

ORIGINAL ARTICLE

# Food choices, perceptions of healthiness, and eating motives of self-identified followers of a low-carbohydrate diet

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## Abstract

**Background:** Low-carbohydrate (LC) diets have gained substantial media coverage in many Western countries. Little is, however, known about the characteristics of their followers.

**Objective:** The article analyses how those who report following an LC diet differ from the rest of the population in their background, food choices, weight reduction status, as well as food-related perceptions and motives. The data are a part of the Health Behaviour and Health among the Finnish Adult Population survey collected in spring 2012 ( $n = 2,601$ ), covering 15- to 64-year-old Finns.

**Results:** Seven per cent of the respondents identified themselves as followers of the LC diet. Gender and education were not associated with following an LC diet. The youngest respondents were the least likely to follow such a diet. The LC diet group preferred butter but also vegetables more commonly than the other respondents and were less likely to use vegetable bread spreads. The followers of the LC diet and the other respondents agreed about the healthiness of whole grain, vegetable oils, vegetables, and fruits and berries, and of the harmfulness of white wheat. Compared to the other respondents, the LC diet group was less likely to regard eating vegetable/low-fat products as important, more likely to regard eating healthy carbohydrates, and the health and weight-managing aspects of foods, as important and placed less value on sociability and pleasures connected to food. The results showed varying food choices among the followers of the LC diet: some even reported that they were not avoiding carbohydrates, sugars, and white wheat in their diet.

**Conclusions:** Planners of nutrition policies should follow-up on new diets as they emerge and explore the food choices and motives of their followers and how these diets affect the food choices of the whole population.

**Keywords:** *low-carbohydrate diet; food choices; fats; carbohydrates; motives; perceptions; health risks; weight management; pleasure*

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Dr. Atkins' Diet Revolution from 1972 is often seen as the onset of the era of various low-carbohydrate (LC) diets. The Atkins diet promoted the view that animal fats are not harmful to health whereas carbohydrates should be avoided. These cornerstones set the Atkins diet against the mainstream advice for weight management, which focused on the restriction of calories and particularly the avoidance of energy-rich fat. Dr. Atkins' Diet Revolution was translated into several languages, including Finnish in 1973. However, it was only in the late 1990s and 2000s that the Atkins diet and other forms of low-carbohydrate diets started to gain substantial media coverage in Europe and the United States, and provoked heated debates about carbohydrates and animal fats (1–3). The recent popularity and media interest have been closely tied to a rising concern about

what has been labelled the 'obesity epidemic', and the related public health concern (4), as proponents of LC diets often present these diets as a cure for obesity.

In Finland, during 2010 and 2011, LC diets became widely reported and discussed in the media, even to the extent of forming a social movement (5). An analysis of popular Finnish online discussion forums revealed strong criticism among proponents of LC diets questioning the scientific expertise and current nutritional recommendations regarding saturated fats and cholesterol (6). Both in newspapers (5) and in online forums (6), individuals reported their positive experiences with LC diets. The phenomenon became associated with advocates and followers with a specific identity in which a key feature was to protest against the national nutrition recommendations. At the same time, health researchers became concerned

that the LC diet boom and the related critique towards national nutrition recommendations had increased butter consumption, and consequently the cholesterol levels among the Finnish population (7). In the media, LC diets were typically accompanied with pictures of butter, cheese, bacon, sausages, and meat, as symbols of the diet. A similar phenomenon was reported a few years earlier in Sweden. There the low-carbohydrate/high-fat movement challenged dietary expertise by claiming that nutrition recommendations in Sweden are based on fraudulent science. The LC movement concurrently showcases personal stories and before-and-after pictures of individuals following LC diets as testimonies of the superiority of the diet (8).

The public interest in LC diets appears to be linked to several factors. The appealing aspects of these diets include an emphasis on the pleasures of eating (1), the centrality of meat in the diet (9), and the favouring of animal fats. Hence, LC diets are typically seen not only as a means of losing weight but also from the viewpoints of pleasure and feeling good and energetic (10). Moreover, low-carbohydrate diets are often associated with release from external dietary controls which characterise many traditional weight reduction techniques (11), although LC diets contain restrictions, too. Pasta, potatoes, and rice are typically forbidden or restricted, often leading to difficulties in balancing between cravings and the dietary requirements (12). Moreover, in LC diets, foods categorised as unprocessed and natural are considered beneficial, whereas processed foods, such as margarines and refined wheat and sugar, are depicted as artificial and thus as foods to be avoided (1). In this respect, the Atkins diet resonates with contemporary cultures where high value is placed on natural and unprocessed foods (13).

LC diets have been well-studied from the nutritional and weight loss perspective (14–16). However, despite intensive media attention, there are not many studies on the popularity of LC diets among the general population, especially in Europe. The few studies on popularity are mainly based on market research by private companies. According to one of these, only a minority of Finns follow the LC diet: 4% in 2009, although 2 years later the figure had risen to 10% (17). Another study in 2011 reported that 6% of Finns were following the LC diet, and 12% had done so at some point previously (18). A report from Sweden showed that in 2012, 4% of Swedes were following the LC, high-fat diet (19). Moreover, qualitative studies have explored the cultural aspects of these diets (1, 8, 12).

However, there is a lack of quantitative studies on persons who identify themselves with LC diets, which would focus on the dieters' socioeconomic backgrounds, food choices, and food-related perceptions. For the moment, little is known about how LC diets appeal to different population groups and whether and how factors such as gender, age, and education affect LC dieting.

Similarly, as far as we know, the differences and similarities between followers of the LC diet and non-followers as concerns their food choices, or the factors that motivate their eating behaviours, have not been investigated earlier. In addition, although LC diets are promoted as weight reduction techniques, the individual stories told by followers of the LC diet illustrate an increase in the dieters' overall well-being and virility, too (6). Against this background, the present study aims to explore how the followers of the LC diet differ from other respondents in a) their food choices and weight reduction status and b) socioeconomic background, perceptions of health risk related to foods and eating motives.

Because the subject is currently ill-studied, we first provide an overview of food choices and perceptions of healthiness among the followers of the LC diet and the other respondents. Second, we apply logistic regression analysis to explore the associations between the LC diet and other factors.

## Material and methods

The data were collected by the National Institute for Health and Welfare in spring 2012. The survey is a part of the annual Health Behaviour and Health among the Finnish Adult Population (AVTK) monitoring survey. For the survey, each year a random sample of 5,000 Finnish citizens residing permanently in Finland and aged 15–64 has been drawn from the National Population Register. The questionnaire is mailed between April and June, with three reminders. The survey instrument and the method have been approved by the Research Ethics Board of the National Institute for Health and Welfare.

The 12-page questionnaire covered questions on socioeconomic background and various health behaviours, such as eating, physical activity, smoking, and alcohol consumption. Food frequency questions (FFQ) and questions on fat choices, which are also reported in the present study, have been repeated in the annual survey since 1978 (20–22) but have not been validated. For the purposes of the present study, new questions on the following areas were added to the questionnaire in 2012: relation to LC diets, perceptions of healthiness of fats and carbohydrates, and eating motives. The new questions were piloted among the consumer panel of the National Consumer Research Centre ( $n=411$ ). After the pilot, the questions were further developed into their final form.

In the final questionnaire, the respondents' relation to LC diet was investigated with the question: 'What is your relation to the LC diet?', with the answering options 'I have not heard about the LC diet', 'I have heard about the LC diet, but do not practice it', and 'I follow the LC diet'. The question contained a term that is commonly used in Finnish with reference to Atkins-type diets (karppaus), hence typically referring to limited consumption of carbohydrates, increased consumption of meats

and other animal proteins, and the view that saturated fats are not harmful to health. At the time of the survey, the concept 'karppaus' had been established in Finnish and was frequently used in the media (5, 6), although it did not always refer to a clearly defined set of dietary practices and it probably could be interpreted in varying ways. In common parlance, it was a very typical way of referring to LC diets.

Weight reduction was measured with the question 'Are you slimming down at the moment?', with the response options of 'no' and 'yes'. BMI was calculated by dividing the respondent's weight (kg) by height squared (m<sup>2</sup>).

Consumption of foods and beverages containing carbohydrates was measured with a FFQ enquiring about the number of days during the past week on which the respondent had eaten 'fresh vegetables', 'cooked vegetables', 'fruits and berries', 'cooked potatoes', 'French fries', 'rice/pasta', 'cereals', 'sweets and chocolate', 'juices', and 'sweetened soft-drinks'. The response options for each item were 'not at all', 'on 1–2 days', 'on 3–5 days', and 'on 6–7 days'. Consumption of bread was enquired with a question 'How many slices of bread do you usually eat daily' for 'dark bread (rye bread or rye crisp, etc.)', 'mixed, graham, wholegrain, or oat bread' and 'bread from refined wheat', and the respondents were asked to fill in the number of slices for each bread type. In addition, the respondents were asked if their diet was 'low in all carbohydrates' and 'low in sugar and refined grain products', both with the response options of 'yes' and 'no'.

Meat, fish, and egg consumption was measured with a FFQ enquiring about the number of days during the past week on which the respondent had eaten 'meat', 'chicken', 'fish', and 'egg', with the response options 'not at all', '1–2 days', '3–5 days', and '6–7 days'.

Fat choices were measured with two questions: the type of fat the respondents used most often for cooking (with the options of vegetable oil, liquid margarine, low-fat spread with ca. 60% fat, soft margarine, hard margarine, mixture of butter and oil, butter, and none), and the type of bread spread used most often (with the options of not at all, spread with max. 40% fat, spread with max. 60% fat, plant stanol/sterol spread, and soft margarine with 70–80% fat, mixture of butter and oil, and butter). In the analysis, products processed from vegetable oils, that is, margarines, low-fat spreads, and plant stanol/sterol spreads, were combined into one category.

The perceptions about the healthiness of fats and foods containing carbohydrates were investigated with a question that was further developed from a question on knowledge of the relationship between dietary fat type and heart disease introduced by Eckel et al. (23). The question 'Foods may have an impact on health. What is your perception of the effects of the following foods on your health?' was followed by a list of foods, including animal fats, vegetable oils, vegetable bread spreads, whole

grain products, refined wheat products, vegetables and root vegetables, and fruits and berries. The options were 'are harmful for my health', 'are beneficial for my health', 'have no effect on my health', and 'I don't know'.

In order to investigate the respondents' food choice motives, we applied the Food Choice Questionnaire (24). However, because of limited space in the questionnaire, it was only possible to include a short list of items that were expected to cover several motives. The motives were asked with the phrase: 'In my opinion . . .', followed by 18 motives and 5 answering options 'is not at all important', 'is not very important', 'is somewhat important', 'is important', and 'is very important'.

Principal component analysis (PCA) was conducted separately for motives related to the contents of diet and other motives. Based on the high loadings of items, five factors emerged in total. The reliability of the factors was evaluated with Cronbach's  $\alpha$  values. The three factors related to the contents of the diet were named 'healthy carbohydrates' (including items 'to eat a lot of vegetables, fruits, and berries', 'to eat fibre-containing foods', 'not to eat sugary foods', 'not to eat bread and pasta from refined grains'; Cronbach's  $\alpha = 0.770$ , mean = 3.47, SD = 0.78), 'vegetable/low fat' (including items 'to use vegetable oil', 'to use vegetable bread spread', 'to eat low-fat foods'; Cronbach's  $\alpha = 0.746$ , mean = 3.09, SD = 0.88), and 'meat and animal fats' (including items 'to eat foods containing butter and cream', 'to eat a lot of beef, pork, and chicken'; Cronbach's  $\alpha = 0.45$ , mean = 2.37, SD = 0.78). The two factors related to potential other motives were 'pleasure and sociability' (including items 'that food tastes good', 'that I eat together with my family or friends', 'that I can eat what I please', 'that it puts me in a good mood'; Cronbach's  $\alpha = 0.607$ , mean = 3.66, SD = 0.63), and 'health and weight' (including items 'that food is good for my health', 'that I don't gain weight from the food I eat'; Cronbach's  $\alpha = 0.615$ , mean = 3.67, SD = 0.80). Three items were omitted ('to eat a lot of fish', 'that I gain fast energy/feeling of fullness from food', 'that I do not worry about the healthiness of food') due to their low contributions in the PCA.

A total of 2,601 respondents were included in the data, with a 52% response rate. The response rate of the yearly survey has been steadily decreasing, falling under less than 60% during the recent years (20). Of the respondents, 57% were women, 24% were 15–30 years old, 35% were 30–49 years old, and 41% were 50–64 years old. Compared to the general population (25), men (43% in the data vs. 51% in the population) and the youngest age group (22% in the data vs. 28% in the population) were underrepresented in the data. In total, 12% had completed less than 10 years of education, 30% had 10–12 years of education, and 58% had more than 12 years of education. In 2010, the mean of completed years of education among Finns was 12.3 (26), compared to 13.8 in the present data. Although the level

of education might have slightly increased in the population in the 2 years between 2010 and 2012, persons with a higher educational level were probably somewhat over-represented and those with a low level of education were underrepresented in our data.

In the analysis, SPSS version 21 was applied. The differences between the followers of the LC diet and the other respondents with regard to food choices and perceptions of health risks are explored with cross tabulations (Chi-square test) and with ANOVA. The associations between the socioeconomic factors, perceptions of health risks, and eating motives were investigated using Pearson correlation coefficients, and in the final analysis, the associations between these variables and following an LC diet were examined with logistic regression analysis.

## Results

In total, 7% of the respondents reported that they were following the LC diet in 2012. Only 3% of the respondents reported that they had not heard of the LC diet.

Of those who were following the LC diet, 57% also reported that they were currently trying to lose weight, compared to 21% among the other respondents ( $p < 0.001$ ). The mean BMI of the LC diet group was 27.21 and among other respondents it was 25.59 ( $p < 0.001$ ).

With regard to foods containing carbohydrates, frequent consumption of fresh vegetables was more common among the followers of the LC diet than among the other respondents (Table 1). The association was similar in cooked vegetables (data not shown), whereas there were no differences between the groups when it came to eating fruits and berries. Eating cooked potatoes, rice, and pasta was less frequent among the followers of the LC diet than among the other respondents. The association was similar in cereals, but with French fries there was no difference between the two groups (data not shown). Drinking juices and sugar-sweetened soft-drinks was less frequent among followers of the LC diet than among the other respondents (Table 1), whereas there were no differences between the groups when it came to eating candies and chocolate (data not shown). Seventy four per cent of the LC group and 80% of the other respondents ate candies or chocolate at least once a week (ns.). The LC diet group ate less rye bread compared to the other respondents (2.1 slices/day vs. 2.6 slices/day,  $p = 0.001$ ); less mixed, graham, wholegrain, or oat bread (0.5 slices/day vs. 1.2 slices/day,  $p < 0.001$ ); and less breads from refined wheat (0.04 slices/day vs. 0.2 slices/day,  $p = 0.01$ ). Moreover, the followers of the LC diet reported more frequently than the other respondents that they were avoiding all carbohydrates (83% vs. 22%,  $p < 0.001$ ) and that they were avoiding sugars and refined wheat products in their diet (87% vs. 47%,  $p < 0.001$ ).

The followers of the LC diet ate chicken and eggs more frequently than the other respondents. With regard to

**Table 1.** Consumption of vegetables, fruits and berries, and pastries during the past week, on how many days in a week, among followers of LC diet and other respondents (%)

	Followers of the LC diet	Others	Total
<b>Fresh vegetables</b>			
Not at all	3	6	6
1–2 days	15	22	21
3–5 days	26	31	31
6–7 days	56	41	42
Total (N) $p = 0.001$	100 (187)	100 (2,341)	100 (2,528)
<b>Fruits and berries</b>			
Not at all	8	11	11
1–2 days	28	30	30
3–5 days	27	29	29
6–7 days	37	30	30
Total (N) ns.	100 (184)	100 (2,346)	100 (2,530)
<b>Cooked potatoes</b>			
Not at all	56	17	20
1–2 days	33	48	47
3–5 days	10	30	29
6–7 days	1	5	4
Total (N) $p < 0.001$	100 (186)	100 (2,362)	100 (2,548)
<b>Rice and pasta</b>			
Not at all	46	22	24
1–2 days	45	59	58
3–5 days	7	18	17
6–7 days	2	1	1
Total (N) $p < 0.001$	100 (177)	100 (2,298)	100 (2,475)
<b>Meat</b>			
Not at all	13	9	10
1–2 days	49	48	48
3–5 days	30	37	36
6–7 days	8	6	6
Total (N) ns.	100 (183)	100 (2,328)	100 (2,511)
<b>Chicken</b>			
Not at all	14	19	18
1–2 days	50	62	61
3–5 days	33	18	19
6–7 days	3	1	2
Total (N) $p < 0.001$	100 (187)	100 (2,330)	100 (2,517)
<b>Eggs</b>			
Not at all	13	28	27
1–2 days	42	54	54
3–5 days	30	15	16
6–7 days	15	3	3
Total (N) $p < 0.001$	100 (182)	100 (2,329)	100 (2,511)
<b>Juices</b>			
Not at all	46	28	30
1–2 days	28	30	29
3–5 days	14	24	23
6–7 days	12	18	18
Total (N) $p < 0.001$	100 (183)	100 (2,357)	100 (2,541)
<b>Sugar-sweetened soft-drinks</b>			
Not at all	80	67	68
1–2 days	17	26	25
3–5 days	3	6	6
6–7 days	0	1	1
Total (N) $p = 0.003$	100 (183)	100 (2,330)	100 (2,513)

eating fish (data not shown) and meat, there were no differences between the two groups.

The followers of the LC diet differed from the other respondents in that they used butter more often, and margarines and vegetable spread products less often, in cooking and on bread (Table 2). However, even in the LC diet group, butter was not the most common cooking fat or bread spread. Instead, in both groups, vegetable oil was the most common cooking fat, and vegetable bread spread was used on bread by a third of the followers of LC diets and by nearly a half of the other respondents. A mixture of oil and butter was used on bread by one third in both groups.

Although a majority in both groups considered products from refined wheat products as harmful to health, this perception was more prevalent among the followers of the LC diet (87% vs. 69%,  $p < 0.001$ ). A majority in both the LC diet group (80%) and the other respondents (90%) regarded whole grain products as good for health. Vegetables and root vegetables were considered as good for health by nearly all the respondents in both groups (followers of LC diet 97%, other respondents 95%). Likewise, fruits and berries were almost unanimously considered as good for health (97 and 96%, respectively).

Concerning the healthiness of fats, the followers of the LC diet differed from the other respondents in that they regarded animal fats as good for health more commonly (26% vs. 10%), and as harmful to the health less commonly than the other respondents (44% vs. 57%,

$p < 0.001$ ); and they considered vegetable bread spreads as harmful to health more commonly (26% vs. 8%), and as good for health (40% vs. 52%), or as having no effect (19% vs. 23%,  $p < 0.001$ ), less commonly. In total, 84% of the respondents in both groups regarded vegetable oils as good for health, and 10% as having no effect on health.

Finally, in order to examine how socioeconomic background, perceptions of health risks related to foods and eating motives are related to following an LC diet, logistic regression analysis was conducted. Of the risk perceptions, we included those which in the previous analysis had been shown to be associated with an LC diet (white wheat, animal fats, vegetable bread spreads). The associations between the independent variables were moderate (Pearson correlation coefficients). Gender and education did not predict the LC diet either in the unadjusted or the adjusted models. In the final model, the older respondents had, higher the probability of following an LC diet (Table 3). The odds of following the LC diet increased by 4% per one unit increase in BMI. Although having significant unadjusted effects, in the final model, perceptions of the health effects of animal fats, vegetable bread spreads, and refined wheat products were not associated with an LC diet. With regard to eating motives, preference for vegetable/low-fat products decreased the probability of choosing an LC diet, whereas preference for healthy carbohydrates and meat and animal fat products were positively associated with an LC diet. Those respondents who considered health and weight management as an important aspect in their food choices were more likely to follow an LC diet, whereas placing value on the pleasure and social aspects of food choices had the opposite effect.

**Table 2.** Typical choices of fat for cooking and for bread among followers of the LC diet and other respondents (%)

	Followers of		Total
	the LC diet	Others	
<b>Fat used for cooking</b>			
Vegetable oils	53	52	51
Liquid margarine, vegetable spreads, hard margarine	8	19	19
Mixture of butter and oil	10	11	11
Butter	27	16	17
None	2	2	2
Total (N) $p < 0.001$	100 (175)	100 (2,213)	100 (2,388)
<b>Bread spread</b>			
< 60% spread, soft margarine 70–80%	34	47	46
Plant sterol/stanol spread	3	4	4
Mixture of butter and oil	35	36	36
Butter	18	5	6
None	10	8	8
Total (N) $p < 0.0001$	100 (184)	100 (2,365)	100 (2,549)

## Discussion

The LC diet was a widely known diet among Finns in 2012. However, only 7% reported that they were following the diet. This proportion resembles earlier results from Finland reporting that 6% (18) and 10% (17) of Finns had followed the LC diet in 2011.

We found that gender and education were not associated with the tendency to follow an LC diet. Population surveys in Finland during the past years show that women are more inclined to try to lose weight than men (20). Other studies have reported similar results (27). The LC diet studied here, in contrast, attracted men and women equally. This might be partly due to the centrality of meat and animal fats in LC diets and the ‘masculinised’ character of the diet (9), in addition to other characteristics that differentiate the LC diet from traditional weight reduction diets. With reference to age, our findings resemble those on dieting in general: The youngest are the least likely to diet (20). Young adults are typically

**Table 3.** Following low-carbohydrate diet by independent background variables, unadjusted main effects, and adjusted models

	Unadjusted main effect		Adjusted model	
	OR, sig.	(95% CI)	OR, sig.	(95% CI)
Gender				
Male	1.00	–	1.00	–
Female	1.31 (ns.)	(0.97–1.79)	0.87 (ns.)	(0.58–1.30)
Age group				
15–24 years	1.00	–	1.00	–
25–34 years	3.87**	(1.67–8.98)	2.38 (ns.)	(0.91–6.18)
35–44 years	4.99***	(2.12–11.26)	3.64**	(1.44–9.19)
45–54 years	5.14***	(2.32–11.41)	3.49**	(1.40–8.69)
55–64 years	4.45***	(2.01–9.85)	3.28*	(1.31–8.24)
Education				
0–9 years	1.00	–	1.00	–
10–12 years	0.76 (ns.)	(0.44–1.32)	0.51 (ns.)	(0.25–1.02)
13 or more years	1.24 (ns.)	(0.77–2.00)	0.79 (ns.)	(0.42–1.50)
BMI, continuous (range 13–61)	1.06***	(1.03–1.09)	1.04*	(1.00–1.08)
Perception on the health effects of vegetable bread spread				
Harmful to health	1.00	–	1.00	–
Good for health	0.23***	(0.16–0.35)	0.78 (ns.)	(0.42–1.46)
No effect	0.25***	(0.15–0.39)	0.65 (ns.)	(0.36–1.18)
Doesn't know	0.27***	(0.17–0.45)	0.75 (ns.)	(0.39–1.44)
Perception on the health effects of animal fats				
Harmful to health	1.00	–	1.00	–
Good for health	3.48***	(2.37–5.11)	1.55 (ns.)	(0.87–2.76)
No effect	1.49*	(1.01–2.18)	1.54 (ns.)	(0.94–2.53)
Doesn't know	0.80 (ns.)	(0.45–1.43)	0.53 (ns.)	(0.24–1.17)
Perception on the health effects of white wheat products				
Harmful to health	1.00	–	1.00	–
Good for health	0.35 (ns.)	(0.09–1.45)	0.39 (ns.)	(0.05–3.19)
No effect	0.26***	(0.14–0.48)	0.51 (ns.)	(0.26–1.02)
Doesn't know	0.45*	(0.24–0.87)	0.68 (ns.)	(0.27–1.68)
Importance of eating vegetable/low fats				
Continuous (range 1–5)	0.81*	(0.68–0.96)	0.44***	(0.33–0.61)
Importance of eating meat and animal fats				
Continuous (range 1–5)	1.98***	(1.65–2.37)	1.65***	(1.30–2.11)
Importance of eating healthy carbohydrates				
Continuous (range 1–5)	2.89***	(2.30–3.63)	2.42***	(1.69–3.48)
Importance of health and weight aspect in food choices				
Continuous (range 1–5)	2.73***	(2.20–3.41)	2.31***	(1.66–3.23)
Importance of food-related pleasure and sociability				
Continuous (range 1–5)	1.03 (ns.)	(0.81–1.31)	0.68**	(0.51–0.91)

Odds ratios from the logistic regression analysis. \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

less concerned about weight and health, and hence show lesser tendency to try to change their diet.

To what extent did the followers of LC diet of the present study follow the core rules of LC diets, that is, avoidance of carbohydrates, consumption of meat and other proteins, and acceptance of saturated fats in the diet? In many respects, there was a tendency towards favouring these components: The followers of LC diet

consumed potatoes, rice, pasta, bread, juices, and sugar-sweetened soft-drinks less frequently than the others and more frequently reported avoiding carbohydrates, sugars, and refined grain products. They ate eggs and chicken slightly more frequently than the other respondents and had a negative perception of refined wheat products more commonly than the other respondents. Furthermore, the followers of LC diet used less margarine and vegetable

bread spread and more butter than the other respondents. The perception that meat and animal fats make up an important part of a diet was also associated with the LC diet.

However, in many respects, the lifestyles of the followers of the LC diet appeared as similar or actually healthier compared to those respondents who were not following the diet. There was no difference in the frequency of fruit and berry consumption between the groups. A majority of the followers of the LC diet and the other respondents agreed with certain core claims of current nutrition recommendations: – that whole grain products, vegetable oils and vegetables, fruits and berries are good for health. Moreover, a majority in both groups agreed that refined wheat products are harmful to their health. Indeed, although the LC diet is typically seen to contradict official nutrition recommendations, there are similarities between the two diet types, too. Excess consumption of sugar-containing products has been linked to obesity, not only in LC diet promotion but also in national nutrition recommendations and scientific publications in the 2000s (28).

Moreover, the followers of the LC diet ate vegetables even more often than the other respondents. Similar results have been reported of LC dieters in the United States, who believed that avoiding sugars and starch and eating vegetables plays a more important part in their diet than increasing fat consumption (10). Moreover, only 5% of these LC dieters had increased their consumption of beef, bacon, and butter to any great degree, whereas more than a majority had increased their consumption of salad/lettuce (10).

Concerning eating motives, the followers of the LC diet did not particularly stand out as pleasure-seekers, as has been suggested by previous research (1, 11). Instead, they placed more importance on the weight-related and health aspects of food, and were more commonly trying to lose weight compared to the other respondents. However, it is interesting to note that even if LC diets have been promoted first and foremost as slimming diets, only a little more than a half of the followers of LC diet in the present study were trying to lose weight. This suggests that LC diets are used for other purposes, too, for instance as a means to improve well-being in terms of feeling good and energetic.

The response rate of the survey was 52%. Although it was even lower among some population groups such as young men, the data still covered these groups, too. Others have concluded that likely candidates not to respond are persons whose lifestyles contain several unhealthy components or who are the least interested in health issues at large (29). Hence, it is possible that the proportion of followers of the LC diet would have been slightly different had the response rate been higher. Still, previous market research of the LC diet has shown similar enough

proportions, giving support to the present findings (17, 18). However, the aim of the present study was not to estimate eating patterns and food-related perceptions on the population level but, rather, their associations with the LC diet. It is unlikely that one of the main findings of the present study – that the LC diet is known by a majority of the population but practiced only by a minority and in varying ways – would be significantly different with a better response rate. We should also note that over the last couple of decades, response rates in surveys have generally declined in European countries, including Finland (29). On the whole, it is becoming increasingly difficult to achieve high response rates in postal surveys (30). This decrease has been detected in all population groups, and consequently in recent studies response rates of over 50% have been considered satisfactory (31).

Another issue to be considered is self-report measurement of dietary behaviours. Self-report is the only feasible and cost-effective method for collecting large, representative data. Moreover, although the questions of the questionnaire may cover only some aspects of diets, they still characterise sufficiently certain key preferences in the dietary choices and provide useful information related to, for example, the thus far ill-studied LC diets. In addition, the food frequency questionnaire of the present study has been previously used to characterise patterns of and changes in food consumption among Finns in a consistent manner (22, 32, 33).

What is surprising in the results is that some of the respondents who identified themselves as followers of the LC diet also reported that they were not avoiding carbohydrates, sugars, and refined wheat products in their diet. This coincides with studies on vegetarianism which consistently find that self-defined vegetarianism is more common than vegetarianism measured by FFQ (34). Vinnari et al. (34) suggest the following reasons for the inconsistency: lay persons' definitions of vegetarianism differ from those of the experts, people are not fully knowledgeable about the food products they consume, and some consumers want to identify as vegetarians although they eat meat. A similar explanation might apply to the results presented here, too. We suggest that in the peak of the LC diet boom, some respondents wanted to identify themselves with the phenomenon even though from the nutritional perspective they were not actually following an LC diet. In addition, some of the respondents may have lacked knowledge of nutritional contents of foods and assumed that they were following the LC diet even though they may have been eating foods actually banned in the LC diet.

An analysis of media discourse on LC diets in Finland showed that the LC diet as a concept is unclear both from a nutritional and a cultural perspective (5). The results of the present study corroborate this finding by showing that people may identify themselves as followers of LC

diet irrespective of whether their food choices are typical of a strict LC diet or not. We should also bear in mind that dietary regimes in practice are always variations of the original recommendations. They change and evolve through public discourses and in everyday life as their followers adjust the dietary advice to fit in with the food practices and expectations of their social environments at work, in family life, and in leisure time.

It seems that LC diets are currently losing their status as the most highly debated fad diet. Instead, new fads are emerging, such as the gluten-free diet, the '5:2 diet' on which dieters fast 2 days a week, and even combining various diets. Planners of nutrition policies and recommendations should closely monitor new diets as they emerge and explore the food choices and motives of the dieters. It seems that those who identify themselves with particular diets apply the diets in varying ways and intensities. Moreover, it might be that diets with wide media publicity, such as the LC diets, affect the food choices of not only the adherents of the diet but also those who do not identify themselves with the diet. In Finland, there is some indication of the LC diet boom having increased butter and cream consumption within only a few years' time so much that it cannot be explained only by the changing consumption habits of low-carb dieters (7). This shows that novel diets may diffuse and affect food cultures in more profound ways than could be expected just by examining the food ways of the followers of the diets.

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