

ᑭᓂ ᓄᐃᑦ ᐱᑦᑦ?
Qanuippitaa?
HOW ARE WE?

HEARING LOSS AND DENTAL HEALTH



ᑭᖅ ᓄᐃᑦ ᐱᑦ?
Qanuippitaa?
HOW ARE WE?

HEARING LOSS AND DENTAL HEALTH

AUTHORS

Hearing loss

Hannah Ayukawa
Tulattavik Health Centre, Kuujjuaq

Dental health

Roger Bélanger
Direction de santé publique du Nunavik

STATISTICAL ANALYSES

Louis Rochette

Unité Connaissance-surveillance,
direction Planification, recherche et innovation,
Institut national de santé publique du Québec



ᓄᐱᐱᐱ ᓄᐱᑦᑦᑦ ᐃᐱᑦᑦᑦ ᐱᑭᑦᑦᑦ ᑲᑲᑲᑲᑲᑲ
NUNAVIK REGIONAL BOARD OF HEALTH AND SOCIAL SERVICES
RÉGIE RÉGIONALE DE LA SANTÉ ET DES SERVICES SOCIAUX NUNAVIK

**Institut national
de santé publique**

Québec 

EXECUTIVE DIRECTOR

Danielle St-Laurent
Unité Connaissance-surveillance, direction Planification, recherche et innovation
Institut national de santé publique du Québec

SCIENTIFIC DIRECTORS

Éric Dewailly
Unité de recherche en santé publique, Centre Hospitalier Universitaire de Québec;
Direction Risques biologiques, environnementaux et occupationnels, Institut national de santé publique du Québec

Serge Déry
Direction régionale de santé publique du Nunavik

EDITING AND COORDINATION

Michèle A. Dupont, Élisabeth Papineau and Mélanie Anctil
Unité Connaissance-surveillance, direction Planification, recherche et innovation
Institut national de santé publique du Québec

LAYOUT

Line Mailloux
Unité Connaissance-surveillance, direction Planification, recherche et innovation
Institut national de santé publique du Québec

PUBLICATION

Institut national de santé publique du Québec
Nunavik Regional Board of Health and Social Services / Régie régionale de la santé et des services sociaux du Nunavik

*This document is available in its entirety in electronic format (PDF) on the Institut national de santé publique du Québec Web site at:
<http://www.inspq.qc.ca>.*

Reproductions for private study or research purposes are authorized by virtue of Article 29 of the Copyright Act. Any other use must be authorized by the Government of Québec, which holds the exclusive intellectual property rights for this document. Authorization may be obtained by submitting a request to the central clearing house of the [Service de la gestion des droits d'auteur of Les Publications du Québec](http://www.droitauteur.gouv.qc.ca/en/autorisation.php), using the online form at <http://www.droitauteur.gouv.qc.ca/en/autorisation.php> or by sending an e-mail to droit.auteur@cspq.gouv.qc.ca.

Information contained in the document may be cited provided that the source is mentioned.

LEGAL DEPOSIT – 3RD QUARTER 2007
BIBLIOTHEQUE ET ARCHIVES NATIONALES DU QUEBEC
LIBRARY AND ARCHIVES CANADA
ISBN 13 : 978-2-550-50446-7 (PRINTED VERSION)
ISBN 13 : 978-2-550-50445-0 (PDF)

©Gouvernement du Québec (2007)

BACKGROUND OF THE NUNAVIK INUIT HEALTH SURVEY

The monitoring of population health and its determinants is essential for the development of effective health prevention and promotion programs. More specifically, monitoring must provide an overall picture of a population's health, verify health trends and how health indicators vary over distance and time, detect emerging problems, identify priority problems, and develop possible health programs and services that meet the needs of the population studied.

The extensive survey conducted by Santé Québec in Nunavik in 1992 provided information on the health status of the Nunavik population (Santé Québec, 1994). The survey showed that health patterns of the population were in transition and reflected important lifestyle changes. Effectively, the Inuit population has undergone profound sociocultural, economic, and environmental changes over the last few decades. The Inuit have changed their living habits as contact with more southerly regions of Quebec increased. A sedentary lifestyle, the switch to a cash-based domestic economy, the modernization of living conditions and the increasing availability and accessibility of goods and foodstuffs imported from southern regions have contributed to these changes. These observations suggest the need for periodic monitoring of health endpoints of Nunavik Inuit to prevent the negative impact of risk factor emergence and lifestyle changes on subsequent morbidity and mortality from major chronic diseases.

In 2003, the Nunavik Regional Board of Health and Social Services (NRBHSS) decided to organize an extensive health survey in Nunavik in order to verify the evolution of health status and risk factors in the population. The NRBHSS and the Ministère de la Santé et des Services sociaux (MSSS) du Québec entrusted the Institut national de santé publique du Québec (INSPQ) with planning, administering and coordinating the survey. The INSPQ prepared the survey in close collaboration with the Unité de recherche en santé publique (URSP) of the Centre hospitalier universitaire de Québec (CHUQ) for the scientific and logistical component of the survey. The Institut de la statistique du Québec (ISQ) participated in methodology development, in particular the survey design.

The general aim of the survey was to gather social and health information on a set of themes including various

health indicators, physical measurements, and social, environmental and living conditions, thus permitting a thorough update of the health and well-being profile of the Inuit population of Nunavik. The survey was designed to permit a comparison of the 2004 trends with those observed in 1992. Data collected in 2004 also allowed researchers to compare the Inuit to other Quebecers.

Target population

The health survey was conducted among the Inuit population of Nunavik from August 27 to October 1, 2004. According to the 2001 Canadian census, the fourteen communities of Nunavik have a total of 9632 inhabitants, 91% of whom identified themselves as Inuit. The target population of the survey was permanent residents of Nunavik, excluding residents of collective dwellings and households in which there were no Inuit aged 18 years old or older.

Data collection

Data collection was performed on the Canadian Coast Guard Ship Amundsen, thanks to a grant obtained from the Canadian Foundation for Innovation (CFI) and the Network of Centres of Excellence of Canada (ArcticNet). The ship visited the fourteen villages of Nunavik, which are coastal villages. The study was based on self-administered and interviewer-completed questionnaires. The study also involved physical and biological measurements including clinical tests. The survey was approved by the Comité d'éthique de la recherche de l'Université Laval (CERUL) and the Comité d'éthique de santé publique du Québec (CESP). Participation was voluntary and participants were asked to give their written consent before completing interviews and clinical tests. A total of 677 private Inuit households were visited by interviewers who met the household respondents to complete the identification chart and the household questionnaire. A respondent was defined as an Inuit adult able to provide information regarding every member of the household. The identification chart allowed demographic information to be collected on every member of the household. The household questionnaire served to collect information on housing, environment, nutrition and certain health indicators especially regarding young children.

All individuals aged 15 or older belonging to the same household were invited to meet survey staff a few days later, on a Canadian Coast Guard ship, to respond to an interviewer-completed questionnaire (individual

questionnaire) as well as a self-administered confidential questionnaire. Participants from 18 to 74 years of age were also asked to complete a food frequency questionnaire and a 24-hour dietary recall, and to participate in a clinical session. The individual questionnaire aimed to collect general health information on subjects such as health perceptions, women's health, living habits and social support. The confidential questionnaire dealt with more sensitive issues such as suicide, drugs, violence and sexuality. During the clinical session, participants were invited to answer a nurse-completed questionnaire regarding their health status. Then, participants had a blood sample taken and physical measurements were performed including a hearing test, anthropometric measurements, an oral glucose tolerance test (excluding diabetics) and toenail sampling. Women from 35 to 74 years of age were invited to have a bone densitometry test. Finally, participants aged 40 to 74 could have, after consenting, an arteriosclerosis screening test as well as a continuous measure of cardiac rhythm for a two-hour period.

Survey sampling and participation

The survey used a stratified random sampling of private Inuit households. The community was the only stratification variable used. This stratification allowed a standard representation of the target population. Among the 677 households visited by the interviewers, 521 agreed to participate in the survey. The household response rate is thus 77.8%. The individual response rates are obtained by multiplying the household participating rate by the individual collaboration rate since the household and individual instruments were administered in sequence. The collaboration rate corresponds to the proportion of eligible individuals who agreed to participate among the 521 participating households. In this survey, about two thirds of individuals accepted to participate for a response rate in the area of 50% for most of the collection instruments used in the survey. A total of 1056 individuals signed a consent form and had at least one test or completed one questionnaire. Among them, 1006 individuals answered the individual questionnaire, 969 answered the confidential questionnaire, 925 participated in the clinical session, 821 had a hearing test, 778 answered the food frequency questionnaire, 664 answered the 24-hour dietary recall, 282 had an arteriosclerosis test, 211 had a continuous measure of their cardiac rhythm for a two-hour period and 207 had a bone densitometry test. More details on the data processing are given in the Methodological Report.

INTRODUCTION¹

In the 1992 health survey among the Inuit of Nunavik, hearing impairment was the most commonly reported health problem (Santé Québec, 1994). The first section of this paper presents the 2004 Nunavik Inuit Health Survey's findings on the prevalence of hearing loss and the variables associated with it. In 1984, the Hearing and Otitis program began to develop audiology services in Nunavik. Since 1994, there have been two audiologists, hearing aid specialist and otolaryngologist visits, as well as numerous Inuit hearing health care providers, providing clinical and rehabilitation services and working on prevention and research projects. Whereas students and more recently preschoolers have been targeted in screening programs, this survey in 2004 was the first time that the general adult population could be systematically approached. The findings of the survey have already led to a new focus clinically on older members of the communities as well as increased efforts in hearing loss prevention for men via promotion of ear protection.

The second section of the paper briefly describes the Nunavik Inuit's dental health, which is generally an indicator of the overall health and quality of life of the population under study.

I. HEARING LOSS

The Inuit have a very high prevalence of hearing impairment. Two of the primary causes of hearing loss began with contact with southern civilization in the 1950s. One cause is otitis media, which leads to a conductive hearing loss and the second is noise pollution, which causes a sensorineural impairment (Baxter, 1990).

Inuit have one of the highest prevalence of chronic otitis media (chronic perforation) and chronic suppurative otitis media in the world (Bluestone, 1998). The earlier the onset of the first episode of acute otitis media, the more likely a child will suffer recurrent episodes and develop a chronic condition (Bruneau et al., 2001). Hearing impairment may begin at a young age due to the effects of recurrent episodes of otitis media. Nineteen percent of Inuit children aged 5-6 years had a hearing loss in one or

¹ For ease of readability, the expression "Inuit" is used throughout the theme paper to define the population under study even though a small percentage of individuals surveyed identified themselves as non-Inuit. Refer to "Background of the Health Survey" for further details regarding the definition of the target population.

both ears (Ayukawa et al., 2004b). While hearing may fluctuate with middle ear condition, in many individuals this conductive hearing loss persists into adulthood. In a study on conductive hearing loss among Inuit living in the Northwest Territories, age was found to be a significant variable, with hearing loss beginning in school years and increasing with age. Gender was not found to be a significant variable for conductive hearing loss (Moore, 1999).

Around the world, men more frequently than women suffer acquired sensorineural hearing loss due to noise exposure (Nelson et al., 2005). In Nunavik, the main sources of noise include rifles, shotguns, snowmobiles, power tools, and motorized ice augers. As well, some men work in occupations that expose them to noise.

Sensorineural hearing loss also occurs due to aging. In 1995, a US survey showed that amongst Caucasians, self-reported hearing loss increases from less than 5% at under age 40, to approximately 10% at age 40-49 years and 16% at age 50-59 years (Lee et al., 2004). As Inuit are now living longer, hearing loss due to aging will increase. Sensorineural hearing loss due to aging and noise exposure is evident first in the high frequencies and is usually bilateral.

There have been previous studies on hearing loss in Inuit in other regions of Canada. In 1990, Inuit of Keewatin (now known as Kivalliq) were surveyed (365 adults, a 20% random sample of 8 villages) by Moffat and colleagues (1994). Overall, 40% of adults had a hearing loss in one or both ears with more high frequency loss, and also a higher prevalence reported for men (57%) vs. women (26%). In an earlier study in the Baffin region, Baxter and Ling (1974) found that up to 85% of adult men had hearing loss probably due to noise exposure. Thirty-two hunters in Greenland and fifty-five hunters in the Baffin region were evaluated in 1977 (Baxter & Røjskjaer, 1979). All except one, age 23, were found to have a high frequency sensorineural hearing loss. Moore (1990) reviewed the audiology files of people assessed in different regions of the Northwest Territories, comparing the Kitikmeot, a region where the population is primarily Inuit with three other regions. In the Kitikmeot, 56% had conductive hearing loss (over half were children) and 37% sensorineural hearing loss. In the other regions where there are fewer Inuit, the pattern was different, with adults having sensorineural hearing losses making up the majority of those seen for assessment.

Hearing impairment was the most commonly reported health problem in the Santé Québec survey in 1992. Overall one in nine adults (12%) reported a hearing problem. Variations were found according to gender and age. The prevalence of hearing problems in women was between 9% (age 15-24 years) and 16% (over 45 years). Men in the same age groups, reported twice as high a rate of hearing problems at 21% and 31%, respectively.

In the 1992 survey, another question asked about difficulties in understanding a normal conversation (hearing disability). Overall, 9% of respondents, with slightly more men than women (11% vs. 8%), reported having this problem. The frequency was higher in communities on the Hudson coast, 11% compared to 8% in the Ungava coast, and increased with age with 20% of the oldest age group (45 years and over) reporting a hearing disability.

In the present survey done in 2004, a hearing test was performed with participants aged 18 to 74 years. The objectives of this study were to (1) describe and determine the prevalence of hearing loss and the variables associated with hearing loss (2) investigate any relationship between hunting and hearing loss and (3) investigate any relationship between hearing loss and educational achievement.

METHODOLOGICAL ASPECTS

The testing protocol used was adapted from the World Health Organisation Ear and Hearing Disorders Survey (WHO, 1999). Testing was performed in a single wall soundproof booth and Amplivox Audiocups noise-excluding headsets were used. Testing did not go below 20 dBHL for the three frequencies tested (1 kHz, 2 kHz, 4 kHz). Examinations were done by technicians who had been trained in the test protocol by an audiologist.

The audiometers (Maico MA 41 and MA 39) were calibrated before the survey and rechecked after it; they conformed to current ANSI standards. A biological check was performed daily.

Noise levels were measured inside the sound booth once or twice a day using a Quest 2900 sound-level meter. The levels varied from 41.9 to 64.0 dBA depending on if the ship's motor was running and on weather conditions. However, because the noise-excluding headset provides an attenuation of 30 ± 8 dB at 1 kHz, 39 ± 7 dB at 2 kHz,

and 44 ± 8 dB at 4 k Hz, ambient noise should not have affected the results.

All adult participants aged 18 to 74 years were to be tested. Hearing tests were performed on 821 participants. There were 106 who were not tested. Nine participants had an incomplete test. In five instances, the people not evaluated had a known hearing loss (reported as deaf or as a hearing aid user). For the others not tested, the reasons given are not related to hearing status, hence it is unknown if prevalence could be affected.

Definition of normal hearing and hearing loss

The “normal” hearing category is defined as an average hearing threshold at 1 kHz, 2 kHz and 4 kHz of 25 dB or less in both ears. In the normal category, an individual could have thresholds of 20, 25, 30 or 20, 20, 35 dBHL. Hence this definition of normal hearing is lenient but appropriate considering our testing conditions and the adult age group. “Unilateral” hearing loss is defined as having normal hearing in one ear and a hearing loss in the other ear. The ear with hearing loss has an average hearing threshold of 26 dB or more. “Bilateral” hearing loss is defined as an average hearing loss of 26 dB or more in both ears. The World Health Organization defines hearing disability causing significant communication problems (WHO, 1991) as a bilateral average hearing loss of 41 dB or greater (for individuals age 15 and over). In its definition, the frequencies 0.5 kHz, 1 kHz, 2 kHz, 4 kHz are averaged.

Statistical analysis

Statistical analyses for comparisons by sex, age group, region and other characteristics have been conducted at a threshold of $\alpha = 0.05$. Chi-square test with a correction for design effect was used to compare proportions. A McNemar test (for matched samples) with a correction for design effect was used to compare proportions of hearing loss between right and left ears.

The Nunavik territory has been divided in two regions because place of residence could influence life habits. The Hudson coast includes the villages of Kuujjuarapik, Umiujaq, Inukjuak, Puvirnituk, Akulivik, Ivujivik and Salluit while the Ungava coast includes Kangiqsujuaq, Quaqtuq, Kangirsuk, Aupaluk, Tasiujaq, Kuujjuaq and Kangiqsualujuaq. Villages were also divided according to their size: small versus large communities (which include Inukjuak, Puvirnituk, Kuujjuaq and Salluit).

For the education variable, the number of people who said they had completed secondary school was likely overestimated. Some of the responses given for the post-secondary category reveal that there was confusion between training that requires a post-secondary diploma and training that does not (e.g. driver’s license, fishing license, etc).

The data used in this study comes from a sample and is thus subject to a certain degree of error. The coefficient of variation (CV) has been used to quantify the accuracy of estimates and the Statistics Canada scale was used to qualify the accuracy of estimates. The presence of an “E” footnote next to an estimate indicates a marginal estimate (CV between 16.6% and 33.3%). Estimates with unreliable levels of accuracy (CV > 33.3%) are not presented and have been replaced by the letter “F”.

RESULTS

Prevalence of hearing loss and associated variables

Fifty-six percent (56.0%) of the adult population were found to have normal hearing in both ears. One in four adults had a hearing impairment in both ears, and one in five had a hearing loss in one ear (Table 1). There were 450 women and 371 men whose hearing was evaluated. Normal hearing was found in 66.7% of women compared to 45.6% of men. Three times more men (36.6%) had a bilateral hearing loss than women (12.5%). Because of the limited numbers, we were unable to determine the prevalence of more severe degrees of hearing loss.

Table 1
Prevalence of hearing loss by sex (%), population aged 18 to 74 years, Nunavik, 2004

	Both sexes (95% c.i.)	Women (95% c.i.)	Men (95% c.i.)
Normal hearing, both ears	56.0 (53.1-58.8)	66.7 (62.9-70.6)	45.6 (41.2-49.9)
Unilateral hearing loss	19.3 (16.9-21.7)	20.8 (17.3-24.3)	17.8 (14.5-21.5)
Bilateral hearing loss	24.8 (22.4-27.1)	12.5 (9.9-15.4)	36.6 (32.8-40.4)

$\chi^2 (2) = 87.15; p < 0.001$.

Source: Nunavik Inuit Health Survey 2004.

The prevalence of hearing loss in Ungava versus Hudson coast communities and in small versus large communities

was not significantly different (data not shown). Prevalence in individual communities could not be determined because of limited numbers.

Hearing loss was significantly associated with both age and gender (Table 2). Normal hearing prevalence was 74.9% in the 18-29 age group, and 55.7% among participants aged 30-44 years. Less than one third (30.3%) of those aged 45 years and over had normal hearing and over half (51.1%) had a hearing loss in both ears.

Comparing men and women, hearing ability is similar in the youngest age group, but at age 30-44, the men show already a greater deficiency compared to the women. In the oldest age group, three out of four men are affected in both ears compared to one out of four women.

Table 2

Prevalence of hearing loss according to age group and sex (%), population aged 18 to 74 years, Nunavik, 2004

	Normal hearing, both ears	Unilateral hearing loss	Bilateral hearing loss
18-29 years			
Men	71.1	18.2 ^E	10.7 ^E
Women	78.6	15.9 ^E	5.4 ^E
Total	74.9	17.0	8.1 ^E
30-44 years			
Men	41.7	22.7	35.6
Women	70.1	21.5	8.4 ^E
Total	55.7	22.1	22.2
45-74 years			
Men	F	F	75.5
Women	44.8	28.1	27.1
Total	30.3	18.5	51.1

Total: $X^2(4) = 169.37; p < 0.001$.

Men: $X^2(4) = 134.97; p < 0.001$.

Women: $X^2(4) = 47.19; p < 0.001$.

E Interpret with caution.

F Unreliable estimate.

Source: Nunavik Inuit Health Survey 2004.

As shown in Table 3, the prevalence of hearing impairment and hearing disability in Nunavik is similar to that found in studies carried out in developing countries where the World Health Organization Ear and Hearing Survey protocol has been used (Smith, 2007). In the WHO surveys, otitis media, wax, congenital hearing impairment, ototoxicity, and noise were the main causes of hearing loss (Pascolini & Smith, 2006).

Table 3

World Health Organization (WHO) hearing loss prevalence (%)

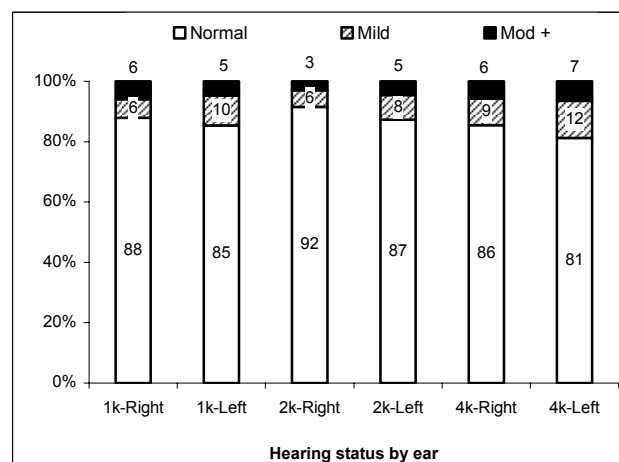
	WHO Hearing Impairment > 25 dB in better ear	WHO Hearing Disability 41 dB or greater in better ear
Myanmar	32.0	8.0
Brazil (Canoas)	26.1	6.8
Nunavik (2004)	24.8	7.6
Sri Lanka	23.0	9.0
India (Vellore)	23.0	6.0
Vietnam	20.4	6.0
Nigeria	17.9	6.2
China (Jiangsu Prov.)	15.9	5.3
Indonesia (Bandung)	13.0	5.0

Source: Smith, 2007.

A further analysis was performed to investigate the relationship between hearing loss, test frequency, age, ear and gender. For this analysis, the 18-29 and 30-44 age groups were grouped together. In the younger age group (Figures 1 and 2), hearing loss was significantly associated with gender at 4 kHz only. In the older age group, 45 years and over (Figures 3 and 4), gender was associated with hearing loss at 1 kHz in the right ear, and at 2 kHz and 4 kHz in both ears. Comparing these figures, it can be seen that hearing loss is present at 4 kHz first and later extends to the lower frequencies.

Figure 1

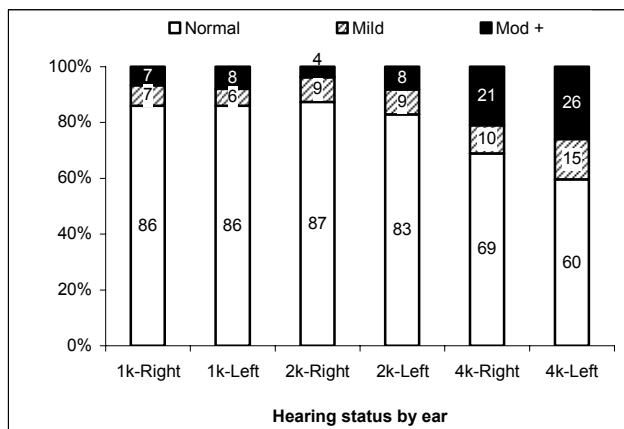
Hearing status in women by ear and frequency (%), population aged 18 to 44 years, Nunavik, 2004



Source: Nunavik Inuit Health Survey 2004.

Figure 2

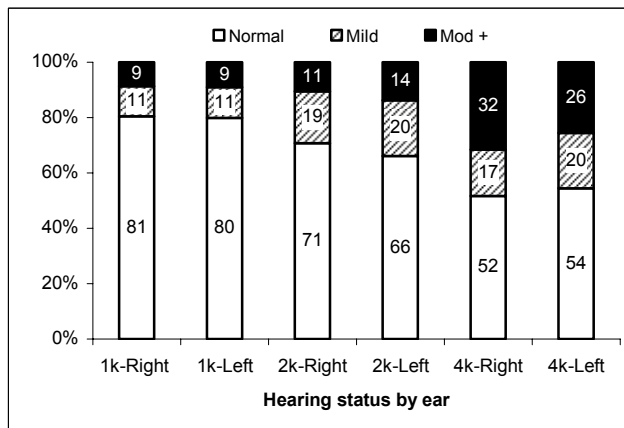
Hearing status in men by ear and frequency (%), population aged 18 to 44 years, Nunavik, 2004



Source: Nunavik Inuit Health Survey 2004.

Figure 3

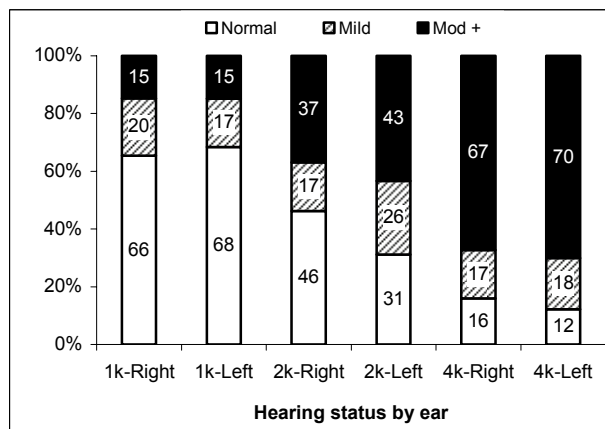
Hearing status in women by ear and frequency (%), population aged 45 to 74 years, Nunavik, 2004



Source: Nunavik Inuit Health Survey 2004.

Figure 4

Hearing status in men by ear and frequency (%), population aged 45 to 74 years, Nunavik, 2004



Source: Nunavik Inuit Health Survey 2004.

When hearing was compared in left and right ears (data not shown), a difference was found with significantly poorer hearing in the left ear. This may be because the left ear is more vulnerable (directed towards the front) in right-handed hunters.

Hearing loss and hunting

As noise exposure can cause hearing problems, a comparison was made between men who hunt once per week or more and those hunting less than once per week (Table 4). As expected, the level of hearing loss at 4 kHz in the worse ear was significantly associated with the rate of hunting, with more frequent hunters having more hearing loss. Although age is associated with hearing loss, it does not appear to be the cause of the difference in hearing in this case as the mean age of the two groups of hunters was not significantly different.

Table 4

Hunting frequency and hearing loss (%), men aged 18 to 74 years who hunt, Nunavik, 2004

	Infrequent hunters	Frequent hunters
Normal at 4 kHz (both ears)	53.1	39.1
Mild or worse at 4 kHz (at least one ear)	46.9	60.9

$X^2 (1) = 7.25; p = 0.007.$

Source: Nunavik Inuit Health Survey 2004.

➤ Hearing loss and educational achievement

Hearing loss is one factor that may have an impact on the level of educational achievement. Even a unilateral hearing loss or a mild hearing loss can contribute to academic difficulties (Northern & Downs, 1991). For this analysis, the age range was limited to the 21-44 age group, in order to exclude those too young to have had time to complete secondary school, and those too old to have attended regular schooling. Sixty nine percent of the respondents had not completed secondary school while 31.0% of the group had graduated from secondary school. The results show that those who had completed secondary school had significantly better hearing than those who did not finish secondary school (Table 5). Only 9.8%^E of the secondary school graduates had a bilateral hearing loss.

Table 5

Hearing status and level of education (%), population aged 21 to 44 years, Nunavik, 2004

	Secondary school not completed	Secondary school completed
Normal hearing, both ears	56.2	74.0
Unilateral hearing loss	23.9	16.2 ^E
Bilateral hearing loss	19.9	9.8 ^E

$X^2(2) = 18.26; p < 0.0001.$

E Interpret with caution.

Source: Nunavik Inuit Health Survey 2004.

There are two possible explanations for this finding. One is that hearing loss is associated with lower levels of academic achievement because it contributes to the student doing more poorly. It could also be that those not attending school are more likely to be participating in activities that contribute to noise-induced hearing loss.

Since there is a relationship between age and hearing loss, we divided the age group into 21-29 and 30-44 years (Table 6). In the younger age group, 33.4% of the individuals had completed secondary school, as compared to 29.4% of the older group. For the 21-29 age group, the relationship between hearing and education level was not statistically significant, although a trend was apparent. In the 30-44 age group, the presence of hearing loss was significantly related to a lower level of education.

Table 6

Hearing status by level of education level and age group (%), population aged 21 to 44 years, Nunavik, 2004

Secondary school	Normal hearing, both ears	Any hearing loss
21-29 years		
Not completed	66.1	33.9
Completed	77.9	22.1 ^E
30-44 years		
Not completed	49.9	50.1
Completed	71.0	29.0

21-29 age group: $X^2(1) = 3.59; p = 0.058.$

30-44 age group: $X^2(1) = 13.35; p = 0.0003.$

E Interpret with caution.

Source: Nunavik Inuit Health Survey 2004.

Since there is an association between gender and hearing loss, we also analysed the women and men separately. In the study group, thirty-three percent of the men and 28.6% of the women had completed secondary school. Normal hearing was present in 83.4% of the women who had completed secondary school and 68.5% of those who had not. For men, normal hearing was found in 66.0% of the secondary school graduates compared to 43.2% of those who did not graduate. The association between graduation and hearing status was significant for both genders (Table 7).

Table 7

Hearing status by sex and level of education (%), population aged 21 to 44 years, Nunavik, 2004

Secondary school	Normal hearing, both ears	Any hearing loss
Women		
Not completed	68.5	31.5
Completed	83.4	16.7 ^E
Men		
Not completed	43.2	56.8
Completed	66.0	34.0

Men: $X^2(1) = 13.72; p = 0.0002.$

Women: $X^2(1) = 6.68; p = 0.0098.$

E Interpret with caution.

Source: Nunavik Inuit Health Survey 2004.

The results must be interpreted with caution because of the assumption that the hearing level measured in 2004 is similar to that at school age. While it is likely that there are differences, it is more probable that the hearing has gotten poorer rather than better over time. If this is so, the association would still be apparent. A multivariate analysis would be necessary to further investigate factors that may relate to school success.

DISCUSSION

The prevalence of hearing loss among adults in Nunavik is very high and is associated with both age and gender. One in two men and one in three women have a hearing loss in one or both ears. Hearing loss was found to increase with age. In the over 45 years age group, an alarming three in four men and one in four women had bilateral hearing loss.

In 1992, 12% of the population reported hearing problems. Our testing found that twice this proportion (24.8%) had bilateral hearing deficit. It is known that the sensitivity of self-reported hearing loss compared to pure tone testing can vary from 56% to 93% (Sindhusake et al., 2001). The 1992 prevalence rate may be an underestimate or there may have been an increase in hearing loss prevalence or both. No differences were found in bilateral hearing loss between the Ungava and Hudson coastal communities.

In the 1990 survey in the Keewatin region (Moffat et al., 1994), a similar percentage had normal hearing but they found 14% with bilateral hearing loss compared to 24.8% in Nunavik. In the earlier study, there were twice as many men as women with hearing impairment whereas the present survey found three times more men than women with hearing loss. In the Keewatin survey, the mean age of the people with hearing loss was also very young, at 43.4 years.

The main limitation of the present survey was that due to testing and personnel constraints, neither bone conduction testing nor an otoscopic evaluation were included in the protocol. Hence, no conclusions about the etiology of the hearing losses can be made.

We could speculate that in the youngest age group, the hearing losses are mostly conductive, due to previous or present middle ear disease. The 40% increase in hearing problems after age 29 is probably primarily sensorineural in origin. This supposition is supported by the observation that the acquired hearing losses were bilateral and

progressed from the higher frequencies to the lower, as is found in presbycusis and noise-induced hearing impairment. Of the adults receiving audiology services in the Ungava coast of Nunavik, slightly more than half have conductive or mixed hearing losses.

Despite the medical care available, it is troubling to see that the levels of hearing impairment and disability in Nunavik are similar to those found in the developing world. In those areas, infectious diseases such as meningitis and measles, as well as ototoxicity are frequent causes of hearing impairment whereas they are very infrequent in Nunavik. The World Health Organization (WHO) estimates that adult onset hearing loss is the fifteenth most serious health problem in the world (Smith, 2004), and that there is a troubling lack of awareness of its impact on individuals and communities.

As in other studies, men had more hearing impairment than women. These differences were marked at ages of 30 and over. In the over 45 age group, 50% more men suffered bilateral hearing impairment than women. If we assume that hearing loss in women is primarily due to age rather than noise exposure, we can observe the deleterious effect of noise in the male population. Noise exposure may be occupational, for example in the mining industry, maintenance, airport workers, construction or heavy machinery. For these occupational hazards, ear protection devices provided by the employer are sometimes used. However, there are traditional activities such as ice fishing, carving and hunting which also expose men to more noise. While foam earplugs are available in most communities, usage is rare. Other forms of ear protection are more difficult to obtain.

Frequent hunters were found to have more damage to their hearing. This is an area where initiatives for the protection of ears from noise exposure may be able to reduce hearing loss in this at-risk group. A slight difference in hearing in the left ear was found that may be related to firearm exposure. This was also observed in hunters of the Baffin region (Baxter & Røjskjær, 1979).

Damage to hearing due to noise is cumulative. It is also synergistic with age, and individuals have varying levels of susceptibility to damage. One recent theory proposes that some adult onset hearing loss is linked to events during fetal life, such as malnourishment or other stresses (Barrenas et al., 2005a). A higher risk of sensorineural hearing loss has been found in men born small for their

gestational age and of short stature (Barrenas et al., 2005b).

The association observed between hearing loss and educational attainment is troubling but was not unexpected. In a study among youth in Inukjuak, Nunavik, hearing loss was found to be associated with poorer grades in a second language (Ayukawa et al., 2004). This was also observed in the Keewatin region where it was found that those with hearing loss had completed an average of 5.7 years of education compared to 7.3 years for those with normal hearing levels (Moffat et al., 1994). With only 30% of the study group having completed secondary school, the possibility of negative effects of hearing loss on academic achievement should not be discounted. In the past few years, more Nunavik classrooms have been equipped with sound amplification systems, following the demonstration of benefits to students' listening measured in a pilot project (Eriks-Brophy & Ayukawa, 2000). Educational attainment has a positive impact on both the employment rate and the income level.

Hearing problems in Nunavik are widespread, with one quarter of adults having hearing problems in both ears. Men have three times more hearing loss than women. Over half the adults over age 45 suffer from a hearing loss in both ears. These auditory problems can contribute to communication difficulties, isolation, unemployment, and social problems and have an impact not only on the individual but also on the community (Smith, 2004). In addition to endeavours to reduce childhood chronic otitis media, more efforts at all levels must be directed towards the adult male population to reduce acquired hearing loss. Further analysis and research is needed to evaluate the multi-factorial relationship between hearing and prenatal, postnatal and later influences.

II. DENTAL HEALTH

Poor dental health is an indicator of general health and quality of life for elders (Locker, 1992). Some oral diseases have been linked to other systemic diseases. For example, the presence of periodontal disease is a risk indicator for cardiovascular disease mortality (Janson et al., 2002). People with poor oral health may avoid chewing firm food resulting in some form of malnutrition (Nowjack-Raymer & Sheiham, 2002; Sheiham et al., 1999; Brodeur et al., 1993). Eventually, the lack of certain nutrients in the diet causes other health problems. Poor

oral health has also been reported to contribute to social problems including social isolation. Most adults can assess their dental health, more specifically their ability to chew firm food. Self-assessed masticatory disability has been linked to lower quality of life and higher mortality rate (Nakanishi et al., 2005).

Over the years, two surveys have revealed that adult Inuit suffered from numerous extractions resulting in significant tooth loss. In 1983-1984, many Inuit, mainly the older ones, had lost all their upper or lower teeth (Blanchet, 1992). In 1991-1992, complete tooth loss was more frequent for the upper jaw in older persons whereas 63.8% of those aged 45 years old and more had lost all their teeth. The proportion of Inuit totally edentulous had increased in all age groups except the younger ones during those twelve years (Gagnon & Brodeur, 1994).

The loss of teeth by the Inuit, whether it be partial or complete, is not often compensated for by the wearing of a removable prosthesis, resulting in different levels of inability to chew some foods. During the 1992 Santé Québec survey, almost half of the totally edentulous persons did not wear dentures. A masticatory disability index was developed for the dentate Inuit based on a minimum of number of teeth occluding together. The masticatory apparatus dentate of Inuit 45 years old and over was inadequate almost 60% of the time. Since the last survey, the dental hygiene habits of the Inuit and the dental care available in Nunavik have not changed. We expect that in 2004 the Inuit, especially the elders, reported having some masticatory disability.

METHODOLOGICAL ASPECTS

A complete survey of the dental health of an adult population usually includes the examination of each tooth present, its gum and the availability and utilisation of a dental prosthesis. It requires the availability of more manpower than was possible in this survey. To elucidate this problem, the masticatory disability of the adult population was assessed by two questions regularly used in other national surveys.

The diet of the Inuit includes a high portion of meat but also some vegetables or fruits. These foods are relatively firm and can be used to evaluate the masticatory ability of the members of a population. The adults, aged 15 and over, were asked two questions on their capability of chewing meat and an apple. They could answer "yes" or "no".

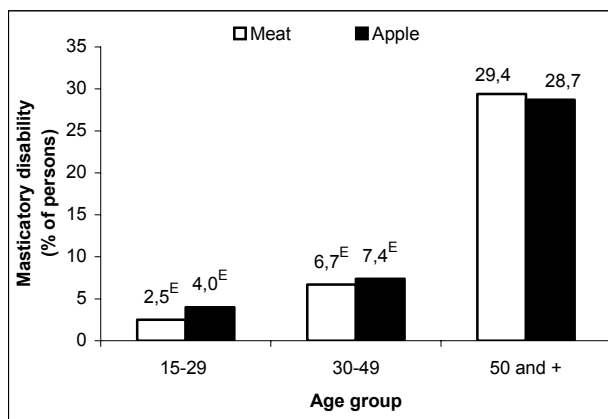
Here again, statistical analyses for comparisons with socio-demographic characteristics have been conducted at a threshold of $\alpha = 0.05$. The Canadian Community Health Survey 2003 (Statistics Canada, 2003) was also used to compare the situation of the Inuit of Nunavik with those of southern Quebec when the questions in the various surveys were judged equivalent.

RESULTS

A fair proportion of Inuit indicated an incapability to chew meat (9.1%) or an apple (9.9%). Masticatory disability is not related to the gender of the person, but more to their age (Figure 5). In fact, the older Inuit are the ones suffering from this burden, given that almost one out of three adults aged 50 years and over is not able to chew either meat or an apple.

Figure 5

Proportion of Inuit stating that they have difficulties chewing meat or an apple, by age group (%), population aged 15 and over, Nunavik, 2004



^E Interpret with caution.

Source: Nunavik Inuit Health Survey 2004.

The two questions used in this research were also present in the Quebec part of the 2003 Canadian Community Health Survey (CCHS). Both research endeavours concluded that older people suffer more from masticatory disability than younger ones. A direct comparison between populations would be biased because the age group structures are different; the population of Nunavik is younger than the Quebec one. The results of those questions are therefore compared by calculating standardized proportions according to the age group structure of the 1996 Canadian Census. The statistical test reveals that a significantly larger proportion of the

population of Nunavik suffers from masticatory disability in comparison with the Quebec population.

DISCUSSION

The two questions evaluating the chewing capacity of the Inuit population give limited information on their dental health. Numerous older Inuit seem to suffer from masticatory disability. It can be assumed that they have lost several teeth. They probably have not replaced their missing teeth with a dental prosthesis. If Nunavik elders react the same way as the elders of other populations, their masticatory disability has a negative effect on their general health and also has a negative impact on their well-being. We should be concerned by the possible decline of the general health of the older Inuit given their masticatory incapacity.

The evolution of masticatory disability in the Nunavik population cannot be evaluated since no similar questions were asked during the 1992 Santé Québec survey or any other known study. There is no possible comparison. It can only be suggested that the masticatory capacity of the Inuit has deteriorated or at best has not changed over the years. A positive evolution meaning better dental health would require better dental hygiene habits, regular dental appointments with scaling and the wearing of dental prostheses. None of these conditions has changed since the last survey. There is no indication that the dental hygiene habits of the Inuit have changed. Dental staff has barely increased since 1985 while the population has increased by 60%. Two dental hygienists are promoting good dental habits among students, but there is still no dental hygienist who scales the teeth of adults. The ultimate consequence of not scaling teeth is severe periodontal disease, the main cause of tooth loss in the adult population. From 1992 to 2003, while Inuit adults were losing their teeth, the availability of dental staff to make dentures has decreased. In fact, dentures are provided by two denturologists travelling to each community three to four times a year.

Some research has demonstrated that young Inuit also have poor dental health (Bélanger, 2000). All the dental indices point to poor dental health among these children. The percentage of children without any cavities could depict that claim fairly well. These percentages were especially low at the age of six (2.9%), twelve (6.7%) and sixteen years (0.7%). In other words, almost all the children of the Nunavik suffer from dental cavities. Even though cavity incidence in these children and teenagers is

high, between 1985 and 2000 it seems to have decreased 20% where permanent teeth are concerned. Other studies would be required to evaluate the dental health of young adults and the elders.

If we want to prevent dental cavities, it is generally recommended that we brush our teeth at least twice a day and avoid the consumption of refined sugar. The oral hygiene of Inuit children and teenagers is deficient (Bélanger, 2000; Bélanger, 2002). Refined sugar has been widely available in Nunavik for less than 40 years. Inuit consumption of this substance, largely through soft drinks, has rapidly become popular and it represents a large portion of their energy intake. The consumption of products containing sugar seems to be the largest contributor to tooth decay among Inuit teenagers.

Encouraging the Inuit to brush with toothpaste at least twice daily should, therefore, remain an objective. Furthermore, the Inuit should be persuaded to eat nutritious foods, including local food, instead of foods containing refined sugar. It is essential that promotional campaigns be created. They should convey a positive self-image and pride in one's teeth. We believe improvements in dental health can be made with the application of preventive measures similar to those adopted in other regions of the world.

KEY ISSUES

Hearing loss

- ↪ Hearing problems in Nunavik are widespread, with one quarter of adults having hearing problems in both ears.
- ↪ The prevalence of hearing loss among adults in Nunavik is associated with both age and gender. Three times more men (36%) had a bilateral hearing loss than women (12%). Hearing loss was found to increase with age. Over half the adults aged 45 and over suffered from hearing loss in both ears.
- ↪ Comparing men and women, hearing ability was similar in the youngest age group, but at ages 30-44, the men began to show more deficiency compared to the women. In the oldest age group (45 and over), 50% more men suffered bilateral hearing impairment than women.

- ↪ Frequent hunters were found to have more damage to their hearing. A slight difference in hearing in the left ear was found that may be related to firearm exposure.
- ↪ With only 30% of the study group having completed high school, the possibility of negative effects of hearing loss on academic achievement should not be discounted. Those who had completed high school or above had significantly better hearing than those who did not finish high school.

Dental health

- ↪ A fair proportion of Inuit indicated an incapability to chew meat (9.1%) or an apple (9.9%).
- ↪ Masticatory disability was not related to an individual's gender, but more to his or her age. The older Inuit were the ones suffering from this burden, given that almost one out of three adults aged 50 years and over was not able to chew either meat or an apple.
- ↪ The statistical test revealed that, in comparison with the Quebec population, a significantly larger proportion of the population of Nunavik suffers from masticatory disability.

ACKNOWLEDGEMENTS

The Nunavik Inuit Health Survey could not have been undertaken without the financial support of the ministère de la Santé et des Services sociaux du Québec, the Nunavik Regional Board of Health and Social Services, the Department of Indian and Northern Affairs of Canada, the Canadian Foundation for Innovation (CFI), the Network of Centres of Excellence of Canada (ArcticNet), the Nasivvik ACADRE Inuit Centre and the Canadian Institutes of Health Research. The valuable assistance of Inuit representatives – both members of the survey advisory committee and Inuit leaders from each community – is gratefully acknowledged. We are also grateful to all of the professionals, technicians, students, interviewers and clerical staff who worked at each stage of the survey process. Our gratitude is also extended to the staff of the Canadian Coast Guard Ship Amundsen. Thanks to Annie Alayco, Nora Kokkinerik, and Johnny Makiuk for hearing testing, Sebastien Dubé for help with statistics, and Isabelle Billard, Ravi Sockalingam and Andrew Smith for advice and comments. Thanks also to Dr. James Baxter (McGill University) and René Larouche

(Direction de santé publique du Saguenay-Lac-St-Jean) who reviewed the draft manuscript for this booklet and provided valuable insights and suggestions for further analysis. Finally, we wish to thank the Inuit of Nunavik for their extensive cooperation with this survey.

REFERENCES

- Ayukawa, H., Bruneau, S., Proulx, J.F., Macarthur, J., & Baxter, J. (2004a). Otitis media and hearing loss among 12-16 year old Inuit of Inukjuak, Quebec, Canada. *Circumpolar Health*, 63, Suppl 2, 312-314.
- Ayukawa, H., Lejeune, P., & Proulx, J.F. (2004b). Hearing screening outcomes in Inuit children in Nunavik, Quebec, Canada. *Circumpolar Health*, 63, Suppl 2, 309-311.
- Barrenas, M.L., Bratthall, A., & Dahlgren, J. (2005a) The association between short stature and sensorineural hearing loss. *Hearing Research*, 205,123-130.
- Barrenas, M.L., Jonsson, B., Tuvemo, T., Hellstrom, P.AI, & Lundgren, M. (2005b). High risk of sensorineural hearing loss in men born small for gestational age with and without obesity or height catch-up growth: a prospective longitudinal register study on birth size in 245,000 Swedish conscripts. *Journal of Clinical Endocrinological Metabolism*, 90, 4452-4456.
- Baxter, J.D. (1990). What have we learned about otitis media and hearing loss by studying the native peoples of Canada? *Journal of Otolaryngology*, 19, 386-388.
- Baxter, J.D. & Ling, D. (1974) Ear disease and hearing loss among the Eskimo population of the Baffin Zone. *Canadian Journal of Otolaryngology*, 3,110-22.
- Baxter, J.D. & Røjskjaer, M.D. (1979). A Greenland-Baffin Zone Project, A study of noise induced sensorineural hearing loss in adult male hunters native to Greenland and to the Baffin zone in the eastern Canadian Arctic. *Journal of Otolaryngology*, 8(4), 315-325.
- Bélanger, R. (2000). *Dental health of Nunavik Children 1998-1999*. Kuujjuaq: Nunavik Regional Board of Health and Social Services.
- Bélanger, R. (2002). *Nunavik teenagers behaviour regarding their dental health in 2001*. Kuujjuaq: Nunavik Regional Board of Health and Social Services.
- Blanchet, C. (1992). *Highlights of the health survey conducted among the Inuit of Northern Quebec 1983-1984*. Quebec: ministère de la Santé et des Services sociaux.
- Bluestone, C.D. (1998) Epidemiology and pathogenesis of chronic suppurative otitis media: Implications for prevention and treatment. *International Journal of Pediatric Otorhinolaryngology*, 42, 207-223.
- Brodeur, J.M., et al. (1993). Nutrient intake and gastrointestinal disorders related to masticatory performance in the edentulous elderly. *The Journal of prosthetic dentistry*, 70, 468-473.
- Bruneau, S., Ayukawa, H., Proulx, J.F., Baxter, J.D. & Kost, K. (2001) Longitudinal observations (1987-1997) on the prevalence of middle ear disease and associated risk factors among Inuit children of Inukjuak, Quebec, Canada. *International Journal of Circumpolar Health*, 60, 632-639.
- Eriks-Brophy, A. & Ayukawa, H. (2000). The benefits of sound field amplification in classrooms of Inuit students of Nunavik: a pilot project. *Language, Speech and Hearing Services in Schools*, 31, 324-335.
- Gagnon, P. & Brodeur, J.M. (1994). Dental Health. In: Santé Québec, Jetté, M. (ed.). *A Health Profile of the Inuit; Report of the Santé Québec Health Survey Among the Inuit of Nunavik, 1992, Vol. 2*. Montreal: ministère de la Santé et des Services sociaux, Gouvernement du Québec.
- Janson, L., Lavstedt, S. & Frithiof, L. (2002). Relationship between oral health and mortality rate. *J. Clin. Periodontol*, 29, 1029-1034.
- Lee, D.J., Gomez-Marin, O., Lam, B.L., & Zheng, D. D. (2004). Trends in hearing impairment in United States adults: the national health interview survey, 1986-1995. *Journal of Gerontology*, 59A, 1186-1190.
- Locker, D. (1992). The burden of oral disorders in a population of older adults. *Community Dental Health*, 9, 109-124.
- Moffat, M.E., Tate, R., Young, T.K., O'Neil, J., Woods, W., & Gillespie, I. (1994).
- Hearing loss in adults in the Keewatin region, NWT. *Arctic Medical Research* 53, Suppl.2, 685-687.
- Moore, J.A. (1999) Comparison of risk of conductive hearing loss among three ethnic groups of Arctic audiology patients. *Journal of Speech Language Hearing Research*, 42, 1311-1322.

Moore, J.A. (1990) Delivery of audiologic service and prevalence of hearing loss in the western Canadian Arctic. *Circumpolar Health*, 90, 630-632.

Nakanishi, N., et al. (2005). Relationship between self-assessed masticatory disability and 9-year mortality in a cohort of community-residing elderly people. *JAGS*, 53, 54-58.

Nelson, D.I, Nelson, R.Y., Concha-Barrientos, M., & Fingerhut, M. (2005). The global burden of occupational noise-induced hearing loss. *American Journal of Industrial Medicine*, 48, 446-58.

Northern, J.L. & Downs, M.P. (1991). *Hearing in Children* (4th ed.) Baltimore: Williams and Wilkins.

Nowjack-Raymer, R.E. & Sheiham, A. (2002). Association of edentulism and diet and nutrition in US adults. *J. Dent. Res.*, 2, 123-126.

Pascolini, D. & Smith A. (2006) *Hearing Impairment in 2005: A compilation of available epidemiological studies*. Unpublished document.

Santé Québec, Jetté, M. (ed.) (1994). *A Health Profile of the Inuit; Report of the Santé Québec Health Survey Among the Inuit of Nunavik, 1992*. Montréal: Ministère de la Santé et des Services sociaux, Government of Québec.

Sheiham, A., et al. (1999). The impact of oral health on stated ability to eat certain foods: findings from the national diet and nutrition survey of older people in Great Britain. *Gerodontology*, 1, 11-20.

Sindhusake, D., Mitchell, P., Smith, W, Golding, M., Newall, P., Hartley, D. & Rubin, G. (2001). Validation for self-reported hearing loss, the Blue Mountains hearing study. *International Journal of Epidemiology*, 30, 1371-1378.

Smith, A. (2004). *The fifteenth most serious health problem in the WHO perspective*. WHO: Presentation to IFHOH World Congress. Helsinki, July 2004. [On-line]. http://www.kuulonhuoltoliitto.fi/tiedoston_katsominen.php?dok_id=150.

Smith, A. (2007). Personal communication.

World Health Organization (WHO) (1991). *Report of the informal working group on prevention of deafness and hearing impairment, Programme planning*. Geneva: WHO, 18-21 June 1991, WHO/PDH/91.1. With adaptations from *Report of the first informal consultation of future program developments for the prevention of deafness and hearing impairment*, Geneva: WHO, 23-24 January 1997, WHO/PDH/97.3.

World Health Organization (WHO) (1999). *Protocol for a population based survey of prevalence and causes of deafness and hearing impairment and other ear diseases*. WHO: Prevention of blindness and deafness. [On-line]. [http://whqlibdoc.who.int/hq/1999/WHO_PBD_PDH_99.8\(1\).pdf](http://whqlibdoc.who.int/hq/1999/WHO_PBD_PDH_99.8(1).pdf)

ᑭᓄᓂᓂᓂᓂᓂ?

Qanuippitaa?

HOW ARE WE?

