

Healthy Menu Scoring Tool (HMST)

Content validity, face validity and internal consistency approaches in development and validation.

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Abstract

Introduction: Food service retailers, policy advisors and researchers need a simple easy to use tool that can measure the healthiness of meals to audit food environment and/or assess meal choices. The primary research objective of this study is to develop a validated meal scoring tool using content validity, face validity and internal consistency methods. Each of these steps have guided the researchers in making appropriate modifications to the meal scoring tool, as deemed relevant by the expert opinion of the participants.

Methods: This study took place in two parts 1) Semi structured interviews and 2) focus group discussions. The comments were thematically analysed to identify broad main themes. The participants independently assessed the clarity, relevance, and essentiality of the scoring tool in its initial and revised stages to provide an item level content validity index (I-CVI). The final step asked a wider sample of nutrition experts to rate four randomly selected meals using the finalised version of the Healthy Menu Scoring Tool (HMST).

Results: Nine nutrition experts took part in the semi-structured interviews and eight nutrition experts attended the focus group discussions. The semi structured interviews and focus group discussions found that a healthy meal is characterised by a variety of the four main food groups consumed within the recommended proportions. The ease of use of the tool and appropriate categorisation of food items and rating headings were identified as key themes to consider in the design of the tool. The intra-class coefficient showed excellent agreement between nine registered or student dietitians with 0.99 and a 95% confidence Interval of 0.96 – 0.99. This significant value in the final stage, revealed there was strong consistency in the scoring process of the finalised tool.

Conclusion: The present study has validated a scoring tool for measuring the healthiness of a meal in line with the Healthy Eating Guidelines and nutrition expert feedback, designed to support healthier food choices. Suggestions are offered for improving the HMST, such as its use for specific clinical conditions or healthy eating across different life stages.

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Statement of contribution

- Conducted a literature review (Chapter 2)
- All stages of data collection explained in the methods of the thesis
 - Interviewed 9 nutrition experts in person and online
 - Conducted two focus group discussions online
 - Created a survey introducing the Healthy Menu Scoring Tool
- All stages of data analysis
- Designed and modified the first and second revision of the Healthy Menu Scoring Tool
- Discussion & concluding (Chapters 13 & 14)

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List of abbreviations

ADG	American Dietary Guidelines
BMI	Body Mass Index
CI	Confidence Interval
CVD	Cardiovascular disease
CVI	Content Validity Index
CVR	Content Validity Ratio
DASH	Dietary Approaches to Stop Hypertension
DQI	Diet Quality Indices
EAG	Eating and Activity Guidelines
FFQ	Food Frequency Questionnaire
HEI	Healthy Eating Index
HMI	Healthy Meal Index
HMST	Healthy Menu Scoring Tool
HSR	Health Star Rating
ICC	Intra-class coefficient
I-CVI	Content Validity Index per item
LDL	Low-density lipoprotein
MOH	Ministry of Health
NHANES	National Health and Nutrition Examination Survey
NPSC	Nutrient Profiling Scoring Criterion
NRF	Nutrient Rich Food
NZ	New Zealand
NZ DQI-A	Food based Diet Index for NZ Adolescents
S-CVI	Scale level - Content Validity Index
SES	Socioeconomic status
SGA	Subjective Global Assessment

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1 Introduction

The study presented in this thesis outlines the content validity, face validity and internal consistency steps to validate and deliver a reliable meal scoring tool. The initial tool was developed for a laboratory study investigating the effect of self-compassion and stress on dietary choice (1). There was no way to objectively measure single meal choices based on New Zealand (NZ) healthy eating guidelines. A tool was needed to evaluate overall lunch choices to provide a more 'real-world' food selection. To assess participant dietary choices, the initial Healthy Menu Scoring Tool (HMST) (Appendix A: Initial meal scoring tool) was based on the NZ Food and Drink Policy and developed in consultation with 68 NZ nutrition experts (dietitians and nutrition students) (1). The HMST at this stage used a modified lunch menu from a university café, including generally accepted healthy foods (e.g., fresh fruits and vegetables) and less healthy foods (e.g., carbonated drinks, brownies). In total, 68 NZ nutrition experts (Dietitians and Nutrition students) scored all lunch menu items on a scale of 1 to 3 (1 = 'least healthy' and 3 = 'most healthy'), and a mean score was calculated for each item (1). Each participants' lunch menu selections were summed and divided by the number of items selected to get an average score. A higher score would show a healthier dietary choice.

The initial scoring tool was based on the NZ Food and Drink policy and used a traffic light approach to measure healthy meals (2). Originally published in 2016, the National Food and Drink policy was designed to support public health by promoting healthy food environments in work and public places. It achieves this through an easy-to-follow rating system that allocates foods and drinks under the colours red, amber and green (2). The policy's objective was to change the food environment found in health care providers such as the District Health Boards through their patient meals, café caterers, onsite vending machines etc. This is an example of a positive change towards decreasing the widespread availability of unhealthy food and drinks in the community.

In the last decade, the retail food environment has significantly grown in unhealthy food options particularly in most deprived areas (3). One can recognise how this increase in availability has facilitated the growth of obesity rates in NZ. Therefore, the current research team observed a usefulness for the initial lunch scoring tool for a wider context and decided to develop an instrument that can be applied to food services and for research of dietary choices. Thus, to broaden the use the present study chose to modify the HMST to align to the national dietary guidelines.

The term 'diet quality' is easily misunderstood and difficult to measure as there is no real consensus on its definition (4). Therefore, the criteria for diet quality is susceptible to subjectivity and are often dependent on the investigator and their research aims. A diet quality index such as a meal scoring tool, is generally characterised by quantifying the quality of a food and/or nutrient intake (5). There are multiple ways to measure diet quality, but common indices

compare dietary patterns with the dietary guidelines and how closely the food choices fall within the recommended core food groups (4)(6). A high diet quality reflects an eating pattern that aligns closely with these recommendations and follows a desirable nutrient intake, while a low diet quality refers to a poor nutritious eating pattern and increased risk of its related diseases (5). Due to the link between diet quality and non-communicable diseases, the accurate measurement of healthiness is essential to assess dietary intake and the impact of interventions. While there are several diet quality indicators in the literature, very few have been validated and/or designed for measuring the healthiness of a single meal as opposed to overall dietary intake.

Validity in this research is defined by the accuracy of the developed instrument and how applicable the findings are in the area of interest (7). This is important because it shows whether the instrument truly measures what it is meant to achieve. Validity testing of the HMST will contribute to its trustworthiness of the results, that may lead to generalisable findings in the literature (7). The present study has used three methods to test for validity: Content validity, Face validity and Internal consistency. Content validation shows that the content of items and overall outcome of the instrument is consistent with the perspective of the nutrition experts and in the requirements for defining a healthy meal (8). This is generally established by seeking to answer the question, does the instrument include all relevant components to achieve what it is trying to measure? On the other hand, face validity evaluates the design of the instrument at the surface level and whether the measure uses appropriate language, terms and a good format to do so (9). In contrast to content validity, it does not require an established theory to support the findings but relies on the judgment of the nutrition experts. Both methods are examples of subjectivity and therefore there is an increased level of trust in the participant's insight (9). The last step evaluates internal consistency through interrater reliability. This refers to the degree to which two or more individuals agree on a rating score using the HMST to assess a random selection of menu items (9). High reliability is obtained if the results produce similar rating scores under the conditions of the same survey questions (10). These findings are valuable because it shows if the instrument can be interpreted in the same way, if it is administered by multiple people outside of the research team.

1.1 Aim and research questions

The overriding research aim of this thesis is to create a validated meal scoring tool to measure the healthiness of a single meal for use of evaluating food service menus, surveillance of food choice or policy development and evaluation. This tool should be reliable and deliver consistent scoring when applied by nutrition health professionals outside of the research team. To support the rationale of the study, it is important to consider relevant background information and literature. With this in mind, the following chapter begins with a comprehensive literature review that describes healthy eating, different perceptions of healthy eating, different scoring tools in

literature and their validation methods. The review identifies relevant strengths and weaknesses in the literature, followed by a conceptual framework that will illustrate concepts that were unclear from the literature review. These are further explored in the research objectives.

The present thesis is organised into three steps: content validity, face validity and internal consistency. The first two steps included semi-structured interviews and focus group discussions with nutrition experts to address the research questions below. It is important to note that this tool is designed for food service menu surveillance, research and policy development and evaluation not individual use.

1. What is a healthy meal?
2. What components are required in a scoring tool to measure healthiness accurately?
3. Who is responsible for administering the tool?

The outcome of the first two steps delivered a final version of the instrument, named the Healthy Menu Scoring Tool. The last step in the study sought consistency in the scoring process when the tool was given to a wider sample of nutrition experts. At this stage the researchers hypothesised strong internal consistency after making modifications that reflected the expert feedback. The findings presented in the Results chapter explored whether the main research aim of the study has been met or not.

The remaining chapters review the methodology and the results gathered from the exercise. While a concluding discussion will address the research questions, strengths and limitations of the study and future implications of the findings.

2 Literature review

While there is a wealth of evidence to support good nutrition and health, the obesity pandemic continues to rise as the patterns observed in food availability favours unhealthy choices and poor nutrition (11). Assessing the healthiness of a diet or single meal provides the opportunity to recognise how closely it adheres to the recommended dietary guidelines. Developing a valid meal scoring tool allows its user to apply this tool in their own research analysis and meal audits. It can be particularly useful to assess the food environment, such as the quality of food in schools, cafes, or restaurants.

This literature review aims to investigate what is healthy eating through a comparison of different healthy dietary guidelines and why this is important to health. This chapter will further cover how healthy eating is perceived by the public in different groups of the population, summarise relevant nutrition scoring tools and its research significance. The chapter will explore gaps in literature for diet quality tools and validation study methods. The outcome of this literature review will inform what research aims the current study needs to conduct a successful validation study and development of a meal scoring tool.

2.1 What is healthy eating?

The following section explores key definitions of healthy eating according to different national dietary guidelines, while acknowledging specific societal influences. This includes the rise in protein alternative sources, influences from the food industry and the environment. This section discusses how these topics have altered the meaning of healthy eating in the current day.

2.1.1 According to national dietary guidelines

Healthy eating is defined in the national dietary guidelines to improve the quality of life and wellbeing significantly, because they are in accordance with nutritional status of the population. The guidelines are evident in preventing cardiovascular disease, metabolic syndromes, and some cancers (12) (13). The Ministry of Health (MOH) NZ defines healthy eating as a combination of nutritious foods from the four food groups: Fruits and vegetables, grain foods high in fibre, milk and milk products and some legumes, fish, other seafood, egg or poultry or meat with fat removed (12). Both the Australian and American dietary guidelines follow the same key food group recommendations, except fruit is presented as its own food group. One key strength of national dietary guidelines is that they are based on the population's nutrition status. For example, the most recent American Dietary guideline (ADG) ensures that accurate research was conducted, contributing to the wealth of scientific knowledge and that is reviewed by a committee (14). This work focused on 5 key research themes: food and nutrient intake, health status and trends, dietary patterns & health outcomes, diet and physical activity change, food and physical environments, and food sustainability (14). The committee's research revealed that the US population was

deviating from the recommended health eating advice and had poor consumption of vegetables, fruits, wholegrains, and dairy, with a higher consumption of refined grains and added sugars. Additionally, recorded increased intake of saturated fat and sodium were acknowledged as significant public health concerns (14). The National Health and Nutrition Examination Survey (NHANES) is an important study designed to assess the nutritional status of the US population. This cohort study continuously examines the population's nutritional and other health status, providing up to date data (15). The research held by the advisory committee and NHANES is central to the development of the ADG, updated every five years. In alignment with the study findings above, the major changes reported in the 2015 ADG focused on the new recommendations for added sugar and saturated fat intake to less than 10% of total calories. This shows a key strength in the development process of the ADG, as the modifications were altered according to the needs of the current population. This example shows that to improve overall health, the guidelines should reflect the current public health concerns of the nation.

In NZ, this is a different story because the latest NZ Adult Nutrition National survey was held in 2008/09. This poses a major problem because it questions the relevance of this data for research purposes when the key findings are dated twelve years back (16). Even so, one study has challenged the findings from this survey, claiming to not be an accurate representation of the population, due to the level of under-reporting in dietary recalls (16). Stats NZ has observed that New Zealanders are now spending more on takeaway and restaurant meals compared to grocery items to prepare fresh home cooked meals (17). The food environment in NZ has seen a significant rise in serve size, energy, and sodium contents of fast-food meals across 2012-2016, with the expectation this will continue to increase (18). This is consistent in the literature on a global scale, where studies in US and Australia have described a higher density of fast-food outlets, contributing to the increased energy intake, higher body mass and obesity rates, observed in their respective populations (19) (20). This is an example of how the dietary pattern of New Zealanders has changed over the last twelve years and reinforces the need for an updated cross sectional nutrition survey. An updated survey will show a better representation of our current population nutrition status to infer correct dietary guideline changes. This will allow researchers to conduct new investigations or update previous findings into the link between diet and health. Furthermore, continued surveillance of dietary choices in the real world, for instance using new systems such as meal ordering programs, would allow for early evidence of changes in dietary choices.

2.1.2 *The influence of protein alternative sources*

The dietary guidelines do not effectively reflect the changes of meat consumption in society today and how this is moving towards plant-based options. Animal meat is composed of essential nutrients and provides 15% of the proteins consumed (12) (21). Protein is linked to suppressing short-term satiety to help with weight management

(22). The MOH suggests at least two servings every day should be made up of legumes, fish and other seafood, eggs, poultry, or red meat with fat removed (23). The adult national nutrition survey reported 94.5% of the total population (aged 15 and over) ate red meat in the last four weeks, while 93.4% reported eating chicken in the last four weeks. This is consistent across deprivation quintiles (24). However, the absence of a more recent national nutrition survey distorts the accuracy of these percentages in today's population.

On the other hand, global awareness for sustainability and health has seemingly increased over the years that new trends have emerged in the form of different diets. This has led to a change in the population's meat consumption and has sparked an increased demand for plant-based proteins and meat alternatives (25). It is expected that the meat industry will struggle to support the exponential growth of our global population, that is expected to reach 9 billion by 2050 (26). Meeting these demands would require the destruction of land and natural resources to provide the agriculture for livestock farming.

Furthermore, there is evidence in literature to suggest that plant-based proteins reduce the risk of type 2 diabetes, heart diseases and support other health benefits (27). Therefore, with both health and sustainability concerns in mind, there is a great push for increasing alternatives and plant-based options (25). The NZ and Australian dietary guidelines reflect the benefits of including protein into a balanced diet, but this is primarily focused on animal and seafood sources. In comparison, the ADG do a better job of mentioning soy products, beans, lentils, nuts, and seeds as a source of protein foods for a healthy vegetarian diet. However, there is conflicting advice in all three dietary guidelines about the intake of meat alternatives and appropriate serving sizes. This calls for further research, as a growing interest and demand for meat alternatives requires evidence-based advice to ensure the recommended protein intake is still being met. The 2015 ADG have introduced more transparency with recommendations of plant-based foods, while reducing intake of red and processed meat (29). Overall, the evidence indicates that following a higher consumption of plant based versus animal meat is better for health and as such upcoming dietary tools should offer more of these choices.

In summary, the literature defines healthy eating through evidence-based research, compiled in the national dietary guidelines. However, these recommendations can be at risk of bias through the influence of alternative protein sources, food industries, and the environment. A more recent NZ adult national nutrition survey will help to better understand dietary patterns, particularly differences in animal consumption over the years. In the meantime, constant surveillance of dietary choices could alert to changes in eating patterns.

2.2 Why is healthy eating important?

A healthy diet as defined by the recommendations in the national dietary guidelines, are important because the suggestions aim to reduce the risk of obesity and its associated conditions. This is particularly important when the food environment today is not protective from this [29]. Around the world the prevalence of individuals living with overweight, and obesity (BMI>30kg/m²) is extremely high [30] and NZ has among the highest rates of obesity, observed in both adult and adolescent groups. This appears to be on the rise according to health and well-being surveys (30). The rate of individuals living at higher body weights is largely driven by the economic growth and changes seen in food environments, promoting a higher energy-dense intake (31). This unhealthy food environment is particularly prominent in schools, where high saturated fat items such as pies, and sausage rolls were commonly available in a sample of 200 NZ primary schools (32). In this same study only 33 schools had a food policy that offered education regarding the role of nutrition, health, and development in children. In another case comparison study, the interaction of the food environment with schools in their respective communities was investigated. The findings clearly showed how the environment was drastically different within a 2km radius of a high decile school compared to a low decile school (33). Students were more likely to be exposed to unhealthy food advertisements and food environments if they attended a low decile school. This influence made it challenging for these schools to promote healthy eating advice when unhealthy options were so easily accessible. Unlike the earlier study, only a small sample of four schools were included in the findings and they are all based in the Wellington region, a region that is reported to be less culturally diverse compared to Auckland (34). This is important to note because ethnic differences are prevalent in body mass index, body fat percentage and health risks in NZ adolescents (35).

The obesogenic food environment is by no means immune to adults. In a cross-sectional study held in Canada, several retail food outlets had a positive association to the level of obesity reported (36). Therefore, the literature demonstrates how the accessibility to appropriate nutrition is even more important today, where the current food environment remains to challenge healthy eating advice. To accomplish this, a quick yet accurate measuring tool can assess the healthiness of food outlet menus. These scores can advise researchers to learn about the food environment, auditors and food service providers, to modify their menus or help policy makers enforce regulations that prevent an unhealthy food environment.

Furthermore, the prevalence of hypertension in NZ has increased 15% in the 2008/09 Adult Nutrition survey compared to the 2002/03 Adult Nutrition Survey and we can expect this to have increased further in more recent years (37). The literature identified that a population of obese individuals with poor insulin signalling also demonstrated higher blood pressure levels. Dietary approaches are key to the reduction in hypertension and is

found successful in the literature. The DASH diet (Dietary Approaches to Stop Hypertension) is a well-known diet pattern that includes a diet full of vegetables, fruits, low fat dairy products and reduced saturated fat (38). We can see here the resemblance of this dietary pattern and the recommended guidelines as mentioned above. This suggests the dietary guidelines align well with a diet pattern to reduce the risk of hypertension. Multiple randomised controlled trials have demonstrated consistent positive results in obese (39) and type II diabetic individuals, when participants are on this diet. Potassium, magnesium, and fibre are minerals associated with reduction in blood pressure but were found not as effective, compared to a DASH diet high in fruits and vegetables in a randomised control trial (39). The strengths of this study included a detailed inclusion and exclusion criteria for both lean normotensive participants and obese hypertensive participants. Gaining an understanding of any medications the participants were taking is important for the study's validity because blood pressure lowering medications would contradict the results of the study, if any improvement was observed in those individuals. In addition, individuals were considered for other medications that can have a flow on effect to lowering blood pressure (39). The DASH diet differed from a normal healthy diet in this study because it had higher estimated folate consumption. Folate has been suggested in literature to lower blood pressure and improve endothelial function (40) . A DASH diet also reduces the consumption of refined sugars that have been linked to raising blood pressure levels (39). Although this diet is primarily successful for individuals living obesity and hypertension, the similarities of this diet to the food groups recommended in the dietary guidelines, re-emphasise why healthy eating is important to prevent the onset of chronic conditions later in life. Healthy eating as suggested by the dietary guidelines provide a way for consumers to reduce risk nutrients such as sugar, salt and saturated fat and improve health outcomes. Thus, tools to determine if the nutritional guidelines are translating to dietary choices are required.

In summary, healthy eating is important because it increases the health and wellbeing of the population, reducing risk of hypertension, diabetes, and cardiovascular diseases. Currently, society is bombarded with food advertisements and easier access to food options. This poses a risk for making unhealthy food choices and policy makers have the role to regulate the density of food outlets, particularly around schools. A validated healthy meal scoring tool offers a form of assessment for diet quality that can be used in these spaces to inform decisions.

2.3 How is healthy eating perceived?

The perception of healthy eating is a critical determinant to how people believe they are meeting the appropriate dietary guidelines. This is important because these perceptions will vary between different groups and affect how

well the guidelines are understood and applied to everyday living. The following section describes how this perception varies according to age, gender and socioeconomic status (41).

2.3.1 Age

Croll et al, 2011 uses 25 structured interviews with adolescent girls and boys across 3 different high schools, to show that these students had a fair amount of knowledge surrounding the information in healthy guidelines. These self-reported perceptions indicated the dietary guidelines were effectively reaching young Americans, and that they found it hard to follow due to a lack of time, limited availability, and lack of concern (41). We understand from this study that better interventions are needed to help adolescents make decisions that better follow the healthy guidelines. We also understand that education effectively reaches young people and is a key indicator in their perception of healthy eating. In focus group discussions about obesity and nutritional knowledge, participants aged between 9-14 years recognised obesity as a problem but did not associate with long term consequences (42). Participants who were classed as overweight at the start of the study felt weight gain was due to non-modifiable risk factors such as genetics and slow metabolism in comparison to responses from participants classed within a healthy weight range.

A study in Canada looked at the perception of healthy eating and identified how these views changed according to different food choices, such as fruit and vegetables, meat, salt, sugar, fat, etc (43). The study found that all age groups identified fruits and vegetables as a strong indicator of healthy eating and is consistent in the literature from as early as the 1980s (44). In addition, all age groups reported salt, fat, and sugar should be avoided to meet their perceived belief of healthy eating (45). This response was like another study held in the UK, where all age groups recognised that limiting fat, salt and sugar were key to a healthy diet (45). All the participants in these studies reported that their perception came from health promotion messages. This suggests that the public respond to effective messages that provide healthy eating education. For example, the participants successfully identified risk nutrients (saturated fat, salt, and sugar) and fruits and vegetables as a key food group in our diet. These align with the recommendations in the dietary guidelines. Therefore, a tool that can translate the dietary guidelines into a simple and practical form can be beneficial for the public.

2.3.2 Gender

Further evidence in literature shows that generally young females have a better understanding of making healthier choices compared to young males. Females are better at avoiding high fat foods, choosing to eat fruit and fibre, and limiting salt (46). For instance, females show a stronger healthy eating belief due to their increased involvement in weight control and dieting (46)(47). When gender differences and education levels were compared, women were more likely to show concern for healthy eating. For example, their responses had a greater emphasis

on 'homemade foods', 'foods containing little additives', and acknowledged choosing skimmed milk and fruit and vegetables as healthier options (47).

However, there are gender differences in the perception of healthy eating (46). When the differences and the relationship it has to healthy eating was explored, adolescent male participants exhibited greater involvement in healthy eating than their adolescent female counterpart. This may be attributed to the different determinants of healthy eating behaviour. For example, male participants were strongly influenced by perceived barriers such as limited choices, while female participants found that situations impacted their healthy eating behaviours. This suggests that each gender could respond differently to the influences of healthy/unhealthy eating and perhaps interventions should be tailored in a way to explore these gender differences. The use of the HMST could draw the attention of males by increasing the convenience and variety of healthy eating options.

2.3.3 *Socioeconomic status*

When a qualitative study combined both gender and SES, it found that women from a low SES were more likely to report unhealthy eating patterns than of high SES women (48). Both groups in the study had appropriate knowledge of healthy eating, time constraints, work commitments, lack of family support and costs. However, these barriers were more of a challenge for women of low SES to continue having a healthy eating diet(48). This example shows that the perception of healthy eating is seen more attainable for those in a better financial position, health promoting environment and less deprivation. However, this could be challenged from the findings of cross-sectional study looking at the adherence to Australian Dietary guidelines in a large cohort of women. This study showed that most women consumed below the recommended servings of cereals, vegetables, and dairy (49). This was true irrespective of age, employment status or SES as the sample aimed to achieve heterogeneity including a random selection of participants across urban and rural areas in Australia (49). Further investigation is required to outline if there are other factors contributing to the poor adherence of the dietary guidelines in this study.

Overall, literature shows us that education and clear messages related to nutrition and health are effective in reaching the public and is a strong influencer of what is perceived as healthy eating. It shows that individuals do understand the healthy eating guidelines. The HMST is useful to see if their understanding translates to actual meal choices in real world situations.

2.4 What are the current scoring tools in literature?

The following section describes different meal scoring tools found in literature and explores their strengths and weaknesses. The four scoring tools discussed are the Healthy Eating Index, Healthy Meal Index, Nutrient Profile Scoring Tool, and the Mediterranean Diet score. Since there are currently no gold standard diet quality scoring tools, this literature review aims to investigate the accuracy and validity of the different instruments available.

2.4.1 *Healthy Eating Index*

The Healthy Eating Index (HEI) developed in America, follows the dietary guidelines for Americans. The HEI is an index to assess diet quality, incorporating nutrient needs and the ADG into one tool (50) There are 10 components in the overall structure of the HEI and each component is scored from 1 to 10. In more detail, components 1 -5 measures the degree to which a diet follows the serving size recommendations for five major food groups (grains, vegetables, fruits, dairy, and meat). Components 6 – 9 measures the total fat, saturated fat, cholesterol intake, and sodium intake. While component 10 considers the degree of variety in an individual's diet (50). This is similar to the advice in dietary guidelines discussed in section 2.1.1, where healthy eating is defined according to these HEI components. Kennedy & Flemming presented a positive correlation coefficient with nutrient intake and HEI scores. Likewise, a positive relationship was observed between the recommended dietary allowances of micronutrients such as vitamin C, and HEI scores. For example, low HEI scores was linked with poorer intake of vitamin C below 75% of the allowance (50). This means the scoring tool successfully evaluated diet quality without having to measure specific nutrient intake. This research confirms that a meal scoring tool focused on food groups rather than nutrients is effective and correlates with individual nutrients as well. In contrast to the purpose of a meal scoring tool, the HEI is a survey that provides a snap shot of overall dietary intake.

With each new update to the ADG, a newer version of the HEI is introduced to reflect these changes. Since the initial index, the most recent update to the index: HEI-2015 has 13 dietary components (51) When an evaluation study of the index's validity and reliability was conducted, the HEI-2015 demonstrated it is capable to examine diet quality. For example, the evaluation found strong instrument validity when the HEI presented high scores for 'exemplary menus', that are high quality diet menus created by nutrition experts (51). In relation to health outcomes, DASH diet that received a perfect HEI score and reinforces discussions in section 2.1.1 regarding examples of a healthy eating pattern. However, what this analysis fails to consider is the degree of harm high intakes of a particular nutrient can cause. For example, positive correlations of a nutrient and HEI score does not capture excessive intakes of a nutrient, and to which point this is no longer beneficial and should not receive a high index score. However, this evaluation has successfully shown correlations between individual components and total scores as the study acknowledges there are several ways to receive the same HEI score (51). This

approach to analyse the validity of each component separately, provides reassurance and meaningful data on dietary pattern changes over the years. This is an example of how the HEI can be a tool for observing dietary patterns by public health researchers.

2.4.2 *Healthy Meal Index*

Unlike the HEI, a similar tool called the Healthy Meal Index (HMI) was developed to reflect the nutritional profile of meals to help monitor the quality of meals served in public settings (52). In contrast to most scoring tools in literature, the HMI assesses the quality of a single meal rather than overall diet quality (52). This is important, because single meal indicators can be practically used by caterers, schools, and other food service providers to monitor the healthiness and nutritional quality of their meals. The HMI scoring in one study used two components: Adequacy score that is based on the presence of food groups for a healthy diet, and unlike the HEI, this design included a Moderation score: based on the absence of food groups recommended in smaller amounts (53). It is the combination of these scores that provides a total HMI score to infer diet quality. Since the HMI was designed for foodservice settings such as canteen meals in work sites, the components of the scoring system differ to the HEI. In particular, the tool took into consideration the portion of food groups of the meals served, by weighing portions of meals from a sample of 180 canteen meals, collected across 15 randomly selected worksite (52). This is because the HMI in this study is developed using the proportions described in the Plate Model for individuals living with diabetes (54) (55). The portion thresholds in the HMI were determined in agreement with the recommended serving quantities in the Danish dietary guidelines. This is an excellent example of how scoring tools should consider both energy density and nutrient components to show how the proportions of each food component in the meal is also key to reflect overall diet quality. Portion size is an important indicator of energy density and a strength of this study because portion control has a noted effect on health and energy intake. Larger portions of unhealthy food groups can increase the risk of obesity and poor health outcomes (56). For example, a meal with a higher proportion of vegetables will have greater benefits than a meal with a higher proportion of saturated fats or sugars (56).

It should be noted that the HMI does not include all aspects of the dietary guidelines, compared to the HEI, for example it does not consider the sodium content of foods. Interestingly, this may be since the Danish do not face a high sodium intake problem compared to the American population. A study in 2018 showed that the estimated salt intake at 15 canteen worksites in Denmark, decreased significantly compared to an earlier study conducted ten years ago (57). The main source of sodium in America is identified as due to the high number of processed foods and added salt for increased palatability in restaurant meals (58). Therefore, the evidence of consistently high sodium intake in the American public, demonstrates how this is an important indicator in the HMI. From this

we learn how both tools (HEI & HMI) are catered around their target population and can be limited by their applicability to different nations or different types of populations, such as a hypertensive population.

2.4.3 *Mediterranean Diet Score*

The Mediterranean diet scoring tool reflects on how closely diet is aligned with the specific Mediterranean diet, that is made up of non-refined cereals, fruits, vegetables, potatoes, legumes, olive oil, fish, red meat, dairy products, and red wine (59). This diet has been reported in literature to positively affect cardiovascular health and reduce the burden of other diseases. The Mediterranean diet differs from dietary guidelines because it emphasizes plant-based foods, omega 3 fatty acids, and moderate portions of dairy. Healthy fats from olive oil and fish are advised as part of this diet because this has been shown to improve lipid profiles and reduce blood pressure (60). Interestingly, 1-2 glasses of wine, accompanied with meals is included in this dietary pattern in contrast with the national dietary guidelines that advise against frequent alcohol consumption. The literature identifies there is a strong link associated with moderate intake of red wine in reducing blood pressure (61), increase high-density lipoprotein cholesterol (62) and reduce vascular oxidative stress (63). The combination of these factors results in improved cardiovascular health. Like the scoring tools mentioned above, the Mediterranean diet score assigns a rating to each component relevant to the Mediterranean diet pattern (59). One study used this scoring tool to assess the results from a short questionnaire, that identified this tool is inversely associated with a reduced risk of myocardial infarction (64). Other researchers in literature have shown an inverse relationship between the Mediterranean scoring tool and all cause and coronary heart disease mortality (65). Therefore, the purpose of the Mediterranean diet score demonstrates how a diet quality scoring tool can be tailored to a specific diet. This would be useful for population groups who are managing their own heart health or require self-monitoring as a preventive measure in high risk for cardiovascular disease.

2.4.4 *Nutrient profiling scoring tool*

When specific nutrient-related health conditions are observed, there is opportunity for scoring tools to be nutrient-focused, which are often found on front of pack labelling. Nutrient profiling is defined as the ability to rank foods according to their nutrient content per unit, such as protein, fat, sugars etc (66). The development of nutrient profiling models provides information to distinguish between foods that are high in essential nutrients (67). They are designed to analyse individual foods, and not the quality of whole diets. However, they are an effective indicator for forming policy and regulations to improve healthy eating. One of the most used formal scoring systems is the Nutrient Rich food (NRF) index. An example of a nutrient profiling model is the NRF 9.3. This system considers the value of 9 nutrients (protein, fibre, vitamin A, vitamin C, vitamin E, calcium, iron, magnesium, and potassium)

that are encouraged to be consumed and the 3 nutrients (saturated fat, added sugar, sodium) that are recommended to be consumed in limited amounts (66).

Nutrient profiling is advantageous because it is guided by the nutrient status of the population and the recommendations from the national dietary guidelines. This means the models can be population specific and adjust for current deficiencies. Specifically in New Zealand, individuals with low SES face increasing rates of obesity and chronic conditions related to diet (68) (69). One of the major influences of food purchasing is food cost. The NRF index allows for identification of affordable and healthy foods, the results showed that milk, potatoes, cereals, beans, and legumes had favourable nutrient-price ratios than even some vegetables and fruit. This analysis, further identified that sweets, fats, and grains that are high in energy, had the least nutrients per dollar (70). The present study shows how using nutrient profiling models provided information that can be used for nutrition education and guidance in different socioeconomic groups. This research allows health professionals to tailor their advice and offer suggestions that are cost effective, ensuring a higher nutrient uptake per dollar. This is important when working with a low socioeconomic demographic.

Additionally, nutrient profiling information can be taken up by public health officials, to help implement regulation and policies, such as packaged food labelling (71). An example of this is the health star rating (HSR) system in Australia and New Zealand, that awards a star rating according to the relative nutritional quality of the product (71). This rating is based on a Nutrient Profiling Scoring Criterion (NPSC) by Food Standards Australia and New Zealand. This criterion uses a similar concept as the NRF9.3, where nutrients are deemed 'positive' or 'negative' according to their benefit to health. For example, NPSC analyses the content of energy, saturated fat, total sugars, and sodium ('negative nutrients'), as well as fibre, protein, fruit, vegetable, nut and legume content ('positive nutrients') (72). This study aimed to determine the accuracy of the NPSC when used to develop the health star ratings. Although most products analysed in this study aligned well with their relative health claim, the results identified there were discrepancies in the star rating and its relative healthiness. For example, 6% of products in this study were eligible to display a health claim, even though they were given a score less than 3.5 stars. Likewise, 2.7% of products were ineligible to display a health claim but had a star rating greater than 3.5 stars (72). This will contribute to the existing confusion within the NZ and Australian public, in their understanding of nutrition labels or claims (73). Overall, the NPSC tool agreed with its corresponding HSR and its usefulness for the public to make healthier choices.

A combined approach that looks at nutrient profiling and desirable food groups together can be used as a 'hybrid' model. A combined approach is considered effective to inform policy makers, create health promotion messages and help individuals make healthier choices (67). This is because, nutrient profiling can provide quantitative

definitions to each of the food groups, which has not been clearly stated in the ADG. For example, the hybrid model gives a final score on the following three components that are focused on nutrients to encourage in the population (protein, fibre, vitamin D), identifying food groups to encourage in the population (based on the current ADG) and the nutrients to limit (saturated fats, added sugars) (67).

The effectiveness of front of pack labelling was shown effective when participants choices for a healthy drink were consistent with the products that displayed a higher rating (74). Importantly, the results further identified how less than 30% of the participants went through the Nutrition Information Table, which was also offered to assess the drinks' healthfulness. This study shows the important role that labelling systems have on consumers' perception of different foods' healthiness. Consumers have shown to change their purchasing behaviours according to labels such as the HSR introduced in Australia and NZ (75). For this reason, nutrient profiling systems need to be cautious on how the information is being presented and retrieved from nutrient profiling models. A hybrid nutrient model proposes that nutrients overlooked in current systems such as vitamin D, will now be considered as part of key food groups suggested in the dietary guidelines. For example, current models rate brown rice and white rice with similar scores however, using the hybrid scoring system, brown rice will generate a higher score, because it will contribute to the daily wholegrain recommendations in dietary guidelines. Similarly, this model attributes a higher score for skim milk, low fat yoghurt and whole milk yoghurt, compared to current nutrient rich food index scores, because they contribute to the daily recommendations of dairy servings (67). Ultimately, nutrient profiling provides an effective measure which can be applied to public health interventions, that do not eliminate or create huge discrepancies in product scores because they are more closely aligned with the dietary guidelines.

The tools described in literature follow different strategies to assess for diet quality. Both the HEI and HMI are not catered for the NZ population because they are based on ADG and focus on nutrients of concern to the American population. The Mediterranean diet score is related to dietary choices for cardiovascular risk and is not relevant for all individuals. In NZ , nutrient profiling systems such as the HSR have been implemented to promote healthy eating. There is potential for a HMST to evaluate the effectiveness of nutrient profiling in translating to dietary choices

2.5 Why is a meal scoring tool important?

A meal scoring tool is important because researchers need to find an effective, efficient, and robust way to measure the quality of diets to assess dietary choice and disease risk. This is important to infer if the diet observed agrees

with the dietary guideline recommendations. Dietary patterns can be measured using scoring tools to assess the nutritional quality and how this is linked to co-morbidities. For example, the HEI-2015 was used to measure the diet quality of participants recruited from the Atherosclerosis risk in Communities study. A high diet quality score was associated with a 16% lower risk of incident CVD (cardiovascular disease), CVD mortality and all-cause mortality (76). A meal scoring tool is advantageous because it is closely aligned with the recommendations of the dietary guidelines. The findings here show that a higher adherence to the 2015-2020 ADG is associated with reducing CVD mortality risk.

On the other hand, diet scoring tools in literature are often measured using 24-hour dietary recalls. This dietary assessment does not always provide researchers with reliable information due to reported variance caused by bias. This bias can arise from how well the participant can remember their diet; therefore, it is not recommended for elderly subjects or children under the age of 12 (77). This means an entire sub population group is removed from dietary assessment when using this method, especially when the elderly is a nutritionally vulnerable group. For example, this group is more likely to experience medical complications, hospital admissions, nursing home admissions and long-term care (78). Optimal nutrition in older adults is reported in literature to minimise the risk of malnutrition (79) and improve mental and physical quality of life on admission to hospital (80). Therefore, older adults are affected by diet quality and require a form of measurement that is not reliant on memory. Other limitations of a 24-hour dietary recall include the interviewer's capacity to explain recipes, ingredients, and food preparation skills. For example, when the HEI index was used to assess the diet quality from the NHANES data, dietary intake was obtained from 24 hour recalls in an automated interactive interview process (79). Self-reported surveys require a high literacy level for respondents to understand the questions. This may explain why high income and high-level educated groups had a higher average HEI score, than lower-income and low-level educated groups (79). The literature has established well that levels of health literacy is associated with income, access to education (81) and the level of reporting in dietary recalls (82). This suggests that researchers should consider the problems associated with 24 dietary recalls as a dietary assessment, whenever using this data to inform diet quality scores.

Dietitians and other health professionals who work closely with dietary behaviour management will benefit from an easy meal scoring tool for their patients. So far in literature, diet quality tools have been used to assess the risk of developing chronic conditions such as type II diabetes (83). There is room for further research to expand on the success of a diet scoring tool for diabetes management and changing dietary habits after receiving advice from a health professional. Although one UK study has developed a validated tool for people at high risk or currently with type II diabetes, this tool was validated using a predominant sample of Caucasians in the UK with a high literacy

level. This is not reflective of a diverse ethnic sample with differing dietary habits and literacy levels (83). Therefore, it is difficult to confirm the reliability of this tool to a diverse population.

Diet as a whole is important for population health however this is limiting because it requires dietary recalls or food frequency questionnaires to inform the researcher on the entire pattern. A meal scoring tool is designed to assess the quality of a single meal. This is advantageous in school, caterers and other food service settings and rest home settings because it removes the respondent's burden to accurately recall their eating patterns in the last 24 hours. It allows researchers to capture data in the moment of time. This means individuals can self-monitor the quality of a single prepared meal, whilst educating and making modifications to their meals to receive a higher score.

2.6 Validation studies

A validation study aims to identify and correct any forms of bias or measurement errors by comparing the accuracy of results with a form of gold standard method (84). The general design of validation studies includes internal and external validity. Internal validity helps establish whether the observed findings are presented as truth in the investigated population and that it is not due to sources of error. External validity helps to understand if the same findings can be applied to a similar population in a different setting (85). The following section describes different validation methods for assessing meal scoring tools in current literature.

The availability of increasing diet quality assessment tools, mean there is an increased need for validation studies to recognise its applicability in a wider context. For example, the HEI was validated amongst 340 women using plasma biomarkers to reveal that a higher index score was associated with a higher plasma concentrations of vitamin C, alpha-carotene, beta-carotene, beta-cryptoxanthin and lutein (86). Nutrition biomarkers is an effective validation method because it is a reliable indicator of fruit and vegetable intake. In addition, this study found that a high HEI score was strongly correlated with diet variety and negatively correlated with the consumption of saturated fat, both of which align within the recommendation of the ADG (86)(14). However, the HEI is limited by its ability to only confirm scores against the consumption of fruit and vegetables.

Most dietary guidelines emphasise the importance of dairy and/or dairy products, grains, and meat/meat alternatives as other major food groups. To improve this study, a combination of urine nitrogen and plasma samples could be collected to investigate the level of protein in a diet. A randomised, crossover dietary intervention reflected how meat and grain protein intake can be best predicted by a series of amino acids in urine (87). This type of data would further improve the validity of the HEI scores, to identify the adherence of two more food groups, as recommended in the dietary guidelines.

Diet Quality Indices (DQI) are another example of dietary assessment methods to quantify the quality of a diet by scoring foods or specific nutrient intakes (5) (88). Food frequency questionnaires (FFQ) are a common diet quality indicator that are designed with this objective. One study tested for its validity against plasma biomarkers from a large sample of 127 male health professionals (88). The results showed reasonable validity of the FFQ, when compared with cholesterol, alpha-carotene, and beta-carotene biochemical measurements(88). FFQs as a dietary assessment method, shows reasonable validity to estimate the healthiness of an individual's diet and often used to gather data on nutrient intake. However, there is an obvious absence of gender representation in the described study sample, as it is made up of only male participants. In addition, the sample is made up of health professionals, suggesting that DQI may be best interpreted by only health professionals as opposed to other individuals with limited health knowledge. This begs the questions of whether the reliability of FFQ can be transferred to the entire population and perhaps diet indicators need to be administered by qualified nutrition or health experts.

Although the literature acknowledges plasma biomarkers as a gold standard for validation, very few studies have used qualitative methods to assess the validity of a meal scoring tool throughout the design process. For example, the design of the HEI used evidence from the Food guide Pyramid, ADG and existing research (50). The design did not include an opportunity for expert opinions to comment on the practicality of such a scoring tool.

In contrast, the development of the HMI used stakeholders such as food service providers, canteen managers and nutrition experts to inform the needs of the proposed scoring tool (52). This is because the study had a clear objective of developing a simple scoring tool to assess meals in a food service business. The outcome would deliver a tool to assist caterers in making healthy meal choices that is time consuming (52). The HMI is different to the objective of the HEI and DQI, that wanted to achieve overall diet quality assessment.

The above study stayed true to their objective of developing a simple scoring tool for menu assessment, by testing validity with a realistic study sample of 180 canteen meals at Danish worksites, selected by the workers themselves. The findings showed the HMI score was an acceptable tool, reliably linking increasing scores with decreasing energy density of the chosen canteen meals (52). Although the present study suggests multiple implications of use by caterers, dietitians and the public, the study fails to test internal consistency in the scoring process (52). The method of scoring reported in the study was conducted by lab technicians and therefore the validity of consistent scoring cannot be promised, if the tool was administered by individuals outside of the research group.

In summary, plasma biomarkers have proven effective in validation studies to correctly compare diet scores to nutrient intake however, it does not have the ability to analyse components of all food groups. Other methods require dietary assessments that have limiting factors of its own. The literature has identified nutrition expert involvement in the development of the HMI, but the same group was not involved in the scoring process or internal consistency assessment.

2.7 Conclusion

The current research focuses on the development and validation of a simple meal scoring tool to assess the healthiness of a meal according to the national dietary guidelines. Meal scoring tools are a useful indicator of diet quality and can be used to make further inferences in research, particularly for health professionals working in this field. However, most existing tools look at the diet as a whole and do not assess the healthiness of a single meal. They are also strongly based on the American population which is not a true representation of dietary patterns in NZ . This literature review has shown that most dietary guidelines share many of the same key components for healthy eating, however NZ requires an updated national nutrition survey to clearly identify the nutritional needs of the population. This is important to make clear dietary recommendations. For example, emerging plant-based diets and increasing dairy alternative consumption, will require more specific serving size advice. Therefore, it is unclear how reliable and achievable the NZ dietary guidelines are to form the basis of a meal scoring tool.

This chapter presented current diet quality scoring tools to measure healthy eating, such as the Healthy Eating Index, Healthy Meal Index, Diet Quality Indicators, Nutrient Profile Scoring, and the Mediterranean Diet score. The different meal scoring tools – HEI, HMI and Nutrient profiling index are closely aligned with the national dietary guidelines from where they were developed and can be used in a range of settings. In contrast, the Mediterranean diet score assesses a diet to the risk of cardiovascular health. This is an example of a meal scoring tool designed strictly for clinical settings and individuals at risk for cardiovascular complications. Most of these tools are designed to assess the quality of an entire diet and require total dietary recall methods. The HMI follows a similar purpose to the current study with an objective to measure the healthiness of a single meal. The HMI looks at proportions and nutrient components when evaluating a meal, in contrast to other diet quality scoring tools that only focus on nutrient components. Further investigation is required to clearly understand what components make up the criteria items for a healthy meal.

Validation studies are important to test the reliability of a scoring tool instrument so they can be reproduced in a variety of settings. The literature found that plasma biomarkers, dietary assessment methods, and chemical analysis of food and nutrient content were commonly used to validate against the scoring tool scores. Only the HMI used expert opinions in the development phase of the scoring tool to understand key components of

measuring a healthy meal. Although most studies suggest the scoring instruments can be used in a range of settings, no study has asked individuals in these settings to score meals and test for the consistency. Therefore, validation studies in literature have not considered consistency in the scoring process for the end users of the scoring tool.

2.8 Conceptual framework

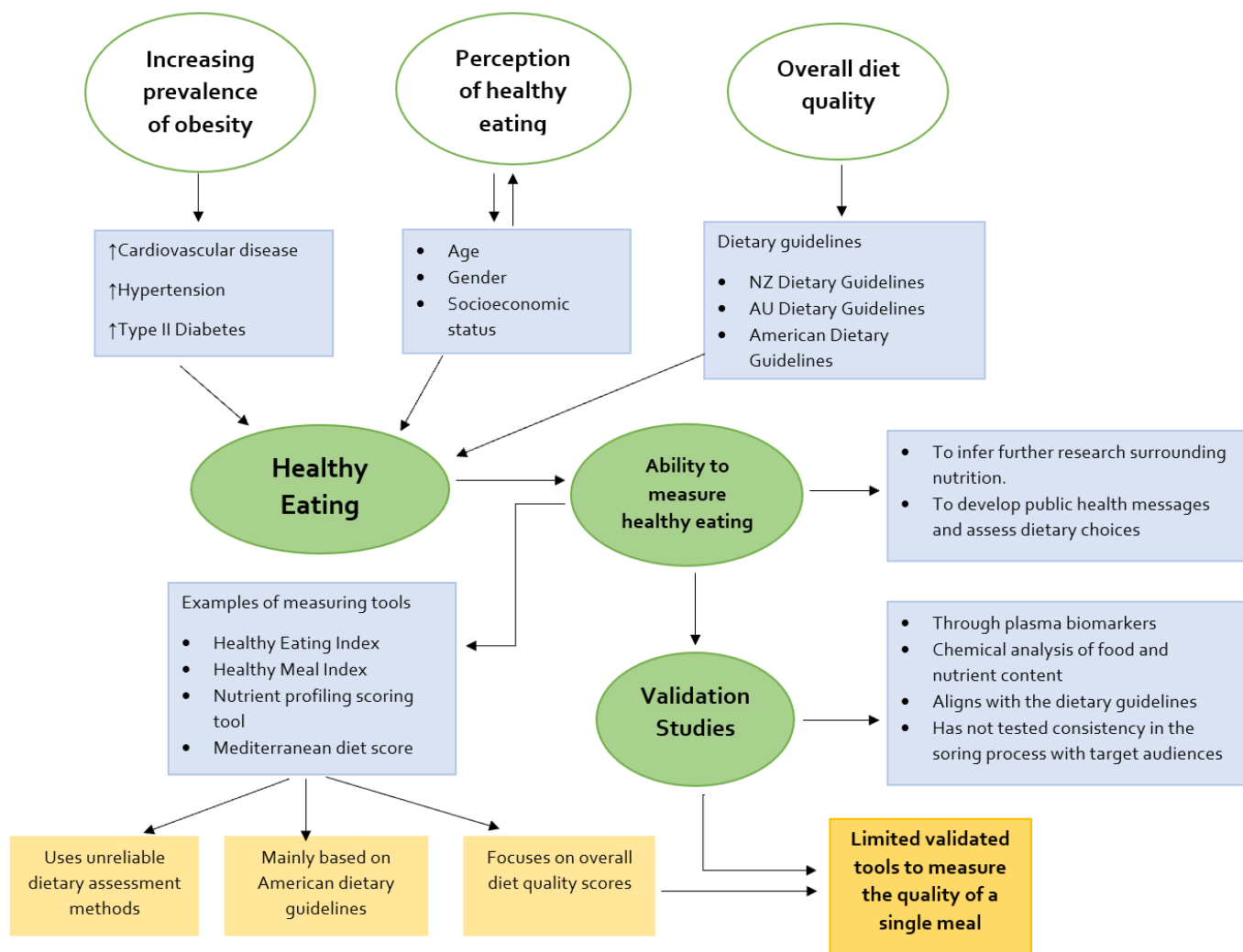


Figure 1: Summary diagram of key concepts discussed in literature review above and its contribution to answering key research questions. Green circles: key concepts, Blue squares: Description of key concepts, Yellow squares: Limitations identified in literature

3 Methodology

This validation study carries on from an earlier intervention study and from this, the existing tool is modified according to the findings of the following methodology. A series of validation methods are used to revise and formulate a better meal scoring tool, with the outcome being to deliver a robust and reliable scoring tool for measuring the healthiness of a meal. In addition, the study aims to define the components required to deliver an accurate tool, the underlying definition of a healthy meal, as well as the ideal target audience for such a tool are also investigated in this study.

This chapter begins with a description of the study design as well as the justification behind the decisions made throughout the research process. Following this, the various steps involved in the selection of participants, data collection and methodology for data analysis are outlined in detail.

3.1 Research study design

The following section of this chapter introduces a mixed methods approach to conduct a validation study. A mixed methods approach draws on the strengths of both qualitative and quantitative designs to answer the research questions that are not able to be answered by just one approach. Content validity is important for this study because it investigates the extent that one can generalise the criteria used to identify a healthy meal, to all possible outcomes, in the wider research scope (8). Content validity provides evidence to the relevance of each component discussed in the scoring tool, determined by experts in the field of nutrition. The initial stage of this study asks participants to comment on the strengths and weaknesses of the existing tool in defining a healthy meal.

3.1.1 Semi-structured interviews

Researchers used both qualitative and quantitative approaches in the form of semi-structured interviews. Semi-structured interviews are valuable in this setting as they allow for an in-depth exploration, that can generate new ideas, confirm, or deny existing knowledge (8). Individuals could show their interest to be part of this study by replying to an email invitation, sent out by the research team. The invite included a detailed outline of the study in the form of a participant information sheet (Appendix B: Participant Information Sheet prior to semi-structured interview). Those who replied, were asked to sign off a participant consent form, explaining the expectations of their involvement and guaranteed researchers' confidentiality of their involvement (Appendix C: Participant consent form). In person or Zoom meetings were arranged once participants returned their signed consent forms. An interview guide was prepared beforehand, and questions were developed from areas of interest identified in the literature review, theoretical framework and research aims (8). The interviewer in this study had the role of using open-ended questions to encourage the participants to elaborate on points. Open questions are utilised in qualitative research because it allows participants to respond in their own words, without a predetermined set of

answer choices (89). For example, the nutrition experts were asked to describe components of a healthy meal for a meal scoring tool, because the literature review found limited validation studies that sought expert opinion on the criteria for a scoring tool. The interview guide explored other topics of interest including understanding public perception of healthy eating, how closely the experts follow the NZ Eating guidelines and how effective these guidelines were to the understanding of healthy eating (Appendix D: Semi-structured interview guide).

At the end of the interview the researchers asked participants to rate the relevance of each criteria item in the proposed scoring tool, using a four-point scale and scoring assessment form. This scale resembles the following: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant. This is important for the researchers to understand what components should be included in the scoring tool and understand areas that may need to be revised or eliminated. A content validity index (CVI) and content validity ratio (CVR) are commonly used to evaluate this quantitative data due to its ease of computation, convenience and focus on consensus rather than consistency (90) (91). The first revised version of the HMST was developed using the comments from the semi-structured interviews.

3.1.2 Content validity scoring – part one

Relevancy	Clarity	Essentiality
1= not relevant	1= not clear	1= not essential
2= somewhat relevant	2= item needs revision	2= useful but not essential
3= quite relevant	3= item needs some revision	3= somewhat essential
4= very relevant	4= very clear	4= very essential

Table 1: Breakdown of relevant scores and their assigned definition for each domain of relevancy, clarity, and essentiality.

At the end of the semi-structured interview, each participant is asked to fill out a four-point rating scale to rank the relevance, clarity, and essentiality of each suggested item of the instrument (**Figure 1**). Evidence suggests a four-point scale retrieves a good level of acceptance by splitting the scale into two dichotomies (**Table 1**). This pushes the participants to respond in either direction by avoiding a neutral option, compared to a five-point scale (92). The criteria items on the left-hand side of (**Figure 2**), are key words adapted from eating statements 1 and 2 in the NZ Eating and Activity guidelines. This is because, at this stage of the scoring tool development, the researchers have decided to move towards these guidelines and away from the National Food and Drink policy. For this reason, the present study collected quantitative data from the experts to gauge consensus regarding the following criteria items in the proposed scoring tool. Additional comments were welcomed as experts used a section at the end of the document to inform further justification of their scores or provide additional feedback (Appendix E: Scoring assessment form - part one).

	How relevant is this item?				Is this item clear?				How essential is this item?			
	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Saturated fat content	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Energy/caloric content	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Added sugar	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Salt content	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Number of fruits and vegetables	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Grain foods/ mostly whole grain foods	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Includes processed foods	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Includes milk or milk products	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4
Includes legumes, nuts, seeds, fish and other seafood, eggs, poultry, red meat with the fat removed.	O1	O2	O3	O4	O1	O2	O3	O4	O1	O2	O3	O4

Figure 2: Scoring assessment form given to participants at the end of each semi-structured interview, where 1 = lowest relevance, clarity, or essentiality and 4 = highest relevance, clarity, and essentiality.

3.1.3 Focus groups

The second stage of this study included face validity in the form of a focus group discussion to review the first modification of the HMST. This discussion was no longer than 60 minutes and used the same sample of participants from the semi-structured interviews. Focus group research is a common qualitative data collection method, designed to investigate a range of perspectives regarding a specific topic (93). The individual interviews and focus group discussions are both viewed complimentary in this study as they are valid techniques for collective qualitative information (8). The moderator guided the discussion to specific sections of the scoring tool, using a pre-determined moderation guide (Appendix F: Focus group moderation guide). To plan the moderation guide, the researchers reflected on items that were found to be unclear in the semi-structured interviews. Identification of sections or items in the scoring tool that were found ambiguous, confusing, or difficult to the user were included in the moderation guide. Examples include the instructions, items, and the scoring process of the revised HMST. The contents of the focus group questions are designed using Freitas et al guide to focus groups. The line of questions were classified into the following categories (93).

- **Introductory questions** that introduced the revised scoring tool asking participants to provide their general reaction, listing its strengths and weaknesses.
- **Key questions** asking more specific questions that address the research aims of the study –*descriptions provided in the revised scoring tool accurate in understanding healthy eating? What group would benefit from using a scoring tool like this?*
- **Ending and summary questions.** The moderator summarises main ideas that emerged from the discussion and asks participants to contemplate on all comments shared to confirm if this was an appropriate summary.

Focus groups are advantageous because individual participants may be prompted to bring new insights into the discussion from other comments made by other individuals (8). However, the possibility of individuals choosing to not express their views or discuss certain insights was taken into consideration. For this reason, the semi-structured interviews allow for a more private environment to explore individual perspectives without the fear of judgement or disagreement in a group context (8). All interviews and focus group discussion were conducted by the same facilitator to maintain consistency in questioning.

Some questions were sent out retrospectively to participants from focus group 1, as there were some confusions about what the purpose and who the target audience of the HMST was. After discussing with the research team, an email was sent out to clarify this and revisit unanswered questions from the discussion. The email clarified the purpose of the tool was for menu audits, where it can be easily applied with reliability following limited training from dietitians by different stakeholders such as food service providers, menu planners, auditors, researchers. It will not be expected to be taken up by consumers or any layperson without the proper training involved. Without this clarification, participants expressed being unable to provide accurate insight into the scoring tool. From a research perspective this would have diminished the true benefit of running these sessions.

An additional round of modifications was made to the proposed scoring tool based on the comments from the discussion in combination with the quantification data collected from the content validity scores.

3.1.4 Content validity scoring – part two

At the end of the focus group discussions, all participants were asked to repeat the quantification of content validity via email, using a revised scoring assessment form (Appendix G: Scoring assessment form – part two) that is relevant to the second modified version of the HMST (**Figure 3**). The criteria items observed on the left-hand side have been modified to represent specifically the format of the proposed scoring tool. At this stage, researchers intended to gauge consensus through quantitative data of how well the design, layout and contents of the scoring tool achieved ease of use and effectively measured a healthy meal. Researchers hypothesised that the content validity scores would be higher and with significance, as the modified HMST reflects the suggestions received from both the semi-structured interviews and focus group discussions.

	How relevant is this item?				Is this item clear?				How essential is this item?			
	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Introductory blurb	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Flow chart instructions	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Core food groups	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Identifying proportions of food groups	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Serving size guide	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Food and Drink rating guide	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Definitions given of each rating range e.g., 1-3, 4-8, 9-12 (found in flow chart manual)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Examples 1, 2 & 3	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4

Figure 3: Scoring assessment form given to each participant at the end of the focus group discussion, where 1 = lowest relevance, clarity, or essentiality and 4 = highest relevance, clarity and essentiality.

3.1.5 Inter-rater reliability assessment

The methodology of this study includes an inter-rater reliability test of the meal scoring tool in the final stage of this study, using a cross-sectional survey design. Inter-rater reliability is a test of validity because it is the degree of agreement between the raters involved in the assessment task. This is important for a validation study because it will assess how well the end users can interpret the HMST in their scoring of meals (10). Traditionally, inter-rater reliability is presented as a percentage of agreement from the data collected and requires two or more raters, as a higher number of responses will not indicate a higher inter-rater reliability (10). Instead, the reliability is affected by how skilled the raters are and the level of understanding they hold of the assessment task. Reliability is reflected

in the chosen sample because it includes registered dietitians and student dietitians who hold relevant nutrition qualifications and experience.

A cross sectional survey is used because it can be distributed easily, is quick to complete, and inexpensive to conduct (94). The survey will ask participants to score the healthiness of selected food items using the finalised HMST. This will determine how well the meal scoring tool can measure the quality of a meal, when used in a wider context. Respondents are asked to access the survey via an online link for Qualtrics survey services, received via email. Upon clicking the link, the survey introduced the purpose of the study in the form of an updated participant information sheet (Appendix H: Participant Information Sheet for survey recruitment). Next the respondents indicated if they are a dietitian or student dietitian to inform researchers characteristics of the sample for descriptive data analysis. The survey continues to explain the design, purpose and intended audience of the HMST, including a link to open the HMST resource. Respondents were asked to keep this open while proceeding to score the list of four randomly chosen café items. The menu items have been slightly modified from several local café menus in Auckland and described below.

Meal 1: Sandwich with 2 x wholemeal slices, 1/2 cup raw salad vegetables, 2 slices of cheese, mayonnaise spread, 60g of luncheon.

Meal 2: Deep fried chicken (160g) dipped in sweet chili sauce and aioli. Side of 250mls Coke.

Meal 3: Vegetarian pasta: 1 cup cooked pasta, 2 cups of mixed vegetables such as broccoli, zucchini, capsicum, and corn cooked in olive oil. 1/2cup canned tomato, 170g plain tofu, 40g of grated cheese.

Meal 4: 2 scrambled eggs with pan fried 65g bacon strips. Pan fried mushrooms and spinach (1 cup) on the side. 1/2 cup fruit juice.

3.2 Sample characteristics

3.2.1 Eligibility

The inclusion criteria for the semi-structured interview and focus group required participants to hold a qualification in Nutrition & Dietetics, who are either practicing or emerged within this field of study. This sample method is known as purposive sampling, where participants are selected based on the assumption, they hold the expert knowledge to answer the key research questions (95). These participants were recruited from within the teaching team in the Department of Nutrition & Dietetics at the University of Auckland, recent dietetic graduates, or currently practicing dietitians. As key members of the University teaching team, it is assumed they hold up-to-date research and knowledge in their domain of expertise, to effectively evaluate the relevant components of this HMST. The same

group of experts participated in the focus group to maintain consistency in the discussions of key points that were raised in the interviews.

Participants in the external validation survey sample were included if they are a dietitian/nutrition expert or dietitian/nutrition student soon to graduate. Including students was important for the present validation study because the scoring tool must be consistent with the most recent knowledge and skills regarding nutrition. The new graduates are expected to hold this knowledge, as the lifespan of this scoring tool in relevant practice will be dependent on how effectively new graduates can apply this tool into their own professional life.

3.2.2 Sample size and characteristics

Purposive sampling method is a non-random technique, where individuals are selected in the study due to a shared commonality (96). The current study concentrated on individuals who have a background in dietetics or nutrition. This is because researchers deliberately picked a sample, who carry nutrition knowledge and experience to appropriately assist in the validation process of the current study (96).

A total of nine nutrition experts responded to the email invitations to participate in the content validity and face validity steps of this study. The participants ranged from a variety of backgrounds such as public health nutrition, clinical nutrition, educators at the University of Auckland and foodservice. Six of the experts responded to an email invite sent out via an email group that only included nutrition experts and registered dietitians. Three participants responded via a message invite posted on a University of Auckland student Facebook page for dietitian students. Therefore, the sample varied in levels of experience, with some graduating from their respective dietetic course within the last year and some having held their qualification for over ten years.

The quantitative data collection through the scoring assessment form included seven expert responses in part one and eight expert responses in part two. Gender and age were not factored into sample recruitment.

The ideal size for a focus group discussion is between six to eight participants, as literature has recognised larger groups tend to limit each participants opportunity to share their thoughts. This is because larger groups are more useful if participants have limited knowledge on the topic (97), which is not the case for the current study. Rather, the researchers welcomed participants to offer their insight and expertise to the discussion. Some studies suggest that groups as small as four are advantageous and for this reason, we organised two different focus group sessions with four participants in each group, eight in total. One participant was excluded from the focus group, due to conflicting schedules timings.

Several studies have indicated that a minimum number of respondents is not required for an inter-rater reliability assessment. The current study uses a survey that received a total of nine responses from both registered dietitians (six responses) and student dietitians (three responses).

3.3 Data analysis

The following section describes three main steps involved in the data analysis of the current study. This is broken down into qualitative analysis and quantitative analysis, due to the mixed methods nature of the research design. Both forms of analysis go hand in hand and are repeated twice in this study. Thematic analysis is used because it finds patterns or themes from the semi-structured interview transcripts. The analysis is followed by the quantification of content validity from the scoring assessment form, by calculating the content validity index and ratio. Both these steps are repeated once more to evaluate the focus group discussion notes and the scoring assessment form – part two.

In the final stage of analysis, researchers investigated how well the second revision of the HMST captured expert feedback and achieved its purpose to measure the healthiness of a meal. A quantitative approach was considered for this step for analysing the inter-rater reliability from the scores received. The outcome of this informed the researchers how successful this study had been in developing a validated meal scoring tool.

3.3.1 Thematic analysis

Grounded theory, first described by Glasser & Strauss uses systematic coding of the data allowing for ideas and theories to emerge as deemed relevant (98). The same researcher conducted the thematic analysis to maintain consistency, as grounded theory is dependent on the subjectivity of the researcher (95). A well-developed outline of the study and understanding of the key research questions (**Table 2**) guided the grounded theory approach and is important to help the researcher remain in alignment with the goals of the study. The process is often non-linear and requires ongoing reviewing of the data to find patterns or codes that build into main themes. Each semi-structured interview was audio recorded and transcribed fully before commencing the analysis.

Coding is undertaken in two stages (**Figure 4**). The initial stages of coding involve the categorising of similar ideas, concepts and thoughts that reoccur in the data (95). A general inductive approach is used to identify the codes and themes relevant to the research questions. This approach is commonly used in qualitative research and uses observations and subjective reasoning to formulate the results of the data. This occurs by identifying patterns, common threads, and explanations (99). The step-by-step analysis of the transcript involves familiarising oneself with the data by reading the transcript several times, highlighting key words and labelling segments of text for potential codes.

Table 2: Summary of key questions to support thematic analysis process.

Research questions
1. What are the key components of identifying a healthy meal?
2. What are the attitudes of the public towards nutrition?
3. Which groups would benefit from a meal scoring tool towards improving diet quality and healthy?
4. What are the strengths and weaknesses of the national dietary guidelines?

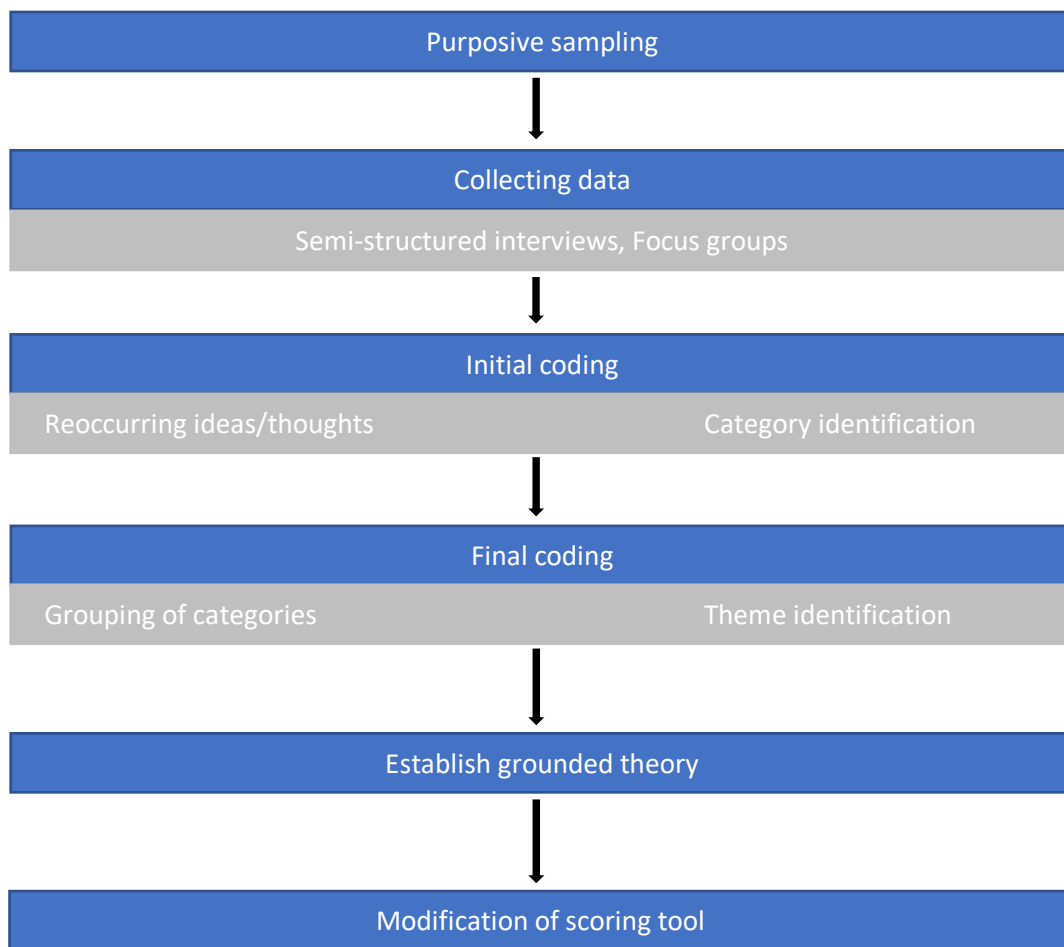


Figure 4: Summary flowchart illustrating steps involved in the thematic analysis of part one in this study.

The outcome of a general inductive approach is the development of codes that would later formulate potential themes (99). NVivo (100) software was used to help establish clear links between text segments, possible meanings, and emerging themes. Unmarked segments of text from this transcript mean they are not relevant to the codes or the research objectives. The final step in general inductive analysis involves continued revision and refinement of the categories by clarifying links made between one category influencing another. Once these categories have been established, a refined version of the scoring tool was developed based on the comments.

3.3.2 Calculating content validity ratio

$$CVR = \frac{n_e - (N/2)}{N/2}$$

Equation 1: Calculate content validity ratio (CVR) as described by Lawshe, n_e = number of participants indication 'somewhat essential, very essential' and N is the total number of participants.

The researchers used the answers from the scoring assessment form part one and part two to determine the content validity index (CVI) for relevancy, clarity, and essentiality. Described in table 1, scores '3' or '4' are assigned to components with a 'quite relevant/very relevant, somewhat clear/very clear, somewhat essential/very essential' ranking. These scores are pooled together by combining values 3 and 4. The CVI is calculated for each individual item (I-CVI), using the following equation: *The number of experts indicating a rating of 3 or 4, divided by the total number of experts in the panel.* A I-CVI of 0.79 or higher is seen to have excellent content validity, while between 0.70 to 0.79 requires some revision and if less than 0.70, the item is eliminated from the instrument (101). Next, the researchers calculate the content validity ratio (CVR) suggested by Lawshe, to specify how many experts found an item essential for operating the instrument or scoring tool (**Equation 1**) (102).

The CVR determines the level of agreement between participants and whether this is above 50%. Values can range between -1 (perfect disagreement) and +1 (perfect agreement). A positive CVR indicates that at least half of the experts agree on the essentiality of the item to the scoring tool (102). It is important to consider whether the level of agreement is attributed to chance. For this reason, the CVR values are considered significant, if given a value above 0.99 (CVR_{critical}). This value is relevant to analyse the data of the scores in part one for 7 expert responses. (102). The analysis of the scoring assessment from part two required a CVR_{critical} value of 0.79 relevant to the 8 responses received. CVR_{critical} values show the lowest level of agreement required, to refute the idea of chance occurring and show how many participants are needed to agree for an item to be significant. Items are included or discarded from the next modification of the HMST according to these results (102).

In addition, content validity was measured using a scale level content validity index (S-CVI). This calculated the level of acceptance for the overall tool, using the number of items that have achieved a rating of 3 or 4 (101). For this study, researchers use the average approach to analyse the data, by taking the sum of I-CVI, divided by the total number of items. An S-CVI value that is greater than 0.8 suggests excellent content validity (103).

3.3.3 Calculating inter-rater reliability

Inter-rater reliability methods are used to reflect any variation in two or more raters, who measure the same variable (104). The present study used intra-class correlation coefficient (ICC) and Cronbach's Alpha to determine the level of agreement. This is because these methods consider both the degree of correlation and agreement. Other

approaches such as Pearson's correlation coefficient is effective when you only have two and paired t-tests measure the level of agreement (104). Therefore, ICC is a better index of reliability when there are more than two raters involved.

The ICC can fall within ranges less than 0.5 (poor reliability), between 0.5 and 0.75 (moderate reliability), 0.75 and 0.9 (good reliability) and above 0.90 (excellent reliability) (104). The literature identifies several models for ICC calculations. Statistical analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) statistics software (version 28.0). Selecting the current ICC model for inter-rater reliability studies is guided by four questions: 1) Are the same set of raters used? 2) Has the sample been randomly selected or specifically selected? 3) reliability of a single rater versus the mean value of multiple raters?, 4) and is the study concerns with consistency or reliability?

The current study used a two-way random-effects, absolute agreement, model. A two-way random model allows researchers to generalise the reliability results to other raters who share similar characteristics (104). Next, absolute agreement was selected because as per the research outcome, the intended protocol assessed how well the raters scored the same for each of the meals in the survey. In support of this test, SPSS also computed a 95% confidence interval to determine the range of values, where the true ICC value would lie (104). The inter-item correlation matrix shows the level of agreement between each rater from 1 – 9.

Further descriptive analysis determined if the proportion of matching ratings varied between registered dietitians and student dietitians.

3.4 Ethics approval

This study protocol was reviewed and approved by the University of Auckland Human Participants Ethics Committee on 26-05-2021 for three years, Reference Number UAHPEC21232. Dietetic and nutrition experts interested in participating in this study were given a participant information sheet, outlining the details and purpose of this study. In addition, written informed consent was obtained from all participants.

3.5 Conclusion

In summary, the methodology chapter explains each step involved in the validation process of the Healthy Menu Scoring Tool (**Figure 5**). Content validity was conducted through nine semi-structured interviews with registered dietitians. The interviews are transcribed, and emerging themes and subthemes are identified through the process of thematic analysis. Criteria items suggested by the researchers for the scoring tool at this stage are scored in three domains (relevance, clarity, and essentiality) by the same experts using a four-point scale assessment form.

Items receiving a 3 or 4 score are pooled together to calculate content validity index and content validity ratio. Both qualitative and quantitative analyses informed the researchers of necessary changes in the scoring tool.

The next stage is marked by face validity where the revised scoring tool is taken to eight of the same interview participants to discuss its strengths and weaknesses. Similarly, the transcripts are analysed through the process of thematic analysis. A second scoring assessment that has been revised to reflect the newer items in the scoring tool is handed to each of the participants at the end of the discussion. At this stage, researchers hypothesised that the content validity index and content validity ratio would increase as the changes made followed on from the expert's feedback. Once this was complete, additional changes to the scoring tool were made and this is presented to a wider sample range to test.

The final stage tested the HMST through a survey that asked the respondents to score 4 randomly chosen café menu items. Interrater reliability was analysed using the ICC and Cronbach's Alpha, to determine how closely the raters scored with each other. The outcome of this informed researchers how well the wider sample of nutrition experts could use the HMST to accurately and reliably measure the healthiness of a given meal.

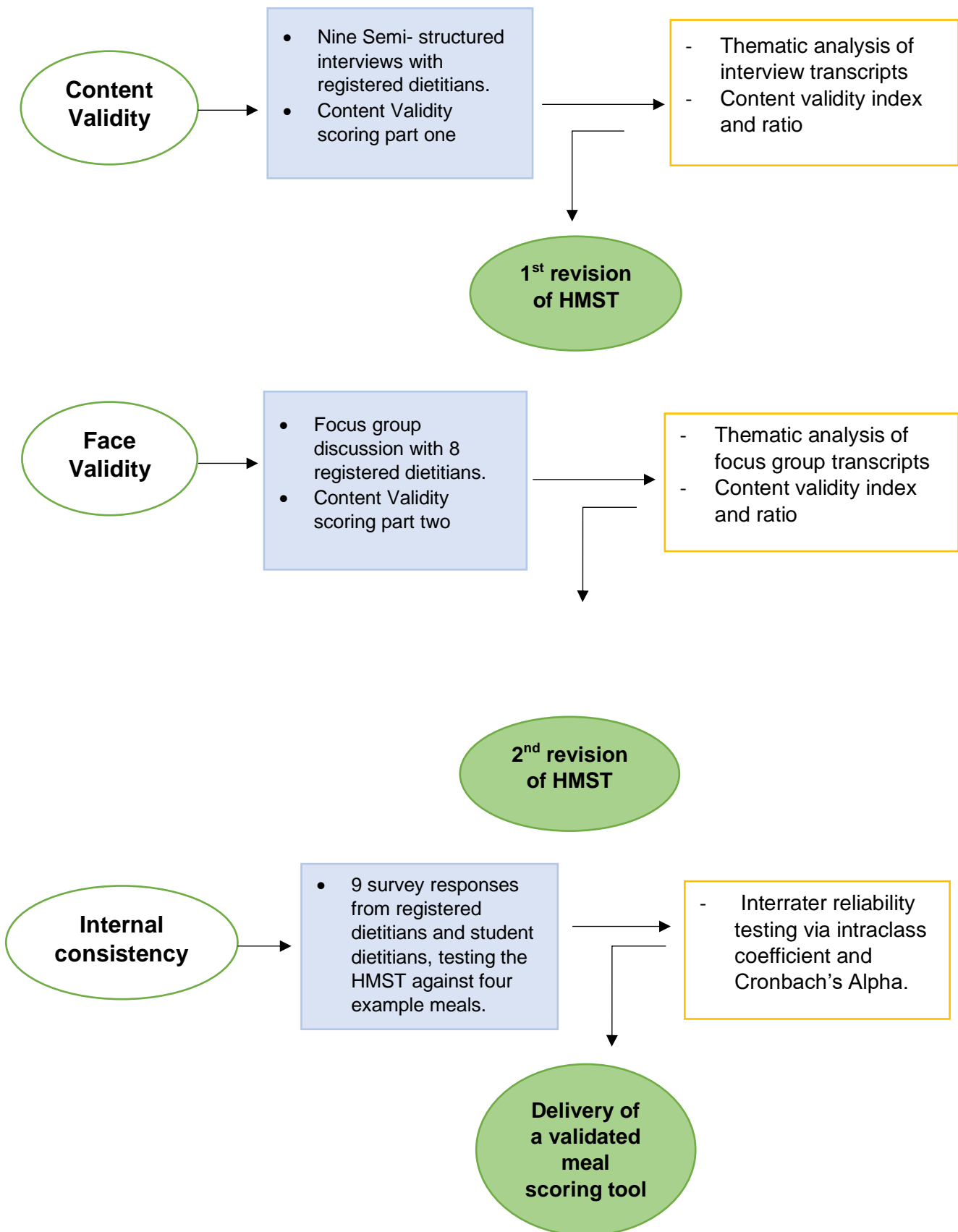


Figure 5: Summary diagram of the methodology processes involved in the delivery of a validated Healthy Menu Scoring Tool. Blue squares describe research study design at each stage of content validity, face validity and internal consistency. Yellow outlined boxes describe the approach used for analysis.

4 Results: Introduction

In the next chapters, the results from a combination of qualitative and quantitative methods from each validation process is outlined in the sections below. These findings have contributed to the development of a validated meal scoring tool to help identify the healthiness of a meal. In addition, the results explored research aims to define and understand components of a healthy meal, identify which groups benefit from a meal scoring tool, and outline the components suggested by the experts to create an effective meal scoring tool.

The chapter begins with a detailed summary of the findings from the semi-structured interview and content validity index scores of the initial meal scoring tool. These findings guided the researchers in the first modification of the tool development. This was brought forward to the focus group discussions where content validity index assessment was repeated, and the experts discussed the face value of the tool. Further appropriate modifications are made in phase II of the tool development in support of these findings. Finally, the chapter describes data collected from a wider sample in a survey response, to assess the inter-rater reliability of the finalised HMST. This last step informs the researchers how well the modifications have been in creating a valid and consistent scoring tool.

5 Results: Semi-structured interviews

This chapter discusses the data analysis and the five overarching themes and several subthemes. Detailed below is the thematic analysis of the semi-structured interviews, and the following main emerging themes:

1. Healthy eating
2. Perception of nutrition
3. NZ Eating guidelines
4. Proposed meal scoring tool

5.1 Healthy eating

The nutrition experts provided feedback regarding the components that make up healthy eating and a healthy meal to introduce the key criteria items for the proposed meal scoring tool.

5.1.1 Food groups

When asked about components of a healthy meal, the experts all emphasised the importance of having certain food groups on the plate. This included a source of fruits and/or vegetables, a source of carbohydrate and protein, as advised in the Healthy plate model.

“I would define healthy eating as a variety of whole foods from each of the main foods groups that is lower in processed foods and high in vegetables, fruits, wholegrains and quality protein sources.”

“Have components that are from all the different food groups, so I guess for me it would have um some sort of carbohydrate source, some sort of protein source and obviously fruit and vegetable source.”

“Well I guess if you think about the plate model, its thinking about those three different sort of groups, you know you’ve got your vegetables and some fruit. You have got some protein foods and carbohydrates, so you’re going to be getting some key nutrients within that meal.”

“So, to me a healthy diet would be you know 50% of your plate is vegetables and then you’ve got protein and carbohydrates [...]”

“What the healthy plate does is clearly marks out you know half the meal being vegetables, and then a quarter carbs and a quarter protein. It would be those elements that are the most important aspects.”

5.1.2 Proportions

Proportions is referred here as the appropriate portion size or serving size of each food group, defined by the NZ Eating guidelines. The nutrition experts all agreed that appropriate proportions of the right food groups were important to a healthy meal. The correct proportion for the core food groups is half a plate of fruits and vegetables, a quarter carbohydrate and a quarter of protein.

“to me a healthy meal, is something that is made up of the right proportions of the right components.”

“we have a limit on these food groups not because they are bad, but because you don’t want to displace other things in the diet by having too much of a certain food.”

“I think ideally you would want to have the right proportions of the right macronutrients. So protein, carbohydrates, and healthier fats [...]”

One expert raises how appropriate proportions are often overlooked in the public’s definition of a healthy meal. They go on to explain how this is important to the moderation and balance of a meal, regardless of how healthy the meal may be.

“I think people have lost touch with right portion for them and what is the right proportion of food groups”.

Throughout the interviews, the experts referred to the macronutrients or core food groups that should typically make up a healthy meal. One expert raised the difference between serving size and portion size of food, that are often used interchangeably. This refers to the terminology used in the eating guidelines compared to the healthy plate model.

“Probably the big one for me is portion sizes. Yeah. What a portion size looks like and what that is in terms of serving size. Cause portion sizes and serving sizes are very different and people would use those terms interchangeably.”

“[...] unless you try and get someone to align their portion size with their serving size so that they can count the number of servings or have a better understanding of their servings.”

“Well I guess if you think about the plate model, its thinking about those three different sort of groups, you know you’ve got your vegetables and some fruit. You have got some protein foods and carbohydrates, so you’re going to be getting some key nutrients within that meal.”

5.1.3 Risk nutrients

The experts recognised three risk nutrients— saturated fat, sodium, and sugar and how this should be consumed in limited amounts. This links back to earlier remarks made of having the appropriate proportions of each food group in order to maintain these limits. One expert noted how these risk nutrients are often in highly processed foods, extra condiments/ sauces and other foods that are easily missed. These ingredients generally do not come to mind when assessing the healthiness of a meal.

“is it balanced from a macronutrient perspective, lower in sodium, lower in good fats [...]”

“Also those at risk nutrients, so you know limiting the saturated fat, limiting the sugar. For example, if its lunch, depending on how you are working out, but you would want to not contribute more than 1/3 of someone’s upper level of sodium or sugar.”

“watching added sugar, added fat, but again within reason[...]”

“I think the thing that gets missed out on that is that we have fats and oils, typically are included as part of meals and they are not displayed in that healthy plate model. And people don’t really know where they would go, so we need to consider things that might be added as condiments and that kind of thing.”

5.1.4 Positive emotion

Although the above focuses on components of a healthy meal, a few experts commented on the impact of having a positive relationship with food. The idea of a healthy meal and what this looks like will differ between individual preferences, cultures, financial status, and dietary lifestyles.

“It is quite dependent on the individual’s food preferences. You know whether they choose to eat meat or don’t eat meat, or choose a dairy alternative verses dairy.”

“I think a healthy diet is one that is generally something that makes people feel good in their body themselves, its not just about what the food is but where it has come from and how they are eating is as well.”

“[...]in saying that also linking in with whether it is appropriate and acceptable in terms of your life stage and culture and your source of income.”

The remarks outlined below, belong to one of the nutrition experts who believes in the importance of social and mental components to healthy eating, alongside its physiological benefits. This challenges the idea of what a healthy meal looks like and suggests that it should be more inclusive of different individual circumstances.

“I think the context as well, because for someone who has limited time or financial resources, a healthy meal for them might look different to someone who has more resources.”

“Healthy eating to me is balance and healthy eating takes into account both what is healthy for us physiology, but also takes into account how you feel mentally and then being able to honour your culture with the way you eat as well, if that’s important to you. I guess at the end of the day meeting all your required daily intakes, and in align with the NZ healthy guidelines, also taking into account the mental and social components.”

5.1.5 Variety

The above results show that a variety of foods from each food group is an underlying concept, important for meeting nutritional recommendations. All the experts recognise that including different foods have additional benefits beyond only meeting its core macronutrient value. The statements below explain how a healthy meal can look different to each other, while continuing to meet its nutritional requirements.

“Yes balance and variety. I guess optimising nutritional quality of diet [...]”

“when I think of healthy eating, I think it can change from day to day and meal to meal, but ideally it would be following the ministry of health Eating guidelines for your specific age group.”

Additionally, the quote below suggests how too much of one thing can have negative effects further reinforcing the importance of having a variety of the food groups.

“Have I got my portions right of things? Am I eating too much? Or am I not eating enough? Have I got a range of foods? Range of colour. Variety and the idea that too much of something even if its meant to be good, isn’t actually good.”

5.2 Perception of nutrition

This theme introduces topics related to personal experience and professional experience of the experts. It comments on both public and health professional perception, influences in society and common perceptions of what healthy eating looks like.

5.2.1 Public perception

When asked to reflect on their experience working with the public, the participants overwhelmingly identified that the public valued fruits and vegetables as a corner stone for healthy eating.

“The general public probably define healthy eating as eating fruits and vegetables, avoiding takeaways.”

“The public would define healthy eating as based on fruit and veggie count. Like that to me seems to be what people think about, they think healthy food, they think lots of fruits and vegetables and lots of colour.”

However, the public did not always understand the appropriate recommendations for the major food group how they could achieve them. They found that the public has a skewed mentality of healthy eating to one particular diet that is made of salads.

“But when I was doing the cooking programs people think of healthy as thinking of salads. That is like where their brain goes to and that is what they said.”

“Sometimes, the general public may not think that, think that they all have to be dry and rabbit food , you know that kind of perception of healthy maybe.”

“The public often think there is only one type of healthy diet you have to have.”

The public generally misinterpret the appropriate amounts of protein and carbohydrates for a healthy meal. Likewise, the growing the popularity of plant-based diets, has confused the public into believing supermarket meat alternatives are ‘healthier’, compared to animal meat. One of the experts has explained that is not the case, as supermarket meat alternatives are easily susceptible to poor nutritional quality as well.

"[...] umm should I be eating more protein and a lot of people who talk to me about cutting down carbs. A lot of people think that a healthy meal is a lot of protein and maybe some fruit or vegetables or whatever is hanging around on the side."

"As a generalisation in New Zealand, we tend to over prescribe protein in our diets, um and sort of under cater in the vegetable domain."

"Plant based is very much used by food companies to maybe the confusion of the consumers, to that plant based is healthy. And its not always necessarily healthy."

The public are also lacking education around the quantities required to match the micronutrients of animal meat with a plant-based diet.

"In terms of like the meat alternatives, so when you are choosing plant based ahead of animal products, is the amount of foods you need to eat. So in theory the amount of, like to get the same, say if you want to look at micronutrients, which we might consider in our minds or in our heads when we are talking to someone, as a dietitian. You're not going to put that out in a paper to a person cause that's complicated. But you know how much steak you need compared to the amount of silver beet."

5.2.2 *The perception of health professionals*

The participants offered a different insight into their perception of healthy eating and how this has changed since their training. In contrast to the public, the key differences include approaching nutrition from a holistic view and recognising there is room for flexibility in diets. The quotes below emphasise the idea that there is more than one way to maintain healthy eating. Unlike the public, this view eliminates the strong emotive connection to the concept of 'good' or 'bad' foods, but rather focuses on creating balanced meals, that include a variety of foods.

"We think more holistically about food and that there's no perfect meal and perfect day. It is about eating across the day and across the week and that so called bad foods, that the public might perceive as bad are actually fine to include as part of an overall balanced diet."

"I think less about nutrients and more about food as a dietitian and particularly when speaking to clients, in trying to get them to focus less on specific nutrients and trying to get them to think about food across the day or across the week."

"As dietitians we need to not just focus on one meal or one day, we need to think about holistically how people are consuming food in a week or month to meet their nutritional requirements"

"Yeah just different dietary patterns that can also achieve health. I think that's something that I have learnt through becoming a nutrition expert."

"I would say my mindset about what a healthy diet is a lot more flexible and it includes where that food has come, the food sovereignty as well as the actual food in its nutritional value. You know now we know that the

social context matters too, so there are many elements to a healthy diet and a relationship with food. Whereas before I probably thought there was a right way and wrong way but its not black and white.”

5.2.3 Awareness of the guidelines

One of the characteristics of the dietary guidelines mentioned in the interviews is how poorly the public are aware of the guidelines and what is advised in them. This can be separated into how they have been communicated/marketed to the public and how well this information has been translated. There is good agreement among the participants that the guidelines have not been marketed effectively to increase public reach, education and change the perception of nutrition.

“[...] you know the new guidelines came out, they’ve changed the number of portion sizes of fruits and vege and yet I have not seen a single piece of information out there, telling the public that this is changed.”

“I know the amount of work that has gone into it and for it to not be like disseminated in a user friendly way for the public, is really sad. Like really sad.”

“[...]also most people aren’t aware of the Ministry of Health guidelines.”

Likewise, there is room for improvement in the translation of the guidelines into practical examples. The interviews recognise that the Healthy Plate model is a good alternative resource for this, especially in a clinic situation. This is because it illustrates information in a pictorial format that is easy to understand.

“I think what we could improve on is actually how does an individual achieve that. You know they give the food groups according to age and gender, so actually giving examples of what that would look like in a day.”

“I mean they [EAG] are definitely relevant. Um.. I think what they would really benefit from, is some really useful infographics for the public.”

“I think designing something that can be read and understood by a wide range of levels of health literacy to get the same message.”

“I think that’s why you know in clinic we use the healthy plate model a lot because its sort of takes aspects of those guidelines. Doesn’t include all of the food groups but you know it presents the information in a way that the consumer can understand because they are thinking about one meal not across the day.”

“Like the healthy plate model whenever I show people that they are always like ‘ohhh’. Even for me, that is such a great visual tool and I think people learn and absorb information in different ways.”

5.2.4 Media influence

The media has proven to have a strong influence over the public's view of healthy eating and its emotive influence over the terms 'healthy versus unhealthy', according to the quotes below. The experts believe that the media has played a role in the over sensationalising of fad diets and introducing misguided ideas of what constitutes healthy and unhealthy.

"I think the media has more influence over the fad use. If you were to ask the general public how they define a healthy diet, they would probably say fruits and vegetables but they may also say for example it shouldn't have any red meat. That is kind of a fad at the moment with the climate change, there is sort of a feeling out there that it is bad for your health and you should never have it."

"[...]in terms of people think healthy is specifically paleo or keto or specific dietary restrictions, or gluten free, or dairy free."

"The general public probably thinks of a healthy meal as probably look at fat as a main thing, because there has been a lot of media around fat. Potentially for some groups- carbohydrates because of all the social media side of things in terms of low carb, keto and that sort of thing."

5.2.5 Element of restriction

This sub theme comments on an ideology that majority of the participants recognised in their semi-structured interview, were true of the public's perception of nutrition. The public often relates healthy eating with some form of a restrictive diet that is challenging and/or has highly specific requirements to adhere to.

"[...]there is a bit of a trend now that health has to be some sort of radical weird restrictive something."

"Certain specific restrictive type questions like 'can I eat this, can I eat that, is this particular thing good for me or bad for me, are there certain foods that are super foods that I should be including into my diet' so very specific about a particular food. Or 'should I be eating gluten, what is gluten doing for me', all those type of things, like very specific type of questions. Not more broadly looking at a diet."

One expert explains that this element of restriction has created a false impression that healthy eating is not achievable for everyone in their everyday lives, adding to the misguided perception of nutrition.

"The general public view healthy eating as a strict diet and sometimes perceived as something that is unattainable."

“You know there’s keto, there’s paleo, there is all of these things... gluten free, dairy free. And I think some people will place those specific dietary restrictions or dietary patterns as healthy, but they may not actually be meeting the food groups that the Ministry of Health recommends or our RDIs.”

Another expert also recognised the growing popularity of plant-based diets and how this has affected the public’s perception of nutrition. As seen below, the element of restriction here is the debate between animal protein sources versus plant-based protein sources. This continues to be a topic of interest that has shifted the view on nutrition, because of medical conditions, ethical stances, or as previously discussed the influence of the media.

“[...]questions around quantities of protein. What constitutes a good protein source? You know red meat or dairy versus plant based options. That is a big one at the moment.”

“We often get questions about specific food trends, I get a lot of questions red meat and whether it is healthy or not.”

5.3 Healthy eating guidelines

The following sections elaborate on the main theme of the NZ dietary guidelines. and how the nutrition experts feel about the relevance and feasibility of them for everyday nutrition. At this stage of the present study, the researchers are contemplating moving away from the NZ Food and Drink Policy and more closely aligning with the healthy eating guidelines. Therefore, comments made by the nutrition experts reveal if this is an effective strategy for the scoring tool, by discussing the strengths and limitations of the guidelines. Other resources such as the Healthy Plate model were also discussed in the interviews.

5.3.1 Evidence based

Among all the experts, there is consensus agreement that the dietary guidelines provide a summary of up to date and reliable knowledge regarding nutrition and health. This is because they are based on a wealth of research from current literature findings. This makes the information from the guidelines relevant to the understanding of what makes up a healthy meal.

“I mean this is the most up to date summary of the literature in terms of what is a healthful dietary pattern that we have. I mean we are lucky in that it was recently updated.”

“I think the guidelines are really well researched and succinct in terms of looking at the current evidence.”

“They are probably relevant in the fact that they are underpinned by a lot of research and evidence in terms of what people need to eat to meet their macronutrients and micronutrient requirements.”

The quotes below reveal an interesting interpretation of the dietary guidelines where it is seen as an objective measure or a 'gold standard' for New Zealanders to aim for with their nutrition goals. This is confirmed by one of the participants who linked the fundamental principle of dietetic advice to the dietary guidelines.

"It is very relevant because we are practicing in NZ and that is the best evidence, we have for us. I guess it's like the gold standard, it's definitely good to have something as the objective, a gold standard to work towards."

"I guess the whole point of the it [dietary guidelines] is that all of it is important because if you miss one thing then it's not a balanced meal."

5.3.2 Context of dietary guidelines

Throughout the interviews, the participants discussed the serving size, feasibility, and misinterpretation of the dietary guidelines. This is grouped under the same sub theme. Although the guidelines include a thorough summary of the serving sizes, the recent changes in the recommendations, have made it challenging to achieve and do not reflect a practical diet for New Zealanders. This is particularly true regarding the serves of breads & cereals, fruit, and vegetables, as outlined below.

"I mean if you compare our guidelines to other guidelines in the world, we have really good information around what is a serve, how many servings of each group we need."

"If you could focus on wholegrain types then even better, so I get it, six servings of bread... I mean there is probably better options. But there is nothing wrong with that recommendation of six serves."

"Even though the fruit is only two servings they have increased the amount of each serve which makes it harder to achieve."

Even with the changes in serving sizes, I still feel the grains section is higher than most, for a lot of people who are just doing their thing, they are a standard, within a healthy weight range, they appear based on recall, to be getting enough of everything.

"I think we always think about the diet as a whole and think are there some key areas over or below the recommendations. I think it's definitely more challenging now that they have increased the servings of vegetables."

Feasibility is a recurring motif throughout the interviews and refers to how easily the guidelines can be achieved. Most experts do not believe the guidelines reflect what New Zealanders are having today and instead represent an 'ideal' dietary pattern.

"I mean the thing is we know that the literature shows us that we should be having up to ten servings of vegetables a day but we cant as a population cant even achieve three serves, which is why it was originally set at three."

"The general public are not getting even five serves of vegetables per day, the research is very clear. No one can question the quality of that advice, but very few people are doing that."

In this context, the participants believe other factors limit the ability of an individual to achieve these guidelines. This includes poor time management, lack of food preparation knowledge and the different lifestyles of people today.

"I think that its just a time management and potential lack of food preparation knowledge now. People's lives are just on the run, so I think the ability to incorporate vegetables into the everyday diet is becoming harder."

"[...] even if you use the plate as your guideline, how do you use that for different cultures? And mixed meals, it worked really well for the person we had because they were a meat 3 vege type person. But most people, I think a lot of people don't eat like that, its changed."

Although the information provides quality advice around nutrition, the guidelines lack practical information on how the public can achieve them. This view is further clarified in the following quote that suggests the guidelines are more useful for health professionals to refer to in their assessment and counselling. The guidelines act as a backbone for nutrition advice that is adjusted and catered towards the situation or lifestyle of the individual.

"you know you can take the guidelines and apply them and you could create some healthy meals across the day easily. But that's coming from a health professional's perspective. That's not coming from the public perspective."

"[...]But bearing in mind there are situations where it might be difficult for someone to kind of maintain perfect eating throughout the day. I would recommend it, but it would also need to be potentially tweaked depending on somebody's life stage."

Two participants referenced how easily the information provided in the dietary guidelines can be misinterpreted by the public. This is especially relevant in their understanding of carbohydrates and protein food groups. People do not understand what a serving size looks like.

"Generically we would say people need six servings of breads and cereals but people would say would that is such a lot of breads and cereals, that is too much. Whereas it is actually not that many when you break it down to the number of serves."

"So I would say the macronutrients... you know the protein and carbohydrate groupings are the ones at the most risk of misinterpretation."

“Making people understand what a serving is, getting people to understand what five servings of vegetable a day would look like. People love examples, even though the internet is out there and you can google it, people just don’t. They like to be told.”

The evidence below emphasises how the guidelines are a useful tool, but perhaps better interpreted by health professionals, or those with some level of nutrition literacy. The experts indicate here that they are a good backbone for the development of further resources. These resources could translate the dietary guidelines into a more practical, simplified format, that limits the risk of misinterpretation.

“I don’t know if there is necessarily anything you know big picture wrong with the guidelines but perhaps people’s interpretation of the guidelines might be quite confused.”

“So I think there is a lot of confusion around the guidelines, but I think as a tool, they are good. But as a practical tool they are maybe not so good.”

5.3.3 Current limitations

While discussing the available resources for defining healthy eating, the experts recognised current limitations of both the Eating guidelines and the Healthy Plate model. One main concern raised was the lack of cultural representation provided in these resources. Other limitations include considering different lifestyles, budgets, and sustainability.

“I think the dietary guidelines do not take into account different cultures, potentially going forward it would be nice to bring a little bit more into the guidelines in terms of sustainability, culture, and what those food norms might be as opposed to typical western way of eating.”

“I feel like I can’t comment on the content of them, but maybe the healthy plate model should take into consideration making it more culturally appropriate.”

“Maybe having different visual of the healthy plate and what it would look like for different cultures.”

“[...]And then also maybe some tips of how to meet those dietary guidelines on an extreme budget.”

One of the limitations below, describes how the Healthy Plate model does not acknowledge additional condiments that can affect the nutritional quality of a meal. Likewise, the way a food is prepared can have the same effect on the relative healthiness of a meal.

“[...]Are there adding the things that is not considered when you do a plate model, are they adding sauces? Are you adding mayonnaise which is a high fat? Or if somebody is assessing their sodium intake and they throw lots of tomato sauce on. Or if someone is watching from a carbohydrate perspective and throw lots of sweet chilli sauce. You know a thumb size or tablespoon, or sweet chilli is the same amount of carb as a

piece of bread. Something like a lunch meal it would depend on how its cooked, what you are doing. Different meals.. the hard thing with the plate model is something like dumplings, what do most people perceive the dumpling dough, where would they put that. Cause when most people think of carbohydrate, they probably don't think of that."

5.3.4 Health inequities

The inequities in health are described as differences in health status caused by social, economic and differences in resource allocation. This is relevant to the dietary guidelines as mentioned below because people may not be able to access foods or preparation methods to make healthier choices. These guidelines provide a blanket approach to healthy eating, but one expert argues this is ineffective for all individuals, without the proper education behind it and structural systems in place to support the guidelines. The guidelines should offer more flexible 'healthy' eating patterns for those who cannot access the types of foods currently being recommended.

"I guess its [EAG] educating people as to what they should be eating, but also creating an environment that allows people to access healthy foods easily."

"I know for a lot of people they might not be able to access that or feed their families through buying specific ingredients or knowing where to source them. So they might end up going to a takeaway store at the end of the day and buy a huge amounts of food. Its not only the education, but its creating a healthy environment[...]"

The feedback from the experts show that a client centred approach is one of the ways that experts can address different individual lifestyles. For example, in a clinic situation, the nutrition experts use the recommendations to tailor their advice and find reasonable solutions to the needs of the specific individual. This reinforces the idea of the EAG acting as a 'gold standard' or backbone for healthy eating.

"we follow the guidelines very closely when we are teaching but keeping in mind what is realistic, what is your budget like, how do we make healthy eating affordable and convenient for you."

"But I probably wont be meeting those dietary guidelines, like it would be over a course of consults that you would be trying to meet the guidelines. Because you want to be working on where the patient is at."

5.4 Proposed meal scoring tool

During the interviews, the experts were asked to comment on the strengths and limitations of the proposed meal scoring tool. Discussions around its practicality, target audience and its potential are important at this stage of the study, to infer the next designs of the HMST. Providing education, increasing the value of dietitians, increasing autonomy of health, future opportunities and any limitations are discussed below.

5.4.1 Provides education

The nutrition experts recognised that the proposed meal scoring tool can provide education around the different levels of healthy eating. It can act as a simplified educational resource that clearly illustrates the healthiness of meals. The first two experts noted the value of the proposed scoring tool for health professionals, who can use this as a resource to reinforce their nutrition advice.

"I am just thinking about a practitioner who is out there working with clients, or in private practice or a sports dietitian. You may only get a couple of meals here and there, so having something to show the scoring and educate your client on that, it is really useful."

"I think definitely for health professionals in terms of an educational resource, so when working with groups."

"Someone who has no idea of, or has never thought of their own diet until perhaps they have been diagnosed with a chronic disease or a new mom and is suddenly looking to eat healthier."

"I think its good, some objective thing would be helpful. Sometimes we want the hard answers because nutrition can be really confusing so its reassuring when there is something a bit more.. like draws a line in the sand and makes it a bit more easier."

5.4.2 Increasing the value of dietitians

The value of dietitians and their involvement were considered crucial in administering the proposed scoring tool with food service retailers, other staff, and individuals. Among the interviews, there is an overwhelming advocacy for nutrition experts to help educate and support the target audience in determining the healthiness of meals.

"I think with this kind of thing, its quite challenging to be able to determine which kind of foods would be green, amber or red. So often it is the support of a nutritionist or dietitian to kind of even get places started."

"The retailers themselves didn't determine it, they did need some help from dietitians and nutritionists to determine what was going to be the healthy option. So I guess in that situation, this tool could be great for community dietitians or public health nutritionists to use it to support food retailers."

"I think what would be good about having a dietitian involved with it is that they could then take the tool and make it come to life in terms of that person's family and their background."

One of the participants used an example of an earlier experience to demonstrate how food retailers did not have the knowledge or time to rate the healthiness of their menu items by themselves.

"The staff didn't necessarily have the knowledge or the time to go through and determine what was meeting each one. So its kind of two things, knowledge and time. So I don't think you could negate the reason for a dietitian or nutritionist to be involved. I think if you wanted it to be effective, it would be good for retailers to

have that kind of support rather than just going for it and thinking everything in this cabinet is green when it actually might not be.”

One expert raised the concern that the scoring tool may take over the responsibility of a dietitian rather than advocate for their value.

“Although at the same time we want to show the value of dietitians and advocate for dietitians in these roles. So we don’t necessarily want a tool to take over where it would be really beneficial if they actually just paid for a dietitian in that role. So that’s a really tricky one, because we know having a dietitian there would be better, but you know not all kindergartens can afford a dietitian.”

However, the quote below challenged this idea by suggesting how the scoring tool can be used by dietitians to teach and train others in the food industry. Combined with the earlier comments, the scoring tool would increase dietitian value rather than replacing them, through an alternative resource that can provide nutrition support.

“[...]Yeah but in saying that there is never enough dietitians or registered nutritionists. So in having something that can be used as a train the trainer type tool. So you could get a collection of people together and they could take that information back to their specific food premises.”

5.4.3 *Autonomy of health*

This sub theme refers to how the proposed scoring tool can help empower individuals or businesses to take up responsibility for their own nutrition and wellbeing. In addition, the following quotes describe potential target audiences for the scoring tool such as food service outlets, restaurants, food companies and individuals to self-monitor the healthiness of their meals.

“it empowers them to make that choice. In terms of individuals themselves, people who are wanting to takeaway or buying lunch, people who know about the healthy scoring tool they can think ‘what could I make myself for lunch or what could I buy?’”

“I think it could be useful for people who want to take ownership of where they are going and need some support in understanding quite easily what and how they are doing things.”

“Outside of a clinic situation I think it could be really useful for cafes or restaurants to be thinking about their menus, so thinking like the wider environment that we are working with.”

“I think in a food service, café situation it could be really good for people to identify healthier options on the menu. I used to do lots of work out in Glen Innes and we had a Healthy Kai programme and food got scored bronZ e, silver and gold or there was some kind of rating used.”

“Realising that profit is obviously important but how can we sort of increase green foods and reduce red foods. If there was some way that companies could score their own foods, it would help to just drive them towards some change.”

5.4.4 Limitations

The following quotes discuss potential limitations for the proposed meal scoring tool. The experts identified that depending on the level of complexity, the tool the tool should not be managed by the public or without proper training. It should be used by someone with background nutrition knowledge.

“If the person scoring the tool has a background knowledge and working understanding of nutrition then you should be able to, those are things to consider.”

“The challenge in finding a tool to give the general public for how can you decide that a meal is healthy, is how do you make that sexy? How do you make that appealing? You know like what’s the why behind, why is it important that I do it?”

“If you give a complex tool to the public, it will be misused. So with the right education it would be great for the public to use it themselves, but you can’t expect people to pick it up and use it without really knowing how to use it appropriately.”

“Its people’s interpretation of some of these areas as well. I think like if we look here it says includes grain foods, well people don’t really know what grain foods are. I think there needs to be a little bit of understanding as to well you know understanding what these foods groups actually entail.”

One of the experts also highlighted how the scoring tool would need to be altered or specified according to the age group that it was dealing with. This is because the nutrition requirements across life stages will vary, particularly for young people.

“I would say.. it’s a little different if you are say under two years, but say from two years onwards, you can look at the same types of food in the same proportions but it just might need to be higher energy. And then for children who are five and above, may have higher energy requirements but they still need the same proportions of protein, carbohydrates and so on. Then going into teenage and adulthood, they can also kind of meet the dietary guidelines, if that makes sense. So for children if you had the lunch scoring tool, it might be need to be different to an early childhood education setting because you wouldn’t want them to be having a lot of very high fibre foods, you would still want them to have quite energy dense foods, which would be quite different to say maybe a sixteen or seventeen year old, who could have predominantly fruit and vegetables ideally but maybe lower proportions of protein.”

5.4.5 Future opportunities

In the context of the proposed scoring tool, the experts recognised opportunities for the future, where the characteristics of the scoring tool may be useful. The interviews uncovered how the scoring tool can develop beyond its current state into different life stages, turn into a virtual meal scoring app, and change the process of nutrition data analysis in future research.

“I think particularly it would be a really nice way of auditing meals.”

“I think a meal scoring tool is helpful for research purposes to track things, changes over time and yeah just makes data easier to read. I guess there would be a written/more descriptive component to it [...]”

“Definitely and I guess you know with the lunch scoring tool, depending on how you are thinking of using it, but for adults it would be following the right proportions and for younger children, it could be always tweaked to align with the healthy eating guidelines for young children.”

“Even the easy diet diary, its painful to fill in and so you know we do have images and all the rest of it, but it is still a burden. I would say if you develop this tool, moving forward, I would try to somehow factor in someone can take a photo. If you could somehow take a photo and use the tool, then that is a game changer. “

“You know I don’t know where you are going with this in the future, but you have a scoring tool but if it was something that was an electronic scoring tool, if it was on a app or something, where you could enter in your data and it gave you some sort of prompts and asked you about this and this.”

6 Content Validity Index – part one

In the first part of this research, the initially pooled items assessed a mix of nine key terms from the National Food and Drink policy and the Eating guidelines. These terms were used to create the first drafts of the HMST. The quantification of content validity (I-CVI) is described in the form of three domains: relevance, clarity and essentiality and are listed in **Table 3**.

Table 3: The content validity index of each listed item(I-CVI) by 7 nutrition experts. A I-CVI above 0.79= the item is remains, I-CVI between 0.70 – 0.79: the item needs revision, I-CVI below 0.70: the item is eliminated.

	Relevance I-CVI	Clarity I-CVI	Essentiality I-CVI
Saturated fat	0.86	0.71	0.86
Energy/Caloric content	1.00	0.71	0.86
Added sugar	0.86	0.71	0.71

Salt content	0.71	0.71	0.71
Number of fruits and vegetables	1.00	0.71	1.00
Grain foods	1.00	0.29	1.00
Includes processed foods	0.71	0.57	0.71
Milk/Milk products	0.86	0.71	0.71
Includes legumes	1.00	0.71	0.86

When the experts were asked to rate the clarity of the listed items, in relation to defining a healthy meal, the results suggested that all items needed revision with a I-CVI between 0.70 – 0.79. Two of the nine items – ‘grain foods’ (I-CVI = 0.29) and ‘includes processed foods’ (I-CVI = 0.57), scored poorly and was eliminated from the next revisions of the scoring tool.

While assessing the relevance of each item, the results showed high agreement in all seven of the listed items with a I-CVI > 0.79, while ‘salt content’ and ‘included processed foods’ have a I-CVI of 0.70, requiring some revision. For essentiality, the experts rated five of the nine items a I-CVI > 0.79, while the remaining four items with a I-CVI > 0.70, needed modifications. The results show that the term ‘grain foods’ was the least clear in this instrument. Both the relevance and essentiality scores indicated that it lacked an adequate description, but it ultimately is important to definition of a healthy meal. For this reason, this term was not eliminated but modified in the latter HMST version.

According to the CVR calculations (**Table 4**), all items in the instrument have a positive CVR value with at least half the experts in agreement. However, only two of the nine items appear significant in comparison to the CVR critical value of 0.99, as suggested by Lawshe’s table. Three remaining items were close to achieving the critical value with a CVR of 0.71, therefore were reviewed and improved in the next design of the HMST.

Table 4: Summary table of content validity ratio (CVR) values per item calculated using Lawshe’s equation to show level of agreement between participants. Values can range from -1 (perfect disagreement) to +1 (perfect agreement).

	CVR
Saturated fat	0.71
Energy/Caloric content	0.71
Added sugar	0.43
Salt content	0.43
Number of fruits and vegetables	1.00

Grain foods	1.00
Includes processed foods	0.43
Milk/Milk products	0.43
Includes legumes	0.71

The S-CVI values obtained for relevance and essentiality is above the recommended 0.8 value. However, S-CVI calculated for clarity of 0.65 is well below the recommended value and reinforces the lack of clarity among the items in the instrument.

7 Tool development – Phase I

From the semi-structured interviews, key criteria items are made clear when determining the relative healthiness of a meal. This included understanding proportions of food groups or serving sizes and recognising how discretionary food items can alter the quality of a meal. This led to the first two drafts of the meal scoring tool (Appendix I: First revisions of the HMST). The first phase in the scoring tool development moves away from the National Food and Drink policy and reflects the Healthy eating guidelines because all the experts agreed that these guidelines were robust, accurate and critically consider aspects of a healthy diet. A key aspect of the guidelines is an appreciation for the major food groups: Carbohydrate, Protein, Fruits, and vegetables. The healthy plate model encompasses the same food groups with emphasis on the appropriate proportions for a meal. Draft one of the HMST, considers this by giving a different rating score to the different proportions of food groups on a plate (**Figure 6**). The serving size guide is taken from the Healthy eating guidelines. This revised HMST also encompass the recommendations for saturated fat, sugar and sodium as per the Healthy Eating guidelines. Ideal ranges of these nutrients are categorised into rating 3, while less ideal and unhealthy ranges will fall into 2 and 1.

Core food groups					
Vegetables		Carbohydrate		Protein	
Portion	Rating	Portion	Rating	Portion	Rating
½ plate (2+ servings)	3	¼ plate (2 serves)	3	¼ plate (1 serve)	3
1/3 plate (1-2 serves)	2	1/3 plate (3-4 serves)	2	1/3 plate (2-3 serves)	2
¼ plate (Less than 1 serve)	1	½ plate (5+ serves)	1	½ plate (3+ serves)	1
Not on plate	0	Not on plate	0	Not on plate	0

Figure 6: HMST draft 1 showing the breakdown of portion sizes of each food group and its relevant rating score descriptions.

An observed difference between the two drafts is in the way the rating system is set up. Draft one separates portion sizes and nutrient intake into two tables and the sum of both ratings gives the overall score for the meal. In contrast, draft two categorises all descriptions under one rating, giving a final score between 1 and 3. The layout of both drafts are dictated by the audience it is intended for. For example, draft one is useful for research purposes or for health professionals to measure portion sizes and nutrient intake separately. In comparison, draft two is easier to follow for audiences with a limited food and nutrition background. The term ‘grain foods’ was not included in this revision but was considered in the serving size guide under breads and cereals.

8 Results: Focus group

Unlike the interview findings, the main themes and sub themes identified from these discussions are specific to the meal scoring tool drafts. The participants were asked to critique the proposed scoring tool and identify its strengths and weaknesses at face value. The comments are categorised into the following two main themes:

1. Ease of use
2. Appropriate categorisation

8.1 Ease of use

A major factor in the success of the HMST, is how well the target audience could follow the scoring process and whether the context was easily understood with limited confusion. Five sub themes are identified from the focus group transcript – User friendliness, realistic examples, target audience, and understanding its context.

8.1.1 User friendly

The experts recognised the new revision of the HMST is far more specific, compared to the earlier version, with easy to quantify capabilities of each food group.

“You’ve obviously made it a lot more specific. And that you’ve got your sort of, you know your half plates of vegetables and quarter plate so it would be easier to quantify.”

The user friendliness of the HMST was also defined by the distinction and clarity of the three rating categories. This is important to consider in the scoring tool, for the target audience to accurately select the right score for their meal.

“are people going to read it. I think it’s got to be foods, you know all of our research sort of for stuff that’s user friendly for the public it’s foods which we want to talk about not nutrients so.”

“because I think the main thing would be whether those three categories are defined or different enough to allow someone to look at it and then be able to rate it if I’m sort of on the right track.”

To improve the ease of use in the HMST, one of the experts suggested creating an introduction or manual of some sort that would demonstrate the scoring process through a provided example.

“Like a training package, because I think if we think of like you know SGA, which is obviously completely different, but it’s the same thing.. when we were you know learning how to do. you know muscle wasting. We have like a couple of examples or pictures to say, this is a three, this is a two, this is a one. Just to give you a bit of a guide as to where to start, because I think that will probably increase the users”

During the discussion, the experts reflected on the usefulness of these examples in the SGA, as a guideline for health professionals, while conducting their own assessment. Due to the subjectivity of the SGA, these examples are important to increase accuracy and reduce errors in the scoring process. Likewise, the HMST has a similar level of subjectivity into ones understanding of each rating and relative healthiness. Therefore, the experts recognise that having a manual that describes the scoring process is important here.

8.1.2 Understanding context

There was consensus among the experts that providing an explanation for the purpose of the HMST and who is expected to use the tool is important in its overall ease of use. This is lacking in the current drafts and is needed to provide the user with a background context of what they are hoping to achieve with the scoring tool and if they are well equipped to administer it.

“Some context around that like is it going to be like a blurb at the beginning, explaining it or is it you know, like just having the tool it needs some context I don't know, for me it would I would need some kind of introduction to it, what it's meant to be like to answer all those questions that enters just asked.”

“[...]if you don't give context around actually why it's a lot going to be a lot more usable and applicable in a quick understanding other tools yeah like yeah what why have you done this by yeah. You can have some text around why this was needed.”

The quote below notes that the clarity of the serving sizes is even more so important now for both the public and nutrition experts, given the recent changes to the MOH serving size guidelines.

“It's just making sure the understanding of the different aspects is pulled out, in terms of... I mean you've given examples in terms of like what servings are. So it's I guess it would just be some checking back and making sure they understood what a serve was. I think the same would apply for nutritionist experts as well, especially in light of the revised serving sizes.”

8.1.3 Target audience

There was consensus among the experts that the target audience needed to be defined clearly to tailor the HMST according to the chosen group. This is important as it would determine how easily the tool can be used by the selected audience.

“Do we really think a consumer..yeah is that going to be meaningful. But if it's for research, for a specific project, then it might you know, then sure. You know that's what I am missing is the context, how you want to use it, because it changes it completely.”

“I'm still a bit confused as to what like setting this is used in so like you've said that the target audience for in terms of people who are using the tool but is it like for like schools or like, what are the sort of the people who are eating off these plates.”

“[...]that's why like identifying what context it should be used in that's what will really help you decide which way to go with it.”

At the start of the discussion, the researcher stated the HMST could be used by the public to self-monitor diet or professionals with a nutrition background to aid in their research, audits or for training purposes. The quotes demonstrate raised concerns regarding this.

“I think it would be quite useful in in different in a research context where you are going in and looking at a plate of food to have a validated tool to do that.”

“You need to test it with the people that you want to use any see if it actually is valid yeah. Because you almost see it based on the level of knowledge yeah to interpret the tool.”

“Yeah the only barrier, I see is that lack of understanding about the context in which it can apply, that we've discussed that already so.”

It was suggested how the tool should be used by health professionals such as dietitians, because it was not simple enough for the public. They felt that the public could easily misinterpret this tool if not given proper training and would find the rating process time consuming without having any prior understanding of food and nutrition. There was a high level of agreement that the features of the HMST can be easily interpreted by dietitians, who would find the scoring process quick and easy, because it is similar to other tools available, such as the Ready Reckoner.

“Well if people don't know what carbohydrates or have a maybe an accurate view of what some of the different nutrients mean.”

“yeah you would need some nutrition knowledge to make sense of this in someone who knows food well to make sense of it. You know potentially someone who's quite good at estimating and amounts and things like that, so that becomes quite specific.”

“yeah so it just you know dietitians because we've like we were talking about before the knowledge that we've got right, so we know what a carbohydrate as we probably should know what a serve is. You know so that's going to be much quicker or easy for us to use a tool like this was the general population that really what Julie say saying before.”

“So I guess that's where if you've got a tool and you want to be like this is how you score something you need to give someone a number really to determine, especially with food, where we have a food label nutrient information, where you can make that differential or your practitioner has enough knowledge of what those are and the prior knowledge from I guess an internal ready reckoner to be able to determine.”

8.1.4 Set of examples

The HMST uses a set of examples of food choices and preparation methods under each rating of 1,2 or 3. The experts commented on how realistic these examples are in terms of everyday foods, for the tool to be effective in categorising a meal. The ability to define a meal using these examples would dictate how easily the end user can administer the HMST. To achieve this, the experts suggested using realistic menu items or meals and trying to make sense of it within the context of the scoring process.

“As I have said I always feel like you need to think about some meals, that would fall into these categories and see if the tool that you have set up now would meet that. ”So you got to think about what foods actually

fit into these categories that you're putting up as well and how you differentiate between them and how people know the difference.”

“just do those like sort of practical examples and then going through and using the model yourself in the way that you've suggested to test it.”

To overcome this limitation, the tool could include a few example meals in the introduction or appendix to show how a meal is scored using the HMST. This will be helpful for the end user to use as a guideline or manual to score their own meals.

“[...]kind of wondering or example meals or you know when you have the tool and attaching sort of a kind of a worst case scenario, but a mixed meal or something to say, for example, this is a bowl of mixed, this is a soup, this is a sandwich and we break it down to kind of it's because I think it was it was it was either mentioned, maybe you know just in terms of when you look at really mixed up meal trying to just as a way of kind of giving somebody a couple of examples before they get started.”

“Because you need to consider your end users, still a product that you're creating and like consider the end user, for that would they find it helpful as that and they said they see is needed because, even though it might not be there, they might not be that need for it.”

8.2 Categorisation

Categorisation is a theme identified from the focus group discussions that encompasses the comments from the experts regarding the components of the HMST, how clear it is and the accuracy of the serving sizes. The sub themes below consider how well the HMST has defined the three rating categories (healthy to least healthy).

8.2.1 Components

Components is defined as the different sections of the HMST that make up the categories of rating 3,2 and 1. During the focus group, it was brought to attention that the terms ‘processed foods’ vs ‘unprocessed foods’ were confusing and does not accurately reflect healthy or unhealthy eating. It was recognised that certain processed foods such as breakfast cereals, are still considered healthy and should not warrant a lower score.

“I think it's great to have information on process and level of processing but there might need to just be a little bit of thought given us too, because sometimes you know you can have a healthy processed food or healthier processed food, but that kind of blur the lines of differentiating a bit so that might just cause a little bit of what are they called an inter rater issues and someone yeah.”

“Yeah that level of processing, I mean like person can just be cutting something. Like that term processing is real broad. I mean, and that you know we're trying to if you wanted to make this an accessible tool, we tend

to tell families that may not have access to fresh fruits and veggies to buy frozen because they are just as good.”

It is clear from the discussions that most of the confusion arose from the descriptions under rating two. The quotes below show how the experts understand that this category is aimed to bridge the gap between most healthy and least healthy and may be susceptible to creating a grey area if not clearly defined. The experts identified the difficulty in categorising mixed meals and is a current limitation of the instrument. For this reason, one of the quotes below outlines how the description of foods and food preparation methods is more useful than giving specific foods a rating score without any understanding of how they have been prepared.

“Because I think that whole, that whole section under rating two, where you’ve stated foods that have undergone some processing and examples that really needs quite a considerable look at because a lot of there a lot of those foods are actually ones that practically most of us would include as absolutely fine as long as they meet your criteria that you’ve defined the sodium maybe you need a criteria for sugar potentially as well.”

“I was interested that instant noodle are in the two. And I said there’s some stuff that we will have different perspectives and these potentially some that are better than others so that’s you know, this is what so tricky about a description of foods. It can look really different depending on how its prepared.”

“Even the burger from Kristen’s example you know homemade burger versus McDonald’s versus a takeaway burger sometimes could have different ratings depending on where they’ve been made and what they’ve done so yeah as I guess it’s trying to think about how you would describe a meal, rather than just rating pizza as a bad meal.”

One expert below suggests using the Health Star rating of packaged foods to help distinguish what rating it would fall under and its relative healthiness in the HMST.

“You may be able to use something like the health star rating to help you with some of this stuff. It’s not going to say whether it’s processed or not, but you may be able to use it to make some assessment of quality of choices right uh you might want to add to this.”

8.2.2 Clarity

In comparison to the earlier version of the HMST, the experts responded positively to the improved format of the revised HMST. In particular, the quotes below comment on the succinctness, overall layout and the use of specific examples in each category.

“yeah, I think how you’ve done them and the revised format makes it it’s a lot more clear than what it was, and it first group I think you’ve defined things like, you’ve defined quite nicely the sodium content and what

the difference between that means. You've given examples of what half a plate constitutes and a quarter of a plate etc throughout."

"I like the succinctness of it like I would definitely like yeah try keep it to like two pages, if you can. That makes it easy to use, so I do like that aspect, and I like how it is, I, like the colours I like. To read and let the important parts of bolded, like sort of making it easy to use. That is a really good aspect of it yeah."

In relation to comments made above, the clarity of each definition under rating 3,2 and 1 is important in a scoring tool. This is because each category should clearly define its relative healthiness to accurately allocate a meal to its score.

"[...] But you've maybe got the same amount of vegetables is rating number two so you need to have a clear differentiation between what is two and what is one so that one's pretty awful, twos okay, and threes good. Otherwise, you're going to get heaps of kind of middle ground."

"You might get a really healthy meal that fits mostly into rating three but has just one or two small process elements, like a little bit of salt, a little bit of say tomato sauce and then with that push it into the rating two."

"I just think they just be clarification around certain around the wording, like unprocessed breakfast cereals and what does it mean."

8.2.3 Serving size guide

Both drafts of the HMST presented to the experts, included proportions of each food group. The proportions are defined by a serving size guide, taken from the MOH serving size guidelines. The quote below shows that the experts liked the inclusion of serving sizes for each food group in draft one of the HMST. However, they suggested modifications that made the guide practical to the user. For example, only including the weight of cooked meat and legumes as opposed to the raw weight, because it is more realistic for the HMST to assess cooked food by the end user as opposed to the meal before it is made up.

"It's really nice to have actually specified what the serving sizes are for each of the food groups because I think the first one, you just talked about plenty of fruit and vegetables, I think it was, whereas this is going to be, you can actually easily quantify kind of how many vegetables."

"You've also talked about cooked fish but then you've talked about raw chicken and raw meat, you know, like like so you've got 100 grams cooked fish. You haven't given a raw weight, but then you've given a cooked weight for chicken and a cooked weight for ready meals and a real weight, so do you need both."

One expert mentioned that the difference between cooked and raw is important for the vegetable food group, as the weight can vary according to how it is made up in a meal. It is also realistic to expect both types of vegetables

in a meal.

“In terms of you know sort of which is half a plate or two servings of vegetables that might you know salad vegetables could be quite different to sort of a kind of more condensed form so might be worth it if you decided to keep it sort of specifying. The size of sort of bringing in the cooked vegetables versus the raw vegetables just that you know you might only have about a cup of vegetables on half a plate of salad. If it was all cooked vegetables, you could end up probably I would imagine having you know up to three servings of starchy vege.”

“I just think you might want to think about that really in a practical sense if you’re going to make a meal for yourself and you put half a plate of vegetables or not, whether it be salad vegetables or cooked vegetables. You know... how many serves is that because I feel like it would be more than two.”

9 Content Validity Index – part two

When the experts were asked to re-score the content validity of the revised HMST using the scoring assessment form, the data showed a significant improvement from previous results in all domains of relevance, clarity, and essentiality. There was far more agreement (in the form of rating 3 or 4) between participants indicated by a higher I-CVI for all listed items in **Table 5** below. Table 5 includes a different list of items compared to the previous assessment form. This is because they now reflect the concepts and items introduced in the revised version of the HMST.

Table 5: The content validity index of each listed item(I-CVI) by 8 nutrition experts. A I-CVI above 0.79: the item remains in the instrument, I-CVI between 0.70 – 0.79: the item needs revision, I-CVI below 0.70: the item is eliminated.

	Relevance I-CVI	Clarity I-CVI	Essentiality I-CVI
Introductory blurb	1.00	0.88	1.00
Flowchart instructions	1.00	0.88	0.88
Core food groups	1.00	1.00	1.00
Proportions of food groups	1.00	1.00	1.00
Serving size guide	1.00	1.00	1.00
Food & Drink rating guide	1.00	0.88	0.88
Definitions of scoring range	1.00	0.75	1.00
Examples	0.88	0.63	0.88

The data presents a more promising outlook on the relevance and essentiality of all the items presented in the HMST. All items in the instrument scored an I-CVI higher than 0.79 and does not need further improvement. In the domain for clarity, the I-CVI has hugely improved from the previous content validity assessment, however there are a few items that require modification, shown by slightly lower I-CVI scores. With a score of 0.75, the nutrition

experts have indicated that the definitions of the scoring ranges need revision. Table 3 shows that the examples provided in the HMST lacked clarity with a I-CVI of 0.63. This is explained by the additional comments written in the assessment form. The experts felt that more examples showing a wider range of meals and scoring would help ease any confusions and help to maintain consistency in the scoring process.

When CVR calculations were repeated in **Table 6**, the new list of items received a positive CVR value, with all 8 of the items scoring a significant value at or above the CVR_{critical} of 0.75, retrieved from Lawshe's table. Five items scored perfect agreement with a CVR value +1.00. The CVR critical value described earlier is different to the previous analysis, because 8 nutrition experts responded to the scoring assessment form.

Table 6: Summary table of content validity ratio (CVR) values per item calculated using Lawshe's equation to show level of agreement between participants. Values can range from -1 (perfect disagreement) to +1 (perfect agreement).

	CVR
Introductory blurb	1.00
Flowchart instructions	0.75
Core food groups	1.00
Proportions of food groups	1.00
Serving size guide	1.00
Food & Drink rating guide	0.75
Definitions of scoring range	1.00
Examples	0.75

The S-CVI of each domain had a value greater than 0.80, reflecting a high content validity for the overall instrument (**Table 7**). The S-CVI scores are broken down further to each domain of essentiality, relevance and clarity. We see in table 7 that after phase I of tool development, all three domains scored greater. The most obvious change in this figure is the difference in clarity between the two versions of the scoring tool.

Table 7: Summary of S-CVI values of the initial scoring tool introduced during the semi-structured interviews and S-CVI values after tool development – Phase I introduced during focus group discussions. CVI>0.8 indicates excellent content validity.

	Relevance S-CVI	Clarity S-CVI	Essentiality S-CVI
Initial scoring tool	0.89	0.65	0.83
After Tool development- Phase I	0.98	0.88	0.98

10 Tool development – Phase II

In phase II of the HMST development, the tool merges concepts from both draft one and two that were effective, according to the comments and content validity scores by the nutrition experts. Further improvements and modifications reflect the comments made in the focus group discussion to improve the overall ease of use and accurate categorisation within the scoring tool (Appendix J: Second revision of the HMST). These changes have led to the inclusion of an instruction guide and examples demonstrating the scoring process.

10.1 HMST Instructions

The comments from the focus group discussions revealed the need for an introductory paragraph and instruction manual to explain the purpose, target audience and guide to the scoring process of the HMST. This is one of the biggest changes made to the final revision of the scoring tool. **Figure 7** below shows a flowchart diagram, illustrating a step-by-step guide to the scoring of a meal. Although, most experts understood the process of scoring section A: Core food groups, there was confusion on the scoring of section B: Food and Drink Rating guide. This became apparent when the experts raised questions surrounding mixed meals, that would not easily fit into rating 3, 2 or 1. The flowchart aims to simplify this by showing the end user, what would happen if a meal could fit into more than one category. The flowchart demonstrates that in section B, the meal is categorised by the component with the lowest rating score. For example, a meal that is made up of components in rating 2 and 1, will be categorised by only rating 1. Therefore, the 'unhealthy' component of the meal is taken into consideration in the scoring process. However, this does not diminish any of the other components of the meal, as the rating score from section A is taken into consideration in the overall score. The outcome of this process alerts the end user of ways to increase the relative healthiness of the meal, by including aspects from rating 3 and 2. When these items are selected, the overall score of the meal will increase, implying a higher score represents a healthier meal, described in the flowchart.

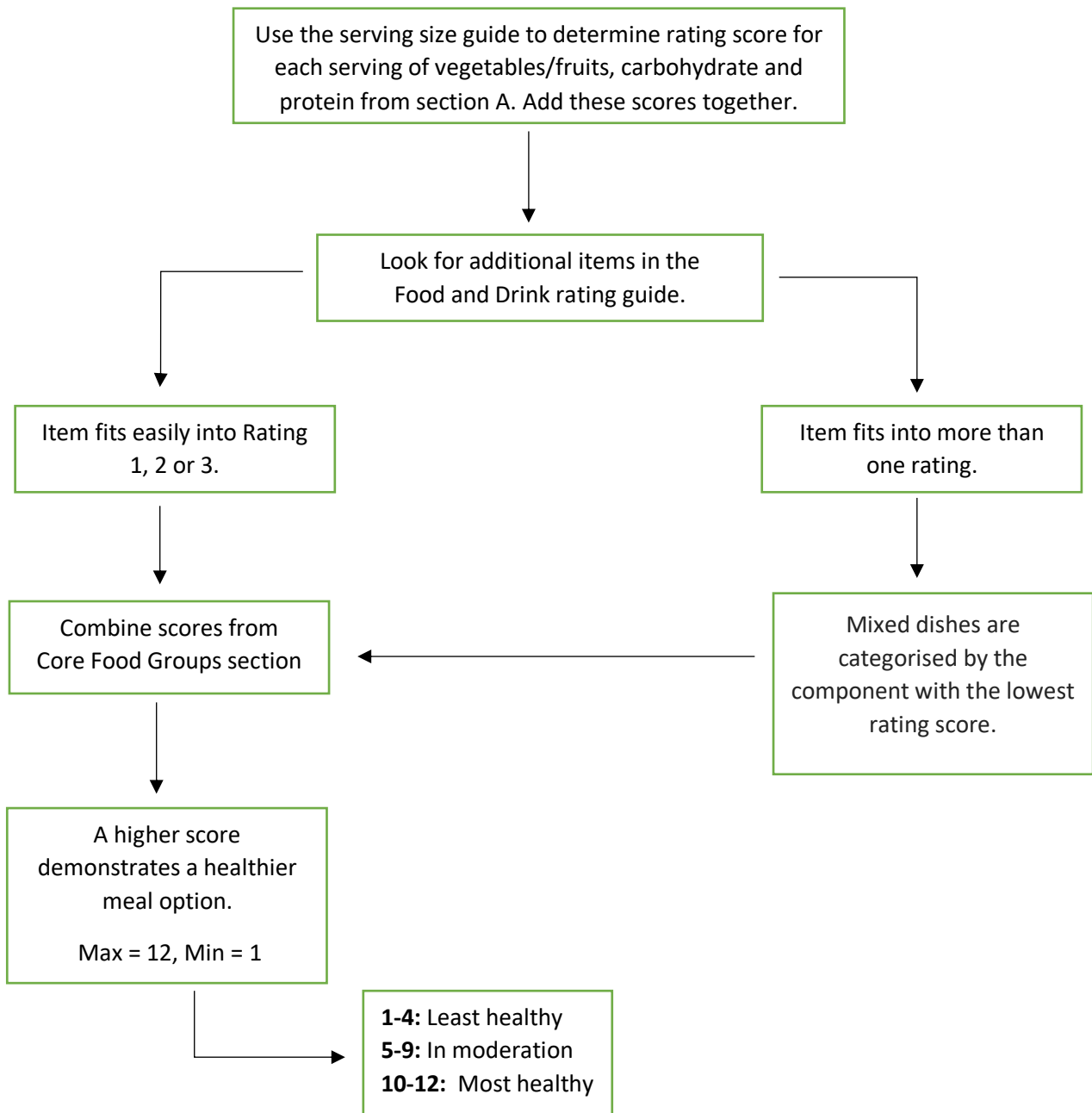


Figure 7: Flowchart guide describing a step-by-step guide of the scoring process for the end user.

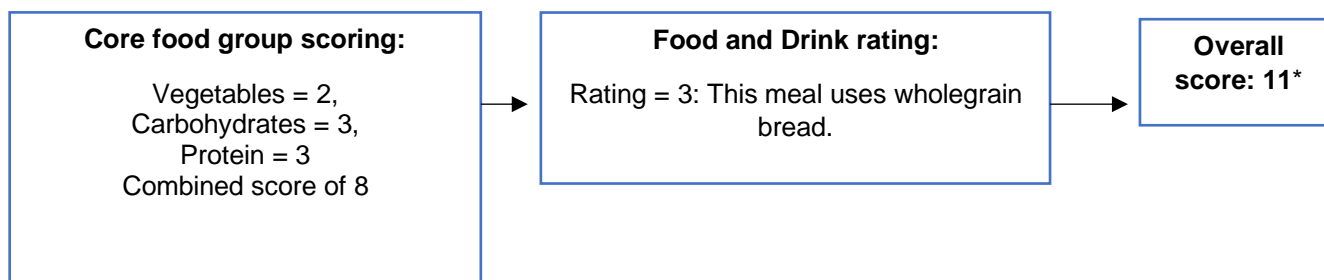
10.2 HMST examples

The second major modification in the final revision of the HMST, is the inclusion of an appendix at the end of the document. The experts agreed that relevant examples should be provided for the end user, to increase consistency in the scoring process. The appendix supports the ease of use and accuracy for the user in allocating rating scores to a meal. The modifications in **Figure 8** shows three examples of meals with varying healthiness to show how each meal would be scored, with brief explanations in the boxes to describe each step. The researchers scored each of the examples themselves and only after these scores matched, they were included in the final document. The researchers concluded that the examples should demonstrate the scores of a healthy meal, a less healthy meal and a meal to be had in moderation. The appendix also aims to clear up confusion around mixed meals that

include sauces, soft drinks, and different preparation techniques. For example, the second example specifies the fish and kumara wedges are deep fried, resulting in a lower score of rating 1 from section B: Food and Drink rating.

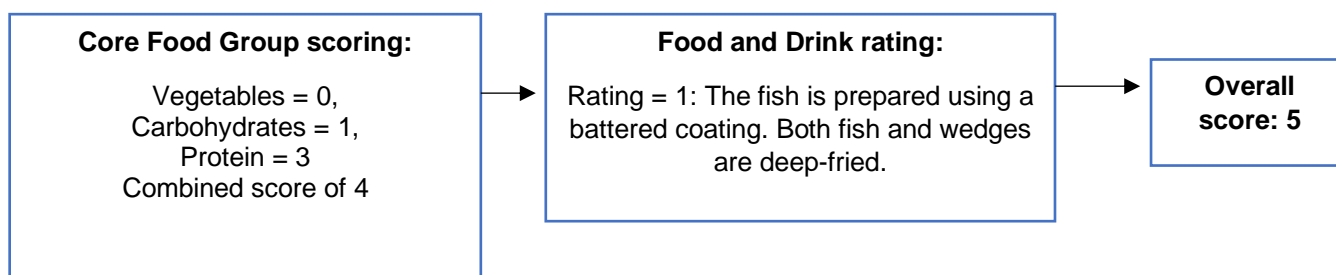
Likewise, the first example notes below what the alternative score would look like if this meal had included a soft drink as well. This example demonstrates to the end users, how the rating scores from section B can change the overall healthiness of the meal.

Example 1 2 wholegrain breads with mashed 1/2 avocado. 2 scrambled eggs and side of 1/2 C spinach.



**Inclusion of a 250ml can of Coke would shift the Food and Drink Rating to 2, giving an overall score of 9*

Example 2 Fish and chips using 100g battered tempura fish and deep fried kumara wedges (1 whole kumara).



Example 3: Instant noodles with extra Asian style sauces and 100g chicken and 1 C of mixed vegetables stir-fried.

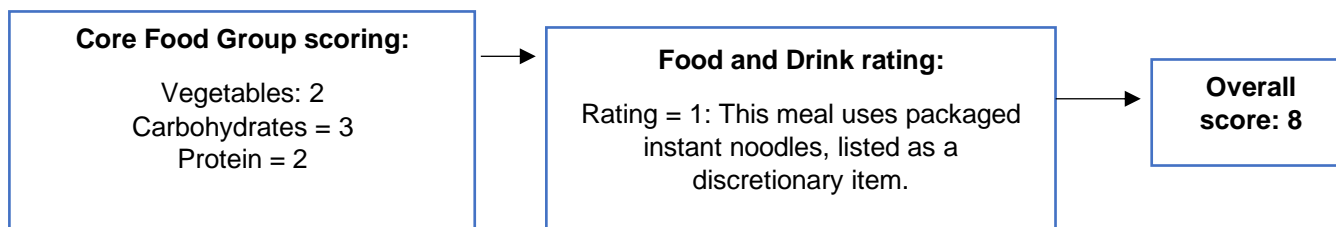


Figure 8: Summary of appendix from the HMST showing three examples of scored meals by the researchers.

11 Results: Inter-rater reliability

In total we received 9 responses, including feedback from combination of 6 registered dietitians and 3 student dietitians. For each of the example meals, the researchers allocated an overall rating score, before sending out of the surveys. These scores are as follows: meal 1 =8, meal 2= 3, meal 3 =11, meal 4= 5. The ICC of a two-way mixed absolute agreement calculation in SPSS showed excellent agreement between registered or student dietitians of 0.99 with a 95% confidence Interval (CI) 0.96 – 0.99. This value is significant with a p value of <.001. A small CI emphasises the reliability of this data set, as low variance is observed amongst the raters. Similarly, SPSS computed the Cohen's K for inter-item correlation between each rater. We observe a high level of agreement in all raters 1 -9. The lowest observed correlation is 0.85 (85% percent agreement) between rater 6 and 7; this is still well above the minimum criteria of 0.75.

Summary **Table 8** shows no pattern of variance in responses between the registered dietitians and student dietitians.

Table 8: Rating scores for each meal assigned to the responses from a registered dietitian (DT1-6) and student dietitians (Student1-3).

	DT1	DT2	DT3	DT4	DT5	DT6	Student1	Student2	Student3
Meal 1	8	8	8	7	9	9	7	7	10
Meal 2	1	3	3	3	3	3	3	3	4
Meal 3	14	11	11	11	10	12	10	14	12
Meal 4	6	7	7	7	6	8	5	7	8

12 Results: conclusion

In summary, a healthy meal is defined by the experts as a variety of foods from each of the main food groups – carbohydrates, fruits/vegetables and protein, with limited at-risk nutrients and consumed within the recommended portions. This is advised as being a quarter plate of carbohydrates, protein and half a plate of vegetables. The NZ Eating guidelines were deemed evidence based and accurate in reporting on healthy eating however, the public have not been effectively made aware of these guidelines, leaving room for confusion and misinterpretation. The proposed scoring tool is seen effective in providing education, increasing autonomy/self-monitoring of health and advocate for the value of dietitians if they are asked to administer it. This presented a key target audience for the proposed scoring tool. The content validity scores at this stage showed the current tool lacked clarity and criteria items needed revision.

After the first tool development phase, focus group discussions presented main themes that discussed the ease of use of the tool and categorisation of the rating headings. The experts recognised this newer version was more specific and user friendly. However, the tool in this stage lacked a clear purpose with a target audience in mind and is limited by the absence of clear instructions or examples that will demonstrate the scoring process. Further discussions around the revised HMST brought up comments regarding the specifications that fell under the category of rating two. The experts recognised there is confusion around certain terminology that did not accurately break down this category that separated the healthiest foods from the least healthy foods. The results showed the revised scoring tool increased in clarity through its layout and through the addition of a serving size guide. All three domains of relevance, clarity, and essentiality from content validity scores at this stage, positively improved, presenting I-CVI values above 0.79. Items are considered appropriate to remain in the instrument of the scoring tool.

Tool development phase II captures feedback from the focus group discussions, presenting a revised scoring tool that includes an instruction guide and set of examples demonstrating the scoring process for a given meal.

Overall, the findings of this study have delivered an accurate meal scoring tool, seen in the results from the inter-rater reliability testing. There was a high level of agreement among the 9 responses received from both registered dietitians and student dietitians. It is important to note there was no variation observed by one group's rating scores over another and both groups responded similarly to the scoring process.

13 Discussion

The primary research objective of this study is to develop a validated meal scoring tool using content validity, face validity and internal consistency methods. Each of these steps have guided the researchers in making appropriate modifications to the meal scoring tool, as deemed relevant by the expert opinion of the participants. Secondary research objectives answered the following questions: What is a healthy meal, what are the strengths and weaknesses of the national dietary guidelines, what groups should use the HMST?

The main findings throughout the development and validation of the HMST provided evidence that it is a valid and reliable scoring tool for assessing the quality of a single meal. The study has identified that having a range of the four main food groups within the recommended proportions is key to the definition of a healthy meal. This is evident in the recommendations of the national dietary guidelines for healthy eating. The guidelines were said to be confusing and easily misinterpreted. Therefore, the findings concluded that the HMST should be administered by health professionals with a background in nutrition to avoid confusion and misuse of the scoring tool. Quantification

of content validity showed that a lack of clarity, misinterpretation and ambiguity of the criteria items in the scoring tool were the primary concerns needing continued revisions and modifications. Face validity demonstrated two main themes surrounding its success as a measuring tool: the ease of use and appropriate categorisation of the scoring tool. After modifications, the researchers anticipated high level of agreement in rating scores, which were strongly supported by quantitative methods. The survey rating scores received a significantly high intra-class coefficient with no real differences associated with years of experience as a nutrition expert.

The following sections aim to make sense of the main findings in more detail and how this contributes to the final HMST, as well as examining the effectiveness of the final scoring tool using the results from the survey responses.

13.1 Phase one: Content validity

Content validity refers to the extent that items on an instrument are a true representation of what it seeks to measure (105). In the present study, content validity refers to the items in the proposed meal scoring tool and how well these items accurately measure the healthiness of a meal. In contrast to most studies in literature, the present study used a mixed methods approach to test content validity and the findings are described in the section below

13.1.1 Healthy eating

The data gathered from the semi-structured interviews revealed that a healthy meal should include a variety from the main food groups: fruits/vegetables, carbohydrate and protein, with limited intake of saturated fat, sodium and sugar. The experts also noted that these food groups are to be consumed within appropriate proportions, that align with the recommendations by the MOH (12), Australian dietary guidelines (28) and the ADG (14). This is because each of these food groups are known to provide a variety of important macro and micronutrients to maintain and perform a well-functioning body (12). Appropriate proportions of each of these food groups is also key to preventing health implications. This is because excessive macronutrient (carbohydrate, protein, fat) intake, or a macronutrient profile high in saturated fats is linked to cardiovascular risk(106) and obesity (107). The definition of healthy eating also includes limited intake of at-risk nutrients such as sodium, saturated fats and sugar. Commercially packaged foods are often higher in risk nutrients 'dietquality'and energy density (108). For instance, foods containing additional dressings and condiments can alter the nutritional quality of a meal. The HMST considers dressings and sauces by separating low fat, low sodium or reduced sugar options into rating 3, while full fat or regular sodium and sugar options have been allocated into rating 2. The distinction offers healthier alternative options for a meal that will increase the overall rating score. The same applies for other packaged foods such as canned foods, breakfast cereals, biscuits and flavoured beverages. Flavoured products such as milk and yoghurts are known to

contain higher concentrations of added and total sugars compared to their unflavoured or plain counterparts (109). These foods have been allocated under rating 2 because they are healthier alternatives of items in rating 1. Although flavoured or full fat dairy products are higher in at risk nutrients, the benefits they carry through protein and micronutrient content justify its rating 2 allocation (109). It should be noted that not all packaged foods are unhealthy and deserving of a poor rating score, because the composition of some packaged foods provide nutritional value. Lastly, the results attribute a positive relationship with food as being critical to the definition of healthy eating.

“I think a healthy diet is one that is generally something that makes people feel good in their body themselves, its not just about what the food is but where it has come from and how they are eating is as well.”

Research shows that positive attitudes towards healthy eating encourages the likelihood of self-control and adherence to healthier options in adolescents and adults (110) (111). For this reason, the start of the HMST noted that ‘all foods can fit into a healthy diet and one food choice does not make a meal unhealthy. In addition, the food and drink rating guide of the HMST includes brief explanations under each rating heading. For example, discretionary food items under rating 1 are described as ‘food and drinks that are occasional choices, in small amounts to add enjoyment to eating.’ As a result, the ratings remain transparent in their distinction from each other but do not penalise or associate negative emotions to any one food item. The aim is to educate the end user of where certain foods lie on a rating scale to help make better choices by swapping for healthier alternatives.

13.1.2 NZ Eating guidelines

At the start of the study, the researchers intended to move towards the national dietary guidelines, to broaden its use in evaluating dietary choices. The consensus among the experts in the interview supported this, as they believed the evidence-based information in these guideline act as a gold standard or objective outline for healthy eating. There were some concerns about how easily an individual could achieve the healthy recommendations. There is evidence of this globally in America (112) and Spain (113) where low adherence to the guidelines is linked to poorer health outcomes. The quotes from the experts below reinforce this idea that the dietary guidelines are a good back bone for the development of further resources but are not always practical for the public to follow. For example, the HMST can translate the dietary guidelines into a more practical, simplified format, that limits the risk of misinterpretation.

“I think the dietary guidelines do not take into account different cultures, potentially going forward it would be nice to bring a little bit more into the guidelines in terms of sustainability, culture, and what those food norms might be as opposed to typical western way of eating.”

While the concept of a unified set of dietary guidelines is easier to implement, current research has indicated this will not remain effective as the population in western society continues to grow in cultural diversity (114). The absence of cultural representation and inequities is a limitation of the guidelines identified by the experts. The above quote refers to how a healthy meal would look different to individuals according to their culture, food preferences, financial situations and circumstances. For example, the Mediterranean diet is a well-known cultural eating pattern that strongly supports positive cardiovascular health (115). Likewise, the 2013 South African dietary guidelines that favour lentils, beans and soya because they are higher in availability and affordable for the population (116). A western society's perception of protein foods is typically identified as animal meat, but research shows how this is different for specific countries. It suggests how the national dietary guidelines can look different when it is linked to the resources of a specific country and how it addresses their cultural eating patterns. The focus of the present study is limited to the NZ population and their general food preferences and cannot be transferred to different populations outside of the western society. The next step of this research would be to explore a greater range of cultural foods that reflect our diverse population in New Zealand.

Inequities in the population that prevent people from access to healthy affordable foods is also a barrier for achieving the dietary guidelines. For example, research shows that the distribution of supermarkets and fast-food restaurants differ according to poverty distribution (112).

“I guess its [EAG] educating people as to what they should be eating, but also creating an environment that allows people to access healthy foods easily.”

Low socioeconomic communities are less likely to have access to foods that enable them to make healthy choices that follow the dietary guidelines. This is equally relevant to the NZ population where there is a strong association of deprivation and geographic access to fast food outlets (117). When the cost and affordability of the dietary guidelines was investigated for the NZ population, the findings showed that the modelled healthy diet in the guidelines was unaffordable for households earning minimum wage or receiving financial support. This ‘ideal diet’ required a large portion of their income to purchase foods to meet the recommendations of the guidelines (118). For this reason, the guidelines should offer more flexible healthy eating patterns that consider affordability and access. The HMST attempts to achieve this by offering a selection of various items on the rating scale in section B. However, this is not by any means an exhaustive list of food items and requires further investigation to identify costs and availability of these items.

13.1.3 Perception of nutrition

A secondary objective of the study was to identify the target audience for the proposed meal scoring tool to understand who would benefit from such a tool. Identification of the target audience was achieved by

understanding the different perceptions of nutrition by individuals and health professionals. The public perception was described as being confused and misinterpreted of healthy eating and the dietary guidelines. For instance, the examples below link this to the influence of the media, an element of restriction and poor awareness of the dietary guidelines.

“I think the media has more influence over the fad use. If you were to ask the general public how they define a healthy diet, they would probably say fruits and vegetables but they may also say for example it shouldn't have any red meat. That is kind of a fad at the moment with the climate change, there is sort of a feeling out there that it is bad for your health and you should never have it.”

“The general public view healthy eating as a strict diet and sometimes perceived as something that is unattainable.”

The public is in need of clarification of healthy eating and the proposed meal scoring tool has potential for informing and translating evidence-based information into a simple educational tool. Although it can be argued that this level of confusion may arise in any situation where the population do not have a sound background understanding of nutrition (119). The literature shows that all age groups can recognise good eating patterns and at-risk nutrients, however they lack the motivation or understanding to apply this in their everyday life (45). The experts suggest that an instrument such as the meal scoring tool should be administered by health professionals with a background in nutrition, to promote sound science-based information to the public (119). The example below supports this statement because nutritional experts carry a holistic perception of nutrition and understand there is room for flexibility and the importance of a balanced diet.

“We think more holistically about food and that there's no perfect meal and perfect day. It is about eating across the day and across the week and that so called bad foods, that the public might perceive as bad are actually fine to include as part of an overall balanced diet.”

Therefore, the present study concludes that nutrition experts such as registered dietitians should oversee the scoring process in the proposed meal scoring tool and become the intended target audience for the remaining duration of the study.

It was later discussed how this would increase the value of dietitians and advocate for their involvement in educating and supporting healthy eating. The integration of dietitians into primary healthcare is proven beneficial for not only client-centred care but for providing quality nutrition care that is accessible to all New Zealanders (120). Dietetic intervention is positively linked to improved nutrition status and wellbeing of individuals. Given the above evidence, the HMST aims to increase the value of dietitians and nutrition experts by creating a tool designed to support their practice.

13.1.4 Quantification of content validity

The quantification of content validity established confidence in the items selected to define a healthy meal. This is considered in three domains of how well the items are clear, relevant, and essential in achieving the purpose of the HMST(121). This step of the study increases the reliability of the tool and answers the question, what components help to measure the healthiness of a meal scoring tool. For example, calculating the content validity index per item (I-CVI) showed that the initial scoring tool lacked clarity and all items needed revision or were eliminated if they had a I-CVI < 0.71. On the other hand, the experts gave an I-CVI > 0.71 for all items, when asked about its relevance and essentiality of the instrument. The necessity is further evident in the content validity ratio (CVR) values in table 5, showing low to moderate agreement of items suggested in the tool. This meant that although the terms did not establish a clear description, they are still important to the assessment of a healthy meal. These findings align with the expert's comments that the contents of the guidelines can be confusing and easy to misinterpret. For this reason, the criteria terms were not eliminated but substantial changes were made to the wording, criteria items and overall format of the HMST in the following revisions.

13.2 Phase two: Face validity

The present study used face validity to assess the strengths and weaknesses of the menu scoring tool and its ease of use for the end user. The degree to which the menu scoring tool is accepted by the nutrition experts is related to the appearance of the tool and if the wording and criteria items achieve the research objective (121). The experts reported on the ease of use of the HMST and how appropriate the categories in the instrument established the degree of healthiness.

13.2.1 Ease of use of the tool

The nutrition experts suggested that the HMST needed clarification regarding the context to which the tool can be used. It was suggested to include an instruction guide for the scoring process along with a list of examples to demonstrate the scoring process and improve user friendliness.

“Like a training package, because I think if we think of like you know (Subjective Global Assessment) SGA, which is obviously completely different, but it's the same thing.. when we were you know learning how to do.. you know muscle wasting. We have like a couple of examples or pictures to say, this is a three, this is a two, this is a one. Just to give you a bit of a guide as to where to start, because I think that will probably increase the users”

One expert compared the ease of use to the layout to the SGA. The SGA is a screening tool introduced to assess a patient's risk for malnutrition at bedside (122). Although the SGA has a vastly different purpose to the HMST, both measuring tools are designed to be administered by health professionals and requires consistent scoring by

the end user to ensure its reliability in patient care (122). The literature identifies several studies that measure the accuracy of the SGA in measuring malnutrition, but few studies have looked at the consistency and reproducibility of the SGA scoring amongst the health professionals who administer this test. When a group of registered nurses were asked about their use of malnutrition screening tools in the hospital, the ease of use of the tool was one of the themes also identified in its results (123). The nurses expressed a need for training, to better understand the concept of the screening tool and to help gain confidence in administering them. These findings can be translated to the present study for improving the layout of the HMST. For instance, an appropriate description of the scoring process is provided to guide the rater through a step-by-step flow diagram and list of example meals. The short training guide acts as a training guide for the end user to increase confidence and consistency in scoring.

13.2.2 *Categorisation of the tool*

Another main finding from the focus group discussions were that the each of the ratings (3,2 and 1) needed to be clearly defined and distinct from each other. A clear distinction between each category allows the end user to clearly allocate ratings to components of a meal without any confusion. Concerns were raised specifically in the distinction of rating two. It was noted potentially confusing and misleading, being the middle ground between the healthiest and least healthy categories. The first quote below is an example of how the term 'processing' under rating two is misleading because it refers to any foods that have undergone some changes during preparation. The alteration of foods is widely recognised to help the preservation of foods, change its properties, restore or refine nutritional content (124).

"I was interested that instant noodle are in the two. And I said there's some stuff that we will have different perspectives and these potentially some that are better than others so that's you know, this is what so tricky about a description of foods. It can look really different depending on how its prepared."

Therefore, the term 'processed' was removed from the final revision as the researchers felt it was more appropriate to define different preparation methods under each rating. For example, meat can be prepared through boiling, steaming, shallow fry, or deep fry. These cooking descriptions align with the meal scoring process reported in the HMI. The HMI demonstrated preparation methods for vegetables and protein and how they are evaluated separately in each meal report (53).

There was less consensus on the categorisation of mixed dishes but following the expert recommendations, it was made aware that the descriptions of foods was more appropriate than listing individual foods. This is because foods can vary according to its preparation methods. For example, the quote below discusses the difference in nutritional quality between a homemade burger and a takeaway burger.

"[...]you know homemade burger versus McDonald's versus a takeaway burger sometimes could have different ratings depending on where they've been made and what they've done so yeah as I guess it's trying to think about how you would describe a meal, rather than just rating pizza as a bad meal."

Takeaway meals are often associated with poor nutrition quality, while their home-made counterparts are often healthier and cost effective (125). The HMST includes words such as 'commercial burgers' or 'bakery items' under rating one to address this discrepancy. Likewise home prepared meals can be flexible in the way it is prepared by choosing oven baked meat instead of deep-fried, low-fat sauces in replace of full fat heavy sauces or by swapping white bread for a wholemeal option. The HMST acknowledges these healthier alternatives with a higher rating score.

The clarity of the HMST was greatly impacted by the categories of the three rating scores. There is no clear number of revisions needed to be certain that the HMST is well developed (126) however, the content validity calculations from the second round revealed excellent I-CVI values of individual items, with significant CVR values above the $CVR_{critical}$ of 0.75. Specifically, the domain for clarity improved after the first round of revisions, with the exception of the examples provided in the HMST. To address this the next round of modifications included a detailed summary of examples outlining the scoring process for a highly nutritious meal, least healthy meal and a moderately healthy meal.

13.3 Phase three: Internal consistency/ reliability

The final stage of this mixed method study assessed the percent agreement and inter-rater reliability scores of the HMST to test for the internal consistency of the instrument (127). Following the expert feedback and after undertaking previous modifications, the researchers hypothesised that the inter-rater reliability of the instrument would show a high level of agreement among the survey respondents. The findings in this study supported this hypothesis with an intra-class coefficient of 0.99 (99%), 95% confidence interval of 0.96 – 0.99, and a p value <.001. Inter-rater reliability was important for this study because the respondents were asked to judge and allocate a meal to a category, in contrast to the HEI that requires no judgement once food intake is recorded and coded (128). Several validation studies of meal scoring tools often compare rating scores to chemical analyses (86), exemplary menus of high nutritional quality and collect data from 24hr recall or food frequency methods (128) . This is because these studies investigated the strength of the scoring tool in defining healthy eating through a process of objective validation measures. This was not the primary objective of the present study, because it focused on the consistency in scoring and practical use of the HMST in a wider sample of nutrition experts. Although there was a high level of agreement between raters in this study, there was some variation in the obtained

score from the researcher's scores of each meal in the survey. This is however subjective and by no means a gold standard measure. Hence, further research is required to confirm the reliability of the HMST through objective measures using any of the previously stated methods in literature. Descriptive analysis of the rating scores showed no variance in individual rating scores between those who identified as a registered dietitian or student dietitian, despite the difference in experience levels. This suggests that the level of previous experience as a nutrition expert does not limit an individual's ability to effectively use the HMST. Therefore, the study has been successful in its aim to deliver a simple and easy scoring tool.

13.4 Conceptual framework

Ultimately the goal of a meal scoring tool is to measure the healthiness of a meal to help make informed decisions that support better health outcomes. This is important to address the increasing prevalence of obesity in NZ adults and its related chronic conditions (129). Additionally, the skewed perceptions of healthy eating and diet quality determined by the dietary guidelines are key concepts that influence the idea of healthy eating. For this reason, researchers need a valid approach to measure healthy eating and make informed decisions for further research, assess dietary choices and monitor the effectiveness of public health interventions.

The literature has identified some examples of diet quality measuring tools such as the HEI, HMI, Nutrient Profiling Scoring tool and the Mediterranean diet score. Each of these tools have strengths and weaknesses that have guided the development of the HMST in the present study. For example, the HEI is based on the American dietary guidelines and have focused on overall diet quality as opposed to the healthiness of a single meal (50). The NZ dietary guidelines follows a similar pattern to the ADG, by encouraging fruit and vegetable intake and eating a variety of foods including wholegrain and low-fat options (130). Importantly, the dietary guidelines often reflect current eating patterns of the population. For example, the United States have alarming low rates of fruit and vegetable consumption compared to the NZ population(130). Therefore, ADG have a greater emphasis on increasing consumption of this food group because it is an observed concern for the American population.

Additionally, while both countries consume saturated fat above the healthy recommendation limits, the NZ population consume this largely from milk and milk products. In contrast, the United States population consume a higher proportion of saturated fat from meat consumption and red meat (130). Although commonalities exist between the two guidelines, discrepancies in population eating patterns are reflected in the dietary guidelines, and limits the applicability of overseas diet quality tools to the NZ population.

Diet quality indices are important to monitor dietary intake and understand how well this aligns with nutrition recommendations and public health messages (50). The HMI is a meal scoring tool with a similar objective to characterise the quality of a single healthy meal. However, like previous scoring tools it relies on American resources and guidelines and existing HMI validation studies have collected data through dietary recalls (53). The present study used a thorough qualitative and quantitative approach that has led to evidence of high internal consistency of the overall HMST instrument. The involvement of multiple nutrition experts at different stages is unique to this study, while other studies have primarily referred to the dietary guidelines to guide its tool development phase.

Specific dietary patterns such as the Mediterranean diet is strongly linked to improving the diet-health relationship for cardiovascular disease (115). Among existing diet quality indicators, the Mediterranean diet score is only appropriate and limited for application in individuals or settings that are characterised by this risk. In contrast, the HMST is not specific to a clinical condition but considers general advice for a healthy meal for all individuals who are not monitoring specific dietary choices related to disease risk.

The strength of a good instrument to measure what it is supposed to and is dependent on the evidence from a validation study. Current validated tools in literature commonly use chemical analysis and plasma biomarkers to test how well the instrument measures diet quality. These methods strengthen the validation process because they offer an objective measurement that is specific to the nutrient intake (131). The research objectives of these studies differ from the present study. This is because the existing research has looked at the accuracy to which these diet quality scoring tools reflect nutrient intake. For example, the HEI validation approached chose to compare plasma biomarkers of fruit, vegetables, saturated fat and energy to determine its validity (132). The present study did not follow this approach because it aimed to fill the gap in literature by recognising validity in its scoring process. Strong inter-rater reliability testing results showed that the HMST is accepted by a wider sample of nutrition experts. Allowing a wider range of experts to administer the tool opens the possibility for the HMST to be applied in a range of settings and does not limit its use to only the researchers within the team.

13.5 Other relevant studies

The HMST is designed to be accessible for nutrition experts outside of the research team to provide a quick and easy menu assessment. In contrast, existing tools such as the HEI is developed for use within the research team to evaluate the population's eating patterns and understand how well this aligns with the dietary guidelines (50). The present study's approach aligns with the research objectives of the HMI, as it is designed to evaluate the diet quality of a single meal in a variety of settings for both researchers, food and nutrition experts (52). Although

nutrition researchers were consulted in the initial design of the HMI, there have since been no further investigations to confirm how well the suggested end users can apply this tool in their setting. Previous validation research for the HMI have established the instrument is reliable in assessing nutritional quality, but it has not evaluated how easily the end user can administer the tool (53). This information can greatly impact the reliability of the proposed scoring tool if the end users are not consistent in their scoring process.

The next step in the tool development phase was to prioritise dishes by asking the user to award the meal with the lowest score it could receive from the three-point scale in section B. While the HMI utilised a 'yes' and 'no' scoring system for the presence or the absence of discretionary food items, the HMST uses rating two to acknowledge differences in the preparation methods (133). For example, the HMST refers to descriptions of foods such as 'wholemeal bread vs white bread' and 'low fat salad dressings vs full fat salad dressings.' There is less consensus in the present and existing research on the categorisation of mixed dishes. Most diet quality studies have referred to a closed list of mixed foods that are counted as a single category (134) (133). In this way our research has separated itself from existing research by allowing for varying degrees of nutritional quality of the same item using three categories.

A useful component of the HMST is that it differentiates between the core food groups and its serving size recommendations according to the NZ dietary guidelines (12). The development of a simple food-based diet index for NZ adolescents (NZ DQI-A), presented similar findings in its design. In this study, the adherence to the serving size recommendations of the major food groups was the primary objective of the instrument (135). This is because the NZ DQI-A examined the diet quality of adolescents in direct comparison to the NZ Food and Nutrition Guidelines of Adolescents. The study hypothesised that a higher score was associated with greater adherence to the guidelines, hence follows a more favourable dietary intake (135). Similarly, the first section of the HMST considers variety and proportion of the major food groups by allocating a different rating score according to the proportion of vegetables/fruit, carbohydrate and protein. This is because the nutrition experts in the present study have deemed the serving sizes for each food group as an important measure for healthy eating. While the design of the NZ DQI-A fails to recognise additional ingredients or food preparation methods that can change the nutritional value of a diet, the HMST addresses this in section B: Food and Rating guide.

13.6 Strengths and limitations

Similar validation approaches to content validity have been widely reported in the literature, although fewer studies have recognised Lawshe's table in determining significance of the CVR generated for each item. This is a strength of the present study because the quantification of content validity was compared to the $CVR_{critical}$ value on both

rounds. The second round of content validity calculations revealed significant values when compared to the $CVR_{critical}$ and this further strengthened the reliability of the items in the scoring tool.

The limitations of this study include the subjectivity of the expert feedback and potential lack of generalisability to different age groups. Subjectivity refers to the opinions, feelings and preferences of an individual as opposed to maintaining impartial judgement (136). This poses a risk of bias in the present study if the expert comments favoured one side over another. For example, the sample included individuals with a background in public health, who may be biased in their opinion of the dietary guidelines. However, subjective analysis is argued in the literature to be useful when it is exploring definitions, experiences and generating data that brings the researcher closer to answering the research objectives (137). In contrast to existing tools, the HMST sought expert feedback during its development. Therefore, this can also be regarded as a strength of the present study because objective measures only help the researcher collect data on the instrument once it has already been established (137).

The HMST is limited to the recommendations found in the healthy eating guidelines for NZ adults and cannot be generalised across lifespans. This is because the nutritional requirements of an individual changes across a lifespan from infancy into older adulthood (138). A major example of this is the higher proportion of protein reported in literature for older adults to preserve muscle mass and strength (139). Similarly, the number of servings recommended for young children differ according to the national food and nutrition guidelines for healthy children (140). Further research is needed to modify the HMST to reflect these requirements. It should be noted the HMST is based on population level recommendations and although the tool can be used in clinical settings, the scoring process does not consider specific nutrition needs for chronic conditions. This limits its usefulness for individuals in acute settings or community care that require individualised nutrition assessment, related to improving clinical outcomes.

13.7 Implications for future research and practice

The HMST is proven to be an easy and valid tool for assessing the quality of meals and has potential to be applied in a range of settings, including food service and research, where the healthiness of a single meal is valuable to improve the nutritional quality of menu items and monitor food choices. Other existing tools are specific to clinical conditions such as the Mediterranean Diet Score where health professionals measure the nutritional quality of an individual diet in regard to risk for cardiovascular health (115). The HMST can be modified in a similar nature to reflect the recommendations for a specific clinical condition. Other implications include the contribution of the HMST to analyse meals as part of further research studies. For example, specific public health initiatives can use the HMST to audit the healthiness of menus and investigate changes in food environments. Such research has

been conducted in NZ (141) and further follow up studies could benefit from a quick, easy and valid menu scoring tool. Future implications may also include modifications to the HMST criteria that fit younger or older age groups, allowing for the extended use of the tool in childcare settings and rest homes to monitor food intake. This is important because overweight and obesity rates in young people continue to rise and track into adulthood (142), while poor nutrition in older adults increases the risk for chronic conditions (143). Therefore, a meal scoring tool can be applied to these settings to ensure that adequate nutrition is provided to individuals in these age groups.

14 Conclusion

The present study has provided a valid tool for measuring the healthiness of a meal in line with the Healthy Eating Guidelines, designed to improve the health of the NZ population. This three-step validation study was critical to the development and design of the HMST, as appropriate modifications were made to reflect the findings of each step.

The semi-structured interviews provided valuable insights to the wider discussion of healthy eating, the perception of nutrition, NZ Eating guidelines and the proposed meal scoring tool. Firstly, the experts concluded that a healthy meal is made up of various foods from each of the four core food groups and consumed within the recommended proportions. They recognised the potential for a meal scoring tool to educate and inform the public of this by translating the dietary guidelines into a practical tool. This prevented any further misleading perceptions of nutrition identified in the results chapter. After further discussion in the focus groups, the experts raised concern regarding the end user of the HMST. They discussed how the ease of use and categorisation of criteria items would have varied descriptions depending on who was using it. Once the researchers established that the tool is targeted for dietitians and nutrition experts to guide research analysis, meal auditing and menu planning, the experts provided relevant feedback to the design of the tool. Under the Ease of use theme, the experts felt that the HMST needed a summary of the scoring process with easy-to-follow examples that demonstrated this. Once the final modifications of the HMST were made, interrater reliability testing revealed excellent agreement between the raters, who responded to the survey questionnaire. This confirmed that the HMST is a valid and reliable tool for measuring the nutritional quality of a meal and can be used by nutrition experts in a range of settings.

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16 Appendices

16.1 Appendix A: Initial meal scoring tool

What makes a healthy lunch?

Lunch Scoring Tool*:

Choices that include these foods score 3 points (Green Category):

These foods and drinks are part of a healthy diet. They are consistent with the healthy food and drink policy principles, and reflect a variety of foods from the four food groups, including:

- plenty of vegetables and fruit
- grain foods, mostly wholegrain and those naturally high in fibre
- some milk and milk products, mostly low and reduced fat
- some legumes, nuts, seeds, fish and other seafood, eggs, poultry(eg, chicken) and/or red meat with the fat removed.

Green category products are low in saturated fat, added sugar and added salt, and are mostly whole and less processed.

Note: green category products must consist only of green category foods, drinks, and ingredients.

Choices that include these foods score 2 points (Amber Category)

These foods and drinks are not considered part of an everyday diet but may have *some* nutritive value. Foods and drinks in this category can contribute to consuming excess energy and are often more processed. The amber category contains a wide variety of foods and drinks, some healthier than others.

Amber category products can contain a mixture of green and amber foods, drinks and ingredients.

Choices that include these foods score 1 point (Red Category)

These foods and drinks are of poor nutritional value and high in saturated fat, added sugar and/ or added salt and energy. They can easily contribute to consuming excess energy. These are often highly processed foods and drinks.

*Modified from the NZ National Healthy Food and Drink Policy

Instructions: a 'healthy lunch score' is calculated by calculating a sum of the lunch choices and dividing by the number of items/choices in the lunch.

This tool is designed to be used with a set menu where individuals have the same multiple choices for each item (including healthy and less healthy items).

Example:

Menu for a 'house sandwich'

1. Wholegrain bread instead of white = 3
2. Bacon instead of grilled chicken = 1
3. Lettuce instead of no lettuce = 3
4. Tomato instead of no lettuce= 3
5. Mayonnaise instead of no sauce = 2
6. Salad instead of fries = 3

Total: 15

Lunch score = $15/6 = 2.5$

16.2 Appendix B: Participant Information Sheet prior to semi structured interview

Project Title: Validation of a healthy meal scoring tool.

What is the purpose of this research?

It is well understood that a nutritionally adequate diet is related to good health and wellbeing outcomes. The effect of good nutrition to different areas of health and wellbeing continues to expand in its research. Therefore, the development of a meal scoring tool allows researchers to apply this tool in their own analysis and field of research related to nutrition. This proposed study aims to validate the different criteria questions (e.g the nutrient content of meals, % of saturated fat etc) in the current tool, to test its applicability to all meals. This will help determine each category's accuracy to explain the healthiness of a meal, suggested by the tool (Green, Orange, Red). We will achieve this by working with nutrition experts/ dietitians to reach a consensus regarding each meal scoring tool element. The proposed research will achieve this through semi-structured interviews and focus groups with nutrition experts/dietitians to identify areas of strengths and weakness within the tool. Future research from this proposed research will provide a robust and accurate meal scoring tool, that can be used to investigate other forms of comparisons with nutrition and health.

How was I identified and why am I being invited to participate in this research?

You have been identified and invited to participate in this research because you are a qualified nutrition expert/dietitian actively participating or contributing nutrition advice, or are currently studying to achieve this qualification. Participants have been selected from the University of Auckland as a matter of convenience while conducting this research.

What will happen in this research?

If you wish to participate in this research project, you will be asked to participate in a semi-structured interview and a focus group discussion (small group discussion) with eight to ten nutrition experts/dietitians like yourself. The semi-structured interview will test the content validity of the revised meal scoring tool. Using your expertise and knowledge, you will be asked to rate each item in the criteria list for its relevance using a four-point scale of relevance: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant.

The focus group will then be facilitated by the researchers at the University of Auckland Grafton Campus. Topics of discussion in the focus group will cover formatively the items found to be unclear from the semi-structured interviews. Once identified, the participants will be requested to propose a better formulation. Comments will then be discussed in the research team until consensus will be reached, and a final version of the tool will be established. It is anticipated that focus groups will be relatively casual and free-flowing; you may feel comfortable asking researcher's questions and expressing your opinions without judgement or penalty, if all participants remain respectful of one another. The focus group will not last more than 60-90 minutes, and it will be audio-recorded.

What are the discomforts and risks? How will these discomforts and risks be alleviated?

Participation in this study includes a semi-structured interview and a focus group discussion which we anticipate taking approximately 60-90 minutes of your time. During the focus group, you will be asked to discuss your opinions about the criteria used to form the tool to assist in developing a valid meal scoring tool. No further participation will be required. The discussion should not elicit any discomfort or risk as no personal information will be sought.

However, if any discomfort or risk felt, you can withdraw from the focus group discussion at any time. Your participation or non-participation will have no impact on your grades, academic relationships or employment.

What are the benefits for you when participating in this research?

Participants will receive a \$50 Westfield voucher for attending the focus group sessions to recognize your time and participation in this research.

How will my privacy be protected?

Prior to the focus groups, participants will be required to complete a semi-structured interview. The interview and will be anonymous; no names, e-mail addresses, or personal information will be collected. The researchers will audio record the focus groups so that discussions can be transcribed verbatim (i.e., word-for-word) for analyses. To protect your confidentiality, no real names will be used in transcriptions. Also, no other identifiable information will be requested or transcribed, such as birth dates or addresses. After each focus group session has been transcribed and analysed, the digital recording of the focus group will be erased. All data, including consent forms, will be kept in the Principal Investigator's locked office inside a locked file cabinet. Therefore, you can be confident that your identity will never be revealed in any dissemination related to this study, for example in university presentations or written papers. All data will be destroyed after six years of completion of the study. You may refuse to answer any questions and are free to leave the group discussion without giving a reason. However, because of the nature of the group situation, the recording device cannot be turned off during the discussion. You may withdraw from the focus group at any time without penalty. If you withdraw, the information you have contributed up to that point cannot be withdrawn. Because of the nature of group discussions, what you say during the focus group will be known to other participants in the focus group and therefore cannot be confidential. Your confidentiality cannot be guaranteed, but each member of the focus group will be asked to respect one another's privacy, talk about the group discussion to others, and agree that everything that is said in the focus group remains confidential the people involved. The research team would never identify you as one of the research participants. Your personal information will never be related to any of the study findings. The risks of participating in this study are minimal.

What are the costs of participating in this research?

The only cost for you is 60-90 minutes of your time for the semi-structured interview as well as the focus group discussion and some additional travel time to and from the University of Auckland Grafton Campus. You will be reimbursed for your time and participation with a \$50 Westfield voucher. You can be assured that participation or non-participation in this study will not have any effect on your grades, employment or relationship with any member of the research team or the University of Auckland.

How do I agree to participate in this research?

You may agree to participate by informing Akeena Raphael arap292@aucklanduni.ac.NZ. You may also contact Dr Rajshri Roy r.roy@auckland.ac.NZ and/or Akeena Raphael if you have general questions.

Will I receive feedback on the results of this research?

If you participate in the focus group sessions, the research team will maintain your name and contact information to provide you with a summary of the research. However, your personal information will never be related to any of

the study findings. You are also always free to contact the research team via phone or e-mail or ask us not to contact you further after the focus group.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Principal Investigator, Dr Rajshri Roy, PhD, r.roy@auckland.ac.nz, Ph: +64 9 235 910 Ext: 85910, or

Whom do I contact for further information about this research?

Principal Investigator Contact Details:

Dr Rajshri Roy, PhD, r.roy@auckland.ac.nz , Ph.: +64 9 235 910 Ext: 85910

Discipline of Nutrition and Dietetics, Head of Department

Contact Details: A/Prof Clare Wall, c.wall@auckland.ac.nz, +64 9 923 9875 extension 89875

For questions regarding participants' rights and ethical conduct of research, contact the Chair, at the University of Auckland Human Participants Ethics Committee, at the University of Auckland Research Office, Private Bag 92019, and Auckland 1142. Telephone 09 373-7599 ext. 83711.

Email: ro-ethics@auckland.ac.nz

Approved by the University of Auckland Human Participants Ethics Committee on 16-May-2019 for three years, Reference Number **022980**

16.3 Appendix C: Consent form



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CONSENT FORM

Semi structured interview & Focus Group Participants

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

Project title: Validation of a healthy meal scoring tool.

Principal investigator Dr Rajshri Roy, co- investigator Jennifer Brenton-Peters.

Student researcher Akeena Raphael (Masters in Nutrition & Dietetics, Faculty of medical sciences)

I have read the Participant Information Sheet, have understood the nature of the research and why I have been selected to participate in three focus group discussions. I have had the opportunity to ask questions and have had them answered to my satisfaction.

- I agree to take part in this research.
- I understand that I am free to withdraw my participation at any time without giving any reason, and the information I have contributed up to that point cannot be withdrawn.
- I understand that what I say during the semi-structured interview will be kept confidential and no personal information will be collected.

- I understand that what I say during the focus groups will be known to other participants in the focus groups and therefore, cannot be confidential.
- I understand that the semi-structured interviews and focus group discussions will be recorded and that I cannot ask for the recorder to be turned off but can choose not to answer any question and/or leave the room. I understand that the Head of Department of Nutrition has given an assurance that my participation or non-participation will have no impact on my employment, grades, or relationship with the University.

I wish /do not wish to receive a summary of findings, which can be emailed to me at this email address below.

Name: _____

Email: _____

Signature: _____

Date: _____

Approved by the University of Auckland Human Participants Ethics Committee on 26-05-2021 for three years, Reference Number UAHPEC21232.

16.4 Appendix D: Semi-structured interview guide

Thank you for agreeing to participate in this interview. We are interviewing you to get a better understanding of what is considered as part of a healthy meal, the relevant guidelines and its applicability and ultimately how we can improve the scoring tool. So there are no right or wrong answers to any of our questions, we are interested in your own experiences and expertise.

Participation in this study is voluntary and your decision to participate, or not participate, will not affect your relationship with the university.

The interview should take approximately 30 minutes depending on how much information you would like to share. With your permission, I would like to record the interview because I don't want to miss any of your comments. All responses will be kept confidential. This means that your de-identified interview responses will only be shared with research team members and we will ensure that any information we include in our report does not identify you as the respondent. You may decline to answer any question or stop the interview at any time and for any reason.

Are there any questions about what I have just explained? .. May I turn on the recorder?

Before we begin, it would be nice if you could tell me a little bit about yourself. Tailor a question here to specific person and/or situation. For example: You are a dietitian and an academic, which area do you specialise in?

Questions:

1. Can you tell me how you define what is 'healthy eating' is?
2. and in your experience how does that differ from how the general public defines healthy eating?
3. In your opinion, has the definition of a healthy meal changed for you since you became a nutrition expert?
4. As a nutrition expert, what type of questions do you often receive regarding healthy eating?
5. How closely do you follow the national dietary guidelines set by the government in your own practice?
6. Do believe the dietary guidelines accurately reflect what people ate and if not,
7. what changes to the dietary guidelines would you like to make?
8. How relevant are the dietary guidelines to your understanding of what constitutes a healthy meal?
9. What components do you believe are most important in defining a healthy meal?
10. How useful do you believe a meal scoring tool would be in your current research and practice?
11. From your experience do you believe this tool is useful for health professionals or general public?
12. Please rate each item in the meal scoring tool for its relevance using a four-point scale of relevance with 1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant.
 - Saturated fat content
 - Energy content/ caloric content
 - Added sugar
 - and salt-
 - Number of fruits and vegetables
 - Includes whole foods

- Includes processed foods
- Includes milk or milk products
- Includes legumes, nuts, seeds, fish and other seafood, eggs, poultry, red meat with the fat removed.

Is there anything else that you would like to comment on that I haven't already asked you about? Thank you very much for your time and the information you shared today. I will keep you posted about the focus group discussion with other experts soon.

16.5 Appendix E: Focus group moderation guide

a. Introduction (3minutes)

Hi everyone, hope you are all doing well in your bubble at the moment. As you know my name is Akeena and I will be your moderator for today. Thank you for attending today's focus group. The purpose of today is to further elaborate on the idea of a meal scoring tool that will allow us to determine the level of healthiness for a prepared meal. I am here to listen to your thoughts and please remember there are no right or wrong answers, only opinions and I'd like to hear from you all equally. Please feel free to speak up even if you disagree with someone else here. It's OK to disagree, because it's helpful to hear different points of view. I'm also interested in any questions you may have as we go along.

I will not take longer than 60 minutes of your time. We are audio recording this discussion, because I want to make sure that I don't miss any comments. Later, we'll go through all of your comments and use them to prepare my discussion in my thesis report. I want to assure you, that all of your comments are confidential and will be used only for research purposes. Nothing you say will be connected with your name. Also, if there are any questions you would prefer not to answer, please feel free not to respond to them.

The initial scoring tool and the revised scoring tool are handed out to the participants to have a look over.

b. Warm up (5 minutes)

1. To begin I'd like to double check that we all know each other... if not could we go around the room and introduce ourselves?
2. If you could please take a minute to have a look at the initial scoring tool that you may have seen earlier and the now revised scoring tool that I had sent through prior to this meeting.

c. Meal scoring tool (30 mins)

1. What's your general reaction to this draft scoring tool?
2. Is there anything you especially like about it?
3. Is there anything you especially dislike about it?
4. Is there anything confusing?
5. Is there anything missing?
6. Are there other recommendations or improvements that would help you to use the scoring tool more effectively and efficiently?
7. Do you find the descriptions provided accurate to determining the level of healthiness?
8. What do you think of how the information is displayed in the second draft?
9. Which one do you believe is better?
10. How much has this revised version of the tool improved from the initial lunch scoring tool?

d. *Target audience (15 mins)*

1. Should this tool be readily available for everyone?
2. What age group should this tool be for?
3. Do you believe there are barriers to the use of this meal scoring tool?
4. Is there a specific target group that would benefit from this tool?
5. Do you think this tool has a purpose to provide education/ as an education resource for healthy eating?
6. Can you identify any other benefits from using a scoring tool like this?

e. *Close (3 minutes)*

1. Are there other things that you would like to say about the revised meal scoring tool before we wind up the session?

We have come to the end of our discussion. I would like to thank you for your participation, your thoughts and ideas today will be very valuable for me to create a validated meal scoring tool. If you could please write down your mailing address here, as we would like to send out a complimentary Westfield voucher to thank you for your participation in this research study.

16.6 Appendix F: Scoring assessment form – part one

Kindly review the components suggested for a meal scoring tool and provide your feedback on the following:

- The relevance of each component in a meal scoring tool (how important is the question?)

	How relevant is this item?				Is this item clear?				How essential is this item?			
	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Saturated fat content	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Energy/caloric content	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Added sugar	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Salt content	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Number of fruits and vegetables	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Grain foods/ mostly whole grain foods	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Includes processed foods	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Includes milk or milk products	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4
Includes legumes, nuts, seeds, fish and other seafood, eggs, poultry, red meat with the fat removed.	o1	o2	o3	o4	o1	o2	o3	o4	o1	o2	o3	o4

- The clarity of each component in a meal scoring tool (how clear is the wording?)
- The essentiality of each component in a meal scoring tool (how necessary is the question?)
- Recommendations for improvement of the listed components

Relevant Scale: 1= Not relevant; 2 = Somewhat relevant; 3 = Quite relevant; 4 = Very relevant

Clarity Scale: 1= Not clear; 2 = Item needs revision; 3 = Item needs some revision, 4 = Very clear

Essential Scale: 1 = Not essential; 2 = Useful but not essential; 3 = Somewhat essential, 4 = Very essential

Any further comments/ recommendations:

16.7 Appendix G: Scoring assessment form – part two

Name: _____

Preferred postal address: _____

Kindly review the components suggested for a meal scoring tool and provide your feedback on the following:

- The relevance of each component in the meal scoring tool (how important is the question?)
- The clarity of each component in the meal scoring tool (how clear is the wording?)

	How relevant is this item?				Is this item clear?				How essential is this item?			
Introductory blurb	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Flow chart instructions	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Core food groups	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Identifying proportions of food groups	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Serving size guide	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Food and Drink rating guide	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Definitions given of each rating range e.g., 1-3, 4-8, 9-12 (<i>found in flow chart manual</i>)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
Examples 1, 2 & 3	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4

- The essentiality of each component in the meal scoring tool (how necessary is the question?)
- Recommendations for improvement of the listed components

Relevant Scale: 1= Not relevant; 2 = Somewhat relevant; 3 = Quite relevant; 4 = Very relevant

Clarity Scale: 1= Not clear; 2 = Item needs revision; 3 = Item needs some revision, 4 = Very clear

Essential Scale: 1 = Not essential; 2 = Useful but not essential; 3 = Somewhat essential, 4 = Very essential

Any further comments/ recommendations:

16.8 Appendix H: Participant Information Sheet for survey recruitment

This project is being supervised by Dr. Rajshri Roy (Lecturer in Nutrition) and carried out by Akeena Raphael (Dietitian student).

It is important to read the following carefully so that you can make an informed decision about whether you would like to participate.

It is well understood that a nutritionally adequate diet is related to good health and positive wellbeing. The effect of good nutrition and its effects on health and wellbeing continues to expand in its research. Therefore, the development of a menu scoring tool allows nutrition experts, to apply this tool in their own research analysis. The Healthy Menu Scoring Tool allows experts to audit menus in food service outlets and assess its relative healthiness. This tool is based on the Healthy Eating Guidelines and therefore offers a meal quality indicator that is relevant for the NZ population.

This questionnaire will take approximately 20 minutes. We recommend completing this survey on a desktop and keeping a pen and paper handy to score the meals in this survey using the Healthy Menu Scoring Tool.

Your rights as a participant: Participation in this study is entirely voluntary. You may stop filling out the survey at any time, without giving reason. However, once the survey is submitted it cannot be withdrawn as the researcher will not know who provided the data.

Anonymity and Confidentiality: Your survey responses are anonymous. Your data (survey responses) will be used to assist with the validation of a 'Healthy Menu Scoring Tool'. Statistical analysis will be performed, the results of which will then be discussed in research reports. Research publications and presentations from this study will not contain any information that could personally identify you, only averages will be presented.

Electronic data (survey responses) are the property of the University of Auckland, Department of Nutrition & Dietetics and will be stored on a password-protected computer and back up on a University of Auckland server indefinitely to allow for publication and future analysis.

Contact details: We appreciate the time you have taken to read this information. If you would like to contact the Student Researcher to discuss this study further, please email **Akeena Raphael:** arap292@aucklanduni.ac.nz .

Alternate contacts:

Principal Investigator Contact Details:

Dr Rajshri Roy, PhD, r.roy@auckland.ac.nz,

Discipline of Nutrition and Dietetics, Head of Department

Contact Details: Prof Clare Wall, c.wall@auckland.ac.nz

For any queries regarding ethical concerns, contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice-Chancellor, Private Bag 92019, Auckland 1142. Telephone 09 373-7599 ext. 83711. Email: humanethics@auckland.ac.nz

Approved by the University of Auckland Human Participants Ethics Committee on 22-02-2021 for three years, Reference Number UAHPEC2123

16.9 Appendix I: First revision of the HMST

Healthy Meal Scoring Tool

Revised from the National Eating and activity guidelines

Rating = 3	Rating = 2	Rating = 1
<p>This includes a variety of foods from the four groups, including:</p> <ul style="list-style-type: none"> • ½ plate (2 serves) of vegetables. • ¼ plate (2 serves) of carbohydrate foods. • ¼ plate (1 serve) of protein foods. <p>Uses whole foods or foods undergone some processing such as:</p> <ul style="list-style-type: none"> ○ Fresh vegetables and fruit, raw legumes, raw nuts and seeds, eggs, fish, chicken and red meat (with visible fat removed). ○ Frozen, packaged vegetables and fruit that may have been frozen quickly to keep their nutrient content, canned legumes, vegetables and fruit with no or minimal added sugar and/ or salt, which have been prepared and cooked ready for use. <p>Reduce saturated fat by:</p> <ul style="list-style-type: none"> ○ Choosing meat with little visible fat or remove fat before cooking ○ Cook meat in a way that removes fat such as grilling it, roast or bake it. ○ Uses low and/or reduced fat milk and cheese. ○ Uses unsaturated plant oils such as olive, canola or rice bran oil <p>Contains <u>low</u> sodium foods¹ such as fruit salad, Low fat milk/yoghurt,</p>	<p>This includes a variety of foods from the four groups, including:</p> <ul style="list-style-type: none"> • 1/3 plate (1-2 serves) of vegetables. • 1/3 plate (3-4 serves) of carbohydrate foods. • 1/3 plate (1-2 serve) of protein foods. <p>Contains <u>medium</u> sodium foods² such as instant noodles, fried rice, chicken soup, canned cream of chicken soup</p> <p>Contains some added sugars</p>	<p>This includes a variety of foods from the four groups, including:</p> <ul style="list-style-type: none"> • ¼ plate (less than 1 serve) of vegetables. • ½ plate (5+ serves) of carbohydrate foods. • ½ plate (3+ serves) of protein foods. <p>Foods that are highly processed. These foods, or the ingredients used to make them, are heavily processed so they are usually very different from their natural state such as ready-to-eat foods.</p> <p>Contains <u>high</u> sodium foods³ such as: pizza, deep fried foods, salami, tomato sauce, potato chips.</p> <p>Is high in added sugar such as cakes, biscuits, sweet bakery items, juices, lollies, and muffins.</p>

¹ Contains less than 120 mg of sodium per 100 g.

² Contains between 120-600mg of sodium per 100g.

³ Contains more than 600 mg of sodium per 100 g.

<p>Plain wholegrain products, unprocessed breakfast cereals, Unsalted nuts and seeds, uses reduced salt/sodium canned foods.</p> <p>Has little or no added sugars. (Total sugars ≤5.0 g/100 g)</p>		
Serving size guide		
Vegetables	Carbohydrate	Protein
<p>Non- starchy vegetables (Fresh, frozen or canned) A standard serving of vegetables is about 75 g, which is about the same as:</p> <ul style="list-style-type: none"> ○ ½ cup cooked pūhā, ○ silver beet, carrot, broccoli, Bok choy, taro leaves, ○ 1 cup green leafy or raw salad vegetables, ○ 1 medium tomato, ○ ½ cup canned beetroot, tomato, sweet corn. 	<p>Starchy vegetables</p> <ul style="list-style-type: none"> ○ ½ medium potato or similar sized piece of kūmara, taewa (Māori potato), yam (Pacific or NZ), taro, cassava <p>Breads, rice & cereals A standard serving is about the same as:</p> <ul style="list-style-type: none"> ○ 1 slice wholegrain bread, ½ medium wholegrain roll or flat bread, ½ cup cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta, bulgur or quinoa, ○ ½ cup (120 g) cooked porridge, ○ ¼ cup (30 g) muesli, ○ 2/3 cup cereal flakes (wholegrain where possible), 3 (35 g) crispbreads or crackers (wholegrain where possible). 	<p>Milk and milk products</p> <ul style="list-style-type: none"> ○ A standard serving is about the same as: 1 cup (250 ml) low or reduced fat fresh, ○ 2 slices (40 g) of cheese such as Edam, ○ ¾ cup (200 g) low- or reduced-fat yoghurt. <p>Milk alternatives</p> <ul style="list-style-type: none"> ○ 1 cup (250 ml) calcium-fortified plant-based milk alternatives (eg, soy, rice, almond, oat milk). <p>Fish and other seafood, eggs, poultry and/or red meat. (Fresh or frozen)</p> <ul style="list-style-type: none"> ○ 100 g cooked fish fillet, ○ One small can of fish, ○ 80 g cooked lean chicken, ○ 65 g cooked lean meat such as beef, lamb, pork, veal. ○ 2 large eggs, <p>Legumes, nuts, seeds and/or meat alternatives.</p> <ul style="list-style-type: none"> ○ A standard serving is about the same as: 1 cup (150 g) cooked or canned beans, lentils chickpeas, or split peas(preferably with no added salt), ○ 170 g tofu, 30 g nuts, seeds, peanut or almond butter or tahini or other nut or seed paste (no added salt).

Core food groups					
Vegetables		Carbohydrate		Protein	
Portion	Rating	Portion	Rating	Portion	Rating
½ plate (2+ servings)	3	¼ plate (2 serves)	3	¼ plate (1 serve)	3
1/3 plate (1-2 serves)	2	1/3 plate (3-4 serves)	2	1/3 plate (2-3 serves)	2
¼ plate (Less than 1 serve)	1	½ plate (5+ serves)	1	½ plate (3+ serves)	1
Not on plate	0	Not on plate	0	Not on plate	0
<ul style="list-style-type: none"> Non- starchy vegetables A standard serving of vegetables is about 75 g, which is about the same as: ½ cup cooked pūhā, silverbeet, carrot, broccoli, bok choy, taro leaves, ½ cup canned, beetroot, tomato, sweet corn, 1 cup green leafy or raw salad vegetables, 1 medium tomato. 		<ul style="list-style-type: none"> Starchy vegetables ½ medium potato or or similar sized piece of kūmara, taewa (Māori potato), yam (Pacific or NZ), taro, cassava Breads, rice & cereals A standard serving is about the same as: 1 slice wholegrain bread, ½ medium wholegrain roll or flat bread, ½ cup cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta, bulgur or quinoa, ½ cup (120 g) cooked porridge, ¼ cup (30 g) muesli, 2/3 cup cereal flakes (wholegrain where possible), 3 (35 g) crispbreads or crackers (wholegrain where possible). 		<ul style="list-style-type: none"> Milk and milk products A standard serving is about the same as: 1 cup (250 ml) low or reduced fat fresh, 2 slices (40 g) of cheese such as Edam, ¾ cup (200 g) low- or reduced-fat yoghurt Milk alternatives 1 cup (250 ml) calcium-fortified plant based milk alternatives (eg, soy, rice, almond, oat milk). Fish and other seafood, eggs, poultry and/or red meat. 100 g cooked fish fillet or one small can of fish, 2 large (2 x 60 g = 120 g) eggs, 80 g cooked lean chicken, 65 g cooked lean meat such as beef, lamb, pork, veal. Legumes, nuts, seeds A standard serving is about the same as: 1 cup (150 g) cooked or canned beans, lentils chickpeas, or split peas (preferably with no added salt), 170 g tofu, 30 g nuts, seeds, peanut or almond butter or tahini or other nut or seed paste (no added salt). 	

Nutrient intake		
Rating = 3	Rating = 2	Rating = 1
<ul style="list-style-type: none"> • Limits saturated fat by: <ul style="list-style-type: none"> - Choosing meat with little visible fat or remove fat before cooking - Cook meat in a way that removes fat such as grilling it, roast or bake it. - Uses low and/or reduced fat milk and cheese. - Uses unsaturated plant oils such as olive, canola or rice bran oil • Contains less than 120 mg of sodium per 100 g. • Has little or no added sugars. • Uses whole foods that are close to their natural state but may have been harvested, washed or cleaned ready for eating or cooking. Examples of whole foods are fresh vegetables and fruit, raw legumes, raw nuts and seeds, eggs, fish, chicken and red meat (with visible fat removed). 	<ul style="list-style-type: none"> • Contains between 120-600mg of sodium per 100g. • Contains some added sugars • Foods that have undergone some processing. Examples include whole grains that have had their outer inedible husks removed but still have the edible parts of their structure, wholemeal flour ground from whole grains, frozen, packaged vegetables and fruit that may have been frozen quickly to keep their nutrient content, canned legumes, vegetables and fruit with no or minimal added sugar and/ or salt, which have been prepared and cooked ready for use. 	<ul style="list-style-type: none"> • Contains more than 600 mg of sodium per 100 g. • Contains mostly added sugars. • Foods that are highly processed. These foods, or the ingredients used to make them, are heavily processed so they are usually very different from their natural state such as ready-to-eat foods.

16.10 Appendix J: second revision of the HMST

The Healthy Menu Scoring Tool (HMST) is designed to assess the healthiness of a meal quickly and conveniently. It is important to note all foods can fit into a healthy diet and one food choice does not make a meal 'unhealthy'. The HMST aims to score the diet quality of a single meal in line with the Healthy Eating Guidelines designed to improve health of the NZ population.

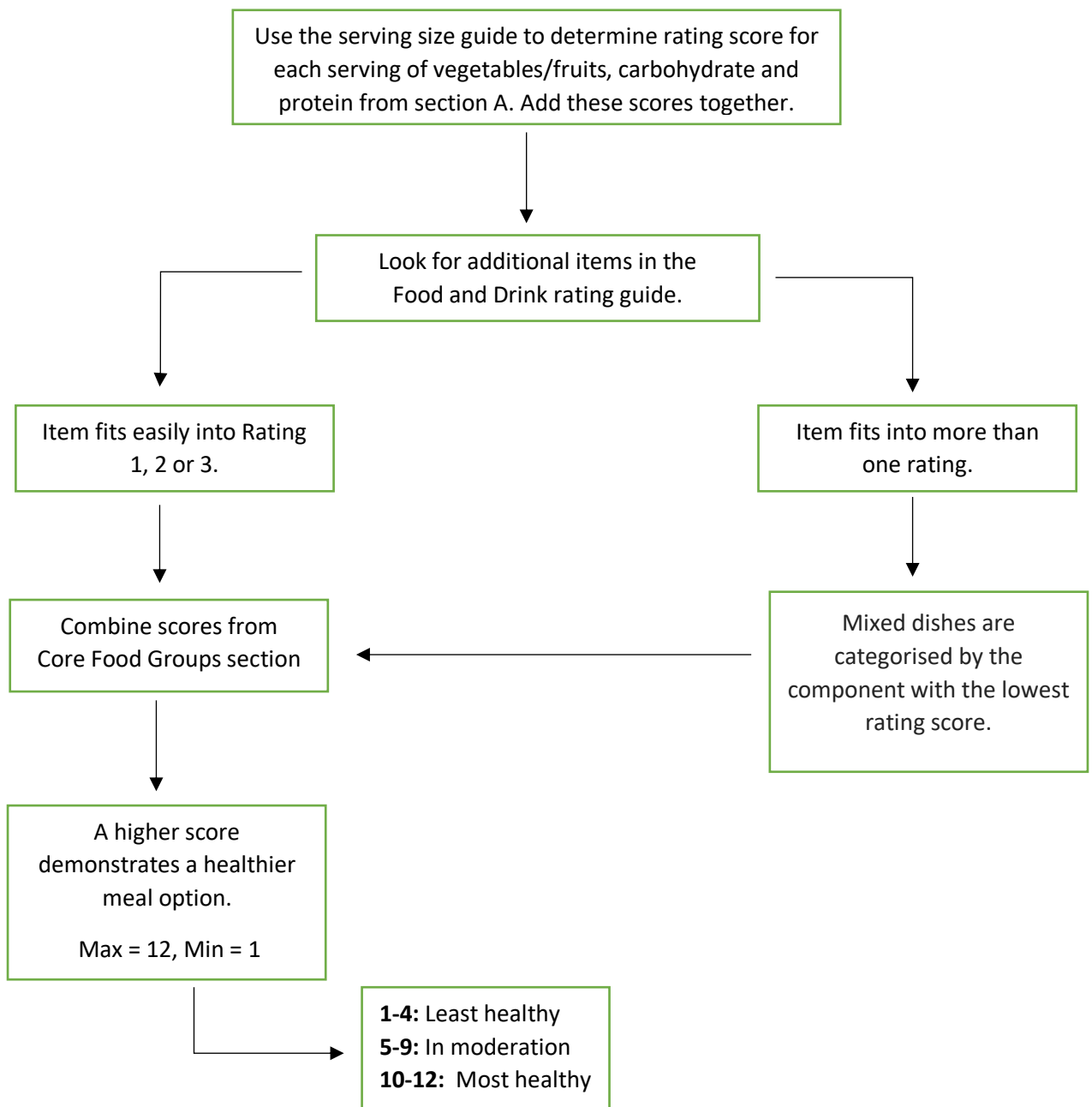
The tool is designed to be used by dietitians or nutrition experts to guide research analysis, meal auditing, and menu planning.

Two main sections characterise the scoring tool:

- A. Core food groups and
- B. Food and Drink rating guide

Section A aims to evaluate the proportions of each main food group relevant to a meal being assessed. In addition, section B considers discretionary food items (foods and drinks do not fit into the core food groups) and food preparation methods that can affect the nutritional quality of a meal. The combined score of both sections will reveal the healthiness of a meal between 1 (least healthy) - 12 (most healthy).

Use the flowchart below to determine a rating score for your food and drink choice. Before you begin, it will be helpful to have the quantities and preparation methods of your meal in the scoring process.



Section A: Core food groups					
Vegetables/Fruit		Carbohydrate		Protein	
Quantity	Rating	Quantity	Rating	Quantity	Rating
2+ servings	3	1-2 serves	3	1-2 serve	3
1-2 serves	2	3-4 serves	2	3-4 serves	2
Less than 1 serve	1	5+ serves	1	5+ serves	1
None	0	None	0	None	0
Serving size guide					
<p>Non-starchy vegetables (Fresh, frozen or canned) A standard serving of vegetables is about 75 g, which is about the same as:</p> <ul style="list-style-type: none"> ○ ½ cup cooked pūhā, silver beet, carrot, broccoli, Bok choy, taro leaves. ○ 1 cup green leafy or raw salad vegetables. ○ 1 medium tomato. ○ ½ cup canned beetroot, tomato, sweet corn. <p>Fruit A standard serve of fruit is about 150 g, which is about the same as:</p> <ul style="list-style-type: none"> ○ 1 medium apple, banana, orange or pear. ○ 2 small apricots, kiwifruit or plums. ○ 1 cup diced or canned fruit (drained and with no added sugar where possible). 		<p>Starchy vegetables</p> <ul style="list-style-type: none"> ○ ½ medium potato or similar sized piece of kūmara, taewa (Māori potato), yam (Pacific or NZ), taro, cassava. <p>Breads, rice & cereals A standard serving is about the same as:</p> <ul style="list-style-type: none"> ○ 1 slice wholegrain bread, rēwena bread. ○ ½ medium wholegrain roll, flat bread, roti. ○ ½ cup cooked rice, pasta, noodles, barley, buckwheat, semolina, polenta or quinoa. ○ ½ cup (120 g) cooked porridge. ○ ¼ cup (30 g) muesli. ○ 2/3 cup cereal flakes (wholegrain where possible). ○ 3 (35 g) crispbreads or crackers (wholegrain where possible). 		<p>Milk and milk products</p> <ul style="list-style-type: none"> ○ 1 cup (250 ml) low or reduced fat. ○ 2 slices (40 g) of cheese such as Edam. ○ ¾ cup (200 g) low- or reduced-fat yoghurt. <p>Milk alternatives</p> <ul style="list-style-type: none"> ○ 1 cup (250 ml) calcium-fortified plant-based milk alternatives (eg, soy, rice, almond, oat milk). <p>Fish and other seafood, eggs, poultry and/or red meat. (Fresh or frozen)</p> <ul style="list-style-type: none"> ○ 100 g cooked fish. ○ 1 small can of fish. ○ 80 g cooked lean chicken, ○ 65 g cooked lean beef, lamb, pork, veal. ○ 2 large eggs. <p>Legumes, nuts, seeds and/or meat alternatives.</p> <ul style="list-style-type: none"> ○ A standard serving is about the same as: 1 cup (150 g) cooked or canned beans, lentils chickpeas, or split peas (preferably with no added salt). ○ 170 g tofu. ○ 30 g nuts, seeds, peanut or almond butter or tahini or other nut or seed paste (no added salt). 	

Section B: Food and Drink Rating Guide

Rating = 3	Rating = 2	Rating = 1
<p>Includes food that are low in sodium, added sugars and/or saturated fat in the following ways:</p> <ul style="list-style-type: none"> ○ Uses low and/or reduced fat yoghurt and cheese. ○ Uses trim/ low fat (green/ light-blue top) milk. ○ Uses unsaturated plant oils such as olive, canola or rice bran oil. ○ Chooses reduced fat spreads based in sunflower or olive oils. ○ Salad dressings, dips and sauces with no added salt or reduced fat varieties. ○ Wholegrain bread/pasta/rice. ○ Unflavoured and/or unsweetened breakfast cereals. ○ Unsalted nuts and seeds. ○ Canned fruit in natural juice or water. ○ Plain tofu. <p>Considers preparing food in the following ways:</p> <ul style="list-style-type: none"> ○ Steamed or boiled. ○ Chooses lean meat with little visible fat or remove fat before cooking. ○ Meat is cooked in a way that removes fat such as oven baked, grilled, or roasted. ○ Canned fish in spring water. ○ Plain smoked fish. <p>Includes drinks with no added sugars and/or choosing plain water.</p>	<p>Includes food and drinks that should be consumed in moderation. They provide some valuable nutrients and contain moderate amounts of saturated fat, added sugar and sodium. These foods may be healthier alternatives of items in rating 1.</p> <p>For example:</p> <ul style="list-style-type: none"> ○ Full fat yoghurt/cheese ○ Salted nuts and seeds ○ White bread/pasta/rice ○ Rēwena Bread ○ Flavoured breakfast cereals⁴ ○ Full fat (dark blue top) milk. ○ Canned fruit in syrup ○ Dried fruit ○ Plain biscuits ○ Packaged tofu in sweet or salty sauce. ○ Full fat salad dressings and sauces. ○ Asian style sauces⁵ <p>Prepares meat in the following ways:</p> <ul style="list-style-type: none"> ○ Meat that is pan fried with a light coat of oil. ○ Crumbed meat ○ Canned fish in brine or flavoured sauce. <p>Moderate consumption of drinks such as:</p> <ul style="list-style-type: none"> ○ Flavoured milks ○ Fruit juice with no added sugar⁶. ○ Kombucha and other fermented soft drinks⁷. ○ 'Diet' or 'no sugar' soft drinks 	<p>Includes discretionary food items⁸ that are high in added sugars, sodium, and saturated fats. These food and drinks are considered occasional choices, in small amounts to add enjoyment to eating.</p> <p>For example:</p> <ul style="list-style-type: none"> ○ All deep-fried foods ○ Fried bread ○ Savoury pies ○ Instant noodles ○ Potato chips ○ Uses butter, cream, jams, marmalades, chocolate spreads. ○ Commercial burgers ○ Sweet bakery items ○ Iced, coated biscuits or filled. ○ Steamed pudding ○ Confectionary items <p>Prepares meat/fish in the following ways:</p> <ul style="list-style-type: none"> ○ Fatty/salty meat ○ Deep fried, battered or shallow fried with generous amounts of oil. ○ Processed luncheon, cured meats, canned spam. <p>Limited intake of sugar-sweetened beverages such as:</p> <ul style="list-style-type: none"> ○ Sugary soft drinks/cordials ○ Flavoured mineral water ○ Sport and energy drinks ○ Fruit drinks

⁴ Standard flavoured cereals > 20g added sugar per 100g. Cereals containing dried fruit > 25g sugar per 100g. Avoid chocolate coated cereals.

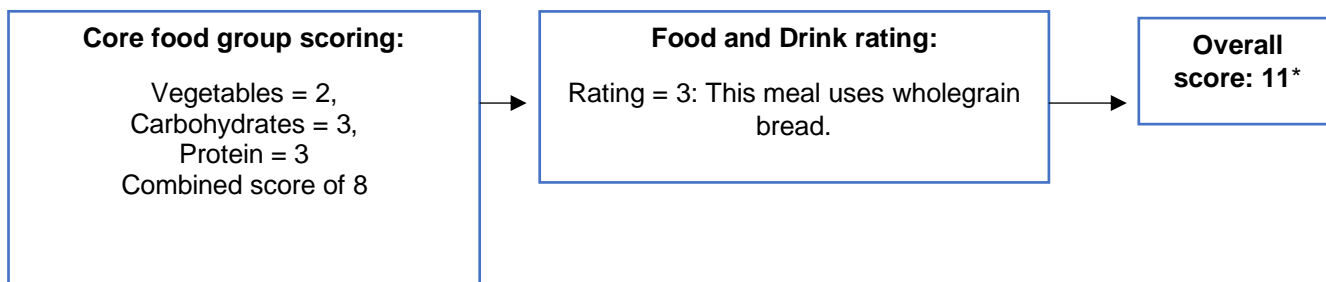
⁵ Moderate amounts advised as these sauces are usually higher in salt and added sugars

⁶ 125ml (½ cup) standard serve. Serves > 125ml = rating 1.

⁷ Less than 1g of sugar per 100ml.

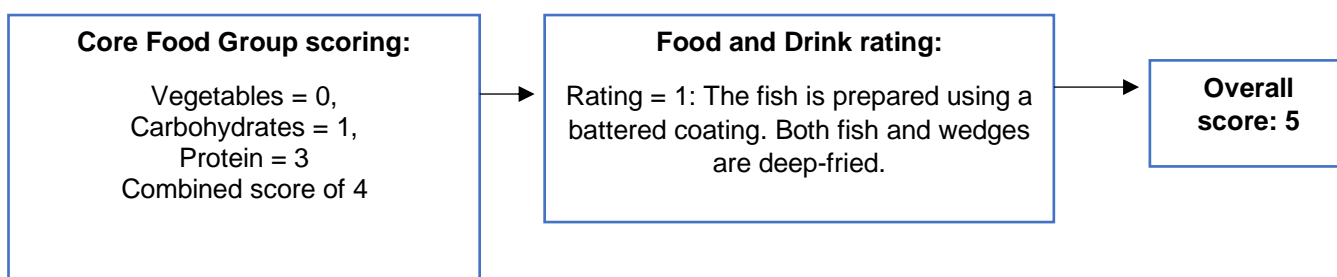
⁸ From Eat for Health Australian Dietary guidelines

Example 1 2 wholegrain breads with mashed 1/2 avocado. 2 scrambled eggs and side of 1/2 C spinach.



**Inclusion of a 250ml can of Coke would shift the Food and Drink Rating to 2, giving an overall score of 9*

Example 2 Fish and chips using 100g battered tempura fish and deep fried kumara wedges (1 whole kumara).



Example 3: Instant noodles with extra Asian style sauces and 100g chicken and 1 C of mixed vegetables stir-fried.

