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Determining the Relative Validity and Reproducibility of a Food Frequency Questionnaire to Assess Food Group Intake in High Performing Athletes

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

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Abstract

Background: *Optimal nutrition is essential for high performing athletes in order to train effectively, optimise recovery and improve their performance. Given the differences in dietary requirements and practices that exist between athletes and the general population, dietary assessment tools designed specifically for athletes are required. Food frequency questionnaires (FFQs) are commonly used to assess habitual dietary intake as they are inexpensive, quick and easy to administer. Currently there are no athlete-specific, up-to-date, valid and reproducible FFQs to assess food group intake of athletes. This study aims to determine the relative validity and reproducibility of an athlete-specific FFQ against an estimated four day food record (4DFR) to assess food group intake in high performing athletes.*

Methods: *Data from 66 athletes (24 males, 42 females) representing their main sport at regional level or higher and aged 16 years and over, was collected as part of a validation study in 2016. Athletes completed the athlete-specific FFQ at baseline (FFQ1) and four weeks later (FFQ2) to assess reproducibility. An estimated 4DFR was completed between these assessments to determine the relative validity of the FFQ1. Foods appearing in the 4DFR were classified into the same 129 food groups as the FFQ, and then further classified into 28 food groups in gram amounts. Agreement between the two methods for intake of food group and core food group intake was assessed using Wilcoxon signed rank tests, Spearman's correlation coefficients, cross classification with tertiles, the weighted kappa statistic and Bland-Altman analysis.*

Results: *The FFQ overestimated intake for 17 of 28 food groups compared with the 4DFR ($p < 0.05$). Correlations ranged from 0.11 (processed foods) to 0.78 (tea, coffee & hot chocolate), with a mean of 0.41. Correct classification of food groups into the same tertile ranged from 35.4% (starchy vegetables) to 55.5% (fats & oils). Misclassification into the opposite tertile ranged from 4.6% (legumes) to 15.4% (starchy vegetables; sauces & condiments). The weighted kappa demonstrated fair to moderate agreement ($k = 0.21-0.60$) for food groups. Bland-Altman plots suggested that for most of food groups, the difference between FFQ1 and the 4DFR increased as the amount of each food group consumed increased. Intake from FFQ1 was significantly higher than from FFQ2 for 13 of 28 food*

groups. All effect sizes were small ($r=0.1$). Reproducibility correlations ranged from 0.49 (potato chips; fats & oils) to 1.00 (tea, coffee & hot chocolate), with a mean of 0.65. For the 23 food groups classified into tertile, 20 had >50% of participants correctly classified, <10% grossly misclassified, and 20 demonstrated moderate to good agreement ($k=0.61-0.80$). The exceptions were dairy; fats & oils; and processed foods & drinks which presented fair agreement ($k=0.21-0.40$).

Conclusions: The FFQ showed reasonable validity and good reproducibility for assessing food group intake in high performance athletes in New Zealand. The FFQ could be used in future research as a convenient, cost-effective and simple way to obtain athletes' food group intake, and identify those who could benefit from interventions to improve their nutritional adequacy and potentially their athletic performance.

Keywords: athlete; dietary assessment; questionnaire; validation; reproducibility

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Dedication

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Table of Contents

Abstract	i
Acknowledgements	iii
Dedication	iv
Table of Contents	v
List of Tables	viii
List of Figures	x
Abbreviations List	xi
Chapter 1: Introduction	1
1.1 Purpose of the study	5
1.2 Aims, objectives & hypothesis	5
1.3 Structure of the thesis	5
1.4 Researcher contributions.....	6
Chapter 2: Literature Review	7
2.1 Introduction to the literature review.....	7
2.2 Dietary intake and performance	7
2.3 Athlete dietary requirements	9
Carbohydrates.....	10
Protein.....	11
Fat	11
Vitamins, minerals and antioxidants.....	12
Fluid.....	12
2.4 Dietary assessment methods.....	13
Prospective methods	14
Retrospective methods.....	15
2.5 Selecting a dietary assessment method to be used in research.....	21
2.6 Dietary assessment challenges in athletes	22
2.7 Dietary assessment methods designed to assess dietary intake in athletes.....	27
2.8 Design and development of food frequency questionnaires	33
2.9 Considerations when assessing the validity of food frequency questionnaires.....	35
2.10 Considerations when assessing the reproducibility of food frequency questionnaires.....	37
2.11 Statistical analysis of validity and reproducibility.....	38
2.12 Summary	40

Chapter 3: Research Manuscript: Determining the relative validity and reproducibility of a food frequency questionnaire to assess intake of food groups in high performing athletes	41
3.1 Abstract	41
3.2 Introduction	43
3.3 Study Methodology.....	45
Study design and participants.....	45
Development of the food frequency questionnaire	45
Study procedures	46
Data handling	47
Statistical analysis	49
3.4 Results.....	51
3.4.1 Participant Characteristics	51
3.4.2 Validity of the FFQ.....	53
3.4.3 Reproducibility of the FFQ	62
3.5 Discussion.....	70
3.5.1 Validity for food groups	70
3.5.2 Reproducibility for food groups.....	74
3.5.3 Strengths and Limitations	76
3.6 Conclusions	78
3.7 Acknowledgements.....	79
3.8 Author Contributions	79
3.9 Conflicts of Interest.....	79
Chapter 4: Conclusions and Recommendations	80
4.1 Introduction	80
4.2 Summary of findings	80
4.3 Strengths and Limitations	81
4.5 Research recommendations for further development and future research.....	85
4.6 Conclusion.....	86
Appendices.....	88
Appendix A: Food frequency questionnaire	88
Appendix B: Standard order of procedures	129
Appendix C: Four day food record	131
Appendix D: Condensed/amended food group list	148
Appendix E: Frequency Conversions.....	153
Appendix F: Conversions into gram amounts.....	154
Appendix G: Assumptions and decision made for the food record.....	159

Appendix H: Supplementary results	165
Bland-Altman plots for validity	165
Bland-Altman plots for reproducibility	169
Bland-Altman and linear regression tables.....	175
Mean results	179
References.....	183

List of Tables

Chapter 1: Introduction

Table 1.1 Researchers contributions to this study.....	6
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Chapter 2: Literature Review

Table 2.1 Dietary assessment methods: procedures, advantages and disadvantages.....	19
---	----

Table 2.2 International dietary assessment validation studies in athletes.....	29
--	----

Table 2.3 International dietary assessment reproducibility studies in athletes.....	32
---	----

Chapter 3: Research Manuscript

Table 3.1 Athlete characteristics.....	51
--	----

Table 3.2 Comparisons of daily food group intakes in grams from FFQ1 and 4DFR (n=65)	54
--	----

Table 3.3 Comparisons of daily core food group intakes in grams from FFQ1 and 4DFR (n=65).....	57
--	----

Table 3.4 Cross classification and weighted kappa for daily food group consumption between FFQ1 and 4DFR (n=65).....	58
--	----

Table 3.5 Cross classification and weighted kappa for daily core food group consumption between FFQ1 and 4DFR (n=65).....	60
---	----

Table 3.6 Comparisons of daily food group intakes in grams from FFQ1 and FFQ2 (n=65).....	62
---	----

Table 3.7 Comparisons of daily core food group intakes in grams from FFQ1 and FFQ2 (n=65).....	65
--	----

Table 3.8 Cross classification and weighted kappa for daily food group consumption between FFQ1 and FFQ2 (n=65).....	67
--	----

Table 3.9 Cross classification and weighted kappa for daily core food group consumption between FFQ1 and FFQ2 (n=65).....	68
---	----

Appendices

Table 1 Condensed/amended food group list.....	148
--	-----

Table 2 Frequency conversions for the FFQ.....	153
--	-----

Table 3 Weights (g) used for analysis of daily amounts used for each food item from FoodWorks9 for the FFQ and 4DFR.....	154
--	-----

Table 4 Assumptions made when classifying food items from the 4DFR into food groups within the FFQ.....	159
---	-----

Table 5 Assumptions made for amounts not reported in the 4DFR.....	162
--	-----

Table 6 Bland-Altman and linear regression analysis for daily food group intakes in gram from the FFQ1 and 4DFR (n=65).....	175
Table 7 Bland-Altman and linear regression analysis for daily core food group intakes in gram from the FFQ1 and 4DFR (n=65).....	176
Table 8 Bland-Altman and linear regression analysis for daily food group intakes in gram from the FFQ1 and FFQ2 (n=65).....	176
Table 9 Bland-Altman and linear regression analysis for daily core food group intakes in gram from the FFQ1 and FFQ2 (n=65).....	178
Table 10 Comparison of mean daily food group intakes in grams from the FFQ1 and 4DFR (n=65).....	179
Table 11 Comparison of mean daily core food group intakes in grams from the FFQ1 and 4DFR (n=65).....	180
Table 12 Comparison of mean daily food group intakes in grams from the FFQ1 and FFQ2 (n=65).....	181
Table 13 Comparison of mean daily core food group intakes in grams from the FFQ1 and 4DFR (n=65).....	182

List of Figures

Chapter 3: Research Manuscript

Figure 3.1 Bland-Altman plots of agreement for daily intake of (A) starchy foods (B) poultry (C) fats, oils, sauces & condiments and (D) processed foods & drinks between the FFQ1 and 4DFR.....61

Figure 3.2 Bland-Altman plots of agreement for daily intake of (A) breakfast cereals (B) poultry (C) takeaway foods and (D) fats, oils, sauces & condiments between the FFQ1 and FFQ2.....69/70

Appendices

Figure H1 Bland-Altman plots of agreement for daily intake of all food groups and core food groups.....165

Figure H2 Bland-Altman plots of agreement for daily intake of all food groups and core food groups.....169

Abbreviations List

FFQ	Food frequency questionnaire
FFQ1	Food frequency questionnaire appointment one
FFQ2	Food frequency questionnaire appointment two
FR	Food record
4DFR	Four day food record
24-hr	Twenty-four hour
DLW	Doubly labelled water
NZ	New Zealand
NZWFFQ	New Zealand Women's food frequency questionnaire
MUHNRC	Massey University Human Nutrition Research Centre
MUHEC	Massey University Human Ethics Committee
ISAK	International Society for Advancement of Kinanthropometry
SPSS	Statistical package for the social sciences
RDI	Recommended daily intake
LOA	limits of agreement
SD	standard deviation
CI	confidence interval
r	correlation coefficient
df	degrees of freedom
t	test statistic
i.e.	in other words
k	weighted kappa statistic
p	p-value
n	number
e.g.	example

BW	body weight
EI	energy intake
PAL	physical activity level
BMR	basal metabolic rate
MJ	Mega-joule
M	male
F	female
CHO	carbohydrate
BCAAs	branched chain amino acids
ATP	adenosine tri-phosphate
FUQ	Food use questionnaire
RAM	Rapid assessment method
REAP	Rapid eating assessment method
DATA	Digital analysis tool for athletes
VSSR	Virtual Self-Service Restaurant
US	United States
UK	United Kingdom
>	greater than
<	less than
≤	less than or equal to