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Current Research in Nutrition and Food Science Vol. **4**(3), 141-152 (2016)

An Investigation into the Pragmatic Diets of Vegetarianism: The Results of a Pilot Study

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http://dx.doi.org/10.12944/CRNFSJ.4.3.01

(Received: October 11, 2016; Accepted: December 13, 2016)

ABSTRACT

Published recommended various classifications of vegetarian diets are widespread across the globe, but few published articles if any report on the types of foods actually consumed by vegetarians in general. The primary objective was to elucidate this aspect of vegetarianism, analysis of food consumption over a fourteen day period, with respect to the various manifestations of vegetarianism, was undertaken in the form of a pilot study to indicate the contents of these diets as compared with recommended daily allowances (RDA) and adequate intake (AI) values. Five lactovegetarians, twenty lactoovovegetarians and fourteen vegans, were recruited. The study included a detailed analysis of the vegetarian participants' diet, through the compilation of an individual diet diary. Statistical analysis employing Microsoft Excel software was conducted to determine the outcome of the vegetarians' diets, with each mean nutrient and mean dietary energy value compared against RDA and AI. Analysis of the participants' diet diaries indicated somewhat unexpectedly a failure to meet the RDA and AI for several important nutrients. Furthermore, the daily metabolizable energy level for all classifications of vegetarians was lower than the recommended AI for daily energy requirements. Whilst it is generally accepted that vegetarianism can lead to a healthy lifestyle, the findings of this research indicate that vegetarianism participants may be at risk of deficiency of certain nutrients that could potentially lead to chronic medical conditions. The statistical findings obtained in the study will allow an accurate sample size to be calculated for each important item for future large definitive studies.

Keywords: Dietary nutrient intake; Dietary energy intake; Nutrient deficiency; Recommended daily allowance.

INTRODUCTION

Worldwide there are 75 million vegetarians by choice and 1.45 billion by necessity [1]. This is consistent with the approximation of 25% of the world's population consuming a largely vegetarian diet [2].

There are ten recognised classifications of vegetarianism. The most common types being vegan (V), lactovegetarian (LV) and lactoovovegetarian (LOV).

The defining differences in these most common diets are as follows [3-5]:

Diet excludes all animal flesh and animal products, and any product tested on animals.

LV

Diet excludes all animal flesh and animal products. They do consume dairy products.

LOV

As per LV, but with eggs included.

Please note that in this paper references to vegetarian or vegetarianism is to be taken as LV, LOV and vegan diets.

This investigation focuses on vegan, LV and LOV diets, with the aim of comparing daily intake of nutrients and energy content of these diets with published RDA and AIs. However,

It was highly unlikely that an accurate calculation of the sample size of a meaningful study could be established unless it was based on existing strong evidence [6, 7]. In view of the rarity of existing published articles that cover this topic, the present pilot study undertaken was designed to provide an insight into the contents of these types of diets. Also, the statistical findings obtained relating to population variances and standard deviations will allow an accurate sample size to be calculated for each important item for future large definitive studies[8].

MATERIALS AND METHODS

This study comprises an in-depth analysis of the diet diaries of LV, LOV and vegans who previously took part in a double blind placebo controlled clinical pilot study conducted by the same authors of this paper and published in this journal [9]. The study was conducted according to the guidelines laid down in the WMA Declaration of Helsinki [10] and all procedures involving human subjects were approved by the University of West London Research Scrutiny & Ethics Sub-committee. Written informed consent was obtained from all subjects.

The research findings presented in this paper are therefore a follow-on from a previously conducted pilot study that did not address the analysis of the entire contents of the diets of the participating groups of vegetarians of the trial.

Recap of recruitment of participants

Over the period July 2012 to December 2013 a total of 39 volunteers living in the UK completed their diet diaries. These subjects were recruited via the Vegetarian and the Vegan Societies and who had been practicing vegetarianism for >3years. These subjects comprised of LV, LOV and vegans. In our study LV and LOVs were treated as one group, since there is no nutritional detrimental difference as far as the diet analysis is concerned.

Recap of inclusion criteria

Inclusion criteria were as follows, age between 18 and 65 years old; not participating in a weight reducing diet; not pregnant, lactating or trying to conceive; non-smoker; not consuming alcohol regularly (>2 units/day for females, >3 units/day for males); moderate caffeine consumption (> 4 cups/day of strong tea or coffee); not suffering from genetic metabolic disease; not suffering from renal failure, diabetes, thyroid disease, cardiovascular disease, dementia or cancer not using medications known to influence nutritional status.

Recap of data collection

Each participant completed a fourteen day diet diary under the strict supervision of a Nutritional Therapist. This involved the daily recording of the quantity of all food and beverages, consumed by the participants.

Statistical analysis

Following analysis of the diet diaries of the participants who completed the study (n=39) the mean, SD, and CI 95% of daily consumed nutrients were calculated employing Microsoft Excel software. Also, calculations were made of the daily mean, SD and CI 95% energy intake of the participants employing the same software.

RESULTS AND DISCUSSION

The socio demographic characteristics of age, gender, and vegetarian classification of the participants who participated in this investigation are presented in Table 1, which shows that there

were thirteen male participants with a mean age of 50.8±14.8 years old and twenty six female participants with a mean age of 44.1±14.4 years old.

It can be observed from Table 2 and Table 3 that both the LV-LOV and the vegan diets exhibited a wide range of daily mean nutrient deficiencies, when compared with appropriate RDA and AIs. It is important to note that in compiling Table 2 and Table 3, nutrient trace values have been taken as zero, since quantities are approaching the limits of detection [11]. Also, some nutrient values have been taken from manufacturers published data.

Specifically both male and female LV-LOVs as well as the vegan diets were deficient in the following components: water, protein, fibre, retinal, vitamin D, potassium, calcium, selenium, iodine, choline and TMG compared to their RDA and AIs. Furthermore, the diets of LVs and LOVs of both genders together with the female vegan diets do not meet the RDA for mean daily intake of vitamin E. Moreover, the diets of the LV-LOV for both genders did not meet the AI level for daily intake of vitamin B5. Also, the diets of the female LV- LOV diets did not meet the RDA for mean daily intake of carbohydrates; vegan diets of both genders did not meet the RDA for mean daily intake of vitamin B12. Both LV-LOV and vegan female diets did not meet the RDA for mean daily intake of vitamin B1, vitamin B3, chloride and iron. Both genders of LV-LOV and the male vegan diets did not meet the AI for mean daily intake of vitamin K. Female LV-LOV diets did not meet the AI for mean daily intake of sodium and finally male LV-LOV and female vegan diets fall slightly short of the RDA for the mean daily intake of magnesium.

It is recognised that whilst both male and female LV-LOV and vegan diets contained only a mean daily intake of d" 1µg of vitamin D, which is much lower than the daily AI of 5µg. This shortfall has the potential to be supplemented by induced vitamin D, generated from sunlight to obtain a sufficient supply of this important essential nutrient.

Dietary energy intake calculations

Calculations of the daily energy intake are based on the formula shown in Figure 1 with the appropriate nutrient values taken from Table 2 and Table 3. Conversion factors for metabolizable energy as shown in Table 4 are also utilised. The calculated energy values are presented in Table 5 and Table 6 which, assumes polyols and organic acids are omitted in the calculation of metabolizable energy, as they only represent a small percentage of energy from which there is no published validated information available. Also, it should be noted that available carbohydrate is the sum of the free sugars (glucose, fructose, galactose, sucrose, maltose, lactose and oligosaccharides) and complex carbohydrates (dextrin, starch and glycogen). These are the carbohydrates which are digested and absorbed and are glucogenic in human beings[12]. Furthermore, that digestibility does not vary significantly among the participants and conversion factors for metabolizable energy of the diets are taken from Table 4.

Table 1: Socio demographic characteristics of volunteers who participated in the clinical trial

Socio demographic characteristics	Age Mean	SD
Male	50.8	14.8
Female	44.1	14.4
Vegetarian classification (N=39 total)	**Males**	**Females**
Lactovegeterian	2 (5.1%)	3 (7.7%)
Lactoovogeterian	9 (23%)	11 (28.3)
Vegan	2 (5.1%)	12 (30.8)

Adapted from: Obersby *et al* [9].

Table 2: Analysis of daily diets of male LV-LOV and vegan pilot study participants

Nutrient	LV-LOV Male (n=11) Mean	LV-LOV Male (n=11) CI 95%	Vegan Male (n=2) Mean	Vegan Male (n=2) CI 95%	RDA	Adult values AI
Water (g)	2001	1785, 2217	2565	2428, 2702		3700
Protein (g)	40	37.2, 42.9	40.12	37.8, 42.4	56	
Fats (g)	57.6	148, 218	67.3	46.3, 88.3		27.5 (x)
Carbohydrates(g) (a)	183	73.8, 124	186	161, 211	130	
Starch (g)	98.7	73.8, 124	107	94.3, 120	(c)	
Total sugar	84.6	74.1, 95	78.7	66.1, 99.2	(c)	
Glucose	17.3	16.6, 18	20.6	19.1, 22	(c)	
Fructose	21	17.7, 24.4	21.4	13.8, 29	(c)	
Sucrose	36.8	27.5, 46	31.5	29.4, 33.5	(c)	
Maltose (g)	3.2	2.8, 3.7	5.1	4.2, 6.1	(c)	
Lactose (g)	6.2	3.6, 8.7	0.2	0.004	(c)	
Dietary fibre (g) (d)	15.8	14, 17.6	20.2	19.2, 21.2		38
Saturated fat (g)	20.7	15.9, 25.6	13	7.2, 18.7		20 (e)
Monounsaturated fat (g)	20.7	16.8, 24.7	26.2	20.7, 31.6	(c)	
Polyunsaturated fat(g)	11.5	9.1, 11.9	24.5	16.6, 32.4	(c)	
Trans fat (g)	1.9	1.2, 2.5	0.6	0.5, 0.6		
Cholesterol (mg)	134	103, 165	11.4	6.3, 16.4	300	2.8 (t)
Retinal (µg)	236	197, 275	0	0, 0	900	
Carotene(µg)	3679	2680, 4678	2739	2562- 2916	(c)	
Vitamin D(µg)	1	0.9, 1.1	0.8	0.6, 2.2		5
Vitamin E(µg)	10.1	7.9, 1.1	17.8	13.3, 22.3	15	
Vitamin B1(µg)	1.9	1.4, 2.3	1.7	0.5, 2.8	1.2	
Vitamin B2(µg)	2.1	1.9, 2.3	1.3	1, 1.7	1.3	
Vitamin B3(µg)	17.5	15.9, 19.2	16.8	9.4, 24.2	16	
Vitamin B6(µg)	1.8	1.6, 2	1.8	1.7, 2	1.3	
Vitamin B12(µg)	2.5	1.9, 3.2	1.3	-0.1, 2.8	2.4	
Folate(µg)	511	504, 518	425	164, 686	400	
Vitamin B5(µg)	3.2	3.1, 3.4	8.2	-1, 17.5		5
Biotin (mg)	38.8	37, 40.4	43.6	21.4, 41.9		30
Vitamin C(mg)	108	59.8, 156	120	60.7, 179	90	
Vitamin K(µg)	88.1	75.5, 101	101	27.1, 175		120
Sodium (mg)	1819	1535, 2103	1623	1532, 1714		1500
Potassium (mg)	2726	2345, 3107	3255	2458, 4052		4700
Calcium (mg)	636	589, 683	668	568, 768		1000
Magnesium(mg)	405	361, 449	431	381, 481	420	
Phosphorus (mg)	907	787, 1027	945	838, 1052	700	
Iron (mg)	8.8	7.9, 9.7	14.2	11, 17.4	8	
Copper (mg)	1.1	0.9, 1.4	1.7	1.3, 2.2	0.9	
Zinc (mg)	11.7	7.3, 16.1	12.5	1.3, 23.8	11	
Chlorine (mg)	3095	2652, 3538	2805	2768, 2842		2300
Manganese(mg)	4.6	3.7, 5.5	5.5	4.8, 6.2		2.3
Selenium (µg)	33.5	22.3, 44.6	43.4	6.3, 80.4	55	
Iodine (µg)	72.7	54.5, 90.9	27.8	17.1, 38.4	150	
Choline (mg)	197	195, 199	205	183, 227		550
Trimethylglycine (mg)	136	82.7, 189	148	107, 189		500 - 1000
Alcohol (g)	13	10.3, 15.8	21.2	7, 35.3		32 (e)
Methionine (mg)	613	532, 694	616	468, 764	(c)	

Legend:
(a) Non-starch polysaccharides, (b) Moderate activity
(c) Not determined, (d) Non-starch polysaccharides.
(e) Maximum, (f) Less than.
(x) Mean acceptable macronutrient distribution range (MAMDR)

Table 3: Analysis of daily diets of female LV-LOV and vegan pilot study participants

Nutrient	LV-LOVMale (n=11) Mean	CI 95%	VeganMale (n=2) Mean	CI 95%	RDA	Adult values AI
Nutrient	Mean	CI 95%	Mean	CI 95%	RDA	AI
Water (g)	1642	1427, 1857	1640	1075, 2204		2700
Protein (g)	29.5	27.3, 31.8	30.1	23.1, 37.1	46	
Fats (g)	46.2	45.1, 47.4	40.4	39.1, 41.7		27.5(x)
Carbohydrates(g) (a)	122	111, 133	152	124, 180	130	
Starch (g)	60.7	51.7, 69.7	75.9	70.6, 81.1	(c)	
Total sugar	60.5	45.1, 75.9	76.2	53.1, 99.2	(c)	
Glucose	11.4	7, 15.7	23.4	17, 29.9	(c)	
Fructose	12	7.4, 16.6	25.8	18.5, 33.2	(c)	
Sucrose	28.5	22.4, 34,7	25.5	16.6, 34.3	(c)	
Maltose (g)	2.3	1.7, 2.9	1.8	1.2, 2.5	(c)	
Lactose (g)	6.2	4.5, 7.9	0	0, 0	(c)	
Dietary fibre (g) (d)	11.7	10.8, 12.5	20	15.7, 24.2		25
Saturated fat (g)	19.7	18.3, 21.1	8	7.7, 8.2		20(e)
Monounsaturated fat (g)	15.9	14.2, 17.7	15.3	14.4, 16.2	(c)	
Polyunsaturated fat(g)	7	5.7, 8.3	12.8	11.3, 14.4	(c)	
Trans fat (g)	1.4	0, 2.3	1.1	0.5, 1.8		2.8(f)
Cholesterol (mg)	119	70.4, 168	11.7	3.6, 19.9	300	
Retinal (µg)	270	222, 318	0	0, 0	700	
Carotene(µg)	1121	850, 1392	5424	2300, 8547	(c)	
Vitamin D(µg)	0.6	0.3, 0.8	0.5	0.3, 0.7		5
Vitamin E(µg)	5.2	3.5, 6.9	9.4	9.3, 9.5	15	
Vitamin B1(µg)	0.6	0.6, 0.7	1	0.8, 1.2	1.1	
Vitamin B2(µg)	1.3	1, 1.6	1.3	1.2, 1.5	1.1	
Vitamin B3(µg)	9.1	8.1, 10.1	10.9	9, 12.8	14	
Vitamin B6(µg)	1.4	1.2, 1.6	1.8	1.6, 1.9	1.3	
Vitamin B12(µg)	3.2	2.3, 4	1.2	0.8, 1.6	2.4	
Folate(µg)	407	374, 440	434	421, 447	400	
Vitamin B5(µg)	2.8	2.5, 3	7.5	3.25, 11.7		5
Biotin (mg)	32.4	27.9, 36.8	31.7	21.4, 41.9		30
Vitamin C(mg)	81.1	43.8, 118	126	87.3, 164	75	
Vitamin K(µg)	46.8	45.3, 48.2	112	98.4, 126		90
Sodium (mg)	1310	1094, 1532	1755	1074, 2436		1500
Potassium (mg)	1948	1578, 2318	2575	2246, 2904		4700
Calcium (mg)	544	487, 591	475	300, 650		1000
Magnesium(mg)	402	352, 452	315	308, 322	320	
Phosphorus (mg)	860	719, 1001	717	552, 882	700	
Iron (mg)	6.8	5.8, 7.7	9.4	7.9, 10.9	18	
Copper (mg)	0.9	0.8, 1	1.4	0.9, 1.8	0.9	
Zinc (mg)	10.4	7, 13.8	15.3	7.2, 23.5		8
Chlorine (mg)	214	211, 217	1926	1491, 2361		2300
Manganese(mg)	6.1	4.3, 8	4.3	4.1, 4.5		1.8
Selenium (µg)	18.9	14.4, 23.3	22.3	19.4, 25.1	55	
Iodine (µg)	71.6	63.2, 79.9	24.9	13.6, 36.3	150	
Choline (mg)	214	211, 217	183	1.7, 196		425
Trimethylglycine (mg)	238	210, 266	223	204, 242		500-100
Alcohol (g)	7.6	0.7, 14.5	5	1.8, 8.1		24(e)
Methionine (mg)	441	415, 465	421	387, 455	(c)	

Legend:
(a) Non-starch polysaccharides, (b) Moderate activity
(c) Not determined, (d) Non-starch polysaccharides
(e) Maximum, (f) Less than
(x) MAMDR

Mean energy intakes were found to be 1488 ± 203 kcal/d and 1648 ± 113 kcal/d for male LV-LOV and vegan diets respectively (Table 5). For female LV-LOV and vegan diets they were found to be 1043 ± 146 kcal/d and 1129 ± 172 kcal/d respectively (Table 6).

The pictorial representation of the calculated mean energy intakes of the participants are presented in Figure 1and Figure 2.

Analysis of the participant food diaries indicates that there is a considerable deficiency

Table 4: Conversion factors for metabolizable energy of the diet

Energy from:	Kcal/g	Kj/g
Protein	4	17
Fat	9	37
Available carbohydrate (monosaccharide equivalent)	3.75	17
Dietary fibre (Non-starch polysaccharides)	2	8
Total polyols	2.4	10
Alcohol	7	29
All organic acids	3	13

Adapted from: Foods Standards Agency [12].Food and Agriculture Organization of the United Nations [23].

Table 5: Energy intakes of pilot study male participants who completed the study

Energy from:	LV-LOV (n=11)			Vegan (n=2)			AI
	Mean (kcal/d)	SD (kcal/d)	CI (95%)	Mean (kcal/d)	SD (kcal/d)	CI (95%)	(kcal/d)
(A) Carbohydrate-total	687	171	586,788	694	48	627, 760	1375 (d)
Starch	370	158	277, 463	399	35	351, 447	(c)
Total sugars	317	66	278, 356	296	33	249, 341	(c)
(B) Fats-total	518	103	457, 579	605	74	503, 707	625 (e)
Saturated fat	186	74	142, 230	117	38	65, 169	(c)
Monounsaturated fat	187	60	151, 221	235	35	186, 284	(c)
Polyunsaturated fat	103	37	81, 125	220	51	149, 291	(c)
Trans fat	17	10	11, 24	5	0.2	4.7, 5.2	(c)
Unidentified fat	25	6	22, 28	28	12	12, 45	(c)
(C) Protein	160	19	149, 171	161	12	151, 169	400(f)
(D) Alcohol	91	33	72, 111	148	7	49, 247	(c)
(E) Dietary Fibre	32	6	28, 35	40.5	1.5	38.4, 42.4	(c)
(F) Total per day (A)+(B)+(C)+(D)+(E)	1488	203	1368, 1608	1648	113	1491, 1804	2500(a) (b)

Legend:
(a) Moderate activity.
(b) Average adult.
(c) Not determined.
(d) Based on an average energy contribution of 55 %.
(e) Based on an average energy contribution of 25%.
(f) Based on an average energy contribution of 20%.

of dietary vitamin D for both LV-LOVs and vegans indicating a likely dietary vitamin D deficiency. This can be clearly observed in Table 2 and Table 3, and these individuals are probably unaware that they need to rely on their supply of vitamin D from synthesis by the body from the sun's ultra violet radiation. Therefore, in this instance it is reasonable to recommend that both vegetarian groups should consider supplementing their diets with this very important essential nutrient, particularly during winter months. In terms of meeting the RDA and AIs both vegetarian groups need to increase their intake of appropriate nutrients in order to satisfy their RDA and AIs. Moreover, it would not be appropriate in this investigation to recommend an increase of nutrients that are based on mean values of groups of people. This can only be effectively achieved on an individual basis (n=39), which is outside the scope of this investigation. However, it is worth noting that the deficiency of the above nutrients can potentially raise health issues, these are summarised in Table 7. The evidence obtained from Table 5 and Table 6 indicates that the mean daily intake of energy 1488 ± 203 kcal/d for male LV-LOVs, 1648 ± 113 kcal/d for male vegans, 1043 ± 146 kcal/d for female LV-LOVs and 1129 ± 172 kcal/d for female vegans appears to be low when compared with the recommended AIs of 2500 kcal/d for males and 2000 kcal/d for females for average adults who undertake moderate physical activity.

Total energy (TE) = TE of carbohydrates + TE of fats + TE of proteins + TE of alcohol +TE dietary fibre
Notes
1) It is assumed that digestibility does not vary significantly among participants.
2) Conversion factors for metabolizable energy of

Table 6: Energy intakes of pilot study female participants who completed the study

Energy from:	LV-LOV (n=11)			Vegan (n=2)			AI
	Mean (kcal/d)	SD (kcal/d)	CI (95%)	Mean (kcal/d)	SD (kcal/d)	CI (95%)	(kcal/d)
(G)Carbohydrate-total	455	128	388, 522	570	157	481, 659	1100 (d)
Starch	228	65	194, 262	284	35	264, 304	(c)
Total sugars	227	110	169, 285	286	153	199, 373	(c)
(H)Fats-total	416	46	392, 440	364	26	349, 379	500 (e)
Saturated fat	177	24	165, 189	72	4	69, 74	(c)
Monounsaturated fat	143	31	127, 159	138	14	130, 146	(c)
Polyunsaturated fat	63	22	51, 74	115	18	105, 125	(c)
Trans fat	13	1.6	11.8, 13.5	10	10.1	4.3, 15.8	(c)
Unidentified fat	20	11	14, 26	29	5.8	26, 33	(c)
(I)Protein	118	17	109	120	50	92	400(f)
(J)Alcohol	30.4	53	28, 78	35	39	13, 57	(c)
(K)Dietary Fibre	23	3	22, 25	40	15	31, 49	(c)
(L)Total per day (A)+(B)+(C)+(D)+(E)	1043	146	967, 1119	1129	172	1031, 1225	2000(a) (b)

Legend:
(a) Moderate activity.
(b) Average adult.
(c) Not determined.
(d) Based on an average energy contribution of 55 %.
(e) Based on an average energy contribution of 25%.
(f) Based on an average energy contribution of 20%.

the diets are taken from Table 4
TE of carbohydrates = TE of starch + TE of sugars. TE of fats = TE of saturated fatty acids (SFA) + TE of polyunsaturated fatty acids (PUFA) + TE of monounsaturated fatty acids (MUFA) + TE of trans-fatty acids (TFA) +TE of unidentified fat (UF).

In conclusion, the findings of this paper demonstrate that all vegetarian participants exhibit a deficiency of several important dietary nutrients that potentially could lead to chronic medical conditions. Whilst it was outside the scope of this research to recommend dietary changes on an individual basis,

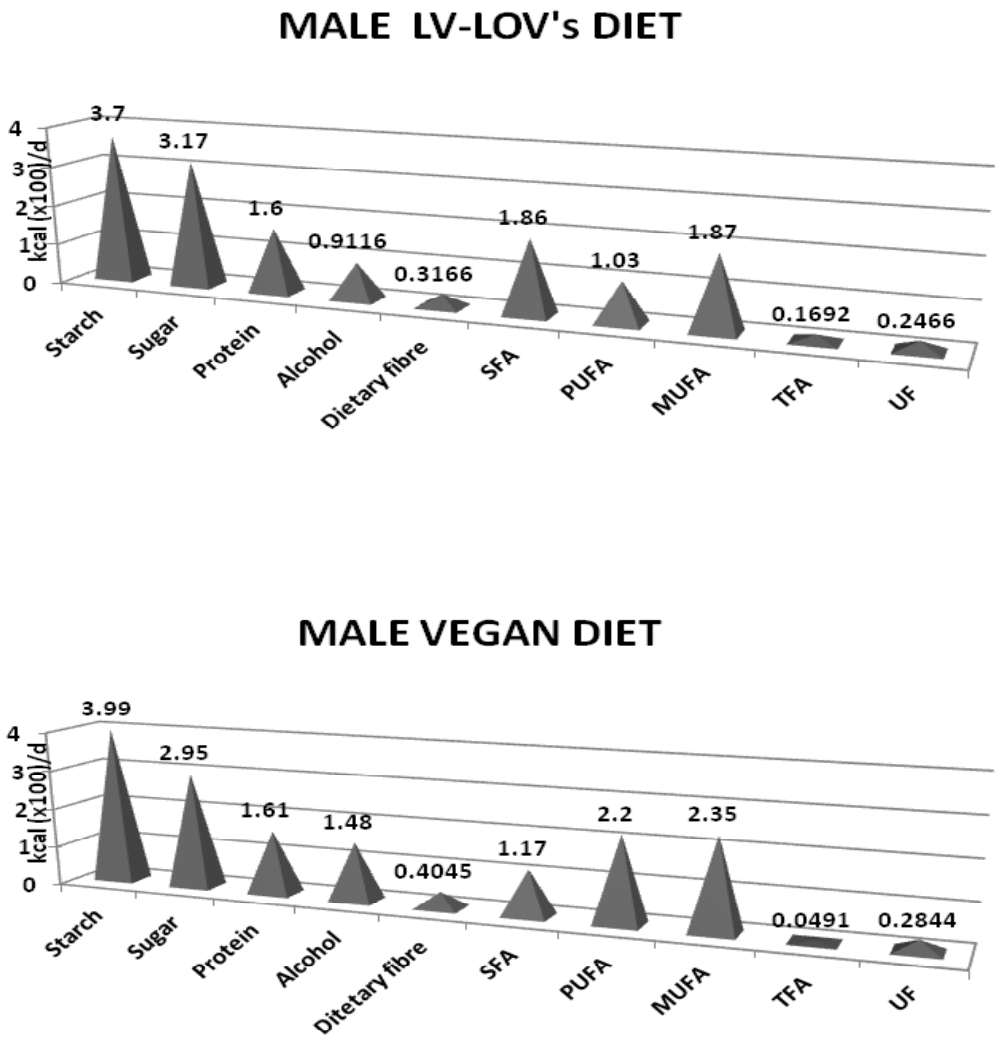

Fig. 1. Pictorial representation of mean daily energy intake of male participants and total energy formula

the results clearly show that on a group basis that there is a dire lack of vitamin B12, due to an absence of dietary animal products in vegan diets. Also, LV-LOV male diets only marginally meet the RDA for this very important nutrient. Furthermore, all groups exhibit a deficiency of dietary vitamin D, although dietary deficiency of vitamin D can be compensated by one's exposure to sunlight.

The mean daily metabolizable energy intake for all groups of participants indicate that this is well below recommendations which, can in certain instances such as with high activity lead to certain individuals becoming significantly under weight.

The analysis of the diets provides suitable statistical data to allow the calculation of an accurate

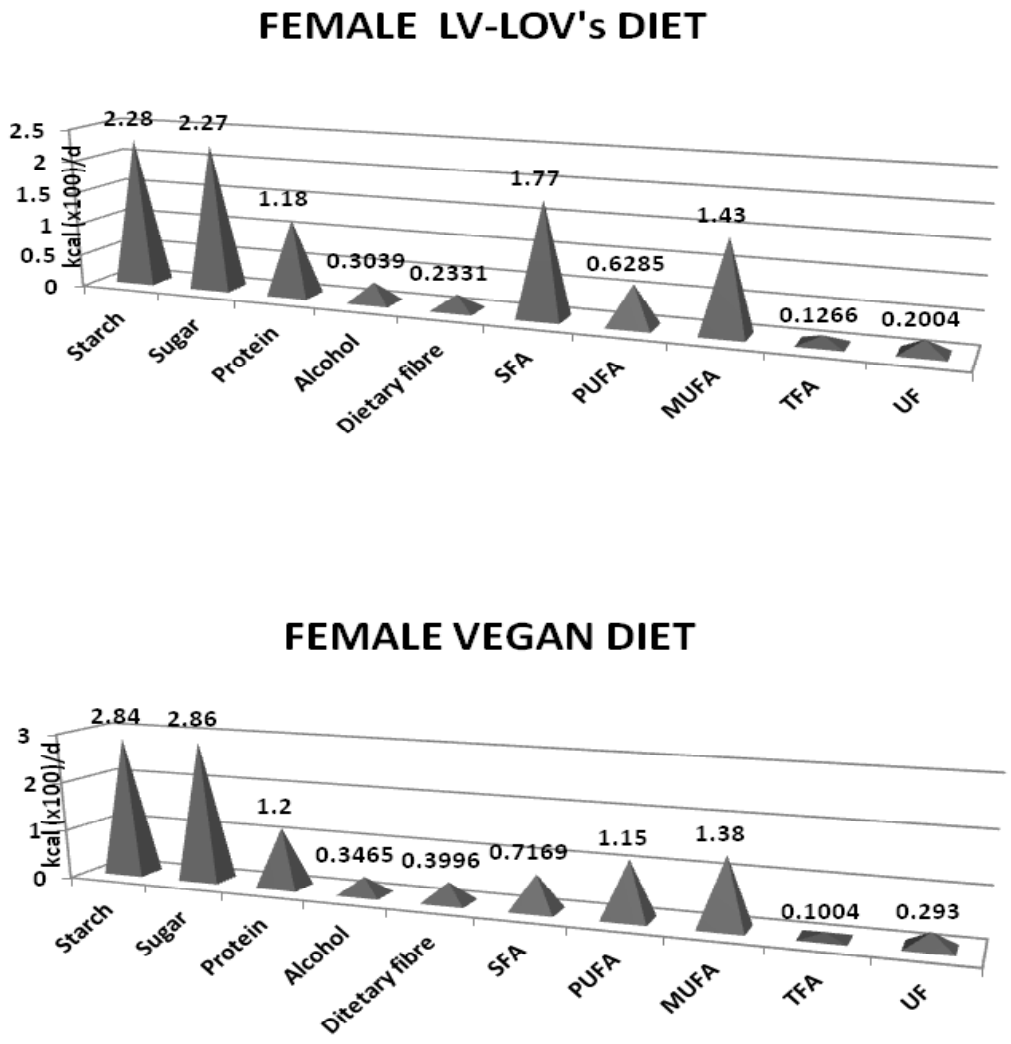

Fig. 2: Pictorial representation of mean daily energy intake of female participants

Table 7: Summary of some potential health issues due to inadequate intake and deficiency of nutrients

Inadequate intake & deficiency of nutrient (< RDA or AI)	Some potential health issues
Water	Dehydration, effects include impaired mental function and motor control, reduced tolerance to stress or exercise and heat and increased resting heart rate.
Protein	Affects all body organs and many of its systems and the immune system , thus elevating risk of infection
Carbohydrates	Increased production of keto acids leading to bone mineral loss, hypercholesterolemia, and increased risk of urolithiasis.
Dietary fibre	Inadequate faeces bulk and may detract from optimal health
Vitamin D	Demineralization of the skeleton. Potential effects are rickets (in children), osteomalacia (in adults), and osteoporosis.
Vitamin E	Deficiency very rare only occurs as a result of genetic abnormalities of vitamin E metabolism, fat malabsorption syndromes or protein-energy malnutrition. Main symptom peripheral neuropathy.
Vitamin B3	Pellagra causing pigmented rash, vomiting, depression, apathy, headache, fatigue, memory loss.
Vitamin B5	Deficiency very rare only occurs with diets completely devoid of the vitamin. Main sympoms include irritability, fatigue, apathy, malaise, sleep disturbances, nausea, muscle cramps.
Vitamin B12	Elevated homocysteine leading to cardiovascular disease, pernicious anemia, dementia, depression, impaired cognition, autoimmune dysfunction, neurological and gastrointestinal effects.
Vitamin K	Deficiency is extremely rare in the general population, in such cases an increase in prothrombin time and bleeding may occur.
Sodium	Overall, there is little evidence of any adverse effect of low dietary sodium intake on serum or plasma sodium concentrations in healthy people.
Potassium	Hypertension, increased salt sensitivity, an increased risk of kidney stones and cardiovascular disease, particularly stroke.
Calcium	Reduced bone mass resulting in ostcopenia, osteoporosis, and increase risk of bone fracture.
Magnesium	Muscle cramps, interference with vitamin D metabolism, latent tetany, spontaneous carpal-pedal spasm, seizures and hypertension.
Iron	Iron deficiency anemia is the most common nutritional deficiency causing reduced physical work capacity, delayed psychomotor development in infants and impaired cognitive function.
Chloride	Deficiency is rarely seen in healthy people because most foods that contain sodium also provide chloride. Excess depletion causes hypochloremic metabolic alkalosis
Selenium	May lead to biochemical changes that can predispose a person to illness associated with other stresses, such as: Keshan disease, and Kashin-Beck disease
Iodine	Goiter, fatigue, lethargy, high cholesterol and depression
Choline	Can cause liver damage, resulting in elevated alanine aminotransferase.
Trimethylglycine	Can contribute to hyperhomocysteinemia, which increases risk of developing cardiovascular disease.

Adapted from: Institute of Medicine of the National Academy of Sciences [16]; Kuwabara et al [23]; Obersby et al [24].

sample size for each important item of future large scale definitive studies.

Further research is called for into establishing the nutritional contents of practical vegetarian diets. Meanwhile, It is recommended for LV, LOV and vegans to carefully monitoring their diets and possibly supports these with supplements.

ACKNOWLEDGEMENT

Our thanks go out to all respondents for their participation, Moreover, we would like to thank the Vegetarian and Vegan Societies for their help in recruiting the participants of the study, without which the research project could not have taken place.

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