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Dietary Intakes of Older Retired Olympic and Commonwealth Games Athletes: A Cross-Sectional Study

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ABSTRACT

The aim of this study was to describe the dietary intakes of a sample of older retired New Zealand Olympics and/or Commonwealth Games athletes and compare intakes to the suggested dietary targets. Participants were recruited via the researchers' networks and by snowballing techniques. Dietary intake was estimated using three 24-h dietary recalls. Thirty-three adults (mean age 76 (8) years) who had represented New Zealand at an Olympic or Commonwealth Games between 1956 and 1990 participated. Men reported consuming 9499 (2646) kJ/day, while women were consuming 7404 (701) kJ/day. Both sexes consumed less carbohydrate, and more total and saturated fat, than recommended by the Acceptable Macronutrient Distribution Ranges (AMDRs). All women, and 56% of men had calcium intakes below the estimated average requirement (EAR), while a substantial proportion of men were also at risk of inadequate magnesium (41%) and zinc (66%) intakes. Despite higher overall energy, macronutrient and micronutrient intakes than the general population of similar age, being an older retired elite athlete does not confer protection against age-related or population-wide dietary challenges. Targeted dietary interventions may be warranted to support healthy aging in this group.

KEYWORDS

Olympian; Macronutrients; Micronutrients

Introduction

Energy intake declines substantially from middle to older age.¹ This decline, is presumably, due at least in part, to declines in physical activity and muscle mass. Unfortunately, this carries risk of a declining cycle, where

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lower energy intake leads to further decline in physical activity, and less than optimal intake of macro and micronutrients.¹ Indeed, data from NHANES indicate that energy intake declines by between 4000 to 5000 kJ in men and 2500 to 3300 kJ in women between the ages of 20 and 80 years, with concomitant declines in absolute intakes of many nutrients, increasing the risk of inadequacies.¹ Similar results are observed in New Zealand, where men and women over the age of 70 years were observed to have energy intakes 3134 and 1740 kJ lower than those aged 15 to 18 years of age.² Correspondingly, 86% and 93% of men and 93% and 28% of women were at risk of inadequate calcium and zinc intakes, respectively.²

In elite athletes, fueling appropriately for high volumes of training results in consumption of substantially more energy (and thus macro- and micro-nutrients) compared to the general population.³ It is possible that the higher intakes in younger adulthood, even if followed by similar rates of decline observed in the general population, may result in higher energy intakes, and thus less risk of inadequate intakes in older age. However, the pattern of dietary intakes of former athletes after retirement from competition, and through into older adulthood is understudied, and may provide insight into the longer-term effects of participating at the highest level of athletic performance. Therefore, the objective of this study was to describe the dietary intake of a sample of New Zealand's older retired Olympic and/or Commonwealth Games athletes and compare intakes of key nutrients to the appropriate suggested dietary targets.

Methods

Experimental design

This cross-sectional study was conducted across four cities in New Zealand (Auckland, Christchurch, Dunedin and Tauranga) between April and October 2023. Written informed consent was obtained from all participants prior to each participant completing a 90-minute session in their home with members of the research team, or at the research team's base of operations in each city. This study was approved by the University of Otago Ethics Committee (Health: H23/054) and conducted and reported in compliance with the STROBE guidelines for reporting of cross-sectional studies.

Participants

Any individual who had represented New Zealand at an Olympic or Commonwealth Games, was over the age of 60 years, and who lived, or was able to easily travel to one of the data collection centers was eligible to participate. Participant recruitment occurred mostly through the research

team's personal and professional networks within the New Zealand Olympic and Commonwealth Games community, and through snowball sampling techniques. A sample size of 32 was determined based on the primary outcome of grip strength (the results of which are still to be published).

Protocol

Interested participants contacted the study coordinator or principal investigator via phone or email, who provided them with an electronic copy of the participant information sheet and encouraged them to ask any further questions prior to completing an online screening questionnaire (REDCap). Eligible participants were then scheduled for a data collection visit and provided with a link to complete an online demographic questionnaire and falls risk assessment prior to the data collection visit. This questionnaire asked participants to report their residential address (which was later used by the researchers to assign a score of deprivation), their annual household income, and asked participants about regular dietary supplement use. However, if participants preferred to fill out the questionnaires using pen and paper this questionnaire was completed as part of the data collection visit.

Each data collection visit lasted approximately 90 minutes. Participants were given the opportunity to read a physical copy of the participant information sheet and ask any questions before providing written informed consent. Any remaining questionnaires were then completed and seated blood pressure and anthropometric measurements were collected following standardized protocols that have been described elsewhere. Participants were then guided through a series of physical function tests including the short physical performance battery test, grip strength and 2 min step test; completed a 24 h activity recall and were fitted with accelerometers to measure 24 h movement patterns, the results of which are reported elsewhere.⁴

Dietary intake was assessed using three 24-h dietary recalls. The first recall was conducted at the in-person data collection session, and the second and third recalls were completed over voice or video call on non-consecutive days following this (including at least one weekend day). All recalls were performed using a multiple pass technique (as described in⁵) All 24-h diet recalls were then entered into Foodworks Dietary Analysis software (version 9, Xyris Software Ltd, Brisbane, Australia) using Foodfiles 2018 (New Zealand Institute for Plant and Food Research Ltd, and the New Zealand Ministry of Health) and nutrient data from commonly consumed recipes collected as part of the 2008/09 New Zealand Adult Nutrition Survey.²

Statistical analysis

All analyses were carried out using Stata 18 (StatCorp. College Station, TX, USA). Mean intakes of energy, relevant macro and micronutrients, calculated from the three 24h diet recalls were used to represent usual dietary intakes of each individual. Intake from supplements was then added to these totals and reported separately. Mean and standard deviations (SD) for nutrient intakes were calculated for men and women separately. Macronutrient intakes as a percentage of total energy were compared to acceptable macronutrient distribution range (AMDR)⁶ and proportion of men and women above and below these ranges (as appropriate) were reported. Similarly, the proportion of men and women below the age and gender appropriate estimated average requirements (EAR) for selected micronutrients were also reported.

The possibility of misreporting was assessed using the Goldberg cutoffs of 1.13 for under-reporters and 2.70 for over-reporters (using a PAL of 1.55),⁷ with the oxford equations use to calculate basal metabolic rate.⁸ Mean nutrient intakes, and proportions of participants above or below the AMDR and EAR were also reported with possible under reporters excluded.

Results

A total of thirty-three, mostly male, New Zealand European participants (Table 1) completed at least one 24-h recall and are included in this analysis (two participants completed two recalls, while the remaining 31 participants completed all three recalls; Supplementary Figure S1). All retired athletes had represented New Zealand at either a Commonwealth or Olympic Games between 1956 and 1990, with representation at the 1964 Tokyo Olympics being most common (30%) followed by the 1974 Christchurch Commonwealth Games (27%). The most common sports were Rowing (39%), Athletics (27%) or Swimming (18%), with the remainder of participants being involved in Hockey, Diving and Weightlifting. Four males (and no females) were identified as having possibly underreported energy intakes.

Both men and women were, on average, consuming less carbohydrate and more fat, in particular more saturated fat, but close to the recommended amount of protein when compared to the AMDRs (Table 2; Supplementary Table S1). Mean protein intakes relative to body mass were 1.3 (0.38) g/kg for men, and 1.32 (0.33) g/kg for women, with 46% of men and 33% of women falling below the 1.0–1.2 g protein/kg of body weight recommended by the European Society for Clinical Nutrition and Metabolism (ESPEN).⁹

One third of participants reported using dietary supplements, with magnesium ($n=7$) and high-dose vitamin c ($n=6$; mean dose 984 mg)

Table 1. Participant characteristics^a (*n* = 33).

	All
Age, y	76 (8)
Gender, <i>n</i> (%)	
Male	27 (82)
Female	6 (18)
Ethnicity, <i>n</i> (%)	
New Zealand European	33 (100)
Deprivation	
Low	17 (52%)
Medium	16 (48%)
High	0
Household annual income	
≥\$100,000	12 (15%)
\$75,000 to \$99,999	1 (3%)
\$50,000 to \$74,999	5 (15%)
\$35,000 to \$49,999	8 (24%)
<\$35,000	2 (6%)
Declined to answer	5 (15%)
Anthropometric Measures	
Weight, kg	79 (12)
Height, cm	173 (11)
BMI, kg/m ²	26 (3)
Total body fat percentage, %	27 (6)
Total muscle mass, kg	56 (11)

^aValues reported as mean (standard deviation), unless otherwise stated.

^bDeprivation assessed using area-level deprivation by applying home address to deciles of the New Zealand Deprivation Index 2023 (NZDep2023). Low deprivation: deciles 1 to 3; medium deprivation: deciles 4 to 7; high deprivation: deciles 8 to 10.

^cIn New Zealand dollars.

being the most common. However, supplementation generally did not align with need. For example, only one male participant took a magnesium supplement to achieve the EAR, and the only male below the EAR for vitamin C was not taking supplements (Table 3). All women had calcium intakes below the EAR, two thirds had selenium intakes below the EAR, most had sodium intakes above the AMDR. Women generally achieved greater overall nutrient adequacy than men (Table 3, Supplementary Table S2).

Discussion

The current study provides novel insight into the dietary intakes of retired New Zealand Olympic and Commonwealth Games athletes aged 60 years or older. Not surprisingly, given their very high levels of physical activity⁴ the energy intake of these participants was ~1300 kJ higher than a representative group of similar age.² This higher overall energy intake is also likely driving the higher absolute intakes of many nutrients. However, the overall diet quality, as assessed by comparing percentage energy from macronutrients to the AMDRs is poorer (less carbohydrate and more fat) than that recorded in the New Zealand National Nutrition Survey for this age group,² but remarkably similar to a group of pre-frail older adults, who provided data more recently.¹⁰

Table 2. Mean (SD) energy and macronutrient intakes of a sample of former New Zealand elite athletes over the age of 60y.

Nutrient	Men (n = 27)		Women (n = 6)	
	Intake	Percentage above/ below AMDR SDT or EAR	Intake	Percentage above/below AMDR SDT or EAR
Energy, kJ/day	9498.6 (2645.7)		7404.3 (700.8)	
Carbohydrate, g/day	235.1 (57.4)		168.7 (33.2)	
Carbohydrates, %TE	43 (7)	63% ^a	39 (8)	83% ^a
Free sugars, g/day				
Free sugars, %TE	9 (4)	37% ^b	9 (5)	33% ^b
Fiber, g/day	27.8 (9.3)	81% ^c	23.0 (6.3)	83% ^d
Fat, g/day	93.9 (42.1)		75.5 (18.2)	
Fat, %TE	35 (7)	56% ^e	37 (6)	67% ^e
Polyunsaturated fat, g/day	13.5 (6.2)		11.2 (4.4)	
Polyunsaturated fat, %TE	5.1 (1.36)		5.5 (1.7)	
Monounsaturated fat, g/day	33.3 (16.6)		28.6 (9.1)	
Monounsaturated fat, %TE	12.5 (3.3)		14.1 (3.4)	
Saturated fat, g/day	36.5 (18.4)		28.3 (7.3)	
Saturated fat, %TE	13.7 (3.7)	81% ^g	14.1 (3.2)	100% ^g
Protein, g/day	92.4 (28.9)	11% ^h	78.7 (17.6)	0% ⁱ
Protein, %TE	17 (3)	26% ^j	18 (5)	33% ^j

AMDR, Acceptable macronutrient Distribution range. EAR, Estimated average requirement. SDT, Suggested Dietary Target.

^aPercentage below 45% total energy from carbohydrates, no intake was above 65%.

^bPercentage above 10% total energy coming from free sugars.

^cPercentage with a fiber intake less than 38 g.

^dPercentage with a fiber intake less than 28 g.

^ePercentage above 35% total energy from fat. One male's fat intake was below 20% of total energy.

^fTwo men reported taking supplements containing polyunsaturated fats in small amounts, including the supplement intake increased the mean to 13.6 (6.2) g.

^gPercentage above 10% total energy coming from saturated fat.

^hThree men over 70y had protein intakes less than the estimated average requirement (EAR) of 65 g per day, none of the men between the ages of 51 and 70y had protein intakes less than the EAR of 52 g.

ⁱNone of the women had protein intakes less than the EAR (37 g per day for 51–70years; 46 g per day for 70+ y).

^jPercentage below 15% total energy coming from protein. No intake was above 25%.

The higher fat, and in particular saturated fat intake, is a concerning trend, given its well established links to cardiovascular disease risk.¹¹ Possibly more surprising is the lower than recommended carbohydrate intake in this group given intake is often higher in athletes.¹² However, a recent study of Masters athletes indicates that while carbohydrate intakes are mostly higher than those observed here (range 183 to 350 g/day), they are still lower than what is recommended for athletes in general.¹³ This lower than recommended carbohydrate probably also helps to explain why so many of the participants (81% of men and 83% of women) are failing to reach the suggested dietary target for fiber, which may in turn be potentially increasing the risk of type 2 diabetes, cardiovascular disease, colorectal and breast cancer.¹⁴

Protein requirements do appear, adequate for the most part, when compared to the EAR. However, when compared to the ESPEN recommendations that were made with the aim of limiting age related decline in muscle mass, strength and functional abilities,⁹ nearly half of men, and a third of women were consuming less than 1.0 g protein/kg of body weight, indicating that some individuals may benefit from increasing protein intake.

Table 3. Mean (SD) intakes of micronutrient intakes in a sample of former New Zealand elite athletes over the age of 60y.

Micronutrient	Men (n = 27)			Women (n = 6)		
	Dietary intake	Intake including supplementation	% Below (or above) EAR	Dietary intake	Intake including supplementation	% Below (or above) EAR
Calcium, mg/day	1048.3(474.3)	1085.4 (495.6) ^a	56% ^b	810.4 (139.4)	827.1 (657.7) ^c	100%
Iron, mg/day	13.2 (5.1)	13.2 (5.1)	0%	9.9 (1.9)	9.9 (1.9)	0%
Magnesium mg/day	381.9 (109.7)	438.8 (212.9) ^d	41% ^e	335.4 (72.9)	378.7 (94.5) ^f	0% ^g
Selenium, µg/day ^h	48.2 (37.9, 74.0)	48.2 (37.9, 74.0) ⁱ	67% ^j	48.3 (41.8, 49.3)	48.4 (41.8, 78.6) ^k	67% ^l
Sodium, mg/day	2700.8 (869.8)	2700.8 (869.8)	81% ^l	2204.5 (621.3)	2204.5 (621.3)	67% ^m
Vitamin C, mg/day ^h	112.7 (71.2, 186.5)	112.7 (73.0, 244.4) ⁿ	4% ^o	75.1 (39.7, 114.2)	120.4 (77.3, 539.7) ^p	0% ^q
Zinc, mg/day	10.7 (4.0)	11.6 (5.2) ^r	66% ^s	9.6 (1.9)	11.3 (4.7) ^t	0% ^u

EAR, Estimated Average Requirement.

^aOne man was taking supplements containing 1000mg calcium per day.

^bTwo men aged between 50 and 70y had calcium intakes under 840mg, 13 men over 70y had calcium intakes under 1100mg.

^cOne woman was taking a supplement containing 100mg calcium per day.

^dFive men were taking supplements containing between 75 and 500mg (mean = 307mg) magnesium per day.

^eThis increases to 44% if intake from supplements is excluded (EAR for all is 350mg/day).

^fTwo women were taking supplements containing between 100 and 160mg (mean 130mg) magnesium per day.

^gThis increases to 16% if intake from supplements is excluded (EAR for all is 265mg/day).

^hIntake is skewed, so medians and interquartile range is presented.

ⁱOne man was taking supplements containing 60µg selenium per day.

^jNot different if intake from supplements is excluded (EAR for all is 60µg/day).

^kOne woman was taking supplements containing 60µg selenium per day.

^lNot different if intake from supplements is excluded (EAR for all is 50µg/day).

^mAMDR for sodium is 2000mg/day for everyone, data reported as % above.

ⁿFour men were taking supplements containing between 1000 and 1200mg (mean = 1100mg) Vitamin C per day.

^oNot different if intake from supplements is excluded (EAR for all is 30mg/day).

^pTwo women were taking supplements containing between 500 and 1000mg (mean = 750mg) Vitamin C per day.

^qNot different if intake from supplements is excluded (EAR for all is 30mg/day).

^rTwo men were taking supplements containing 10 and 15mg of zinc per day.

^sThis increases to 74% if intake from supplements is excluded (EAR is 12mg).

^tOne woman was taking a supplement containing 10mg of zinc per day.

^uNot different if intake from supplements is excluded (EAR is 6.5mg/day)

The micronutrient intakes observed in this cohort are, in general, higher than those observed in participants of a similar age in the New Zealand National Nutrition Survey. Again, this is likely the result of higher energy consumption of this group. Despite this, 100% of women and 56% of men were at risk of inadequate calcium intakes, with men additionally at risk of inadequate intakes of magnesium (41%) and zinc (66%). Interestingly, despite one third of participants taking supplements, they did not appear to be taken by those who needed them, as not including dietary supplements had little impact on the proportion of participants at risk of inadequacy. The use of these commonly reported supplements (high-dose vitamin C and magnesium) suggests that their intake may be driven more by marketed claims of improved immune function and sleep than by dietary nutrient inadequacies.

While other analyses conducted as part of this study indicate that retired elite athletes engage in very high levels of physical activity⁴ and are at much lower risk of frailty than their non-athletic counterparts, being a retired elite athlete does not appear to protect these older adults against unfavorable population trends in dietary intake. They, as with other older adults in the general New Zealand population, may benefit from dietary interventions that improve the overall quality of their diet.

A key strength of this study is the use of multiple 24 hour recalls providing an estimate of dietary intake, rather than relying on food frequency or dietary habits questionnaires. Additionally, this study is the first of its kind to describe the dietary intake of retired older athletes in New Zealand and contributes to a very limited body of knowledge around the health of these individuals.

However, there are several limitations that should be considered. First, although 24-h recalls provide a better estimate of overall dietary intake than other questionnaire methods, they remain subject to social desirability and recall bias. We identified four participants as possible under-reporters; however, at least one experienced significant illness requiring hospitalization after participating, suggesting that their reported intake, although flagged as under-reporting by the algorithm, may have accurately reflected true intake. Additionally, excluding under reporters from the analysis did not markedly change our overall conclusions. Second, the overall study sample was recruited via word of mouth and was small, representing approximately 9% of the entire number of retired Olympic and Commonwealth Games athletes over the age of 60 year in New Zealand, possibly limiting generalizability. However, the sample generally reflects the wider population of retired Olympic and Commonwealth Games athletes over the age of 60y in New Zealand, which is 75% male and who represented in New Zealand in athletics (21%), Hockey (15%), Rowing (12%) Lawn bowls (6%) Sailing (6%) and Swimming (5%).

This study is, to our knowledge, the first to provide a description of the dietary intakes of older retired elite athletes in New Zealand over the age of 60 years. Although these retired athletes consume more energy, macronutrients, and micronutrients than the general population of a similar age, their diets still reflect broader population trends, with carbohydrate intake below, and saturated fat intake above recommendations. Overall, the results of this study indicate that being a retired elite athlete does not confer protection against age-related or population-wide dietary challenges. As such targeted dietary interventions may be warranted to support healthy aging in this group. These interventions should have a particular focus on improving carbohydrate quantity and quality, reducing saturated fat intake and addressing possible micronutrient inadequacies.

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Author contributions

CRedit: **Meredith Peddie**: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing; **Jennifer Gale**: Data curation, Formal analysis, Project administration, Supervision, Writing – review & editing; **Millie M. Harland**: Data curation, Writing – review & editing; **Sophie Grenfell**: Data curation, Writing – review & editing; **Xaviour Walker**: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Writing – review & editing; **David Gerrard**: Conceptualization, Writing – review & editing; **Takiwai Russell-Camp**: Conceptualization, Writing – review & editing; **Eduardo C. Costa**: Conceptualization, Writing – review & editing; **Debra L. Waters**: Conceptualization, Writing – review & editing; **Lara Vlietstra**: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Writing – review & editing.

Disclosure statement

None of the authors have any conflicts of interest to declare.

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