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Original Article

The relative impact of a vegetable-rich diet on key markers of health in a cohort of Australian adolescents

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Childhood obesity is a widespread health problem in Australia. Overweight in childhood can lead to adult overweight and the development of risk factors for cardiovascular disease (CVD). Effective strategies for reducing childhood obesity are urgently required. A vegetarian diet has been shown to be an effective prophylactic to many lifestyle diseases in the adult population and may therefore be beneficial in children. However the metabolic demands of adolescents are different to adults and the impact of a vegetarian diet on CVD markers in this demographic is not certain. We compared key physiological and biochemical markers of health against responses to a modified, Schools Physical Activity and Nutrition Survey (SPANS) using one-way and two-way Analysis of Variance. 215 adolescents (14-15yrs) from 5 Adventist secondary schools in the Sydney and Hunter regions of New South Wales, Australia, participated in this study. Adolescents consuming predominantly vegetarian foods showed significantly better scores on markers of cardiovascular health, including, body mass index (BMI), waist circumference, Cholesterol/High density lipoprotein ratio and low density lipoprotein. Adolescents consuming nuts more than once per week, also showed lower scores for BMI and serum glucose irrespective of their vegetarian status. Markers of general health including haemoglobin and average height were not different between groups; however a lower serum level of vitamin B12 was apparent in the vegetarian cohort. Surprisingly, exercise on its own was not statistically associated with any of the risk factors tested suggesting that diet may be the most significant factor in promoting health in this age group.

Key Words: vegetarian, glucose, nuts, BMI, vitamin B12

INTRODUCTION

In Australia, childhood obesity rivals asthma as the most prevalent chronic 'child-health' condition. [1] The incidence of over-weight and obese children has increased significantly over the last two decades. [2] This is of major concern as childhood overweight increases the risk of adult overweight and the development of related cardiovascular disease (CVD) risk factors including, hypertension, dyslipidaemia, chronic inflammation, insulin resistance and type-2 diabetes (reviewed in 3, 4) and increased psychosocial morbidity. [5]

Strategies targeted at the prevention of overweight and halting the progression of overweight to obesity are urgently required in school-aged children in order to stem this epidemic in our future adult population.[6]

Diet and lifestyle choices are generally considered to play major roles in the development of cardiovascular disease.[7, 8] In Australian studies involving adolescent children, researchers have demonstrated that higher cardiovascular risk is associated with both dietary excesses, particularly in fat, cholesterol and sodium intake, and deficiencies of a number of adjunct nutrients including vitamins, minerals and dietary fibre.[9] Research published by Morley and associates [10] also suggests that teenagers exercising at least once a day have significantly lower serum total cholesterol and low density lipoprotein cholesterol levels than those exercising less frequently.

A number of investigations have shown that a vegetable-rich diet reduces the CVD risk profile in adults.[11-13] In light of the pattern of adult diet and life-style disorders now being reflected in the childhood population, it is reasonable to suggest that a vegetarian based diet may also be beneficial in this younger age group.

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However, the metabolic requirements for health in a growing child are different when compared to an adult.[14] Although logical to extrapolate from the adult population, the benefit of a predominantly vegetarian diet in children and adolescents remains to be established.

Unfortunately the number of studies investigating the effect of a predominantly vegetarian diet on the health of adolescents worldwide are minimal,[15-18] and with the exception of a report by Ruys and Hickie [19] in 1976, are essentially absent in the Australian context.

This study aimed to investigate possible relationships between nutrition and lifestyle behaviours and selected markers of health in 14-15 year old children attending five (5) Seventh-day Adventist high schools within the Sydney-Newcastle area. A vegetarian diet has been advocated as the most healthy diet alternative by Seventh-day Adventists for all age groups for over 100 years. Therefore this demographic was likely to include a greater number of participants with a predominantly vegetarian diet, compared to the general population and should provide information from which inferences may be drawn regarding the contribution of a predominantly vegetarian diet to observed differences in selected health markers.

MATERIALS AND METHODS

Recruitment

Two hundred and fifteen participants who were generally in good health and who were at least 14 years of age and had not turned 16 by the date of the study, were recruited for this project. Subjects were recruited from five Adventist secondary schools in the Sydney and Hunter regions of New South Wales, Australia.

Exclusions

Participants were not actively excluded from participation in the study. Data regarding current medical conditions and medications, which were recorded on the survey forms, were used to exclude participants if necessary to reduce possible confounding factors (e.g. antidepressant medication may increase BMI etc), at the time of data analysis.

The final data set contained a sample size of 215 participants. However, eight participants' observations had missing data for one or more of the variables required for the specific analysis (e.g. gender was missing for two participants) and were excluded. A total of 207 complete observations were therefore used for analysis requiring all variables. The records with complete data consisted of 124 girls and 83 boys. The distribution of boys and girls was not significantly different between vegetarian and non-vegetarian groups (Pearson X^2 = 2.02, df = 1, p = 0.15) where there were 17 vegetarian and 69 non-vegetarian boys and 36 vegetarian and 91 non-vegetarian girls.

Blood sampling and Diet and Lifestyle Survey

Following an over night 12 hour fast, ~ 5-10 mL of blood was drawn from each subject by normal venipuncture. Subjects were then given breakfast and instructions on how to complete a modified version of Booth et al's NSW Schools Physical Activity and Nutrition Survey (SPANS).[20] The section of this survey relating to fundamental movement skill proficiency was not used.

Blood was analysed for: Total cholesterol (CHOL), Low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides, glucose, homocysteine, vitamin B12, folate, and haemoglobin.

Sport Intensity

Only summer sports were used for statistical analysis, as this was the season applicable for the time of this study. All sports were first coded then assigned an energy expenditure value in kJ/kg/min according to predetermined ratings.[21] Sport intensity was calculated from each participant's entries relevant to all the organised and unorganised (maximum is 6) summer sports using the formula:

$$SummerSportIntensity = \sum_{i=1}^{12} \text{timesperweek} * \text{minutes} * (kJ/kg/\min)$$

Sport categories were created by using the log of sports intensity, as sports intensity alone was not normally distributed. If a participant's log sport intensity score was less than the 25th percentile (i.e. 1.6) then this participant was classified as LOW; if a participant's log sport intensity score was between the 25th (1.6) and the 75th percentile (2.1) then this participant was classified as MODERATE. Finally if a participant's log sport intensity score was above the 75th percentile (2.1) then this participant was classified as HIGH. The median intensity score was 1.9.

Vegetarian status

For the purpose of this study we classified a participant as vegetarian (i.e. having a vegetable-rich diet), if they consumed red meat less than once a week, chicken less than once a week and fish less than once a week. Based on this definition, 53 participants placed in the vegetarian category with the remaining 160 (154 with complete records) participants classified as non-vegetarian.

Nut usage

Nut usage included all nut and nut products (including the legume, peanut) such as peanut butter, almonds, cashews, nut bars and nut-based meat alternatives. Two categories of nut usage were compared: no-nut use (use nut or nut products less than once a week), (175 participants where 170 with complete records) and nut or nut products use at least one to three times a week or more (38 participants with 37 complete records).

Breakfast consumption

Two categories of breakfast consumption were defined as (a) less than or equal to 1 -2 times per week (81 students with 80 complete records) and (b) 3 – 4 times or more per week (132 students with 127 complete records).

Waist circumference

The waist circumference of each participant was measured midway between the top of the ileac crest and the lowest rib.

Body mass Index (BMI)

BMI was calculated using the standard formula of net weight in kg divided by the height in meters squared.

Statistical analyses

All statistical analyses were performed by using the program Statistical Package for Social Sciences (SPSS for windows version 14.0, SPSS Inc., Chicago, US). One-way and two-way analysis of variance (ANOVA) was used to investigate the main effects of individual factors and the interactions between the factors on a single outcome variable (e.g. vitamin B12). When significant differences were identified by ANOVA, Bonferroni adjustments were made for multiple pairwise comparisons. When there was only one independent variable (risk factor) the student's two-tailed independent sample t-test was performed to determine significant differences between the categories. Statistical significance for all the tests was defined at $p<0.05$.

Predictive variables (risk factors) used were: gender, non-vegetarian or vegetable rich diet (i.e. vegetarian), soft drink consumption, breakfast frequency, fish, nut, and dairy consumption and summer sports intensity.

Response variables used were: height, weight, waist circumference, body mass index (BMI), blood concentrations for; vitamin B12, triglycerides, homocysteine, haemoglobin, glucose, folate, high density lipoprotein (HDL), low density lipoprotein (LDL), CHOL/HDL ratio, systolic and diastolic blood pressures.

RESULTS

Health markers affected by a vegetarian diet

Statistically lower scores were observed on average for vegetarians compared to non vegetarians, for serum vitamin B12, CHOL/HDL ratio, LDL, waist circumference, body weight and BMI (Table 1). No significant difference was observed in average height between the two groups.

Health markers affected by variables other than vegetarian status

Effect of nut consumption. Nut use, independent of vegetarian status, was associated with significant differences in both BMI and blood glucose.

On average, adolescents who ate nuts less than once per week had higher BMI scores and blood glucose concentrations than participants who ate nuts at least once per week (Table 2). There were no significant interactions between vegetarian status and nut usage ($p > 0.05$).

Table 1. Comparison of average values for health markers between non-vegetarians and vegetarian adolescents

Variable	category	Mean (95% CI)	Min	Max
Waist, (cm)	Non-vegetarian	73.5 (72.0 – 75.0) **	59.5	113.5
	Vegetarian	69.2 (67.4 – 70.9)	58.0	87.1
BMI, (kg/m^2)	Non-vegetarian	21.9 (21.3 – 22.6) *	14.9	39.2
	Vegetarian	20.5 (19.6 – 21.3)	13.1	31.6
Chol/HDL	Non-vegetarian	2.9 (2.8 – 3.0) **	2.0	4.9
	Vegetarian	2.7 (2.6 – 2.8)	1.7	3.8
LDL, (mmol/L)	Non-vegetarian	2.3 (2.2 – 2.4) **	0.9	4.2
	Vegetarian	2.1 (1.9 – 2.2)	1.0	3.2
Vitamin B12 , (pmol/L)	Non-vegetarian	339 (317-361) ***	126	876
	Vegetarian	260 (231– 288)	119	702
Weight, (kg)	Non-vegetarian	62.2 (60.0 – 64.4) *	36.2	130
	Vegetarian	57.8 (55.3 – 60.4)	37.3	85.9
Haemoglobin (g/L)	Non-vegetarian	143 (142 – 145)	87	164
	Vegetarian	142 (139 – 145)	109	168
Height (cm)	Non-vegetarian	168 (167-169)	150	192
	Vegetarian	168 (166 – 170)	153	188
Triglycerides (mmol/L)	Non-vegetarian	0.84 (0.78 – 0.90)	0.32	3.47
	Vegetarian	0.88 (0.79 – 0.97)	0.36	2.12
HDL, (mmol/L)	Non-vegetarian	1.43 (1.39 – 1.48)	0.85	2.40
	Vegetarian	1.49 (1.41 – 1.57)	0.93	2.23
BP Systolic (mmHg)	Non-vegetarian	120 (118 – 122)	93	157
	Vegetarian	118 (115 – 121)	97	144
BP Diastolic (mmHg)	Non-vegetarian	70 (69 – 71)	48	97
	Vegetarian	71 (69 – 73)	52	91
Folate (nmol/L)	Non-vegetarian	27 (25 – 30)	5	86
	Vegetarian	32 (27 – 36)	10	101
Homocysteine (mol/L)	Non-vegetarian	9.1 (8.7 – 9.5)	4.6	30.8
	Vegetarian	9.4 (8.4 – 10.3)	5.3	27.1
Glucose (mmol/L)	Non-vegetarian	4.6 (4.5 – 4.6)	3.4	6.0
	Vegetarian	4.5 (4.4 – 4.1)	2.2	5.7

Statistical significance between vegetarian and non-vegetarian categories. * $p < 0.05$; ** $p<0.01$ and *** $p<0.001$

Table 2. Effect of Nut consumption on BMI, and blood glucose

Variable	category	Mean (95% CI)	Min	Max
BMI (kg/m^2)	No nut <1 per week	21.9 (21.2 – 22.5) **	13.1	39.2
	Nut use ≥ 1 per week	20.0 (19.3 – 20.7)	15.2	25.5
Glucose (mmol/L)	No nut <1 per week	4.6 (4.5 – 4.6) *	3.4	6.0
	Nut use ≥ 1 per week	4.4 (4.2 – 4.5)	2.2	5.1

Statistical significance between nut consumption categories * $p < 0.05$ and ** $p<0.01$

Table 3. Effect of frequency of breakfast consumption on selected categories

Variable	category	Mean (95% CI)	Min	Max
Vitamin B12 (pmol/L)	Breakfast once or twice per week	280 (260 – 302) **	126	550
	Breakfast more than three times per week	345 (319 – 371)	119	876
Folate (nmol/L)	Breakfast once or twice per week	23.3 (20.6 – 26.0) ***	4.6	73.9
	Breakfast more than three times per week	31.2 (28.3 – 34.1)	9.6	101.0
Homocysteine (μmol/L)	Breakfast once or twice per week	10.1 (9.4 – 10.7) ***	5.6	30.8
	Breakfast more than three times per week	8.6 (8.1 – 9.0)	4.6	27.1

Statistical significance between breakfast frequency categories. * $p < 0.05$; ** $p<0.01$ and *** $p<0.001$

Effect of frequency of breakfast consumption. The frequency of breakfast consumption was positively associated with higher average vitamin B12 and folate concentrations and correspondingly lower blood homocysteine levels (Table 3).

Effect of soft drink consumption. BMI was positively associated with soft drink consumption and there was no interaction effect between soft drink consumption and vegetarian status ($F_{(1,208)}=0.2$, $p=0.90$). If a student did not consume any amount of soft drink, on average his/her BMI was lower than a student who consumes any amount of soft drink regardless of vegetarian status (Fig.1).

Effect of Gender. As expected, gender alone was associated with significant differences (Table 4) in a number of physiological and biochemical markers irrespective of vegetarian status.

Boys had higher blood levels of homocysteine and haemoglobin and were on average taller than girls.

On average boys had lower blood levels of triglycerides, HDL and total Cholesterol while on average, the systolic BP of boys was higher than that of girls (Table 4).

Health markers affected by Sport Intensity. As exercise is regarded as an important element of a healthy lifestyle, we investigated the association between the amount of

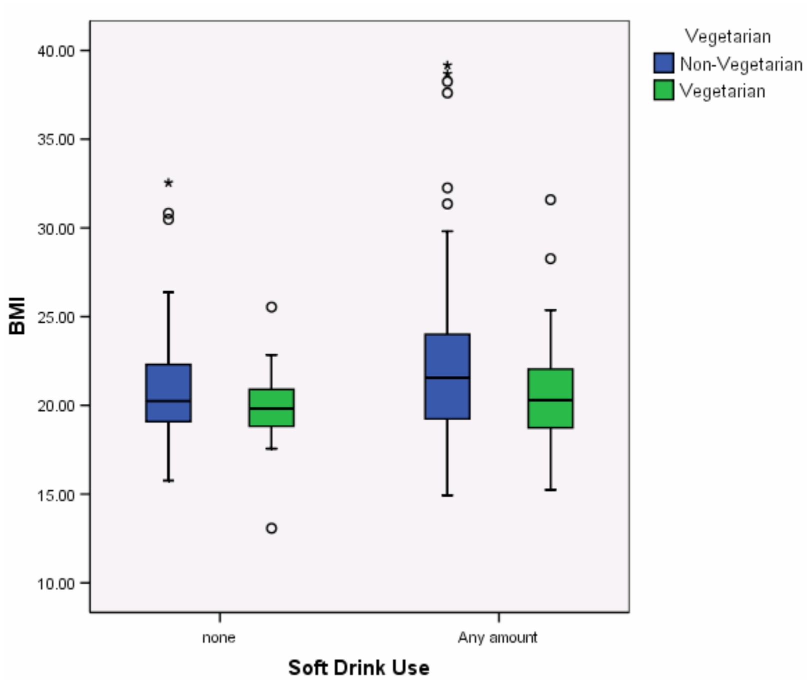

Figure 1. Effect of soft drink use on BMI. BMI was on average 1.2 ± 1.1 points higher for adolescents who drank soft drink regularly compared to their non-soft drink consuming classmates.

Table 4. Statistical summaries of variable differences between boys and girls

Variable	Gender	Mean(95% CI)	Min	Max
Homocysteine (μmol/L)	Boys	9.9 (9.3 – 10.5) **	5.5	27.1
	Girls	8.7 (8.2 – 9.2)	4.6	30.8
Haemoglobin (g/L)	Boys	150 (148 – 152) ***	127	168
	Girls	138 (137 – 140)	87	125
Triglycerides (mmol/L)	Boys	0.75 (0.69 – 0.82) **	0.33	2.28
	Girls	0.91 (0.84 – 0.98)	0.32	3.47
HDL (mmol/L)	Boys	1.34 (1.29 – 1.39) ***	0.85	2.04
	Girls	1.52 (1.47 – 1.57)	0.91	2.40
Cholesterol (mmol/L)	Boys	3.8 (3.7 – 3.9) ***	2.7	6.1
	Girls	4.3 (4.1 – 4.4)	2.5	6.3
LDL (mmol/L)	Boys	2.12 (2.01 – 2.24) **	1.24	3.99
	Girls	2.34 (2.23 – 2.44)	0.93	4.21
BP Systolic (mmHg)	Boys	124 (122 – 127) ***	100	157
	Girls	116 (114 – 118)	93	144
Height (cm)	Boys	173 (171 – 174) ***	150	192
	Girls	165 (164 – 166)	150	179

Statistical significance between-gender categories * $p < 0.05$; ** $p<0.01$ and *** $p<0.001$

Table 5. Statistical summary of the effect of Sport Intensity on health markers

Variable	Sport Intensity Category	Mean(95% CI)	Min	Max
Weight (kg)	Low	58 (55 – 61)	37	86
	Medium	61 (59 – 64)	41	105
	High	63 (59 – 68)	36	130
Waist (cm)	Low	71 (68 – 73)	58	88
	Medium	73 (71 – 74)	60	107
	High	74 (71 – 77)	60	114
BMI (kg/m^2)	Low	20.9 (19.8 – 21.9)	13.1	32.5
	Medium	21.7 (21.0 – 22.5)	15.8	38.7
	High	21.7 (20.5 – 22.9)	16.2	39.2
BP Systolic (mmHg)	Low	117 (114 – 120)	97	152
	Medium	120 (117 – 122)	93	153
	High	121 (118 – 125)	100	157
BP Diastolic (mmHg)	Low	70 (68 – 72)	52	88
	Medium	71 (69 – 72)	54	97
	High	71 (69 – 73)	48	91
Triglycerides (mmol/L)	Low	0.81 (0.71 – 0.90)	0.32	2.12
	Medium	0.85 (0.78 – 0.93)	0.42	3.47
	High	0.87 (0.75 – 0.98)	0.33	2.28
Cholesterol (mmol/L)	Low	4.0 (3.8 – 4.2)	2.5	5.7
	Medium	4.1 (4.0 – 4.2)	2.8	6.3
	High	4.1 (2.9 – 4.3)	2.9	6.1
HDL (mmol/L)	Low	1.50 (1.41 – 1.59)	0.93	2.40
	Medium	1.45 (1.40 – 1.50)	0.91	2.34
	High	1.41 – 1.33 – 1.48)	0.85	2.06
LDL (mmol/L)	Low	2.13 (1.99 – 2.27)	0.93	3.33
	Medium	2.27 (2.16 – 2.38)	1.24	4.13
	High	2.30 (2.13 – 2.47)	1.33	3.99
Chol/HDL	Low	2.7 (2.6 – 2.9)	1.7	4.1
	Medium	2.9 (2.8 – 3.0)	2.1	4.9
	High	3.0 (2.8 – 3.1)	2.1	4.0

No statistically significant differences were observed between any sport intensity categories for any of the health markers

exercise (sport intensity) and key markers of health.

Summer sports intensity categories did not show any significant association with any of the key markers of health evaluated in this study (Table 5).

DISCUSSION

Over recent decades public health observers of many societies including Australia have recorded a change in diet-related disease patterns away from nutrient deficiencies toward chronic disorders associated with caloric excess.[22]

The current epidemic of obesity among children and adolescents is of major concern with many public health professionals calling for the urgent implementation of successful intervention strategies.[23, 24] A vegetarian diet may be effective in reducing the growing incidence of lifestyle diseases in this population.[13] Although logical to extrapolate from the adult demographic, the benefit of a predominantly vegetarian diet in children and adolescents in relation to health markers of lifestyle diseases remains to be established.

In this study on Australian adolescents, eating a predominantly vegetarian diet had better scores on a range of recognised markers of CVD risk, including: BMI, waist circumference, LDL and CHOL/HDL ratio (Table 1); where the CHOL/HDL ratio is more indicative of CVD than total cholesterol alone.

These results are consistent with prospective studies in both adolescents [15] and adults,[25, 26] showing that a high consumption of plant-based foods is associated with lower BMI, reduced weight gain,[27] lower cholesterol [25] and a significantly lower risk of coronary artery disease and stroke.[28]

While these results support the view that plant-based diets give health benefits to adolescents similar to adults, some studies have raised concern over the nutritional adequacy of vegetable based diets.[15, 29-31] We observed no difference in either haemoglobin, (a surrogate marker of iron status), or height, (a general indicator of long term nutritional adequacy), between the vegetarian and non-vegetarian groups (Table 1). As none of the participants in this study reported a vegan diet, these results support the view that the lacto-ovo vegetarian diet of these children was nutritionally adequate.

In addition to the observed effects of the overall patterns, individual food groups such as nuts also demonstrated significant associations with some health markers independent of vegetarian status. A wide range of nuts and nut products are both available and consumed by vegetarians and non-vegetarians alike. We found a significant association between nut consumption and lower scores for both BMI and glucose for children who reported regular nut (including peanut) consumption, independent of vegetarian status. While the average reduction in plasma glucose was modest (0.2 mmol/L), it was statistically significant (Table 2). The reason for this is not clear but does reflect previous observations that nut consumption can reduce the risk of type 2 diabetes,[31] possibly through promotion of insulin sensitivity.[32] Further work needs to be done to establish the mechanism behind this important and exciting observation.

The negative association between BMI and nut usage in our young and healthy population was also not expected (Table 2). BMI is an independent marker for both insulin resistance and the development of negative cardiovascular changes. Previous studies in overweight adults have shown that adding nuts to the diet tends to lower fat mass and body weight.[28, 33] Why nut consumption would be associated with a lower BMI is unknown but may be linked to increasing satiety, increased cellular metabolic rate or both. This is a potentially important observation and needs further investigation.

Irrespective of the cause, with the rise in incidence of obesity and type 2 diabetes among the childhood population in Australia and elsewhere, these results support the view that promotion of nut consumption, (with the caveat for caution due to nut allergies), by children and adolescents is beneficial.

While children on a predominantly vegetarian diet appeared to gain significant health benefits as discussed above, lower serum B12 levels were observed in the vegetarian cohort, (Table 1). Many previous studies in vegetarian adults have made this observation,[16, 34-36] though not universally.[17, 37] Although B12 levels were lower in vegetarian children it is difficult to interpret the clinical relevance of this finding. No clinical manifestation of vitamin B12 deficiency was obvious in any of the children studied and unfortunately no consensus has been reached in the literature regarding the serum level at which B12 is considered deficient.[38-40] While this problem has been actively discussed in relation to the adult population it may be an even more relevant issue for growing children and adolescents where the consequences of a reduced serum B12 may contribute to both fulminant pathology and reduced adult potential. Further studies are needed to both establish the serum B12 level at which health risk becomes apparent and the incidence of B12 deficiency in this age group.

It is well known that serum vitamin B12 and folate levels are required for adequate metabolism of the vascular disease marker homocysteine. As many breakfast cereals in Australia are now fortified with folate we were not surprised to find a positive association between the frequency of breakfast consumption and serum folate, vitamin B12 and homocysteine (Table 3). Our results are consistent with a previous report in adults showing increased serum folate concentrations following folate food fortifications in Australia.[41] The breakfast meal for most Australians also includes milk and cereal where milk is a recognised source of vitamin B12. In addition, in those households where soy milk replaces dairy milk, leading brands of soy milk in Australia are fortified with vitamin B12 and have also been observed to be an excellent source of B12.[39, 40]

With raised homocysteine levels considered an independent risk factor for CVD,[42] (although this association is currently under review),[43] this association supports the view that promoting breakfast consumption will contribute to a healthier biological profile. Therefore the influence of folate fortification and breakfast consumption on homocysteine levels observed in this study in addition to the benefits outlined in previous studies [44, 45] suggests that encouraging breakfast consumption in adolescents can promote physiological and biochemical health benefits.

Overall effect of exercise on markers of health

The defined summer sport exercise categories did not show any significant association with the health markers tested in this study (Table 5). This was surprising in light of the association in adults between exercise and lower serum triglycerides in particular.[46, 47] However the question of whether exercise also shows this same association in children has not been completely settled in the literature.

Rowland and colleagues reported that aerobic training in 10-12 yr olds had no effect on serum lipid profiles although VO_2 max was significantly increased.[48] This observation was further supported by a study of one thousand nine hundred and nineteen, 7–15 year old Australian children by Dwyer et al[49] in 1994 where fitness again showed no association with serum lipids. In contrast to these findings a smaller British study of 119 children aged 12-15 yrs did find an association between exercise and both total and low density serum cholesterol but surprisingly found no association at all with lipids and any dietary factors.[10]

Consistent with the studies by Rowland et al[48] and Dwyer & Gibbons,[49] we did not observe any significant association between exercise and serum lipids in our cohort of generally healthy adolescents. The reasons for this are not clear though it is probable that in a healthy young population associations are likely to be weaker due to the biochemical markers tested being close to their homeostatic set point. Therefore larger numbers may be needed to provide the required sensitivity. However, it has been acknowledged that the metabolic requirements of adolescents are different to adults. These differences could reflect a generally exercise resistant, diet sensitive, lipid metabolism at this growth stage suggesting that diet may be a more important factor in promoting cardiovascular health in this age group. Further studies are required to confirm this hypothesis.

Conclusion

For many individuals a meat-based diet can exceed optimal energy intake promoting excess weight gain and associated disease risk. Although maintaining adequate levels of essential nutrients, meat based diets can be deficient in beneficial nutritional adjuncts such as fibre, flavonoids, plant sterols, and other phytochemicals. These deficiencies may predispose to increased risk of cancer, stroke and CVD.[50]

Vegetarian diets rich in fruit, nuts and vegetables are high in nutritional adjuncts and in adults are consistently associated with lower average weight, BMI and cholesterol.[25] This translates into a significantly reduced incidence of a range of lifestyle diseases in the adult population including, coronary artery disease [11, 51], cancer [52], and type-2 diabetes.[53, 54]

Consistent with the observed health benefits in adults, adolescents who reported a predominantly vegetarian diet showed significantly better scores for selected risk factors for CVD such as BMI, waist circumference and cholesterol, compared to their non-vegetarian classmates.

Although well-planned vegetarian diets provide the nutrition needed to promote normal growth in children, eating patterns between vegetarians can vary greatly. Participants in this study were selected from within the Adventist school system. As Adventists have advocated vegetarian diets as a healthy lifestyle alternative for all ages for over a century, the diet of these vegetarian children may reflect an experienced approach to nutrition selection. This general pattern of food choices may not be representative of the wider community and the health benefits attributed to this vegetarian cohort may not be seen in children with significantly different vegetarian diet patterns.

Nonetheless, in light of the current trend toward an overall increasing risk of CVD in children, this study supports the view that a balanced predominantly vegetarian diet may be an effective adjunct strategy for combating lifestyle diseases in children.

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Original Article

The relative impact of a vegetable-rich diet on key markers of health in a cohort of Australian adolescents

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富含蔬菜飲食對一個澳洲青少年世代健康主要標誌的相對影響

在澳洲，兒童肥胖是一個普遍的健康問題。孩童時期的體重過重會導致成年時的體重過重，及心血管疾病(CVD)危險因子的發展。迫切需要有效降低孩童肥胖的策略。素食已指出可以有效預防成人族群許多與生活型態相關的疾病，因此也可能有益於孩童。然而青少年的代謝需求與成年人不同，且素食飲食對 CVD 的影響在這個族群尚未被確定。我們用單元及二元變異數分析，比較學校體能活動與營養調查(SPANS)選項的健康的主要生理及生化標誌，。澳洲新南威爾斯州雪梨及杭特區的 5 個浸性會中學，215 名青少年(14-15 歲)參與這個研究。青少年以攝取素食為主的，其心血管健康標誌分數顯著較好，這些標誌包括：身體質量指數(BMI)、腰圍、膽固醇/高密度脂蛋白比及低密度脂蛋白。青少年每週攝取堅果超過 1 次，也顯示出有較低的 BMI 及血清葡萄糖，但這與他們素食狀態無關。一般健康標誌包括：血紅素及平均身高兩組間沒有差異；但是素食族群有較低的血清維生素 B12。令人意外的是，運動本身與任何危險因子的分析均沒有統計相關，這說明飲食可能是這個年齡層在促進健康最顯著的因子。

關鍵字：素食者、葡萄糖、堅果、BMI、維生素 B12。