

What is known about the health and living conditions of the indigenous people of northern Scandinavia, the Sami?

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Background: The Sami are the indigenous ethnic population of northern Scandinavia. Their health condition is poorly known, although the knowledge has improved over the last decade.

Objectives: The aim was to review the current information on mortality, diseases, and risk factor exposure in the Swedish Sami population.

Design: Health-related research on Sami cohorts published in scientific journals and anthologies was used to compare the health condition among the Sami and the majority non-Sami population. When relevant, data from the Sami populations in Swedish were compared with corresponding data from Norwegian and Finnish Sami populations.

Results: Life expectancy and mortality patterns of the Sami are similar to those of the majority population. Small differences in incidences of cancer and cardiovascular diseases have been reported. The traditional Sami lifestyle seems to contain elements that reduce the risk to develop cancer and cardiovascular diseases, e.g. physical activity, diet rich in antioxidants and unsaturated fatty acids, and a strong cultural identity. Reindeer herding is an important cultural activity among the Sami and is associated with high risks for accidents. Pain in the lower back, neck, shoulders, elbows, and hands are frequent among both men and women in reindeer-herding families. For men, these symptoms are related to high exposure to terrain vehicles, particularly snowmobile, whereas for women psychosocial risk factors seem to be more important, e.g. poor social support, high effort, low reward, and high economical responsibilities.

Conclusions: Although the health condition of the Sami population appears to be rather similar to that of the general Swedish population, a number of specific health problems have been identified, especially among the reindeer-herding Sami. Most of these problems have their origin in marginalization and poor knowledge of the reindeer husbandry and the Sami culture in the majority population. It is suggested that the most sustainable measure to improve the health among the reindeer-herding Sami would be to improve the conditions of the reindeer husbandry and the Sami culture.

Keywords: *review; Sami; reindeer herding; health; mortality; cancer; cardiovascular diseases; physical and psychosocial risk factors; dietary habits; marginalization*

Received: 9 August 2011; Revised: 20 August 2011; Accepted: 22 September 2011; Published: 14 October 2011

The Sami people are the indigenous ethnic group of northern Scandinavia and the Kola Peninsula. Taking advantage of the receding Fennoscandian ice sheet 10,000–7,000 years ago, they migrated from Western Europe through Eastern Europe, up to Northern Scandinavia via Finland and the coastal areas of Norway (1). Phylogenetic reconstructions based on DNA markers have shown that the Sami descended from a small and

distinct subgroup of Western Europeans rather than from indigenous Siberian populations (2, 3).

The size of the present Sami population in the Scandinavian countries is not well known due to lack of ethnic markers in national population records and censuses. Different estimates suggest the total population to consist between about 80,000 and 110,000 Sami (4, 5). The Norwegian Sami population is largest (a high

estimate, 60,000), followed by the Swedish (36,000), the Finnish (10,000), and the Russian (1,991 self-identified in the Census of 2002).

The majority of the Sami still inhabit the northern parts of the Scandinavian countries. The highest density is found along the valley of the *Tana* River where they constitute the ethnic majority in two Norwegian municipalities (*Karasjok* and *Kautokeino*) and in one Finnish municipality (*Utsjoki*) (5). From this core area, the relative frequency of Sami gradually declines with distance, particularly toward the eastern and southern parts of the Scandinavian countries. In Sweden, about 50% of the total Sami population inhabits the northernmost county (*Norrbotten*) and about 15% inhabits the second northernmost county (*Västerbotten*) (6).

Today, most Sami have adopted an ordinary western way of living, with, e.g. modern professions and similar food habits as in the general population. Only small groups are still holding on to a more traditional lifestyle based on fishing, hunting, and reindeer herding. In Sweden and Norway, the legal right to breed and herd reindeer for commercial purposes is restricted to inhabitants of Sami heritage. There are approximately 2,000 Sami in each of Norway and Sweden who are economically dependent on reindeer husbandry (7).

The political situation of the Sami has improved over the last decades. In Norway, Finland, and Sweden, the Sami have been acknowledged as the original inhabitants of northern Scandinavia, and a National Sami Parliament has been established in each of the three countries. However, the mandates of these parliaments are weak and important parts of the national legislations and social structures are not adjusted to meet the rights and needs of the Sami.

Like other ethnic minorities, the Sami people have suffered from centuries of discrimination and marginalization. The sociocultural vulnerability of the Sami, together with their genetic origin (8–10), suggests deviating disease and mortality patterns between the Sami and the majority populations in the Scandinavian countries. It might therefore appear a bit surprising that the knowledge of the health condition of the Sami is still quite poor, particularly regarding the condition of the Russian Sami.

In a research review published in 2005, we concluded that most of the published researches on health and diseases among Sami were fractionated, unsystematic, and anecdotal (11). However, the situation has improved over the last years. An increasing number of research initiatives have been taken in the Scandinavian countries, particularly in Norway where substantial governmental resources have been assigned to research on the health condition of their Sami population.

Our current knowledge on health and diseases in the Swedish Sami population rests to a large extent on

studies conducted by me and my coworkers at the Southern Lapland Research Department in Vilhelmina. The results have previously been reviewed in Swedish and in Sami with the primary objective to disseminate the knowledge among national authorities, health-care organizations, and within the Sami community (6, 7).

The aim of the present article is to review the current knowledge on the health and living condition of the Swedish Sami. When relevant, data from the Swedish Sami population are compared with corresponding data from Norway and Finland.

Ethical considerations

All studies conducted at the Southern Lapland Research Department have been approved by the regional ethics committee at the University of Umeå, and conform to the principles of the Declaration of Helsinki, the International Ethical Guidelines for Biomedical Research Involving Human Subjects, and the International Guidelines for ethical review for epidemiological studies.

The research question always emanated from health concerns posed by Sami organizations, Sami communities, or individual Sami. The risk for stigmatization was always thoroughly discussed with Sami representatives before a research project was commenced, and whenever the Sami thought the stigmatization risk was too large in relation to potential gain in knowledge, the project was canceled or substantially modified.

In all research projects, Sami representatives were guaranteed continuous information and participation as well as large possibilities to influence the research process, i.e. during the entire process from planning to interpretation of results and dissemination of results. Through web pages, newsletters, and meetings, the research has always been fully transparent toward the Sami society, and efforts to disseminate the research results within the Sami society and among relevant national and regional authorities have been strongly prioritized.

Methods and study populations

Different methods for data acquisition and selection of study populations have been used. Several studies are based on data from national and regional registers of causes of death, diagnoses, lifestyle, and socioeconomic conditions. In other studies questionnaires, medical examinations and interviews have been applied in the process of collecting data. An overview of methods for data acquisition and selected study populations of original studies in collaboration with me and my coworkers at the Southern Lapland Research Department is presented in Table 1.

In order to enable epidemiological research on large cohorts of Swedish Sami, a database was created from several sources, adopting generous inclusion criteria to

Table 1. Health-related studies in the Swedish Sami population performed at the Southern Lapland Research Department during the last decade

Reference	Research topic	Data source/method of data collection	Year of data collection/follow-up period	Sami cohort	Reference population	Characteristics of reference population
Hassler et al. 2004 (14)	Causes of death	The National Causes of Death Register	1961–2000	n = 7,482 (reindeer-herding Sami) n = 34,239 (non-reindeer-herding Sami)	n = 144,930	Non-Sami matched by age, gender, and area of living
Hassler et al. 2005 (15)	Risk of fatal, work-related accidents, and suicide	The National Causes of Death Register	1961–2000	n = 7,482 (reindeer-herding Sami)	n = 31,349	Non-Sami matched by age, gender, and area of living
Ahlm et al. 2010 (17)	Causes of fatal, work-related accidents, and suicide	The National Causes of Death Register, autopsy records at the National Board of Forensic Medicine, police reports, and medical records at the County Council	1961–2001	n = 7,482 (reindeer-herding Sami)	None	
Hassler et al. 2001 (24)	Cancer incidences	The National Cancer Register	1961–1997	n = 2,033 (reindeer-herding Sami, 1961) n = 1,988 (reindeer-herding Sami, 1980)	n = 8,132 (1961) n = 7,952 (1980)	Non-Sami matched by age, gender, and area of living
Hassler et al. 2008 (25)	Cancer incidences	The National Cancer Register	1961–2003	n = 4,782 (reindeer-herding Sami) n = 34,239 (non-reindeer-herding Sami)	n = 144,930	Non-Sami matched by age, gender, and area of living
Sjölander et al. 2008 (16)	Incidence of and mortality from cardiovascular diseases	The National Hospital Discharge Register and the National Cause of Death Register	1985–2002	n = 4,465 (reindeer-herding Sami) n = 11,449 (non-reindeer-herding Sami)	n = 71,550	Non-Sami matched by age, gender, and area of living
Edlin-Liljegren et al. 2004 (32)	Clinical, psychosocial, and behavioral risk factors for cardiovascular	The Regional Preventive Cardiovascular Diseases Program Register of the County of Västerbotten	1990–2001	n = 170 (reindeer-herding Sami) n = 441 (non-reindeer-herding Sami)	n = 1,222	Non-Sami matched by age, gender, and area of living
Ross et al. 2009 (39)	Nutrient and food intake	The Regional Preventive Cardiovascular Diseases Program Register of the County of Västerbotten	1990–2001	n = 145 (reindeer-herding Sami) n = 450 (non-reindeer-herding Sami)	n = 1,000	Non-Sami matched by age, gender, and area of living
Nilsson et al. 2011 (31)	Dietary habits and lifestyle 50–70 years ago in relation to present day	The Regional Preventive Cardiovascular Diseases Program Register of the County of Västerbotten and interviews	1990–1996, 2008 (interviews)	n = 81 (reindeer-herding Sami) n = 226 (non-reindeer-herding Sami) n = 20 interviews (elderly Sami)	n = 1,842	Non-Sami matched by age, gender, and area of living

Table 1 (Continued)

Reference	Research topic	Data source/method of data collection	Year of data collection/ follow-up period	Sami cohort	Reference population	Characteristics of reference population
Kaiser et al. 2011 (37)	Symptoms and predicting factors of depression and anxiety	Questionnaire	2007	n = 319 (reindeer-herding Sami)	n = 1,393	Non-Sami, from rural and urban areas of northern Sweden
Daerga et al. 2011 (49)	Confidence in health-care organizations	Questionnaire	2007	n = 356 (reindeer-herding Sami)	n = 1,441	Non-Sami, from rural and urban areas of northern Sweden
Sjölander et al. 2008 (45)	Prevalence and relative risk for musculoskeletal symptoms and perceived psychosocial work strain	Questionnaire	2003-2007	n = 74 (male reindeerherders)	n = 53 (adult females in reindeer herding families) n = 194 (non-reindeer-herding men in blue-collar occupations)	Non-Sami men in construction, industry, and transportation occupations
Daerga et al. 2008 (44)	Quality of life	Questionnaire	2003-2007	n = 99 (reindeer-herding Sami)		The general Swedish population
Daerga et al. 2004 (30)	Causes of musculoskeletal pain and impact of interventions	Questionnaire and medical examinations	2001-2003	n = 51 (reindeer-herding Sami)	None	
Zabel et al. 2011 (50)	Carnivore-induced stress	Questionnaire	2009	n = 401 (reindeer-herding Sami)	None	

minimize the risk of excluding Sami who satisfied only one out of several Sami definitions. People with Sami ethnicity were identified in electoral registers of the Sami Parliament, registers of reindeer-breeding companies held by the Department of Agriculture, and the registers of the population censuses administrated by Statistics Sweden. Their relatives, i.e. forefathers, siblings, and children, were identified in the National Kinship Register, administrated by Statistics Sweden, and added to the Sami database.

The database could be perceived as a reconstruction of the Swedish Sami population between 1941 and 1997 (kinship relations were available from 1941 and forwarded at the time of the construction of the database). A total of 41,721 Sami individuals were identified over the time period, and for a given year, e.g. in 1998 the number of Sami totaled 36,000 individuals.

By electronic data linkage of the Sami database with high-quality national and regional registers on health and diseases, it became possible to study the health condition on the entire or subgroups of the Sami population, and to relate it to various demographic, geographic, and socioeconomic factors. For comparison with the non-Sami majority population, a reference population was compiled, at a 4:1 ratio, from the population register by Statistic Sweden. The reference population was matched with the Sami cohort regarding age, gender distribution, and area of residency.

A detailed account of the Sami database and the reference population, together with results from validation studies, has been presented previously (12, 13).

In the following sections, I will briefly review the current knowledge on different health-related areas, with comparisons to relevant data reported from the Sami populations in Norway and Finland.

Mortality and diseases

Causes of death

The Swedish Causes of Death Register was used to examine life expectancy and specific causes of death among reindeer-herding and non-reindeer-herding Swedish Sami over the period 1961–2000 (14–17). No difference in life expectancy was observed between the Sami and the non-Sami population of the same geographic region. The incidence of specific causes of death was also quite similar among Sami and non-Sami. These results are basically in agreement with mortality studies conducted in the Norwegian and the Finnish Sami populations (18–20).

Beyond the similarities in mortality patterns, it was found that reindeer-herding Sami men had significantly lower relative risks compared with non-Sami men to die from cancer, cardiovascular diseases, and gastrointestinal diseases (15, 16, 21). However, the reindeer-herding men

also showed significantly higher risk for fatal accidents and suicide, risk elevations that increased over time (15). The incidence of fatal accidents was 6–10 times as high among the reindeer-herding men as among farmers and construction workers, two occupations known to show high relative rates of severe accidents in Sweden. It was concluded that commercial reindeer management is one of the most dangerous occupations in the country.

Detailed analyses of all unnatural death that occurred among reindeer-herding men between 1961 and 2001, using autopsy records at the National Board of Forensic Medicine, police reports, and medical records at the County Council, showed that suicides contributed to 23% of all deaths, road traffic accidents to 16%, and snowmobile fatalities to 11% (17). Half of the victims tested positive for alcohol, and alcohol abuse was documented in 15% of the victims. The accident pattern reflects an outdoor lifestyle and working conditions characterized by high socioeconomic pressure and extensive use of off-road vehicles (15, 17).

An increased risk of suicide among Sami men in Sweden is in agreement with findings from Norway and Finland (20, 22). Although the elevated risk is small in relation to the non-Sami majority populations, the excess risk is probably a consequence of marginalization of the Sami culture and lifestyle in the Scandinavian countries (14, 15).

Among the reindeer-herding men, the incidence of suicide increased by 75% between periods 1961–1980 and 1981–2000 (14). In three-fourth of all suicides, the causes of death were gunshot wounds and hanging (17). The geographic distribution showed that the incidence of suicide is significantly larger in the southern part of the reindeer-herding district of Sweden (results in preparation). A conceivable reason for this is that the reindeer husbandry is more in question in the southern parts, and is put under larger pressure from the majority population to used grazing land for other purposes than reindeer herding (i.e. forestry, tourism, energy, and mineral production).

Cancer

Our knowledge on the incidence of various diseases in the Swedish Sami population is based on data from national health and diagnosis registers, and is largely confined to information on cancer and cardiovascular diseases. Cancer is the disease that is most thoroughly studied in the Sami population. In Sweden, a significantly lower cancer incidence among Sami men has been observed (23–25). The occurrence of prostate cancer was considerably lower among Sami than among other Swedes of the same region. Sami women have been observed to have an increased risk of gastric and ovarian cancer, while Sami men had an increased risk for stomach cancer. A general trend in all Scandinavian countries is

that the cancer risk is lower among Sami men than among Sami women (for review, see (26)). In Sweden, the lowest cancer incidence has been observed among reindeer-herding Sami men, and the highest among non-reindeer-herding Sami women (25).

Northern Scandinavia received considerable amounts of radioactive fallout from nuclear weapon tests in northern Russia during the 1950s and 1960s as well as from the nuclear power plant accident in Chernobyl in 1986. As the diet of the reindeer-herding Sami to a large extent is based on locally produced meat, i.e. from reindeer, moose, and fish, they have been exposed to relatively high levels of radioactive radiation for several decades. However, an increased risk of particular radiation-sensitive cancers (leukemia and thyroid cancer) has not been observed among the Sami, neither in Sweden nor in Norway and Finland (27, 28).

The relatively high levels of physical activity (29–32), in combination with high intake of antioxidants and unsaturated fatty acids and low intake of dairy products, have been suggested as the main reasons for the low risk of cancers of the colon and the prostate among the reindeer-herding Sami (24, 27, 28). Thus, the traditional Sami lifestyle may contain behaviors and habits that protect them from developing cancer. This conclusion is supported by the fact that reindeer-herding Sami who leave the traditional Sami lifestyle by migrating to urban regions develop a similar risk of prostate cancer as that in the general Swedish population (25).

The temporal trend of cancer diagnoses shows an increase in incidence in the general population as well as in the Sami population (25). However, for some cancer sites, the risk has increased faster among the Sami than in the majority population. Over the time span 1961–2003, there was a relatively larger increase in incidences of breast cancer among Sami women, and leukemia among Sami men (25). The reduction of incidence of stomach cancer observed in the general non-Sami population was not observed in the Sami population, in which the incidence was nearly constant.

Cardiovascular diseases

There are only small differences between the Sami and other Swedes regarding the risk to develop cardiovascular diseases (16, 32). In both Swedish and Norwegian studies, it has been found that the reindeer-herding Sami show lower incidences of cardiovascular diseases than other Sami (16, 33). Another consistent observation is that the relative risk to contract cardiovascular diseases is higher among Sami women than Sami men. The risk of stroke is increased among women in reindeer-herding families and Sami men not involved in reindeer herding. Women from reindeer-herding families also showed a significantly lower risk to develop myocardial

infarction, while the reindeer-herding men were observed to have a lower risk for stroke.

An analysis of income development in relation to mortality from and incidence of cardiovascular diseases suggest that the differences in incidence of stroke between herding and non-herding Sami men, and between Sami women and non-Sami women, are caused by behavioral and psychosocial risk factors rather than by traditional socioeconomic ones (16). It was also indicated that the elevated mortality rates from myocardial infarction rather than stroke explain the excess mortality for cardiovascular diseases previously shown among Sami women (15).

Other somatic diseases

There is no published information on the frequency of other somatic diseases in the Swedish Sami population. However, preliminary results among approximately 15,000 Sami in Sweden indicate that they showed the same incidence of diabetes as the majority population between 1985 and 2002 (results in preparation).

Among Sami children and adolescents in northern Norway, asthma and allergies are more common compared to aged matched non-Sami in the same geographic setting (34, 35). It was also found that between 1985 and 1995, there was a faster increase in prevalence of asthma and allergy among Sami children. The causes of these differences are not known.

Mental health

There are a few studies where mental problems have been investigated among Sami children and adolescents in northern Norway (for review, see (36)). It appears as the mental health conditions are equally good among the Sami and the non-Sami youth. Yet, some interesting differences have been noted. The Sami adolescents showed less frequent risk-taking behavior and eating disturbances, and they more often expressed satisfaction with their body. The mental health condition was better among Sami living in a strong Sami cultural context than that of Sami children growing up in areas where the Sami culture was weak. Moreover, the mental health of young Sami men was more affected by ethnocultural factors than that of young Sami women.

The findings of Kvernmo and coworkers might explain, at least partly, why the incidence of suicide is higher among Sami men in the southern parts of the Swedish reindeer-herding district, where the Sami culture is relatively weak, as compared to those living in the northern areas (see above). In a recent study, reindeer-herding Sami men and women were identified as being at particular risk for suicidal expressions, and it was suggested that specific attention should be paid to young and middle-aged reindeer-herding men with hazardous alcohol consumption and symptoms of anxiety (37).

Lifestyle, health behavior, and socioeconomic conditions

Diet

The traditional Sami diet was characterized by high intake of proteins and fat, especially from fish and reindeer meat, and low consumption of carbohydrates, fibers, and certain vitamins (31, 38). This dietary pattern persists to some extent among today's reindeer-herding Sami, although the differences compared with the western diet have decreased, which means that the meat and fish consumption has decreased, whereas the intake of fruit, vegetables, bread, and sugar has increased (31, 38, 39).

In studies of Sami living in the Swedish county of Västerbotten, lower blood levels of HDL cholesterol and lower systolic and diastolic blood pressure have been found but no differences in BMI, total cholesterol, and triglycerides compared with non-Sami in the county (31, 32, 39). Lower levels of cholesterol have also been reported from elderly Norwegian Sami in comparison to age-matched non-Sami (40). These findings support the suggestions that a high intake of reindeer meat and wild-caught fish is a contributing factor behind the relatively low risk of cancer and cardiovascular diseases among reindeer-herding Sami (16, 25, 27, 39).

Tobacco and alcohol

The tobacco and alcohol habits appear to be roughly the same among the Sami and non-Sami Swedes, and between reindeer-herding Sami and other Sami (31, 32, 39). In a recent study, it was found that, although the level of consumption of alcohol was similar, subgroups among reindeer-herding Sami men might have a somewhat more hazardous drinking pattern compared with non-Sami (41). Similar results have been reported among Norwegian and Finnish Sami (42, 23, 55).

Young Sami in northern Norway consume less alcohol than young non-Sami Norwegians (for review, see (43)). Interestingly, the lowest consumption was found among Sami with a strong Sami identity.

In a study on health-related quality of life among Swedish reindeer-herding Sami, it was found that poor mental quality of life was positively related to the consumption of alcohol for women but not for men (44). Among the men, however, low quality of life was positively connected to feelings of guilt about one's alcohol habits.

Physical activity

There seem to be no major differences in physical activity between Swedish Sami and non-Sami (32, 39), except for reindeer-herding men who execute physically strenuous work more often than other Sami and non-Sami (31). Another interesting exception is that non-reindeer-herd-

ing Sami women seem to be significantly less physically active in comparison to their men (32, 39). This could contribute to the observed gender differences in incidences of cardiovascular diseases and some cancers among non-reindeer-herding Sami (16, 25).

Socioeconomic condition

It has been shown that the increase in income has been similar among Sami and non-Sami between 1970 and 2000, except for the reindeer-herding men who show a significantly lower income and slower increase in income compared with non-Sami men (45). While the women of reindeer-herding families have the highest formal education, the reindeer-herding men had the lowest (16, 45). Non-reindeer-herding Sami, both men and women, appear to have approximately the same level of education as other Swedes in the same geographic setting.

Risk factors and health in the reindeer husbandry

Accidents

As mentioned above, there is a high incidence of fatal accidents among reindeer herders (see, *Causes of death*). Due to frequent work in a harsh environment and cold climate, it is not surprising that this occupation and lifestyle is associated with a high risk for accidents, frostbite, musculoskeletal pain, and vibration injuries. This has been verified among both Swedish and Finnish reindeer herders (45, 46, 56–60). Accidents are to an important extent related to the use of off-road vehicles (snowmobile, motorcycles, and all-terrain vehicles). Collisions with rocks and trees are common, often causing injuries of the head, wrists, hands, neck, and back. Other common accidents occur during handling of the reindeer, e.g. cut by reindeer antler, cut by knives during slaughter, and marking of calves, and squeeze or pulled over during gathering or transportation of reindeer.

Musculoskeletal disorders

The occurrence of musculoskeletal symptoms is high among both men and women in the reindeer-herding families. Pain and discomfort in the lower back, neck, shoulders, elbows, and hands/wrists are frequent (45–48, 46, 49). Among reindeer-herding men, there is a significantly higher prevalence of pain in the hands, elbow, and lower back as compared to other blue-collar occupations with high prevalence of musculoskeletal pain, i.e. industry, construction, farming, and transport (45).

Although the accidents are frequent, about three-fourth of the reported musculoskeletal pain conditions have another origin, such as long-term exposure to static, repetitive work, or work in awkward body postures (45, 49). For men, the symptoms are most likely related

to physical risk factors, with high exposure to snowmobile and motorcycle driving, while the women's symptoms are more influenced by psychosocial risk factors such as poor social support, high effort, low reward, and a feeling of being disconnected from the daily reindeer-managing activities (32, 45, 49). Reindeer herders are also heavily exposed to vibration when driving snowmobiles, all-terrain vehicles, and motorcycles (46). Consequently, a large proportion of the reindeer-herding men show clear-cut clinical indications of vibration damages of the nerves and blood vessels in hands and arms.

Psychosocial and socioeconomic working conditions

The conditions for the Sami to breed and herd reindeer have changed dramatically over the last decades. Historically, reindeer herding was a Sami lifestyle and is still a culturally very important activity. In the 1970s, the Swedish government imposed regulations and control systems in order to transform reindeer husbandry to an economically profitable business. Today, a successive reindeer-herding business needs a large livestock, good grazing areas, four-wheel driven cars, and different kind of terrain vehicles (and a good portion of skills and luck). One consequence of the extensive motorization is that the modern reindeer husbandry requires continuous income in order to pay for the continuous operating costs.

The legal right of the Sami to use large areas for reindeers herding is increasingly questioned in large areas of the reindeer-herding areas of Sweden. A growing competition from exploiters who intrude on their traditional grazing land has certainly had a negative impact on the psychosocial and socioeconomic conditions of the reindeer-herding Sami. Together with the governmental goals to tolerate a given size of the populations of predators (i.e. bears, wolves, wolverines, lynxes, and eagles), the accumulated demands from various land exploiters generate a serious threat to the sustainability of the reindeer husbandry and the Sami culture (6, 16, 44, 45, 50).

The working conditions for many reindeer-herding Sami are characterized by high job demands, low control over external factors influencing the reindeer-herding conditions (e.g. national rules and legislation), and low level of social support (32, 45, 49). In comparison with both women of reindeer-herding families and Swedish men in other blue-collar professions, the reindeer-herding men not only experienced higher demands but also larger opportunities to influence how and when daily working activities should be executed (45). Reindeer-herding women also experienced higher demands than Swedish women from urban areas in the northern part of Sweden, but not in comparison with

non-Sami women living in the same area. A tendency toward increased job demands and reduced decision latitude could be observed over the period 1990–2007 among both men and women of reindeer-herding families (32 and results in preparation).

The work organization within the Sami communities ('*Samebyar*') has been reported as unsatisfactory by many reindeer herders (results in preparation). Almost, 70% of the reindeer-herding Sami indicated that the workload was dissatisfactory in that it was unevenly distributed and that the communication was too poor. A large proportion of the women reported a shortage of appreciation, help, and support from others in the Sami community. These findings are probably related to the complex organization and social structure of the Sami communities. Within a *Sameby*, the herders and their families compete about having successful reindeer-breeding companies, which implies possessing the largest possible part of the total number of reindeer allowed by the *Sameby*. At the same time, the reindeer herders are coworkers and depend on each other in many collective tasks, e.g. building and maintaining collective infrastructure such as fences and cottages, gathering, and transportation and slaughtering of reindeers. Furthermore, close kinship is common among members of different reindeer-herding families within the Sami communities.

Reindeer-herding men showed a significantly lower income than Swedish men in general, and the differences in income have increased slightly over the past decades, probably as a result of declining profitability of the reindeer husbandry (16). Today, women of reindeer-herding families demonstrated larger average income compared with their men, and they often have a regular employment in addition to their duties in the reindeer-herding work (16, 32, 45). The increased financial responsibility, together with the fragmented working situation, is thought to be important factors associated with the women's relatively low quality of life, poor social support, decision latitude, and intellectual discretion (32, 44, 45). Many women also report low degree of involvement in the reindeer-herding work compared with the men as well as less appreciation, assist, and reward for the work they are doing (32, 44, 45).

Most reindeer herders experience that they have small possibilities to influence national and regional decisions and regulatory frameworks of importance for the reindeer husbandry. Price trends for reindeer meat, vehicles, and fuel, and the national policy regarding the size of the predator populations are determined by complex systems beyond the control of the reindeer herders. The reduced size of the grazing lands that is fragmented into smaller unconnected areas due to the expansion of forestry, mining, and energy production

decreases the possibility of the reindeer-herding companies to maintain a reasonable economic return.

In light of the psychosocial and socioeconomic conditions of the reindeer husbandry, it is not surprising that members of reindeer-herding families report low social, physical, and mental quality of life, high prevalence of symptoms of depression and anxiety, and poor confidence in national institutions and authorities (45, 49, 51).

Conclusions and suggested actions

In comparison with other indigenous people in the circumpolar region, the health and living conditions of the Sami are exceptionally good. For instance, there are no evidences of low-life expectancy, of significantly elevated incidences of common diseases, or of increased prevalence of alcohol and substance abuse that are serious health problems among other indigenous populations (52, 53). Although the health condition of the Sami population appears to be similar to that of the general Swedish population, a number of specific health problems have been identified, especially among the reindeer-herding Sami. Most of these problems have their origin in marginalization and poor knowledge in the majority population of the reindeer husbandry and the Sami culture. Thus, the most sustainable measure to improve the health among the reindeer-herding Sami would be to improve the conditions for the reindeer husbandry and the Sami culture. The key issue is to strengthen the legal rights of the Sami people to use their traditional homeland for reindeer herding and other culturally and economically important activities. For this to happen, there have to be alterations of laws and radical changes of the majority population's and its institutions attitudes toward the Sami people.

A concrete way of improving the health condition for reindeer-herding Sami is to establish occupational health-care centers as an integrated part of the reindeer husbandry (6, 7, 54). Their health condition would also benefit from a system of appointed health coordinators with specific assignment to facilitate the relationships between the reindeer-herding Sami and existing occupational health-care services and various health-care institutions and clinics (6). The coordinator's main responsibility should be to guide the reindeer-herding men and women within the health-care system and to inform and educate the health-care professionals about the reindeer-herding lifestyle, the working conditions, and the Sami culture.

This review implicitly shows that the available information on the health condition of the Swedish Sami population is limited. There are several reasons for that. The most important, in my opinion, is that the different needs and possibilities of ethnic minorities are neglected in Sweden as a consequence of our effort to

treat all citizens equal. In the absolutistic interpretation of the equality principle, there is little room for specific actions directed toward ethnic minorities as they should be treated as everybody else. As a result, Sweden lacks a national health policy for the Sami people, and there have been no resources allocated to research focused on their health conditions (6, 7). Another reason for the shortage of information in some health-related domains, e.g. mental and inherited health problems, is that some research questions have been rejected by the researchers and/or Sami organizations to avoid unnecessary stigmatization, or due to a lack of attentiveness within the existing health-care organizations to meet potential medical needs exposed by such studies.

There is a need to examine a wide range of diseases that hitherto have not been studied among the Sami, how various diseases are connected to different risk factors, and how diseases and risk factors develop over time. It would also be a great asset to have comparable data on different subpopulations of Sami, e.g. reindeer-herding and non-reindeer-herding Sami, men and women, and different age groups. Another topic of importance is to elucidate health consequences of climate changes.

To obtain long-term, sustainable, and coordinated information about the health condition of the Sami, the Swedish government has been recommended to establish a national center for research on Sami health (6, 7, 54). In Norway, such a center was established a decade ago, which significantly has increased the available knowledge on the health and living conditions of the Norwegian Sami.

Conflict of interest and funding

Funding has been received from the County Council of Västerbotten, the EU:s mål 1 Sápmi Norra Norrland, and the Swedish Council for Working Life and Social Research. No conflict of interest declared.

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