Journal of Nutrition and Health Sciences
Volume 1 | Issue 2
ISSN: 2393-9060

Research Article Open Access

Nutritional Adequacy of Vegetarian and Omnivore Dietary Intakes

Turner DR*[1], Sinclair WH[2] and Knez WL[3]

[1]Skin Cancer Research Group, School of Public Health Tropical Medicine & Rehabilitation Sciences, James Cook University, Queensland, Australia
[2]Institute of Sport & Exercise Sciences, School of Public Health, Tropical Medicine & Rehabilitation Sciences, James Cook University, Queensland, Australia
[3]Athlete Health and Performance Research Centre, ASPETAR–Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

***Corresponding author:** Turner DR, Skin Cancer Research Group, School of Public Health Tropical Medicine & Rehabilitation Sciences, James Cook University, Townsville, Queensland, Australia, Tel: +61408457983, E-mail: denise.turner@my.jcu.edu.au

Citation: Turner DR, Sinclair WH, Knez WL (2014) Nutritional Adequacy of Vegetarian and Omnivore Dietary Intakes. J Nutr Health Sci 1(2): 201. doi: 10.15744/2393-9060.1.201

Received Date: March 24, 2014 **Accepted Date:** April 10, 2014 **Published Date:** August 04, 2014

Abstract

Background: Vegetarian diets are associated with reduced risk for diseases such as diabetes and cardiovascular disease. We aimed to determine the nutritional adequacy of usual food intake in a cohort of young vegetarians and omnivores who regularly exercise.

Methods: Five vegetarian (aged 21.7±2.0 yrs), three vegan (aged 31.3±7.5 yrs) and eight age and sex matched omnivore participants (aged 21.1±1.9 yrs) volunteered for this project. Participants completed diet diaries to determine usual intake of macronutrients such as protein and fat and micronutrients such as vitamin C and iron.

Results: All participants met or exceeded the recommended dietary intake (RDI) of protein, thiamine, riboflavin, niacin, vitamin B_6, phosphorus, and vitamin C. Vegetarians and vegans consumed insufficient quantities of vitamin B_{12} and vegans consumed less the half the amount that omnivores managed (1.7µg compared to 4.5µg). Folate consumption was adequate amongst vegetarians and vegans (510µg and 696µg respectively) and vitamin C consumption was highest among the vegan group (>400% of the RDI). Zinc intake was lowest among the vegetarians while low iron and copper intakes were reported by omnivores. Calcium consumption was poor overall.

Conclusions: Nutritional inadequacies can arise from consuming omnivore, vegetarian and vegan diets. Over time such inadequacies may result in nutrient deficiencies thus it is important to consume a variety of nutrient rich foods to ensure nutrition requirements are being met.

Keywords: RDI; Vegan; Iron; Diet diary

Introduction

Vegetarian diets take numerous forms with the exclusion of animal products being a shared factor. The most common variation is a lacto-ovo vegetarian diet, which excludes meat, fish and poultry but includes dairy and eggs [1]. A vegan diet excludes all animal products so that meat, poultry, fish, dairy, eggs, gelatin, honey, animal derived additives and colours obtained from animal skeletons are not consumed [1,2]. A fruitarian diet is a modified, more controlled version of the vegan diet that is primarily associated with the consumption of raw or dried fruits thus making this the least common of all vegetarian diets consumed and the one most likely to be lacking in essential nutrients [1]. Interestingly, some individuals consider themselves to be vegetarian despite consuming meat products and a recent survey even reports a daily meat intake of approximately 80 grams by some self-identified vegetarians [3,4]. Consequently, research concerning vegetarianism can be limited by the definition of a vegetarian diet and the motivating factors for being vegetarian [4].

Interest in factors related to health, environmental concerns and animal ethics has led to an increase of popularity and subsequent consumption of vegetarian diets [3,5,6]. However vegetarian diets are considered unhealthy and even feminine by some which can impact on an individual's likelihood to consume the diet [3]. A well-planned vegetarian diet can adequately meet the nutritional demands of adulthood as plant based foods contain an array of vitamins and minerals [5,7,8]. A vegetarian diet is rich in complex carbohydrates, fibre, fruits, vegetables and antioxidants and may reduce the risk of developing type 2 diabetes, hypertension, obesity and some types of cancer such as prostate and colon cancer [1,8-11]. Furthermore a vegetarian diet has been shown to be low in saturated fats with an emphasis on polyunsaturated and omega 6 fatty acids which play a role in reducing cholesterol levels and could help guard against cardiovascular disease (CVD) [12,13].

Literature investigating vegetarian athletes is mostly well dated [14-16] however athletes, particularly those involved in endurance events, may benefit from a vegetarian diet as it is naturally rich in complex carbohydrates [8]. Research exploring the relationship between athletic performance and the consumption of vegetarian diets is limited which may be attributed to the small population of true vegetarian athletes from which to sample and their motivation for following the diet [8]. This research aimed to compare the nutritional adequacy of usual dietary intakes of young adults who identify as vegan, vegetarian or omnivorous with an interest in fitness.

Methods

Participants

Participants were recruited to take part in a study investigating the effect of diet on aerobic performance. Information leaflets were placed on University campus which encouraged vegetarians and omnivores who exercised regularly to participate. The researchers ascertained dietary status (i.e. individuals were asked to identify as vegetarian or omnivore) whilst written consent to participate in the study was obtained. Individuals were classified as vegetarian if they did not consume any animal meat/flesh on a regular or occasional basis or vegan if they did not consume any animal derived products at all. The vegetarian cohort consisted of one male who was 20.0 years of age; 188.5cm in height; and had a body mass of 72.4kg and 4 females who were 21.7±2.0 years of age; 165.3±4.6cm in height; and had a body mass of 58.7±5.6kg. The vegan group consisted of one male who was 31.0 years of age; 181.5cm in height; and had a body mass of 89.1kg and two females who were 31.5±10.6 years of age; 176.9±8.3cm in height; and had a body mass of 69.7±8.9kg. Eight omnivore participants were matched for gender, age (21.1±1.9 years), height (168.1±6.0cm) and body mass (71.9±16.9kg). Participants did not use nutrition supplements nor did they smoke. The mean period of vegetarianism/veganism prior to testing was 6±4 yr. The investigation was conducted with the approval of the University Human Ethics Committee.

Dietary analysis

Participants completed a 7 day food diary and were instructed to provide as much information as possible regarding the quantity, type and manufacturer of food consumed. Participants were asked to use kitchen scales, measuring spoons and cups supplied to record food eaten as soon as practically possible (ideally immediately post consumption) to increase accuracy of the diet diary. Participants also provided food recipes, product labels and nutrition panels where possible. Diaries were analysed with FoodWorks (Xyris software, v.5, service pack 1, Highgate Hill, Australia) using nutrient reference values set for Australia by the National Health and Medical Research Council (NHMRC) [17]. Participants were encouraged to consume foods that they would normally consume so that food diaries would be representative of typical diet.

Statistical analysis

SPSS statistical analysis software package (SPSS Inc., v.19 for Windows, Chicago, IL) was used for the statistical analysis of data. Normality tests indicated dietary data were not normally distributed. Subsequently the Kruskal-Wallis H test was used to compare dietary intake and data are presented as median [25^{th} quartile, 75^{th} quartile]. Significance was set to 95% level of confidence ($p<0.05$).

Results

All participants met or exceeded the RDI of protein, thiamine, riboflavin, niacin, vitamin B_6 phosphorus, and vitamin C. Vegans consumed significantly less vitamin B_{12} than omnivores and vegetarians (1.7μg compared to 4.5μg and 2.4μg respectively). Folate and vitamin C consumption was highest among the vegan group ($p=0.007$ and $p=0.004$ respectively) and vegans were more likely to meet the dietary requirements for magnesium and vitamin E ($p=0.031$ and $p=0.017$ respectively).Vegetarians consumed insufficient quantities of zinc while omnivores consumed inadequate amounts of iron and copper. All participants failed to meet the RDI of calcium.

Discussion

We found protein, thiamine, riboflavin, niacin, vitamin B_6 phosphorus, and vitamin C intakes were sufficient among our group of health-conscious vegetarians, vegans and omnivores. Vegans consumed inadequate amounts of vitamin B_{12} and vegetarians failed to meet the recommended intake of zinc. The typical omnivorous diet consumed by our cohort was not rich in iron, magnesium or copper. Calcium intake by all participants was poor.

Folate consumption was highest among our vegan participants and lowest among the omnivorous cohort which is contrary to previous research [12,18-20]. Iron consumption was also higher among our vegans and vegetarians and unlike the omnivorous group they exceeded the RDI. Vegetarians are often assumed to consume insufficient quantities of iron however research reports similar [7,21] and increased intakes compared to omnivores [2,22,23].

Vitamin B_{12} intake was lowest among our vegans and vegetarians which is a common finding [2,19,20]. Vegetarians, especially vegans, are at a high risk for vitamin B_{12} deficiency since plant based foods are a poor source of this vitamin [11,24]. Consumption of vitamins C and E was markedly higher among our vegans and vegetarians although all dietary groups exceeded the RDI for vitamin C. Vegetarian diets usually contain increased amounts of vitamins C and E compared to omnivore diets [7,15,25-28].

Median [IQR]	Omnivore (n=8)	Vegetarian (n=5)	Vegan (n=3)	P value
Fat (g)^	65.0 [56.0, 78.0	42.0 [21.5, 52.0]	63.0 [56.0, -]	0.030
Carbohydrate (g)^	225.0 [165.0, 372.0]	233.0 [175.5, 315.5]	375.0 [356.0, -]	0.218
Protein (g)	81.0 [66.0, 106.0]	53.0 [44.5, 79.0]	80.0 [63.0, -]	0.184
RDI Protein	163.0 [127.0, 226.0]	111.0 [90.5, 156.5]	186.0 [144.0, -]	0.119
Thiamin (mg)	1.3 [0.9, 1.5]	2.5 [1.7, 3.3]	2.2 [1.4, -]	0.112
RDI Thiamin	122.0 [83.0, 132.0]	206.0 [154.5, 299.5]	198.0 [126.0, -]	0.112
Riboflavin (mg)	1.6 [1.2, 2.3]	2.6 [1.6, 2.7]	1.94 [0.7, -]	0.268
RDI Riboflavin	149.0 [108.0, 180.0]	208.0 [147.5, 238.5]	176.0 [66.0, -]	0.313
Niacin (mg)	30.9 [26.6, 45.3]	35.9 [22.6, 39.9]	38.5 [25.0, -]	0.663
RDI Niacin	220.0 [190.0, 305.0]	245.0 [161.0, 273.0]	275.0 [178.0, -]	0.626
Vitamin B_6 (mg)	1.4 [1.1, 1.7]	1.9 [0.9, 2.3]	2.0 [1.1, -]	0.651
RDI Vitamin B_6	104.0 [84.0, 130.0]	143.0 [67.5, 179.5]	150.0 [81.0, -]	0.651
Vitamin B12 (μg)	4.5 [3.2, 4.7]	2.4 [1.4, 3.0]	1.7 [0.9, -]	0.133
RDI Vitamin B_{12}	187.0 [131.0, 195.0]	98.0 [59.0, 126.0]	69.0 [37.0, -]	0.133
Folate (μg)	205.9 [188.4, 255.0]	510.5 [381.7, 638.0]	696.0 [368.2, -]	0.007
RDI Folate	51.0 [47.0, 64.0]	128.0 [95.5, 159.5]	174.0 [92.0, -]	0.007
Magnesium (mg)	256.0 [190.6, 310.5]	337.9 [214.9, 482.4]	457.5 [426.7, -]	0.067
RDI Magnesium	75.0 [61.0, 99.0]	109.0 [69.0, 138.0]	148.0 [138.0, -]	0.031
Calcium (mg)	776.4 [453.0, 842.8]	870.9 [651.6, 1131.9]	974.5 [584.2, -]	0.267
RDI Calcium	78.0 [45.0, 84.0]	87.0 [65.0, 113.5]	97.0 [58.0, -]	0.29
Phosphorus (mg)	1507.9 [941.1, 1645.3]	1184.0 [956.8, 1786.7]	1628.6 [1172.0, -]	0.578
RDI Phosphorus	151.0 [94.0, 165.0]	118.0 [95.5, 178.5]	163.0 [117.0, -]	0.578
Iron (mg)	11.3 [9.9, 11.9]	20.3 [10.3, 31.5]	19.0 [13.8, -]	0.107
RDI Iron	65.0 [55.0, 126.0]	139.0 [57.0, 232.0]	105.0 [77.0, -]	0.304
Vitamin C (mg)	56.2 [43.5, 61.1]	134.7 [65.8, 151.0]	197.0 [174.5, -]	0.004
RDI Vitamin C	125.0 [97.0, 136.0]	299.0 [146.5, 335.5]	437.0 [388.0, -]	0.004
Vitamin E (mg)	5.7 [5.0, 6.2]	8.2 [5.0, 12.0]	14.3 [9.7, -]	0.039
AI Vitamin E	73.0 [61.0, 89.0]	117.0 [72.0, 139.0]	205.0 [139.0, -]	0.017
Zinc (mg)	9.6 [8.6, 13.6]	7.7 [5.6, 10.7]	11.0 [8.8, -]	0.297
RDI Zinc	108.0 [88.0, 120.0]	81.0 [70.5, 111.5]	137.0 [110.0, -]	0.071
Copper (mg)	1.2 [1.1, 2.1]	1.5 [1.0, 2.3]	2.6 [1.9, -]	0.147
AI Copper	88.0 [78.0, 121.0]	128.0 [78.5, 158.5]	212.0 [159.0, -]	0.062

^No reference value set by the NHMRC
- Unable to be computed
RDI – Recommended daily intake [17]
AI – Adequate intake [17]

Table 1: Comparison of nutritional intake of omnivore,vegetarian and vegan cohort

Low fat diets, especially those low in saturated fats such as vegetarian diets, are beneficial to health status as they may be able to reduce the risk of developing potentially fatal diseases such as CVD [12,13,23,27]. Fat intake was lowest among our vegetarians whilst intake by vegans and omnivores was similar. Calcium is critical for bone health yet our participants reported inadequate intakes. The literature comparing calcium intake between vegetarians and omnivores is conflicting with research suggesting similar and insufficient intakes regardless of dietary preference [16,23,29,30]. Vegetarians, particularly those who exclude dairy products and do not consume calcium-fortified alternatives may become calcium deficient therefore should take care to appropriately balance their diet [1].

Dietary preferences may account for differences in dietary intake of vitamins and minerals of our participants. Perhaps vegetarians had higher intakes of vitamins such as folate, vitamin C and vitamin E because they favoured and consequently consumed more foods naturally rich in these vitamins such as wholegrains, fruits, vegetables and nuts. Perhaps iron intake was higher (although not significantly so) among vegetarians because they were aware that iron obtained from animal sources, haem iron, is better absorbed than that from plant sources, non-heam, therefore made a conscious decision to eat more plant sources of iron [9]. Lower intakes of minerals, for example zinc, by the vegetarian and vegan groups could be attributed to the exclusion of animal products since meat products can provide more minerals in a readily bio-available manner. Unlike prior research [2,19-21,25] our

participants did not use nutritional supplements such as vitamins or minerals. Nutritional gaps were found regardless of dietary preference consequently adults should consider their dietary needs and appropriately plan food intake to ensure nutritional goals are met. We acknowledge that our research is limited by the small sample size, particularly the vegan group size. We believe that our research provides an insight into the nutritional habits of young adults with an interest in health.

Conclusion

Vegetarian diets may be associated with a reduced risk for a number of health problems such as CVD and colon cancer. Compared to omnivores, vegetarians and vegans can consume greater amounts of folate, vitamin C and vitamin E however without supplementation vitamin B_{12}, calcium and zinc intake of vegetarians may be insufficient. Omnivores consume a variety of animal products however we found their intake of folate, magnesium, iron, calcium, vitamin E and copper can be inadequate. Regardless of dietary focus, adults should consume a variety of foods to ensure their nutritional requirements are being met.

References

1. Venderley AM, Campbell WW (2006) Vegetarian diets: nutritional considerations for athletes. Sports Med 36: 293-305

2. Draper A, Lewis J, Malhotra N, Wheeler E (1993) The energy and nutrient intakes of different types of vegetarian: a case for supplements? Br J Nutr 69: 3-19.

3. Ruby MB (2012) Vegetarianism. A blossoming field of study. Appetite 58: 141-50.

4. Rothgerber H (2014) A comparison of attitudes toward meat and animals among strict and semi-vegetarians. Appetite 72: 98-105.

5. Lea E, Worsley A (2003) The factors associated with the belief that vegetarian diets provide health benefits. Asia Pac J Clin Nutr 12: 296-303.

6. Fox N, Ward K (2008) Health, ethics and environment: A qualitative study of vegetarian motivations. Appetite 50: 422 - 9.

7. Ball MJ, Bartlett MA (1999) Dietary intake and iron status of Australian vegetarian women. Am J Clin Nutr 70: 353-8.

8. Cox GR (2001) The Vegetarian athlete. International SportMed Journal 2: 1-8.

9. Barr SI, Rideout CA (2004) Nutritional considerations for vegetarian athletes. Nutrition 20: 696-703.

10 Teixeira RC, Molina Mdel C, Zandonade E, Mill JG (2007) Cardiovascular risk in vegetarian and omnivores: a comparative study. Arq Bras de Cardiol 89: 237-44.

11. Craig WJ (2009) Health effects of vegan diets. Am J Clin Nutr 89: 1627S-33S.

12. Krajcovicova-Kudlackova M, Simoncic R, Bederova A, Klvanova J, Brtkova A, et al. (1996) Lipid and antioxidant blood levels in vegetarians. Nahrung 40: 17-20.

13. Oh K, Hu FB, Manson JE, Stampfer MJ, Willett WC (2005) Dietary fat intake and risk of coronary heart disease in women: 20 years of follow-up of the Nurses' Health Study. Am J Epidemiol 161: 672-9.

14. Nieman DC (1988) Vegetarian dietary practices and endurance performance. Am J Clin Nutr 48: 754-61.

15. Millet P, Guillard JC, Fuchs F, Klepping J (1989) Nutrient intake and vitamin status of healthy French vegetarians and nonvegetarians. Am J Clin Nutr 50: 718-27.

16. Abdulla M, Andersson I, Asp NG, Berthelsen K, Birkhed D, et al. (1981) Nutrient intake and health status of vegans. Chemical analyses of diets using the duplicate portion sampling technique. Am J Clin Nutr 34: 2464-77.

17. NHMRC (2005) Nutrient reference values for Australia and New Zealand. Council NHaMR, Canberra: Australian Government, Australia.

18. Yen CE, Yen CH, Huang MC, Cheng CH, Huang YC (2008) Dietary intake and nutritional status of vegetarian and omnivorous preschool children and their parents in Taiwan. Nutr Res 28: 430-6.

19. Karabudak E, Kiziltan G, Cigerim N (2008) A comparison of some of the cardiovascular risk factors in vegetarian and omnivorous Turkish females. J Hum Nutr Diet 21: 13-22.

20. Gilsing AM1, Crowe FL, Lloyd-Wright Z, Sanders TA, Appleby PN, et al. (2010) Serum concentrations of vitamin B12 and folate in British male omnivores, vegetarians and vegans: results from a cross-sectional analysis of the EPIC-Oxford cohort study. Eur J Clin Nutr 64: 933-9.

21. Donovan UM, Gibson RS (1996) Dietary intakes of adolescent females consuming vegetarian, semi-vegetarian, and omnivorous diets. J Adolesc Health 18: 292-300.

22. Wilson AK, Ball MJ (1999) Nutrient intake and iron status of Australian male vegetarians. Eur J Clin Nutr 53: 189-94.

23. Deriemaeker P, Alewaeters K, Hebbelinck M, Lefevre J , Philippaerts R et al. (2010) Nutritional status of Flemish vegetarians compared with non-vegetarians: a matched samples study. Nutritents 2: 770-80.

24. Craig WJ (2010) Nutrition concerns and health effects of vegetarian diets. Nutr Clin Pract 25: 613-20.

25. Rauma AL, Torronen R, Hanninen O, Verhagen H, Mykkanen H (1995) Antioxidant status in long-term adherents to a strict uncooked vegan diet. Am J Clin Nutr 62: 1221-7.

26. Poomima K, Cariappa M, Asha K, Kedilaya HP, Nandini M (2003) Oxidant and antioxidant status in vegetarians and fish eaters. Indian J Clin Biochem 18: 197 - 205.

27. Szeto YT, Kwok TC, Benzie IF (2004) Effects of a long-term vegetarian diet on biomarkers of antioxidant status and cardiobascular disease risk. Nutrition 20: 863-6.

28. Sebeková K, Boor P, Valachovicová M, Blazícek P, Parrák V, et al. (2006) Association of metabolic syndrome risk factors with selected markers of oxidative status and microinflammation in healty omnivores and vegetarians. Mol Nutr Food Res 50: 858-68.

29. Krivosikova Z, Krajcovicova-Kudlackova M, Spustova V, Stefíková K, Valachovicová M, et al. (2010) The association between high plasma homocysteine levels and lower bone mineral density in Slovak women: the impact of vegetarian diet. Eur J Nutr 49: 147-53.

30. Yen CE, Yen CH, Yen CH, Huang YC (2010) Vitamin B-12 status is not associated with plasma homocysteine in parents and their preschool children: lacto-ovo, lacto, and ovo vegetarians and omnivores. J Am Coll Nutr 29: 7-13.