

Nutritional Deficiencies in Vegan Runners: A Comparison of Actual Versus Recommended Nutritional Intake and Dietary Recommendations

Original Research

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Abstract

Introduction: The aim of this study was to assess the dietary intake of vegan runners against targets and Reference Nutrient Intakes (RNIs) to identify potential nutritional deficiencies.

Methods: Thirty vegan recreational runners who do not run professionally (mean \pm SD; age: 42.9 ± 10.6 y, stature: 171 ± 0.1 cm, body mass: 65.7 ± 8.8 kg) were assessed using 3-day food diaries. Key nutrients, energy intake, lifestyle characteristics and dietary habits were determined.

Results: Deficiencies (actual v target intake/RNI) were identified in energy intake (2219 ± 531 kcal v 2554 ± 420 kcal), protein intake (72.9 ± 20.0 g v 92.0 ± 12.4 g), vitamin D (5.0 ± 6.3 μ g/d v 10.0 μ g/d) and selenium (45.7 ± 21.0 μ g/d v 60.0 μ g/d and 75.0 μ g/d for females and males, respectively; all at $p < 0.05$). In contrast, the average intake of iron, zinc, vitamin B₁₂, calcium and iodine were shown to be above the RNI.

Conclusions: These results suggest that the dietary intakes of the vegan recreational runners in the study were deficient in some key nutrients whilst being above target RNI in other nutrients. Therefore, careful planning is required to normalize nutrient intake and achieve a balanced diet. This paper presents dietary recommendations to address key nutrient deficiencies in the vegan diet to improve health and performance.

Key Words: macronutrient intake, micronutrient intake, RNI, vegan, runners

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Published September 23, 2020

Introduction

Veganism, a form of vegetarian diet, involves restriction of all animal products and has seen a three-fold increase since 2006 corresponding to approximately 1% of the UK adult population¹. The vegan diet presents several advantages; 1) it can be a healthier alternative to omnivorous diets as it helps promote longevity², 2) it is an ethical, animal-friendly practice that helps reduce the suffering of farmed animals, 3) it is 'planet-friendly' as it helps reduce the population of large farmed animals and the environmental damage caused by their gas emissions², 4) it is appropriate for all individuals and ages as it is superior in type of fat and dietary fiber intake³, 5) it can be used by athletes to optimize carbohydrate intake and manage weight³ and 6) it is of higher nutritional quality compared to non-vegan/non-vegetarian diets based on a study of runners⁴.

The vegan diet also presents nutritional limitations; 1) it restricts the intake and absorption of heme iron (found in abundance in animal products e.g. red meat), which diminishes the capacity to synthesize

hemoglobin hence limiting the oxygen supply to muscle that impairs performance⁵ and may lead to iron deficiency anemia with serious health consequences³, 2) it does not allow for sufficient consumption of key micronutrients such as zinc, vitamin B₁₂, calcium and vitamin D leading to deficiencies that affect endurance performance^{6,7} and can predispose the female athlete to osteoporosis⁽⁸⁾ low bone mineral density, impaired muscle function and impaired performance^{9,10}, 3) it is difficult to consume sufficient calories to meet energy needs. This is partly due to the diet's high carbohydrate/ high fiber nature leading to low energy availability¹⁰. LEA can also impact immunosuppression that may affect respiratory health, a problem often reported in endurance athletes¹¹, despite evidence suggesting that a long-distance vegan mountain biker during eight days of racing had an energy intake that exceeded energy needs by consuming energy dense liquids¹² and 4) it is difficult to identify the nutritional requirements for vegan athletes as there are no Dietary Reference Values (DRVs) specifically set for physically active people.

Reference Nutrient Intakes (RNIs) are broadly recommended for the general population as they are designed to cover the needs of approximately 98% of people¹³. Previous research suggests that athletes consuming the RNI are unlikely to be deficient in a nutrient¹⁴. Nutritional recommendations for endurance athletes have specified; a high carbohydrate intake (6-10 g•kg⁻¹ of body weight per day)¹⁵ balanced with adequate fluid intake¹⁶; a protein intake of 0.3 g•kg⁻¹ of body weight after exercise sessions and every 3-5 hours over multiple meals¹⁶; a fat intake not lower than 20% as restriction of fat intake below this cut-off point may result in decreased intake of fat-soluble vitamins and essential fatty acids⁽¹¹⁾. Similar recommendations have been made for vegetarian athletes¹⁶ but there are currently no recommendations available for vegan athletes.

Previous studies have investigated the benefits and nutritional quality of vegan diets through comparisons with omnivorous diets, however little research is available on the actual effects of a vegan diet on athletic performance^{9, 10}. Comparisons of evidence-based studies on the effect of a vegetarian versus an omnivorous diet on physical performance showed that a vegetarian diet does not seem to improve nor impair physical performance⁹. Despite this, a study of marathon runners reported that the highest proportion of runners were vegetarian, pescatarian or vegan¹⁷. Another study investigated the health status of omnivorous, vegetarian and vegan endurance runners and showed that vegan runners had higher scores for mental health and were extraordinarily health conscious in their food choices¹⁸.

To our knowledge, there have not been any published studies that have exclusively investigated the nutritional intake of vegan runners and whether vegan runners meet existing dietary recommendations. Therefore, the purpose of this study was to explore the dietary intake of vegan runners by comparison to current reference and recommended values. The hypothesis of the study was that the participants would be below the RNI for protein and a number of micronutrients.

Methods

Participants

Thirty vegan, recreational runners (males, n=15; mean age: 45.3 ± 11.5 years, body mass: 70.0 ± 7.1 kg, stature: 179 ± 0.10 cm and females, n=15; mean age: 40.5 ± 9.5 years, body mass: 61.4 ± 8.4 kg, stature: 164 ± 0.10 cm) were recruited via email communications and social media adverts posted on the Vegan Runners Club Facebook page. Approximately 96% of participants exercised on more than 3 d•wk⁻¹ and ran on average a distance of 35.4 ± 17.9 km (22.0 ± 11.1 miles) per week. Mean performance times for 5 km were 20.2 ± 2.93 min and 27.0 ± 5.0 min for male and female runners, respectively. Mean performance times for 10 km were 42.8 ± 6.0 min and 54.1 ± 9.2 min for male and female runners, respectively. This study was conducted according to the guidelines laid down in the declaration of Helsinki. The study received ethical approval by the Ethics Committee of St. Mary's University, Twickenham, United Kingdom.

Protocol

Participants' dietary intake was assessed using a three-day, unweighted, self-reported food diary. Food intake (grams or ounces) including all beverages consumed over two self-reported running days and one rest day was recorded. Distances were not standardized. Information was given to participants to record portion sizes and fortified foods¹⁹. Participants also completed a vegan lifestyle questionnaire (VLQ; adapted from Dyett et al., 2014)²⁰ to gather lifestyle information on: a) gender, age and anthropometric characteristics (stature and body mass) and b) lifestyle information (e.g. meal and training frequency,

training volume, best performance times, use of supplements, number of years, and reasons for, being vegan). The validity of self-reported energy intake was assessed using the Goldberg two cut-offs method that calculates whether the EI:BMR ratio is consistent with lifestyle and activity levels (Goldberg et al., 1991) ⁽²¹⁾.

Energy Intake (EI), macronutrients and a number of key micronutrients were determined from the three-day food diaries using nutritional analysis software (Nutritics 4.097, Dublin, Ireland). Body Mass Index (BMI, kg•m²) was calculated from self-reported height and weight measurements. Basal Metabolic Rate (BMR) was estimated using the Henry (2005) equation ²².

$$\begin{aligned} \text{Males: } & 11.4 \times \text{body mass in kg} + 541 \times \text{stature in cm} - 137 \\ \text{Females: } & 8.18 \times \text{body mass in kg} + 502 \times \text{stature in cm} - 11.6 \end{aligned}$$

Total Energy Expenditure (TEE) was calculated as described in the equation stated in the Position Statement of the Academy of Nutrition and Dietetics, Dietitians of Canada, and American College of Sports Medicine (2016) ⁶.

$$\text{TEE} = \text{BMR} + \text{TEF} + \text{TEA}$$

TEF is the thermic effect of physical activity. TEA includes planned exercise expenditure, spontaneous physical activity and non-exercise activity thermogenesis. The self-reported daily physical activity and exercise levels were derived from the VLQ.

The ratio of work metabolic rate to a standard resting metabolic rate (MET) value for running was calculated using the equation:

$$\text{PA} = \text{MET} \times \text{body mass in kg} \times \text{running duration in hours to give TEE} \supseteq 23.$$

Average speed was calculated using the self-reported miles/week and best performance time for 5k/10k race in order to calculate the appropriate MET value²³.

$$\begin{aligned} \text{Average speed for 5k} &= 5 / (\text{5k time in min}) \times 60 \times 0.62 \\ \text{Average speed for 10k} &= 10 / (\text{10k time in min}) \times 60 \times 0.62 \end{aligned}$$

The TEE calculated was subsequently used as the EI target to maintain energy balance and promote optimal training and recovery ²³. The EI target was then compared to the EI obtained from the food diaries to determine whether the calories consumed by the vegan runners were above or below the target.

Statistical Analysis

Data was analyzed using SPSS V. 22.0 (IBM Commercial, Chicago, USA). Descriptive statistics (mean ± SD) were used to describe parametric normally distributed data. Medians and 95% CI were used to describe non-parametric data. Independent t-tests were computed to determine differences in macronutrient, vitamin and mineral intake between male and female runners for normally distributed variables. Mann Whitney U tests were used to identify differences between genders for not normally distributed variables. Paired samples t-tests were used to assess differences between estimated dietary intake of normally distributed variables of concern and target intake. Wilcoxon matched paired t-test was used for not normally distributed variables. The $p \leq 0.05$ was considered statistically significant a priori.

Justification of sample size

The Vegan Runners Club UK was selected as the target population due to its members' high degree of suitability for the study i.e. a membership of 500 runners. The sample size needed for the study was calculated using Creative Research Systems online calculator (www.surveysystem.com/sscalc.htm). Based on a confidence level of 95% with a confidence interval of 17.36 and a moderate effect size of 50%, the number of participants was indicated as 30. We selected 30 participants with usable food diaries.

Results

The Goldberg method revealed that 83% of participants were identified as adequate-reporters. Participant mean (\pm SD) anthropometric characteristics (age, body mass, stature and BMI) actual macronutrient intake (%CHO and g CHO, %Fat and g Fat, %Protein and g Protein) and alcohol intake (% and g) are summarized in Table 1.

Table 1. Mean (\pm SD) anthropometric characteristics of 30 vegan runners and actual macronutrient intakes expressed in kcal, g and as a % of total energy expenditure, in male (n=15) and female (n=15) vegan runners.

	Male Mean (\pm SD)	Female Mean (\pm SD)
Age (years)	45.3 \pm 11.5	40.5 \pm 9.5
Body mass (kg)	70.0 \pm 7.1	61.4 \pm 8.4
Stature (cm)	179 \pm 0.1	164 \pm 0.1
BMI (kg.m ²)	21.9 \pm 1.6	23.0 \pm 3.7
EI (kcal)	2529 \pm 484	1909 \pm 378
Carbohydrate (g)	343.0 \pm 81.4	245.8 \pm 45.0
Carbohydrate (% total EI)	52.4	49.7
Protein (g)	81.0 \pm 20.6	64.7 \pm 16.2
Protein (% total EI)	12.9	13.6
Fat (g)	96.3 \pm 39.0	75.4 \pm 25.3
Fat (% total EI)	33.7	34.9
Alcohol (g)	4.3 \pm 7.6	5.4 \pm 7.1
Alcohol (%)	1.1	1.8

Actual energy intake was significantly lower compared to target intake in both male and female vegan runners (Figure 1). Actual macronutrient intake for CHO, Fat and Protein versus RNI is shown in Figure 2.

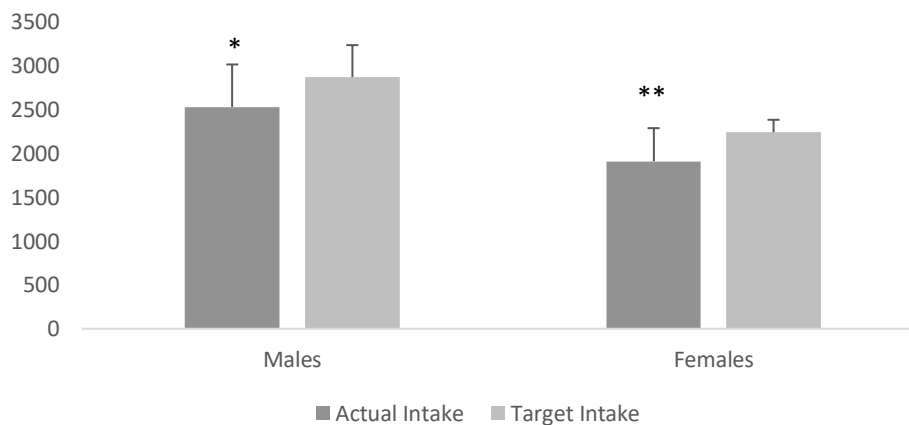


Figure 1. Mean actual versus target energy intake in male and female vegan runners (* $p=0.006$, ** $p=0.005$).

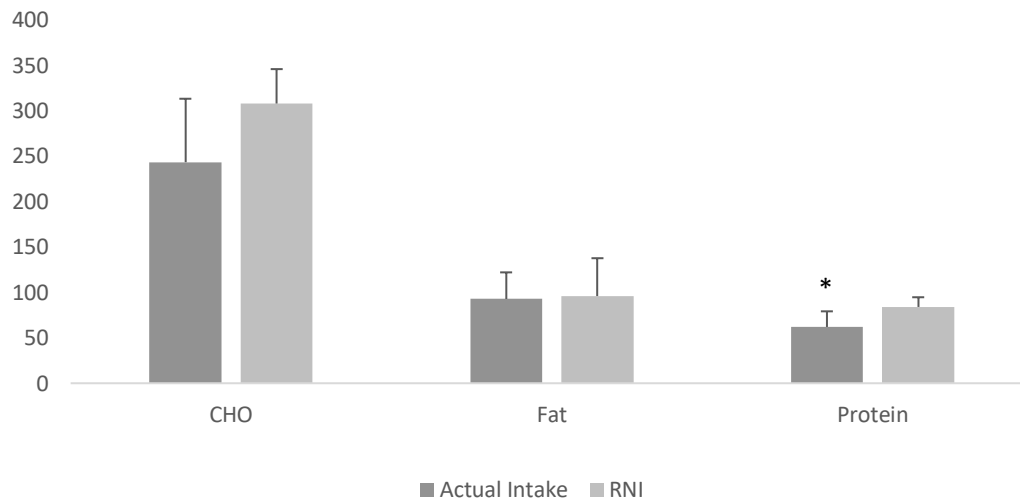


Figure 2. Mean actual macronutrient intake for carbohydrate (CHO), Fat and Protein versus RNI in both male and female vegan runners (* $p=0.001$).

Mineral intake for sodium, potassium, chloride, phosphorus, magnesium and copper were within the recommended RNI targets ($p>0.05$). Iron and zinc intakes were shown to be significantly higher than the recommended RNI targets, in both male and female participants. Selenium was one mineral that demonstrated deficiency (intake well below the recommended RNI target) in both male and female vegan runners. Gender specific differences were identified for iron and calcium intake being lower than RNI in females. Iodine intake was lower than the RNI for the majority of participants. Vitamin intake was found to be within the recommended RNI targets for most vitamins including vitamin A, riboflavin, thiamin, niacin, and lower than the RNI targets for Vitamin D in both males and females (Table 2).

Discussion

Vegan runners in this study were shown to have energy and protein deficiency and were significantly below the recommended RNI for vitamin D and selenium. These findings are in line with previous studies that have identified nutritional deficiencies in vegetarian or vegan diets ⁹. Although mean dietary intake of most minerals and vitamins appeared within or above RNI target values for most participants, range values revealed that some participants were not reaching the RNI for iron, zinc, vitamin B₁₂, calcium and iodine. These minerals alongside vitamin B₁₂ are essential for maintaining good health while their under-consumption may impair athletic performance ^{9,10}.

Eighty per cent of our participants, irrespective of gender, consumed insufficient calories to sustain daily metabolic needs (actual intake: 2219 kcal, target intake: 2554 kcal). The calculated target energy intake was similar to that stated for recreational (2400 kcal/day) and endurance athletes (2500 kcal/day) ²⁴. Our findings concur with the literature that has reported low energy intake due to the high fiber/low calorific nature of vegan diets ⁹. For female vegan runners in particular, under-consumption of calories puts them at risk of contracting Relative Energy Deficiency Syndrome (previously identified as the 'Female Athlete triad') ²⁵. Inadequate energy intake can reduce athletic performance and even reverse any beneficial training effects ⁶. Chronic under-consumption of calories may also negatively affect immune, endocrine and musculoskeletal function ⁶. Currently, there is no evidence relating to the energy intake of vegan runners with which to compare our data.

Actual protein intake was below the target intake (72.9 ± 20.0 g and 92.0 ± 12.4 g, respectively) with male runners consuming an average of 81 g (12.9%) and female runners an average of 65 g (13.6%). Athletes should consume up to 15% of their daily calories or 1.2 to 2.0 g/kg of body mass when in strenuous endurance training or competition ⁶. Previous research noted that vegetarian female runners are at risk of protein deficiency as plant protein has lower digestibility compared to animal protein ²². To

our knowledge, there are no studies that have investigated protein intake, digestibility and/or protein availability in vegan runners.

Table 2. Actual mineral and vitamin intake, RNI target intake and p-values for male (n=15) and female (n=15) vegan runners. Intake is shown as mean \pm SD. P-values are shown only for minerals and vitamins of concern with statistical significant differences at $p < 0.05$.

	MALE (n=15)			FEMALE (n=15)		
	Actual Intake	RNI	p-value	Actual Intake	RNI	p-value
Sodium (mg/d)	2925 \pm 1262	1600	-	2060 \pm 850	1600	-
Potassium (mg/day)	5211 \pm 1496	3500	-	4400 \pm 1169	3500	-
Chloride (mmol/d)	4672 \pm 1690	2500	-	3229 \pm 1644	2500	-
Calcium (mmol/day)	1169 \pm 367	700	0.001	854 \pm 340	700	0.233
Phosphorous (mmol/day)	1685 \pm 382	550	-	1340 \pm 338	550	-
Magnesium (mmol/d)	640 \pm 145	270	-	550 \pm 164	270	-
Iron (mg/d)	24.7 \pm 8.4	8.7	0.001	20.2 \pm 6.4	14.8	0.004
Zinc (mg/d)	14.0 \pm 3.2	9.5	0.001	13.8 \pm 5.6	7.0	0.001
Copper (mg/d)	3.4 \pm 1.0	1.2	-	3.2 \pm 1.0	1.2	-
Selenium ($\mu\text{g}\cdot\text{d}^{-1}$) #	44.1 \pm 18.3	75	0.006	47.3 \pm 23.7	60	0.002
Iodine ($\mu\text{g}\cdot\text{d}^{-1}$)#	56.6# \pm 41.2	140	-	437 \pm 1570	140	-
Vitamin A ($\mu\text{g}\cdot\text{d}^{-1}$)	1551 \pm 845	700	-	1397 \pm 888	600	-
Vitamin D ($\mu\text{g}\cdot\text{d}^{-1}$)#	4.6 \pm 4.5	10 $^{\pi}$	0.003	5.3 \pm 7.8	10 $^{\pi}$	0.027
Thiamin (mg·d⁻¹)	3.9 \pm 1.8	1.0	-	4.1 \pm 3.3	0.8	-
Riboflavin (mg·d⁻¹)	3.1 \pm 2.0	1.3	-	2.6 \pm 2.0	1.1	-
Niacin (mg·d⁻¹)	48.5 \pm 21.1	17	-	35.0 \pm 10.6	13	-
Vitamin B6 (mg·d⁻¹)	4.1 \pm 2.6	1.4	-	6.0 \pm 12.8	1.2	-
Vitamin B12 ($\mu\text{g}\cdot\text{d}^{-1}$)	7.4 \pm 17.1	1.5	0.073	29.6 \pm 44.7	1.5	0.069

RNI targets derived from Department of Health (1991) (21)

#Significantly below RNI target value

Vitamin D intake was below recommended levels for 87% of male and 80% of female runners i.e. $< 10 \mu\text{g}\cdot\text{d}^{-1}$ 26. Our findings are in line with research showing low vitamin D serum levels in athletic populations and particularly in vegans during winter months 27. At particular risk of low vitamin D status are athletes

who train early or late in the day, train indoors, or wear sports kit that restricts sunlight exposure²⁶. Our study was conducted during the winter months and our runners trained outdoors 3 d·wk⁻¹ covering an average weekly distance of 35.4 ± 17.9 km (22.0 ± 11.1 miles). It is possible that the vegan runners in the study had sunlight exposure which was adequate to obtain enough vitamin D for their metabolic needs. It was not possible to conduct serum vitamin D concentration measurements to ascertain vitamin D deficiency and our results are based only on self-reported data. It was also not possible to identify any effect of low vitamin D status on either muscle, immune or cardiovascular function, bone health and/or performance²⁶.

Selenium intake was significantly below the recommended target in 93% of male and 60% of female vegan runners. Low selenium intake has been reported previously in vegetarian²⁷ and vegan populations⁷. The vegan diet contains a high number of antioxidants compared to an omnivorous diet, yet the intake of specific micronutrients like selenium was below the recommended levels⁷. Even though selenium intake is not considered to have performance enhancing benefits it is directly linked to good health and plays a key role in the body's defense system that combats free radical formation⁹. Currently, there is debate as to whether dietary supplementation of selenium is beneficial to athletes^{9,10}. It was not possible to verify the selenium levels of the vegan runners in the study.

Even though the overall mean was shown to be above the RNI, gender differences were noted in two key minerals; iron and calcium. For iron, 87% of female vegan runners showed intakes well below the recommended 14.8 mg·d⁻¹ compared to only 7% of male vegan runners who had intakes below 8.7 mg·d⁻¹¹². Lower iron stores in female vegetarians compared to meat eaters have been previously documented. Iron losses through the menstrual cycle²⁸ and limited bioavailability of iron in vegetarian diets have been implicated as factors leading to deficiencies. Lack of iron has been reported to affect oxygen delivery to the muscles and can impair aerobic performance^{7,9,10}. Some of our female vegan runners in the study were taking iron supplements, which caused the overall mean to be above the RNI. Calcium intake was also below the RNI target in 53% of female and 13% of male vegan runners. Previous studies have highlighted that vegans have calcium intakes below recommended levels due to lack of dairy consumption. Lack of calcium could increase their risk of sustaining bone fractures³ and puts female athletes at greater risk of developing the female athlete triad¹⁰. Calcium aids athletic performance by supporting physiological mechanisms such as growth, maintenance and repair of bone tissue, regulation of muscle contraction and blood clotting¹⁰. Supplementation with calcium was beneficial for some of the vegan runners in the study.

Iodine intake was below the recommended RNI in 93% of vegan runners with only two participants above the RNI. Previous studies have shown low iodine intake in vegetarians and vegans¹⁰. Dairy and seafood products are the main sources of iodine and these are absent in the vegan diet. Serious health implications are linked to low iodine intake including increased risk of illness, fatigue and injury with subsequent adverse effects on performance²⁹. Zinc intake was below the RNI target in 40% of female and 53% of male vegan runners. Vegetarian diets have limited zinc bioavailability which can contribute to zinc deficiency¹⁶. Vegetarians may require up to 50% more zinc than non-vegetarians⁷. Zinc depletion has been shown to negatively impact endurance performance¹⁰. We did not measure plasma zinc levels in our study, which could have provided insight into zinc absorption and bioavailability. Routine assessment and screening of vegetarian athletes for nutritional status of zinc is recommended^{10,22}.

Vitamin B₁₂ (including supplements) was shown to be within normal levels for the entire group (RNI 1.5 µg·d⁻¹). Forty seven percent of participants reported using a B₁₂ supplement. Previous research has noted that serum B₁₂ concentrations are lower in vegans and vegetarians compared to omnivores and many athletes resort to taking a supplement to rectify this imbalance increasing the popularity of B₁₂ supplements^{9,10}. Indeed, B₁₂ was the most popular supplement taken by our vegan runners and those who did not take it (47%) had an intake below the RNI target for B₁₂. This finding suggests that vegan runners who do not take a B₁₂ supplement may struggle to meet the RNI.

Nutritional strategies for vegan runners

Knowledge of the potential shortfalls of a vegan diet is useful in developing appropriate dietary plans and recommending possible supplementation¹⁷. In order to develop diet plans to address the nutritional deficiencies identified in this study it is useful to identify the key food sources which can potentially improve intake of each specific nutrient (Table 4). Diet plans were produced for the range of EI targets of 2200-3500 kcal identified in this study. Macronutrient targets, based on percentage of total energy intake, were identified as 55.0% CHO, 15.0% protein and 30.0% fat based on general guidelines for proportion of nutrients for athletes²⁹.

Table 4. Nutritional strategies for vegans aimed at improving nutrient status.

Nutrient	Food source
Total energy	Consume frequent meals, include snacks, more meat alternatives, dried fruit, nuts and seeds with a focus on energy-dense, lower fiber foods.
Protein	Ensure food combinations supply all essential amino acids. Examples are: rice and beans, beans on toast, hummus with tahini, lentils and rice, tofu, vegetable burgers, tempeh. Aim for all meals to supply 20g of protein to aid recovery.
Vitamin D	Consume fortified breakfast cereals and soya products.
Vitamin B ₁₂	Use nutritional yeast, yeast extract, fortified soya products.
Selenium	Add brazil nuts and cereals.
Iron	Eat leafy green vegetables and fortified foods such as soya milk, beans and cereals. Consume Vitamin C with meals for improved iron absorption such as fruits and fruit juices.
Zinc	Add beans, nuts, seeds, peas, fortified cereals and soya products.
Calcium	Include green leafy vegetables, calcium fortified foods such as soya and rice milk, and cereals.
Iodine	Increase intake of products such as seaweed, iodized salt, and/or iodine supplements. Some caution should be taken when consuming seaweed and supplements to avoid excess intakes and fortified plant-based dairy free milks can also be used.

Limitations and Recommendations

One of the limitations was the use of a self-reported 3-day food diary to assess dietary intake. This method has been shown to not accurately reflect habitual intake due to under-reporting of nutritional intake by the participants¹⁷. Some participants in our study (17.0%) under-reported their intake, however 83.0% of participants were identified as adequate reporters. Under-reporters were not excluded from our analysis making some of the values of participants questionable. This was an exploratory study into nutritional intakes of vegan runners and it is recommended that a follow up study employs a more robust data collection method and the possible use of mobile technology to collect the dietary intake data more accurately. Another limitation was that convenience sampling was used that has the potential to reduce the representativeness of the sample population⁹. Increasing the sample size would help improve confidence in the findings. The protein intake assessment did not include amino acid breakdown, as no facility was available to determine this in the participants' diets. Future research could use the protein digestibility-corrected amino acid score (PDCAAS) method to develop amino acid scores for the diets being assessed³⁰. Finally, we did not have a facility to determine the bioavailability of nutrients identified as below the RNI. Our findings, therefore, focused on whether reported consumption fell below the targets set for each nutrient or the published RNI. Future studies could combine both dietary intake analysis and nutritional status assessment (using serum concentrations) to assess the impact of any dietary nutritional deficiencies.

Conclusion

The vegan runners in this study had dietary intakes of energy, protein, vitamin D and selenium below the RNI. Intakes of iron, zinc, vitamin B₁₂, calcium and iodine may also be insufficient for optimal health and performance partly due to the reduced bioavailability of these minerals in the vegan diet. The majority of participants used supplements, yet deficiencies were evident in some key minerals. The diet plans produced addressed all nutritional deficiencies identified in the study with the exception of vitamin D and iodine intake. These minerals require supplementation or the inclusion of fortified cereals and soya

products to compensate for lack of sunlight exposure during the winter months in the UK. The use of fortified foods and supplements to achieve the 10 µg RNI for vitamin D is advised particularly in the winter months. Vegan runners should follow a diet rich in fruit, vegetables, whole grains, nuts and seeds as it is rich in antioxidants and may reduce oxidative stress, prevent illness and stave off fatigue (4).

Media-Friendly Summary

A study of 30 vegan runners showed that their food intakes were below the recommended levels for total calorie intake, protein, vitamin D and selenium. Diet plans were produced which addressed the deficiencies identified by focusing on diets rich in fruit, vegetables, nuts and seeds.

Acknowledgements

We would like to thank the Vegan Runners Club UK for their gracious participation in this study.

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