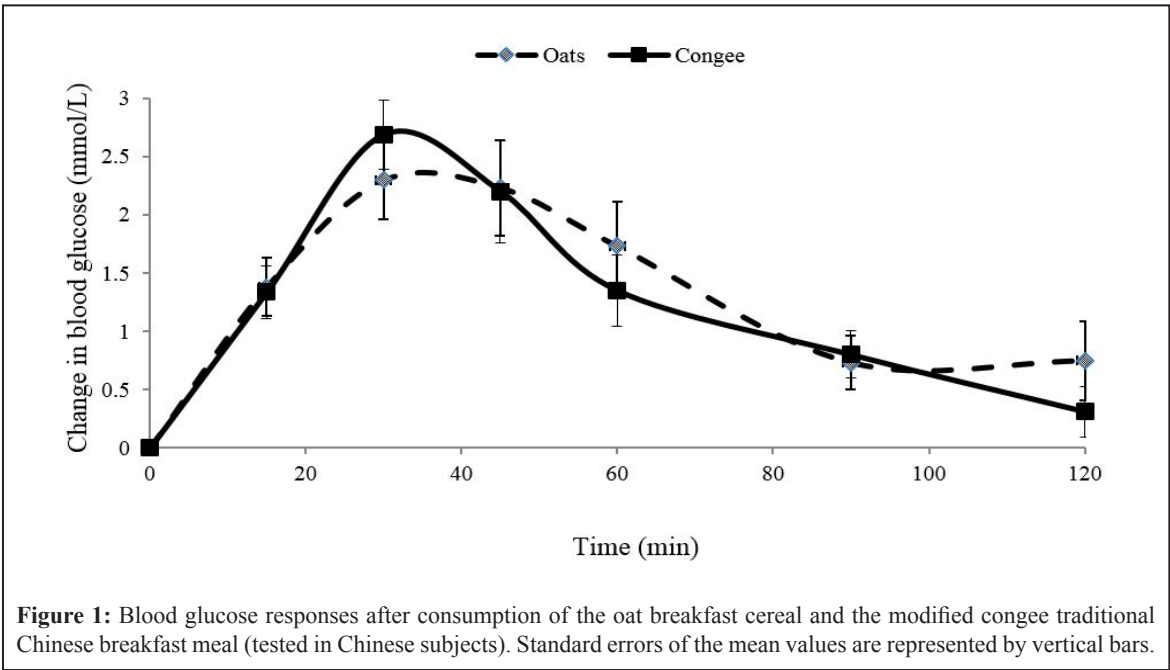
*Values are Mean \pm SD

Glycaemic Response and Satiety

The glycaemic response by Chinese and SE Asian groups to the different meals is shown separately in figures 1, 2 and combined in figure 3. The mean (\pm SEM) blood glucose response for the reference food (oats) was $169 \pm 15 \text{ mmol.min/L}$ for all participants with no significant difference in response between the SE Asian group ($173 \pm 18 \text{ mmol.min/L}$) and the Chinese group ($163 \pm 30 \text{ mmol.min/L}$) ($P > 0.05$).

Mean fasting blood glucose levels and incremental area under

the curve data are shown in table 3. There were no statistically significant differences in the glycaemic response between the traditional SE Asian breakfast meal (nasi lemak) and the oat porridge ($P = 0.37$) or between the traditional Chinese breakfast meal (congee) and the oat porridge ($P = 0.46$). Furthermore, the peak change in blood glucose and the time taken to achieve peak blood glucose did not significantly differ between the oat porridge and the traditional test meals. There were also no significant differences ($P > 0.05$) in perceived ratings of hunger, appetite and satiety or in actual food intake between the groups or between different meal conditions.



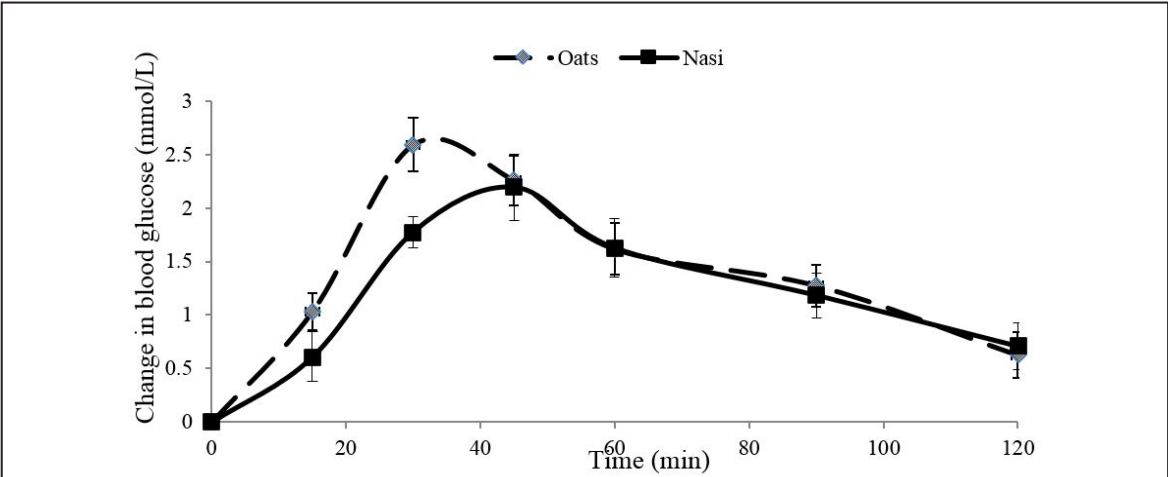


Figure 2: Blood glucose responses after consumption of the oat breakfast cereal and the modified nasi lemak traditional South East Asian breakfast meal (tested in South East Asian subjects). Standard errors of the mean values are represented by vertical bars.

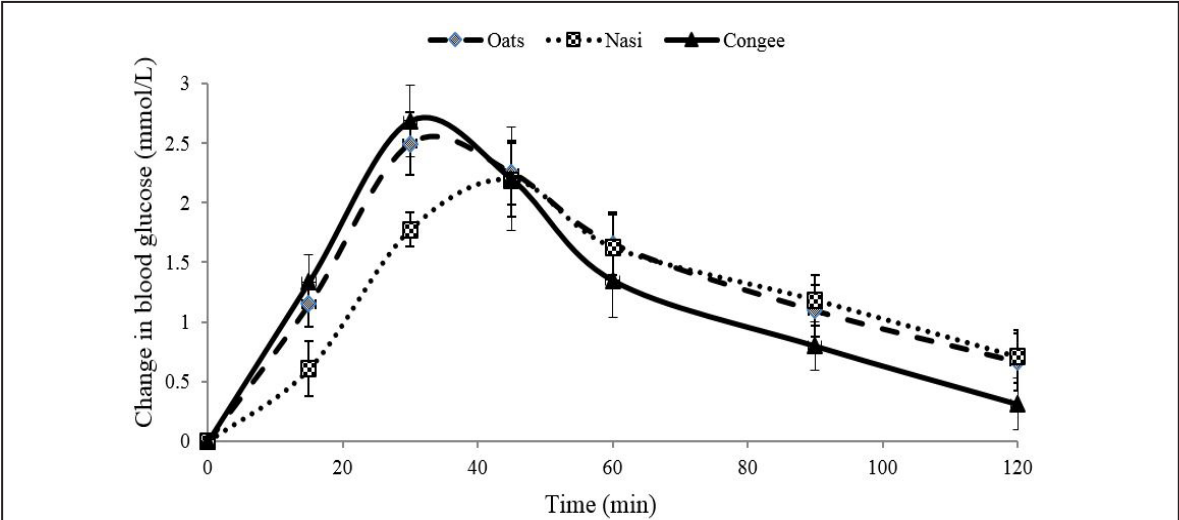


Figure 3: Blood glucose responses after consumption of the oat breakfast cereal tested in all subjects (n = 20), the modified congee traditional Chinese breakfast meal (tested in Chinese subjects) and the modified nasi lemak traditional South East Asian breakfast meal (tested in South East Asian subjects). Standard errors of the mean values are represented by vertical bars.

Test meal	n	Mean FBG± SEM (mmol/L)	Mean IAUC ± SEM (mmol. min/L)	P-value* (IAUC)	PeakΔBG± SEM (mmol/L)	P-value* (Peak ΔBG)	Time to reach Peak BG ± SD (mins)	P-value* (Time)
Oats porridge (All)	20	5.0 ± 0.4	169± 15		2.7± 0.2		37.5 ± 7.7	
Oats (SE Asian)	12	5.0± 0.2	173 ± 18		2.8± 0.2		37.5 ± 7.8	
Nasi Lemak	12	4.9± 0.1	152 ± 17	0.37	2.4± 0.2	0.26	42.5 ± 10.8	0.17
Oats (Chinese)	8	5.1± 0.2	163 ± 30		2.5± 0.4		37.5 ± 8.2	
Congee	8	5.2± 0.1	159 ± 23	0.46	2.9± 0.4	0.38	31.9 ± 5.3	0.36

Table 3: Mean Fasting Blood Glucose (FBG), Incremental Area Under the blood glucose Curve (IAUC), peak change in Blood Glucose (ΔBG)and the time (mins) taken to reach peak blood glucose for each test food.

*indicates the P-value for differences between oats (SE Asian) vs nasi lemak and oats (Chinese) vs congee test meals.

Reported length of stay in Australia

All participants (n = 20) completed the 5-item questionnaire. The responses were collated and summarised in table 4. Three

from each group (SE Asian and Chinese) were born in Australia. The other participants reported to have an average stay (\pm SD) in Australia of 6.4 years (\pm 9.1) for the SE Asian group and 18.2 years (\pm 5.8) for the Chinese group.

Criteria	Chinese (n = 8)	SE Asian (n = 12)		
Born in Australia	3	3		
Not born in Australia	5	9		
Duration of stay in Australia (years ± SD)	18.2 ± 5.8	6.4 ± 9.1		
Breakfast choice 1	Cereal (3), yoghurt (2), oats (2), leftover from dinner (1)	Bread (4), oats (3), cereal (2), milo & biscuits (1), meal replacement (1), rice & soup (1)		
Breakfast choice 2	Oats (1), Weetbix (1), noodles (1) (no 2 nd choices by the others)	Cereal (3),bread (3), oats (2), yoghurt (2), instant noodles (1), eggs (1)		
Reasons for breakfast choices:				
- Taste preference	6	10		
- cost	1	1		
- accessibility of the ingredients/food	0	6		
- easy to prepare	6	12		
- transportability	3	2		
- familiarity	1	7		
- nutritional values	5	4		
- health needs	1	0		
- others	1 (convenience)	1 (availability)		
Breakfast type:	Oats	Congee	Oats	Nasi Lemak
‘Liked the breakfast provided?’	6	8	8	12
‘Will you have it most days?’	5	3	8	6
• Reasons for ‘liking’ the breakfast	• personal preference, familiar • easy to prepare, similar to usual breakfast • healthy, fast to prepare • important to maintain health and have a strong start of the day • maintain healthy weight, prevent disease as health is important	• want to be healthier • for health benefits, feel fuller for longer as breakfast is the most important meal of the day • its yummy, easy to digest and having the health factor added value to it	• generally eat oats • easy to prepare, healthy, not heavy • choosing the healthier option • want to eat healthy • easy to make • tasty, and usually eat oats • similar to usual breakfast • definitely fill me up	• as long as it is healthy • healthy • tastes good and is familiar • tastes good • like the flavour, what I usually eat for breakfast back home • like breakfast at home, but will not have it in Australia because not easy to access nasi lemak here
• Reasons for not ‘liking’ the breakfast	• enjoy current breakfast (muesli & yoghurt) • doesn’t taste nice	• not used to eating congee • time restraint • don’t usually have Asian food for breakfast at home, takes time to cook • more used to eat toast, cereal for breakfast, as it is easier to prepare than congee • takes time to cook, used to eating muesli, yoghurt for breakfast	• not exactly the same • dislike skim milk • never like eating oats • preparation time too long	• quite a bit of work to put the food together • takes time to prepare • it was too spicy • takes longer to prepare • not used to having Asian/rice for breakfast, feels like a lunch/dinner • preparation time may be longer

Table 4: Qualitative analysis using 5-item questionnaire for both modified traditional Asian breakfast vs oats.

Breakfast habits

Every participant reported habitual consumption of breakfast. The most common breakfast choices were cereals, bread with a spread and muesli with yoghurt. Some participants reported having an Asian breakfast irregularly, however, only if it was left over from dinner the night before.

Determinants of breakfast choices

The determinants of breakfast choices were preparation time required, taste preference, nutrition, familiarity and accessibility. Preparation time was the strongest determinant of breakfast choice. Many participants reported 'liking' the modified Asian breakfast but stated that they would not have it regularly as 'it requires a long preparation time'. It was also highlighted that many would like eating oats regularly due to its perceived health benefits.

Although all participants from SE Asian group liked the modified version of nasi lemak that was prepared for them, many claimed that they will have this meal due to its perceived health benefits. However, long preparation time hindered some participants from having this meal for breakfast. It was also reported that some participants have moved away from having Asian breakfast, possibly secondary to dietary acculturation, or having least experience growing up eating Asian breakfast in Western culture when busy parents prefer to spend less time preparing hot breakfast for their children.

While in Chinese group, the prepared congee was liked much by all participant but some reported that they would not consume the modified congee regularly for its long preparation time. Again, due to this factor, and as younger generation, they have adapted to consume Western breakfast more regularly.

Discussion

This is the first study known to the authors to examine the effect of modified traditional Chinese and SE Asian breakfast meals on glycaemic response compared with oat breakfast cereal. Oat-enriched diet has been generally recommended to and consumed by T2DM patients to improve insulin resistance and reduce inflammation [29,30]. Recent studies demonstrated the effect of protein- or amino acid-rich mixed meals in reducing GI and the GR to South Asian staples [31,32]. Our study has illustrated that making small modifications to traditional breakfast meals can generate a similar GR to the currently recommended oat breakfast cereal in these populations. Previous research has shown that GI values of foods commonly tested on Caucasian subjects are likely to be applicable to Asian populations living in their own countries with no change in the GR [15,33]. The present study has highlighted that the GR to oat breakfast cereal was similar in Chinese and SE Asian subjects. Furthermore, the GR of each modified traditional breakfast was also similar to the consumed Western breakfast. These results create an opportunity in dietetic practice to offer the option of modifying traditional meals using low GI and GL ingredients rather than opting for drastic dietary change, depending on patients' individual preference.

Many studies on GR to foods focus purely on the blood glucose data. The modified Asian breakfasts were shown to have a lower GR, similar to the Western oat porridge, and this could inform clinical practice recommendations towards recipe modification of traditional meals. However, an additional important aim of this study was to examine the cultural appropriateness of modified traditional breakfast meals. Interestingly, despite the promising physiological results and participants claiming preference to the modified breakfast meals, many also reported that they would not have the traditional breakfast regularly due to time constrain. In fact, as the reported usual breakfast choices reflected, cultural appropriateness was not the primary breakfast choice determinant. Similarly, previous anthropologic study in the United States has reported that Chinese immigrants chose to eat Western-style breakfasts as preparation of traditional breakfast was 'too time-consuming' [34].

The duration of stay in Australia may be one of the factors whether or not participants are able to acclimatise to Western lifestyle including breakfast eating habits. Five Chinese participants that were not born in Australia have lived in the country on average of 18 years, while 9 migrated SE Asian participants have only lived in Australia on average of 6.4 years. Our results indicate that the longer they have lived in the country, the more exposed and adaptable they are to the Western food. The length of stay in the western environment also somehow influences Asians' dietary intakes, where GI (and GL) inversely associated with length of residence [35]. Younger Asian generations have been shown to be more likely to adopt Western foods at certain meals, while older generations preferred to consume western foods with traditional diets [36]. However, younger Asian generation would still prefer to have traditional meals containing rice for dinner [37]. Since most participants were from younger generation of Asians further analysis using older adults would warrant a better outcome.

Other possible explanation is that eating out for breakfast is also very common in Asia and hot breakfasts such as savoury rice porridge and nasi lemak tend to be readily available cheaply on the street [13], allowing time-pressured Asians to enjoy their traditional culturally appropriate breakfast without the hassle of preparation. The GI of nasi lemak varied between medium (GI = 66) in one study [38], too high in another (GI = 99) [39], which depends on many factors especially the rice varieties used. Hence, we decided to utilise low GI Basmati rice variety (GI = 58) to reduce the overall GR of the prepared meal. Results indicate that by opting to use low GI rice variety, that is culturally accepted by participants, without dramatic changes in the sensory qualities, GR of nasi lemak is similar to oats porridge. Comparable results were also obtained for Chinese group, where culturally accepted low GI long grain rice (GI = 50) was used to lower overall GR of modified congee. Traditionally, broken rice with increased starch gelatinisation, is commonly used to make congee, which has a high potential GI depending on cooking time and test subjects (79 - 107, average 86) [33,40]. This study reported that when living in a Western society where traditional hot breakfasts are not as accessible, Asians adapted to eat quick and convenient Western breakfasts such as cereals, bread with a spread and muesli with yoghurt. Since half of the participants would still prefer to have their

traditional breakfast with healthier versions, this idea may present an opportunity for the food industry to investigate the acceptance and develop novel 'ready-to-eat' traditional meal varieties.

The present study has also highlighted that perceived health benefits was another important cultural-specific determinant of food choice. As food is culturally valued as 'a natural healing agent or a form of medicine' among Asians [41], many participants in this study reported that they would willingly adopt the modified Asian breakfasts for better health. Previous research reported that Chinese living in Taiwan and Malaysia demonstrated a clear difference from their New Zealand and Japanese counterparts, for having health as one of the strongest food choice motives, rated it higher than sensory appeal and familiarity [42]. This helps to in part explain the Asian participants choosing to eat breakfast cereals and muesli marketed on their health benefits, even though they were culturally-unfamiliar breakfast food choices.

A considerable strength of the current study is that the need for this research was driven by requests from T2DM patients being seen in clinical practice. Furthermore, the two Asian populations under investigation are representative of having the highest incident of T2DM in the world [43]. The use of a mixed methods approach (qualitative and quantitative) has enabled us to explore the actual determinants of breakfast choice in these ethnic groups.

We do, however, acknowledge that the relatively narrow age range of participants and small sample size suggest the need for further research in these populations. Since younger adults were used as participants in this study, who are generally more adaptable to Western culture (including their breakfast choices), a more definite outcome was not perceived. Older adults were not used in this study either due to the eligibility criteria or not physically available to volunteer for the study. Despite their age and health status, this study also aimed to determine the cultural appropriateness of the modified traditional breakfasts.

In this study, a random selection of congee for Chinese and nasi lemak for SE Asians were chosen as most commonly consumed breakfast. Others have mentioned that Asians also tend to choose breakfast containing bread, pastry or noodles that are known to have high GI [13,44], which also require further investigation for their GR. Although it could have strengthened the outcome of this study, the actual GI value of the congee, nasi lemak and oats cereal were not tested before or after being modified to reduce the frequency of participants' test visits, hence to reduce withdrawal. The present study also did not capture dietary acculturation due to significant differences in length of stay among the participants, which is possible in bigger sample size.

In conclusion, these results indicate that small modifications to traditional meals may be a viable alternative option in diabetes prevention. This study further highlights the importance of acknowledging key determinants of food choice in dietary strategies for different population groups. This information suggests that rather than spending resources exploring different breakfast meal options, time should instead be spent understanding these populations, their dietary habits, low GI and GL ingredients and developing necessary skills to help facilitate dietary change to

decrease T2DM risk. The information generated from this study will be used to inform dietetic practice in the Australian Asian community.

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Appendix 1

Original recipe for nasi lemak was from http://www.nutriweb.org.my/resipi_sihat/nutriweb_rice_BI.htm

Ingredients in the modified nasi lemak (1 serve/280g):

- | | |
|---------|--|
| Rice: | - 140 g Mahatma Basmati rice, cooked (GI = 58) |
| | - 2 tsp reduced fat canned coconut milk |
| | - Salt |
| Sambal: | - ¼ small onion |
| | - ¼ garlic |
| | - 2.5 red chillies |

- ½ tsp canola oil
- 20g tomato
- 1 tsp lemon juice

Served with:

- 5 slices of cucumber
- 10 fried peanuts
- 1 hard-boiled egg

Ingredients in the modified congee (1 serve/506g):

Congee:

- 87.5 g Mahatma long grain rice, cooked (GI = 50)
- 200 mL water
- 50g sweet potato, boiled
- ¾ tsp canola oil

Served with:

- 10 roasted peanuts
- 70 g silken tofu
- 1 tsp soy sauce

Ingredients in the oat porridge (1 serve/361g):

Oats porridge:

- 73 g Uncle Toby's rolled oats, raw (GI = 42)
- 150 g Zymil low fat milk

Served with:

- 1.5 tsp honey
- 5 almonds with skin
- 130 mL water

Appendix 2

Questionnaire to measure cultural appropriateness of provided meal:

Please answer the following questions by ticking the box that seems most appropriate for you, or writing your answer (in English) on the line.

1. Were you born in Australia?
 - a. Yes
 - b. No

If No, how long have you been in Australia? _____

2. Do you usually eat breakfast?
 - a. Yes (proceed to Q3)
 - b. No (proceed to Q4)

3. What do you normally have for breakfast? (Please list all)

4. What are the factors influencing your breakfast choice? (you can choose more than one)
 - a. Taste preference

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- b. Cost
- c. Accessibility of the ingredients / food in Australia
- d. Easy to prepare
- e. Transportable (can be eaten in the car)
- f. Familiarity of the food
- g. Nutritional values / perceived health benefits
- h. Health needs for your conditions

Others: _____

5. Do you like the breakfast you were provided?

- a. Yes
- b. No

6. If this breakfast is a healthier option, do you think you will have similar food most days of the week?

- a. Yes
- b. No

Why?
