Development and validation of the New Zealand Women’s Healthy Diet Index

A thesis presented in partial fulfilment of the requirements for the degree of

Masters of Science
In
Nutrition and Dietetics

at Massey University, Albany
New Zealand

Andrea Fenner
2015
Abstract

Background: Diet quality indices represent an alternative approach to assessing associations between diet, health, and disease. At present, there is no simple, valid, food-based diet quality index to reflect the adherence of young women to national dietary guidelines in New Zealand.

Aim: To develop and validate a healthy diet index to assess diet quality and adherence of young women to the Eating and Activity Guidelines for New Zealand Adults (EAGNZA).

Method: Dietary information was obtained from young women (n=110) aged 19 – 45 years who completed the New Zealand Women’s Food Frequency Questionnaire (NZWFFQ). Data from the NZWFFQ was used to develop the New Zealand Women’s Healthy Diet Index (NZW-HDI). Participants also completed a four-day weighed food record (FR), which was used to validate the index. Relative validity was evaluated by comparing the NZW-HDI total scores derived from the NZWFFQ against the NZW-HDI derived from the FR. Paired t-tests, Pearson’s correlation coefficients, cross-classification, and weighted kappa were used to assess relative validity. Construct validity of the NZW-HDI was determined using nutrient intakes from the FR and Spearman’s correlation coefficients and linear contrast analysis.

Results: Participants achieved an average total score of 76.7 ± 0.9 for the NZW-HDI derived from the NZWFFQ and 75.2 ± 11.1 derived from the FR. For relative validity, a significant correlation between total scores from the NZWFFQ derived NZW-HDI and the FR derived NZW-HDI (r = 0.29; P < 0.05) was found. Cross-classification of participants showed 50% were classified into the same tertile, and 16% were grossly misclassified into opposite tertiles. The weighted κ-statistic found both methods had fair agreement in ranking the NZW-HDI total score (κ = 0.244). For construct validity, the NZW-HDI total score was significantly and positively related to dietary fibre (0.227), vitamin C (0.214), folate (0.286), and calcium intakes (0.277), and inversely related to intakes of saturated fat (-0.318) and alcohol (-0.236) (all p<0.05). In addition, using linear contrast analysis, higher NZW-HDI scores were associated with higher intakes of vitamin C and folate (P < 0.05).

Conclusion: Adherence to the EAGNZA was moderate in this sub-sample of participants. The NZW-HDI was found to have fair relative validity in assessing diet quality. As expected, the total score was positively associated with dietary fibre, vitamin C, folate, and calcium intakes, and inversely related to intakes of saturated fat and alcohol. Future research is required to improve the validity of the NZW-HDI before use in larger study populations.
Acknowledgements

There are a number of people I would like to acknowledge for their involvement in this study. First of all, I would like thank the women who participated in the wider EXPLORE study, without which none of this research would have been possible.

To my academic supervisor, Kathryn Beck. Your innovative ideas, constant support, and motivation over the last two years are much appreciated.

A special thank you to Rozanne Kruger, the key driver of the EXPLORE study, who gave insightful and constructive feedback on methods and results, and coordinated assistance for data entry. Thank you to Wendy O’Brien and Shakeela Jayasinghe who coordinated the recruitment, screening and testing of participants. To Sarah Philipsen, your help with the analysis of the food records is much appreciated. It was also great to work with other members of the EXPLORE team, who assisted with testing of participants, Pam von Hurst, Cathryn Conlon, Richard Swift, Owen Mugridge, PC Tong, Maria Casale, Jenna Schrijvers, Adrianna Hepburn, and Zara Houston.

A personal dedication to my family and friends. In particular, to Zeke - for being a constant through the chaos. You were right by my side every step of the way. To Mum and Dad, thank-you for inspiring me to always achieve my goals. I cannot wait to spend more family time together. To Mark and Chrissie, I will be forever grateful for your love and generosity.
# Table of Contents

Abstract .................................................................................................................................................... i  
Acknowledgements ........................................................................................................................................ ii  
List of Tables .......................................................................................................................................... vi  
List of Figures ........................................................................................................................................ vii  
Abbreviations ....................................................................................................................................... viii  

1. Introduction ........................................................................................................................................ 1  
   1.2 Aims and objectives ...................................................................................................................... 5  
   1.3 Thesis structure ............................................................................................................................. 5  
   1.4 Researcher’s contribution to study ............................................................................................... 6  

2. Literature review ................................................................................................................................. 7  
   2.1 Young women and diet quality ..................................................................................................... 7  
   2.2 Dietary assessment ....................................................................................................................... 8  
      2.2.1 Levels of measuring food consumption ................................................................................. 8  
      2.2.2 Assessment of dietary intake for individuals ........................................................................ 9  
   2.3 Analysis of dietary data ............................................................................................................... 14  
      2.3.1 The traditional approach - determination of nutrient and food intakes ............................. 14  
      2.3.2 Evaluation of nutrient and food intakes .............................................................................. 14  
      2.3.3 Limitations in the analysis of nutrient and food intake ....................................................... 15  
   2.4 An alternative approach - dietary pattern analysis .................................................................... 16  
      2.4.1 Empirically derived dietary patterns .................................................................................... 16  
      2.4.2 Theoretically derived dietary patterns .................................................................................. 17  
         2.4.2.1 Diet quality indices – a new dietary assessment method ................................................ 17  
         2.4.2.2 Purpose of diet quality indices ........................................................................................ 17  
         2.4.2.3 Application of diet quality indices ..................................................................................... 18  
   2.5 Previous research on diet quality indices developed based on dietary guidelines .................... 21  
      2.5.1 Original diet quality indices – an overview ........................................................................ 21  
      2.5.2 Diet quality indices developed overseas .............................................................................. 22  
      2.5.3 Diet quality indices developed in Australia ......................................................................... 22  
      2.5.4 Diet quality indices developed in New Zealand ................................................................. 23  
   2.6 Development of a diet quality index ........................................................................................... 30  
      2.6.2 Types of components used .................................................................................................. 31  
      2.6.3 Assigning foods to selected components ............................................................................ 39
List of Tables

Table 1.1 Contribution of Researcher’s to study ................................................................. 6
Table 2.1 Overview of traditional dietary assessment methods for individuals ................. 12
Table 2.2 Types of dietary pattern analysis methods and their relative strengths and limitations ..... 20
Table 2.3 Overview of diet quality indices developed based on dietary guidelines or recommendations ........................................................................................................ 24
Table 2.4 Nutrients included as components in previous diet quality indices .................. 34
Table 2.5 Foods, food groups, and other measures of diet quality used as components in previous diet quality indices ........................................................................................................ 36
Table 3.1 Eating Guidelines Statements for New Zealand Adults ...................................... 56
Table 3.2 Point system used for NZW-HDI individual components .................................. 58
Table 3.3 Components and scoring of the NZW-HDI ......................................................... 60
Table 4.1 Participant characteristics of a subsample of women from the EXPLORE study ....... 71
Table 4.2 Distribution of participants by NZW-HDI scores ................................................. 72
Table 4.3 Frequency of participants in each scoring category for NZW-HDI component sub-scores, and correlation of index components with total score .............................................................. 73
Table 4.4 Comparison of sub-scores for each component and total score from NZWFFQ-derived NZW-HDI to FR-derived NZW-HDI ................................................................. 79
Table 4.5 Pearson’s correlation coefficients and agreement between NZWFFQ-derived NZW-HDI to FR-derived NZW-HDI ........................................................................................................ 82
Table 4.6 Correlations between the NZW-HDI (total score and individual components) based on the NZWFFQ and energy and nutrient intakes derived from the FR .......................... 86
Table 4.7 Dietary intakes derived from FR by tertiles of the NZW-HDI ............................... 88
List of Figures

Figure 2.1 Stages involved in the development of a DQI ......................................................... 30

Figure 3.1 Stages involved in the development and validation of the New Zealand Women’s Healthy Diet Index .............................................................................................................................................. 49
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternate Healthy Eating Index</td>
<td>A-HEI</td>
</tr>
<tr>
<td>Australian Eating Survey Food Frequency Questionnaire</td>
<td>AES FFQ</td>
</tr>
<tr>
<td>Australian Health Eating Index</td>
<td>Aust-HEI</td>
</tr>
<tr>
<td>Australian Recommended Food Score</td>
<td>ARFS</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>BMI</td>
</tr>
<tr>
<td>Bioelectrical Impedance Analysis</td>
<td>BIA</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>CHD</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>CVD</td>
</tr>
<tr>
<td>Canadian Healthy Eating Index</td>
<td>Canadian-HEI</td>
</tr>
<tr>
<td>Dietary Guidelines Index</td>
<td>DGI</td>
</tr>
<tr>
<td>Dietary Guidelines for Americans Index</td>
<td>DGAI</td>
</tr>
<tr>
<td>Diet Quality Index</td>
<td>DQI</td>
</tr>
<tr>
<td>Diet Quality Indices</td>
<td>DQIs</td>
</tr>
<tr>
<td>Diet Quality Index Alternative</td>
<td>DQI-a</td>
</tr>
<tr>
<td>Diet Quality Index China</td>
<td>DQI-C</td>
</tr>
<tr>
<td>Diet Quality Index Revised</td>
<td>DQI-R</td>
</tr>
<tr>
<td>Dietary Quality Score</td>
<td>DQS</td>
</tr>
<tr>
<td>Eating and Activity Guidelines for New Zealand Adults</td>
<td>EAGNZA</td>
</tr>
<tr>
<td>Examining Predictors Linking Obesity Related Elements</td>
<td>EXPLORE</td>
</tr>
<tr>
<td>Food Based Dietary Guidelines</td>
<td>FBDG</td>
</tr>
<tr>
<td>Food Frequency Questionnaire</td>
<td>FFQ</td>
</tr>
<tr>
<td>Food Habits Questionnaire</td>
<td>FHQ</td>
</tr>
<tr>
<td>Food Record</td>
<td>FR</td>
</tr>
<tr>
<td>Healthy Diet Indicator</td>
<td>HDI</td>
</tr>
<tr>
<td>Healthy Eating Index</td>
<td>HEI</td>
</tr>
</tbody>
</table>
Healthy Eating Index – 2005 HEI-2005
Healthy Eating Index – 2010 HEI-2010
Healthy Eating Index for Australian adults HEIFA-2013
Healthy Food Index HFI
Healthy Food and Nutrient Index HFNI
Human Nutrition Research Unit HNRU
Low-Density Lipoproteins LDL
New Zealand NZ
Nutrient Reference Values NRVs
New Zealand Adolescent Food Frequency Questionnaire NZAFFQ
New Zealand Women’s Food Frequency Questionnaire NWFFQ
New Zealand Diet Quality Index for Adolescents NZDQI-A
New Zealand Women’s Healthy Diet Index NZW-HDI
Mediterranean Diet Score MDS
Overall Dietary Index Revised ODI-R
Recommended Food Score RFS
Saturated Fat SF
Simple Diet Quality Index SDQI
Standard Deviation SD
The Index of Relative Socioeconomic Disadvantage SEIFA
United States US
United States Department of Agriculture USDA