Comparison of self-reported speed of eating with an objective measure of eating rate.

Eilis Rose Woodward

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Abstract

Background: Research has shown a reduction in eating rate may be beneficial in the reduction of energy intake, obesity and diabetes risk. There is currently limited research as to what constitutes a fast eater and therefore how these individuals could be identified. Therefore the purpose of this study was to assess the effectiveness of self-reported eating rate at predicting objectively measured eating rate.

Methods: Participants were healthy young adults (n=78), mostly female (74%), at the University of Otago. A self-reported eating rate question was embedded in an eating habits questionnaire and administered at baseline and at two months. The question used was “On a scale of 1-5, how fast do you believe you eat?” the options provided were: 1-very slow, 2-relatively slow, 3-medium, 4-relatively fast, and 5-very fast. Each participant consumed a hot lunch meal comprising beef mince in a Bolognese sauce, a starchy carbohydrate (rice or pasta), and non-starchy vegetables. All meals weighed 550g and were consumed on three occasions. Using a digital clock, the candidate, while unobserved, recorded the start and finish times of the meals for each participant. The recorded times were used to calculate meal duration in minutes and eating rate in grams of food per minute. Self-reported eating rate categories and objective eating rates were compared using a mixed effects regression model, percentage agreement, and kappa coefficients.

Results: The number of people who self-identified as very slow, relatively slow, medium, relatively fast and very fast were 1, 9, 31, 35, and 2, respectively. Due to the small numbers in the very slow and very fast categories, very slow and relatively slow were combined to form the slow category (n=10), and very fast and relatively fast were combined to form the fast category (n=37). On average, self-reported fast, medium, and
slow eaters ate at a rate of 48.95±13.65g/min, 41.77±12.19g/min, and 35.28±10.46g/min, respectively. There was a mean difference of 14 (5.27-22.07, 95%CI) g/min between self-reported fast eaters and self-reported slow eaters (p=0.004). There was no significant difference in eating rate between the medium and fast self-reported categories and between the medium and slow self-reported categories. Each self-reported eating rate category had a wide range of eating rates with considerable overlap, and thus a low sensitivity of 56.8% was found when identifying fast eaters. Individual analyses revealed ‘fair’ agreement between self-reported eating rate and objective eating rate (κ=0.219), with exact and adjunct agreements of 47.4% and 48.7%.

Conclusions: Asking someone about their perceived speed of eating is highly subjective and unreliable. At a group-level, self-reported eating rate was sufficient to detect group mean differences in eating rate between self identified fast and slow eaters, however self-reported eating rate had poor sensitivity for classification of individuals. Hence, self-reported eating rate is unlikely to provide reliable information on an individual’s actual speed of eating. However, even a timed rate of eating is quantitatively vague given there are currently no population reference ranges of slow, medium and fast eating speeds by which to compare.

Key words: eating rate, speed of eating, self-reported eating rate, objective eating rate.
Preface

Self-reported eating rate by category was evaluated against objective eating rate in grams per minute, and the extent of relative validity is reported in this thesis. The research undertaken in this thesis was one of four segments of data collected from one larger study. The MDiet candidate, Eilis Woodward, alongside primary supervisor Dr. Bernard Venn, and two other MDiet candidates, Anna Worsfold and Kate Martin, developed the study design and protocol. Supervisor Dr. Bernard Venn ideated the research topic, and together with the candidate the research topic evolved.

In conjunction with the two other MDiet candidates, the candidate planned the logistics of dining sessions, recruited students from a third year human nutrition class, developed the test meals, and produced test meals, from procurement to reheating. Teaching fellow, Elizabeth Williams-Erickson, served the test meals and ran the dining sessions, with assistance from the candidate. The candidate was responsible for the development and dissemination of the eating habits questionnaire, demographics questionnaire, and palatability questionnaire. During the dining sessions the candidate was responsible for recording each participant’s meal duration and measuring their height and weight.

Post-intervention the candidate collated the data for statistical analysis by Biostatistician Dr. Jill Haszard. The candidate was responsible for interpreting and reporting the data.

The candidate was responsible for the research behind, and writing within this thesis, and primary supervisor Dr. Bernard Venn was responsible for advising the candidate.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BED</td>
<td>Binge Eating Disorder</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>g/min</td>
<td>Grams per minute</td>
</tr>
<tr>
<td>IBD</td>
<td>Irritable Bowel Syndrome</td>
</tr>
<tr>
<td>Kcal/min</td>
<td>Kilocalories per minute</td>
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<tr>
<td>mins</td>
<td>Minutes</td>
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<tr>
<td>MoH</td>
<td>Ministry of Health</td>
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<tr>
<td>secs</td>
<td>Seconds</td>
</tr>
<tr>
<td>VAS</td>
<td>Visual Analogue Scale</td>
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</table>
1 Introduction

New Zealand’s Eating and Activity Guidelines for adults have no guidelines regarding speed of eating (1). Yet other countries, such as Argentina, Brazil, Macedonia, Germany, and Ireland have general nutrition guidelines which advise the population to ‘take your time’ when eating and/or to ‘enjoy meal times’ (2-6). These recommendations were made based on the idea that slower eating increases satiety and reduces risk of overeating (7) which may lead to health risks associated with the metabolic syndrome (8, 9).

Numerous observational and experimental studies have shown that a faster eating rate may lead to a higher energy intake (10-18) and, consequently, a higher body mass index (BMI) (19-26). A fast self-reported eating rate and high BMI have been linked to increased insulin resistance (24) and type 2 diabetes (24, 27, 28).

Over 50% of the New Zealand adult population is overweight or obese and 11% of New Zealand children are obese (29), reflecting the need for clear, well-informed primary prevention and treatment. Indeed, when people slow down their eating rate, decreases in energy intake and reductions in BMI and diabetes risk have been found (7-28).

In order to advise people on speed of eating in the clinical setting it is important to establish a means of identifying fast eaters. One common indicator used in research is to ask people whether they are fast or slow eaters (22, 24, 28, 30-35), but this is a highly subjective perception without a frame of reference by which to judge the veracity of the claim. Various methods have also been developed whereby eating rate has been measured in the home or laboratory setting. These methods provide a means for making relative comparisons with self-reported eating rates, although there are no
population reference ranges with which to establish a normal range. This observational study therefore seeks to investigate the association between self-reported speed of eating and eating rate measured objectively in the laboratory.
2 Literature Review

Literature relevant to objective and self-reported eating rate is reviewed in the following sections:

- What is eating rate/speed of eating?’ which examines the various measures of eating rate and the variables affecting eating rate.
- ‘Eating rate and metabolic disease’ which gives a brief insight into the associations of eating rate with energy intake, obesity, and diabetes.
- ‘Eating rate and intervention strategies’ discussed with regard to behavioural strategies and tools.
- ‘Defining speed of eating’ investigates the terms fast and slow and what they mean in the literature.
- ‘The validity of self-reported eating rate’ analyses previous literature validating self-reported eating rate.
- ‘Can we trust self-reported eating rate?’ encompasses previously discussed literature as well as literature on eating behaviours and memory formation.

2.1 Methodology of Literature Review

The literature examined was gathered through databases MEDLINE, CINAHL, and Scopus using keywords such as ‘eating rate’, ‘speed of eating’, ‘self-reported eating rate’, ‘validity’, ‘energy intake’, ‘metabolic syndrome’, ‘vegetables’, ‘carbohydrate’, ‘protein’, and ‘eating behaviour’. Articles acquired by these searches were manually searched for further relevant references. The inclusion criteria were observational and experimental studies carried out in human subjects.
2.2 What is eating rate/speed of eating?

The terms eating rate and speed of eating are interchangeable in the literature and are expressed as grams of food (g/min) or energy (kcal/min) consumed per minute.

Another measure used is meal duration; the time taken to eat a test meal. Meal duration however, is not indicative of the amount of food consumed and is therefore not widely reported. There are other methods of assessing eating characteristics related to eating rate. These include acceleration-eating rate, deceleration-eating rate, total chews, chew rate, chews per bite, bite size, total swallows, and oral exposure time. However, these are not direct measures of eating rate and are not covered in this literature review.

Subjective speed of eating is an individual’s perception of eating rate, often defined by five self-reported categories: very slow, relatively slow, medium, relatively fast, and very fast (22, 24, 28, 30-35). In many studies, the number of people identifying as being very fast or very slow eaters are small and investigators tend to re-classify these five categories into slow, medium, and fast (25, 28, 30, 32-34, 36, 37). These terms may differ slightly in some studies, such as ‘fast’ instead of ‘very fast’ (25, 36, 37), or participants are asked to select one of three categories: slow, medium, or fast (8, 9, 38).

Self-reported eating rate is often obtained through an eating rate question embedded in a health or dietary related questionnaire, drawing attention away from the key data being collected (8, 22-25, 28, 30-37).

Both subjective and objective eating rate measures are reported in the literature. Subjective measures are reported more frequently, while objective measures are predominantly reported in randomised controlled trials designed to manipulate an individual’s eating rate. Objective eating rate is not widely used in observational trials for analyzing correlations between speed of eating and health risks.
2.2.1 Variables affecting subjective eating rate
The terms, ‘fast’ and ‘slow’ are subjective. When asked if one is a slow or fast eater, the response is that person’s perception. Perception is an opinion, and so is based on experience and knowledge. Therefore, a person’s perceived self-reported eating rate is likely formed in relation to whether they finish their food more or less quickly than others around them. Self-reported eating rate can be unreliable, as there is currently no frame of reference by which to determine subjective eating rates.

2.2.2 Variables affecting objective eating rate
Objective eating rate is highly variable with many factors involved. These factors include type of food, palatability, hunger, portion sizes, distractions, heightened awareness in a laboratory setting, and the increase of the modern fast-paced lifestyle.

2.2.2.1 Food types
The level of processing and difference in food texture has been associated with eating rate (12, 17, 18, 39-41). Whole, firmer foods, which require more chewing, slow the eating process and lengthen meal duration, compared to softer, more liquid food. This has been shown in the literature by altering the form of foods such as apples and carrots, and comparing eating rates at different levels of processing (12, 17, 39, 40). For example, one study showed 50g of raw carrot was eaten at a rate of 19.3g/min with 290 chews, boiled carrot at 36g/min with 149 chews, and mashed carrot at 64.6g/min with 68 chews (40). Additionally, other work has shown raw apple is consumed more slowly than apple puree, which in turn is consumed more slowly than apple juice (17, 39). These differences have previously been attributed to the difference in fibre content (39), however, they are now thought to be a result of texture and viscosity (17, 18, 40, 41).
Very little evidence is available in regards to how heavily one macronutrient affects eating rate compared to another, and whether the structural properties of various foods override any influence macronutrient composition may have on eating rate. While energy density, carbohydrate content, protein content and fibre content have been shown to independently decrease eating rate (17), research in this area is lacking. Nonetheless, given the studies reported above, it is likely that structural properties of foods, somewhat influenced by macronutrient composition, gives rise to changes in eating rate, with more solid foods decreasing eating rate.

2.2.2.2 Palatability and hunger

Palatability has been found to affect speed of eating. In one study, when served a palatable meal, participants ate significantly faster than when served a more strongly flavoured, less preferred tasting meal (42). Similarly, eating rate can increase with hunger (43-45). As one’s taste for a food and baseline hunger affects eating rate, it is important that these variables are measured in objective eating rate studies.

2.2.2.3 Portion sizes

Recent research in 37 overweight women has shown larger portion sizes increase eating rate (46). This association may be due to hedonism, whereby desire and a larger portion size create an impulse to eat faster (46, 47). The increased eating rate observed with larger portions may explain the increased energy intake seen with larger portion sizes (48-51), as a faster eating rate is associated with increased energy intake (10-18). Also observed has been a more consistent eating rate with larger portions and a slower eating rate when a meal exceeds 540g, suggesting subconscious pacing with larger meals (46).
2.2.2.4 *Modern lifestyle of the Western world*

The pace of living has increased over the past decade (52, 53) and, as such, ready-made, fast, and on-the-go foods have increased in popularity (54). Additionally, many New Zealand families no longer sit down to a family meal everyday (55). This could be a result of many commitments, be they work, social, or sporting, impeding on mealtimes. These findings suggest that taking time to eat meals is no longer a priority. This becomes an issue when meals become a time for multi-tasking with distractions such as reading and watching television, activities that have been found to increase eating rate (56) and food intake (10-18, 56-59). Passive distractions such as television or reading can cause disassociation with one’s eating behaviours, increasing energy intake (60). Comparatively, active and more engaging distractions such as social media and the internet tend to reduce energy intake due to the physical interaction with the device (60). Although not investigated, these associations may be due to eating rate, with more consistent eating rates observed with passive distractions, and in active distractions more breaks in eating observed for interaction with the distraction.

2.2.2.5 *Environmental influences*

The social context in which a meal is consumed has been found to affect the amount of food eaten, with more food consumed in the presence of other people than when eating alone (61-65). Potentially, the amount of food eaten is reflected in eating rate although little has been established on the effect of dining companions on eating rate. However, no effect on eating rate was found in a study in which 82 adults kept 7-day diaries on their dining environment, companions, meal duration, intake and their hunger, anxiety, and mood (66). Music has been found to influence eating rate, with slower music significantly increasing meal duration, thought to be as a result of tempo (67).
2.2.2.6  *Binge Eating Disorder*

Binge Eating Disorder (BED) is defined as consuming a large quantity of food very quickly (68) and is associated with the part of the Three Factor Eating Questionnaire dealing with disinhibition (69). The lack of control seen in BED results in altered eating rate, where one consumes food much faster than usual, though most notably this behaviour is executed privately, while vigilantly keeping public eating behaviours somewhat normal (68). In conducting research on eating rate it may be wise to assess participants for BED in the screening phase, as the disorder has the potential to confound results.

2.2.2.7  *Observation awareness*

A confounding effect of eating rate observation awareness is yet to be reported. However, awareness of observation has been associated with a decreased energy intake (70). If observation awareness affects eating rate, then due to self-presentation participants may decrease their eating rates based on ‘healthful connotations’ (65, 71).

2.3  *Eating rate and metabolic disease*

Fast eating potentially has a domino effect on metabolic disease. Gut hormones such as cholecystokinin, peptide YY, and glucagon-like peptide-1 regulate satiety signals (72). Eating slowly increases these gut hormones more so than eating quickly (73). Eating too quickly for the response of satiety signals may explain why faster eating is also associated with increased energy intake (7, 10, 73-75). When eating rate increases energy intake an association with BMI is also seen (19-26). Additionally, as eating quickly is associated with a higher BMI and central adiposity, there is an increased risk of developing type 2 diabetes (24, 27, 28). As these health risks are on the rise in New Zealand (29, 76), eating rate interventions may be useful in improving the health of New Zealanders.
2.4 Eating rate intervention strategies

Due to the evidence associating fast eating with negative health outcomes many strategies have been developed to moderate eating rate for both research purposes and intervention. Mindful eating has received a lot of attention in recent years. Mindful eating and its strategies focus consumer attention on the body’s physiological signals of hunger and satiety, as well as on the food being consumed (77). In doing so, overeating is less likely to occur, as eating rate is reduced and satiety reached before overconsumption can occur (7, 10, 73-75). Additionally, other strategies to reduce eating rate include smaller portion sizes (46, 78, 79), smaller utensils (10, 80), eating more solid foods (12, 18, 40, 81-83), and counting chews (84, 85).

Tools such as the Universal Eating Monitor (81, 86) and the Mandometer (13, 87-91) have also been developed. These measure the weight of food taken from the plate at certain time intervals and can feedback in the form of a graph to a computer. An eating rate can be graphed and displayed alongside visual feedback allowing someone to adjust his or her eating rate to meet the prescribed graph (13, 87-91). These tools are used in research to manipulate eating rate to target a particular percentage of usual rate (88, 89). These have also been tested for clinical intervention in retraining eating behaviours (90, 91). Another tool in the public domain is the HAPIfork, which monitors meal duration, time between forkfuls, number of forkfuls, etc. (92). It uses this information to discourage its users from exceeding a self-selected pace by sounding an alarm (92). Any such tools are somewhat invasive and provide a high burden on participants with particular regard to eating out. Such intensive tool-based interventions should be considered secondary to lighter strategy-based interventions such as mindful eating. Nonetheless we must be able to differentiate a fast eater from a slow eater in order to provide relevant intervention.
2.5 Defining speed of eating
In order to define fast or slow eating, a frame of reference must be established. Current literature does not provide a fixed frame of reference for objective eating rate, nor does it provide any clear, clinically relevant eating rates for defining one as fast (at risk) or slow (not at risk). There are also no published population norms of eating rate distributions for comparison. Similarly, there is no standard for self-reported eating rate, as the subjective measure is simply the perception of an individual. Objective eating rate reference ranges would be useful, because although reducing eating rate has been associated with weight loss in obese adolescents (90, 91) an absolute eating rate consistent with health parameters has not been established.

2.6 The validity of self-reported eating rate
Self-reported eating rate has previously been used to report on health outcomes in observational studies (8, 9, 22-25, 28, 31-33, 35-38). The dominant question in the literature has been found to be repeatable (24, 30, 34), however its validity is still in question. Recent studies have obtained both subjective and objective measures of eating rate and compared them to determine the validity of self-reported eating rate (30, 34, 93). Average objective measures of the fast self-reported eating rate categories were significantly faster than the slow categories. This indicated that self-reported eating rate at a group level, is sensitive enough to detect associations between fast self-reported eating rate and health outcomes (93). These results however, do not indicate whether self-reported eating rate is sensitive enough to predict actual eating rate at an individual level, due to the use of the subjective measure as the independent variable rather than the objective measure.

In 2003, Sasaki and colleagues published a paper assessing the validity of self-reported eating rate at an individual level by comparing the self-report with a friend-report. In
222 subjects, they found 46% of friend-reports matched self-reports (35). Although less than 50% correspondence is not ideal, many people have used this paper to justify the use of self-reported eating rate (33, 36, 94). However, using a subjective measure is insufficient to validate a subjective eating rate question. A decade later participants compared their eating rate to other participants (27). These reported eating rates were compared to diabetes risk and found an increased risk of diabetes with a faster report (27). These comparative eating rates were used in an attempt to make self-report less subjective (27). Nonetheless, these reports were still subjective as participants’ self-reported eating rates are dependent on others’ eating rates, meaning their perception of their own eating rate would vary based on whom they ate with.

Of these validation studies, none compared self-reported eating rate against a strictly objective measure. Classifying individuals according to self-reported eating rate and then for each category, presenting mean values for objectively measured eating rate has limitations. Taking the objective measures and calculating means within each self-reported group may miss outliers. This would allow an objectively fast eating individual to self-report as a slow eater, and go unreported. Ordering participants by objective eating rate would allow for a direct comparison with self-reported eating rate. In doing so, categorization of fast or slow eating rates may be more clearly and numerically defined for comparing health issues with self-reported eating rate.

2.7 Can we trust self-reported eating rate?
Due to the dearth of literature, there is no evidence that can be used to examine how self-reported eating rate correlates with an individual’s actual eating rate. As stated previously, self-reported eating rate relies heavily on perception. Currently, we cannot rely on this perception when it is 1) not proven to be valid, 2) influenced by those
around them, 3) influenced by the meal consumed (12, 17, 18, 39-41), and 4) the environment in which it is consumed (56, 67).

As previously discussed, the type of meal consumed alters eating rate (12, 17, 18, 39-41). Someone who predominantly eats more solid foods may have a different perception of slow and fast eating compared to someone who predominantly eats softer foods. Should an individual eat a meal with someone else who is eating a different meal, a perception of eating rate may become biased. Similarly, sharing the same meal as someone but with different portion sizes may alter perception. Also unknown is the accuracy of the perception of someone who usually eats alone, compared to the perception of someone who usually eats in company.

One of the larger queries of the accuracy of perceived eating rate stems from distracted meal times. To encode memories of meals the brain requires full attention on the meal (95). It has been found that distractions while eating can inhibit one’s memory of the meal (58, 96-98). Less physically engaging distractions with a visual focus, such as watching television, appears to draw attention away from a meal (58, 99, 100), inhibiting one’s memory of the meal. However, post-prandial awareness of food consumption can increase one’s memory of the food, for example lolly wrappers as a trigger for the memory of the food and amount consumed (101). Applying focus away from the food being eaten may therefore restrict ability to be aware of the speed of eating, and thus reduce self-reporting of eating rate to guesswork. However, no research has been undertaken to determine whether perception of eating rate in particular is altered by distraction.

In summary, self-reported eating rate relies on many non-standardised variables. It is based on perception and has no frame of reference by which to judge the accuracy of
the perception. Furthermore, there is no study in which self reported eating rate has been validated against objective eating rate at an individual level. With the limited research available and the variability of perception, it is possible that self-reported eating rate may be poorly predictive of actual individual eating rate, however can detect differences at a group level (30, 34, 93). It is also important to note that objectively measured eating rate may not be truly indicative of usual eating rate in the free-living environment, as the conditions and meal being observed may be atypical of their usual eating experience.

2.8 Rationale for research

As eating faster has been shown to increase energy intake (10-18), correlations of high BMI (20, 22-26) and diabetes risk (24, 27, 28) with fast self-reported eating rate are plausible. If a focus were to be put on reducing eating rate in the prevention and treatment of obesity, guidelines could be implemented at population level, and one-on-one interventions could be implemented at the clinical level. However, there are currently no reference ranges describing what is fast or slow eating. So unlike the New Zealand nutrition guidelines for food intake, which give portions and quantities (1), a recommendation to reduce eating rate cannot currently be quantified and thus would be vague, and clinical intervention would be presumptuous. Thus there is a need to quantify the terms fast and slow eating, and to assess the predictive ability of self-reported eating rate compared to actual eating rate, at an individual level.
3 Objective Statement

Identification of fast eaters may be beneficial in a clinical setting for the prevention and treatment of obesity and other related non-communicable diseases. Currently, there is a lack of literature regarding the validity of self-reported eating rate and it’s applicability in the clinical setting. Additionally, there is no definition, or reference as to what constitutes slow or fast eating. Therefore the key purpose of this study was to compare self-reported eating rates against objectively measured eating rates in a group of University students. A secondary objective was to place the objective eating rates in context of the published data.

Objective 1: At a group level, compare self-reported eating rates to objective eating rates measured under standardised laboratory conditions.

Objective 2: At an individual level, compare self-reported eating rates to objective eating rates measured under standardised laboratory conditions.

Objective 3: Compare measured objective eating rates against the published data.
4 Methods:

This thesis compares self-reported eating rates against objectively measured eating rates. Self-reported eating rates were collected within an eating habits questionnaire, and meal duration and rate of eating were observed across three lunch meals. Three other outcomes were assessed during the lunch meals and were reported in other theses (102, 103). The University of Otago Human Ethics Committee granted ethical approval (Appendix A) and Maori consultation was conducted through the Ngāi Tahu Research Consultation Committee (Appendix B). The trial was retrospectively registered with the Australian New Zealand Clinical Trial Registry on June 1st 2016, trial registration ACTRN12616000722493 (Appendix C).

4.1 Participants

Participants were a convenience sample, recruited from a 300-level Human Nutrition class at the University of Otago. Each student was contacted and received an information sheet (Appendix D) via email and the University’s online student network (Blackboard). Students attended a lecture in which the study method was explained, but the eating rate outcome was not divulged (Appendix E). Participants gave informed, written consent before the experiment commenced (Appendix F).

4.1.1 Inclusion and exclusion criteria

Participants were male or female students aged between 18-60 years. Students with self-reported food allergies, which could not be catered to, were excluded.
4.2 Study design

The study included an eating habits questionnaire for collection of self-reported eating rate data, and a laboratory observation where participants were timed while eating a lunch meal. The questionnaire was completed twice, once before and once after the laboratory observation. The laboratory observation consisted of eating lunch meals on three occasions. On each occasion participants were unaware of objective eating rate being recorded. As seen in Figure 4-1, the laboratory observation included a randomised controlled crossover design, in which participants consumed three meals of varying proportions, in a randomised order. All three meals were of equal weight, and had different proportions of starchy carbohydrate and non-starchy vegetables. Half of the participants received pasta as their starchy carbohydrate, while the other half received rice. The different meal compositions were selected for generalizability.
Figure 4-1 Flow diagram of study design and participation, adapted from CONSORT
4.3 Meal development

4.3.1 Ingredient selection

The meal was comprised of steamed stir-fry vegetables, premium beef mince, a Bolognese sauce, and jasmine rice or penne pasta. Ingredients and brands were selected based on affordability (average meal cost $3.52), availability for bulk purchase, ease of preparation and consumption, nutritional value, palatability and familiarity to the study population.

Alternative vegetarian, vegan and Irritable Bowel Syndrome (IBS) meals were developed, with problem ingredients substituted for the most similar option within practical reason. Vegetarians received Vegetarian Mince, an egg-based meat alternative, similar in texture and appearance to beef mince. Chickpeas were used in place of mince and Vegetarian Mince for vegan meals, for practicality. For IBS meals, an alternative pasata sauce and stir-fry vegetable mix were chosen due to their lack of gastric irritants. For further information regarding special meals, refer to Appendix G. All meals were pre-tested for practicality and palatability.

4.3.2 Standardised cooking practices

Standardised cooking practices were established via two pre-tests, where raw to cooked weight conversion factors were determined (Appendix H). Meals were cooked in bulk on three occasions and frozen, for thawing and reheating prior to dining sessions. At each occasion Food Safety Standards were met and standardised cooking practices adhered too. The standardised cooking practices are as follows:

*New World Premium Beef Mince and Quorn Vegetarian Mince*

2tsp of Canola Oil (Sunfield Oils, Tasty Products Ltd.; New Zealand) was heated in a large fry pan, and 1kg of raw Premium Beef Mince (New World; Dunedin, New Zealand) or frozen Vegetarian Mince (Quorn™ Marlow Foods Ltd.; Australia) was
added and cooked until browned. As on the pasta sauce label, Extra Bolognese Sauce (Dolmio®, Mars Food; Australia) was added to the mince at a 1:1 ratio (1kg) and left to simmer. The mince mix was temperature probed (Cooper-Atkins Corporation, model DPP400WW) to ensure it was above 68°C (104). Once cooked, the mince mix was removed from the heat and weighed in 200g lots into aluminum plates for freezing.

**Wattie’s Chickpeas in Springwater**

Chickpeas in Springwater (Wattie’s®, Heinz Wattie’s Ltd; New Zealand) were drained and 100g were weighed into each aluminum plate, with 125g of Dolmio Extra Bolognese Sauce poured over top.

**Wattie’s Asian Stir-Fry Vegetables and Wattie’s International Stir-Fry Vegetables**

A glass bowl was filled with frozen vegetables and 1Tbsp of water, then covered and placed in a microwave for 10 minutes until vegetables were Al Dente. The vegetables were strained and weighed into aluminum plates for freezing.

**San Remo Dried Penne Pasta**

In a large pot, 10L of water was brought to boil and 2.5kg of Dried Penne Pasta (San Remo Macaroni Co. Pty Ltd; Australia) was added. The heat was reduced and the pasta left to cook for 10 minutes, occasionally stirred. The pasta was checked regularly, and once Al Dente was removed from heat and strained. The pasta was run under cold water to cease the cooking process. Once cold, 2tbsp of Canola Oil (Sunfield Oils, Tasty Products Ltd.; New Zealand) was mixed through the pasta. The pasta was weighed into aluminum plates for freezing.
On dining days Jasmine Rice (Pams®; New Zealand) was cooked in a Tefal Automatic Rice Cooker (Model Serie R07; China) at a 1c rice to 2c water ratio. Once cooked the rice cookers kept the rice hot until weighed into reheated meals.

4.3.3 Portioning
The test meal was based off the New Zealand Ministry of Health (MoH) Food and Nutrition Guidelines in collaboration with the plate model, where half the plate is vegetables, one quarter is protein food, and one quarter is carbohydrate food (105, 106). A standard portion size was developed in accordance with the MoH guidelines; 150g of white rice or pasta is one serve of carbohydrate, and approximately 200g of mince is one serve of protein. A standard portion of 200g mixed vegetables was established, equating to two to three serves and was found to reflect the plate model, relative to the 150g portion of carbohydrate (105, 106). Outcomes regarding proportion of vegetables to carbohydrate were examined through this trial and reported in other theses (102, 103). As such, the three meals participants’ received varied in composition, these were as follows:

- 100g white rice/pasta : 250g mixed vegetables : 200g meat and sauce
- 150g white rice/pasta : 200g mixed vegetables : 200g meat and sauce
- 200g white rice/pasta : 150g mixed vegetables : 200g meat and sauce

The standard meals weighed 550g, whereas the vegan meal was 25g heavier, as an extra 25g of sauce was added for palatability.

Meals were weighed into aluminum dishes, 214mm in diameter, and covered with tin foil for freezing, chilling, reheating, and serving. Each of the six meal types were
colour coded by dot stickers to ensure the correct meals were given to each participant, and to prevent explicitly informing participants of meal compositions.

4.4 Study procedure

4.4.1 Eating habits questionnaire
An eating habits questionnaire was generated from a compilation of validated (questions 7-13, (69)) and non-validated eating habits questions (questions 1-5 and 14-20) (Appendix I). The questionnaire included the eating rate question being investigated (question 6); ‘On a scale of 1 – 5, how fast do you believe you eat?’ with options; ‘very slow’, ‘relatively slow’, ‘medium’, ‘relatively fast’, and ‘very fast’ (35). The question was adapted from a study by Sasaki et al. (35) and is commonly used in the literature (33, 36, 94). The eating habits questionnaire was administered before and after the observation phase to evaluate repeatability, with a two-month interval between questionnaires. The questionnaire also included a question regarding usual dinnertime distractions. Participants were told to complete the questionnaire during their 300-level nutrition lecture, to avoid rushed answers.

4.4.2 Laboratory procedure
Reheating the meals
The meals were removed from a freezer at 9am the day prior to dining days, and placed into a refrigerator. At 8am on dining days, three Sanyo Ovens were turned on to pre-heat to 180°C. Meals were placed in the ovens to reheat and rice put on to cook, one hour and 45 minutes before service. Rice was dished onto meals and placed back in the oven, 30 minutes prior to service. Meals were temperature checked (Cooper-Atkins Corporation, model DPP400WW) before each service to ensure all meals were >60°C as per Food Safety Standards ((104)).
Dining sessions

Participants were to arrive in the laboratory at 11:50am or 1pm, in a 2.5-hour fasting state, and were not to have consumed water in the 30 minutes prior to arrival. Dining sessions were run inside the University of Otago’s new undergraduate human nutrition laboratory (Appendix J). The room was temperate, clean, and contained three long white tables (Appendix K). Participants were allocated seats, with seating location varying from week to week. At each allocated seat, participants were provided with a preference questionnaire (Appendix L), and on one of three occasions a demographics questionnaire (Appendix M). Participants were given verbal instructions to eat their entire meal, as well as to eat how they would usually. Participants were given a 250mL glass of water with their meal. The candidate, and an assisting researcher were responsible for recording start and stop times of 20 participants at any one time, via a digital clock (Appendix N). A digital stopwatch was allocated to each participant and was held by one of four other laboratory staff, whom were responsible for starting and stopping the stopwatches for five participants at any one time. The start and stop points were defined as when food first entered the participant’s mouth, and when the participant swallowed their last mouthful. Participants were unaware that their eating was being timed.

Upon finishing the meal, participants were asked to evaluate the meal for post-prandial comfort, size, appearance, and taste via 100mm visual analogue scales (VAS) (Appendix L). “Just right” was considered the middle of the scale (50/100), with 0/100 representing ‘too small’ and ‘disliked’, and 100/100 representing ‘too big’ and ‘liked a lot’.
Demographic questionnaire

Demographic and anthropometric data were collected from participants. The demographic questionnaire collected data on sex, age, nationality, ethnicity, smoking status, and body mass index (BMI). Questions on smoking, and ethnicity were adapted from the 2013 New Zealand Census of Population and Dwellings: Individual Form (107). BMI (weight in kg dividing by height in m$^2$) was determined through standardised anthropometric measures of height (m) and weight (kg), according to published methods (108). Participants weight was measured on a set of calibrated scales (Seca Alpha, model 770; Germany) to the nearest 100g and height on a stadiometer (Holtain Limited; United Kingdom) to the nearest mm.

4.4.3 Eating rate recordings and calculations

Eating rate was recorded in two ways; by noting clock times and by stopwatch. Using a digital clock, the candidate recorded, to the nearest second, the time at which each participant began and finished their meal. The same digital clock was used to determine all start and stop times. Other research staff used digital stopwatches to record meal duration, as a back up for missed values. All stopwatches used were of the same make and model. The candidate and research staff marked any missed times with an asterisk and recorded the time when it was caught.

To determine meal duration values for each individual at each meal, the clock times were used. If the clock times were marked as incorrect/missed, the stopwatch duration was taken. For 14 of 234 meal sittings the exact time of either start or finish was not observed for both clock and stopwatch durations. In these instances the clock and stopwatch durations were averaged. Three participants had one of their three meal duration values excluded from analysis due to being substantially different from their two other meal durations.
Eating rate per meal was determined by grams consumed divided by meal duration in minutes (g/min). Individual eating rate was determined by averaging an individual’s three eating rates.

4.5 Statistical methods

4.5.1 Power calculation
A sample size of 70 is sufficient to detect a statistically significant (p<0.05) kappa coefficient of 0.40, with 90% power for agreement between self-reported eating rate and objective eating rate (109).

4.5.2 Randomisation and allocation
The randomization and allocation process was carried out using Stata 13.1 (StataCorp, Texas) and student identification numbers. Participants were randomised into either rice or pasta intervention groups, then into one of six permutations for meal composition order, followed by one of ten combinations for dining dates, and finally allocated to one of two dining times (11:50am or 1pm). Block randomization was used to remove gender discrimination.

4.5.3 Statistical analysis
The very slow and relatively slow self-reported categories were combined to form the slow category, and the very fast and relatively fast categories were combined to form the fast category. This was done due to small numbers in the very slow and very fast categories.

Data were analysed using Stata 13.1 (StataCorp, Texas) and Microsoft Excel 2011.

Test-retest reliability of the self-reported eating rate question was tested using a linearly weighted Cohen’s Kappa Coefficient and also assessed by examining the percent agreement.
An objective mean eating rate was calculated for each participant, using the three meals they were served. Means and standard deviations of these objective eating rates for each self-reported category were determined. A mixed effects model regression was used to determine differences in objective eating rate by self-reported categories. These models were adjusted for type of meal (i.e. rice or pasta) with a random effect for participant ID. As the variance of eating rate was different between the self-reported groups, eating rate was log-transformed and mean differences were back-transformed and presented as percent difference with 95%CI and p-values.

Objective eating rates were divided into groups for slow, medium, and fast based on the number of participants for each self-reported category. The self-reported categories were compared against the objective groups for level of agreement using Cohen’s Kappa Coefficient and percent agreement. Variability in meal duration within an individual was determined by calculating the coefficient of variation. Mixed effects regressions were used to assess differences in eating rate by meal proportions within pasta and rice groups. Participant ID was included as a random effect and mean differences, 95%CI and p-values were calculated.

Objective eating rates were also divided by tertiles to develop three reference ranges for slow (n=26), medium (n=26), and fast (n=26).

All models were adjusted for special diet meals, and for order in which meals were given and residuals plotted and visually assessed for homogeneity of variance and normality.
5 Results

5.1 Subject characteristics

Baseline characteristics of the study population are presented below in Table 5-1.

There was an equal distribution of males and females across the rice and pasta groups, with a larger proportion of females in the study overall. Participants were on average 21 years of age, within the normal BMI range (23.5±3.9kg/m²), and predominantly of New Zealand European decent.

Table 5-1 Subject baseline characteristics according to carbohydrate randomisation

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Pasta (n=39)</th>
<th>Rice (n=39)</th>
<th>Total (n=78)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (%F)</td>
<td>74</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Age (years) (mean±SD)</td>
<td>21.0±2.4</td>
<td>21.4±1.9</td>
<td>21.3</td>
</tr>
<tr>
<td>BMI (kg/m²) (mean±SD)</td>
<td>23.6±4.3</td>
<td>23.5±3.5</td>
<td>23.5±3.9</td>
</tr>
<tr>
<td>Ethnicity (n (%))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>23 (58.97)</td>
<td>31 (79.49)</td>
<td>54 (69.23)</td>
</tr>
<tr>
<td>Asian</td>
<td>8 (20.51)</td>
<td>5 (12.82)</td>
<td>13 (16.67)</td>
</tr>
<tr>
<td>Maori</td>
<td>2 (5.13)</td>
<td>2 (5.13)</td>
<td>4 (5.13)</td>
</tr>
<tr>
<td>Other</td>
<td>6 (15.38)</td>
<td>1 (2.56)</td>
<td>7 (8.97)</td>
</tr>
<tr>
<td>Smoking (n (%))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History (previously ≥1 per day)</td>
<td>1 (2.56)</td>
<td>2 (5.13)</td>
<td>3 (3.85)</td>
</tr>
<tr>
<td>Current (≥1 per day)</td>
<td>1 (2.56)</td>
<td>1 (2.56)</td>
<td>2 (2.56)</td>
</tr>
<tr>
<td>Self-reported eating rate (n (%))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very slow</td>
<td>1 (2.56)</td>
<td>0 (0.00)</td>
<td>1 (1.28)</td>
</tr>
<tr>
<td>Relatively slow</td>
<td>5 (12.82)</td>
<td>4 (10.26)</td>
<td>9 (11.54)</td>
</tr>
<tr>
<td>Medium</td>
<td>18 (46.15)</td>
<td>13 (33.33)</td>
<td>31 (39.74)</td>
</tr>
<tr>
<td>Relatively fast</td>
<td>14 (35.90)</td>
<td>21 (53.85)</td>
<td>35 (44.87)</td>
</tr>
<tr>
<td>Very fast</td>
<td>1 (2.56)</td>
<td>1 (2.56)</td>
<td>2 (2.56)</td>
</tr>
</tbody>
</table>

All 78 consented subjects, consumed all three meals and completed the pre-observation eating habits questionnaire. The post-observation eating habits questionnaire was completed by 76 subjects, partially completed by one subject and missed by two subjects.
5.2 Self-reported eating rate

The self-reported eating rates of the sample population were skewed towards the faster categories, with a larger proportion reporting as fast eaters compared to slow eaters (Table 5-1). The average objective eating rate of each self-reported category and the mean differences between categories are reported in Table 5-2.

<table>
<thead>
<tr>
<th>Self-reported categories</th>
<th>Eating rate (g/min)</th>
<th>Mean differences (95%CI) (g/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>35.28±10.46</td>
<td>6.49 (-1.85-14.83)(^a)</td>
</tr>
<tr>
<td>Medium</td>
<td>41.77±12.19</td>
<td>13.67 (5.27-22.07)(^c)*</td>
</tr>
<tr>
<td>Fast</td>
<td>48.95±13.65</td>
<td>7.18 (0.92-13.44)(^b)</td>
</tr>
</tbody>
</table>

\(^{1}\) Mean±SD
\(^{a}\) Mean difference of Self-reported Slow and Medium eating rates
\(^{b}\) Mean difference of Self-reported Medium and Fast eating rates
\(^{c}\) Mean difference of Self-reported Slow and Fast eating rates
\(*\) p<0.005

There is a positive association between mean eating rate and self-reported category, as eating rate increased by 6-7 g/min with each category (p for trend=0.003). Pairwise comparison revealed a statistically significant difference between the average speed of self-reported fast and slow eaters (p=0.004).

Objective eating rates for each individual are plotted by self-reported categories in Figure 5-1, with the mean of each category shown as a bar. It is apparent that there is considerable overlap in eating rate among the categories, with all participants who identified as slow eaters (23.18-53.28g/min) within the range of medium (18.62-59.80g/min) and fast eaters (24.24-84.41g/min). Both the medium and fast categories had a normal distribution for objective eating rates, while the distribution of the slow category was skewed towards a slower eating rate.
5.3 Meal duration and objective eating rates

There were no significant differences in objective eating rate between meals of varying carbohydrate to vegetable proportions. Additionally, those who had pasta ate approximately 6.38g/min faster on average than those who had rice (p=0.003). Overall, the mean time to eat a meal varied from a fast eater (6min 33sec) to a slow eater (29min 59sec), with an overall average of 14min 2sec. A coefficient of variation for meal durations within each person was calculated and averaged at 14.8% (12.9-16.8, 95%CI).

Mean individual objective eating rates varied from 18.62g/min to 84.40g/min with an overall average of 44.34g/min. Objective eating rates were divided according to tertiles, with 36.65g/min dividing the lower and mid third and 51.24g/min dividing the mid and upper third. Figure 5-2 shows the average eating rate of each participant within these
thirds, and the means of each third. The mean eating rate of each successive third is significantly different (p<0.005).

Figure 5-2 Objective eating rates based on dividing the population into thirds. The bar represents the mean eating rate of each third.

5.4 Self-reported vs. objective eating rate
The percentage agreement between self-reported categories and objective eating rate groups are reported in Table 5-3.

Table 5-3 Percentage agreement between self-reported and objective eating rate categories

<table>
<thead>
<tr>
<th></th>
<th>Slow (n=10)</th>
<th>Medium (n=31)</th>
<th>Fast (n=37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported eating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rate categories</td>
<td>Slow (n=10)</td>
<td>Medium (n=31)</td>
<td>Fast (n=37)</td>
</tr>
<tr>
<td></td>
<td>4 (5.1%)</td>
<td>4 (5.1%)</td>
<td>2 (2.6%)</td>
</tr>
<tr>
<td>Slow (n=10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium (n=31)</td>
<td>5 (6.4%)</td>
<td>12 (15.4%)</td>
<td>14 (18.0%)</td>
</tr>
<tr>
<td>Fast (n=37)</td>
<td>1 (1.3%)</td>
<td>15 (19.2%)</td>
<td>21 (26.9%)</td>
</tr>
</tbody>
</table>

Values are n followed by (% from total sample population)
Shading represents agreement between self-report categories and objective groups
There was 47.4% exact agreement between self-reported eating rate categories and their respective objective groups, and 48.7% adjunct agreement. In accordance with the classification assigned to Cohen’s kappa coefficient there was ‘fair’ agreement between the two classification methods (κ=0.219) (109). The self-reported eating rate question had a sensitivity of 56.8% and specificity of 61.0% when identifying fast eaters.

### 5.5 Test-retest

To test repeatability the post-observation self-reported eating rates were compared against the pre-observation self-reported eating rates (Table 5-4).

<table>
<thead>
<tr>
<th>Table 5-4 Percentage agreement between pre- and post-observation self-reported eating rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Pre-observation</strong></td>
</tr>
<tr>
<td>Slow (n=10)</td>
</tr>
<tr>
<td>Slow (n=9)</td>
</tr>
<tr>
<td>6 (7.9%)</td>
</tr>
<tr>
<td>3 (4.0%)</td>
</tr>
<tr>
<td>Medium (n=31)</td>
</tr>
<tr>
<td>4 (5.3%)</td>
</tr>
<tr>
<td>20 (26.3%)</td>
</tr>
<tr>
<td>Fast (n=35)</td>
</tr>
<tr>
<td>8 (10.5%)</td>
</tr>
<tr>
<td>12 (15.8%)</td>
</tr>
<tr>
<td><strong>Post-observation</strong></td>
</tr>
<tr>
<td>Slow (n=9)</td>
</tr>
<tr>
<td>6 (7.9%)</td>
</tr>
<tr>
<td>3 (4.0%)</td>
</tr>
<tr>
<td>Medium (n=36)</td>
</tr>
<tr>
<td>4 (5.3%)</td>
</tr>
<tr>
<td>20 (26.3%)</td>
</tr>
<tr>
<td>Fast (n=31)</td>
</tr>
<tr>
<td>8 (10.5%)</td>
</tr>
<tr>
<td>23 (30.3%)</td>
</tr>
</tbody>
</table>

Values are n followed by (% from total sample population)

Shading represents agreement between pre- and post-observation self-reported eating rates

There was a 64.5% exact agreement between pre- and post-observation self-reported eating rates, with the remaining 35.5% in adjunct agreement. Post-observation self-reported eating rate was in moderate agreement with pre-observation self-reported eating rate (κ=0.5007) (109). The pre-observation self-reported eating rates were used for the comparisons with objective eating rate.

### 5.6 Free-living mealtime distractions

Approximately 63% of participants reported multi-tasking while eating dinner in the free-living environment. Of these participants, 71% reported watching television during dinner, 51% talking during dinner, and 24% used their mobile phones during dinner.
5.7 Palatability

On average, the meal with the least carbohydrate was rated 61/100 for comfort and size with 50/100 being ‘just right’ and 100/100 being ‘too big’. These ratings increased with the size of the carbohydrate proportion. The meal with the least carbohydrate and most vegetables was on average considered more appetizing by participants. On average the taste of all three meals received consistent ratings around 48/100 with 0/100 being ‘dislike’ and 50/100 being ‘just right’.
6 Discussion

In the sample population of young healthy adults around half self-identified as fast eaters, while few identified as slow. At a group level, self-reported fast eaters ate significantly faster than self-reported slow eaters. However, self-reported eating rate had a low level of agreement with objective eating rates. The findings suggest that self-reported eating rate is predictive of actual eating rate at a group level, but lacks sensitivity and specificity at an individual level. To the best of our knowledge this is the first study to directly compare self-reported eating rate against objective eating rate at an individual level, however, self-reported eating rate has previously been assessed in the literature at a group level (30, 34).

Petty et al. compared self-reported eating rates with objective eating rates of 60 university students (34). Objective eating rates were measured in both kcal/min and g/min during a pasta lunch by means of a Universal Eating Monitor (34). Self-reported fast eaters ate more grams per minute on average than self-reported slow eaters but not self-reported medium eaters (34). Similarly, we only found a significant difference between self-reported fast and self-reported slow eaters. In contrast, Ekuni et al. assessed chewing of a 100g rice ball against self-reported eating rate categories (30). On average, those who self-reported as fast eaters took less time to chew their food compared to those who self-reported as slow or medium eaters (30). In other words, Ekuni et al. found a significant difference between self-reported fast and slow eaters and between self-reported fast and medium eaters. The finding of a difference between self-reported fast and medium eaters is in contrast to our findings and those of Petty et al. (34). This may be a consequence of the sex distribution across the categories (30, 34). In our study, and the work by Petty et al., the ratios of males to females among the various eating rate categories were approximately 30:70 (34). In the Ekuni et al. study
ratios of males to females were also 30:70 in the slow and medium categories but 57:43 in the fast category (30). As males have been reported to eat much faster than females (14, 34, 86) this may have biased the comparison between self-reported eating rate categories, leading to an artefactual difference between self-reported medium and fast eaters. In summary, it appears that self-reported eating rate is sensitive enough to detect group-level differences between slow and fast eaters, with questionable sensitivity to discern differences between slow/medium and medium/fast eaters.

Despite the uncertainty regarding the ability of self-report to discriminate between slow/medium and medium/fast eaters, the methodology is widely used throughout the literature with claims that the method has been validated (22, 28, 31-33, 36), generally citing one of two studies, Sasaki et al. (35) or Maruyama et al. (36).

In both the aforementioned studies an individual’s self-reported eating rate has been compared to his or her eating rate as reported by a friend. The comparison of self-report versus laboratory-timed eating rate used in our study had a similar level of exact and adjunct agreement as friend-report (35, 36). In light of this, the timing of eating in a laboratory may be as effective a method as friend-report for validating eating rate. However, the predictive value of laboratory eating rate and friend-report remains unclear in regard to usual eating rate in the free-living environment (34). Therefore, the most appropriate tool for assessing whether self-reported eating rate is predictive of free-living eating rate remains to be determined.

While laboratory-assessed eating rate may not be a proven representation of free-living eating rate, measures of laboratory eating rate are far more controlled, and likely less variable, than self- or friend-reports. The variability of self-reported eating rate both among and between individuals may be attributable to the level of consciousness when
consuming a meal in the free-living environment. A large proportion of our study population reported usually eating dinner with distractions such as television or mobile phones. Distracted mealtimes have been reported to impair recollection of the meal consumed and therefore may alter perceived eating rates (58, 95-98). No previous research has assessed the impact of distracted mealtimes on self-reported eating rate.

The repeatability of self-reported eating rate has also been investigated. In our test-retest analyses we found moderate agreement between pre- and post-observation self-reported eating rates, which had a two-month interval. This aligned with another, much larger study by Otsuka et al. who assessed repeatability over an interval of a year and found moderate correlations (r=0.55 in males and 0.58 in females) (24). In contrast, substantial rather than moderate agreement between repeated self-reports has been found over two months (30, 34). It therefore seems likely that repeatability of the eating rate question lies within the moderate to substantial range (κ=0.41-0.80) when measured over a relatively short timeframe. These findings indicate some degree of variability in people’s perception of eating rate over time. However, whether this change in perception is the result of a change in actual eating rate is undetermined.

Repeatability of self-reported eating rate is an important component of validation, particularly with regard to clinical application. To be predictive, self-reported eating rate needs to remain consistent, unless a change in actual eating rate has occurred.

Collapsing the five original self-reported eating rate categories down to three did not improve the repeatability of the self-reported question. This is due to the small proportion reporting as ‘very fast’ or ‘very slow’ in this and other studies (28, 30, 32-34, 37). In one study, three-category self-reports were found to be in substantial agreement with five-category self-reports (34), and so collapsing categories should not create bias.
Whether using three or five categories, these subjective eating rate questions have not been quantified relative to a standardised objective measure of eating rate. Without a standardised objective measure of speed of eating, self-reported eating rate is based on subjective perception that may change due to external factors and over time. Currently, there are no reference ranges available in the literature by which to classify speed of eating. We divided our sample into thirds based on tertiles of measured eating rate that were significantly different among the thirds. These rates potentially provide useful reference information when examining speed of eating by self-report.

Our objective thirds were comparable to rates reported in the literature in which 20-30g/min has been referred to as ‘normal’ (90, 91, 110). In comparison to our reference tertiles, this target range of 20-30g/min is within our slow tertile (<36.65g/min). Interventions to reduce faster eating rate to 20-30g/min over a period of a year has been associated with significant weight loss in adolescents (90, 91).

The validity of self-reported eating rate remains to be verified. Currently, self-reported eating rate is sensitive enough to detect group-level differences between self-reported fast and slow eaters (30, 34) but not between self-reported medium versus fast eaters, nor between self-reported medium versus slow eaters (34). Additionally, self-reported eating rate is poorly predictive of an individual’s actual eating rate in the laboratory. The low sensitivity and agreement of self-reported eating rate with objective eating rate and questionable repeatability suggests self-report to be an unreliable method by which to assess objective eating rate. Furthermore, there are currently no reference ranges available in the literature for comparison and no standardised conditions under which to test eating rate. Future research needs to establish standardised conditions for measuring and compiling eating rates of the general population for the development of reference ranges with particular regard to age and sex. In producing population-
reference ranges, slow or fast eating rates will be defined and comparisons with eating rates relevant to optimal health may provide applicability to the clinical setting.

6.1 Strengths and limitations

A major strength of this study is that participants were unaware that they were being timed, removing investigator influence over the speed of eating. This was helped by a time lapse between asking the self-reported eating rate question and embedding the question amongst 19 other eating habits questions. Additionally, timing measurements were made in triplicate together with a high degree of standardization both before and during the laboratory sessions. The test meals served are a popular meal in New Zealand homes (111), which participants rated as ‘just right’ for taste. The palatability of a meal is an important variable in the determination of eating rate, with less favourable food being eaten more slowly (42).

A limitation of our work is that speed of eating was measured in a laboratory setting rather than in the home or workplace. The laboratory environment is likely to differ considerably to the family or social construct in which meals are normally consumed. Whether speed of eating in the laboratory differs to speed of eating under free-living conditions has not been tested in this study. Another limitation is the size and composition of the meal, which may or may not represent foods and amounts normally consumed by the participants. However, standardization of the meal was a necessary component of the study design. This study details the relationship of self-reported eating rate and objectively measured speed of eating among healthy young adults who were mostly female, and therefore results are restricted to this sample population.
6.2 Conclusion

This is a unique study whereby self-reported eating rate is assessed at a group and individual level. Self-reported eating rate was sufficiently sensitive to detect a significant difference between slow and fast reported eating rates measured at a group level but not at an individual level. This lack of individual discriminatory ability suggests that the use of self-reported eating rate is insufficient by itself for identifying fast eaters.

This study is also the first to attempt designing objectively measured eating rate reference ranges using a sample population of mostly female University students. Future research is required to further develop reference ranges through standardised objective measures of eating rate. Furthermore, development of practical methodology by which to identify fast eaters would be useful, with a first step in characterizing population-based reference ranges and their association with health outcomes.
7 Application to Dietetic Practice

With the prevalence of obesity and diabetes rising (29, 76), attention to food and eating behaviours is needed to combat unhealthy lifestyle choices. Reducing eating rate may be a useful intervention in the prevention and treatment of obesity and other related non-communicable diseases. Identification of fast eating and implementing change in eating rate at a personal level may therefore be clinically beneficial.

Self-reported eating rate is currently not sensitive and specific enough to effectively classify individual eating rate in the clinical setting. Furthermore, health-related eating rates or goals have yet to be established. As such, clinical interventions to reduce eating rate should be secondary to that of food choices and portion sizes. Nevertheless, if a person reports as being a fast eater, strategies to reduce eating rate in combination with appropriate food choice and portion sizes may assist with weight management.

Strategies to reduce eating rate may include counting chews while eating (84, 85), putting utensils down in between bites (10, 80), or using mindful eating techniques, such as turning off the television and removing distractions or focusing on the sensory qualities of the food (58, 77). However, as research is yet to establish who would benefit from direct intervention in eating rate, recommending individuals use technology designed to retrain eating rate (90-92) may cause unnecessary burden.

It is important for the dietetic field to acknowledge the effect of eating rate on metabolic disease. Implementing mindful eating guidelines into New Zealand’s nutrition guidelines would be beneficial for outlining healthful eating behaviours regarding meals. Additionally, advising people to eat more slowly and to take time to enjoy their meals may have positive health benefits.
8 References


62. de Castro JM, Brewer EM. The amount eaten in meals by humans is a power function of the number of people present. Physiol Behav. 1992;51(1):121-5.


103. Worsfold A. The effect of altering the proportions of starchy foods and non-starchy vegetables within a meal on subsequent energy intake: a randomised controlled trial. Dunedin, New Zealand: University of Otago; 2016.


9 Appendices

Appendix A  Ethical approval

Appendix B  Maori consultation

Appendix C  Australian New Zealand Clinical Trial Registration

Appendix D  Information sheet for participants

Appendix E  Powerpoint slides from information lecture

Appendix F  Consent form for participants

Appendix G  Ingredients for special meals

Appendix H  Raw to cooked weight calculations

Appendix I  Eating habits questionnaire

Appendix J  Photos of dining setting

Appendix K  Dining session seating chart

Appendix L  Preference questionnaire

Appendix M  Demographics questionnaire

Appendix N  Eating rate recording sheet
9.1 Appendix A: Ethical approval

This letter states that this trial is a part of a repeated teaching activity and as such has ethical approval. The 2016 letter of renewal approval has been misplaced.

16 February 2015

Dr B Venn
Department of Human Nutrition
Division of Sciences

Dear Dr Venn,

I am again writing to you concerning your proposal entitled “HUNT311 clinical nutritional laboratory: a repeated teaching activity”, Ethics Committee reference number 14/204.

Thank you for your request for amendment to add blood pressure as a measurement into this year’s HUNT 311 laboratory. In addition, you have added Natasha Rodrigues, an MSc student, to the project due to her skills with carbohydrate and fructose metabolism.

Your proposal continues to be fully approved by the Human Ethics Committee. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing. I hope all goes well for you with your upcoming research.

Yours sincerely,

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Professor S Samman  Department of Human Nutrition
Appendix B: Maori consultation

Tuesday, 18 November 2014.

Dr Bernard Venn,
Department of Human Nutrition,
DUNEDIN.

Tēnā Koe Dr Bernard Venn,

HUNT311 clinical nutritional laboratory; a repeated teaching activity

The Ngāi Tahu Research Consultation Committee (the committee) met on Tuesday, 18 November 2014 to discuss your research proposition.

By way of introduction, this response from The Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states "Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago". As such, this response is not "approval" or "mandate" for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of importance to Māori health.

The Committee notes this is a class laboratory exercise but also notes it is dealing with some important aspects for Māori health. The Committee suggests that Māori health issues are outlined as part of this class to discuss important health disparities.

We wish you every success in your research and the committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 18 November 2014 to 18 May 2016.
Nāhaku noa, nā

Mark Brunton
Kaiwhakahaere Rangahau Māori
Research Manager Māori
Research Division
Te Whare Wānanga o Otago
Ph: +64 3 479 8738
Email: mark.brunton@otago.ac.nz
Web: www.otago.ac.nz
### 9.3 Appendix C: Australian New Zealand Clinical Trial Registration

#### Trial registered on ANZCTR

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#### Titles & IDs

| Public title | Comparing self-reported speed of eating with an objective measure of eating rate. |
| Scientific title | Comparing self-reported speed of eating with an objective measure of eating rate in healthy young adults. |
| Secondary ID [1] | None |
| Universal Trial Number (UTN) | U1111-1183-5035 |

#### Health condition

**Health condition(s) or problem(s) studied:**

**Eating rate**

**Diet and Nutrition**

**Condition category** | **Condition code**
--- | ---
Eating rate | Other diet and nutrition disorders
Diet and Nutrition | Other diet and nutrition disorders

#### Intervention/exposure

**Study type**

Interventional

**Description of intervention(s) / exposure**

The time to eat a lunch meal will be recorded on three occasions. Each meal will weigh 550g. The composition of the meals will differ with the proportion of starchy carbohydrate and non-starchy vegetables. The starchy carbohydrate will be rice or penne pasta. The composition of the meals are: Stir-fried beef (100g); Dolmio pasta sauce (100g); white rice or penne pasta (100g); and mixed vegetables (250g). Stir-fried beef (100g); Dolmio pasta sauce (100g); white rice or penne pasta (150g); and mixed vegetables (200g). Stir-fried beef (100g); Dolmio pasta sauce (100g); white rice or penne pasta (200g); and mixed vegetables (150g).

The washout will be one week. Participants will be asked to arrive having fasted for a minimum of 2.5 hour.

**Intervention code [1]**

Lifestyle

**Intervention code [2]**

Behaviour

**Comparator / control treatment**

Participants will self-report on their general eating habits using a previously published validated eating

---

https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=370739&isReview=true
Control group

Outcomes

Primary outcome [1]

Comparison of subjective (self-reported) and objective (timed) eating rate. The subjective rate will be self-reported using a previously published question (Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. Journal of Psychosomatic Research. 1985;29(1):71-83).

Self-reported speed of eating will be specifically assessed using a previously published question (Sasaki S, Katagiri A, Tsuji T, Shimoda T, Amano K. Self-reported rate of eating correlates with body mass index in 18-25 year-old Japanese women. Int J Obes (Lond). 2003;27(11):1405-10). The objective eating rate will be determined by the investigator recording the time taken to eat each meal. As each person consumes a meal on three occasions, the average time taken (minutes) will be calculated.

Timepoint [1]

The questionnaire regarding self-reported eating rate will be administered at baseline and then again two weeks after the completion of the last meal.

Primary outcome [2]

Rate of eating (g/min): The amount a participant consumes at the lunch meal will be divided by the meal duration to determine grams of food eaten per minute.

Timepoint [2]

A digital clock will be used to determine start and stop times of all participants. These times will be recorded to the nearest second to determine meal duration. The start and stop points will be defined as when food first enters the participant’s mouth, and when the participant swallows their last mouthful. Participants will be unaware of their meal duration and eating rate being recorded.

Secondary outcome [1]

Duration of meal: The start and stop points of eating will be recorded by the researcher when food first enters the participant’s mouth and when the participant swallows their last mouthful. The duration of the meal (in minutes and seconds) will be calculated as the difference between the start and stop times.

Timepoint [1]

The duration of meal will be measured on three occasions: after baseline at one week intervals thereafter.

Eligibility

Key inclusion criteria

University students

Minimum age

18 Years

Maximum age

60 Years

Gender

Both males and females

Can healthy volunteers participate?

Yes

Key exclusion criteria

People with special dietary requirements that we cannot cater to

Study design

Purpose of the study

Treatment

Allocation to intervention

Randomised controlled trial

Procedure for enrolling a subject and allocating the treatment (allocation concealment procedures)

Methods used to generate the sequence in which subjects will be randomised (sequence generation)

Masking / blinding

Who is / are masked / blinded?

Intervention assignment

Other design features

https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=370739&isReview=true
Phase
Type of endpoint(s)

Recruitment

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Summary

Self-reported eating rate is commonly used on a population level to show associations between eating rate and health risks/non-communicable diseases. However, there is little to suggest the applicability of self-reported eating rate in a clinical setting, as well as, clear clarification as to what is fast and slow eating and at which rates do these risks occur. The primary objective of this study was to compare objective eating rate with self-reported eating rate to establish the applicability of self-reported eating rate in a clinical setting.

Contacts

Principal investigator
Name: Dr Bernard Venn
Address: Department of Human Nutrition
University of Otago
PO Box 56
Dunedin
9054
Country: New Zealand
Phone: +6434795068
Fax: 
Email: bernard.venn@otago.ac.nz

Contact person for public queries
Name: Dr Bernard Venn
Address: Department of Human Nutrition
University of Otago
PO Box 56
Dunedin
9054
Country: New Zealand
Phone: +6434795068
Fax: 
Email: bernard.venn@otago.ac.nz

Contact person for scientific queries
Name: Dr Bernard Venn
Address: Department of Human Nutrition
University of Otago
PO Box 56
Dunedin
9054
Country: New Zealand
Phone: +6434795068
Fax: 
Email: bernard.venn@otago.ac.nz
9.4 Appendix D: Information sheet for participants

HUNT311 clinical nutritional laboratory; a repeated teaching activity

INFORMATION SHEET FOR PARTICIPANTS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The aim of this study is to test the glycaemic and satiating properties of three meals. This requires attending the laboratory on three occasions. You and other HUNT311 students will use the information in the writing of a HUNT311 assignment. If you choose not to participate, you will still be required to attend the laboratory to observe and data will be provided to you; the assessment of your assignment will in no way be affected.

What Type of Participants are Being Sought?

HUNT311 students who are willing to participate. If you have special dietary needs please let us know. The meal will be gluten-free, dairy-free, and nut-free. A vegetarian option is available.

What will Participants be Asked to Do?

You will be asked to attend the Department of Human Nutrition Undergraduate Laboratory on three occasions, separated by one or two weeks apart. If eligibility criteria are met, you will be asked to read and sign a consent form, we will collect some personal information from you comprising demographics, height and weight. Following this, the first test will be conducted. Testing is conducted at lunchtime, you will be streamed to arrive at the laboratory either at 11:50am, or at 1:15pm. You will be asked not to eat or drink for two and a half hours before the start time (ie; for those people attending the 11:50 lab, please do not eat or drink after 9:15am: for those attending the 1:15pm lab, please do not eat or drink after 10:30 am). If you have eaten within this period of time you will be turned away and asked to reschedule your lab. Note: no sugar-sweetened chewing gum, you may drink water up until 30 min before the start time but please do not drink too much water as you are required to eat a full sized meal.

If you walk or cycle to the laboratory please do so slowly so as not to elevate your heart rate and blood glucose. On arrival a finger-prick blood sample will be taken in the fasting state using a single-use disposable lancet designed to minimize discomfort. You will then be given a meal. After this, additional finger-prick blood samples will be taken at 15, 30, 45, 60 and 90 min. The fingerpricks may cause some discomfort. In the event of an abnormal result, a repeat finger-prick may be required. The total volume of blood collected will amount to less than half a teaspoon. During this time we would like you to remain seated in the room with the exception of toilet visits if necessary. You are free to read or talk.
What Data or Information will be Collected and What Use will be Made of it?

For the main laboratory exercise we will collect data on your age, ethnicity, smoking habits and gender and we will be measuring your height and weight. The purpose of collecting this information is to describe the overall characteristics of the study population. From your blood samples we will be testing glucose concentration. Personal information will remain confidential to the study investigators. Paper copies will be kept in a lockable office and electronic data stored on a departmental computer. The results of the project will be pooled and may be published and available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity. The data and samples collected will be securely stored in such a way that only those mentioned below will be able to gain access to it. Data and samples obtained as a result of the research will be retained for at least 5 years in secure storage. Any personal information held on the participants such as contact details may be destroyed at the completion of the research even though the data and samples derived from the research will, in most cases, be kept for much longer or possibly indefinitely. If you choose not to supply information this may exclude you from taking part in the study. You have rights of access to the personal information that you have given to us and you may correct or change this information.

Testing blood glucose has the potential to reveal whether a person has diabetes or is at risk of pre-diabetes. If elevated blood glucose concentrations are found, you will be advised to make an appointment with student health or with your general practitioner.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself or to your HUNT311 assessment of any kind.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please contact -

Liz Williams; email e.williams@otago.ac.nz

Dr Bernard Venn; email bernard.venn@otago.ac.nz

Telephone: 03 479 5068

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
9.5 Appendix E: Powerpoint slides from information lecture

What you will be asked to do:
- Attend your 3 allocated glycaemic labs
- When: Friday 11:50am or 1pm (approx. 2hrs)
- Where: Human Nutrition Port-a-Lab
- What: Eat a full hot meal, complete surveys, get 6 finger pricks per lab, complete diet records

On the day
- On Friday, record your intake via weighed diet record, from when you wake up, to when you go to sleep
- You will be provided with scales and a record booklet with instructions at the conclusion of this lecture
- You do not need to record the lunch meal we provide you
- DO NOT eat or drink (except water) 2½ hours before your lab begins
  - i.e. 11:50am lab – DO NOT eat after 9:15am
  - 1pm lab – DO NOT eat after 10:30am
- DO NOT drink water 30 minutes before your lab begins
- Consume a similar breakfast and/or snack for each scheduled lab, consume these at a similar time
- Keep exercise consistent between lab days (type and time)
- DO NOT exercise 2½ hours before your lab begins
- Arrive on time!
  - If you are late you may be turned away and have to reschedule your lab
  - Upon arrival you will be seated, fill out a consent form, complete a survey and questionnaire.
  - You will be required to eat the whole meal
  - Might help to have a small breakfast on lab days
  - Your blood glucose will be measured at baseline, 15, 30, 45, 60 and 90 minutes
On the day

- After the lab...
- Eat whatever you like, whenever you like
- Make sure you record everything you eat AND drink
- If for some reason you are unable to weigh your food/drink, make an estimate and note this in your diet record
- But PLEASE do your best to weigh everything!

5% of HUNT311

- Enter all 3 weighed diet records into KaiCulator before 9am, Wednesday 20th April
- Complete 3 lab exit tests

Participation

- Attendance is compulsory, however participation requires your consent
- You will still be required to attend all 3 labs, complete all 3 food records
- Class results from these labs will be used for one of your assignments
- Full participation would be greatly appreciated

Participation

- Check out the Information Sheet located on Blackboard in Course Documents
- Read the Consent Form (do not print it out, we will give you a Consent Form to sign in the first laboratory)

What you need to do now

- Go to Port-a-Lab now, sign out scales and receive instruction/diet record booklet
- Check which labs and time you have been streamed into - today is the last day to change streams!
- Any queries please contact Liz or Bernard
9.6 Appendix F: Consent form for participants

HUNT311 clinical nutritional laboratory; a repeated teaching activity

CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet and understand the procedures. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage to myself or to my HUNT311 assessment;
3. Personal identifying information will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for at least five years;
4. Fingerprick blood sampling may cause some discomfort.
5. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand), but every attempt will be made to preserve my anonymity.

I consent to attending the laboratory on three days following a two and a half hour fast, having height and weight taken, consuming the meals and providing six blood samples obtained by finger pricking over two hours on each test day.

Yes / No □

Name ........................................... Signature................................................. . Date .............. .

This study has been approved by the University of Otago Human Ethics Committee. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
9.7 Appendix G: Ingredients for special meals

**Vegetarian meal ingredients:**

- Canola Oil (Sunfield Oils, Tasty Products Ltd.; New Zealand)
- Vegetarian Mince (Quorn™ Marlow Foods Ltd.; Australia)
- Extra Bolognese Sauce (Dolmio®, Mars Food; Australia)
- Asian Stir-Fry Vegetables (Wattie’s®, Heinz Wattie’s Ltd; New Zealand)
  - Julienne carrots, broccoli, celery, red onion, red peppers, and sugar snap peas
- Carbohydrate:
  - Dried Penne Pasta (San Remo Macaroni Co. Pty Ltd; Australia)
  - Jasmine Rice (Pams®; New Zealand)

**Vegan meal ingredients:**

- Canola Oil (Sunfield Oils, Tasty Products Ltd.; New Zealand)
- Chickpeas in Springwater (Wattie’s®, Heinz Wattie’s Ltd; New Zealand)
- Extra Bolognese Sauce (Dolmio®, Mars Food; Australia)
- Asian Stir-Fry Vegetables (Wattie’s®, Heinz Wattie’s Ltd; New Zealand)
  - Julienne carrots, broccoli, celery, red onion, red peppers, and sugar snap peas
- Jasmine Rice (Pams®; New Zealand)

**Irritable Bowel Syndrome meal ingredients:**

- Canola Oil (Sunfield Oils, Tasty Products Ltd.; New Zealand)
- Premium Beef Mince (New World; Dunedin, New Zealand)
- Italian Herbs with Spice Pasata Sauce (Leggo’s™, Simplot Australia Ptd; Australia)
- International Stir-Fry Mix (Wattie’s®, Heinz Wattie’s Ltd; New Zealand)
  - Green beans, carrots, butter beans, broccoli, cauliflower, and red peppers
- Carbohydrate:
  - Dried Penne Pasta (San Remo Macaroni Co. Pty Ltd; Australia)
  - Jasmine Rice (Pams®; New Zealand)
9.8 Appendix H: Raw to cooked weight calculations

Conversion of raw weights to cooked weights:

Mince (Premium Beef Mince)
Raw = 432g + 1t canola oil
Cooked = 336g
Conversion factor: 432g / 336g = 1.29
100g mince cooked: 100g x 1.29 = 129g raw mince

Mince alternative (Quorn Mince)
Raw = 300g + 1t canola oil
Cooked = 272g
Conversion factor: 300g / 272g = 1.10
100g mince alternative cooked: 100g x 1.10 = 110g raw mince alternative

Sauce (Dolmio Extra Bolognese Sauce)
Raw = 150g
Cooked = 350g
Conversion factor: 400g / 350g = 1.14
100g sauce cooked: 100g x 1.14 = 114g raw sauce

Rice (Pams Jasmine)
Raw = 500g + 1000g water
Cooked = 1300g
Conversion factor: 500g / 1300g = 0.39
100g rice cooked: 100g x 0.39 = 39g raw rice

Pasta (Budget Penne Pasta)
Raw = 500g
Cooked = 1252g
Conversion factor: 500g / 1252g = 0.40
100g pasta cooked: 100g x 0.40 = 40g raw pasta

Vegetables (Watties Asian Stir-Fry Mix)
Raw = 800g
Cooked = 649g
Conversion factor: 800g / 649g = 1.23
100g rice cooked: 100g x 1.23 = 123g raw frozen vegetables
9.9 Appendix I: Eating habits questionnaire

**Eating Habits Questionnaire:**  
Student ID#:______________

Please take your time and answer the following questions as truthfully as possible. Once finished, please hand in as you leave the room.

Please circle the meals/snacks you have in a usual day, and writing the usual number of snacks you’d have in a day.

- Breakfast
- Lunch
- Dinner
- Dessert
- Snack(s): x______

What time do you usually eat dinner?

_____________________

Do you usually eat dinner by yourself or with others? (please circle)
If others, who (e.g. flatmates, family, partner, etc.)?

- By myself
- With others:_____________________

Do you usually eat dinner at a dining table, or on your lap/couch? If neither, please specify where.

- Dining table
- Lap/couch
- Neither_____________________

On average how long does it take you to eat dinner?

- <5mins
- 5-10mins
- 10-15mins
- >15mins

On a scale of 1 – 5, how fast do you believe you eat? (please circle)

- 1 very slow
- 2 relatively slow
- 3 medium
- 4 relatively fast
- 5 very fast

Sometimes when you start eating, do you find it hard to stop?

- Yes
- No
Do you find you are always hungry, making it hard to stop eating before finishing the food on your plate?

Yes  No

Without even thinking about it, do you take a long time to eat?

Yes  No

How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours? (please circle)

1 easy  2 slightly difficult  3 moderately difficult  4 very difficult

Do you eat sensibly in front of others and splurge alone? (please circle)

1 never  2 rarely  3 often  4 always

How likely are you to consciously eat slowly in order to cut down on how much you eat? (please circle)

1 unlikely  2 slightly likely  3 moderately likely  4 very likely

How likely are you to consciously eat less than you want? (please circle)

1 unlikely  2 slightly likely  3 moderately likely  4 very likely

Are you social at your dinner meal?

Yes  No

Do you multi-task during your dinner meal?

Yes  No
If yes, what are you doing other than eating? (e.g. watching tv, reading, etc.)

______________________________________________________________

Do you have any food intolerances or allergies, or food restrictions (e.g. vegetarian, vegan, gluten-free, dairy-free, etc.)?

Yes  No

If yes, what intolerances/allergies do you have?

______________________________________________________________

Do you dislike any particular foods?

______________________________________________________________
Rank these foods within their groups based on your personal preference: (1 being most preferred)

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<td>Fish</td>
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</table>
9.10 Appendix J: Photos of dining setting
9.11 Appendix K: Dining session seating chart
9.12 Appendix L: Preference questionnaire

Student ID number:_______________ Date:______________
Lab time: 11:50am or 1pm

1. How **comfortable** did you feel after eating this meal?

   Comfortable with room to spare | Just right | Uncomfortably full

2. How did you find the **size** of this meal?

   Far too small | Just right | Far too big

3. Did this meal **look appetising** to you?

   Hated the look | Just right | Liked it a lot

4. How much did you like the **taste** of this meal?

   Didn’t like it | Just right | Liked it a lot

5. Any additional comments about this meal?
9.13 Appendix M: Demographics questionnaire

Demographics Questionnaire: Student ID#:________________

Please complete this questionnaire in full and as accurately as possible. Your answers will not only inform our research, but will also inform your assignment!

Which sex are you? (please circle)

Female  Male

What is your date of birth? (DD/MM/YYYY)

___/___/____

Please read the next two questions carefully, and note the difference between nationality and ethnicity. Nationality is the country one is born or 'belongs to', and ethnicity refers to ancestral affiliations/bloodlines. e.g. Nationality: New Zealander, Ethnicity: Maori.

Which Nationality are you? (please circle)

New Zealander  Samoan
Tongan  Chinese
Indian  American
Other: __________________________________________________________

Which ethnic group do you affiliate with? (please circle)

New Zealand European  Maori
Samoan  Cook Island Maori
Tongan  Niuean
Chinese  Indian
Other: __________________________________________________________
Do you smoke regularly (that is, one or more a day)? (please circle)

Yes  No

Have you ever been a regular smoker of one or more cigarettes a day? (please circle)

Yes  No

How many times (not days) in an average week do you partake in moderate to intense exercise? (Please circle)

Not at all  1-2  3-4  5-6  7+  

On average how long do you exercise for at a time? (Please circle)

I don’t  30mins  1hr  2hrs+  

Your height and weight will be measured either before baseline, or after your 90-minute blood glucose reading. Please record these measures below.

Height: __________cm

Weight: __________kg

BMI: __________kg/(m²)

Thank you for completing this questionnaire!
9.14 Appendix N: Eating rate recording sheet

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