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ORIGINAL ARTICLE

Stroke and acute myocardial infarction in the Swedish Sami population: Incidence and mortality in relation to income and level of education

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Abstract

Background: Gender differences in cardiovascular diseases (CVD) among the Sami have been reported previously. The aim of the present study was to investigate the incidence of and mortality from stroke, subarachnoid haemorrhage (SAH), and acute myocardial infarction (AMI) in the Swedish Sami population between 1985 and 2002, and to analyse the potential impact of income and level of education on cardiovascular morbidity and mortality. Methods: A Sami cohort of 15,914 persons (4,465 reindeer herding and 11,449 non-herding Sami) were followed up from 1985 to 2002 with regard to incidence and mortality rates of AMI, stroke, and SAH. Incidence and mortality ratios were calculated using a demographically matched non-Sami control population (DMC) as the standard (71,550 persons).

Results: There was no elevated risk of developing AMI among the Sami compared with the DMC. However, the mortality ratio of AMI was significantly higher for Sami women. Higher incidence rates of stroke and SAH for both Sami men and women was observed, but no differences in mortality rates. Apart from the reindeer-herding men who demonstrated lower levels of income and education, the income and education levels among Sami were similar to the DMC.

Conclusions: High mortality rates from AMI rather than stroke explain the excess mortality for CVD previously shown among Sami women. The results 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 behavioural and psychosocial risk factors rather than by traditional socioeconomic ones.

Key Words: Education, incidence, income, mortality, myocardial infarction, reindeer herders, Sami, stroke, subarachnoid haemorrhage

Background

In a recent study on the causes of death in the Swedish Sami population it was found that the mortality from cardiovascular diseases (CVD) was similar or increased in comparison with a demographically matched reference population of non-Sami[1]. There was no significant difference between Sami and non-Sami men in the case of acute myocardial infarction (AMI) and stroke. However, death due to subarachnoid haemorrhage (SAH) was significantly more common among the Sami. Sami women showed overall increased risk for mortality from CVD, specifically from SAH and ischaemic heart diseases. Similar gender differences in mortality rates for CVD have been reported from Sami in Norway[2], whilst the incidence of coronary heart diseases among Norwegian Sami seems to be the same as in the general population of northern Norway[3]. There are no data from the Swedish Sami population on the incidence of clinically verified CVD, and it is unknown to what extent the observed differences in mortality reflect differences in cardiovascular incidence or prognosis.
It has been suggested that the reduced risk of dying from CVD among Sami men might be due to a diet rich in antioxidants [4–6] and to a high level of physical activity [7]. However, the pattern of risk factors is rather complex. In Finland, reindeer-herding Sami men have been reported to exhibit a high concentration of blood triglycerides and cholesterol as well as unfavourable smoking and alcohol habits [4,5,8,9]. In a study on Swedish Sami it was concluded that differences in exposure to behavioural and biomedical risk factors can only partly account for the differences in CVD mortality between Sami men and women [10]. This study indicated that Sami women, particular those of reindeer-breeding families, were more exposed than the men to psychosocial risk factors, such as lower decision latitude, social support, and intellectual discretion.

In Sweden there are approximately 40,000 Sami [11]. The large majority has adopted an ordinary Westernized lifestyle, whereas some 2,000–2,500 have kept to a more traditional lifestyle based on reindeer breeding, hunting, and fishing. Over the last few decades, the socioeconomic conditions of the reindeer breeders have changed dramatically, mostly as a consequence of the commercialization of reindeer-breeding management. Reindeer breeding, which was the heart of the trading economy of the traditional Sami lifestyle, has evolved into small family businesses with a demand for monetary profit [12]. Modern reindeer-breeding management is struggling in a system of inconsistent governmental regulations and subsidies, which reduces the possibility for the individual reindeer owner to control the income earned from his business. Poor profit has forced Sami families to sell their breeding herds, or to seek complementary income from other employment. The impact of socioeconomic risk factors on the CVD morbidity and mortality among the Sami has not yet been investigated.

The aim of the present study was to investigate the incidence and mortality rates of stroke, SAH, and AMI in the Swedish Sami population between 1985 and 2002, and to discuss these findings in relation to aggregated data on income and level of education.

Material and methods

The study has been approved by the regional ethics committee and conforms 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 study cohort was extracted from a large Swedish Sami cohort described in detail elsewhere [1,11]. The cohort of the present study contained a total of 15,914 Sami (8,271 men and 7,643 women) born in 1960 or earlier, and alive on 1 January 1985, or later. To enable analyses of potential differences in CVD morbidity, CVD mortality, and socioeconomic indicators between Sami with a more traditional lifestyle and Sami with a more Westernized lifestyle, the cohort was divided into two sub-populations: (1) Sami of reindeer-herding households and (2) non-herding Sami. The reindeer-herding Sami were identified in National Occupational Registers and the Register of Reindeer Breeding Enterprises, and the non-herding Sami in the Electoral Registers of the Sami Parliament and the National Kinship Registers [1,11]. A four times larger reference population of non-Sami (demographically matched reference population: DMC) was randomly selected from the National Population and Housing Census Registers to match the Sami cohort with regard to age, gender, area of residence, and date of identification. To refine the Sami cohort regarding Sami heritage, persons who were related to both Sami and non-Sami were excluded from the study (n = 490). The age and gender distribution of the two Sami cohorts and the DMC are given in Table I.

Diagnoses of and deaths from AMI, stroke (ischaemic and haemorrhagic combined), and SAH were collected from the National Hospital Discharge Register and the National Cause of Death Register. The linkages between the registers were done through the unique personal identification numbers. No data were lost due to incorrect matching of personal identification numbers. An event was considered a case if AMI, stroke, or SAH was either the primary or secondary diagnosis of the hospital admission, or the underlying or contributing cause of death. A case with the same diagnosis occurring later than 28 days after the previous hospital admission was considered a new case. If death occurred within the first 28 days after admission it was considered a single case (fatal case). A case was considered non-fatal if the death occurred later than 28 days after first diagnosis.

The earliest start of follow-up was 1 January 1985, and the end of follow-up was 31 December 2002, or the time of death or emigration. Standard incidence ratios (SIR) and standard mortality ratios (SMR) were calculated using annual age- and sex-specific distribution of all incidences of and deaths from
AMI (ICD10: I21), stroke (ICD10: I60–I69) and SAH (ICD10: I61) over the follow-up period. Confidence intervals (CI) were calculated with Byar’s approximation formula with a Poisson assumption [13]. The DMC was used as the standard for all comparisons, and expected cases were calculated by applying the standard annual sex- and cause-specific incidence rates within five-year age categories to the Sami cohort. Case-specific mortality rates were calculated correspondingly. Age-adjusted incidence rates were calculated for AMI and stroke for the period 1987 to 2002 using the Swedish population of 1995 as standard. Recoding of diagnoses between ICD8, ICD9, and ICD10 was done in accordance with the guidelines from Statistic Sweden and the World Health Organization (Classifications of Causes of Death in Swedish Statistics, 1990). Income and education were used as socioeconomic indicators. The data were collected from the Population and Housing Census of 1970, 1990, and 2000, and compiled separately for reindeer-herding Sami, non-herding Sami, and DMC as well as for the entire Swedish population. The highest level of education recorded for each individual was extracted from the Population and Housing Census of 1990 and categorized into three levels: (1) basic level: 6–9 years of compulsory education, (2) middle level: 10–12 years of education, compulsory and vocational or upper secondary school, and (3) high level: more than 12 years of education, including university education. The data on education were collected for those who were 30–74 years of age in 1990, i.e. 87% of the Sami cohort and 88% of the DMC. Gender-specific median, mixed net income was calculated for the age group 40–64 years in 1970, 1990, and 2000, which corresponds to 23%, 52%, and 63% of the Sami cohort and 25%, 53%, and 62% of the DMC.

Results

Between 1985 and 2002 there were a total of 1,443 observations of AMI among 1,156 Sami (788 men and 368 women), 2,306 incidences of stroke among 1,182 Sami (684 men and 498 women), and 145 incidences of SAH among 74 Sami (34 men and 40 women). The incidence ratios of AMI and stroke among both the Sami and the DMC were higher than the rates for Sweden as a whole (Table II).

The overall incidence ratio of AMI revealed no significantly elevated risk for either Sami men or women compared with the DMC (Table III). However, the mortality ratio of AMI was higher for Sami women. The data on stroke and SAH demonstrated the opposite pattern, i.e. significantly higher overall incidence ratios among both Sami men and women, but only slightly higher mortality rates.

The incidence and mortality patterns of the non-herding Sami men and women were similar to those

<table>
<thead>
<tr>
<th>Person-years</th>
<th>Age distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sami – reindeer herders</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>35,296</td>
<td>24,608</td>
</tr>
<tr>
<td>Median age (years)</td>
<td>51</td>
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<tr>
<td>25–34 years</td>
<td>8.3</td>
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<tr>
<td>35–44</td>
<td>23.7</td>
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<tr>
<td>45–54</td>
<td>25.3</td>
</tr>
<tr>
<td>55–64</td>
<td>19.3</td>
</tr>
<tr>
<td>65–74</td>
<td>14.6</td>
</tr>
<tr>
<td>75+</td>
<td>7.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sami – non-herding</th>
<th>Demographically matched reference population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>37,072</td>
<td>34,478</td>
</tr>
<tr>
<td>Median age (years)</td>
<td>51</td>
</tr>
<tr>
<td>25–34 years</td>
<td>7.8</td>
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<td>35–44</td>
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<td>65–74</td>
<td>11.7</td>
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<tr>
<td>75+</td>
<td>9.9</td>
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</tbody>
</table>

Table II. Incidences as age-adjusted incidence rates per 100,000 person-years of acute myocardial infarction (AMI) and stroke between 1987 and 2002 among persons 50 years old or older in different Sami populations, in a demographically matched population of non-Sami (DMC) and in the Swedish general population. Statistics from 1995 were used for the Swedish general data.

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of the total Sami population (see Table III). In contrast, the reindeer-herding Sami demonstrated quite different incidence rates and mortality patterns. The reindeer-herding Sami women showed significantly lower incidence rates of AMI, and no excess mortality rate from AMI, but higher incidence ratios of stroke and SAH, whilst the reindeer-herding Sami men revealed a significantly lower incidence of stroke. Similarly to the non-herding Sami and the reindeer-herding Sami women, they had high incidence ratios of SAH. There were no statistical differences in case fatality in stroke between the Sami and the DMC (Sami, 19%; DMC, 20%; Sami women, 21%; DMC women, 23%). For AMI, the Sami women were found to have relatively more case fatalities than the non-Sami women (Sami, 46%; DMC, 27%). This was also demonstrated for the non-herding Sami women. For Sami men the case fatality in AMI was similar to that of men in the DMC. No statistical difference was observed between the Sami and the DMC for out-of-hospital deaths, except for the reindeer-herding Sami men with an AMI diagnosis who died out of hospital more often than the non-herding Sami and the non-Sami men (72%, 56%, and 61%, respectively).

The annual net income for Sami men and women, in comparison with the DMC and Sweden as a
whole, is illustrated in Figure 1. While there were small differences in median net income between the non-herding Sami and the DMC men, the income for the reindeer-herding Sami men was considerably lower than that for the non-herding Sami and DMC men. There were more similarities in level of income between the women in the Sami cohorts, the DMC, and the Swedish population. However, between 1990 and 2000 there was a trend towards a faster increase in income among reindeer-herding Sami women as compared with non-herding Sami and DMC women. More interestingly, since the late 1980s the net income of the reindeer-herding Sami women has been higher than that of the reindeer-herding Sami men. By 2000 this difference was quite substantial.

Educational levels and their distribution across the different populations are shown in Figure 2. There were virtually no differences in educational level between the women in the different populations. However, the number of reindeer-herding Sami women with a high level of education was significantly larger when compared with the non-herding Sami, the DMC, and Swedish population. At all educational levels, the proportion of reindeer-herding Sami men was significantly different from the men of the other groups, i.e. lower frequency of high and middle level of education, and considerably higher frequency of compulsory education.

Discussion
This study shows that the incidence ratio of stroke, but not of AMI, was significantly increased for both Sami women and men who have adopted a more Westernized lifestyle. Among the reindeer-herding
Sami, the men demonstrated a reduced risk of stroke while the women revealed an increased risk of stroke, but a decreased risk of AMI. Thus, the previously reported excess mortality from CVD among Swedish Sami [1] could partly be explained by higher incidences of stroke among the non-herding Sami and the reindeer-herding Sami women. In comparison with the reindeer-herding men, the reindeer-herding women showed higher net income and education, suggesting that the elevated risk for developing stroke among the women is related to a combination of psychosocial and lifestyle factors rather than to traditional socioeconomic ones.

**Incidence and mortality ratios**

The present study substantiates previous results showing that Sami women have a significantly increased risk of mortality from ischaemic heart disease in comparison with non-Sami women in the same region [1]. However, there was no difference in the incidence of AMI between the Sami and the non-Sami, either for men or women. The discrepancy between the mortality and the incidence risks indicates either that AMI is under-diagnosed among the Sami women, or that the mortality is elevated due to long distances to hospitals. The latter seems less likely, since it would imply that the highest mortality rates should be found among the reindeer-herding Sami men, who work long periods far from roads and emergency care. Other studies have also showed that long distances to hospitals are poorly associated with coronary mortality in Sweden [14]. Thus, the incidence of AMI might be underestimated among the Sami women, possibly as a result of a socioculturally related reluctance to seek help at Swedish local healthcare centres and hospitals.

While the reindeer-herding Sami men had a reduced risk of developing stroke, the non-herding Sami men displayed an increased incidence rate in relation to the DMC. These results are partly in agreement with Norwegian and Finnish studies showing a significantly decreased mortality rate from CVD for Sami men in comparison with non-Sami living in the same regions [2,4]. The reason for the higher mortality rate among the Swedish non-herding Sami is obscure since they appear to be similarly exposed to important behavioural and biomedical risk factors [10]. The explanation is perhaps to be found in the acculturation process, which has affected the non-herding Sami differently from the herding Sami [cf. 12,15]. In future studies a breakdown of stroke into ischaemic and haemorrhagic strokes might shed further light on such differences since there is evidence of higher incidences of cerebral haemorrhage in the earlier stages of an epidemiological transition [16].

**Relations to income and education**

The data on income and education do not suggest that the observed differences in stroke incidence and AMI mortality were caused by dissimilarities in these socioeconomic conditions. In spite of the lowest
income and level of education the reindeer-herding men demonstrated the lowest risk of stroke, and a similar risk of AMI to the DMC men. In contrast, the Sami women showed higher risks of AMI and stroke in comparison with the DMC women, despite similar levels of income and education. Thus, for the Sami low income and level of education do not appear to be linked to AMI risk factors such as high unemployment rate, poor diet, and unfavourable smoking and alcohol habits [7–10,17–19]. Factors that affect socioeconomic status within the reindeer-herding communities are more likely to be associated with occupational skills and family relations [15]. The system of apprenticeship reinforce-reindeer-herding management, which means that the elderly teaching the young skills for breeding and herding, is not part of the Swedish educational system and therefore not documented in official statistics. Furthermore, dietary habits are minimally influenced by level of income since the basic elements of the Sami diet, reindeer meat and fish, are the main products of their reindeer-breeding businesses [17,18,20]. The reindeer-breeding lifestyle also incorporates factors that may have preventive effects on the risk of CVD, such as high level of physical activity, an abundance of dietary antioxidants, soft water, high level of satisfaction, and autonomy at work [4–7,10,19,21].

The most intriguing find of the present study was perhaps, the differences between Sami men and women regarding the incidence of CVD, particularly that for stroke. There are several possible explanations for an elevated risk among the women. It has been indicated that Norwegian Sami women have higher BMI, cholesterol, and triglyceride concentrations as well as blood pressure [7,21]. However, these differences were not confirmed in recent studies on Swedish Sami women, irrespective of whether they were from reindeer-herding families or not [10,19]. While there were no significant gender differences regarding the anthropometric and biomedical risk markers, small but statistically significant disparities for some psychosocial risk factors were observed. The Sami women showed lower intellectual discretion and decision latitude, and had reduced social support at work [10], together with lower levels of physical activity [19]. Such psychosocial risk factors are related to increased risk of CVD [22–25], and it has been indicated that women are more sensitive to psychosocial risk factors related to working conditions than men [25].

While the reindeer-herding men are responsible for the daily management of the reindeer, the women are typically responsible for service functions directly related to the reindeer industry (e.g. providing supplemental food to the reindeer, transportation of reindeer, and meat management during slaughter), along with responsibility for the household and the family's social network [26]. In order to maintain a reasonable family income despite the declining profit from the reindeer-breeding business (cf. Figure 1), it has become common for women to have regular part-time employment [19]. It seems conceivable that the increased responsibility for the family economy has further added to the unfavourable risk-factor pattern for CVD amongst the herding Sami women. An alternative interpretation is that the increase in net income has bolstered the economic independence of the women, and has then contributed to an improvement in their psychosocial conditions. The latter might be indirectly supported by the fact that death from CVD decreased significantly between 1960 and 2000 among women in reindeer-herding families [1]. However, as the available psychosocial data emanate from small and potentially biased samples of Swedish Sami [10,19] and since the socioeconomic data are aggregated in the present study, the relations between CVD among Sami women and their exposure to psychosocial and socioeconomic risk factors remain to be elaborated in future, individual-based studies.

The incidence of SAH was significantly elevated for all Sami groups except for reindeer-herding men, which is basically in agreement with the results of our previous mortality study [1]. It has been suggested that genetic factors have a smaller effect on the risk of stroke and ischaemic heart diseases when compared with behavioural and lifestyle factors [27]. Yet, the importance of hereditary risk factors is relatively large for SAH. For instance, the first-degree relatives of patients with SAH run a 3–7 times larger risk of developing SAH [28]. It has also been shown that gender, ethnicity, and geographical setting have significant effects on the incidence of SAH. Women have 1.6 times higher risk than men, and black Afro-Americans 2.1 times higher risk than white Caucasians [28]. Alcohol consumption, cigarette smoking, hypertension, and coffee consumption are other known risk factors for developing SAH [29]. Except for high coffee consumption, there is no indication that these risk factors are more common among the Sami [17,18]. Since the incidence rates of SAH were significantly elevated both among herding and non-herding Sami, the data support a genetic predisposition for SAH among the Sami [1]. Similar findings have also been reported from Inuit populations [30,31], suggesting that high incidences of SAH are a common genetic trait amongst native populations.
of the Arctic, possibly indicating a relatively early stage in an epidemiological transition.

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References