Causes of death in the Sami population of Sweden, 1961–2000

Sven Hassler, Robert Johansson, Per Sjölander, Henrik Grönberg and Lena Damber

Background

Indigenous people often have a pattern of mortality that is disadvantageous in comparison with the general population. The knowledge on causes of death among the Sami, the natives of northern Scandinavia, is limited. The aim of the present study was to compare gender and cause specific mortality patterns for reindeer herding Sami, non-herding Sami, and non-Sami between 1961 and 2000.

Methods

A Sami cohort was constructed departing from a group of index-Sami identified as either reindeer herding Sami or Sami eligible to vote for the Sami parliament. Relatives of index-Sami were identified in the National Kinship Register and added to the cohort. The cohort contained a total of 41 721 people (7482 reindeer herding Sami and 34 239 non-herding Sami). A demographically matched non-Sami reference population four times as large, was compiled in the same way. Relative mortality risks were analysed by calculating standardized mortality ratios (SMRs).

Results

The differences in overall mortality and life expectancy of the Sami, both reindeer herding and non-herding, compared with the reference population were relatively small. However, Sami men showed significantly lower SMR for cancers but higher for external causes of injury. For Sami women, significantly higher SMR was found for diseases of the circulatory system and diseases of the respiratory system. An increased risk of dying from subarachnoid haemorrhage was observed among both Sami men and women.

Conclusions

The similarities in mortality patterns are probably a result of centuries of close interaction between the Sami and the non-Sami, while the observed differences might be due to lifestyle, psychosocial and/or genetic factors.

Keywords

Sami, reindeer herders, cause of death, diseases of the circulatory system, cancer, subarachnoid haemorrhage, external cause of injury

The Sami people are natives of northern Scandinavia. While most of the Sami have adopted an ordinary western lifestyle, the reindeer herding Sami still live more traditionally. They herd their reindeer on grazing land in the mountain areas during summer and in the forests during winter. Their dietary habits are characterized by high consumption of meat and fish and low intake of vegetables and fruit.1–3 The herding is physically demanding, and nowadays mostly carried out on snowmobiles and motorcycles in a hazardous environment (steep and rocky mountains, thin ice, low temperatures, etc). Their psychosocial and socioeconomical situation is vulnerable, partly due to pressure imposed by the society to rationalize the reindeer industry and partly due to pressure induced by other inhabitants in the reindeer herding regions who claim access to the privileges belonging to the herding communities.4,5 The reindeer herding Sami population totals about 2000 individuals in Sweden, which corresponds to ~5–10% of the Sami population in the country.6

There is a plethora of studies showing that native populations often have a pattern of mortality that is unfavourable in comparison with the general population. The transition from a traditional lifestyle to a westernized way of living has caused dramatic changes in the health and living conditions of many natives. For instance, among natives in Canada and Greenland,
Table 1 Construction of a Swedish Sami population using national registers

<table>
<thead>
<tr>
<th>Register</th>
<th>Index-Sami</th>
<th>Forefathers</th>
<th>Siblings</th>
<th>Descendants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational Register of:</strong></td>
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<tr>
<td>1960</td>
<td>1045</td>
<td>166</td>
<td>305</td>
<td>3399</td>
<td>4915</td>
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<tr>
<td>1970</td>
<td>113</td>
<td>55</td>
<td>72</td>
<td>484</td>
<td>726</td>
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<tr>
<td>1975</td>
<td>40</td>
<td>35</td>
<td>48</td>
<td>264</td>
<td>387</td>
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<tr>
<td>1980</td>
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</tr>
<tr>
<td>1990</td>
<td>55</td>
<td>107</td>
<td>158</td>
<td>419</td>
<td>739</td>
</tr>
<tr>
<td><strong>Register of Reindeer Breeding Enterprises</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2761</td>
<td>2292</td>
<td>2258</td>
<td>9660</td>
<td>16 971</td>
</tr>
<tr>
<td><strong>Electoral register of the Sami parliament of 1993</strong></td>
<td>1290</td>
<td>1437</td>
<td>2302</td>
<td>9206</td>
<td>14 235</td>
</tr>
<tr>
<td><strong>Electoral register of the Sami parliament of 1997</strong></td>
<td>268</td>
<td>376</td>
<td>404</td>
<td>1567</td>
<td>2613</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5699</td>
<td>4622</td>
<td>5725</td>
<td>25 675</td>
<td>41 721</td>
</tr>
</tbody>
</table>

\[a^{Index-Sami}. Start of follow-up: January 1, following the year of identification.\]

\[b^{Parents, grandparents, and forefathers alive in 1941 or later. Start of follow-up: 1961 or birth of Index-Sami if later than 1961.} \]

\[c^{Siblings to index-Sami and/or forefathers. Start of follow-up: 1961 or year of birth if later than 1961.} \]

\[d^{Descendants to index-Sami, forefathers and/or siblings. Start of follow-up: 1961 or year of birth if later than 1961.} \]

\[e^{Also identified in the Population and Housing Census of 1995 (Årsys. 95).} \]

\[f^{Also identified in the Population and Housing Census of 1998 (RTB 98).} \]

deads from infectious diseases have dropped considerably over the last 50 years while alcohol- and accident-related deaths, suicide, and lung cancer have increased.7,8

The knowledge about the causes of death among the Sami is limited. In a study on the causes of death between 1961 and 1984 among 2000 Swedish reindeer herding Sami, the overall mortality rate was similar to that of the general population \( (P > 0.05) \). However, the mortality from cancers was significantly lower than expected in relation to the general population while that from external causes of injury was significantly higher \( (P < 0.05) \). In studies on Sami in Norway and Finland, it was indicated that the mortality from coronary heart diseases might be lower than among others living in the Sami regions.10–12

The aim of the present study was to analyse the mortality risk between 1961 and 2000 in a large cohort of Swedish Sami, and thereby explore the hypothesis that the mortality pattern in the Sami population differs from that of the non-Sami reference population. The study was designed to enable time, gender, and cause specific comparisons of mortality data for reindeer herding Sami, non-herding Sami, and a non-Sami reference population.

**Methods**

In Sweden it is not possible to separate different ethnic groups directly in national population registers. Therefore an attempt was made to reconstruct the Sami population by using the national kinship register. The reconstruction departs from the two definitions of Sami identity stated in Swedish law. One is used to regulate the right to breed reindeer and the other the right to vote for the Sami parliament. According to these definitions index-Sami were identified in the Occupational Register of Statistics Sweden of 1960–1990, the National Register of Reindeer Enterprises, and the Electoral Registers of the Sami parliament of 1993 and 1997.6 Starting with the 1045 reindeer herding Sami identified in the Occupational Register of 1960, relatives (forefathers, full siblings, and descendents) were identified in the National Kinship Registers of Statistics Sweden (Table 1). Thus, 3870 relatives to the index-Sami of 1960 were added to the total population. The 115 reindeer herding Sami of the Occupational Register of 1970 that had not been identified in the previous kinship runs, and their 611 relatives, were added to the Sami cohort. The same procedure was used to identify relatives of the index-Sami identified in the Occupational Register of 1975 and onwards (Table 1).

The total study cohort contained 41 721 persons (21 867 men and 19 854 women). To enable comparisons of potential differences in mortality pattern between Sami with a more traditional life style and Sami with a more westernized life style, the cohort was divided into two sub-populations: (i) reindeer herding Sami, containing 4451 men and 3031 women and (ii) non-herding Sami, containing 17 416 men and 16 823 women (Table 2). In order to reduce the non-Sami influence in the Sami cohort, spouses were only added to the cohort if they were related to an index-Sami.

A demographically matched non-Sami reference population was constructed the same way as the Sami cohort (Figure 1 and Table 2). For each index-Sami four non-Sami persons were randomly selected from the National Population and Housing Census Registers, to match the index-Sami with respect to age, gender, area of residency (i.e. by parish or municipality) and date of identification. Forefathers (23 657), full siblings (23 764), and descendants (74 713) of these non-Sami index-persons were identified in the National Kinship Register, thereby creating a reference population that was demographically similar to the Sami cohort and contained a total of 144 930 persons (75 899 men and 69 031 women). To refine the Sami cohort and the reference population regarding Sami heritage, people who were related to both index-Sami and non-Sami index persons were excluded from the study. The overlap comprised a total of 5690 persons.
In the Kinship Register, ancestors alive in 1941 or later were identified. Thus, families containing up to five generations were detected. The average number of siblings was 2.4 in the Sami cohort and 2.3 in the reference population. The average length of follow-up was 23.2 years for the Sami and 25.2 for the reference population.

The earliest start of follow-up was January 1, 1961, and the end of follow-up was December 31, 2000. The follow-up was also ended at the time of death or emigration. Standard mortality ratios (SMRs) were calculated for all Sami as well as for reindeer herding Sami and non-herding Sami using age, sex, and cause specific distribution of all deaths that occurred over the entire follow-up period and separately for the periods 1961–1980 and 1981–2000. The reference population was used as the standard for all comparisons, and expected deaths were calculated by multiplying the mortality rates from the reference population by the Sami population. The standard annual sex and cause specific mortality rates of the reference population were applied within 5-year age categories of all Sami, reindeer herding Sami, and non-herding Sami, respectively. SMR was calculated for the main groups of causes of death and for some sub-groups, such as cerebrovascular diseases (ICD10: I60-I69), ischaemic heart diseases (ICD10: I20-I25), diabetes (ICD10: E10-E14), suicide (ICD10: X60-X84), and vehicle accidents.
Results

Between 1961 and 2000 a total of 4576 deaths occurred in the Sami cohort, 3546 among the non-herding Sami and 1030 among the reindeer herding Sami (Table 3). The three most common causes of death were diseases of the circulatory system, cancers, and external causes of injury. Life expectancy at birth was 74.9 years for Sami men (74.6 years for men in the reference population) and 80.0 years for Sami women (80.3 years for women in the reference population). No statistically significant difference of life expectancy was observed between any of the populations.

The overall SMR for Sami men was similar to that for men of the reference population, while a slightly higher overall SMR was observed for Sami women (Table 3). Sami men showed significantly lower SMR for cancers but higher for external cause of injury. For Sami women, higher mortality rates than expected were found for diseases of the circulatory system, ischaemic heart diseases, and diseases of the respiratory system. A significantly increased risk of dying from subarachnoid haemorrhage was observed among both Sami men and women.

A comparison of reindeer herding Sami and non-herding Sami men revealed that the non-herding Sami showed mortality rates similar to their non-Sami neighbours, with the exception of significantly lower cancer mortality, while the reindeer herding Sami demonstrated significantly higher SMRs for subarachnoid haemorrhage and external causes of injury (Table 3). Among the reindeer herding Sami men, a significantly lower SMR was observed for diseases of the digestive system.

Among the Sami women, the non-herding Sami showed higher SMRs for diseases of the circulatory system, ischaemic heart diseases, and subarachnoid haemorrhage, whereas the reindeer herding Sami women demonstrated only non-significant differences in mortality ratios (Table 3). For most of the causes of death, no differences in mortality risks were found between 1961–1980 and 1981–2000. However, among the non-herding Sami women, a statistically significant increase in death due to cancers was observed, from SMR 0.88 (95% confidence interval (CI) 0.71–1.09) to 1.13 (0.99–1.29), and a significant reduction in suicide, from SMR 1.98 (0.79–4.08) to 0.35 (0.11–0.83). Deaths from cardiovascular diseases were significantly increased during the later period among non-herding Sami men, from SMR 0.89 (0.69–1.13) to 1.15 (0.96–1.37), but significantly reduced among reindeer herding Sami women, from SMR 1.68 (0.80–3.09) to 0.96 (0.54–1.59).

Discussion

The main result of the present study was that the mortality rates and life expectancy of the Sami and their non-Sami neighbours were quite similar. This is in clear contrast to several other native populations for which the mortality statistics are largely unfavourable in comparison with that of the general populations. The similarities between the Sami and the non-Sami were probably a result of centuries of close interaction that has caused mixed marriages, similarities in culture, attitudes and life style, as well as equal accessibility to health care services and the social security systems.

Specific causes of death

Beyond the finding of a general resemblance between the Sami and the non-Sami there were significant differences with respect to some causes of death. One distinct finding was that the mortality due to diseases of the circulatory system was significantly higher among Sami women than among their non-Sami neighbours. Since almost 50% of all deaths among Sami women were caused by diseases of the circulatory system, the excess risk of dying from such diseases was the main reason for the slightly higher total mortality of the Sami women. Male Sami, however, showed the same risk of dying from diseases of the circulatory system as did the non-Sami males. This discrepancy between men and women is basically in agreement with results from previous studies. In a study on Swedish reindeer herding Sami it was shown that the women had significantly higher mortality rates for diseases of the circulatory system as compared with the general Swedish population, while the men demonstrated significantly lower risks. The latter was substantiated by results from a Norwegian study showing that Sami men had a significantly lower risk of dying from diseases of the circulatory system as compared with the Norwegian male population living in the same area. The Sami women, however, did not show any reduced mortality risk from diseases of the circulatory system. Thus, it might be concluded that the relative risk of dying from diseases of the circulatory system is higher among Sami women than among Sami men as compared with their non-Sami neighbours. However, the excess risk among women appeared to decline over time, at least for cerebrovascular diseases.

Comparisons of mortality data from the present study and previous Norwegian and Finnish studies indicate a higher mortality risk from diseases of the circulatory system among Swedish Sami. However, the results from these studies are not directly compatible due to large differences in study design (i.e. different study groups, follow-up periods, and outcome variables).

Nutritional studies on Swedish reindeer herding Sami indicate that their traditional diet, which is dominated by reindeer meat and has a low content of vegetables and fruit, could constitute a potential risk factor for diseases of the circulatory system. This is in agreement with findings among Norwegian Sami who consume more meat, fat, table sugar, and coffee, and less fruit and vegetables in comparison with the average Norwegian living in the same region. Although the diet could be an important general risk factor among Sami who have a more traditional life style, this could not explain the observed gender difference in mortality rates from diseases of the circulatory system.
The high SMRs from diseases of the circulatory system among Sami women might be related to their psychosocial situation. In the herding communities, the women mostly share the responsibility of the reindeer herding enterprise with their husbands. The men are responsible for the daily herding of the reindeer, while the woman are directly involved only periodically, e.g. during slaughter, transportation of herds, and during periods when the reindeer are fed. In addition to sharing the responsibility for the herding, the women are also responsible for the household and the family's social network. Today, most women of reindeer herding families also hold regular part-time work (teacher, nurse, etc.).
women appear to be exposed to particularly stressful working loads where the demands and the decision latitudes are unbalanced. In combination with little daily physical activity and traditional dietary habits, the unfavourable psychosocial situation of the Sami women could be a major factor responsible for their elevated mortality risk from diseases of the circulatory system. This hypothesis should be addressed in future studies along with comprehensive analyses of potential socioeconomic risk factors.

It is known that the incidence of subarachnoid haemorrhage is higher among Greenlandic Inuits than among Caucasian Danes, and it has been suggested that genetic dissimilarities might be the main reason. Interestingly, in the present study, the mortality rate from subarachnoid haemorrhage among Sami was significantly higher than among their non-Sami neighbours. Tobacco smoking, hypertension, and high coffee consumption are known risk factors. It has been indicated that the intake of coffee is high among the Sami, but also that they have low blood pressure. The smoking habits of the Sami seem to be similar to that of their non-Sami neighbours, as indicated by self-reported data collected during the 1990s. Thus, it is tentatively suggested that the increased mortality risk from subarachnoid haemorrhage among the Sami, at least partly, has genetic causes. This is indirectly supported by studies indicating that the Sami constitute a genetically distinct ethnic group without strong links to other European and Asian populations.

The low mortality from cancers found among Sami men is in conformity with previous studies reporting significantly lower cancer incidences in this group than among others living in the same region. The observation that the SMR was equally low among reindeer herding Sami and non-herding Sami, together with the assumption that the non-herding Sami have adopted a lifestyle identical or very similar to that of the reference population, indicates that the low mortality rate from cancers might be a result of genetic rather than life style factors. Yet, lifestyle factors cannot be excluded. The increasing risk of dying from cancer among non-herding Sami women might be a reflection of reduced influence of protective factors related to the traditional Sami lifestyle. It has also been suggested that the excess risk of stomach cancer among herding Sami is caused by a large consumption of smoked and salted reindeer meat.

Excess mortality among men from external causes of injury, such as accidents and suicide, has been reported for several native populations. In the present study, the risk of dying from accidents was only elevated among the reindeer herding Sami men, presumably as a result of an extensive rationalization and motorization of the reindeer herding industry over the last decades. Today much of the herding work is done under time-pressure on snowmobiles, motorcycles, and helicopters, which is the main reason for the high incidence of fatal vehicle accidents among the reindeer herding Sami men.

Although the reindeer herding Sami men suffered a significantly increased risk for suicide, the SMR was only moderately elevated as compared with other native populations. Among the reindeer herding Sami men, a statistically significant excess mortality from suicide was only found during the early follow-up period (1961–80) and not during the later period (1981–2000). Interestingly, the non-herding Sami did not show any increased risk of suicide, which is somewhat in contrast to findings from other native populations where the incidence of suicide often is considerably higher among the westernized/urbanized natives than among those living more traditionally.

### Methodological considerations

Most previous epidemiological studies of the Sami have been restricted to the reindeer herding part of the Sami population. The cohort compiled for the present study was an attempt to reconstruct the actual Sami population, implying that both herding and non-herding Sami were included. A long follow-up period made it possible to evaluate major time trends. By comparing with a demographically matched reference population, known geographical differences in morbidity and lifestyle could be controlled for.

A common source of statistical uncertainty in studies of the present type is poor quality of the death certificates. The Swedish cause of death register is based on death certificates that have been found to be of good validity for use in epidemiological studies. In this register, the accuracy is largest for major causes of death (e.g. most forms of cancer, cardiovascular diseases, and external causes of death), young individuals, violent deaths, and diseases with a rapid lapse. The accuracy is hence lower for, e.g. suicide and cerebrovascular diseases, indicating that the time trends for these causes of death should be interpreted with caution.

In the present study an attempt was made to reconstruct the actual Sami population rather than to randomly select a representative Sami cohort. In spite of this approach, the statistical power was low for uncommon causes of deaths, particularly in the smaller sub-populations. For instance, the inconsistency between men and women regarding deaths from subarachnoid haemorrhage among reindeer herding Sami and non-herding Sami is most likely due to the low number of cases observed in some of these sub-groups (Table 3).

In the absence of information on ethnicity in Swedish national population registers, a Sami population was identified using occupational, electoral, and kinship registers. A demographically matched reference population of non-Sami was compiled using the same method, as was the Sami population (Figure 1). The non-Sami index-persons were matched with the index-Sami for age, gender, and area of residency while the relatives of the index-groups were added to the cohorts irrespective of each other, resulting in small differences in age and gender distribution between the Sami and the reference population (Table 2). However, this should not have had any impact on the results since the mortality risk was calculated as age, gender, and time period adjusted mortality rates.

In Sweden there are well known geographical differences in lifestyle, incidence of various diseases and life expectancy. For instance, the households in the sparsely populated regions of the north spend more of their budget on meat, fat and oil, and less on vegetables, fruit and fish than households in other regions of the country. In northern Sweden the life expectancy is lower and the incidence of cardiovascular diseases higher, while the incidence of cancer is lower. Thus, since most of the Sami are residents of the northern inland of Sweden, comparisons of mortality rates in a geographically matched reference population, rather than the Swedish general population, would greatly enhance the possibility to disclose relations between mortality risks and cultural, lifestyle, and genetic factors.
One might argue that the small differences in mortality rates reported here could be due to a mixture of non-Sami in the Sami cohort, and vice versa. This is of course unavoidable to some extent since mixed marriages have occurred for a long time, although at a very low frequency before the 20th century. To reduce the non-Sami bias of the Sami cohort, all spouses without family relations to an index-Sami were excluded, as were relatives to both index-Sami and non-Sami index-persons. More importantly, the Sami cohort has previously been found to have a high content of independent sources of Sami identity, i.e. the parish registers and the electoral register of the Sami parliament, while the frequency of Sami in the reference population was low. Finally, the fact that reindeer herding Sami and the non-herding Sami showed mortality rates that were similar to each other, but different from the reference population, indicates genuine differences between the Sami and the reference population.

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References

19. Amfit A, Sámhi in a time of change. A study of Swedish Sami living conditions during the twentieth century from a gender and ethnic perspective. Department of Archaeology and Sami Studies, Umeå University, 2000 (PhD-thesis).

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