

ORIGINAL ARTICLE

Public views of the benefits and barriers to the consumption of a plant-based diet

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Objective: The aim of this study was to examine consumers' perceived benefits and barriers to the consumption of a plant-based diet.

Design: Mail survey that included questions on perceived benefits and barriers to the consumption of a plant-based diet.

Setting: Victoria, Australia.

Subjects: Four hundred and fifteen randomly selected Victorian adults.

Results: The main perceived barrier to adoption of a plant-based diet was a lack of information about plant-based diets (42% agreement). Sex, age and education differences were present in over a quarter of the barrier items. For example, non-university-educated respondents and older people were less willing to change their current eating pattern than were university educated and younger respondents. The main benefits associated with plant-based diets were health benefits, particularly decreased saturated fat intake (79% agreement), increased fibre intake (76%), and disease prevention (70%). Age, sex and education differences with regard to benefits were apparent, although sex differences were more important than age or education differences.

Conclusions: The majority of respondents perceived there to be health benefits associated with the consumption of a plant-based diet. Compared with the proportion of respondents who agreed that there were particular benefits of eating a plant-based diet, perceived barriers were relatively low. An understanding of the perceived benefits and barriers of consuming a plant-based diet will help formulate strategies that aim to influence beliefs about plant foods, plant food consumption, and, ultimately, public health.

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Introduction

The consumption of plant foods (fruits, vegetables, grains, legumes, nuts and seeds) has important health benefits. There is evidence, for example, that high consumption of plant foods decreases the risk of heart disease and certain cancers (World Cancer Research Fund and American Insti-

tute for Cancer Research, 1997; Dwyer, 1999; Messina, 1999; Bazzano *et al.*, 2002; Hu, 2003; Montonen *et al.*, 2003). However, consumption of plant foods in many developed countries does not meet recommended levels (Stables *et al.*, 2002; Lang *et al.*, 2003; Victorian Government Department of Human Services, 2004). In Australia, for example, only 11% of Victorian adults consume the recommended daily intake of five or more serves of vegetables and 51% the recommended daily intake of two or more serves of fruit (Victorian Government Department of Human Services, 2004).

Despite many consumers not meeting the recommended levels of intake of plant foods, certain segments of the population appear to be increasingly aware of and interested in plant foods. One segment is that which contains vegetarians, semi-vegetarians, and the recently identified 'cognitive vegetarians' (Lea and Worsley, 2004). Cognitive

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vegetarians are those who hold similar beliefs about meat and vegetarian diets as do vegetarians and have lower red meat consumption compared to the general population, but do not consider themselves to be semi-vegetarian or vegetarian. It has been estimated that 13.5% of the South Australian population may be cognitive vegetarians. The same study also found that 1.5% of the South Australian population considered themselves to be vegetarian and 7.2% as semi-vegetarian (Lea and Worsley, 2004). Polls from the US and UK also suggest that a substantial proportion of the population avoid meat to some degree (Ginsberg and Ostrowski, 2003; Vegetarian Society UK, n.d.). This reduced meat consumption segment of the population may consume a higher quantity of plant foods than the general population, due in part to their lesser dependence on meat (Haddad and Tanzman, 2003).

The second segment of the population that is likely to be interested in plant foods is that of organic food consumers. The organic market has been growing rapidly over recent years. In Australia, consumer demand for organic food has been estimated to be expanding at a rate of 20–25% per year (Biological Farmers of Australia, 2003). The horticultural sector is leading domestic market growth (Biological Farmers of Australia, 2003), meaning that Australians are eating more organic plant foods. Consumers of organic food have been found to rate health more highly than do non-organic consumers when making food choices (Lockie *et al.*, 2002). For these reasons, many of the people in the organic food segment, as well as those in the reduced meat consumption segment, are likely to be interested in or are currently eating a 'plant-based diet'.

A plant-based diet may be defined as an eating pattern dominated by fresh or minimally processed plant foods and decreased consumption of meat, eggs and dairy products. Compared to meat-centred diets, it involves increased consumption of a variety of grains (including whole grains), fruits, vegetables, legumes, nuts and seeds. Many of the potential health benefits of consuming a vegetarian diet (Li *et al.*, 1999; Key *et al.*, 2003) may be achieved by eating a high quantity of plant foods with a lesser emphasis on meat, as it is likely that it is the quantity of plant foods consumed that benefits health rather than the lack of consumption of meat (Thorogood *et al.*, 1994; Hill, 1999; Biesalski, 2002). In addition, plant-based diets are likely to appeal to a larger proportion of the population than those attracted to vegetarian diets as they may include some meat. Meat is a high status food (Fieldhouse, 1986) and is usually considered a central element of a meal in modern Western society (Twigg, 1983).

The benefits of change need to outweigh the barriers for behavioural change to occur (Rosenstock, 1974; Wolinsky, 1980; McIntosh *et al.*, 1996; Nestle *et al.*, 1998). Many studies have examined perceived benefits and barriers to dietary change (Lloyd *et al.*, 1995; Balch *et al.*, 1997; Lappalainen *et al.*, 1997; Sparks *et al.*, 1997; Zunft *et al.*, 1997; Cox *et al.*, 1998; McDonnell *et al.*, 1998; Holgado *et al.*, 2000; Ma *et al.*,

2002). Perceived benefits of healthy eating and dietary change include weight control, being healthy, improved quality of life, and disease prevention (Zunft *et al.*, 1997). People often face barriers when they attempt to alter their food intake (Lloyd *et al.*, 1995; Lappalainen *et al.*, 1997; Cox *et al.*, 1998). Barriers may be practical or attitudinal. For example, irregular working hours is an important practical barrier (Lappalainen *et al.*, 1997), while an attitudinal barrier to dietary change is the belief that one's diet is already healthy (Kearney *et al.*, 1997; Beard *et al.*, 1989; Cox *et al.*, 1998; Stubenitsky and Mela, 2000). However, to our knowledge, the perceived benefits and barriers that the general population has to eating a plant-based diet have not been examined in detail.

One model which may be useful in understanding how new ideas and practices, such as the adoption of plant-based diets, spread throughout society is the diffusion of innovations model (Rogers, 1983). An innovation, such as eating a plant-based diet, is likely to be adopted if it is compatible with the current beliefs, values and behaviours of adopters and if its benefits outweigh those of current practices (Contento *et al.*, 1995). It is also important to recognise that health care and food beliefs and behaviours are related to demographic differences such as sex, age and education (Turrell, 1998; Kalof *et al.*, 1999; Fraser *et al.*, 2000; Kearney *et al.*, 2000; Parmenter *et al.*, 2000; Wardle and Steptoe, 2003; Worsley *et al.*, 2003). For example, female sex and increasing age and education level have been found to be positively associated with reported attempts to eat a healthier diet (Kearney *et al.*, 2000). Therefore, it is important to examine whether there are similar demographic differences with regard to beliefs about plant-based diets.

The aim of this paper is to explore the perceived benefits and barriers of consuming a plant-based diet among a sample of Australian adults. The presence of any demographic differences will also be examined. The information provided will allow the implementation of health promotion strategies to increase consumption of plant foods and the prevalence of plant-based diets.

Methods

Procedure

One thousand adults were selected at random from the Victorian population by using the software package Australia on Disc (May 2003 version, Dependable Database Data Pty Ltd), which contains a comprehensive list of residences from the telephone directory. The state of Victoria has a population of around five million, representing approximately one-quarter of the total Australian population.

A questionnaire, cover letter and reply-paid envelope were mailed to each person in the sample in early 2004. This was preceded by a letter informing each person that a questionnaire would be delivered to them in the next few days. A number of follow-ups to the original mailing were conducted

in order to improve the response rate. A reminder postcard was posted 1 week after the questionnaire. This was followed 5 weeks later by a replacement questionnaire posted to all non-respondents. After another 4 weeks, at least two attempts were made to reach non-respondents by telephone. Finally, a replacement questionnaire was sent by registered post to a small number (10) of those who were unable to be contacted, in order to ascertain if they were actually present at that address.

The questionnaire

The questionnaire consisted of eight pages of questions and a cover sheet. Placed prominently on the cover sheet was a definition of plant-based diets: 'An eating pattern dominated by fresh or minimally processed plant foods and decreased consumption of meat, eggs and dairy products. Compared to meat-centred diets, it involves increased consumption of a variety of grains (including whole grains), fruits, vegetables, legumes, nuts and seeds. This does not necessarily mean a vegetarian diet.' There was no specification of the quantity of each food that should be consumed, in recognition of the potential for variation in a plant-based diet and due to the lack of such a definition in the literature. Examples of plant foods and plant-based foods and meals were provided, such as 'legumes – lentils, split peas, chickpeas, green peas, soybeans', 'vegetable pasta sauce', 'bread', 'baked beans' and 'vegetable and almond stir fry topped with a small amount of chicken or tofu served with rice'.

The questionnaire was formulated from a review of the literature (Schwartz, 1992; Cox *et al.*, 1998; Povey *et al.*, 1999; Marks *et al.*, 2001; Rutishauser *et al.*, 2001; Ma *et al.*, 2002), from questionnaires previously composed to examine beliefs about healthy eating (Zunft *et al.*, 1997; Kearney and McElhone, 1999) and vegetarian diets (Lea and Worsley, 2003), and from focus groups conducted with Victorian consumers about plant foods (Lea *et al.*, 2005). The main sections of the questionnaire relevant to this paper included:

1. Perceived barriers to eating a plant-based diet (27 items), including 'It would not be tasty enough' and 'It would be too expensive' (Table 3). Response options ranged between strongly disagree and strongly agree on a five-point scale.
2. Perceived benefits of eating a plant-based diet (24 items), including 'Control my weight' and 'Stay healthy' (Table 4). Response options ranged between strongly disagree and strongly agree on a five-point scale.
3. Background information (14 items), including demographic items such as sex, age and highest education level, as well as vegetarian status.

Participants were also asked for their level of interest in learning about plant-based diets and for information on their current eating habits. The latter included the number of serves of vegetables and fruit usually eaten each day and frequency of consumption of a range of plant foods and meat.

Data analysis

Analyses were conducted with SPSS for Windows statistical software (version 11.5). Frequency of participants' responses to the items was measured, and crosstabulations (including Pearson χ^2 test of statistical significance) by sex, age and university education group were performed. Age groups were created by splitting respondents' ages into tertiles: 20–44, 45–59 and 60–91 years. Participants were split into two education groups, dependant on whether or not they had a university qualification. Correlations between the three groups were weak: 0.214 for age group and male sex, –0.156 for university education and age group, and –0.028 for male sex and university education. Therefore, it was unnecessary to perform a multivariate test of effects.

Results

Of those in the sample who could be contacted, 51% completed the questionnaire ($n = 415$). Approximately 19% ($n = 187$) of the sample could not be contacted because their addresses were incomplete or had changed since the sampling frame was compiled, or they were unable to be contacted by telephone, or were deceased.

Demographic characteristics of the respondents and the general Victorian population, as obtained from the 2001 Census of Population and Housing (Australian Bureau of Statistics, 2002), are listed in Table 1. Compared with the Census data, the main biases were overrepresentation of women, those aged 45 years and over, and those with a non-school (university or technical) qualification.

One potential limitation of the study was the modest response rate (51%). However, a response rate of 50% can be considered adequate for reporting (Babbie, 1989) and our response rate was high compared with other recently conducted population health mail surveys (e.g. Cox *et al.*, 1998; Timperio *et al.*, 2000; Andajani-Sutjahjo *et al.*, 2004). In addition, the possibility of response bias needs to be considered, such as the overrepresentation of those with a non-school qualification. However, survey results are shown for demographic subgroups, such as university versus non-university educated, which can allow any possible bias to be taken into account.

Respondents consumed 2.5 serves of vegetables per day and 2.1 serves of fruit per day. The majority (61.3%) of respondents ate legumes at least once per week. Respondents ate wholemeal or mixed grain bread more frequently than white bread (49.0% ate the former while 33.6% ate the latter five or more times a week). The majority (68.5%) reported that they ate red meat between one and four times per week. White meat was eaten this often by 76.8% of respondents. Table 2 provides details of mean number of serves per day of fruit and vegetables and frequency of consumption of other food items. The proportion of self-reported vegetarians in the sample was low (0.7%), although a higher number (11.0%) considered themselves to be semi-vegetarian. The

Table 1 The demographic characteristics of the random population survey respondents ($n=415$) compared with the Victorian population as a whole, as obtained from the 2001 Census

	Survey respondents (%)	2001 census ^a (%)
Sex		
Female	59.4	50.9
Male	40.6	49.1
Age^b (years)		
20–24	0.7	9.3
25–44	31.9	41.8
45–64	43.1	31.4
65 +	24.2	17.5
Country of birth		
Australia	78.1	71.1
Other country	21.9	28.9
Employment status^c		
Employed full time	31.5	29.4
Employed part time	17.8	14.4
Unemployed	2.0	3.3
Marital status		
Married ^d	75.2	51.6
Widowed/divorced	15.0	13.1
Education status		
Non-school qualification ^e	55.3	34.8
≤ Year 12 school education only	44.8	65.2

^aNote that data could only be included in this table where Census items were directly comparable to questionnaire items.

^bNo minimum age prerequisite was specified for participation in the survey, but as the survey was addressed to a person listed in the phone directory it was expected that younger people (particularly under 18 years) would be less likely to participate. As no one under 20 years participated in the survey, the Census data for age excludes those under 20 years (i.e. the percentages are expressed as a percent of those aged 20 years and over).

^cThe survey percentages for 'employed full time' and 'employed part time' exclude those self-employed, as there was a separate category for the latter, comprising 9.5% of the sample. However, the Census data included the self-employed with full- or part-time employed. Therefore, the survey 'employed full time' and 'employed part time' categories are an underestimate. Also note that in both the Census and the questionnaire 'unemployed' does not include students and those not looking for work, such as retired people. Census percentages refer to those aged 15 years and over.

^dIn the survey, 'married' includes 'living together', whereas in the Census, it does not. Therefore, the survey figure is an overestimate.

^eIn the survey, this was defined as a technical or trade certificate or a university or tertiary qualification. In the Census, this was a postgraduate degree, graduate diploma, graduate certificate, bachelor degree, advanced diploma, diploma or certificate.

majority of the sample (62%) indicated that they were somewhat or very interested in learning about plant-based diets. Respondents' food habits will be examined more closely in a later paper.

The main perceived barrier to adopting a plant-based diet was a lack of information about plant-based diets (Table 3). Other common barriers were related to an unwillingness or inability for themselves or their family to alter present dietary patterns and lack of availability of plant-based

Table 2 Means and s.d. for respondents' ($n=415$) frequency of consumption of food items

Item	Mean (s.d.)
Fruit (serves/day)	2.08 (1.23)
Vegetables (serves/day)	2.54 (1.43)
Nuts (times/day)	0.32 (0.37)
Seeds (times/day)	0.27 (0.41)
Legumes (times/day)	0.33 (0.32)
Fruit juice (times/day)	0.51 (0.49)
White bread (times/day)	0.52 (0.56)
Wholemeal/mixed grain bread (times/day)	0.70 (0.60)
Breakfast cereals (times/day)	0.65 (0.46)
Cooked cereals (e.g. pasta, rice, noodles) (times/day)	0.38 (0.33)
Red meat (times/day)	0.43 (0.31)
White meat (times/day)	0.35 (0.22)
Fish/seafood (times/day)	0.26 (0.22)
Eggs (times/day)	0.23 (0.23)
Dairy (e.g. milk, cheese) (times/day)	0.95 (0.60)

options when eating out. Health concerns were of relatively low importance.

The strongest barriers to the consumption of a plant-based diet for both men and women were a need for more information about plant-based diets and being unwilling to alter eating habits or routines. However, sex differences were present in almost a third of the barrier items (Table 3). In particular, women were less likely than men to believe that humans are 'meant' to eat large quantities of meat ($P<0.001$), that someone else decides on the food that they eat ($P<0.001$), and that a plant-based diet would not be sufficiently tasty ($P<0.001$).

There were some differences in the ranking of the strongest barriers for each of the three age groups. The strongest barrier for the two youngest groups was lack of information about plant-based diets, while for the oldest group it was being unwilling to alter eating habits. The second strongest barrier for the two youngest groups was unwillingness of the family or partner to eat a plant-based diet, whereas for the oldest group it was lack of information. There were age differences for over a quarter of the barrier items. The strongest difference was found for the item on unwillingness to eat strange or unusual foods, for which agreement increased as age increased ($P<0.001$).

The strongest barrier for both university- and non-university-educated groups was lack of information about plant-based diets. The second ranking item for the university-educated group was family or partner being unwilling to eat a plant-based diet, whereas for the non-university-educated group it was unwillingness to alter their own eating habits. There were statistically significant education group differences present in almost half of the items, with education differences therefore more frequent than age or sex differences. The main differences ($P<0.001$) were that those who were university educated were more likely than those who were not to accept changes to their eating habits, unusual foods, and the perceived need to eat large quantities of plant foods.

Table 3 Percentages of total respondents in agreement with barriers to eating a plant-based diet, together with percentages and *P*-values for comparisons between sex, age and education (university vs non-university) groups^a

Item	% Agree (% unsure)										
	All	Women	Men	P-value	20–44 years	45–59 years	60–91 years	P-value	Uni	Non-uni	P-value
I need more information about plant-based diets	42 (22)	42 (23)	40 (22)	NS	44 (21)	37 (23)	40 (24)	NS	40 (21)	42 (24)	NS
I don't want to change my eating habit or routine	30 (25)	28 (26)	33 (23)	NS	21 (26)	25 (25)	42 (25)	**	20 (26)	36 (24)	***
My family/partner won't eat a plant-based diet	25 (18)	27 (18)	21 (18)	NS	31 (13)	26 (21)	16 (19)	NS	24 (17)	25 (18)	NS
Plant-based meals or snacks are not available when I eat out	22 (28)	20 (26)	26 (30)	NS	23 (31)	20 (18)	23 (34)	**	20 (22)	22 (31)	NS
There is not enough choice when I eat out	21 (28)	19 (28)	24 (26)	NS	20 (31)	19 (26)	24 (25)	NS	18 (23)	22 (30)	NS
I don't have enough willpower	19 (20)	20 (18)	16 (23)	NS	24 (15)	19 (21)	11 (24)	NS	14 (18)	21 (21)	NS
Someone else decides on most of the food I eat	17 (43)	9 (8)	29 (15)	***	11 (13)	12 (8)	25 (11)	**	15 (11)	18 (10)	NS
It would be too expensive	17 (24)	17 (20)	16 (30)	NS	17 (26)	15 (23)	17 (24)	NS	11 (20)	19 (28)	**
I don't want to eat strange or unusual foods	17 (22)	15 (21)	18 (25)	NS	8 (17)	13 (25)	25 (25)	***	9 (17)	20 (26)	***
I would have to go food shopping too often	17 (19)	19 (17)	14 (21)	NS	22 (23)	17 (14)	12 (18)	NS	14 (16)	18 (20)	NS
There is not enough protein in them	16 (42)	12 (39)	19 (47)	*	17 (41)	10 (42)	18 (43)	NS	11 (39)	19 (44)	*
I would get indigestion, bloating, gas or flatulence	16 (29)	16 (29)	14 (29)	NS	12 (34)	12 (28)	21 (25)	NS	12 (27)	17 (30)	NS
It would not be filling enough	16 (22)	12 (20)	20 (23)	NS	16 (23)	13 (20)	15 (23)	NS	9 (18)	19 (24)	**
I would (or do) miss eating lots of 'junk' (e.g. sugary) food	16 (15)	17 (11)	14 (20)	*	23 (18)	15 (14)	9 (12)	**	14 (12)	17 (15)	NS
There is not enough iron in them	14 (39)	14 (33)	14 (47)	**	16 (36)	12 (34)	13 (46)	NS	15 (32)	14 (43)	NS
I would be worried about my health (other than iron, protein)	14 (29)	11 (26)	16 (33)	NS	13 (27)	14 (25)	14 (33)	NS	11 (22)	16 (33)	**
It is inconvenient	14 (28)	11 (27)	16 (27)	NS	15 (27)	15 (19)	10 (36)	*	14 (19)	12 (33)	**
I don't know how to prepare plant-based meals	14 (21)	14 (22)	15 (21)	NS	16 (18)	14 (21)	11 (24)	NS	15 (17)	13 (24)	NS
I wouldn't get enough energy or strength	13 (28)	10 (26)	16 (31)	NS	9 (29)	12 (28)	15 (27)	NS	5 (30)	17 (27)	**
It would not be tasty enough	13 (23)	10 (20)	16 (27)	***	9 (21)	13 (22)	14 (25)	NS	9 (20)	15 (24)	NS
I would need to eat such a large quantity of plant foods	12 (29)	10 (25)	16 (34)	*	11 (25)	10 (26)	14 (35)	NS	7 (24)	16 (32)	***
I think humans are meant to eat lots of meat	12 (23)	8 (21)	20 (25)	***	10 (21)	8 (19)	19 (25)	*	8 (21)	15 (23)	NS
The plant foods I would need aren't available where I shop or in the canteen or at my home	11 (25)	7 (23)	14 (27)	*	11 (23)	11 (21)	9 (27)	NS	9 (21)	11 (27)	NS
I don't know what to eat instead of lots of meat	11 (14)	11 (13)	10 (16)	NS	14 (12)	11 (12)	7 (17)	NS	11 (13)	10 (15)	NS
It takes too long to prepare plant-based meals	10 (30)	8 (29)	12 (33)	NS	8 (25)	10 (28)	9 (36)	NS	11 (24)	9 (35)	*
I don't want people to think I'm strange or a hippy	7 (15)	6 (14)	6 (18)	NS	3 (15)	6 (15)	11 (15)	NS	2 (11)	10 (17)	**

^aThe full question asked was: 'Some people believe that eating a plant-based diet has specific difficulties. How much, if at all, do these statements apply to you? (Please circle one answer for each statement.) Eating a plant-based diet would be or is *difficult* for me because...' Responses provided were 'strongly disagree', 'disagree', 'not sure', 'agree' and 'strongly agree'. '% Agree' results here combine 'agree' and 'strongly agree'.

All *n* = 415; women *n* = 243; men *n* = 166; 20–44 years *n* = 131; 45–59 years *n* = 138; 60–91 years *n* = 132; university educated *n* = 155; non-university educated *n* = 250.

****P* < 0.001, ***P* < 0.01, **P* < 0.05, NS = not significant.

Consumption of a plant-based diet was considered to have important benefits, particularly health-related benefits such as decreased saturated fat intake and increased fibre intake (Table 4). It is noteworthy that there was higher agreement with the benefits of eating a plant-based diet than there was with the potential barriers to eating such a diet. Non-health-related benefits, such as environmental and animal welfare benefits, ranked relatively low, with a large proportion of respondents being unsure of these benefits.

Sex differences were present for half of the benefit items. In contrast, there were relatively few age and education differences, being present for one-sixth of the items. The two strongest perceived benefits were the same for men and women (decreased saturated fat intake, increased fibre intake). The main sex differences ($P < 0.001$) were that more women than men believed plant-based diets could help people remain healthy, provide plenty of energy, be tasty, and could help the environment and animal welfare.

There were some age group differences in the ranking of the most important benefits. Decreased saturated fat intake was the most important benefit for the two youngest age groups, while it ranked second for the oldest group. A high intake of vitamins and minerals was the second most important benefit for the youngest age group. Increased fibre consumption ranked second for the middle-aged group and first for the oldest group. The strongest age difference ($P < 0.001$) for the benefit items was that as age increased, so did agreement that increased fibre intake was a benefit of eating a plant-based diet.

Decreased saturated fat intake was the main perceived benefit for both university- and non-university-educated groups. Increased fibre intake ranked second for the university-educated group. This was also basically the case for the non-university-educated group, although eating a more 'natural' diet and increased intake of vitamins and minerals were equally as important. The strongest education group difference was that a higher proportion of the university-educated group compared to the non-university-educated group believed that increased fibre intake was a benefit of eating a plant-based diet ($P < 0.001$).

Discussion

This study shows that there is a high awareness of the potential benefits of eating a plant-based diet, particularly health-related benefits such as decreased saturated fat intake, increased fibre intake and disease prevention. Compared with the proportion of participants who agreed that there were particular benefits of eating a plant-based diet, relatively few adults surveyed perceived any barriers. Furthermore, they were lower than those found in a previous study of barriers towards vegetarian diets (Lea and Worsley, 2003). In the present study, the most frequently cited barrier was the lack of information about plant-based diets. The finding is particularly relevant to the food industry and to

health professionals. It highlights the need for both sectors to provide more appropriate nutrition education and advertising in order to promote plant food consumption.

Barriers to consumption of a plant-based diet were related more to lack of dietary information, lack of desire of self or family to alter current diet and lack of options when eating out than to intrinsic concerns (e.g. concerns with the healthiness or taste of a plant-based diet). Clearly, more research is required to further understand these findings, which may reflect the community's unfamiliarity with the concept of plant-based diets. These barriers are the most important ones to address if the aim is to increase consumption of plant-based diets. In particular, the results suggest there needs to be readily available information on the nutrition, preparation and other aspects of plant-based diets, including how to cook tasty plant-based meals that would appeal to the whole family. In addition, if plant-based options are not increased among the food service industry, information may need to be provided about the most appropriate eating venues and plant-based meal options that may already be available (e.g. vegetable-based pasta sauces at Italian restaurants).

It is important to note however, that on the whole the majority of participants *disagreed* that these were barriers to eating a plant-based diet. Yet fewer than one-tenth of respondents (7.4%) ate the recommended daily intake of five or more serves of vegetables, half ate wholemeal or mixed grain bread less than five times a week, and well over a third ate legumes less than once a week. This suggests that the majority of participants were not currently eating a plant-based diet, which in turn means that it is possible that there are other barriers to consumption that were not assessed in the questionnaire. Issues such as the heavy advertising of fast food and confectionary compared to that of unprocessed plant foods may be important. In addition, it is possible that although many people perceive health benefits associated with a plant-based diet, the perceived health benefits are not great enough to encourage dietary change. It may be that other benefits of eating a plant-based diet, such as environmental benefits associated with reduced meat production (Pimentel and Pimentel, 2003), may be more effective at altering diets if they were to become more generally known. Indeed, almost half of the respondents were unsure whether there were environmental benefits associated with plant-based diets.

As no other studies appear to have been conducted on the perceived barriers and benefits of eating a plant-based diet, there are no studies with which to directly compare the present findings. However, there are surveys on the more general behaviour of eating a healthy diet and on vegetarian diets with which indirect comparisons can be made. There were some differences between the present study and findings from general population surveys of barriers and benefits of eating a healthy diet. For example, the main barriers in a European Union survey related to lack of time and taste factors, rather than lack of knowledge or informa-

Table 4 Percentages of total respondents in agreement with benefits of eating a plant-based diet, together with percentages and *P*-values for comparisons between sex, age and education (university vs non-university) groups^a

Item	% Agree (% unsure)										
	All	Women	Men	P-value	20–44 years	45–59 years	60–91 years	P-value	Uni	Non-uni	P-value
Decrease my saturated fat intake	79 (17)	83 (15)	76 (20)	NS	80 (17)	84 (13)	75 (21)	NS	88 (9)	75 (22)	**
Eat more fibre	76 (19)	77 (18)	73 (22)	NS	65 (32)	79 (16)	83 (11)	***	85 (10)	70 (25)	***
Prevent disease in general (e.g. heart disease, cancer)	70 (23)	74 (20)	64 (28)	NS	68 (24)	75 (20)	68 (24)	NS	74 (22)	68 (23)	NS
Eat a more 'natural' diet	68 (24)	73 (23)	61 (27)	**	72 (23)	72 (20)	61 (30)	NS	67 (25)	70 (23)	NS
Have lots of vitamins and minerals	67 (27)	74 (23)	59 (33)	**	73 (26)	63 (28)	68 (27)	*	64 (28)	70 (26)	NS
Stay healthy	63 (29)	72 (23)	51 (39)	***	68 (27)	65 (24)	58 (35)	NS	65 (30)	63 (29)	NS
Control my weight	63 (26)	67 (25)	58 (28)	NS	67 (23)	67 (22)	55 (35)	NS	63 (26)	63 (27)	NS
Improve my digestion	58 (35)	62 (31)	51 (40)	NS	62 (34)	60 (32)	52 (39)	NS	58 (34)	58 (35)	NS
Eat a greater variety of foods	52 (35)	55 (34)	48 (36)	NS	51 (36)	55 (32)	50 (37)	NS	49 (37)	55 (33)	NS
Be fit	48 (35)	50 (35)	45 (35)	NS	47 (32)	50 (32)	47 (42)	NS	49 (35)	48 (34)	NS
Have a better quality of life	44 (41)	51 (37)	34 (47)	**	50 (38)	50 (35)	32 (52)	**	47 (38)	42 (43)	NS
Have plenty of energy	40 (49)	48 (43)	29 (56)	***	48 (45)	39 (47)	34 (54)	NS	41 (48)	40 (49)	NS
Have a tasty diet	40 (37)	45 (38)	33 (35)	***	43 (43)	42 (30)	36 (40)	*	40 (38)	40 (36)	NS
Be more content with myself	37 (44)	42 (41)	31 (47)	NS	42 (44)	39 (38)	32 (48)	NS	40 (42)	36 (44)	NS
Lower my chances of getting food poisoning	36 (39)	41 (37)	28 (42)	*	32 (43)	38 (38)	38 (38)	NS	31 (42)	39 (36)	NS
Help the environment	35 (44)	40 (46)	29 (41)	***	33 (50)	37 (45)	36 (39)	NS	34 (47)	36 (42)	NS
Help animal welfare/rights	30 (43)	37 (42)	20 (43)	***	33 (44)	33 (42)	26 (41)	NS	31 (43)	30 (42)	NS
Increase efficiency of food production	26 (51)	27 (55)	24 (45)	**	20 (56)	28 (52)	31 (46)	NS	23 (52)	27 (51)	NS
Decrease hunger in the Third World	19 (52)	20 (54)	17 (47)	NS	13 (55)	21 (49)	23 (51)	NS	13 (55)	22 (49)	NS
Save money	19 (49)	18 (52)	20 (45)	NS	17 (49)	21 (52)	19 (46)	NS	18 (51)	18 (49)	NS
Save time	16 (51)	20 (51)	10 (53)	*	17 (54)	18 (50)	15 (50)	NS	13 (54)	18 (50)	NS
Have fewer food storage problems	16 (48)	16 (48)	13 (48)	NS	10 (52)	17 (47)	18 (44)	NS	10 (47)	18 (49)	*
Appear more 'trendy' to my friends	6 (31)	5 (33)	7 (29)	NS	3 (33)	8 (28)	7 (31)	NS	4 (29)	7 (32)	NS

^aThe full question asked was: 'Some people believe that eating a plant-based diet has specific benefits. How much, if at all, do these statements apply to you? (Please circle one answer for each statement.) I believe eating a plant-based diet could or does *help* me to...or I believe eating a plant-based diet can *help*...' Responses provided were 'strongly disagree', 'disagree', 'not sure', 'agree', and 'strongly agree'. '% Agree' results here combine 'agree' and 'strongly agree'.

All *n* = 415; women *n* = 243; men *n* = 166; 20–44 years *n* = 131; 45–59 years *n* = 138; 60–91 years *n* = 132; university educated *n* = 155; non-university educated *n* = 250.

****P* < 0.001, ***P* < 0.01, **P* < 0.05, NS = not significant.

tion (Kearney and McElhone, 1999). Not wanting to change one's current diet was less important in the EU study than in the present one (Kearney and McElhone, 1999). The main benefits associated with eating a healthy diet in the EU study were staying healthy and disease prevention, which were also important in the present study (Zunft *et al.*, 1997). The two most important benefits in the present study, decreased saturated fat intake and increased fibre intake, were not measured in the EU study. A UK study on fruits and vegetables found that expense was an important barrier to increased consumption (Cox *et al.*, 1998), whereas it was less important for the present study. This may be due to the lower cost of fruits and vegetables in Australia. Taste and health factors were considered benefits of eating fruits and vegetables, with taste being somewhat more important (Cox *et al.*, 1998). The present study found perceived health benefits to be overriding.

A previous South Australian study on barriers and benefits of vegetarian diets (Lea and Worsley, 2003) also allows comparisons to be made. The primary barrier to eating a vegetarian diet related to taste, whereas taste barriers ranked relatively low in the plant-based diet survey. Presumably, this is due to meat not necessarily being excluded from a plant-based diet, whereas it is from a vegetarian diet. Unwillingness to alter one's current eating pattern was a barrier for a substantially higher proportion of vegetarian survey respondents than among plant-based survey respondents. This suggests that consumers' perceive switching to a plant-based diet as a smaller change than switching to a vegetarian diet, as might be expected. The need for more dietary information was important in both surveys, which is of concern considering the broader nature of a plant-based compared to vegetarian diet. The belief that humans are 'meant' to eat meat was a stronger barrier to consumption of a vegetarian diet than the equivalent item in the plant-based diet survey. Thus, small amounts of meat, such as in a plant-based diet, are apparently adequate. Indeed, health concerns were lower for a plant-based diet than they were for a vegetarian diet. In concurrence, there were generally perceived to be stronger health benefits gained from eating a plant-based as opposed to a vegetarian diet. These findings may be due to the presence of some meat in a plant-based diet, with meat being viewed as fundamentally healthy (Lea and Worsley, 2002). Animal welfare was a stronger perceived benefit in the vegetarian diet survey than the plant-based diet survey. An explanation may be that because a plant-based diet may contain some meat, the animal welfare benefits are less obvious (more ambiguous). Thus, there were some similarities as well as important differences between the vegetarian and plant-based diet studies, with the differences related to the possible inclusion of some meat in plant-based diets.

There were some demographic differences in levels of agreement with perceived barriers and benefits of consumption of a vegetarian diet. Sex differences were particularly important for perceived benefits. This is consistent with the literature, which has found that women generally view their

diet as more important to their health than do men (Kearney *et al.*, 2000). In addition, women have greater responsibility for family health and still commonly assume the traditional role of household food purchasers and 'gatekeepers' (Worsley and Worsley, 1989; Beardsworth *et al.*, 2002). The findings show that around a third of men (in contrast to 10% of women) do not make their own decisions about the food they eat. Sex differences have been found previously for beliefs about vegetarian diets and meat. More women than men are vegetarian and meat reducers (Australian Bureau of Statistics, 1997; Kalof *et al.*, 1999; Lea and Worsley, 2004) and these dietary behaviours are associated with certain beliefs and values (e.g. health, environment, animal welfare) (Lea and Worsley, 2004). In addition, meat is seen as men's food in many cultures and is associated with power, while lower status non-meat foods such as fruit and vegetables are viewed as women's food (Twigg, 1983; Adams, 1990).

Education status was particularly important for perceived barriers. This concurs with the existing literature on socio-economic status differences (including education) in diet (Kearney *et al.*, 2000; Wardle and Steptoe, 2003). University-educated and younger people may be more receptive to information on changing to a plant-based diet, as they appeared to be more willing to alter their diet than the non-university educated and oldest groups. According to the diffusion of innovations model (Rogers, 1983), it is to be expected that high socio-economic status sections of the population, such as individuals with higher education levels, would take up this novel form of eating first.

These findings have public health implications. The largely positive beliefs about plant-based diets held by the survey respondents, viewed in conjunction with other research findings with regard to reduced meat consumption and organic diets, suggests that there is a trend towards plant-based foods. However, further studies are needed to establish this, particularly given the cross-sectional nature of the present study. In order for the public to gain the health benefits associated with consuming a plant-based diet, it is important to provide practical information on how to eat a plant-based diet. The results also suggest that people are largely unaware of the importance of the benefits that may be gained from eating a plant-based diet, particularly those that fall outside health such as environmental benefits. However, they may also be unaware of the impact that the health benefits have for improving morbidity and mortality, as well as quality of life. This suggests the need for greater publicity about the benefits of these diets and ways to change people's eating habits. There is a need to use communication models to influence opinion leaders in all strata of society, not only women and the highly educated. Structural support for a communications campaign should come from a broad base, including government and food retailers. However, sufficient financial resources are required to run such a campaign; lack of funds has been identified as a strong barrier to plant food promotion by the plant food industry (Nestle, 2002; Lea, 2003). One way to gain such

funds is for plant food advocates, including horticulture and grains food industry sectors, to influence key stakeholders in society. This could allow them to access part of the multi-million dollar government health budget with the aim being to improve public health by producing and marketing plant-based foods more effectively.

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