Health consumption in Sami speaking municipalities and a control group with regard to medical imaging

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Objectives: The Northern Norway Regional Health Authority trust aims to offer a high quality specialist health care to all inhabitants. The objective of this study was to document the consumption of medical imaging [conventional radiography (CR), computerised tomography (CT), magnetic resonance (MR), ultrasound (US)].

Methods: The eight municipalities in northern Norway included in the administration area of the Sami language law (Sami group – 132,490 persons/year in the period 2003–2009, mean/year 19,363 inhabitants) were matched with a control group of 11 municipalities (non-Sami group – 135,539 persons/year, mean/year 18,927 inhabitants). Population data was accessed from Statistics Norway. Data on imaging exams were derived from a regional database including production data from all public and private institutions within the region. All four main modality groups (CR, CT, MR, US) were analysed. Variations for imaging frequency on each modality were compared between the Sami and non-Sami municipalities.

Results: A total of 278,832 exams were performed during study period. The age adjusted exam rate (all modalities) was significantly higher (p < 0.001) in non-Sami (females and males) group. There was no difference with regard to conventional radiography (CR) (p = 0.855). Whereas MR (p < 0.001) imaging was more common in the Sami group, CT (p < 0.001) and US (p = 0.003) exams were more frequently used in the control group.

Conclusion: People living in Sami speaking communities experienced significantly less CT and US exams, but had more MR exams than the control group. A relatively high physical activity, obesity and a lower risk of cancer may be explanations.

Keywords: Sami; radiology; imaging; Norway.

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of ethnicity that can be employed for research purposes has existed except for the Census 1970 (2). This census information has been used in record linkage studies of ethnicity and cancer incidence (3).

In Norway, all inhabitants are members of the national health insurance and have equal rights concerning primary and secondary health care services independent of ethnic group (4). Norwegian health care authorities have been concerned about offering the Sami minority an equal quality of health care service as the one offered to Norwegians in general. Several national reports have therefore put the Sami healthcare into focus (4,5). Furthermore, the topic has been stated in the annual mission document from the Ministry of Health and Care Services to the Northern Norway Regional Health Authority (NNRHA) (6).

Prior research has indicated Sami people less satisfied, than Norwegians in general, with the health care service offered to them (7). Despite the fact that they are protected by a Sami Act, they have a different native language and culture that may cause several difficulties and challenges when assessing the public health care (4). These challenges have often been summarised as threshold, counter, queue and cultural challenges. These hindrances may influence on the ease of access to medical imaging. Medical imaging is an important tool in diagnosing, treatment planning and follow up of patients suffering from accidents, trauma and various diseases. The NNRHA has invested in magnetic resonance (MR) and computerised tomography (CT) machines at the various hospitals in the region as part of a strategy to make a decentralised imaging service available to the population. Furthermore, all imaging production units are fully digitised and all images are available at all locations with transfer mechanisms respecting Norwegian legislation for protection of privacy. On this background, we aimed to clarify the use of medical imaging in the Sami speaking municipalities and a selected control group. The hypothesis was that medical imaging services are equally available to Sami and non-Sami inhabitants in northern Norway.

Material and methods
Whereas 40 Norwegian municipalities have Sami settlers, eight municipalities have been included in the administration area of the Sami language law. The latter are located in the inland and they were selected as the Sami communities in this study (Sami group). Despite these municipalities employ the Sami language, the share of Sami people or the percentage having Sami as their mother tongue is not known. The coastal municipalities of northern Norway have generally few Sami inhabitants and eleven of them were chosen as the control group (non-Sami group). Details concerning number of inhabitants and geographical location of Sami speaking municipalities and the control group are shown in Fig. 1 and Table I.

The names of the Sami municipalities written in Sami language (when employed) and Norwegian were Deatnu Tana, Unjárga Nesseby, Porsanger Porsangú Porsanki, Kárásjohka Karasjok, Guovdageaidnu Kautokeino, Gáivuotna Kåfjord, Ástäváluva Lavangen and Divtasvuona Tysfjord. In 2009, these municipalities had a total of 18,891 inhabitants (9,164 females and 9,727 males). The

![Fig. 1. Map of northern Norway and the Sami and non-Sami speaking municipalities.](image-url)
control group had a total population of 18,043 inhabitants (8,803 females and 9,240 males). The female/male ratio was thus 0.94 and 0.95 in the Sami and the control cohort, respectively. In comparison, the female/male ratio of the Norwegian population in 2009 was 1.01.

In northern Norway medical imaging data have been registered employing two different Radiology Information Systems (RIS). The DIPS-RIS and TRIS constituted 38 and 62% of the registered data, respectively. Employing these two harmonised systems, data from the production databases at all medical imaging departments and private radiology institutes for the time period 2003-2009 was extracted into an anonymous depersonalised database. The work was performed in January 2011.

The following data were extracted from the database at the day of examination: Gender, age, place of living and imaging modality. The imaging modality was classified according to the following alternatives: Conventional radiography (CR), computerised tomography (CT), magnetic resonance (MR) and ultrasound (US). The coded name of the performed examination was registered with the supplemental information on side (left/right) and the coded name of supplemental procedures (e.g. use of contrast media, number of sequences in CT and MR). Furthermore, we registered the imaging unit’s location and the state of emergency (urgent or non-urgent) as registered at the time of request for examination. The latter was only consistent at all locations in the time period 2005-2009, hence the result concerning this parameter includes this period only.

Only imaging procedures performed was included in the study. Consequently, second opinion reports, registrations as “no show”, referrals and other administrative recordings were excluded from analysis due to inconsistency between the two RIS systems.

The age distribution of the two cohorts was imported from Statistics Norway (www.ssb.no). The data were organised in steps, each of 5 years. The median age was located in the age group 40–44 years in both cohorts. Details are shown in Fig. 2. The extracted production data from RIS were also organised in steps of 5 years each, similar to the population cohorts. Details are shown in Fig. 2.

### Statistical analysis and authorisation

The initial data was extracted from a Microsoft SQL 2005 database and further handled in an IBM-Cognos 8 Cube. The Statistical Package for Social Science (SPSS) version 16.0 and Microsoft Excel 2007 were employed for the calculations and final database.

The comparison between the two groups with regard to frequency of imaging where based on calculated rates (Number of imaging procedures 2003–2009/Population 2003–2009 × 1000). Focusing the total number of imaging procedures, the comparisons were done on age adjusted rates. The comparisons were made separately for each of the four modalities on unadjusted age rates. Rates, standard deviation of the rates, rate differences, observator (Z-value), p-value of rate difference, level of significance, level of significance with Bonferroni-correction (4 × 20 comparison) were all calculated employing Microsoft Excel 2007.

The non-Sami female population in the period 2003–2009 was employed as a basis for the age adjusted rates. The number of inhabitants was calculated according to the 2009 figures from Statistics Norway (www.ssb.no). All imaging data implemented were derived from the regional production and quality assurance databases. The data was depersonalised and made anonymous and then exported to the final database. We did not access any individual patient data and consequently any approval from the Regional Committees for Medical and Health Research Ethics (REK) was not necessary. Furthermore, the study was recommended by the Regional committee.

### Table I. Number of inhabitants in the Sami speaking municipalities and the control group. The number of inhabitants is according to the 2009 figures from Statistics Norway (www.ssb.no)

| Sami speaking municipalities | Control group |
|-----------------------------|---------------|
| Municipality | Inhabitants 2009/2003 - 2009* | Municipality | Inhabitants 2009/2003 - 2009* |
| Tana | 2,951/3,000 | Vardø | 2,144/2,317 |
| Nesseby | 878/895 | Hasvik | 970/1,037 |
| Kautokeino | 2,971/2,986 | Nordkapp | 3,180/3,340 |
| Karasjok | 2,786/2,857 | Båtsfjord and Berlevåg | 3,135/3,306 |
| Kåfjord | 2,236/2,278 | Salangen | 2,203/2,234 |
| Porsanger | 4,000/4,192 | Lebesby, Gamvik and Måsøy | 3,666/3,306 |
| Lavangen | 1,023/1,034 | Bjarkey | 503/524 |
| Tysfjord | 2,046/2,121 | Lødingen | 2,242/2,316 |
| Total | 18,891/19,363 | | 18,043/18,927 |

*Mean value.
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**Results**

A total of 278,832 medical imaging exams (Sami 136,688 vs. non-Sami 142,144) were performed during the seven years study period. An overview of exams is visualised according to modality and cohort in Table II. CR and CT were the modalities most frequently employed and constituted 55 and 24% and 56 and 25% in the Sami and non-Sami groups, respectively. The distribution of exams between hospitals/imaging centers was according to patients’ place of living.

There was only a minor difference with regard to state of emergency between groups. Whereas 31.1% of exams were considered as urgent in the Sami group, the figure

![Fig. 2. The percentage of the female and male Sami and non-Sami cohorts in each age group.](image)

**Table II.** The number of exams according to modality in the Sami and non-Sami group

| Modality | Subgroup | Exams | Percent (%) | Exams | Percent (%) | Total rate/1,000/year |
|----------|----------|-------|-------------|-------|-------------|-----------------------|
| CR       | Total    | 75,995| 55.6        | 78,607| 55.3        | 576.8                 |
|          | Female   | 40,898|             | 43,376|             |                       |
|          | Male     | 35,097|             | 35,231|             |                       |
| CT       | Total    | 32,500| 23.8        | 35,417| 24.9        | 253.4                 |
|          | Female   | 15,633|             | 17,666|             |                       |
|          | Male     | 16,867|             | 17,751|             |                       |
| MR       | Total    | 13,824| 10.1        | 12,879| 9.1         | 99.6                  |
|          | Female   | 7,226 |             | 6,809 |             |                       |
|          | Male     | 6,598 |             | 6,070 |             |                       |
| US       | Total    | 14,369| 10.5        | 15,241| 10.7        | 110.5                 |
|          | Female   | 8,657 |             | 9,312 |             |                       |
|          | Male     | 5,712 |             | 5,929 |             |                       |
| Total    | 136,688  |      | 100         | 142,144| 100        | 1,040.3               |

(CR = conventional radiography, CT = computerised tomography, MR = magnetic resonance, US = ultrasound). Rate = rate/1,000 inhabitants.
was 34.7% among the non-Sami. Including all categories (CR, MR, CT and US), the rates per 1,000 inhabitants/year during study period was 1,008 and 1,073 exams in the Sami and non-Sami group, respectively. Adjusting for minor age differences, medical imaging was in general more frequently employed among non-Sami (p < 0.0001) (both females and males) than Sami, and the age group 75–85 years were most frequently examined. Details are visualised in Table III.

CR was employed in a similar manner (p = 0.855) in both the Sami and non-Sami municipalities. The exam rate increased with age and reached its maximum in the oldest group (>90 years). CT exams was most common in the non-Sami group (p < 0.0001). The rate of CT exams during study period per 1,000 inhabitants was 240 and 267 in the two groups, respectively (Table III). The difference was greater among women (238 vs. 273) than men (241 vs. 262). CT was most frequently employed among the elderly and reached its maximum in the age group 75–79 years.

The group undergoing MR exam was characterised by younger age and most frequently employed in the age group 55–59 years. The modality was more commonly employed in females than men. The exam rate per 1,000 inhabitants in Sami and non Sami males were 94 and 90, respectively. The corresponding figures in females were 110 and 105, respectively. Furthermore, MR exam was significantly more common in the Sami group (p < 0.0001) (Table III).

US was more often employed in women with a female/male ratio of 1.6 in both groups. Furthermore, US exam was more common in the non-Sami group (p < 0.0001) (Table III). It reached its maximum in the age group 75–85 years and compared to other modalities, US was more frequently used in children below the age of 5 years.

Table III. The exam rate for conventional radiography (CR), computerised tomography (CT), magnetic resonance (MR) and ultrasound (US) according to Sami or non-Sami group. Significant differences between groups are shown.

| Modality | Subgroup   | Rate  | StandRate | SD StandRate | p-value |
|----------|------------|-------|-----------|--------------|---------|
| All modalities | Sami males | 919   | 979       | 3.6          | p < 0.0001* |
|          | Non-Sami males | 958   | 968       | 3.8          |         |
|          | Sami females | 1,103 | 1,107     | 4.1          | p < 0.0001* |
|          | Non-Sami females | 1193  | 1,136     | 4.3          |         |
| CR       | Sami       | 561   | 576       | 2.03         | p = 0.855   |
|          | Non-Sami   | 593   | 577       | 2.12         |         |
| CT       | Sami       | 240   | 248       | 1.33         | p < 0.0001* |
|          | Non-Sami   | 267   | 258       | 1.42         |         |
| MR       | Sami       | 102   | 103       | 0.87         | p < 0.0001* |
|          | Non-Sami   | 97    | 96        | 0.86         |         |
| US       | Sami       | 106   | 109       | 0.88         | p = 0.003*  |
|          | Non-Sami   | 115   | 112       | 0.93         |         |

Rate = rate/1,000 inhabitants, SD = standard deviation, * = statistically significant difference.

Discussion
In this study we have revealed the use of medical imaging in Sami and non-Sami municipalities in northern Norway. We have documented the age adjusted exam rate being significantly higher (p < 0.001) in non-Sami (females and males) municipalities. There was no difference with regard to conventional radiography (p = 0.855). Whereas MR was more commonly employed in the Sami group (p < 0.001), CT (p < 0.001) and US (p = 0.003) was more frequently used in the control group. Patients undergoing MR was in general characterised with younger age (fertile age) compared to those having a CT scan.

Data quality
The study was based on a total population of two groups of municipalities in northern Norway. The database is the largest collection of medical images taken of people living in the Sami areas of Norway. In Norway, data on minorities as the Sami people are not available as we are forbidden by the law to register people based on ethnicity. Those living in the administration area of the Sami language law were in this survey selected as a surrogate for the Sami people. Whereas there are, without any doubt, a high percentage of Sami people in these municipalities, the exact percentage is not known. Similarly, the percentage of Sami people among the control group consisting of coastal municipalities is low. However, the exact percentage is not known.

Do the study cohort and the control group differ in any other way than being mostly Sami and mostly non-Sami which possibly could affect the need for medical imaging? They differ in geographical setting. Whereas the Sami group is located in the inland, the control group is located in the coastal areas. However, both groups are living in rural areas. Despite both Vardø and Honningsvåg...
(in Nordkapp municipality) are registered Norwegian towns, we argue that the number of inhabitants (about 2,000 in each town) and their location support the classification as rural areas. Traditionally, the coastal population has easier access to the fisheries resources than those living in the inland (Sami group). However, except for the reindeer pattern, ethnicity has not been shown to play a major role in predicting dietary pattern (8). Researchers explaining a lower risk of cancer among Sami have indicated a relatively higher physical activity in this group as one of the explanations (9). Whereas especially the Sami shepherds are physical active, this is also the fact in the non-Sami group where combined farming and fishery traditionally has been a common lifestyle. However, today a lot of people in the Sami and non-Sami groups are not living the traditional lifestyles and the factor of physical activity is at least doubtful.

Access to medical imaging and ethnic minorities

Our finding is somewhat deviating from the mission document from the Ministry of Health and Care Services to the NNRHA, ordering equal availability to medical imaging for all inhabitants in the northern region (6). The Ministry of Health and Care Services has been concerned about the Sami people's rights. They have clearly stated that this ethnical minority must experience the same access to and a similar quality of health care services as the one offered to Norwegians in general. Differences between groups therefore have to be based on different medical needs.

Some differences have been shown between Sami and non-Sami populations in northern Norway. In the SAMINOR study individuals living at the inland area had higher iron levels than the coastal population (10). This was probably due to a higher prevalence of obesity in the Sami population. Obesity causes more loads on joints and may be a reason for more use of MR in the Sami cohort in our survey. Correspondingly, a relatively high physical activity (9) may be another culprit. This statement is based on the fact that MR is frequently employed in orthopaedics.

Individuals living in the Sami municipalities are frequent users of snow mobiles. It could be argued that an increased risk of snow mobile accidents could influence on the need for medical imaging, especially conventional radiography (CR). This could thus be an explanation for the fact that CR is equally used in both cohorts.

Several studies have documented a reduced risk of cancer among the Sami (4,9,11). The decreased risk has been observed for frequent cancers such as colon, lung, prostate and breast cancer. The causality is most probably explained by dietary habits and genetic inheritance. Cancer is most common among the elderly and CT and US is frequently employed in the diagnosing and follow up of cancer patients. The less use of CT and US in the Sami group could partly be caused by the lower risk of cancer. On the other hand, a lower incidence of cancer could be due to a lower diagnostic activity. However, this is probably not true as we are aware of studies under publication that documented a similar referral rate to somatic hospitals and the same attendance rate for mammography in both of our study groups.

The documented less access to imaging services (CT and US) in the Sami group may be because of ethnical status and the problems related to language and cultural differences (4). However, we are in serious doubt concerning this conclusion as these so-called thresholds, counter, queue and cultural challenges did not influence on the access rate to MR and CR.

Multiple sclerosis is an uncommon disease among the Sami people (12). Whereas these patients are frequently followed up by the use of MR imaging, the numbers are too low to have any significant influence on the result in our study.

Several studies have documented that ethnical minorities have less access to medical imaging (13,14). A study from California US (13) documented that American Indian and Alaskan native women had the lowest rate of mammography screening compared with other races. Patient navigation has been documented improving mammography rates among minority populations (14). The mammography screening program in Norway is run by the Cancer Registry of Norway (CRN) and imaging data from this program was not included in our survey. However, knowing the significant reduced risk of breast cancer among the Sami people, it could be suspected a lower participation rate in this cohort. Further studies should elucidate this question.

Generally, the use of CT scan should be limited in the fertile part of the population as irradiation may cause risk of cancer and fetal damages. When appropriate, MR should be considered a better alternative in this age group and the use of CT should be “reserved” for the elderly. This policy was illustrated in both cohorts in our survey.

Delayed access to medical imaging may worsen the prognosis of cancer (15). Recently, the Norwegian Directorate of Health has taken an initiative to register the time span from referral to first therapy for breast, lung and colon cancer. The program will be initiated in 2011. The delay in access to medical imaging may be an important part of this issue. We had no access to any data on waiting time in our survey. However, when the program is initiated this topic should be focused in future studies.

Conclusion

People living in Sami speaking communities experienced less CT and US exams, but underwent more MR exams than the control group. There was no difference
concerning the use of CR. A relatively high physical activity, obesity and lower risk of cancer may be explanations for these findings. Differences between Sami and non-Sami municipalities with regard to medical imaging may therefore be acceptable, but further investigations should be done.

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