

ORIGINAL ARTICLE

# DIETARY PATTERNS IN THE POPULATION LIVING IN THE SÁMI CORE AREAS OF NORWAY – THE SAMINOR STUDY

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Received 3 July 2007; Accepted 15 October 2007

## ABSTRACT

**Objectives.** To identify dietary patterns and to investigate their association with selected life-style and demographic factors, ethnicity and self-perceived health.

**Study design.** Population-based cross-sectional design, using food frequency questionnaires.

**Methods.** A total of 12,811 subjects aged 36–79 years participated from the municipalities in Norway where more than 5–10% of the population reported to be Sámi in the 1970 Census, in addition to some selected districts. The data were collected during 2003–2004. A principal component analysis was used to assess the associations among food variables. Seven principal components were then used as input in a cluster analysis.

**Results.** Five dietary patterns were identified and labelled “reindeer,” “fish,” “average,” “fruits and vegetables” and “Westernised, traditional marine.” The reindeer pattern was highly represented by subjects with three generations of Sámi language (Sámi I), obese subjects and those with low levels of physical activity. The fish pattern was dominated by women and had the largest proportion of individuals who reported their health as being “not so good” (35%). However, this pattern had the largest proportion of subjects in the oldest age categories. The fruits and vegetables pattern was characterised by a health-conscious life-style, included more women than men, and had the largest proportion of subjects reporting “very good” health. Ethnicity did not play a major role in predicting dietary patterns except for the reindeer pattern, especially in the inland areas.

**Conclusions.** In the dietary cluster analysis we identified five distinct dietary patterns that were also characterised by additional life-style factors. (*Int J Circumpolar Health* 2008; 67(1):82-96)

**Keywords:** Sámi people, diet, indigenous, traditional food, ethnicity, SAMINOR

## INTRODUCTION

The Sámi people are defined as an indigenous population living in the northern part of Scandinavia and on the Kola Peninsula in Russia. Norway has the greatest proportion of the total Sámi population. However, few dietary surveys have been conducted among the Norwegian Sámi population, and the sample sizes are small (1,2). No population-based dietary study with data on ethnicity from the Sámi geographical area in Norway has been published. Some dietary studies were undertaken after the Chernobyl accident among the southern Sámi to investigate the contribution from traditional food to whole body radiocesium (3). These studies showed that the consumption of reindeer meat and fresh water fish was significantly reduced after the accident, which prevented high intakes of radiocesium among the reindeer-herder Sámi (4). Dietary assessments have also been carried out in the cardiovascular studies in Finnmark and analysed in relation to geographical areas, but not by ethnicity (5).

Dietary pattern analyses have gained popularity and have been suggested as being more appropriate in studies of diet-disease associations than the classical epidemiological approach of focusing on single nutrients (6). We have previously shown by using data from the population-based health-screening investigation in Sámi areas, the SAMINOR study, that reported diet in childhood among adults could be clustered into 4 dietary patterns: a reindeer meat pattern, a pattern with a high intake of fish and fish products in addition to food sources from the local envi-

ronment, a Westernised food pattern with a high intake of meat balls and sausages and, finally, a pattern with a high intake of fish but not of any other foods included in the questionnaire. The pattern distribution differed by ethnicity, but the effect of ethnicity on diet differed according to coastal and inland residence (7).

Based on food frequency questionnaire (FFQ) data from the SAMINOR study on use of selected food items, the main purpose of this study was to identify current dietary patterns and to investigate the association with selected life-style factors, demography, self-perceived health and ethnicity.

## MATERIAL AND METHODS

### The SAMINOR study

This paper is based on data from the Population Based Study of Health and Living Conditions in Areas with a Mixed Sámi and Norwegian Population (the SAMINOR study). The data collection for the SAMINOR study was carried out during 2003–2004. The study has been described in detail elsewhere (8). Blood samples, physical measures (blood pressure, pulse recording) and anthropometric measurements were collected in addition to questionnaire data (from three different questionnaires) on ethnicity, social conditions, self-reported physical and mental health, as well as diet in childhood and today. The questionnaires were self-administered and machine readable. The questions on ethnicity were checked for completeness at the clinical examination.

### Geographical area

The SAMINOR study covered the population in all municipalities<sup>1</sup> in Norway where more than 5% of the population reported to be Sámi in the 1970 Census (9). In addition, some selected districts were included from municipalities with an overall lower proportion of subjects with Sámi ethnicity. Altogether, 24 municipalities from mid-Norway to the Russian border in northern Norway were included in the survey. The sample was further divided into coastal and inland residences in the analysis.

### Sample

Everyone in the defined SAMINOR area aged 36–79 years was initially invited to participate in the SAMINOR study, 27,151 subjects in total. Of these, 16,538 (60.9%) participated and gave informed consent to medical research. All three questionnaires in the survey were completed by 13,366 individuals. Immigrants (n=211) and persons not reporting their ethnicity (n=36) were excluded from the analysis. Furthermore, we excluded subjects who had answered less than half of the FFQ questions (n=308). After these exclusions, our study sample consisted of n=12,811 individuals.

### Ethnicity

Ethnicity was divided into 4 groups, 1 Norwegian and 3 Sámi-affiliated groups: Sámi I – 3 generations speaking the Sámi language (all grandparents, both parents and the participant used Sámi as their home language); Sámi II – at least 2 Sámi-speaking grand-

parents; and Sámi III – some Sámi affiliation (i.e., at least one Sámi indicator, for example, language, self-perceived ethnicity or family background).

### Food frequency questionnaire (FFQ) data

The dietary cluster analysis was based on FFQ data. Respondents were asked to report their usual intake of the following foods: fruit, berries, cheese (all types), potatoes, cooked vegetables and raw vegetables/salad. The response options were rarely/never, 1–3 times/month, 1–3 times/week, 4–6 times/week, 1–2 times/day and  $\geq 3$  times/day. Questions were also asked about the usual intake of the following drinks: whole milk, kefir, yoghurt; low-fat milk, “cultura,” low-fat yoghurt; skimmed milk (fresh, soured); extra low-fat milk; fruit juice; water; soda/coke with sugar; and soda/coke without sugar. The response options were rarely/never, 1–6 glasses/week, 1 glass/day, 2–3 glasses/day and  $\geq 4$  glasses/day. The daily number of cups was reported for filtered coffee, boiled (unfiltered)/press pot coffee, “other coffee” and tea. The responses were open ended (2 digits).

In addition, the respondents were asked questions about traditional and modern food items assumed to be part of the current diet of the study population. The questions included the usual intake of the following foods (dinner only): boiled cod and saithe, “other” boiled fish (lean and fatty), fried fish (lean and fatty), fish products (fishcake/balls/pudding; fish gratin; fish sticks, breaded fish) and whole meat (chicken, pork, beef, mutton/lamb, moose and whale). Questions were also asked about fish

<sup>1</sup>Municipality is understood to be the smallest administrative unit in Norway. The entire country of Norway is divided into 431 municipalities.

sandwich spreads (cured/salted fish, smoked fish, mackerel in tomato sauce, pickled herring, caviar and “other fish spreads”), fish liver, fish roe and eggs from sea birds. The modern food items included pizza; spaghetti, pasta dishes; hamburger; meatballs/ground meat patties; sausages; and casseroles. Separate questions were included for the intake of boiled, fried, smoked and dried reindeer meat, as well as for some reindeer products (blood dishes, bone marrow, tongue and liver). Most questions had 7 pre-coded responses with “never” as the first option. The maximum frequency was  $\geq 5$  times/week for fish spreads;  $\geq 3$  times/week for boiled cod and coalfish, and reindeer meat;  $\geq 2$  times/week for “other” boiled fish, fried fish, fish products, all modern dishes and whole meats. Reindeer products had 6 response options with a maximum of  $\geq 1$  time/week. Fish liver and fish roe (times/year) and sea bird eggs (number/year) had 5 response options and the range was 0 to  $\geq 10$ .

The study was approved by the Regional Ethical Committee for Medical Research in northern Norway and their Sámi consultant. The National Data Inspectorate (Datatilsynet) gave approval for the storing of individual information and for establishing subsequent linkages.

### Statistical analyses

SAS software, version 9.1, was used for the statistical analysis. The food frequencies were converted to times per week or units (glasses/cups) per week. A factor analysis (SAS PROC FACTOR method), using a principal component analysis (PCA) to extract factors, was used in order to reduce the number of variables. Although the eigenvalue criterion (eigenvalue  $> 1$ ) suggested 16 important factors,

the scree-plot together with an evaluation of the interpretability of factors led to a choice of 7 principal components (factors). Scores from these 7 factors were used as input to a cluster analysis. The principle of a cluster analysis is to divide the subjects into groups (clusters) in such a way that subjects within a cluster are more similar than cases from different clusters. SAS recommends a 2-step procedure when clustering on large datasets. We first used k-means clustering with Euclidian distance (SAS PROC FASTCLUS)(10) making 50 initial clusters, which were used as input to Ward’s minimum variance clustering (SAS PROC CLUSTER). We decided to present 5 clusters, mainly based on the interpretability of the clusters. Differences in food frequencies (times or units per week) by cluster were tested using ANOVA followed by the Tukey-Kramer test for pair-wise comparisons of clusters. Pearson’s chi-square test was used when testing for differences in dietary pattern by different subject characteristics and self-perceived health. All tests were two-sided with a significance level of 0.05.

## RESULTS

### Characteristics of study sample

Table I presents some selected characteristics of the study sample. About one-third of the sample (33%) reported some Sámi affiliation. One-fifth of the study sample (21%) was from the inland areas, whereas the rest lived in the defined coastal areas. More than 70% of the total study sample was classified as overweight according to their body mass index (BMI, kg/m<sup>2</sup>) with BMI  $> 24.9$ . The proportion of obese with BMI  $\geq 30$  was 26%. The mean age of the study sample was 54.6 (SD=11.0).

**Factor loadings**

The 7 selected factors all had eigenvalues greater than 1.42 and explained 35.6% of the variance. Food items with factor loadings of absolute value greater than 0.30 are presented in Table II. The first factor captured all the reindeer variables, with very high loadings (0.66-0.82). Fish variables, together with

boiled vegetables and potatoes were well covered by factor 2, while factor 3 accounted for more modern foods, as sausages, pasta and pizza. Factor 4 covered fruit, vegetables (raw, boiled), berries and cheese, while factors 5 and 6 covered traditional fish products. Finally, factor 7 captured boiled (non-filtered) coffee.

**Table I.** Characteristics of the study sample (n=12 811).\*

Characteristics	%	N
Gender		
Men	47.8	6119
Women	52.2	6692
Age		
36–49 years	35.8	4590
50–64 years	43.1	5527
65–79 years	21.0	2694
Geographical area		
Inland	20.5	2628
Coast	79.5	10183
Ethnicity		
Sami I	11.3	1453
Sami II	14.9	1914
Sami III	7.0	900
Norwegian	66.7	8544
Education		
<7 years	5.3	647
7–9 years	31.8	3878
10–12 years	30.6	3727
>12 years	32.4	3947
Family income		
<NOK 150 000	10.2	1200
NOK 150 000–300 000	28.0	3295
NOK 301 000–450 000	28.1	3303
NOK 451 000–600 000	22.1	2597
NOK 601 000–750 000	8.0	943
>NOK 750 000	3.5	417
Light physical activity		
None	5.9	686
Less than 1 hour per week	14.0	1625
1–2 times per week	30.3	3511
3 or more times per week	49.8	5771

Characteristics	%	N
Hard physical activity		
None	29.3	3094
Less than 1 hour per week	28.3	2987
1–2 times per week	26.3	2777
3 or more times per week	16.2	1709
Body mass index		
<18.5	0.3	40
18.5–24.9	28.2	3608
25–29.9	45.5	5818
≥30	26.0	3322
Cod liver oil		
Daily	22.7	2454
Sometimes	21.3	2305
Never	56.0	6046
Fish oil capsules (omega 3)		
Daily	29.9	3435
Sometimes	15.0	1720
Never	55.2	6348
Vitamins/mineral supplements		
Daily	28.6	3361
Sometimes	25.5	3000
Never	45.9	5390
Daily smoking		
Current	30.5	3873
Previously	36.4	4631
Never	33.1	4209
Is the food you eat today different from what you ate during childhood?		
Slightly different	54.8	6947
Quite different	30.6	3881
Very different	6.8	868

\*Subgroups might not total 12 811 due to missing values.

**Table II.** Factor loadings for the 7 factors found in the principle component analysis (PCA) (only factor loadings with absolute value  $\geq 0.30$  are listed) (n=12 811).

<b>Factor 1</b> Items	<b>Factor 2</b> Items	<b>Factor 3</b> Items	<b>Factor 4</b> Items	<b>Factor 5</b> Items	<b>Factor 6</b> Items	<b>Factor 7</b> Items
Reindeer tongue	Boiled cod	Meat casseroles	Fruit	Potatoes	Hard roe	Boiled coffee (non-filtered)
0.82	0.55	0.52	0.62	0.59	0.40	0.53
Boiled reindeer meat	Fried lean fish	Sausages	Raw vegetables	Mackerel*	Fish liver	Filtered coffee
0.80	0.52	0.62	0.62	0.42	0.40	-0.66
Bone marrow	Boiled fatty fish	Spaghetti/pasta dishes	Cheese	Other fish spreads	Fish cakes	
0.79	0.52	0.62	0.55	0.32	-0.4	
Fried reindeer meat	Fried fatty fish	Pizza	Boiled vegetables	Pickled herring	Fish gratin	
0.78	0.51	0.60	0.50	0.30	-0.38	
Reindeer blood dishes	Boiled coalfish	Meatballs	Berries		Fried fatty fish	
0.78	0.50	0.60	0.41		Breaded fish	
Smoked reindeer meat	Fish liver	Hamburger	Fish liver			
0.78	0.46	0.59	-0.38			
Dried reindeer meat	Fish roe	Breaded fish	Potatoes			
0.74	0.45	0.47	0.34			
Reindeer liver	Boiled vegetables	Chicken	Fish roe			
0.66	0.43	0.45	-0.34			
	Potatoes	Pork				
	0.39	0.42				
	Fish gratin	Beef				
	0.39	0.38				
	Pickled herring	Fish gratin				
	0.38	0.31				
	Other fish spreads					
	0.36					
	Boiled lean fish					
	0.36					
	Berries					
	0.35					
	Mutton/lamb					
	0.34					
	Mackerel*					
	0.34					
	Smoked fish					
	0.34					
	Cured/salted fish					
	0.33					
	Raw vegetables					
	0.33					
	Fish cakes					
	0.32					

\* In tomato sauce.

### Dietary patterns

Five dietary patterns were identified by the combined factor analysis and 2-step clustering method. The first pattern was labelled “reindeer” and was characterised by the most frequent consumption of reindeer meat and other reindeer products, in addition to moose meat and cured/salted fish (Table III). The use of boiled (non-filtered) coffee was also frequent in this cluster. The second pattern was named

“fish” because it consisted of subjects who frequently used all marine food items in the questionnaire. Pattern 3 was labelled “average” and characterised by average intakes of most food items, except whole milk and processed fish (smoked or cured/salted), which were significantly higher in this group. In addition, this pattern showed a high intake of both boiled (non-filtered) and “other” coffee, as well as sausages, pork and mutton. The fourth pattern

**Table III.** Food consumption by cluster given as frequency per week (n=12 811).

Food items	Clusters				
	Reindeer	Fish	Average	Fruits and vegetables	Westernised, traditional marine
Fruit	4.42	5.14	<u>3.86</u>	<b>9.83</b>	4.83
Berries	3.70	4.12	3.36	<b>5.70</b>	3.70
Cheese	6.11	6.08	5.63	<b>9.40</b>	6.17
Potatoes	7.16	6.52	6.70	7.47	6.93
Boiled vegetables	4.61	4.66	4.20	<b>6.73</b>	4.76
Raw vegetables/salad	2.24	2.67	2.04	<b>5.26</b>	2.42
Whole milk, kefir, yoghurt*	2.57	1.63	<b>3.18</b>	1.35	1.36
Low-fat milk, “cultura,” low-fat yoghurt*	5.34	4.22	5.80	<u>3.28</u>	5.23
Skimmed milk (fresh, soured)*	1.20	2.35	1.14	2.73	2.06
Extra low-fat milk*	1.20	1.37	1.11	1.53	1.82
Fruit juice*	3.28	2.67	2.36	<b>4.38</b>	3.09
Water*	15.67	17.62	16.32	<b>20.49</b>	16.50
Soda/coke with sugar*	1.77	0.81	1.99	0.85	1.80
Soda/coke without sugar*	0.68	0.68	0.61	<b>1.15</b>	0.86
Filtered coffee*	21.20	20.38	<u>8.19</u>	19.56	<b>36.69</b>
Boiled (non-filtered)/press pot coffee*	<b>26.99</b>	8.27	<b>25.43</b>	5.45	4.65
“Other” coffee*	3.46	3.37	<b>6.10</b>	4.02	<u>1.67</u>
Tea*	6.76	7.48	4.50	<b>8.25</b>	<u>3.74</u>
Poached cod	0.71	<b>1.50</b>	0.92	0.79	1.08
Poached coalfish	0.34	<b>0.96</b>	0.40	0.40	0.58
Poached fatty fish (salmon, halibut, red fish, char, trout, powan)	0.48	<b>0.78</b>	0.38	0.39	0.39
Poached lean fish, other than cod and coalfish ( haddock, perch, pike, grayling)	0.12	<b>0.31</b>	0.07	0.08	0.10
Fried fatty fish (e.g., salmon, herring, char, trout, powan)	0.41	<b>0.73</b>	0.33	0.31	0.36
Fried lean fish (e.g., coalfish, cod, perch, pike, grayling)	<u>0.28</u>	<b>0.91</b>	0.38	0.42	0.54
Fish cakes/balls/pudding	<u>0.37</u>	<b>0.86</b>	0.47	0.51	0.54
Fish au gratin or fish in white sauce	<u>0.22</u>	<b>0.62</b>	0.26	0.30	0.35
Fish fingers/breaded fish	0.14	<b>0.31</b>	0.15	0.17	0.19
Cured/salted fish (spread)	<b>0.82</b>	0.42	0.54	<u>0.26</u>	0.39

Table III continues on next page

was labelled “fruits and vegetables” due to the frequent intake of these items in addition to water, tea, pasta and chicken. The last pattern was named “Westernised, traditional marine.” This was dominated by Westernised products like hamburgers, pizza, sausages, casseroles, pork and beef. This pattern also had the highest frequency of the traditional food fish of liver and hard roe, in addition to whale, sea bird eggs and filtered coffee.

### Dietary patterns by selected characteristics

Table IV presents dietary patterns by different subject characteristics. Due to the large sample size, statistical significance was found for all characteristics. Therefore, the focus in the result presentation is on the estimates rather than the p-values. The reindeer pattern had the highest proportion of subjects with Sámi I ethnicity (3 generations using the Sámi language), inland residence, low physical activity and obesity

Table III continues from previous page

Food items	Reindeer	Fish	Clusters		
			Average	Fruits and vegetables	Westernised, traditional marine
Smoked fish (spread)	0.33	0.38	<b>0.54</b>	0.32	0.38
Mackerel in tomato sauce (spread)	<u>0.46</u>	<b>0.75</b>	0.65	0.80	0.57
Pickled herring (spread)	0.21	<b>0.38</b>	<b>0.38</b>	0.29	0.26
Smoked cod caviar (spread)	0.85	1.04	1.00	0.97	1.03
“Other” fish spreads (spread)	0.29	0.46	0.41	0.35	0.35
Fish liver	0.06	0.06	0.06	<u>0.04</u>	<b>0.09</b>
Fish roe	0.05	0.05	0.05	0.04	<b>0.08</b>
Pizza	0.26	0.26	0.29	<b>0.37</b>	<b>0.38</b>
Spaghetti, pasta dishes	0.36	<u>0.28</u>	0.34	<b>0.48</b>	0.44
Hamburgers in a bun	0.13	0.09	0.13	0.11	<b>0.17</b>
Meatballs/hamburger patties	0.45	0.55	0.53	<u>0.41</u>	0.53
Sausages	0.38	0.49	<b>0.55</b>	0.38	<b>0.57</b>
Stew/casserole	0.39	0.35	0.37	0.36	<b>0.44</b>
Chicken	0.28	0.32	0.31	<b>0.41</b>	0.37
Pork	0.32	0.39	<b>0.45</b>	0.33	<b>0.46</b>
Beef	0.21	0.27	0.35	0.25	<b>0.38</b>
Mutton/lamb	0.28	0.38	<b>0.42</b>	0.27	<b>0.44</b>
Moose meat	<b>0.37</b>	0.16	0.19	0.19	<u>0.11</u>
Whale meat	0.03	<b>0.07</b>	0.06	0.04	<b>0.07</b>
Eggs from sea birds*	0.01	0.01	0.01	0.01	<b>0.01</b>
Boiled reindeer meat (broth)	<b>1.63</b>	0.21	0.16	0.14	0.16
Fried reindeer meat	<b>1.20</b>	0.19	0.18	0.17	0.18
Smoked reindeer meat	<b>0.65</b>	0.07	0.06	0.05	0.05
Dried reindeer meat	<b>0.81</b>	0.09	0.08	0.07	0.09
Dishes with reindeer blood	<b>0.20</b>	0.01	0.01	0.01	0.01
Reindeer bone marrow	<b>0.24</b>	0.02	0.03	0.02	0.03
Reindeer tongue	<b>0.25</b>	0.02	0.02	0.02	0.02
Reindeer liver	<b>0.13</b>	0.01	0.01	0.00	0.01

\*Indicates units per week.

Bold numbers mark foods with the significant highest frequency of intake. Underlined numbers indicate clusters with the significant lowest frequency of intake, tested by ANOVA. More than one figure in bold for each food, indicate that the two highest estimates were not significantly different.

(BMI>30). The reindeer pattern subjects had the highest proportion who reported their diet to be no different from their childhood diet (14%), but also the largest proportion who reported that their diet today was very different (10%). The fish pattern was characterised by a higher proportion of women, high age, use of cod liver oil supplements

and fish oil capsules, and the highest and lowest proportions reporting their health to be “not so good” (35.3%) and “very good” (8.3%), respectively (Table V). The average pattern also shared the selected characteristics listed in Table IV, except that this pattern had the highest proportion of men. The fruits and vegetables pattern was characterised by

**Table IV.** Cluster distribution by different characteristics in %.

Characteristics	Reindeer n=804	Fish n=1751	Average n=3211	Fruits and vegetables n=2466	Westernised, traditional marine n=4579
Gender					
Men	50.1	41.6	54.91	29.3	54.6
Women	49.9	58.4	45.09	70.7	45.4
Age					
36–49 years	41.8	18.5	36.59	39.3	39.0
50–64 years	41.9	45.0	41.45	42.5	44.2
65–79 years	16.3	36.6	21.96	18.2	16.8
Geographical area					
Inland	83.1	18.3	19.96	23.2	9.4
Coast	16.9	81.7	80.04	76.9	90.7
Ethnicity					
Sami I	71.6	9.1	8.22	7.0	6.1
Sami II	12.4	11.8	14.17	11.8	18.8
Sami III	5.4	6.7	7.29	6.0	7.8
Norwegian	10.6	72.4	70.32	75.2	67.2
Education					
<7 years	13.4	7.2	5.37	3.2	4.3
7–9 years	30.0	45.0	35.82	21.7	29.8
10–12 years	24.7	26.5	33.24	26.6	33.4
>12 years	31.9	21.4	25.57	48.5	32.6
Family income					
<NOK 150 000	13.6	16.2	11.5	8.4	7.6
NOK 150 000–300 000	29.9	34.7	31.3	24.3	25.1
NOK 301 000–450 000	29.2	25.2	29.5	25.1	29.6
NOK 451 000–600 000	18.0	16.6	19.0	25.2	25.2
NOK 601 000–750 000	6.4	4.9	6.1	12.0	9.1
>NOK 750 000	2.8	2.4	2.6	6.1	3.4
Light physical activity					
None	9.0	5.2	8.4	3.0	5.5
Less than 1 hour per week	20.2	11.9	16.4	9.2	14.6
1–2 times per week	30.8	31.2	29.3	30.9	30.2
3 or more times per week	40.1	51.7	45.9	56.9	49.6

Table IV continues on next page

the highest proportion of women. Subjects in this pattern had a higher education and income, a higher level of physical activity (both light and hard), a low BMI, were never smokers and used cod liver oil, fish oil and vitamin/mineral supplements. This pattern had the highest proportion that considered their health to be “very good.” Like the

average pattern, the Westernised, traditional marine pattern had a high proportion of men and an average distribution of the selected characteristics, except that this group had the highest proportion living in coastal areas (91%), was slightly younger and reported a higher income than those in the average pattern.

Table IV continues from previous page

Characteristics	Reindeer n=804	Fish n=1751	Average n=3211	Fruits and vegetables n=2466	Westernised, traditional marine n=4579
Hard physical activity					
None	33.5	33.9	33.2	22.2	28.0
Less than 1 hour per week	31.5	23.4	27.7	27.9	30.0
1–2 times per week	21.7	26.2	24.8	30.7	25.8
3 or more times per week	13.3	16.6	14.3	19.2	16.2
Body mass index					
<18.5	0.3	0.2	0.4	0.3	0.3
18.5–24.9	26.6	24.3	29.8	30.4	27.8
25–29.9	38.9	47.7	44.8	44.8	46.7
≥30	34.3	27.9	25.0	24.5	25.3
Cod liver oil					
Daily	18.9	30.3	18.2	29.7	20.3
Sometimes	24.4	19.7	22.0	18.1	22.5
Never	56.7	50.0	59.7	52.3	57.2
Fish oil capsules (omega 3)					
Daily	19.9	40.2	25.6	34.8	28.3
Sometimes	16.3	14.3	15.0	13.6	15.7
Never	63.8	45.6	59.4	51.7	56.1
Vitamins/mineral supplements					
Daily	19.9	35.5	24.7	38.4	25.1
Sometimes	27.9	23.5	24.7	24.0	27.3
Never	52.3	41.0	50.6	37.6	47.7
Daily smoking					
Current	34.6	25.0	35.0	18.3	35.2
Previously	30.5	40.1	34.2	37.1	37.3
Never	35.0	34.9	30.8	44.6	27.6
Is the food you eat today different from what you ate during childhood?					
No	14.0	9.79	8.25	4.7	7.2
Slightly different	51.4	55.04	56.00	52.5	55.7
Quite different	24.8	27.93	29.30	35.1	31.2
Very different	9.8	7.24	6.45	7.7	6.0

**Table V.** Self-reported health by dietary pattern %\*.

Pattern	Poor	Not so good	Good	Very good
Reindeer	2.3	30.9	54.4	12.5
Fish	2.1	35.3	54.4	8.3
Average	2.4	31.2	55.5	10.9
Fruits and vegetables	1.7	25.4	54.6	18.3
Westernised, traditional marine	1.7	28.7	56.5	13.0

\* Distribution tested by chi-square test,  $p < 0.001$ .

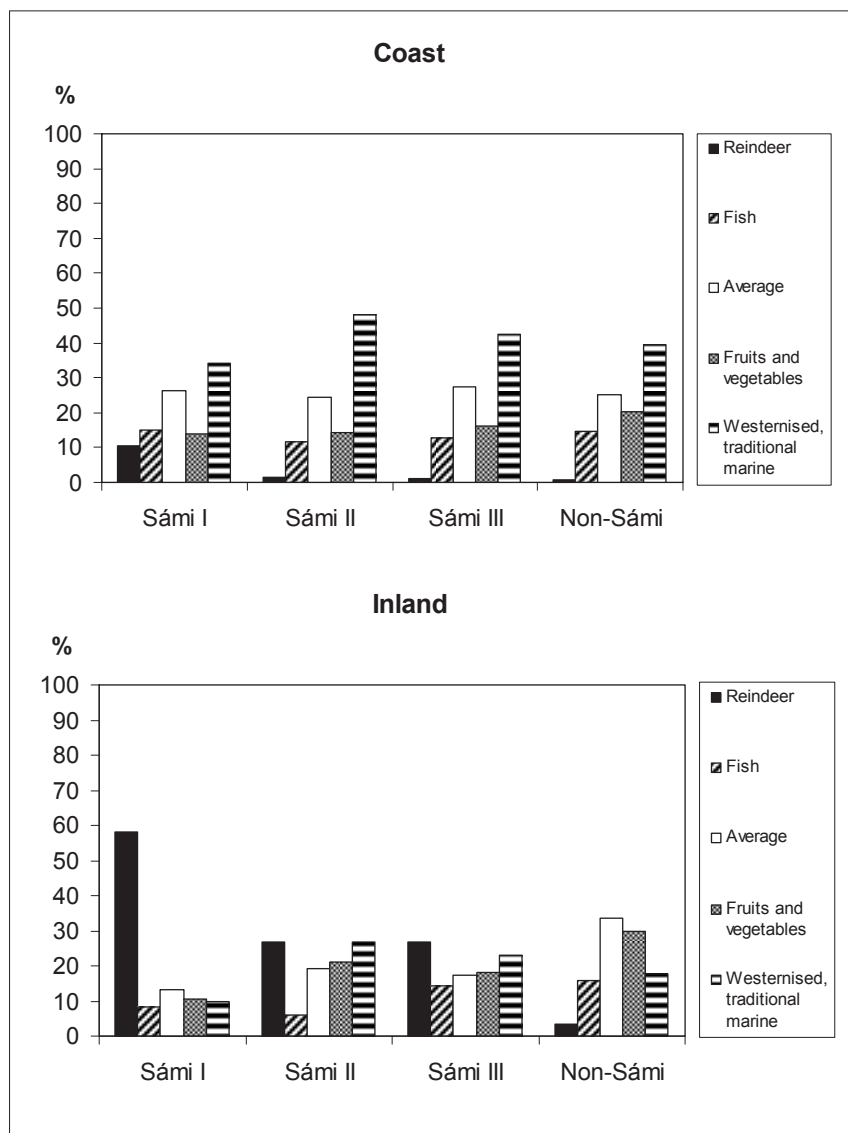


Figure 1. Distribution of dietary patterns by ethnicity stratified by coastal and inland residence.

### Dietary pattern distribution by ethnicity

According to Table IV, the distribution of ethnicity across the different food patterns was rather homogeneous, except for the reindeer pattern where more than 70% of the subjects were Sámi I and around 10% were non-Sámi, that is, the opposite ethnicity distribution compared with the other food patterns. The fruits and vegetables pattern had the lowest proportion of Sámis (25%).

When stratifying by coastal/inland residence, the dietary pattern distribution was more homogenous across the ethnic groups in coastal than in inland areas (Figure 1). The pattern distribution for Sámi II and Sámi III were not statistically different for inland or coastal residence ( $p=0.11$  and  $0.12$ , respectively,  $\chi^2$ -test). The pattern distribution for Sámi III and the non-Sámi on the coast was statistically different ( $p=0.005$ ,  $\chi^2$ -test). All remaining ethnic groups were highly statistically different within each geographical stratum ( $p<0.0001$ ,  $\chi^2$ -test). On the coast, the occurrence of the reindeer pattern was around 10 % among Sámi I, but less than 1.5 % among the other ethnic groups. In the inland stratum, the pattern distribution of Sámi I was the most atypical compared with the other ethnic groups. The reindeer cluster occurred among 3.2% in the non-Sámi group compared with 58% among the Sámi I.

### DISCUSSION

We have identified and described 5 different food patterns among subjects living in the SAMINOR geographical area. Each pattern was characterised by selected life-style factors, some of which are established risk factors for diabetes, cancer and cardiovascular disease.

The analysis of food patterns, rather than single nutrients or food items, has gained attention in nutritional epidemiology (11). The development and use of this methodology have mainly been driven by the fact that dietary exposures are often highly interrelated. Thus statistical adjustments for single nutrients or foods have limitations (12). Several studies have found associations between food patterns and different health outcomes (11). Most studies applying the dietary pattern approach have either used factor or cluster analysis, but Engeset et al. have (13) suggested that the 2 methods could be combined for a more convincing pattern definition. An important methodological issue in pattern analysis is the inherent subjectivity of both factor and cluster analysis (11). However, there is some evidence that the underlying dietary patterns are revealed by either method or a combination of the two, as used in the present study. The fruits and vegetables pattern is analogous to a healthy pattern found in several other studies (11). The questionnaires on dietary intake were not designed to cover total diet but rather to gather information on use of selected foods relevant for the SAMINOR area. Therefore, the reindeer, fish and Westernised, tradi-

tional marine patterns may be more country or culture specific. But in a cultural context, these patterns have high interpretability. They are supported by previous knowledge and some background characteristics of the study sample (e.g., gender, age, inland or coastal residence and ethnicity).

The SAMINOR study was initiated since limited epidemiological data were available on the health status of the Sámi population. Indigenous peoples in the North have been the focus of research on nutrition and diet in relation to mainly 3 areas: (1) contaminants in marine food from the Arctic as a source of persistent organic pollutants (POPs) (14,15); (2) use of traditional food and its contribution to nutrient intake (16); and (3) changes in use of traditional food and its predictors and consequences for nutrition and health (17–19). Most of these studies are based on investigations from Arctic Canada, Alaska and Greenland, with some from Russia (20). In relation to the 3 approaches listed above, our study will contribute to filling in the knowledge gap on diet-related health issues for the population living in the SAMINOR geographical area. We believe that the patterns defined in the present study and our previous study (7) can be useful in future research.

The issue regarding traditional food as a source of contaminants could be investigated by comparing blood levels of subjects with the food patterns defined in the present study. This will illuminate the impact of a traditional marine versus a traditional animal dietary pattern on levels of POPs in humans. This can be compared in relation to patterns with a high vegetable and fruit intake or a Westernised diet, both of which represent

a changed dietary pattern from the original northern Norwegian diet that consisted of a high intake of either animal meat or fish, or both.

It is interesting to note that the reindeer pattern had the highest proportion of subjects who were overweight and who reported a low level of physical activity. This could be explained by an increasingly sedentary life-style due to a greater reliance on motorized vehicles but the maintenance of a high-calorie intake of dense traditional food. To investigate this pattern's potential effect on life-style related health outcomes would be extremely compelling.

It has been shown that the traditional marine food habit of consuming fish liver in northern Norway during the winter has been of significant importance for the intake of fat-soluble vitamins, in particular vitamin D, but also essential fatty acids (21). Our results confirm that the tradition of eating this nutrient-dense food is, for some, still part of their diet. The “Westernised, traditional marine” group had sustained this tradition through the use of fish liver and roe, while otherwise they generally used fish and fish products less frequently than the “fish group.”

The use of coffee differed by food pattern. Boiled unfiltered coffee is the traditional method of brewing, while the filtered coffee represents a more modernized method. The finding that the “fruits and vegetables” group often drank filtered coffee, while the “reindeer” group had a high intake of unfiltered coffee, fits with the assumption that the “fruits and vegetables” group represented a more modern dietary pattern in contrast to the latter. However, the “reindeer” cluster

had a total intake of coffee equal to more than 7 cups per day on average (the total of filtered, nonfiltered and other coffee). Thus, due to the broad range of coffee consumption, the SAMINOR data seem useful for further assessments of, for example, how the intake of coffee affects health.

The impact of ethnicity on dietary patterns was influenced by coastal/inland residence. But overall, our results suggest that ethnicity does not play a major role in predicting dietary patterns, except for subjects in the reindeer cluster who live in the inland areas and, to a lesser extent, those living on the coast. When comparing this to ethnicity and geographic interactions found in childhood (7), it seems as though this impact is less pronounced today than it was previously.

It has been proposed that diet in childhood affects the risk of some health outcomes in adulthood and may be an important risk factor among several life-style factors that serve as predictors for the risk of cancer (22) and cardiovascular disease (23). The use of both the defined dietary patterns in childhood (7) and the patterns identified in this present study enables analysis of the cross-over effect on health of changing from one type of diet to another or maintaining a similar diet from childhood to adulthood.

Self-perceived health has been found to predict mortality, thus it seems to be a valid measure for health status (24). The finding of a highest proportion of subjects reporting their health to be “not so good” in the fish cluster is most likely explained by the elevated age in this group. The fruits and vegetables cluster, which also were characterised by health-conscious behaviour, had at the same time the highest proportion of

subjects who reported their health to be “very good.” This confirms the predictive value of self-perceived health.

Based on our results, we suggest that future investigations on dietary patterns and different health outcomes merge the Sámi II and Sámi III groups. However, merging all Sámi categories will attenuate possible differences related to ethnicity.

In conclusion, diet among the population living in the SAMINOR area can be categorised in 5 different dietary patterns. These classifications will be useful for future epidemiological investigations into the relationship between dietary patterns and the health of the Sámi population in Norway.

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