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No ethnic disparities in nutritional adequacy between the Indigenous Sami and the non-Sami population living in rural Northern Norway—the SAMINOR 2 Clinical Survey

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ABSTRACT

The diet of the Indigenous Sami people has become more Westernized. The lack of population-based data on nutrient intake and nutritional adequacy, in combination with a high prevalence of obesity/metabolic syndrome among Sami, was the rationale behind the present study. We hypothesized that differences in nutrient intake between Sami and non-Sami populations may still exist but that these differences are likely small, especially with respect to nutritional contributors to cardiometabolic health. We used cross-sectional data from the SAMINOR 2 Clinical Survey (2012-2014) to study nutrient intake, assessed by a food frequency questionnaire, in 2743 non-Sami, 622 multiethnic Sami, and 1139 Sami participants aged 40-69 years. We applied quantile regression to study ethnic and inland/coastal regional differences. The median intake of most nutrients met the Estimated Average Requirements of the 2012 Nordic Nutrition Recommendations. However, the average intake of saturated fatty acids and sodium was higher, and average intake of fiber was lower than recommended, regardless of ethnicity and geographic region. The diet of Sami vs non-Sami participants and participants from the inland vs coastal region contained significantly more iron and vitamin B12. We found a number of statistically significant ethnic differences in nutrient intake; however, many of these differences were small (3%-4%). We observed no ethnic disparities in nutritional adequacy between Sami and non-Sami populations living in rural Northern Norway. Our results suggest that, compared to the non-Sami, the Sami have a dietary intake that may reduce their risk of iron deficiency but not their cardiometabolic risk.

Abbreviations: AR, Estimated Average Requirements; BMI, body mass index; CI, confidence interval; E%, energy %; FFQ, food frequency questionnaire; MUFA, monounsaturated fatty acids; NNR, 2012 Nordic Nutrition Recommendations; Norkost 3, Third National Diet Survey in Norway; NOWAC Study, Norwegian Women and Cancer Study; PUFA, polyunsaturated fatty acids; SAMINOR Study, Population-Based Study on Health and Living Conditions in Regions with Sami and Norwegian Populations; SD, standard deviation; SFA, saturated fatty acids.

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1. Introduction

Recently, the Global Burden of Diseases project reported that the burden of cancer, cardiovascular diseases, and type 2 diabetes in the Norwegian population is largely related to diet [1]. Worldwide, inadequate dietary intake; high intake of added sugars, sodium, industrial trans-fat, and alcohol; and low intake of fiber contribute to the onset and progression of these chronic diseases [2,3].

Since the 1970s, there has been a dietary shift in the Norwegian population, which has led to a reduced intake of total fat, saturated fatty acids (SFA), trans-fat, and added sugars and an increased intake of fiber, fruits and berries, whole grain products, and fish [4]. However, the third and most recent national dietary survey in Norway (Norkost 3, 2010-2011) showed that the average intake of SFA and sodium exceeded recommended amounts, especially in males. It also showed that the dietary intake of vitamin D, folate, and fiber should be increased [5]. Moreover, Norwegian health authorities are concerned about the suboptimal iodine intake in the population, especially in females [6,7].

The Indigenous Sami were traditionally a nomadic people, whose culture and lifestyle were founded on reindeer herding, fishing, hunting, and gathering foods from the local environment. Historically, the Sami people have inhabited the geographic area known as *Sápmi*, which covers about 388 000 km^2 of Northern Europe (www.samer.se/karta and Fig. 1). This territory includes parts of Norway, Sweden, Finland, and Russia, and in all of these countries, the Sami people represent the minority. Norway has the largest Sami population, with core areas in the inland region of Finnmark County. In 1970, the number of Sami living in Norway was estimated at about 40 000 individuals [8], but there are no current official statistics, and this number could vary according to the definition of "Sami" applied. Inhabitants of different geographic regions speak different Sami languages; however, because of harsh assimilation policies, a large part of the Sami population has lost their Sami language.

Traditional food systems of Indigenous peoples are composed of items from the local, natural environment that are culturally acceptable [9]. Sami culture and Sami food traditions are unique. Essential components of the traditional Sami diet include reindeer and local fish species, especially oily fish such as trout, grayling, char, whitefish, and salmon (Salmonidae family). Indeed, fresh water fish are an important traditional Sami staple in Sweden [10] and Russia [11]. Not only do reindeer and fish have a high nutritional value, but they are also intrinsically related to the Sami culture, the level of physical activity in the Sami, and the Sami way of life [10]. Other elements of the traditional Sami diet include wild game; food made with animal blood; local berries and plants; and a high intake of boiled, unfiltered coffee [10].

Norway has a long coastline, and part of the Sami population resides in coastal villages. Historically, the diet of coastal Sami has been different from that of inland Sami [12], and dietary pattern analyses have shown that these geographic differences in diet are still present [13,14]. Reindeer herding occurs primarily in the inland region of Northern Norway.

However, it is important to note that the diet of all Sami has changed considerably during the 20th century [15,16]. Previously, the traditional Sami diet was protein rich and contained more fat and less carbohydrates in the form of vegetables, fruits, and sugars when compared with the present-day diet [10,15,16]. A few small studies have explored nutrient intake in grams per day in the present-day rural population of Northern Norway, with a focus on the Indigenous Sami [17,18]. Some dietary studies among the Sami have also been performed in other Nordic countries, such as Finland [19-21] and Sweden [10,15,16,22-24].

When it comes to differences in dietary intake between Sami and non-Sami populations, the latest findings (1980s-

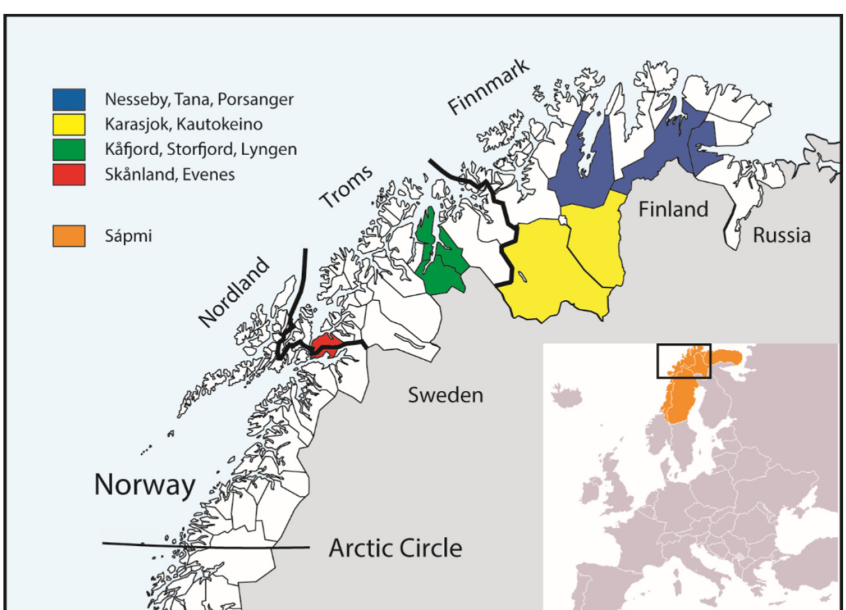

Fig. 1 – Map of study sites.

2000s) vary and show that the Sami may have a higher total energy intake; higher intakes of protein, fat, saturated fat, cholesterol, sugars, sodium, niacin, vitamin B12, vitamin B6, iron, zinc, selenium, vitamin E, and phosphorus; and lower intakes of carbohydrates, calcium, β-carotene, fiber, folate, and magnesium [15,16,18,20,22,23].

Lifestyle changes within the last century have brought about a rapid transition in nutrition, characterized by a decrease in the consumption of traditional foods and an associated increase in the consumption of processed, store-bought foods [25,26]. These changes have also been observed in non-Indigenous populations, but it has been suggested that the negative effects of these changes impact Indigenous populations to a larger degree [27]. There is growing evidence of a high prevalence of central obesity and diet-related chronic conditions like diabetes in the Sami population [28,29]. The lack of population-based data from the Sami population on diet and nutrition was the rationale behind this study. More specifically, we carried out a comprehensive assessment of nutrient intake with a focus on Sami ethnicity and studied ethnic and regional differences in nutrient intake in rural Northern Norway. We also attempted to describe the adequacy of average daily intake of nutrients according to the Estimated Average Requirements (AR) in the 2012 Nordic Nutrition Recommendations (NNR). Therefore, we hypothesized that differences in nutrient intake between Sami and non-Sami populations may still exist but that these differences are likely small, especially with respect to nutritional contributors to cardiometabolic health.

2. Methods and materials

2.1. Study design and population

The data used in this analysis were taken from the Population-Based Study on Health and Living Conditions in Regions with Sami and Norwegian Populations (the SAMINOR 2 Clinical Survey), which was conducted by The Centre for Sami Health Research, UiT The Arctic University of Norway. The SAMINOR 2 Clinical Survey was carried out in 10 municipalities of Northern Norway in 2012-2014 (Fig. 1). All inhabitants of these municipalities aged 40-79 years were invited to participate in the study by personal letter, and those who agreed to participate completed a self-administered questionnaire (see www.saminor.no for an English translation of the questionnaire), which included a 4-page food frequency questionnaire (FFQ), and underwent a short clinical examination. However, as the FFQ was only distributed to invitees aged 40-69 years, our study sample was restricted to participants in this age group (10 399 invited, 4876 attended, participation rate 47%).

We excluded participants with solely non-Western European, Asian, or African backgrounds because the FFQ did not necessarily match their diet (n = 69); those who did not provide information on ethnicity (n = 115); those with incomplete FFQ (>50% blanks on standardized food frequency intake per week) (≥57 food items) (n = 91); those with missing height/weight measurements (n = 7); and those in the top and bottom 1% of ratios of energy intakes: basal metabolic rate [30] (n = 90) [31]. In total, 372 participants were excluded (7.6%), resulting in a final analytical sample of 4504 individuals (2054 men and 2450 women) (Fig. 2).

2.2. Ethnicity

We categorized ethnicity based on information from the questionnaire using the following question: “What do you consider yourself to be?” Response options were “Norwegian,” “Sami,” “Kven,” and “Other” (please describe). Participants who chose solely “Other” (n = 142) were further divided into immigrants from Western European countries and those from non-Western European, Asian, and African countries. The non-Sami group included participants who considered themselves as something other than Sami, that is, Norwegian, Kven, Other (Western European countries). The multiethnic Sami group included participants who defined themselves as Sami in combination with any kind of other ethnicity. The Sami group included participants who defined themselves solely as Sami, without reporting any other ethnicities. Based on this classification, our study sample consisted of 2743 non-Sami, 622 multiethnic Sami, and 1139 Sami.

2.3. Nutrient intake

Daily nutrient intake was extracted from the FFQ. Participants reported the frequency with which listed foods and beverages were consumed over the past 12 months. The FFQ did not cover the entire diet, but it did cover a wide range of food items consumed in Norway. The SAMINOR FFQ was based on that used in the Norwegian Women and Cancer (NOWAC) Study [32], but with minor adjustments: (1) questions were added on the intake of some known traditional food items (fresh water fish, halibut, moose meat, grouse and other game birds, seagull eggs, food made with animal blood, ie, black pudding from lamb/sheep, cattle, reindeer, or moose); (2) more response options were added to describe the frequency of consumption of reindeer meat and eggs; and (3) the questions about potato and water intake were changed (www.saminor.no). We used the NOWAC Study nutrient calculation program, updated with the newly added food items, to estimate daily energy and nutrient intake. The NOWAC FFQ has previously been validated for the general female population of Norway [32-34].

The Norwegian Food Composition table was used to estimate energy and nutrient intakes (www.matportalen.no/verktoy/the_norwegian_food_composition_table/). The category “carbohydrates” included starch, glycogen, and all types of sugar (glucose, fructose, lactose, sucrose, and maltose) intake. Dietary fiber was not included in carbohydrates. Total mono- and disaccharides comprised naturally occurring glucose, fructose, lactose, and maltose, as well as sugar (sucrose) or added sugars (other sugars that are added during preparation). Added sugars comprised refined or industrially processed sugars in the form of glucose, fructose, lactose, maltose, sucrose, glucose syrup, and other hydrolyzed starch products, as well as honey that is added during industrial production or home preparation; it did not include naturally occurring sugars.

We estimated daily total energy intake in kilojoules, the intake of 38 nutrients, and the intake of water. Only 1 supplement, that is, liquid cod liver oil, was included in nutrient intake calculations.

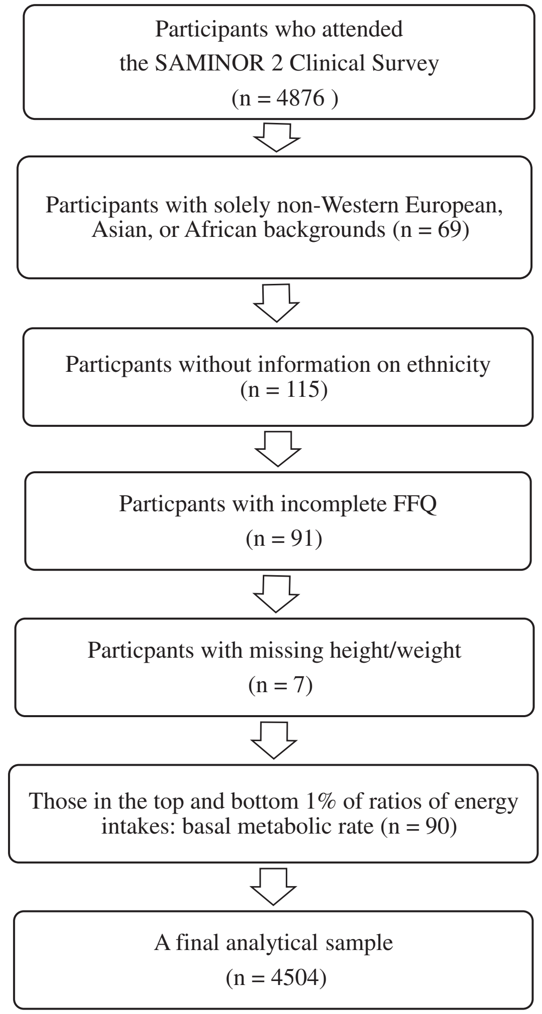

Fig. 2 – Flowchart of participant selection.

2.4. *Assessment of nondietary variables*

Information on education, smoking status, and physical activity was taken from the self-administered questionnaire. Education was categorized as <13 years and ≥13 years, and smoking status was categorized as current, former, and never. Participants rated their overall physical activity level [35] on a scale of 1 ("very low") to 10 ("very high"), and based on their response, they were divided into 3 groups: low (1-3), moderate (4-7), and high (8-10) physical activity level.

2.5. *Anthropometrics*

Height and weight were measured by trained personnel during the clinical examination using an electronic Height, Weight & Fatness Measuring System device (DS-103, Dongsahn Jenix, Seoul, Korea) with the participants wearing light clothing and no shoes. Height was measured to the nearest 0.1 cm and weight to the nearest 100 g. Body mass index (BMI) was then calculated in kilograms per square meter. *Obesity* was defined as BMI ≥30 kg/m^2.

2.6. *Register-based variables*

Sex, year of birth, and municipality of residence were obtained from the National Registry (Folkeregisteret). *Age* was defined as that of participants at the end of the year in which clinical examination took place and was categorized into 40-49, 50-59, and 60-69 years. Geographic region of residence was categorized as inland (municipalities of Karasjok and Kautokeino in Finnmark County) and coastal (including the remaining eight municipalities) based on whether or not the municipalities include coastal areas (Fig. 1).

2.7. *Ethics approval*

The Regional Committees for Medical and Health Research Ethics of Northern Norway approved the data collection. The storing of personal data for the SAMINOR 2 Clinical Survey was approved by the National Data Inspectorate. All participants gave written informed consent. The application for the present research project was approved by the Regional Committees for Medical and Health Research Ethics of Northern Norway and the SAMINOR Project Board.

2.8. Statistical analyses

All data were analyzed separately in men and women, and sample characteristics were presented as proportions within each of the 3 ethnic groups (non-Sami, multiethnic Sami, and Sami). Ethnic comparisons were made using Pearson χ^2 tests. In addition, participants' BMI was expressed as means ± standard deviation (SD) and compared across the ethnic groups using analysis of variance.

We assessed the adequacy of nutrient intake by comparing median nutrient intakes with the AR (the level of a nutrient intake that is sufficient to cover the requirement for half of a defined group of individuals) mentioned in the 2012 NNR [36]. Median intakes of protein, total fat, SFA, polyunsaturated fatty acids (PUFA), carbohydrates, added sugar, fiber, and alcohol were compared with intake ranges recommended by the 2012 NNR for proteins (10-20 energy %, E%), total fat (25-40 E%), SFA (<10 E%), PUFA (5-10 E%), carbohydrates (45-60 E%), added sugars (<10 E%), and alcohol (<5 E%). For dietary fiber and alcohol, median intakes were compared with the adequate intake of ≥35 g/d (men) and ≥25 g/d (women) for fiber and< 20 g/d (men) and< 10 g/d (women) for alcohol, as recommended by the NNR. Median intakes of sodium and potassium were compared with population targets for adults set by the World Health Organization [37,38].

Most nutrient intake distributions did not meet the assumption of normality; thus, the unadjusted medians are presented for descriptive purposes. In addition to unadjusted medians, unadjusted means ± SD are presented across ethnic groups. Ethnic/regional differences in nutrient intakes were assessed by nonparametric, multivariable-adjusted quantile regression models [39]. Quantile regression at median estimates the median of the dependent variable conditional on the values of the independent variables, and interpretation is similar to ordinary least squares regression. The β coefficient represents the difference in the median between groups. The models included the covariates age, BMI, education, smoking status, physical activity level, and daily energy intake. First, daily nutrient intakes were compared between ethnic groups. We compared the Sami group and the non-Sami group (reference group) as well as the multiethnic Sami group and the non-Sami group (reference group). In addition, associations between energy intake and ethnicity in the inland and coastal regions are shown by sex. Second, because of the well-known effect of residence on dietary intake [13], the sample was stratified by region, and daily nutrient intake was compared between inland and coastal populations (reference group).

Standard errors and 95% confidence intervals (CIs) of quantile-regression coefficients were obtained using the bootstrap method (500 bootstrap replications were used). Fully adjusted medians and their 95% CIs [40], fully adjusted β coefficients, and P values are presented. P values below .05 were considered statistically significant. All tests were 2-sided. Percent difference was calculated using the following formula: percent difference = β coefficient/(adjusted median nutrient intake in the reference group)*100%. Data were analyzed using STATA version 14 (StataCorp, College Station, TX, USA).

3. Results

The average age of participants was 56.5 ± 8.5 years in men (n = 2054) and 55.4 ± 8.5 years in women (n = 2450). No major differences in participant characteristics were found across the 3 ethnic groups or by sex, although Sami participants more often reported a low physical activity level and had a higher BMI. Sami women had a higher education level than their non-Sami counterparts. In the inland region, Sami participants constituted the majority of the study sample; 84% percent of multiethnic Sami men and 78% of multiethnic Sami women resided in the coastal region (Table 1).

The median intake of most nutrients met the AR in the 2012 NNR (Tables 2 and 3). However, the median contribution of SFA to energy intake was >10 E%, and median fiber intake was lower than 25-35 g/d in both sexes in all ethnic groups. Median sodium intake exceeded the recommended value (<2000 mg/d), especially among men. Median iodine intake was below 100 μg/d (the AR in the 2012 NNR) for women in all ethnic groups. Overall, the contribution of alcohol to energy intake among non-Sami, multiethnic Sami, and Sami was low (men: 1.0 E%, 1.0 E%, and 0.7 E%, respectively; women: 0.7 E%, 0.6 E%, and 0.3 E%, respectively) (Tables 2 and 3).

Minimum-maximum values of daily energy intake were 3067-22 096 kJ in men and 2615-15 131 kJ in women. In the fully adjusted regression model, median daily energy intake was lower in men of Sami than in men of non-Sami ethnicity (β = −497, P < .01) (Table 4). There was no significant difference in energy intake between coastal Sami men (n = 187) and coastal non-Sami men (n = 1195). However, inland Sami men (n = 333) had a significantly lower energy intake (adjusted β = −1562, P < .01) than non-Sami men (n = 53) (Table 4). No ethnic differences in daily energy intake were observed in women (Table 5).

When looking at the contribution of the intake of protein, fat, SFA, PUFA, carbohydrates, and added sugars to daily energy intake, the greatest difference was found for the intake of added sugars between Sami and non-Sami women (12% higher in Sami, P < .01) (Figs. 3 and 4). We also observed a higher contribution of SFA to energy intake in Sami men (P < .05) than in non-Sami men and a higher protein intake in Sami men (P < .001) and women (P < .01) than in their non-Sami counterparts. In addition, Sami men had a significantly lower fiber intake than non-Sami men (P < .05), and multiethnic Sami men (P < .01) and women (P < .01) had a significantly higher sodium intake than their non-Sami counterparts. Multiethnic Sami men had a significantly higher cholesterol intake than non-Sami men (P < .05). All listed ethnic differences were small (3%-4%). The contribution of alcohol to energy intake was significantly lower in Sami men and women than in non-Sami men and women (P < .001) (Tables 4 and 5).

Daily dietary intakes for vitamin B12, iron, and zinc were significantly higher among Sami (to a lesser extent in multiethnic Sami) than non-Sami participants, regardless of sex (Tables 4 and 5). The greatest differences between Sami and non-Sami were found for vitamin B12 (P < .001) and iron (P < .001). On average, Sami men and women consumed 17% and 19% more vitamin B12, and 15% and 19% more iron, respectively. In addition, compared with non-Sami men,

Table 1 – Characteristics of the study sample by ethnicity and sex (n = 4504) [a]

Characteristics	Men (n = 2054)			P [b]	Women (n = 2450)			P [b]
	Non-Sami n = 1248	Multiethnic Sami n = 286	Sami n = 520		Non-Sami n = 1495	Multiethnic Sami n = 336	Sami n = 619	
Age group, y (%)								
40-49	25.3	28.7	22.7	.37	27.9	36.6	25.2	.001
50-59	30.9	31.5	33.5		32.4	34.2	35.1	
60-69	43.8	39.9	43.8		39.7	29.2	39.7	
Education (%)								
<13 y	58.2	56.7	60.1	.62	50.4	37.7	46.7	<.0001
≥13 y	41.8	43.3	39.9		49.6	62.3	53.3	
Geographic region (%)								
Inland	4.2	15.7	64.0	<.0001	4.7	22.0	68.2	<.0001
Coastal	95.8	84.3	36.0		95.3	78.0	31.8	
Physical activity level (%)								
Low (1-3)	19.9	19.9	25.6	.018	14.5	18.1	25.3	<.0001
Moderate (4-7)	66.5	63.0	58.6		65.0	65.6	59.6	
High (8-10)	13.6	17.1	15.7		20.5	16.3	15.1	
BMI (kg/m^2)	28.3 ± 4.0	28.2 ± 4.2	28.7 ± 4.2	.15	27.4 ± 4.9	27.7 ± 4.7	28.7 ± 5.0	<.0001
BMI groups (%)								
Normal/overweight (<30 kg/m^2)	72.2	72.0	66.0	.027	74.7	70.8	65.4	<.0001
Obese (≥30 kg/m^2)	27.8	28.0	34.0		25.3	29.2	34.6	
Smoking status (%)								
Never	35.1	38.5	33.7	.39	37.2	36.5	35.6	.92
Former	47.4	41.7	46.8		40.6	39.5	41.7	
Current	17.5	19.8	19.5		22.2	24.0	22.7	

Values are % for categorical variables and means ± SD for a continuous variable BMI.
[a] Education, physical activity, and smoking status subgroups may not total 4504 because of missing values (<4%).
[b] Differences in proportions between non-Sami, multiethnic Sami, and Sami were tested by Pearson χ^2 test, and comparisons of BMI between the ethnic groups were conducted using analysis of variance.

multiethnic Sami men reported a significantly higher vitamin D intake (14%, *P* < .001), vitamin E intake (5%, *P* < .05), and selenium intake (6%, *P* < .001) (Table 4). The diet of Sami vs non-Sami men and women contained more vitamin B2 (8% and 10%, respectively) and Zn (8% and 9%, respectively) (*P* < .001). In addition, Sami men consumed significantly less carotene (12%, *P* < .01), folate (3%, *P* < .05), magnesium (2%, *P* < .05), and iodine (7%, *P* < .05) when compared with non-Sami men (Table 4).

No significant regional differences were observed in the energy intake of men and women. Regional differences followed a pattern similar to that of ethnic differences. We found that the inland diet was more favorable to the intake of vitamin B2, vitamin B12, iron, and zinc when compared with the coastal diet in both men and women. However, in addition to higher intakes of SFA and added sugars, lower intakes of fiber, vitamin E, carotene, and folate were observed in inland men and women. Higher protein and potassium intake was detected in inland men, and inland women reported lower sodium intake than their coastal counterparts. Overall, inland men and women had a significantly lower alcohol intake (Table 6).

4. Discussion

The main finding of the present study was that, unlike other studies of Indigenous vs non-Indigenous populations, we observed no ethnic disparities in nutritional adequacy between Sami and non-Sami populations living in rural Northern Norway. Overall, the medians for most nutrient intakes were in agreement with reference values from the 2012 NNR in all investigated ethnic groups and in both sexes. There were a number of significant differences detected in the medians of nutrient intakes across ethnic groups. However, as hypothesized, although the differences were significant, many of them were so small that they may have no nutritional or clinical meaning in terms of health effects. The other important observation was that the diet of the population of rural Northern Norway did not comply with recommended values for intakes of SFA, sodium, and fiber, regardless of ethnicity and geographic region. This is in line with the results of the Norkost 3 survey, which reported on the general Norwegian population. When we compared nutrient intakes between inland and coastal populations, they were very reflective of those observed between Sami and non-Sami populations. As the population of the inland region is only 12% non-Sami, the inland/coastal region comparison largely reflects a comparison between inland Sami (including multiethnic Sami) and all other ethnic groups.

In the present study, Sami men, multiethnic Sami men, Sami women, and men residing in the inland region reported that protein represented a significantly higher proportion of their energy intake, which is in line with previous findings [15,18,23]. Indeed, the diet of Sami and multiethnic Sami generally contains more reindeer meat, which has higher concentrations of vitamin B12, iron, zinc, and selenium when compared with Norwegian beef, lamb,

Table 2 – Nutrient intakes by ethnicity and geographic region in men (n = 2054)

		Men							
		Ethnicity						Region	
		Non-Sami (n = 1248)		Multiethnic Sami (n = 286)		Sami (n = 520)		Coastal (n = 1623)	Inland (n = 431)
Daily nutrient intakes	DRVs	Mean ± SD	*Median*	Mean ± SD	*Median*	Mean ± SD	*Median*	*Median*	*Median*
Water		3097 ± 880	*3027*	3163 ± 996	*3065*	3169 ± 994	*3083*	*3028*	*3095*
Energy (kJ)		9113 ± 2556	*8889*	9218 ± 2886	*9097*	8705 ± 2652	*8403*	*8843*	*8510*
Protein (g)		100.0 ± 29.2	*97.0*	104.3 ± 32.9	*101.2*	99.2 ± 32.0	*93.9*	*97.0*	*96.1*
Total fat (g)		87.9 ± 29.8	*84.2*	90.1 ± 31.9	*86.5*	84.9 ± 30.8	*80.4*	*83.8*	*82.0*
SFA (g)		33.2 ± 13.2	*30.8*	33.9 ± 14.0	*31.2*	32.2 ± 13.1	*30.2*	*30.6*	*31.3*
Trans-fatty acids (g)		0.7 ± 0.4	*0.6*	0.7 ± 0.4	*0.6*	0.7 ± 0.4	*0.6*	*0.6*	*0.6*
MUFA (g)		31.2 ± 10.6	*30.0*	32.0 ± 11.5	*31.0*	29.8 ± 11.3	*27.9*	*29.7*	*28.7*
PUFA (g)		14.7 ± 5.0	*14.0*	15.2 ± 5.3	*14.5*	14.4 ± 5.4	*13.4*	*14.0*	*13.4*
Omega 3 fatty acids (g)		1.3 ± 1.2	*0.9*	1.4 ± 1.3	*0.9*	1.2 ± 1.0	*0.9*	*0.9*	*0.8*
Omega 6 fatty acids (g)		1.1 ± 0.7	*0.9*	1.1 ± 0.7	*0.9*	1.0 ± 0.7	*0.8*	*0.9*	*0.8*
Cholesterol (mg)		358.2 ± 129.5	*341.0*	382.6 ± 141.5	*361.7*	347.0 ± 132.7	*321.8*	*341.3*	*332.3*
Carbohydrates (g)		224.1 ± 67.4	*221.4*	220.9 ± 75.4	*215.0*	210.9 ± 69.6	*206.3*	*218.3*	*209.0*
Starch (g)		129.3 ± 39.8	*129.5*	128.4 ± 44.6	*126.7*	119.4 ± 43.1	*118.5*	*128.2*	*120.8*
Mono-/disaccharides (g)		90.6 ± 36.2	*87.1*	88.2 ± 39.5	*80.5*	87.1 ± 38.0	*81.8*	*85.3*	*83.2*
Fiber (g)	≥35	21.9 ± 7.3	*21.6*	21.8 ± 7.9	*20.9*	20.3 ± 7.6	*19.9*	*21.5*	*19.8*
Added sugars (g)		30.1 ± 19.8	*26.3*	29.8 ± 21.5	*24.9*	29.8 ± 22.2	*25.1*	*25.3*	*26.8*
Alcohol (g)	<20	5.7 ± 7.0	*3.1*	6.0 ± 8.2	*3.1*	4.0 ± 6.6	*2.0*	*3.1*	*2.0*
Retinol (μg)		1008 ± 692	*835*	1048 ± 746	*889*	1021 ± 782	*813*	*836*	*815*
Carotene (μg)		3420 ± 2188	*3029*	3474 ± 2346	*3000*	3034 ± 2190	*2582*	*3066*	*2395*
Vitamin A (RAE μg)	600	1343 ± 754	*1178*	1389 ± 826	*1242*	1329 ± 831	*1136*	*1190*	*1110*
Vitamin D (μg)	7.5	14.6 ± 9.5	*11.2*	16.1 ± 10.0	*13.0*	14.1 ± 9.0	*11.1*	*11.9*	*10.7*
Vitamin E (mg alfa-TE)	6	17.3 ± 9.0	*14.4*	18.3 ± 9.3	*15.8*	16.2 ± 8.5	*13.8*	*14.8*	*13.3*
Vitamin B1 (mg)	1.2	1.9 ± 0.6	*1.8*	1.9 ± 0.6	*1.8*	1.8 ± 0.6	*1.7*	*1.8*	*1.8*
Vitamin B2 (mg)	1.4	2.6 ± 0.8	*2.5*	2.6 ± 0.9	*2.5*	2.7 ± 1.0	*2.6*	*2.5*	*2.7*
Niacin (mg)	15	24.1 ± 6.7	*23.4*	25.2 ± 7.8	*24.6*	24.4 ± 7.8	*23.2*	*23.6*	*23.4*
Vitamin B6 (mg)	1.3	1.8 ± 0.6	*1.7*	1.9 ± 0.7	*1.8*	1.8 ± 0.6	*1.7*	*1.8*	*1.7*
Folate (μg)	200	267.4 ± 85.2	*261.9*	266.0 ± 93.0	*255.6*	249.6 ± 87.3	*236.0*	*259.4*	*239.3*
Vitamin B12 (μg)	1.4	9.1 ± 3.8	*8.4*	10.0 ± 4.0	*9.4*	10.4 ± 4.6	*9.6*	*8.6*	*9.9*
Vitamin C (mg)	60	94.8 ± 55.1	*83.6*	92.7 ± 55.0	*82.1*	91.1 ± 58.6	*75.8*	*83.3*	*75.6*
Calcium (mg)	500	1073 ± 490	*1025*	1054 ± 528	*978*	1028 ± 483	*956*	*1000*	*1000*
Iron (mg)	7	10.7 ± 3.1	*10.4*	11.7 ± 3.9	*11.1*	12.3 ± 4.5	*11.6*	*10.5*	*11.9*
Sodium (mg)	<2000	2933 ± 883	*2852*	3023 ± 990	*2916*	2843 ± 963	*2717*	*2849*	*2740*
Potassium (mg)	≥3510	4732 ± 1335	*4606*	4739 ± 1500	*4615*	4664 ± 1418	*4444*	*4586*	*4519*
Magnesium (mg)		392.1 ± 108.9	*386.9*	392.9 ± 120.5	*381.8*	371.3 ± 111.1	*355.5*	*383.6*	*363.9*
Zinc (mg)	6	11.9 ± 3.5	*11.6*	12.7 ± 4.3	*12.4*	12.6 ± 4.3	*12.1*	*11.6*	*12.3*
Selenium (μg)	35	75.0 ± 30.0	*70.6*	79.1 ± 29.8	*73.4*	73.0 ± 31.0	*67.1*	*71.2*	*66.8*
Copper (mg)	0.7	1.3 ± 0.4	*1.2*	1.3 ± 0.4	*1.3*	1.2 ± 0.4	*1.2*	*1.2*	*1.2*
Phosphorus (mg)	450	1956 ± 599	*1903*	1986 ± 650	*1933*	1907 ± 606	*1818*	*1889*	*1858*
Iodine (μg)	100	128.8 ± 68.8	*118.1*	124.9 ± 72.5	*108.5*	118.8 ± 67.0	*99.7*	*114.0*	*103.5*
Protein (E%)	10-20	18.8 ± 2.7	*18.6*	19.4 ± 2.8	*19.2*	19.6 ± 3.2	*19.3*	*18.7*	*19.3*
Total fat (E%)	25-40	35.4 ± 4.9	*35.3*	36.0 ± 4.6	*35.7*	35.8 ± 5.1	*35.7*	*35.4*	*36.0*
SFA (E%)	<10	13.3 ± 2.9	*12.9*	13.4 ± 2.7	*13.2*	13.5 ± 2.9	*13.3*	*12.9*	*13.6*
PUFA (E%)	5-10	6.0 ± 1.1	*5.9*	6.1 ± 1.1	*6.1*	6.1 ± 1.2	*6.0*	*6.0*	*5.9*
Carbohydrates (E%)	45-60	41.9 ± 5.4	*41.9*	40.7 ± 5.5	*41.4*	41.2 ± 5.9	*41.2*	*41.7*	*41.6*
Added sugars (E%)	<10	5.5 ± 3.2	*5.0*	5.3 ± 3.2	*4.7*	5.7 ± 3.4	*5.0*	*4.9*	*5.4*
Alcohol (E%)	<5	1.9 ± 2.3	*1.0*	1.9 ± 2.4	*1.0*	1.4 ± 2.2	*0.7*	*1.0*	*0.7*

Data are presented as unadjusted means ± SD and medians (for easy comparison, median values are marked in italic font).
Abbreviations: DRVs, dietary reference values; RAE, retinol activity equivalents.

mutton, pork, and chicken [41], and Sami have been reported to have a higher intake of moose meat and food made with animal blood [42]. In our study, the Sami diet was particularly beneficial in relation to intakes of vitamin B12 and iron, although it was also beneficial in relation to zinc, all of which are meat-derived micronutrients. On the other hand, the multiethnic Sami diet appeared to be less beneficial in relation to these micronutrients. These results support previous findings from the SAMINOR 1 Survey in which Broderstad et al reported a positive association between "the reindeer meat" pattern and s-ferritin concentrations [43]. In another study, s-ferritin concentrations were higher among Sami than non-Sami men and women, and in the inland population than the coastal population, suggesting a

Table 3 – Nutrient intakes by ethnicity and geographic region in women (n = 2450)

		Women							
		Ethnicity						Region	
		Non-Sami (n = 1495)		Multiethnic Sami (n = 336)		Sami (n = 619)		Coastal (n = 1883)	Inland (n = 567)
Daily nutrient intakes	DRVs	Mean ± SD	*Median*	Mean ± SD	*Median*	Mean ± SD	*Median*	*Median*	*Median*
Water		2948 ± 863	2902	3133 ± 852	3130	3018 ± 929	2976	2931	2977
Energy (kJ)		7597 ± 2079	7403	7985 ± 2105	7836	7470 ± 2190	7264	7459	7302
Protein (g)		83.8 ± 23.5	81.3	89.7 ± 24.2	89.6	84.9 ± 25.6	82.5	82.6	82.6
Total fat (g)		72.5 ± 24.0	70.5	76.8 ± 25.0	73.0	72.1 ± 24.0	68.6	70.7	68.8
SFA (g)		27.3 ± 10.4	26.0	28.9 ± 10.7	27.1	27.3 ± 10.3	25.8	26.0	26.4
Trans-fatty acids (g)		0.6 ± 0.3	0.6	0.6 ± 0.3	0.6	0.6 ± 0.3	0.6	0.6	0.6
MUFA (g)		25.5 ± 8.7	24.8	27.0 ± 9.2	25.7	25.2 ± 8.6	23.8	24.9	23.9
PUFA (g)		12.4 ± 4.2	12.0	13.2 ± 4.4	12.8	12.3 ± 4.3	12.0	12.2	11.8
Omega 3 fatty acids (g)		1.0 ± 1.0	0.7	1.2 ± 1.1	0.8	1.1 ± 1.1	0.7	0.7	0.7
Omega 6 fatty acids (g)		0.9 ± 0.6	0.8	1.0 ± 0.6	0.8	0.8 ± 0.5	0.7	0.8	0.7
Cholesterol (mg)		297.9 ± 102.4	283.9	315.5 ± 103.1	301.4	293.3 ± 107.6	278.0	288.9	274.6
Carbohydrates (g)		189.1 ± 56.9	184.7	196.1 ± 58.0	196.1	184.3 ± 60.9	176.6	184.9	179.2
Starch (g)		103.7 ± 34.0	103.3	109.1 ± 33.9	110.5	100.2 ± 35.5	97.8	103.9	99.5
Mono-/disaccharides (g)		80.4 ± 31.6	76.8	81.8 ± 33.1	77.7	78.8 ± 33.5	75.6	76.2	77.0
Fiber (g)	≥25	21.8 ± 6.7	21.4	22.2 ± 7.0	21.5	20.8 ± 7.3	20.3	21.5	19.8
Added sugars (g)		23.9 ± 15.1	21.1	25.3 ± 15.4	22.5	25.0 ± 14.4	22.8	21.4	22.8
Alcohol (g)	<10	3.2 ± 4.2	1.8	3.3 ± 4.4	1.7	1.6 ± 2.5	0.6	1.8	0.4
Salt (g)	<5	5.7 ± 1.8	5.6	6.2 ± 1.8	6.2	5.7 ± 1.8	5.5	5.7	5.5
Retinol (μg)		836 ± 623	693	903 ± 643	758	880 ± 716	688	706	685
Carotene (μg)		4143 ± 2382	3697	4039 ± 2395	3597	3818 ± 2463	3536	3732	3265
Vitamin A (RAE μg)	500	1235 ± 684	1112	1301 ± 703	1159	1255 ± 783	1072	1118	1067
Vitamin D (μg)	7.5	11.8 ± 8.3	9.1	12.9 ± 9.0	9.2	12.5 ± 9.4	9.4	9.2	9.0
Vitamin E (mg alfa-TE)	5	15.1 ± 8.2	12.6	16.0 ± 8.7	12.8	15.2 ± 8.9	12.3	12.7	12.2
Vitamin B1 (mg)	0.9	1.6 ± 0.5	1.5	1.7 ± 0.5	1.6	1.6 ± 0.5	1.5	1.5	1.5
Vitamin B2 (mg)	1.1	2.1 ± 0.7	2.1	2.3 ± 0.7	2.2	2.3 ± 0.8	2.3	2.1	2.3
Niacin (mg)	12	20.2 ± 5.5	19.7	21.7 ± 5.9	21.4	20.8 ± 6.0	20.2	20.0	20.0
Vitamin B6 (mg)	1.1	1.6 ± 0.5	1.5	1.7 ± 0.5	1.6	1.6 ± 0.5	1.5	1.6	1.5
Folate (μg)	200	251.8 ± 75.8	244.1	258.8 ± 78.5	253.4	239.5 ± 82.4	235.6	245.0	236.6
Vitamin B12 (μg)	1.4	7.3 ± 3.0	6.8	8.3 ± 3.2	7.8	8.6 ± 3.5	8.3	7.0	8.2
Vitamin C (mg)	50	106.9 ± 56.3	96.7	106.3 ± 58.2	97.2	103.9 ± 60.0	93.9	96.8	91.6
Calcium (mg)	500	900 ± 393	821	957 ± 412	896	876 ± 383	812	826	824
Iron (mg)	10/6 [a]	9.4 ± 2.7	9.1	10.5 ± 2.9	10.4	11.2 ± 3.6	10.8	9.3	11.0
Sodium (mg)	<2000	2334 ± 716	2285	2532 ± 746	2521.3	2316 ± 720	2226	2331	2219
Potassium (mg)	≥3510	4134 ± 1128	4071	4259 ± 1157	4196	4150 ± 1219	4106	4091	4106
Magnesium (mg)		336.1 ± 87.9	329.6	350.6 ± 89.5	348.3	326.5 ± 95.0	315.5	331.9	316.3
Zinc (mg)	5	10.2 ± 2.9	10.0	11.1 ± 3.0	10.9	11.0 ± 3.4	10.5	10.1	10.8
Selenium (μg)	30	60.8 ± 22.8	57.7	63.9 ± 22.7	61.8	61.7 ± 24.0	58.2	58.7	56.0
Copper (mg)	0.7	1.1 ± 0.3	1.1	1.2 ± 0.3	1.1	1.1 ± 0.3	1.1	1.1	1.1
Phosphorus (mg)	450	1660 ± 483	1613	1760 ± 494	1780	1650 ± 501	1598	1630	1605
Iodine (μg)	100	96.0 ± 53.0	82.4	101.8 ± 55.3	91.4	91.2 ± 50.4	79.7	82.5	83.3
Protein (E%)	10-20	18.9 ± 2.9	18.7	19.2 ± 2.8	18.9	19.5 ± 3.0	19.3	18.8	19.1
Total fat (E%)	25-40	35.1 ± 4.9	35.0	35.4 ± 5.1	35.0	35.6 ± 4.9	35.6	35.0	35.5
SFA (E%)	<10	13.2 ± 2.7	12.9	13.3 ± 2.8	13.1	13.5 ± 2.7	13.3	12.9	13.4
PUFA (E%)	5-10	6.0 ± 1.1	5.9	6.1 ± 1.1	6.0	6.1 ± 1.2	6.0	6.0	5.9
Carbohydrates (E%)	45-60	42.3 ± 5.7	42.6	41.7 ± 5.6	41.7	41.8 ± 5.7	42.2	42.4	42.5
Added sugars (E%)	<10	5.2 ± 2.8	4.8	5.3 ± 2.7	4.9	5.6 ± 2.8	5.4	4.8	5.4
Alcohol (E%)	<5	1.2 ± 1.7	0.7	1.3 ± 1.8	0.6	0.7 ± 1.1	0.3	0.7	0.2

Data are presented as unadjusted means ± SD and medians (for easy comparison, median values are marked in italic font).
[a] Refers to postmenopausal women.

reduced risk of iron deficiency in the Sami and in the inland population [44].

In the Nordic countries, an intake of <10 E% of SFA is recommended [36]. In the present study, SFA medians were between 12.9 E% and 13.3 E% in all ethnic groups and in both sexes. It appeared that the percentage of energy derived from SFA was higher among Sami men and among inhabitants of the inland region in the present study, although the differences were small (3%) and likely did not have a measurable metabolic effect. The best comparison for our results is a small study published in 1999 from Northern Norway, which compared the nutrient intakes of Sami and Norwegian participants of approximately the same age. However, the study used dietary history and different definitions of

Table 4 – Differences in nutrient intakes by ethnicity in men

Daily nutrient intakes	Adjusted medians (95% CIs) Non-Sami (n = 1248)	Adjusted medians (95% CIs) Multiethnic Sami (n = 286)	Adjusted medians (95% CIs) Sami (n = 520)	β^a	β^b
Water	3048 (3001, 3095)	3095 (2991, 3200)	3169 (3086, 3252)	47.0	**121.1***
Energy (kJ)	8948 (8777, 9119)	9079 (8716, 9442)	8451 (8106, 8797)	130.7	**−496.8****
Energy (kJ) [c]	10 006 (9145, 10 867)	8994 (7526, 10 462)	8444 (8026, 8863)	−1011.4	**−1561.7****
Energy (kJ) [d]	8869 (8689, 9049)	9048 (8662, 9435)	8719 (8243, 9195)	179.5	−150.0
Protein (g)	99.0 (98.1, 100.0)	102.4 (100.5, 104.4)	101.7 (100.0, 103.4)	**3.4****	**2.7****
Total fat (g)	86.9 (86.0, 87.7)	87.7(86.2, 89.2)	88.3 (87.0, 89.6)	0.9	1.4
SFA (g)	32.2 (31.7, 32.7)	32.9 (32.1, 33.6)	33.2 (32.5, 33.9)	0.7	**1.03****
Trans-fatty acids (g)	0.7 (0.6, 0.7)	0.7 (0.6, 0.7)	0.7 (0.7, 0.7)	0.01	0.03
MUFA (g)	30.9 (30.5, 31.3)	31.1 (30.4, 31.9)	30.9 (30.4, 31.4)	0.2	0.001
PUFA (g)	14.5 (14.3, 14.7)	14.9 (14.4, 15.3)	14.7 (14.4, 15.0)	0.4	0.2
Omega 3 fatty acids (g)	0.9 (0.9, 1.0)	1.0 (0.9, 1.1)	1.0 (0.9, 1.1)	0.08	0.04
Omega 6 fatty acids (g)	1.0 (0.9, 1.0)	1.0 (0.9, 1.1)	0.9 (0.9, 1.0)	0.04	−0.06
Cholesterol (mg)	348.7 (343.2, 354.3)	362.4 (350.5, 374.3)	356.3 (345.6, 366.9)	**13.7***	7.5
Carbohydrates (g)	222.7 (220.8, 224.5)	218.0 (214.5, 221.5)	220.6 (217.8, 223.4)	**−4.6***	−2.1
Starch (g)	128.8 (127.3, 130.4)	127.5 (124.2, 130.8)	124.5 (121.9, 127.0)	−1.4	**−4.4****
Mono-/disaccharides (g)	88.8 (87.3, 90.2)	83.6 (80.0, 87.2)	90.5 (87.3, 93.8)	**−5.2****	1.8
Fiber (g)	21.6 (21.3, 21.8)	21.1 (20.5, 21.6)	20.9 (20.4, 21.5)	−0.5	**−0.6***
Added sugars (g)	26.8 (25.8, 27.8)	25.4 (23.3, 27.4)	27.5 (25.8, 29.2)	−1.4	0.7
Alcohol (g)	3.3 (3.0, 3.6)	3.1 (2.5, 3.7)	2.4 (2.0, 2.7)	−0.2	**−0.9*****
Retinol (μg)	862.9 (830.6, 895.1)	890.3 (824.3, 956.3)	899.9 (849.4, 950.4)	27.4	37.0
Carotene (μg)	3011 (2871, 3152)	2927 (2524, 3331)	2662 (2492, 2833)	−83.9	**−348.7****
Vitamin A (RAE μg)	1202 (1168, 1236)	1246 (1163, 1329)	1227 (1173, 1281)	44.3	25.4
Vitamin D (μg)	11.6 (11.2, 12.1)	13.3 (12.4, 14.1)	12.1 (11.5, 12.7)	**1.6*****	0.4
Vitamin E (mg alfa-TE)	14.3 (14.0, 14.6)	15.0 (14.4, 15.6]	14.1 (13.7, 14.4)	**0.7***	−0.2
Vitamin B1 (mg)	1.8 (1.8, 1.8)	1.8 (1.8, 1.9)	1.9 (1.8, 1.9)	0.02	**0.05****
Vitamin B2 (mg)	2.6 (2.5, 2.6)	2.6 (2.5, 2.7)	2.8 (2.7, 2.9)	0.04	**0.2*****
Niacin (mg)	24.0 (23.7, 24.3)	24.7 (24.2, 25.2)	24.7 (24.3, 25.2)	**0.7***	**0.7****
Vitamin B6 (mg)	1.8 (1.8, 1.8)	1.8 (1.8, 1.8)	1.8 (1.8, 1.8)	0.01	0.02
Folate (μg)	261.1 (257.9, 264.3)	257.5 (250.8, 264.2)	254.6 (250.0,259.2)	−3.6	**−6.5***
Vitamin B12 (μg)	8.7 (8.5, 8.9)	9.6 (9.2, 9.9)	10.3 (9.9, 10.6)	**0.8*****	**1.5*****
Vitamin C (mg)	86.6 (83.5, 89.8)	82.2 (76.3, 88.1)	82.9 (77.7, 88.1)	−4.4	−3.7
Calcium (mg)	1024 (991, 1058)	988 (932, 1044)	1002 (960, 1045)	−36.1	−21.7
Iron (mg)	10.6 (10.5, 10.7)	11.2 (11.0, 11.4)	12.1 (11.8, 12.4)	**0.7*****	**1.6*****
Sodium(mg)	2890 (2858, 2922)	2970 (2915, 3025)	2913 (2872, 2954)	**80.3****	23.4
Potassium (mg)	4687 (4632, 4742)	4684 (4535, 4832)	4797 (4705, 4890)	−3.1	**110.3***
Magnesium (mg)	391.0 (387.8, 394.2)	386.6 (379.3, 394.0)	385.0 (380.1, 390.0)	−4.3	**−6.0***
Zinc (mg)	11.8 (11.7, 11.9)	12.3 (12.1, 12.5)	12.7 (12.5, 12.9)	**0.5*****	**0.9*****
Selenium (μg)	71.6 (70.1, 73.1)	75.9 (74.0, 77.7)	71.9 (70.2, 73.6)	**4.3*****	0.3
Copper (mg)	1.2 (1.2, 1.2)	1.2 (1.2, 1.3)	1.2 (1.2, 1.3)	0.01	0.01
Phosphorus (mg)	1919 (1896, 1943)	1951 (1905, 1997)	1937 (1902, 1971)	31.9	17.3
Iodine (μg)	121.8 (117.2, 126.5)	114.9 (103.2, 126.5)	113.8 (107.4, 120.1)	−7.0	**−8.1***
Protein (E%)	18.7 (18.5, 18.9)	19.3 (18.9, 19.7)	19.3 (19.1, 19.6)	**0.6***	**0.6*****
Total fat (E%)	35.3 (35.0, 35.6)	35.8 (35.1, 36.5)	35.8 (35.2, 36.3)	0.5	0.4
SFA (E%)	12.9 (12.7, 13.1)	13.2 (12.9, 13.6)	13.3 (13.0, 13.6)	0.3	**0.4***
PUFA (E%)	5.9 (5.8, 6.0)	6.1 (5.9, 6.3)	6.0 (5.9, 6.2)	0.2	0.1
Carbohydrates (E%)	41.8 (41.4, 42.2)	41.0 (40.3, 41.7)	41.6 (41.0, 42.3)	**−0.8***	−0.2
Added sugars (E%)	5.0 (4.8, 5.2)	4.5 (4.1, 4.9)	5.0 (4.7, 5.4)	−0.5	0.04
Alcohol (E%)	1.1 (1.0, 1.2)	1.1 (0.9, 1.3)	0.8 (0.6, 0.9)	−0.01	**−0.3*****

Medians and their 95% CIs adjusted for all covariates are shown for each ethnic group.

[a] Values are β coefficients (ethnic differences in median of nutrient intakes between multiethnic Sami and non-Sami [ref.]) obtained by multivariable-adjusted quantile regression at the median. Models included ethnic groups (non-Sami, multiethnic Sami, Sami), age groups (40-49, 50-59, 60-69 years), education groups (<13, ≥13 years), physical activity groups (low, moderate, high), BMI groups (<30, ≥30 kg/m^2), smoking groups (current, former, never), and energy intake as a continuous variable (kJ). Energy intake was not included in the models with the dependent variable total energy intake, protein (E%), total fat (E%), SFA (E%), PUFA (E%), carbohydrates (E%), added sugars (E%), and alcohol (E%). Statistical significance is indicated with *$P < .05$, **$P < .01$, and ***$P < .001$ and marked in bold font.

[b] Values are β coefficients (ethnic differences in median of nutrient intakes between Sami and non-Sami [ref.]) obtained by multivariable-adjusted quantile regression at the median. Models included ethnic groups (non-Sami, multiethnic Sami, Sami), age groups (40-49, 50-59, 60-69 years), education groups (<13, ≥13 years), physical activity groups (low, moderate, high), BMI groups (<30, ≥30 kg/m^2), smoking groups (current, former, never), and energy intake as a continuous variable (kJ). Energy intake was not included in the models with the dependent variable total energy intake, protein (E%), total fat (E%), SFA (E%), PUFA (E%), carbohydrates (E%), added sugars (E%), and alcohol (E%). Statistical significance is indicated with * $P < .05$, ** $P < .01$, and *** $P < .001$ and marked in bold font.

[c] For inland region.

[d] For coastal region.

Table 5 – Differences in nutrient intakes by ethnicity in women

Daily nutrient intakes	Adjusted medians (95% CIs)	Adjusted medians (95% CIs)	Adjusted medians (95% CIs)	β[a]	β[b]
	Non-Sami (n = 1495)	Multiethnic Sami (n = 336)	Sami (n = 619)		
Water	2880 (2832, 2928)	2979 (2866, 3092)	2991 (2912, 3070)	98.9	**111.2***
Energy (kJ)	7434 (7300, 7568)	7780 (7422, 8138)	7265 (7050, 7481)	345.8	–168.9
Energy (kJ)[c]	7385 (6635, 8136)	7326 (6784, 7869)	7188 (6929, 7447)	–58.8	–197.6
Energy (kJ)[d]	7449 (7313, 7585)	7988 (7596, 8379)	7237 (6803, 7672)	538.4	–212.2
Protein (g)	83.6 (82.8, 84.3)	85.1 (83.3, 86.9)	85.9 (84.6, 87.2)	1.6	**2.4*****
Total fat (g)	72.5 (71.8, 73.2)	72.5 (71.1, 73.9)	73.6 (72.7, 74.4)	–0.00002	**1.1***
SFA (g)	26.9 (26.5, 27.2)	26.8 (26.1, 27.5)	27.3 (26.8, 27.9)	–0.06	0.5
Trans-fatty acids (g)	0.6 (0.6, 0.6)	0.6 (0.5, 0.6)	0.6 (0.6, 0.6)	–0.02	0.01
MUFA (g)	25.6 (25.3, 25.9)	25.2 (24.7, 25.7)	25.7 (25.3, 26.1)	–0.4	0.1
PUFA (g)	12.3 (12.1, 12.4)	12.5 (12.2, 12.9)	12.6 (12.3, 12.9)	0.3	0.3
Omega 3 fatty acids (g)	0.7 (0.6, 0.7)	0.8 (0.7, 0.9)	0.7 (0.6, 0.8)	0.1	0.02
Omega 6 fatty acids (g)	0.8 (0.8, 0.8)	0.8 (0.8, 0.9)	0.7 (0.7, 0.8)	0.03	**–0.06****
Cholesterol (mg)	291.0 (286.2, 295.8)	296.5 (286.1, 306.9)	291.2 (283.8, 298.6)	5.5	0.2
Carbohydrates (g)	190.4 (188.9, 192.0)	188.3 (184.7, 191.9)	188.7 (186.1, 191.2)	–2.1	–1.8
Starch (g)	104.9 (103.8, 106.0)	103.5 (100.7, 106.3)	103.6 (101.4, 105.8)	–1.4	–1.3
Mono-/disaccharides (g)	79.1 (77.7, 80.6)	76.8 (74.0, 79.5)	79.2 (77.2, 81.1)	–2.39	0.01
Fiber (g)	21.5 (21.2, 21.9)	21.1 (20.4, 21.8)	21.1 (20.6, 21.6)	–0.4	–0.4
Added sugars (g)	22.0 (21.3, 22.7)	22.5 (21.3, 23.7)	24.1 (22.8, 25.4)	0.5	**2.1****
Alcohol (g)	1.8 (1.6, 2.0)	1.6 (1.3, 1.9)	1.0 (0.8, 1.1)	–0.2	**–0.8*****
Retinol (μg)	707.0 (683.3, 730.8)	728.6 (669.0, 788.2)	703.5 (659.8, 747.1)	21.6	–3.6
Carotene (μg)	3711 (3559, 3863)	3611 (3296, 3926)	3545 (3317, 3772)	–99.7	–166.3
Vitamin A (RAE μg)	1123 (1094, 1151)	1131 (1075, 1186)	1087 (1041, 1133)	8.2	–35.5
Vitamin D (μg)	9.2 (8.8, 9.5)	9.8 (9.0, 10.5)	9.5 (9.0, 10.0)	0.6	0.3
Vitamin E (mg alfa-TE)	12.5 (12.3, 12.6)	12.5 (12.1, 12.8)	12.2 (11.9, 12.5)	–0.01	–0.3
Vitamin B1 (mg)	1.5 (1.5, 1.6)	1.6 (1.5, 1.6)	1.6 (1.5, 1.6)	0.03	0.01
Vitamin B2 (mg)	2.1 (2.1, 2.1)	2.2 (2.1, 2.2)	2.3 (2.2, 2.4)	0.08	**0.2*****
Niacin (mg)	20.1 (19.9, 20.3)	20.7 (20.2, 21.2)	20.9 (20.5, 21.3)	**0.6***	**0.8*****
Vitamin B6 (mg)	1.6 (1.6, 1.6)	1.6 (1.5, 1.6)	1.6 (1.5, 1.6)	0.01	–0.01
Folate (μg)	245.6 (242.6, 248.6)	243.6, (238.3, 249.0)	238.5 (232.1, 244.9)	–2.0	–7.1
Vitamin B12 (μg)	7.0 (6.9, 7.1)	7.7 (7.4, 8.0)	8.3 (8.0, 8.6)	**0.7*****	**1.3*****
Vitamin C (mg)	99.7 (96.5, 102.9)	99.6 (92.8, 106.3)	97.5 (91.7, 103.4)	–0.2	–2.2
Calcium (mg)	855 (836, 875)	863 (823, 903)	850 (820, 880)	7.7	–5.8
Iron (mg)	9.3 (9.3, 9.4)	9.8 (9.6, 10.0)	11.1 (10.9, 11.3)	**0.4*****	**1.8*****
Sodium(mg)	2344 (2322, 2365)	2420 (2366, 2475)	2357 (2321, 2392)	**76.7****	13.1
Potassium (mg)	4105 (4056, 4153)	4126 (4023, 4229)	4177 (4082, 4271)	21.6	72.3
Magnesium (mg)	336.9 (334.9, 338.9)	337.2 (331.8, 342.6)	333.7 (330.6, 336.8)	0.3	–3.2
Zinc (mg)	10.2 (10.1, 10.3)	10.5 (10.3, 10.7)	11.1 (10.9, 11.2)	**0.3****	**0.9*****
Selenium (μg)	58.6 (57.6, 59.6)	60.3 (58.6, 61.9)	58.8 (57.2, 60.3)	1.7	0.2
Copper (mg)	1.1 (1.1, 1.1)	1.1 (1.1, 1.1)	1.1 (1.1, 1.1)	–0.002	0.01
Phosphorus (mg)	1643 (1629, 1658)	1680 (1644, 1716)	1657 (1633, 1681)	36.6	13.5
Iodine (μg)	87.9 (85.2, 90.5)	87.5 (82.4, 92.6)	86.1 (82.7, 89.5)	–0.3	–1.8
Protein (E%)	18.7 (18.5, 18.9)	19.0 (18.7, 19.3)	19.2 (18.9, 19.6)	0.3	**0.5****
Total fat (E%)	35.0 (34.7, 35.4)	35.0 (34.4, 35.6)	35.4 (35.0, 35.8)	–0.03	0.4
SFA (E%)	12.9 (12.8, 13.1)	13.1 (12.8, 13.4)	13.2 (12.9, 13.4)	0.2	0.2
PUFA (E%)	5.9 (5.9, 6.0)	6.1 (5.9, 6.2)	6.0 (5.9, 6.2)	0.2	0.1
Carbohydrates (E%)	42.4 (42.1, 42.7)	42.0 (41.1, 42.8)	42.0 (41.5, 42.5)	–0.4	–0.4
Added sugars (E%)	4.8 (4.6, 5.0)	5.1 (4.7, 5.4)	5.4 (5.1, 5.7)	0.2	**0.6****
Alcohol (E%)	0.7 (0.6, 0.8)	0.6 (0.5, 0.7)	0.4 (0.3, 0.4)	–0.1	**–0.3*****

Medians and their 95% CIs adjusted for all covariates are shown for each ethnic group.

[a] Values are β coefficients (ethnic differences in median of nutrient intakes between multiethnic Sami and non-Sami [ref.]) obtained by multivariable-adjusted quantile regression at the median. Models included ethnic groups (non-Sami, multiethnic Sami, Sami), age groups (40-49, 50-59, 60-69 years), education groups (<13, ≥13 years), physical activity groups (low, moderate, high), BMI groups (<30, ≥30 kg/m^2), smoking groups (current, former, never), and energy intake as a continuous variable (kJ). Energy intake was not included in the models with the dependent variable total energy intake, protein (E%), total fat (E%), SFA (E%), PUFA (E%), carbohydrates (E%), added sugars (E%), and alcohol (E%). Statistical significance is indicated with $^{*}P < .05$, $^{**}P < .01$, and $^{***}P < .001$ and marked in bold font.

[b] Values are β coefficients (ethnic differences in median of nutrient intakes between Sami and non-Sami [ref.]) obtained by multivariable-adjusted quantile regression at the median. Models included ethnic groups (non-Sami, multiethnic Sami, Sami), age groups (40-49, 50-59, 60-69 years), education groups (<13, ≥13 years), physical activity groups (low, moderate, high), BMI groups (<30, ≥30 kg/m^2), smoking groups (current, former, never), and energy intake as a continuous variable (kJ). Energy intake was not included in the models with the dependent variable total energy intake, protein (E%), total fat (E%), SFA (E%), PUFA (E%), carbohydrates (E%), added sugars (E%), and alcohol (E%). Statistical significance is indicated with $^{*}P < .05$, $^{**}P < .01$, and $^{***}P < .001$ and marked in bold font.

[c] For inland region.

[d] For coastal region.

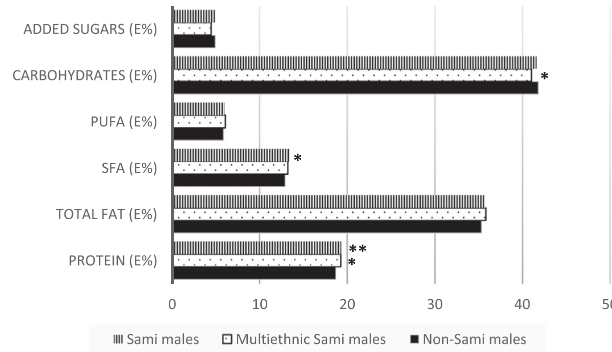

Fig. 3 – Contribution of protein, total fat, SFA, PUFA, carbohydrates, and added sugars (E%) to daily energy intake by ethnicity[a] in men.[a] [a]Comparison of adjusted medians between ethnic groups. Adjusted medians and median differences were calculated using multivariable median regression adjusting for age, education, physical activity, BMI, and smoking status. Significant differences from non-Sami are indicated with *P < .05, **P < .01, and ***P < .001.

ethnicity; thus, comparisons should be treated with caution [18]. In the comparison study, mean SFA intakes were between 12.9 E% and 15.2 E%, and no ethnic differences were found in the combined male and female sample [18]. In the present study, multiethnic Sami men had a higher cholesterol intake, a finding which has been documented [18,23], but the difference was small. Our participants reported a satisfactory PUFA intake.

High sodium (salt) intake has been associated with hypertension and cardiovascular disease [45,46]. There is also increasing evidence of direct link between high sodium intake and obesity [47-49]. We saw high sodium intake in our study sample, especially in men, which is in agreement with a previous report that showed high sodium intake among Sami

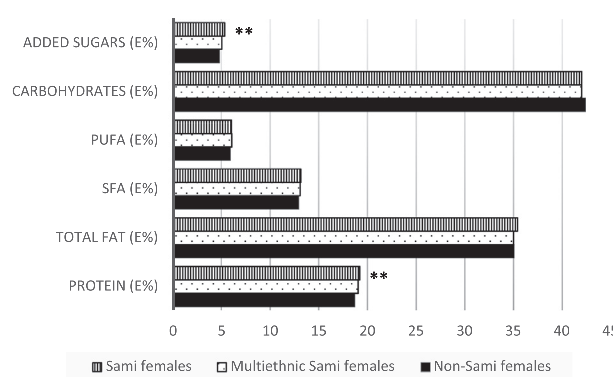

Fig. 4 – Contribution of protein, total fat, SFA, PUFA, carbohydrates, and added sugars (E%) to daily energy intake by ethnicity[a] in women.[a] Comparison of adjusted medians between ethnic groups. Adjusted medians and median differences were calculated using multivariable median regression adjusting for age, education, physical activity, BMI, and smoking status. Significant differences from non-Sami are indicated with *P < .05, **P < .01, and ***P < .001.

and Norwegian men and women [18]. Further investigation as to whether excessive sodium intake is a possible risk factor for obesity and metabolic syndrome is warranted in this study population.

In the present study, median fiber intake was lower than the recommendations of the 2012 NNR in both sexes and in all ethnic groups. Sami men had a significantly lower fiber intake than non-Sami men, and the inland population had a significantly lower fiber intake than the coastal population, which are similar to previous results (2.1 vs 2.5 g/kJ among Sami and Norwegian men, respectively, and 2.6 vs 2.9 g/kJ among Sami and Norwegian women, respectively) [18].

Excess weight gain, dental caries, and nutrient displacement are health concerns related to an increase in the intake of added sugars [50]. Added sugars provide significant energy, and the recommended intake is <10 E% [36]. In a previous study by Nilsen et al [18], the contribution of sugars to daily energy intake was higher in Sami than Norwegian men (10.6 vs 8.9 E%, respectively) and in Sami than Norwegian women (9.9 vs 7.5 E%, respectively). Indeed, considerably reduced intakes of added sugars have been reported in the Norwegian population [4], following national campaigns that aim to promote a healthier diet. We found that Sami women derived 12% more energy from added sugars than non-Sami women and that the inland population tended to have a higher intake of added sugars than the coastal population. Given the high rate of central obesity (45%) observed in Sami women with strong Sami affiliation in the SAMINOR 1 Survey [51] and the high prevalence of metabolic syndrome observed in Sami women younger than 50 years [29], it is important to obtain more knowledge on the factors that contribute to these conditions in Sami women. The intake of sugars should be considered in these investigations.

Overall, the intake of the fat-soluble vitamins A, D, and E was high in this rural population of Northern Norway, and there are several possible explanations for this. Cod liver oil supplements are widely used in Norway [52], and the intake of fish, fish liver, and roe is also high in the rural coastal areas [53]. Cod liver oil is generally considered a supplement. However, in Norway, there is a long tradition of taking a spoonful of liquid cod liver oil («tran» in Norwegian) on a daily basis, especially during the dark winter period. For this reason, we included liquid cod liver oil in our calculations.

We found that multiethnic Sami men had significantly higher intakes of vitamins D, E, and selenium than non-Sami men. In fact, the diet of multiethnic Sami men was characterized not only by a high intake of lean marine fish species (like the Norwegian diet) but also by moderate intake of reindeer meat (like the Sami diet) and a higher intake of oily and fresh water fish than in non-Sami men [42]. The majority of men who reported multiethnic Sami ethnicity (84%) resided in the coastal region; therefore, higher fish consumption is likely the more important driver of the observed differences between multiethnic Sami and non-Sami men.

In line with the aforementioned comparison study [18], we found that calcium and vitamin C intakes were adequate in relation to recommended values and were similar in all ethnic groups, whereas intakes of carotene and folate were lower among Sami men than non-Sami men. Folate was reported to be low among Sami in the comparison study (mean folate

Table 6 – Differences in nutrient intakes by geographic region in men and women

Daily nutrient intakes	Men			Women		
	Region			Region		
	Coastal	Inland		Coastal	Inland	
	Adjusted medians (95% CIs)	Adjusted medians (95% CIs)	β[a]	Adjusted medians (95% CIs)	Adjusted medians (95% CIs)	β[a]
Water	3059 (3019, 3100)	3166 (3078, 3253)	**107***	2906 (2862, 2949)	2982 (2899, 3065)	76.3
Energy (kJ)	8915 (8764, 9066)	8638 (8209, 9068)	−277	7480 (7359, 7602)	7260 (7021, 7499)	−220
Protein (g)	99.6 (98.7, 100.5)	101.8 (100.2, 103.3)	**2.2***	84.1 (83.5, 84.8)	85.1 (83.6, 86.5)	0.9
Total fat (g)	87.1 (86.3, 87.9)	88.0 (86.6, 89.4)	0.8	72.7 (72.1, 73.3)	73.3 (72.3, 74.3)	0.6
SFA (g)	32.3 (31.9, 32.7)	33.6 (32.7, 34.4)	**1.3****	26.8 (26.5, 27.1)	27.5 (27.0, 28.1)	**0.7***
Trans-fatty acids (g)	0.7 (0.6, 0.7)	0.7 (0.7, 0.7)	0.03	0.6 (0.6, 0.6)	0.6 (0.6, 0.6)	0.02
MUFA (g)	31.0 (30.7, 31.3)	30.7 (30.2, 31.3)	−0.3	25.6 (25.3, 25.8)	25.5 (25.1, 26.0)	−0.02
PUFA (g)	14.6 (14.5, 14.8)	14.4 (14.1, 14.7)	−0.2	12.3 (12.2, 12.5)	12.4 (12.1, 12.6)	0.02
Omega 3 fatty acids (g)	1.0 (0.9, 1.0)	0.9 (0.8, 1.0)	−0.05	0.7 (0.7, 0.8)	0.7 (0.6, 0.8)	−0.02
Omega 6 fatty acids (g)	1.0 (0.9, 1.0)	0.9 (0.8, 0.9)	**−0.1****	0.8 (0.8, 0.8)	0.7 (0.7, 0.8)	**−0.1*****
Cholesterol (mg)	352.5 (347.3, 357.7)	345.4 (333.8, 357.09	−7.0	292.2 (287.7, 296.7)	288.2 (279.5, 296.9)	−4.0
Carbohydrates (g)	221.7 (220.0, 223.3)	222.0 (218.9, 225.0)	0.3	189.9 (188.6, 191.2)	189.2 (186.6, 191.89	−0.7
Starch (g)	128.5 (127.0, 129.9)	123.9 (120.8, 127.0)	**−4.6****	104.6 (103.5, 105.6)	103.0 (100.6, 105.3)	−1.6
Mono-/disaccharides (g)	87.3 (85.8, 88.8)	92.7 (89.8, 95.7)	**5.4****	78.3 (77.0, 79.69	80.3 (78.3, 82.4)	2.1
Fiber (g)	21.6 (21.4, 21.9)	20.4 (19.9, 20.9)	**−1.2*****	21.6 (21.4, 21.9)	20.7 (20.2, 21.3)	**−0.9****
Added sugars (g)	26.3 (25.4, 27.1)	29.1 (27.2, 31.0)	**2.8****	22.2 (21.6, 22.8)	24.5 (22.9, 26.0)	**2.3****
Alcohol (g)	3.2 (3.0, 3.5)	2.1 (1.8, 2.5)	**−1.1*****	1.8 (1.6, 1.9)	0.9 (0.7, 1.0)	**−0.9*****
Retinol (μg)	875.5 (849.0, 901.9)	847.9 (787.3, 908.5)	−27.6	709.4 (689.0, 729.8)	707.9 (659.1, 756.7)	−1.5
Carotene (μg)	3059 (2915, 3203)	2495 (2298, 2691)	**−564.3*****	3740 (3607, 3873)	3338 (3041, 3634)	**−402.7***
Vitamin A (RAE μg)	1223 (1191, 1254)	1186 (1126, 1246)	−36.7	1123 (1098, 1147)	1093 (1045, 1140)	−30.0
Vitamin D (μg)	12.1 (11.7, 12.5)	11.7 (11.1, 12.3)	−0.4	9.3 (8.9, 9.6)	9.5 (9.0, 10.0)	0.2
Vitamin E (mg alfa-TE)	14.5 (14.2, 14.8)	13.9 (13.5, 14.2)	**−0.6****	12.5 (12.3, 12.6)	12.1 (11.7, 12.4)	**−0.4***
Vitamin B1 (mg)	1.8 (1.8, 1.8)	1.9 (1.8, 1.9)	**0.05*****	1.5 (1.5, 1.6)	1.6 (1.5, 1.6)	**0.02***
Vitamin B2 (mg)	2.6 (2.5, 2.6)	2.9 (2.8, 2.9)	**0.3*****	2.1 (2.1, 2.1)	2.4 (2.3, 2.4)	**0.3*****
Niacin (mg)	24.2 (24.0, 24.5)	24.4 (23.9, 25.0)	0.2	20.3 (20.1, 20.5)	20.7 (20.2, 21.2)	0.4
Vitamin B6 (mg)	1.8 (1.8, 1.8)	1.8 (1.7, 1.8)	−0.01	1.6 (1.6, 1.6)	1.6 (1.5, 1.6)	−0.01
Folate (μg)	261.0 (258.0, 264.0)	252.3 (247.7, 256.9)	**−8.7****	245.3 (242.7, 247.9)	237.1 (230.6, 243.7)	**−8.1***
Vitamin B12 (μg)	8.9 (8.8, 9.1)	10.5 (10.0, 10.9)	**1.6*****	7.2 (7.1, 7.3)	8.5 (8.1, 8.8)	**1.3*****
Vitamin C (mg)	86.0 (83.0, 89.1)	83.4 (78.2, 88.6)	−2.6	99.3 (96.3, 102.2)	99.7 (93.7, 105.7)	0.4
Calcium (mg)	1014 (986, 1042)	1011 (960, 1062)	−3.5	849 (831, 866)	879 (850, 908)	30.2
Iron (mg)	10.7 (10.6, 10.8)	12.5 (12.2, 12.8)	**1.8*****	9.5 (9.4, 9.6)	11.1 (10.9, 11.3)	**1.6*****
Sodium(mg)	2917 (2890, 2944)	2888 (2838, 2938)	−28.6	2366 (2347, 2386)	2292 (2246, 2337)	**−74.5****
Potassium (mg)	4680 (4632, 4729)	4841 (4750, 4932)	**160.9****	4104 (4061, 4147)	4196 (4101, 4290)	91.7
Magnesium (mg)	390.6 (387.8, 393.4)	383.9 (379.3, 388.4)	**−6.8****	336.7 (334.9, 338.5)	334.1 (330.5, 337.6)	−2.6
Zinc (mg)	11.9 (11.8, 12.0)	12.8 (12.6, 13.1)	**1.0*****	10.3 (10.2, 10.3)	11.1 (10.9, 11.3)	**0.8*****
Selenium (μg)	72.6 (71.3, 73.9)	71.4 (69.5, 73.2)	−1.3	59.2 (58.3, 60.1)	58.1 (56.6, 59.7)	−1.0
Copper (mg)	1.2 (1.2, 1.2)	1.3 (1.2, 1.3)	0.01	1.1 (1.1, 1.1)	1.1 (1.1, 1.1)	0.01
Phosphorus (mg)	1921 (1901, 1942)	1964 (1924, 2004)	42.8	1647 (1633, 1660)	1662 (1638, 1686)	15.2
Iodine (μg)	119.8 (115.6, 124.0)	116.1 (108.2, 124.1)	−3.7	87.3 (84.8, 89.8)	87.1 (83.2, 91.0)	−0.2
Protein (E%)	18.8 (18.7, 19.0)	19.3 (19.0, 19.6)	**0.5***	18.8 (18.7, 19.0)	19.2 (18.8, 19.6)	0.3
Total fat (E%)	35.4 (35.1, 35.7)	35.8 (35.2, 36.5)	0.4	35.1 (34.8, 35.4)	35.2 (34.7, 35.7)	0.1
SFA (E%)	12.9 (12.8, 13.1)	13.5 (13.1, 13.9)	**0.6****	12.9 (12.8, 13.1)	13.3 (13.0, 13.6)	**0.3***
PUFA (E%)	6.0 (5.9, 6.0)	5.9 (5.8, 6.0)	−0.1	6.0 (5.9, 6.0)	6.0 (5.8, 6.1)	0.01
Carbohydrates (E%)	41.7 (41.3, 42.0)	41.9 (41.3, 42.5)	0.2	42.3 (42.0, 42.6)	42.1 (41.5, 42.7)	−0.2
Added sugars (E%)	4.9 (4.7, 5.1)	5.4 (5.0, 5.8)	**0.5***	4.9 (4.7, 5.0)	5.4 (5.0, 5.8)	**0.5***
Alcohol (E%)	1.1 (1.0, 1.2)	0.7 (0.6, 0.8)	**−0.4*****	0.7 (0.6, 0.8)	0.3 (0.2, 0.4)	**−0.4*****

[a] Values are β coefficients (regional differences in median of nutrient intakes between inland and coastal ([ref.] regions) obtained by multivariable-adjusted quantile regression at the median. Models included geographic regions (inland, coastal), age groups (40-49, 50-59, 60-69 years), education groups (<13, ≥13 years), physical activity groups (low, moderate, high), BMI groups (<30, ≥30 kg/m^2), smoking groups (current, former, never), and energy intake as a continuous variable (kJ). Energy intake was not included in the models with the dependent variable total energy intake, protein (E%), total fat (E%), SFA (E%), PUFA (E%), carbohydrates (E%), added sugars (E%), and alcohol (E%). Statistical significance is indicated with $^{*}P < .05$, $^{**}P < .01$, and $^{***}P < .001$. β coefficients are marked in bold if statistically significant in fully adjusted models.

intake 203 μg/d in Sami men and 156 μg/d in Sami women) [18]. Our findings of a lower alcohol intake in Sami than non-Sami participants are also in line with previous studies [44,54].

Currently, suboptimal iodine intake in the general population, especially in women, is of concern to Norwegian health authorities [6]. This may be linked to a reduction in milk intake, which is one of the main sources of iodine in the Norwegian population [4]. The health effects of mild iodine deficiency have not been well studied in the Norwegian population, but impaired fetal neurological development, brain damage, and impaired cognitive development in children are possible consequences [55-59]. In the present study, iodine intake was also moderately low in women, and Sami men had a lower iodine intake than non-Sami men.

Mean energy intake in Sami men was 8705 kJ, which was significantly lower than that observed in non-Sami men. The corresponding value in the comparison study was 12 624 kJ in Sami men, which was significantly higher than that reported in Norwegian men [18]. However, approximately the same energy intake was reported for Sami women in both studies, and no ethnic differences were observed. One explanation of the lower energy intake observed among Sami men in our study might be the differences in lifestyle and the lower energy requirements in Sami men today as compared with the 1990s, when the comparison study was performed. Indeed, 25% of our Sami men reported a low physical activity level; only 15% reported a high physical activity level.

Our study has its limitations. Daily nutrient intake was derived from the FFQ, in which participants reported how often each food item was eaten over the past 12 months. This is the most commonly used method to study differences in nutrient intakes between large population subgroups and provides reasonably valid estimates [33,60]. It also allowed us to take into consideration seasonal eating habits for some foods, like certain fish species and fish liver. However, one of the main limitations of the FFQ is that it did not cover the entire diet, which could result in lower estimated energy and nutrient intake. Indeed, it has been shown that the restricted list of food items and the restricted response categories included in an FFQ likely contribute to measurement error and that the prevalence of underreporting differs by nutrient [61]. We should specifically mention this in relation to the possible underestimation of iodine intake. Although the most important sources of iodine in the Norwegian Food Composition table were analyzed for their iodine content, these data were missing for several foods (www.matportalen.no/verktoy/the_norwegian_food_composition_table/). We relied on subjects' self-reported dietary and lifestyle data. Thus, we cannot rule out recall, education, and social desirability biases. Another limitation of this study is that the FFQ we used has not been specifically validated in men or in the Indigenous Sami population. It is possible that Sami men (especially in the inland region) were more likely to underreport their daily nutrient intake in the present study or that the FFQ did not include some of the traditional food items they consumed, in which case the nutrient intakes might be underestimated. On the other hand, attitudes toward the FFQ might differ between Sami men and other groups, and Sami men may have completed the FFQ less precisely. It is also possible that Sami participants overreported reindeer meat consumption as a way of confirming their occupational success as reindeer herders. Selective underreporting of dietary intake in participants with a high BMI is a well-known phenomenon [61-63] and may have been a factor in underreporting energy intake in Sami men. In the present study, the prevalence of obesity was higher in Sami men (34%) than in non-Sami men (28%). Interestingly, the mean BMI among Sami men was 28.7 kg/m^2 in the present study vs 26.1 kg/m^2 in the previous study [18]. Another relevant limitation of our study includes the relatively low response rate; thus, the generalizability of the findings may be questionable. Also, only 10 municipalities were included, and the sample was limited to the age group 40-69 years. Therefore, our results cannot be applied to young adults or the elderly. Ethnicity is assumed to influence our food traditions and habits. However, there are no standardized, validated methods to define ethnicity. Categorization based on ethnic self-definition is widely used in international research [64-66], and this method was used in the present study. The practice of allowing participants to report self-perceived ethnicity, rather than assigning them to an ethnic group based on other variables, acknowledges both the ethical and methodological challenges of determining ethnicity because self-perceived ethnicity is partly determined by cultural practices like dietary habits. Our results confirmed that the variable self-perceived ethnicity was sensitive for cultural practices like dietary habits.

An important strength of the present study was its large sample size. This study is a follow-up of the SAMINOR 1 Survey, which included only a limited number of dietary questions. In contrast, the SAMINOR 2 Clinical Survey questionnaire was much more comprehensive and gives a better assessment of diet. Our rural population sample is a unique, heterogeneous sample with respect to sex, ethnicity, education, and lifestyle.

In conclusion, the results from the present study are consistent with our hypotheses. These survey data show that generally reported dietary intake of the Indigenous Sami population was not different from that of the non-Sami population, except for certain meat-derived nutrient intakes: primarily iron and vitamin B12. Overall, a higher intake of SFA and sodium and a lower intake of fiber than that recommended in the 2012 NNR may be contributing factors in the risk of chronic disease in the population of rural Northern Norway, regardless of ethnicity and geographic region.

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research project, designed the study, and revised the paper. All authors contributed to the interpretation of data and approved the final version of the manuscript. The authors declare that they have no competing interests.

REFERENCES

[1] GDB. GDB (Global Burden of Diseases) profile: Norway. http://www.healthdata.org/sites/default/files/files/country_profiles/GBD/ihme_gbd_country_report_norway.pdf; 2015, Accessed date: 9 March 2015.

[2] Mozaffarian D. Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. Circulation 2016;133:187–225.

[3] Marmot M, Atinmo T, Byers T, Chen J, Hirohata T, Jackson A, et al. Food, nutrition, physical activity, and the prevention of cancer: a global perspective. World Cancer Research Fund / American Institute for Cancer Research; 2007.

[4] Utviklingen i norsk kosthold 2017 (Development of the Norwegian diet 2017). Available in norwegian from https://helsedirektoratet.no/Lists/Publikasjoner/Attachments/1414/Utviklingen-i-norsk-kosthold-2017-IS-2680.pdf.

[5] Totland TH. Helsedirektoratet. Norkost 3: en landsomfattende kostholdsundersøkelse blant menn og kvinner i Norge i alderen 18–70 år, 2010–2011. Helsedirektoratet: Oslo; 2012.

[6] Risiko for jodmangel i Norge Identifisering av et akutt behov for tiltak. Nasjonalt råd for ernæring; 2016.

[7] Brantsaeter AL, Haugen M, Julshamn K, Alexander J, Meltzer HM. Evaluation of urinary iodine excretion as a biomarker for intake of milk and dairy products in pregnant women in the Norwegian Mother and Child Cohort Study (MoBa). Eur J Clin Nutr 2009;63:347–54.

[8] Aubert V. Den samiske befolkningen i Nord-Norge = Sámi ál'bmut Davvi-Norgas = the Lappish population in Northern Norway. Statistisk sentralbyrå: Oslo; 1978.

[9] Kuhnlein HV, Receveur O. Dietary change and traditional food systems of indigenous peoples. Annu Rev Nutr 1996;16:417–42.

[10] Nilsson LM, Dahlgren L, Johansson I, Brustad M, Sjolander P, Van Guelpen B. Diet and lifestyle of the Sami of southern Lapland in the 1930s-1950s and today. Int J Circumpolar Health 2011;70:301–18.

[11] Kozlov A, Borinskaya S, Vershubsky G, Vasilyev E, Popov V, Sokolova M, et al. Genes related to the metabolism of nutrients in the Kola Sami population. Int J Circumpolar Health 2008;67:58–68.

[12] Kloster J. The distribution and frequency of rickets in one of the fishery districts of Finnmark and relation of diet to the disorder. Acta Paediatr 1931;12(Suppl 3):S1–S82.

[13] Brustad M, Parr CL, Melhus M, Lund E. Dietary patterns in the population living in the Sami core areas of Norway—the SAMINOR study. Int J Circumpolar Health 2008;67:82–96.

[14] Brustad M, Parr CL, Melhus M, Lund E. Childhood diet in relation to Sami and Norwegian ethnicity in northern and mid-Norway—the SAMINOR study. Public Health Nutr 2008;11:168–75.

[15] Haglin L. Nutrient intake among Saami people today compared with an old, traditional Saami diet. Arctic Med Res 1991:741–6 [Suppl.].

[16] Haglin L. The nutrient density of present-day and traditional diets and their health aspects: the Sami- and lumberjack families living in rural areas of northern Sweden. Int J Circumpolar Health 1999;58:30–43.

[17] Brox J, Bjornstad E, Olaussen K. Hemoglobin, iron, nutrition and life-style among adolescents in a coastal and an inland community in northern Norway. Int J Circumpolar Health 2003;62:130–41.

[18] Nilsen H, Utsi E, Bonaa KH. Dietary and nutrient intake of a Sami population living in traditional reindeer herding areas in North Norway: comparisons with a group of Norwegians. Int J Circumpolar Health 1999;58:120–33.

[19] Luoma PV, Nayha S, Sikkila K, Hassi J. High serum alpha-tocopherol, albumin, selenium and cholesterol, and low mortality from coronary heart disease in northern Finland. J Intern Med 1995;237:49–54.

[20] Laitinen J, Näyhä S, Sikkilä K, Hassi J. Diet and cardiovascular risk factors among Lapp and Finnish reindeer herders. Nutr Res 1996;16:1083–93.

[21] Luoma P, Nayha S, Hassi J. High serum concentrations of vitamin E and cholesterol and low mortality from ischaemic heart disease in northern Finland. Arctic Med Res 1995;54 (Suppl. 2):26–8.

[22] Haglin L. The food and nutrient intake of a Swedish Saami population. Arctic Med Res 1988;47(Suppl. 1):139–44.

[23] Ross AB, Johansson A, Vavruch-Nilsson V, Hassler S, Sjolander P, Edin-Liljegren A, et al. Adherence to a traditional lifestyle affects food and nutrient intake among modern Swedish Sami. Int J Circumpolar Health 2009;68:372–85.

[24] Nilsson LM, Winkvist A, Brustad M, Jansson JH, Johansson I, Lenner P, et al. A traditional Sami diet score as a determinant of mortality in a general northern Swedish population. Int J Circumpolar Health 2012;71:1–12.

[25] Kuhnlein HV, Receveur O, Soueida R, Berti PR. Unique patterns of dietary adequacy in three cultures of Canadian Arctic indigenous peoples. Public Health Nutr 2008;11:349–60.

[26] Mattei J, Malik V, Wedick NM, Hu FB, Spiegelman D, Willett WC, et al. Reducing the global burden of type 2 diabetes by improving the quality of staple foods: the Global Nutrition and Epidemiologic Transition Initiative. Global Health 2015; 11:23.

[27] Gracey M, King M. Indigenous health part 1: determinants and disease patterns. Lancet 2009;374:65–75.

[28] Naseribafrouei A, Eliassen B-M, Melhus M, Svartberg J, Broderstad AR. Prevalence of pre-diabetes and type 2 diabetes mellitus among Sami and non-Sami men and women in Northern Norway—the SAMINOR 2 Clinical Survey. Int J Circumpolar Health 2018;77:1463786.

[29] Broderstad AR, Melhus M. Prevalence of metabolic syndrome and diabetes mellitus in Sami and Norwegian populations. The SAMINOR—a cross-sectional study. BMJ open 2016;6: e009474.

[30] Energy and protein requirements. Report of a joint FAO/WHO/UNU expert consultation, 724. World Health Organization technical report series; 1985. p. 1.

[31] Black AE. Critical evaluation of energy intake using the Goldberg cut-off for energy intake:basal metabolic rate. A practical guide to its calculation, use and limitations. Int J Obes Relat Metab Disord 2000;24:1119–30.

[32] Parr CL, Veierød MB, Laake P, Lund E, Hjartåker A. Test-retest reproducibility of a food frequency questionnaire (FFQ) and estimated effects on disease risk in the Norwegian Women and Cancer Study (NOWAC). Nutr J 2006;5:4.

[33] Hjartaker A, Lund E, Bjerve KS. Serum phospholipid fatty acid composition and habitual intake of marine foods registered by a semi-quantitative food frequency questionnaire. Eur J Clin Nutr 1997;51:736–42.

[34] Hjartaker A, Andersen LF, Lund E. Comparison of diet measures from a food-frequency questionnaire with measures from repeated 24-hour dietary recalls. The Norwegian Women and Cancer Study. Public Health Nutr 2007;10: 1094–103.

[35] Borch KB, Ekelund U, Brage S, Lund E. Criterion validity of a 10-category scale for ranking physical activity in Norwegian women. Int J Behav Nutr Phys Act 2012;9:2.

[36] Nordic Nutrition Reccomendations. Integrating nutrition and physical activity. 5th ed.; 2012.

[37] Guideline: sodium intake for adults and children. Geneva: World Health Organization; 2012.
[38] Guideline: potassium intake for adults and children. Geneva: World Health Organization; 2012.
[39] Davino C, Furno M, Vistocco D. Quantile regression. Quantile regression. John Wiley & Sons, Ltd.; 2014. p. 22–63.
[40] McGreevy KM, Lipsitz SR, Linder JA, Rimm E, Hoel DG. Using median regression to obtain adjusted estimates of central tendency for skewed laboratory and epidemiologic data. Clin Chem 2009;55:165–9.
[41] Hassan AA, Sandanger TM, Brustad M. Selected vitamins and essential elements in meat from semi-domesticated reindeer (*Rangifer tarandus tarandus* L.) in mid- and northern Norway: geographical variations and effect of animal population density. Nutrients 2012;4:724–39.
[42] Petrenya N, Skeie G, Melhus M, Brustad M. Food in rural northern Norway in relation to Sami ethnicity: the SAMINOR 2 clinical survey. Public Health Nutr 2018;21:2665–77.
[43] Broderstad AR, Melhus M, Brustad M, Lund E. Iron stores in relation to dietary patterns in a multiethnic population: the SAMINOR study. Public Health Nutr 2011;14:1039–46.
[44] Broderstad AR, Melhus M, Lund E. Iron status in a multiethnic population (age 36-80 yr) in northern Norway: the SAMINOR study. Eur J Haematol 2007;79:447–54.
[45] He FJ, MacGregor GA. Salt, blood pressure and cardiovascular disease. Curr Opin Cardiol 2007;22:298–305.
[46] Appel LJ, Frohlich ED, Hall JE, Pearson TA, Sacco RL, Seals DR, et al. The importance of population-wide sodium reduction as a means to prevent cardiovascular disease and stroke: a call to action from the American Heart Association. Circulation 2011;123:1138–43.
[47] Ma Y, He FJ, MacGregor GA. High salt intake: independent risk factor for obesity? Hypertension 2015;66:843–9.
[48] Yoon YS, Oh SW. Sodium density and obesity; the Korea National Health and Nutrition Examination Survey 2007-2010. Eur J Clin Nutr 2013;67:141–6.
[49] Song HJ, Cho YG, Lee HJ. Dietary sodium intake and prevalence of overweight in adults. Metabolism 2013;62:703–8.
[50] Erickson J, Sadeghirad B, Lytvyn L, Slavin J, Johnston BC. The scientific basis of guideline recommendations on sugar intake: a systematic review. Ann Intern Med 2017;166:257–67.
[51] Nystad T, Melhus M, Brustad M, Lund E. Ethnic differences in the prevalence of general and central obesity among the Sami and Norwegian populations: the SAMINOR study. Scand J Public Health 2010;38:17–24.
[52] Brustad M, Braaten T, Lund E. Predictors for cod-liver oil supplement use—the Norwegian Women and Cancer Study. Eur J Clin Nutr 2004;58:128–36.
[53] Brustad M, Sandanger T, Aksnes L, Lund E. Vitamin D status in a rural population of northern Norway with high fish liver consumption. Public Health Nutr 2004;7:783–9.
[54] Spein AR, Melhus M, Kristiansen RE, Kvernmo SE. The influence of religious factors on drinking behavior among young indigenous Sami and non-Sami peers in northern Norway. J Relig Health 2011;50:1024–39.
[55] Nyström HF, Brantsæter AL, Erlund I, Gunnarsdottir I, Hulthén L, Laurberg P, et al. Iodine status in the Nordic countries—past and present. Food Nutr Res 2016;60.
[56] Brantsæter AL, Abel MH, Haugen M, Meltzer HM. Risk of suboptimal iodine intake in pregnant Norwegian women. Nutrients 2013;5:424–40.
[57] Delange F. Iodine deficiency in Europe and its consequences: an update. Eur J Nucl Med Mol Imaging 2002;29(Suppl. 2): S404–16.
[58] Abel MH, Ystrom E, Caspersen IH, Meltzer HM, Aase H, Torheim LE, et al. Maternal iodine intake and offspring attention-deficit/hyperactivity disorder: results from a large prospective cohort study. Nutrients 2017;9.
[59] Abel MH, Caspersen IH, Meltzer HM, Haugen M, Brandlistuen RE, Aase H, et al. Suboptimal maternal iodine intake is associated with impaired child neurodevelopment at 3 years of age in the Norwegian Mother and Child Cohort study. J Nutr 2017;147:1314–24.
[60] Yuan C, Spiegelman D, Rimm EB, Rosner BA, Stampfer MJ, Barnett JB, et al. Validity of a dietary questionnaire assessed by comparison with multiple weighed dietary records or 24-hour recalls. Am J Epidemiol 2017;185: 570–84.
[61] Park Y, Dodd KW, Kipnis V, Thompson FE, Potischman N, Schoeller DA, et al. Comparison of self-reported dietary intakes from the automated self-administered 24-h recall, 4-d food records, and food-frequency questionnaires against recovery biomarkers. Am J Clin Nutr 2018;107:80–93.
[62] Tooze JA, Subar AF, Thompson FE, Troiano R, Schatzkin A, Kipnis V. Psychosocial predictors of energy underreporting in a large doubly labeled water study. Am J Clin Nutr 2004;79: 795–804.
[63] Ferrari P, Slimani N, Ciampi A, Trichopoulou A, Naska A, Lauria C, et al. Evaluation of under- and overreporting of energy intake in the 24-hour diet recalls in the European Prospective Investigation into Cancer and Nutrition (EPIC). Public Health Nutr 2002;5:1329–45.
[64] Pettersen T. Sami ethnicity as a variable. Tromsø: UiT; 2015.
[65] Harris RB, Cormack DM, Stanley J. The relationship between socially-assigned ethnicity, health and experience of racial discrimination for Māori: analysis of the 2006/07 New Zealand Health Survey. BMC Public Health 2013; 13:844.
[66] Mays VM, Ponce NA, Washington DL, Cochran SD. Classification of race and ethnicity: implications for public health. Annu Rev Public Health 2003;24:83–110.