ORIGINAL ARTICLE

ADHERENCE TO A TRADITIONAL LIFESTYLE AFFECTS FOOD AND NUTRIENT INTAKE AMONG MODERN SWEDISH SAMI

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Received 25 July 2008; Accepted 15 June 2009

ABSTRACT

Objectives. To compare the nutrient and food intake of Sami still engaged in reindeer herding (traditional lifestyle or reindeer-herding Sami [RS]) and Sami not involved in reindeer herding (industrialized lifestyle or non-reindeer-herding Sami [NRS]) with other northern Swedish populations.
Study design. Cross-sectional analysis of data from a prospective cardiovascular intervention program in northern Sweden.
Methods. Data were used from a prospective cardiovascular intervention program in northern Sweden. Sami recruited into this study were divided according to whether they were involved in reindeer herding (traditional lifestyle, RS) (66 females, 79 males) or not (NRS) (255 females, 195 males), and compared to non-Sami from the same area taking part in the same study (controls) (499 females, 501 males). Subjects completed a Food Frequency Questionnaire (FFQ) and clinical parameters were analysed.
Results. RS had a higher overall intake of energy for both females ($P<0.01$) and males ($P<0.05$), but not total food intake compared to controls and NRS. The overall Sami diet was characterized by a higher proportion of energy from protein and fat. RS had a lower energy adjusted intake of vitamins A and E, and fibre, and a higher intake of sodium. RS and NRS both had a lower intake of vegetables and a higher intake of meat, and for RS, fish. Nutrient and food-intake patterns were similar for males and females.
Conclusions. Classification of Sami into RS and NRS indicates that a traditional lifestyle defined by occupation is reflected in differences in food and nutrient intake.
(Int J Circumpolar Health 2009; 68(4):372-385)

Keywords: Sami, traditional diet, dietary intake, reindeer herding

Supplementary material related to this article available at: www.ijch.fi

INTRODUCTION

The Sami are the Indigenous people of the Fennoscandian peninsula and inhabit the northern areas of Sweden, Norway, Finland and the Kola Peninsula. The traditional Sami diet consists of a high amount of animal products, particularly from reindeer, and a low amount of grains, fruits and vegetables (1,2). With increased colonization of traditional Sami areas and contact with other Nordic peoples, the lifestyle of the Sami has become more "Westernized" and more similar to other local populations. This is reflected in dietary changes, including a decrease in the amount of protein consumed and an increase in the proportion of energy coming from carbohydrates compared to earlier dietary studies (1,3). In Sweden, Sami that still herd reindeer maintain a more traditional lifestyle, while Sami with other occupations have a lifestyle that is similar to other Swedish populations living in the north of Sweden. As previous studies on Sami populations have either focused on the traditional Sami diet or the Sami as a single population, it is not known if this difference in lifestyle is also reflected in their diet.

A number of studies on the risk of lifestyle-related diseases suggest that Sami have or have had a lower risk of disease when compared to other Fennoscandian populations, including cardiovascular disease (4–8) and some cancers (4,9–11). More recent data suggest that the risk of heart disease and some cancers among Sami is similar or even higher (for Sami women) compared to other local populations (12–14). As there are apparent changes in disease risk among Sami, understanding what role diet plays in this change in risk is important for any public health-based attempts to prevent an increase in lifestyle-related diseases that have afflicted other Indigenous populations (15–18). Diet may play an important role in the risk of disease among Sami, as they have adapted to a diet high in protein and fat, and low in carbohydrate as part of their traditional lifestyle of hunting and reindeer herding (2,19–21). Diet and the risk of disease among Sami has been recently reviewed (22).

Information about the dietary intake of both reindeer herding and non-reindeer-herding Sami is lacking. Sami who still engage in reindeer herding, as a surrogate determinant of a traditional lifestyle, have a different risk of some diseases compared to those who are not engaged in reindeer herding (13,23), thus, comparing the dietary differences between these two groups and applying local controls may help to understand if this could in the future explain some of these differences. We have analysed dietary intake and clinical data for 2 groups of Sami from the same region of northern Sweden, grouped into different lifestyles on the basis of their occupations (reindeer herding and non-reindeer herding), and compared them to location-matched non-Sami controls.

MATERIAL AND METHODS

Participants

A cross-sectional study was performed by selecting subjects from a database on the health and living conditions of people participating in a regional cardiovascular disease prevention program between 1990 and 2001 (the Västerbotten Intervention Program) (24).

This program is described in detail by Weinehall (25). The study was carried out in the county of Västerbotten in northern Sweden. A total of 595 people (321 women, 274 men) were identified as Sami, of which 145 were classified as reindeer-herding Sami (RS) (reindeer herders and husband, wife or children of reindeer herders), and 450 classified as non-reindeer-herding Sami (NRS) (identified as Sami, but with no direct or close familial link [first degree relations] to reindeer herding) (24). The control group (n=1,000) consisted of individuals of non-Sami origin from the same geographic region as the Sami who participated in the Västerbotten Intervention Program and were matched as far as possible by age and gender to the Sami population. The control group served as a reference for a Westernized lifestyle (verses a traditional one). Data were collected throughout the year, with the exception of the summer months (June–August). The study was approved by the Ethical Committee of Umeå University.

Clinical measures, physical activity and tobacco

Participants in the program underwent a general medical check-up, which included measurement of plasma lipid levels, blood pressure and blood glucose, and completed a questionnaire that examined aspects of their health, physical activity and diet. The methods used for the clinical measurements have been described elsewhere (26).

Physical activity was calculated from the answers to 6 questions: 3 about physical activity at work, and 3 about activity during leisure time, and before the age of 20. The answers to these questions were converted into physical activity scores for both work and leisure time activities, and used to compare physical activity between the groups, with a maximum score of 13 and 38 for each category, respectively (the highest amount of physical activity).

The use of tobacco in Sweden consists of cigarettes and snus, a moist tobacco taken orally. Answers to questions on the amount used of each of these tobacco products were added together to calculate “tobacco points.” This score was used to get an idea of the amount of tobacco products that were used, rather than to suggest any relative risk.

Food Frequency Questionnaire (FFQ)

The intake of nutrients was assessed by a previously validated Food Frequency Questionnaire for the general northern Swedish population (27). Participants were asked to mark how often they consumed 84 foods and beverages or food/beverage categories on a scale of 0–8, where 0 was (never), 1 (a few times a year), 2 (1–3 times/month), 3 (once a week), 4 (2–3 times a week), 5 (4–6 times a week), 6 (once a day), 7 (2–3 times a day) and 8 (4 times or more a day). Each frequency was converted to a score to give the number of times/day each food/food category was consumed. It was assumed that 1 “time” per day was equal to 1 serving of food/drink. Serving sizes were those used in the Swedish Food Database (28). Differences in individual serving sizes were adjusted on the basis of answers to questions about serving sizes for vegetables, potatoes/rice/pasta and meat. If these questions were left blank, it was assumed that the serving size was the same as that used for the Swedish Food Database. Nutrient values for each food/food category were calculated from the Swedish Food Database, which includes traditional Sami foods (28). When a food or food type indicated in the questionnaire represented 2 or more different foods in the food database, the average value for all relevant foods was used.

To remove obvious outliers, participants whose total energy intake fell outside of the range of probable energy intakes (2.1–14.7 MJ for women; 3.36–16.8 MJ for men) (29) were not included in the study. Missing values were assumed to mean "zero times per day" (29).

Statistical analyses

Data for nutrient and food intake from males and females were normalized by log transformation. As total energy intake (nutrients) was found to differ between groups, this was corrected for by regressing nutrients with total energy intake. Residuals were analysed using a general linear model using group (controls, Sami reindeer herders, Sami non-reindeer herders) and age in the model and body mass index (BMI) and physical activity points as covariates. No difference was found between groups for total food intake as servings/day, so analyses were done directly on log transformed values as for nutrients, including total food intake as a covariate. Differences between groups were determined using pairwise comparisons with Tukey's family error rate. Differences between untransformed nutrient intake data and recommended daily intakes were performed using 2-tailed 1-sample t-tests, with a 95% confidence interval. Results are reported as mean ± standard error and residual mean ± standard error. Differences for all analyses were considered significant at $p<0.05$. Calculations were performed using Minitab 14.0 (State College, PA, USA).

RESULTS

In all groups, less than 7% of subjects were removed from the analysis on the basis of incomplete FFQ (less than 50% of diet questions answered) and/or improbable (too high or too low) energy intakes. If there were complete clinical data for these subjects, they were included in the comparison of clinical measurements. The individuals excluded from different parts of the study did not differ from the initial cohort with respect to mean age and sex, so this exclusion process is unlikely to have introduced a systematic bias into the study. The average age differed between the groups (Table I), so this was included as a variable in the analysis. The selection of participants from the Västerbotten Intervention Program were estimated to constitute 45% of the total number of RS participating in the program and 20% of the NRS (25,30). The study did not investigate the reasons behind the lower participation of Sami, though geographic remoteness and discomfort with the Swedish-language health system (31) are possible reasons.

Clinical measurements, physical activity, tobacco and alcohol

RS women had lower fasting plasma glucose concentrations compared to the other 2 groups ($p=0.0004$ vs. controls, $p=0.0175$ vs. NRS) (Table I). RS males had lower diastolic blood pressure compared to controls ($p=0.0266$) and a higher score for work-time physical activity compared to NRS ($p=0.0014$) and controls ($p=0.00001$). Control males had a higher leisure time activity score compared to RS ($p=0.0092$). Other clinical parameters, the use of tobacco products (Table I) or alcohol (Tables II-IV), did not differ between the groups studied.

Table 1. Clinical parameters, self-reported exercise and nicotine use among non-reindeer herding Sami, reindeer-herding Sami and local controls. Values are means and standard error of the mean (SEM).

Females	Controls			Sami (non-reindeer herders)			Sami (reindeer herders)			
	Mean	SEM	n	Mean	SEM	n	Mean	SEM	n	P
Age (years)	$47.3^{b,*}$	0.428	499	45.1^{a}	0.655	255	46.4^{ab}	1.25	66	<0.01
BMI (kg/m^2)	25.4	0.185	496	25.2	0.243	253	25.9	0.534	66	ns
Total serum cholesterol (mmol/L)	5.8	0.057	497	5.6	0.078	252	5.7	0.138	66	ns
HDL %	31.2	6.780	160	29.1	4.270	103	23.7	1.29	37	ns
Total serum triglycerides (mmol/L)	1.3	0.041	440	1.3	0.048	226	1.2	0.058	62	ns
Systolic blood pressure (mm Hg)	126.2	0.813	496	123.7	1.14	251	127.1	3.10	65	ns
Diastolic blood pressure (mm Hg)	78.0	0.476	496	77.1	0.708	251	76.43	1.54	65	ns
Blood glucose (mmol/L)	5.3b	0.037	495	5.2^{b}	0.069	251	4.8^{a}	0.098	64	<0.01
Physical activity points	19.9	0.266	494	21.0	0.347	254	20.2	0.728	65	ns
% Smoking or using oral tobacco	55.1			56.9			54.6			
Tobacco points per user	4.00	0.156	275	3.97	0.192	145	3.28	0.385	36	ns

Males	Controls			Sami (non-reindeer herders)			Sami (reindeer herders)			
	Mean	SEM	n	Mean	SEM	n	Mean	SEM	n	P
Age (years)	47.4^{b}	0.434	501	42.0^{a}	0.718	195	45.8^{b}	1.18	79	<0.01
BMI (kg/m^2)	26.0	0.156	496	25.9	0.246	193	26.2	0.372	79	ns
Total serum cholesterol (mmol/L)	5.9	0.059	496	5.7	0.097	194	6.0	0.136	79	ns
HDL %	30.7	4.690	212	21.9	1.310	85	20.3	0.839	54	ns
Total serum triglycerides (mmol/L)	1.6	0.064	408	1.4	0.059	158	1.5	0.122	76	ns
Systolic blood pressure (mm Hg)	130.1	0.754	487	127.9	1.130	192	127.2	1.830	78	ns
Diastolic blood pressure (mm Hg)	80.6^{b}	0.462	487	78.8^{ab}	0.784	192	77.0^{a}	1.190	78	<0.05
Blood glucose (mmol/L)	5.4	0.051	494	5.3	0.095	192	5.3	0.130	79	ns
Physical activity points	21.1	0.244	494	20.9	0.387	192	21.0	0.608	76	ns
% Smoking or using oral tobacco	64.6			62.1			70.9			
Tobacco points per user	4.86	0.151	323	5.20	0.222	121	4.66	0.319	56	ns

*Means not sharing a common superscript letter are significantly different at the P value indicated, where "a" is lowest and "c" is highest.

Table II. Difference in nutrient intake between female reindeer-herding Sami (n=63), non-reindeer-herding Sami (n=247) and local controls (n=488). Residuals from regression of log transformed nutrient intake data with total energy intake are presented as means and SEM.

Energy adjusted residuals for daily intake	**Controls**		**Sami (non-reindeer herding)**		**Sami (non-reindeer herding)**		**P**
Macronutrients	Mean	SEM	Mean	SEM	Mean	SEM	
Total energy (MJ)	6.91[a,*]	0.101	7.07[a]	0.16	7.15[b]	0.284	<0.01
Protein (g)	-0.00308[a]	0.00294	-0.00094[a]	0.00421	0.02752[b]	0.00837	<0.01
% of energy from protein[†]	1.1893	0.00292	1.1923	0.00410	1.2075	0.00744	ns
Total fat (g)	-0.00708[a]	0.00327	0.00658[b]	0.00405	0.02909[c]	0.00870	<0.001
% of energy from fat[†]	1.4709	0.00327	1.4707	0.00478	1.4783	0.00930	ns
Saturated fat (g)	-0.00648[a]	0.00395	0.00416[a]	0.00514	0.03389[b]	0.00980	<0.001
Monounsaturated fat (g)	-0.01059[a]	0.00391	0.01215[b]	0.00480	0.03441[b]	0.00995	<0.001
Polyunsaturated fat (g)	-0.00092	0.00469	-0.00030	0.00620	0.00825	0.0110	ns
Cholesterol (mg)	-0.01811[a]	0.00449	0.01881[b]	0.00656	0.0666[c]	0.0140	<0.001
Total carbohydrate (g)	0.00677[c]	0.00237	-0.00585b	0.00341	-0.02946[a]	0.00802	<0.001
% of energy from carbohydrate[†]	1.6982	0.00249	1.6990	0.00307	1.6900	0.00648	ns
Sucrose (g)	0.00662[b]	0.00931	0.00124[ab]	0.0122	-0.0561[a]	0.0252	<0.05
Alcohol (g)	0.0138	0.0227	-0.0348	0.0302	0.0351	0.0553	ns
Fibre (g)	0.01535[b]	0.00554	-0.01745[a]	0.00807	-0.0505[a]	0.0171	<0.001
Vitamins and minerals							
Vitamin A (RE[‡])	0.02480[b]	0.00914	-0.0400[a]	0.0113	-0.0352[a]	0.0236	<0.001
Vitamin D (μg)	-0.01504[a]	0.00688	0.00807[a]	0.0115	0.0848[b]	0.0250	<0.001
α-tocopherol (mg)	0.01444[b]	0.00557	-0.02540[a]	0.00651	-0.0123[ab]	0.0141	<0.001
Vitamin C (mg)	0.0305[b]	0.0103	-0.0414[a]	0.0131	-0.0740[a]	0.0312	<0.001
Folate (μg)	0.02234[b]	0.00733	-0.03327[a]	0.00883	-0.0426[a]	0.0218	<0.001
Calcium (mg)	0.02051[b]	0.00641	-0.03122[a]	0.00933	-0.0365[a]	0.0176	<0.001
Iron (mg)	-0.00271	0.00418	0.000499	0.00605	0.0190	0.0120	ns
Magnesium (mg)	0.00736[b]	0.00425	-0.01556[a]	0.00544	0.00398[ab]	0.00939	<0.05
Sodium (g)	-0.0125[a]	0.00344	0.01415[b]	0.00595	0.04141[b]	0.00992	<0.001
Zinc (mg)	-0.00133[a]	0.00296	-0.00319[a]	0.00430	0.02278[b]	0.00798	<0.05
Selenium (μg)	-0.00676[a]	0.00496	0.00166[a]	0.00757	0.0458[b]	0.0150	<0.01

[*]Residual means with different superscript letters are significantly different at the P value indicated, where "a" is lowest and "c" is highest.

[†]Log transformed values presented as variables are already corrected for total energy intake.

[‡]RE: Retinol equivalents, mg.

Table III. Difference in nutrient intake between male reindeer herding Sami (n=74), non-reindeer-herding Sami (n=186) and local controls (n=475). Residuals from regression of log transformed nutrient intake data with total energy intake are presented as means and SEM.

Daily intake	Controls		Sami (non-reindeer herding)		Sami (non-reindeer herding)		P
	Mean	SEM	Mean	SEM	Mean	SEM	
Macronutrients							
Total energy (MJ)	7.51[a,*]	0.112	8.17[ab]	0.205	8.43[b]	0.343	<0.05
Protein (g)	-0.00553[a]	0.00278	0.00511[ab]	0.00443	0.02266[b]	0.00579	<0.001
% of energy from protein[†]	1.1954[a]	0.00275	1.1952[a]	0.00483	1.2353[b]	0.00669	<0.001
Total fat (g)	-0.00408[a]	0.00322	0.00364[ab]	0.00517	0.01702[b]	0.00876	<0.05
% of energy from fat[†]	1.4884[a]	0.00297	1.4998[a]	0.00451	1.5182b	0.00914	<0.05
Saturated fat (g)	-0.00437	0.00395	0.00412	0.00642	0.0177	0.0107	ns
Monounsaturated fat (g)	-0.00617[a]	0.00404	0.00774[b]	0.00619	0.0201[b]	0.0101	<0.05
Polyunsaturated fat (g)	0.000346	0.00456	-0.00590	0.00733	0.01261	0.00879	ns
Cholesterol (mg)	-0.01025[a]	0.00510	0.01142[b]	0.00775	0.0371[b]	0.0131	<0.05
Total carbohydrate (g)	0.00584[b]	0.00232	-0.00708[a]	0.00368	-0.01973[a]	0.00640	<0.001
% of energy from carbohydrate[†]	1.6829[b]	0.00226	1.6782b	0.00349	1.6476[a]	0.00907	<0.001
Sucrose (g)	0.01535[b]	0.00942	-0.0267[a]	0.0158	-0.0314[ab]	0.0213	<0.05
Alcohol (g)	0.00535	0.0235	-0.00535	0.0235	-0.0250	0.0547	ns
Fibre (g)	0.00843[b]	0.00555	-0.01648[a]	0.00760	-0.0127[ab]	0.0175	<0.05
Vitamins and minerals							
Vitamin A (RE[‡])	0.01214[b]	0.00914	-0.0315[a]	0.0129	0.00124[ab]	0.0283	<0.05
Vitamin D (μg)	-0.01033[a]	0.00701	0.00629[ab]	0.00966	0.0505[b]	0.0184	<0.01
α-tocopherol (mg)	0.01179[b]	0.00530	-0.03430[a]	0.00805	0.0105[b]	0.0173	<0.001
Vitamin C (mg)	0.02218[b]	0.00975	-0.0504[a]	0.0162	-0.0158[ab]	0.0324	<0.001
Folate (μg)	0.00977[a]	0.00722	-0.02565[ab]	0.00999	0.00174[b]	0.0273	<0.01
Calcium (mg)	0.00521	0.00648	-0.00460	0.0112	-0.0219	0.0182	ns
Iron (mg)	-0.00075[a]	0.00394	-0.01050[a]	0.00596	0.0312[b]	0.0123	<0.01
Magnesium (mg)	-0.00183	0.00423	0.000565	0.00568	0.0104	0.0129	ns
Sodium (g)	-0.01055[a]	0.00353	0.01123[b]	0.00567	0.03948[c]	0.00867	<0.001
Zinc (mg)	-0.00433[a]	0.00287	0.00189[ab]	0.00481	0.02305[b]	0.00724	<0.01
Selenium (μg)	-0.00459	0.00479	0.000879	0.00766	0.0272	0.0102	ns

[*]Residual means with different superscript letters are significantly different at the P value indicated, where “a” is lowest and “c” is highest.
[†]Log transformed values presented as variables are already corrected for total energy intake.
[‡]RE: Retinol equivalents, mg.

Table IV. Intake of different food and beverage groups by male and female non-reindeer-herding Sami (n=186; 247), reindeer-herding Sami (n=74; 63) and local controls (n=475; 488). Intake is reported as mean servings per day and SEM.

Daily intake	Controls		Sami (non-reindeer herding)		Sami (non-reindeer herding)		P
			Males				
	Mean	SEM	Mean	SEM	Mean	SEM	
Total food & drink intake	25.033	0.373	25.650	0.629	25.101	0.805	ns
Spreads	2.1235	0.0656	2.2973	0.0944	2.599	0.180	ns
Added oil	1.0867	0.0390	1.2506	0.0624	1.1932	0.0872	ns
Dairy	2.9595	0.0855	3.026	0.128	2.539	0.173	ns
Breads/Cereals	3.7572[b,*]	0.0957	3.694[ab]	0.163	3.516	0.228[a]	<0.01
of which wholegrain	2.4098	0.0694	2.238	0.111	2.211	0.171	ns
Vegetables	1.4311[c]	0.0715	1.2566[b]	0.0968	0.897[a]	0.134	<0.001
Fruits	1.4745	0.0540	1.3694	0.0846	1.243	0.112	
Potatoes/rice/pasta	1.9408	0.0467	2.2390	0.0819	2.237	0.141	
Meat	1.7508[a]	0.0553	1.9117[b]	0.0937	2.450[c]	0.164	<0.001
Fish	0.28693[a]	0.00904	0.3096[a]	0.0180	0.5279[b]	0.0597	<0.001
Sweets	2.0677	0.0704	2.196	0.105	2.065	0.181	ns
Coffee/tea	3.3324	0.0595	3.483	0.102	3.262	0.148	ns
Alcohol	0.4114	0.0223	0.3796	0.0360	0.3611	0.0567	ns
			Females				
Total food & drink intake	24.304	0.388	24.918	0.502	23.899	0.908	
Spreads	1.8525	0.0561	2.0530	0.0889	2.022	0.136	ns
Added oil	1.2557	0.0434	1.3339	0.0601	1.470	0.127	ns
Dairy	2.9821	0.0764	2.995	0.111	2.637	0.194	ns
Breads/Cereals	3.4356	0.0954	3.486	0.121	3.294	0.178	ns
of which wholegrain	2.3257	0.0729	2.3754	0.0962	2.188	0.154	ns
Vegetables	2.386[b]	0.118	2.359[ab]	0.154	1.965[a]	0.359	<0.05
Fruits	1.9176	0.0638	2.0411	0.0862	1.810	0.150	ns
Potatoes/rice/pasta	1.6621	0.0418	1.6762	0.0669	1.871	0.109	ns
Meat	1.2848	0.0355	1.3167	0.0556	1.479	0.124	ns
Fish	0.27521[a]	0.00859	0.2763[a]	0.0136	0.3679[b]	0.0291	<0.001
Sweets	1.4718	0.0540	1.4847	0.0777	1.250	0.137	ns
Coffee/tea	3.2400	0.0628	3.3391	0.0844	3.300	0.176	ns
Alcohol	0.2140	0.0122	0.1827	0.0135	0.2452	0.0554	ns

[*]Means with different superscript letters are significantly different at the P value indicated, where "a" is lowest and "c" is highest.

Intake of nutrients

Both female and male RS had a higher mean energy intake than the control group, and female RS also had a higher energy intake compared to female NRS. As total energy intake differed between groups, all subsequent analyses of nutrient intakes were corrected for total energy intake (Tables II and III). Female RS had higher intakes of energy adjusted protein, total fat, saturated fat and monounsaturated fat, while female NRS had a higher intake of total fat and monounsaturated fat, compared to the control group (Table II). Female controls had a higher total carbohydrate intake than both groups of Sami, and NRS had a higher intake than RS. There were no differences when protein, fat or carbohydrate intakes were expressed as percentage of energy. Sources of dietary energy showed similar trends for both male RS and NRS with a higher intake of protein and fat and lower intake of carbohydrate compared to controls, though RS had a higher percentage of their energy from fat and less from carbohydrates (Table III).

Energy adjusted intake of many vitamins and minerals differed between groups for both males and females (Tables II and III). It should be noted that RS had the highest absolute intake of most vitamins and minerals (see supporting data at www.ijch.fi), though this was highly correlated with total energy intake (data not shown). Female controls had higher energy adjusted intake for vitamins A and C, folate, calcium and fibre compared to both RS and NRS, and higher energy adjusted intakes of vitamin E and magnesium than NRS. RS had higher energy adjusted intakes of vitamin D, zinc and selenium than both NRS and controls, while both RS and NRS had a higher energy adjusted intake of sodium compared to controls. For males, controls had higher energy adjusted intakes of vitamins A and C and fibre compared to NRS, and controls and RS had a higher energy adjusted intake of vitamin E compared to NRS. RS had higher energy adjusted intakes of vitamin D, folate, iron and zinc compared to controls, and both RS and NRS had a higher energy adjusted intake of sodium. Absolute values for macro- and micronutrient intake can be found in the Supplementary tables published online (http://ijch.fi/issues/684/SupplementaryRoss.pdf).

Intake of food groups

Total intake of food calculated as servings per day did not differ between groups for males or females (Table IV). Female RS had a higher intake of fish compared to NRS and controls, while the control group had a higher intake of vegetables than RS. Male controls also had a higher intake of vegetables compared to RS and NRS, and a higher intake of bread and cereals compared to RS. RS males had a higher intake of meat and fish compared to both NRS and controls.

DISCUSSION

This study addresses the differences in food and nutrient intakes between non-reindeer-herding Sami (NRS) and reindeer-herding Sami (RS), and is the first to our knowledge to be based on a relatively large population of both female and male Sami. The differences in diet indicate that a traditional lifestyle, as determined by occupation, is still an important determinant of dietary intake among Swedish Sami.

Clinical parameters and physical activity

Given the overall differences in diet, it is remarkable that there were no differences in serum lipids. Earlier studies have reported that Sami have higher plasma total cholesterol levels (5,32), and lower systolic blood pressure compared to local non-Sami controls (6,33). The BMI for all groups did not differ, which is in contrast to many Indigenous Arctic populations that are in transition from traditional to modern lifestyles, including the Sami as some previous studies have shown (5,32). As RS had a higher total energy intake as well as fat intake, we would have expected a higher BMI compared to local controls. RS males had lower diastolic blood pressure compared to the local controls. Dietary factors do not appear to explain this difference (RS had a lower intake of fibre, and higher intake of fat and sodium), though higher rates of self-reported physical activity at work may explain this.

Similar to the findings of an earlier study on Norwegian Sami (34), RS males had higher rates of self-reported physical activity at work compared to controls or NRS. This was expected given the highly physical nature of reindeer herding, though it was notable that RS males also had lower leisure time activity scores. Other studies on Indigenous circumpolar populations have also found that traditional lifestyle is associated with higher physical activity as well as total energy expenditure.(35). Higher rates of physical activity and fitness were correlated with lower risk of coronary heart disease in the northern Norwegian population (36), emphasizing the importance of assessing physical activity when studying lifestyle and disease risk. As there are inherent weaknesses in using non-tailored questionnaires on physical activity for assessing physical activity among RS, further studies using non-subjective methods to assess physical activity among Sami are needed if this question is to be properly addressed.

Food and nutrient intake

Total energy intake for Sami populations was low compared to previously reported values for men, but not for women (1,37). Other studies on general northern Swedish populations using the same FFQ have found mean energy intakes to be in the same range as this study (6.7–7.4 MJ/d for women, and 7.5–8.4 MJ/d for men) (27,38). Previous studies have estimated the energy intake of reindeer-herding Sami men from Finland to be 11.3 MJ/day (6), much higher than the 7.9 MJ/d in this study. Others have estimated energy intake to be 8.9–13.8 MJ/d for Sami males and 6.1–8.6 MJ/d for Sami females (1,37,39,40). The FFQ used in the current study did not capture the total diet, and the previous studies that have estimated energy intake among Sami have been based on 24-hour recall methods.

The higher total energy intake, percent energy from protein and fat, energy-adjusted intake of cholesterol, sodium (salt) and lower intake of fibre by RS compared to controls would suggest that their diet could be improved. It could be controversially suggested that as Sami males have a lower incidence and mortality from cancer and coronary heart disease (13,23), that there is a health benefit with the traditional animal-based Sami diet, at least for Sami males. That the intake of high amounts of reindeer meat have also been associated with positive health benefits (5,14) is also intriguing from this perspective, though recent dietary cluster analysis of Norwegian Sami found that a "reindeer-based diet" was associated with a higher BMI and lower physical activity (41,42). Epidemiological studies including data on other lifestyle factors, particularly physical activity, and intervention studies are needed in order to know if there is any general protective effect of the traditional Sami diet.

Most of the differences in nutrient intake of RS can be accounted for by a higher intake of nutrients present in high amounts in fish and animal products (e.g., protein, vitamin D, iron), though only male RS had a higher intake of meat products compared to both NRS and controls. RS also had a lower intake of calcium, which would indicate a lower intake of dairy products, though we found no difference in the total intake of dairy products. Laitinen et al. (6) reported that RS in Finland had a higher intake of reindeer meat and lower intake of dairy products, probably due to a traditional lack of access to dairy products. Patterns of nutrient intake in this study were not directly reflected in differences in the intake of different food groups, indicating that differences in choices of specific foods were a key factor in determining differences in nutrient intake.

As the FFQ was designed for a general Swedish population (27), there were no specific questions about intake of reindeer and game meat and offal, which are important traditional foods for the Sami. General questions about meat and offal intake in the FFQ were still able to capture the higher intake among Sami, so macronutrient intake would probably not have been different with specific questions about traditional foods, though there could have been some differences for micronutrients. For example, it was not possible to determine differences in nutrient intake due to the higher vitamin E content of reindeer (43). Traditional foods make up a seasonally important part of the diet among indigenous Arctic populations, for example, making up to 36% of total energy intake among older Inuit men (44) and even the consumption of a single portion of traditional food (normally fish or animal-based) increased daily intake of vitamins B_2, B_6, E and D, copper, iron, magnesium, manganese, phosphorus, potassium and zinc among Arctic Canadians (45). Future FFQ-based dietary surveys for Sami should include questions about traditional food intake.

The premise that reindeer herding is a valid predictor of a traditional lifestyle can be argued, but in lieu of other indicators of a traditional lifestyle, this appears to be a good surrogate measure. In view of the finding that RS did indeed have a diet higher in fat and meat, as found in previous studies on the traditional Sami diet (1), then it would appear to be a valid indicator of a traditional lifestyle from a dietary perspective.

Recent studies examining the changes in food and nutrient intake over time among the general northern Swedish population (38) and Indigenous Arctic peoples (44,46), have observed decreases in the amounts of traditional foods eaten and an increase in consumption of low-fat (e.g., reduced fat milk) and fast-food products. A change from a traditional diet to a market-based diet is frequently, but not always, associated with increased rates of health problems

(47), and there is evidence that there may be recent increases in the rates of some diseases among Swedish Sami (9,12,13,23). The issues surrounding the contamination of traditional dietary sources (e.g., radionuclides from nuclear weapons testing and accidents) (48) mean that the complex picture of diet, lifestyle, genetic adaptation and health among Sami and other circumpolar populations need to be continuously monitored.

A key finding in this study was that NRS have an intermediate level of nutrient intake between the RS and control groups. Previous studies on dietary intake among Sami have focused on RS or the Sami population as a whole, meaning that there is little prior information on the diet of NRS. Rates of obesity are climbing among circumpolar peoples (49), with factors associated with modernization and decreased physical activity such as urbanization and higher economic status appear to be associated with higher rates of obesity and body fat (16,50).Given the problems associated with dietary transformation among Indigenous peoples (51), special attention should be given to the diet-related health of NRS.

Conclusions

This study strongly indicates that a traditional lifestyle is an important factor in determining nutrient intake among Sami, and that RS have a different dietary intake, characterized by a higher intake of meat and fish and a lower intake of vegetables, compared to local controls. NRS are at an intermediate level between RS and controls in both their nutrient and food intake. A detailed understanding of how lifestyle affects the diet of groups such as the Sami and having improved and specific tools for lifestyle assessment, along with a greater knowledge of genetic and other health-related parameters, are important in order to ensure that diet-related diseases that have adversely affected many Indigenous populations can be managed, either by following standard nutritional guidelines or by following advice about maintaining a traditional diet.

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