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

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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, Spearmans 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

I would like to dedicate this thesis to my Oma, Julia Vonk. Sadly you passed away during the completion of this thesis, but I know you will be watching on from heaven proud of my achievements. You had the most beautiful soul and were always so supportive and encouraging of everything I did in life. You are dearly missed and will always hold a place in my heart.

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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