

AUDITORY ACUITY OF NATIVE POPULATION AT IGLOOLIK, KEEWATIN, N.W.T.

T. Cummings and J.R. Brown
Dept. of Preventive Medicine & Biostatistics,
University of Toronto.

ABSTRACT

The use of snowmobiles on a routine basis by Eskimo hunters has led to some concern regarding potential risk to hearing.

Noise levels of snowmobiles were measured, under representative operating field conditions.

Audiograms of hunters and of the general native population were obtained. Composite audiograms were prepared. Preliminary results indicate that: (a) the general native population presents a normal response pattern (b) the Eskimo hunters demonstrate a typical noise induced pattern of hearing loss.

The following survey was carried out by the Department of Environmental Health, University of Toronto, at the request of the Federal Department of Indian and Northern Affairs.

Concern has been expressed about the loss of hearing in native populations residing in the circum- and sub-arctic regions. Surveys have been carried out by Baxter and Ling (1)(2)(3).

Whereas snowmobiles are used for recreational purposes throughout most of the North American continent, they are now widely used on a day-to-day basis in the Arctic regions. In many Eskimo settlements these vehicles have largely replaced dog teams as a means of transportation. Eskimo hunters may be exposed to snowmobile noise for periods ranging up to 12 - 14 hours/day. Results from this study indicate that noise levels at the snowmobile driver's ears may range from approximately 90 to 115 decibels A-weighted network. These levels are in excess of present accepted criteria for hearing conservation (4).

Effects of noise on hearing

The effects of noise on hearing have been extensively reported in health literature over the last twenty years. The loss of hearing is attributed to irreversible changes in the hair cells located in the inner ear. At the onset, hearing thresholds at 4,000 and 6,000 Hz are normally the first to indicate significant change. With continued exposure, one normally finds increased losses at these frequencies. The loss is often referred to as the 4,000 cycle notch. However, with continuing exposure to noise, the speech frequencies of 500, 1,000, 2,000 and 3,000 Hz become involved. The recognition of the 3,000 Hz area as a significant factor

in the understanding of speech is a recent development. Eventually the degree of loss in the speech frequencies becomes such that the subject starts to experience difficulty in voice communication.

Survey:

The Eskimo settlement of Igloolik is located on a small island between the north-west tip of Hudson Bay and Baffin Island. Approximately 40 hunters provide food for the settlement of 360 people.

This study consisted basically of two parts:

1. measurement of hearing thresholds of the hunters and of the general population; and
2. measurement of snowmobile noise and an estimate of exposure pattern.

1. Hearing Threshold

A. Audiometer

Hearing thresholds were obtained using a manually operated pure tone audiometer. The instrument was calibrated (I.S.O. 1964) on the first morning of the survey. A biological check was carried out each morning thereafter.

B. Otoscopic examinations

Otoscopic examinations of the ear were carried out in order to detect any major occlusions of the canal or damage to the membrane which might influence the hearing testing results. The subjects were questioned concerning any hearing damage or disease.

C. Test room

The tests were carried out in a frame building belonging to the Northern Laboratory of the Ministry of Indian and Northern Affairs. Ambient noise levels in the test room were measured with the following results.

TABLE 1

Noise Octave Band Mid-Frequency (Hertz)	Noise Level (Decibels)
250	30
500	22
1,000	20
2,000	< 20
4,000	< 20
8,000	< 20

results were obtained with:

- a) door to test room closed;
- b) no conversation in adjacent room
- c) building furnace switched off.

These levels lie well within the limits in the proposed CSA Standard Z107.4, "Pure Tone Audiometers for Limited Measurement of Hearing and for Screening.

D. Subjects

The audiometric test procedure was explained in some detail to our interpreter following which he received the first test. He then operated the various audiometer controls on a demonstration run. His subsequent explanation and instructions to the subjects appeared to be readily understood. In almost all cases the tone presentation-response pattern indicated successful testing.

Audiograms from a sample of 79 people of which 30 were hunters, 45 general population, and 4 diesel driver/mechanics, were obtained. In view of the high noise levels associated with the use of diesel equipment the diesel operators were excluded from the general population and reported separately. Four subjects, including one hunter, were excluded from the results due to the presence of aural pathology.

Snowmobile noise levels

The results are given in Table 2. We failed to observe any snowmobiles other than SKI-D00 models in use at the settlement. The Igloolik results are compared with previous results from other results involving SKI-D00S in Table 2.

It would seem reasonable to assume that the noise level at the driver's ears could range from about 90 to 115 dBA. Some Eskimos reported having driven their machines for some time, either with broken or missing mufflers. Noise levels under these circumstances are not available, but one might speculate that they would be significantly higher than those listed.

As noted previously, the hunters may be exposed to these noise levels for periods up to 12 to 14 hours/day.

TABLE 2

Noise Levels - Snowmobiles

Model	Noise Level - dBA near driver's head idling/slow - full speed	Reference
SKI-DOO 340 20 H.P. Twin	90 - 103	Igloolik
SKI-DOO 300 15 H.P. Single	98 - 114	
SKI-DOO 440 24 H.P. Twin	104 - 108	
SKI-DOO Nordic	113	(5) Information Canada Catalogue No. T46-173
SKI-DOO Elan SS 320	95 - 105	(6) Snowmobile Handbook 1974 Popular Science
SKI-DOO T'NT 440	95 - 106	
SKI-DOO	100 - 110	(7) Journal of Environmental Health Nov/Dec. 1971
Assorted mix of 10 snowmobiles	87 - 118*	(8) Sound & Vibration May 1973

*Measured at side of vehicle.

- a) Noise levels measured close to driver's ear
- b) Snowmobiles were driven on hard packed snow
- c) Instrument used - Bruel-Kjaer S.L.M. 2205;
Windscreen UA 0207
- d) Ambient Temperature - approximately -10°F.
(Sound Level Meter was returned to heated
room between tests; and stored beneath parka
between readings).

Discussion

With reference to the group audiograms of the hunters, the median

follows the classical pattern of noise-induced hearing loss, showing a relatively slight loss at 500, 1,000 and 2,000 Hz, then sloping rather steeply to a threshold of 55 dB at 4,000 Hz. The upper and lower quartile lines illustrate the relatively wide range of values that one might anticipate when testing a group with a mixed experience of noise exposure, and ages ranging from 19 to 74. The upper quartile demonstrates the marked encroachment of the speech frequencies.

In contrast, the general population audiograms indicate a normal response pattern with the upper and lower quartiles lying mostly within 5 dB of the median, and displaying no significant loss at any frequency.

Each subject was questioned following the taking of the audiogram for the purpose of discovering any unusual "noise" experience or clinical history. In the case of the hunters, many reported incidents that occurred while hunting from small boats. During the summer, small groups of Eskimos hunt together in small (10' - 12') boats. During these expeditions rifles may be discharged within one foot or less of a neighbour's ear. About half of the hunters related, through the interpreter, that following such incidents they (a) could not hear in one ear for about two days, or: (b) heard noises in their ear(s) for some time following, or: (c) their ear(s) hurt for awhile. A review of the individual audiograms revealed that six of the hunters disclosed appreciable difference in hearing threshold from one ear to the other. This effect was more noticeable in the right ear. This is in contradiction to what one might expect from a group of right-handed marksmen.

The small boat episodes place serious constraint on any conclusions regarding the effect of snowmobile noise. The noise level of the snowmobiles and the duration of exposure on a routine basis, clearly suggests a resultant exposure to noise well in excess of present accepted hearing conservation criteria. However, one must assume that the effect of rifle noise complicates any effect of snowmobile noise on the individual and group audiograms.

A comparison of the median threshold of Eskimo hunters with sports hunters (9) is shown in Figure 1. A comparison is also made with industrial workers in Figure 1. Both comparisons show general agreement.

The hearing losses exhibited by the 4 diesel operators, ages ranging from 31 to 50, are unfortunately and predictably all typical of severe noise exposed hearing loss.

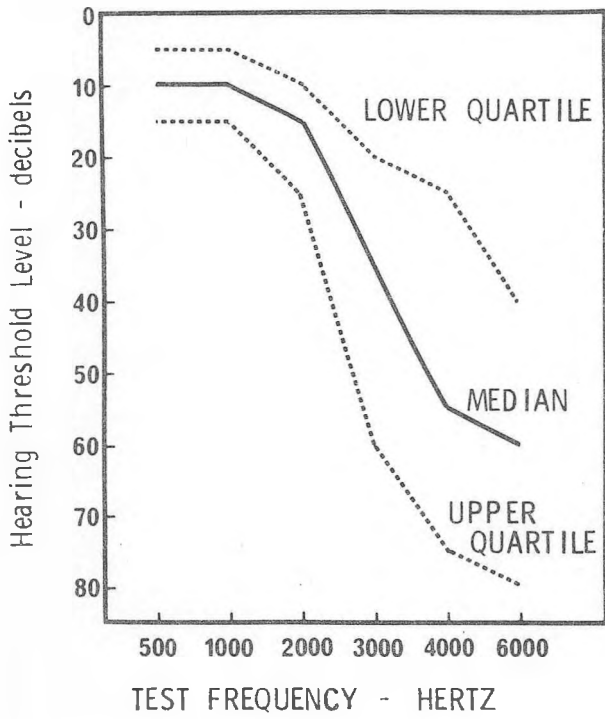
Whilst recognising the problems associated with the wearing of hearing protection under Arctic conditions, it would appear that the only hope of conserving what hearing remains within the hunter and diesel operator groups lies in the wearing of such protection. In the case of the hunters, hopefully, quieter snowmobiles will become commercially available. The problem of group rifle fire offers no ready solution.

It would appear that a more active programme of health education with regard to hearing conservation should be undertaken as soon as possible if deafness of native populations is to be avoided.

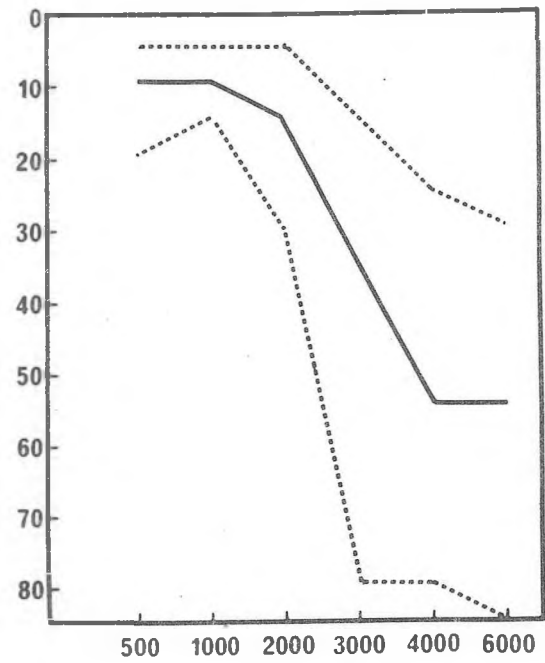
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3. Ling, D., Katsarkas, A., Boscher, J.D. Ear Disease and Hearing Loss Among Eskimo Elementary School Children. Can. J. Public Health. Vol. 65, No. 1, 1974.
4. Criteria for a recommended standard . . . Occupational Exposure to Noise. U.S. National Institute for Occupational Safety and Health, 1972.
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10. Taylor, et al. Journal of the Acoustical Society of America, 1965.

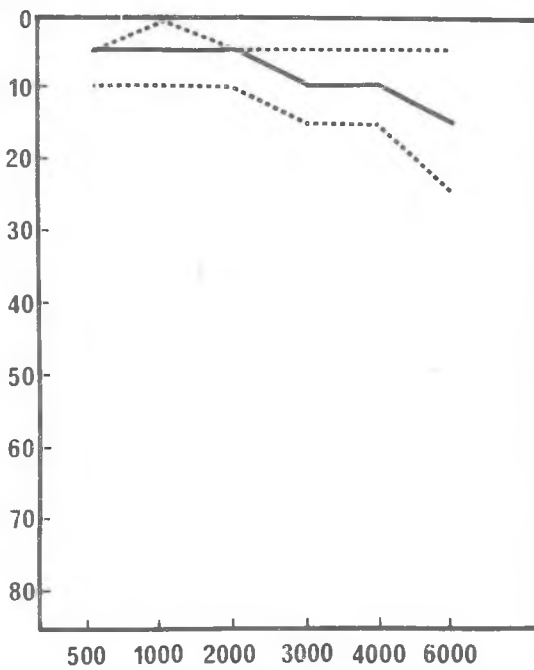
Hearing Threshold : Hunters Left Ear



Hearing Threshold : Hunters Right Ear



Hearing Threshold : General Population Left Ear



Hearing Threshold : General Population Right Ear

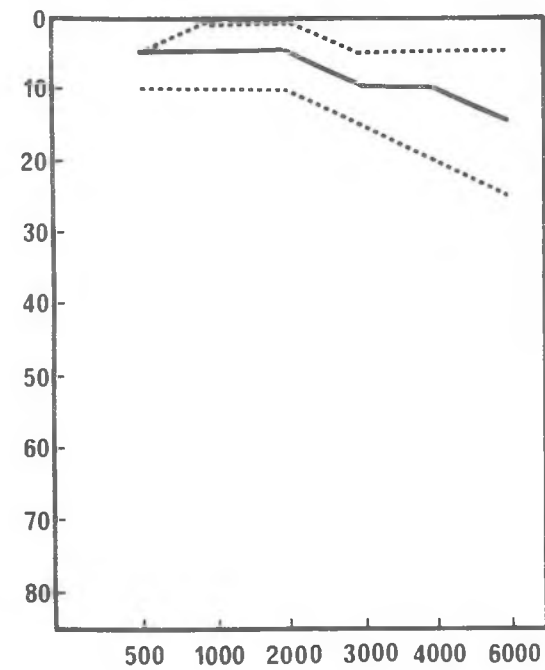
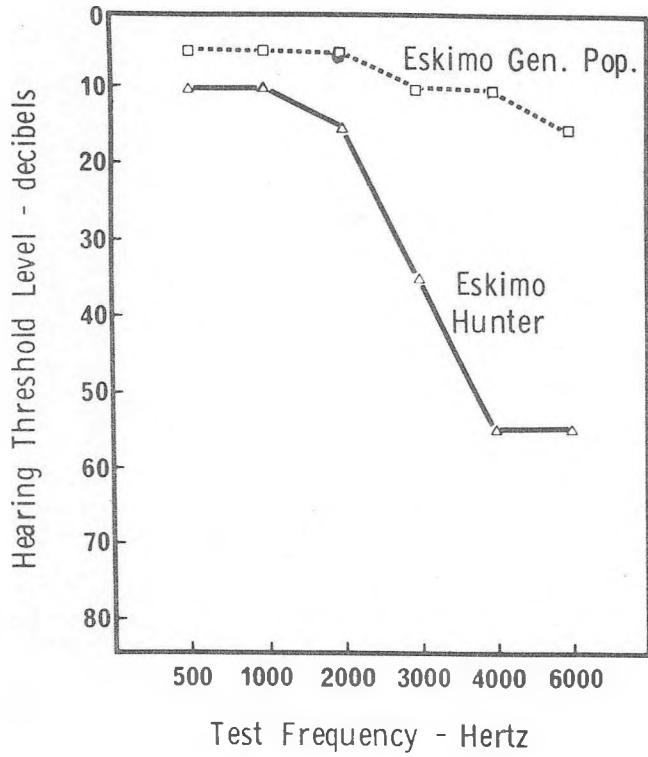


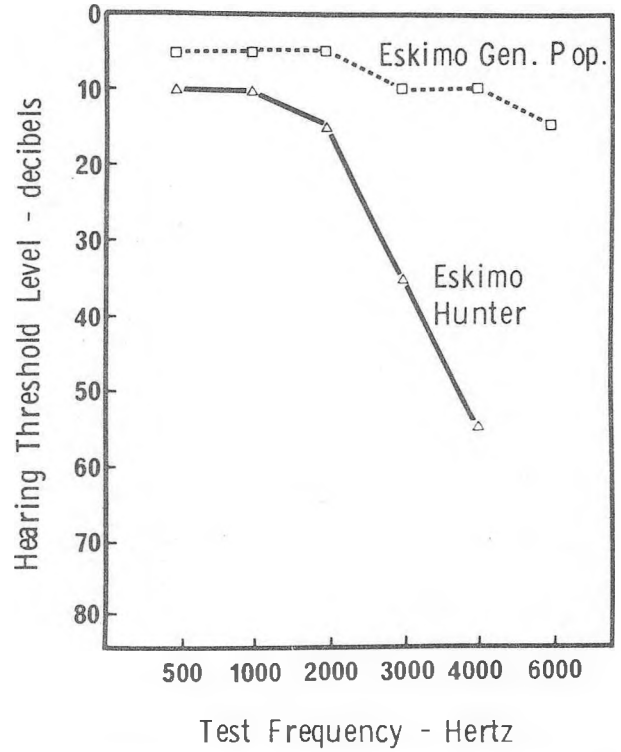
FIG. 1

Comparison: Median H.L. - Hunters vs Gen. Pop.

AUDIOGRAM RIGHT EAR

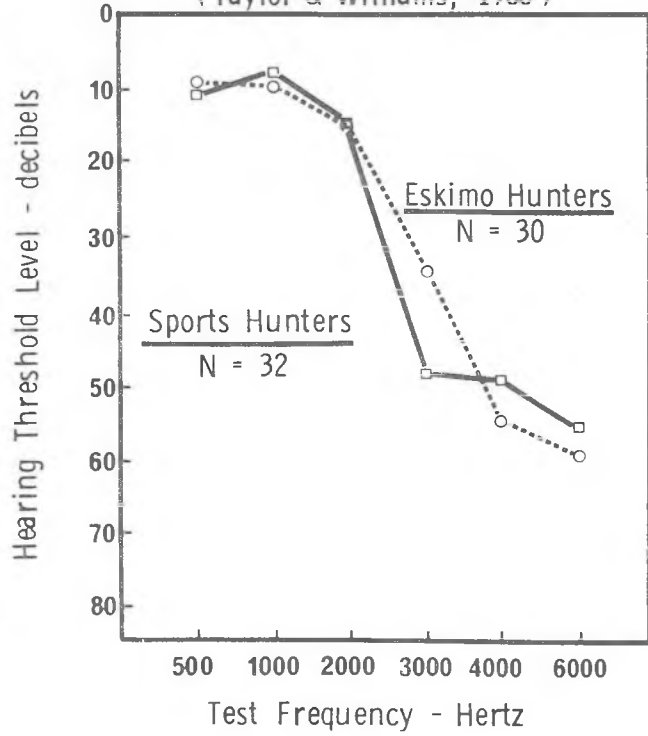


AUDIOGRAM LEFT EAR



Comparison: Eskimo Hunters vs. * Sports Hunters

(Taylor & Williams, 1966)



Comparison: Eskimo Hunters vs Textile Workers Exposed to Noise (Taylor et al)

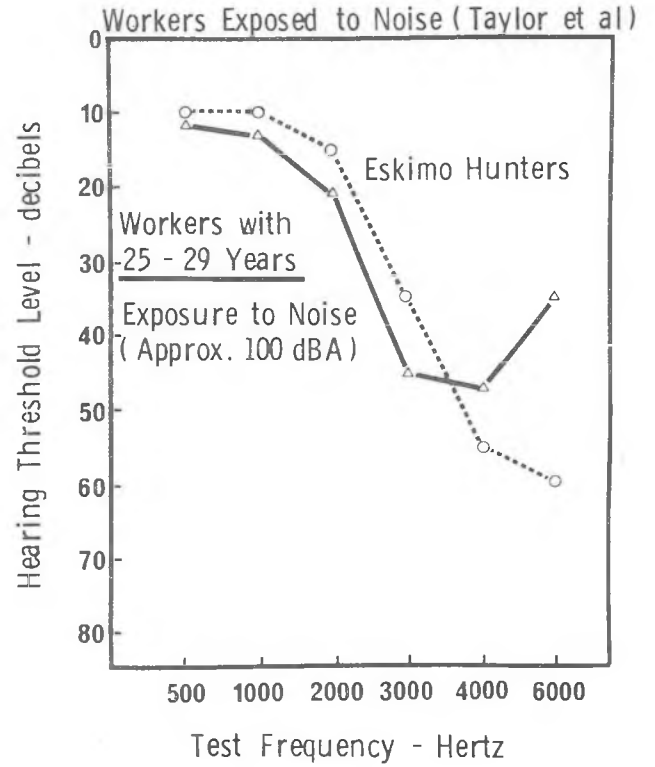


FIG. 2

DIESEL OPERATOR'S LEFT EAR
4 SUBJECTS

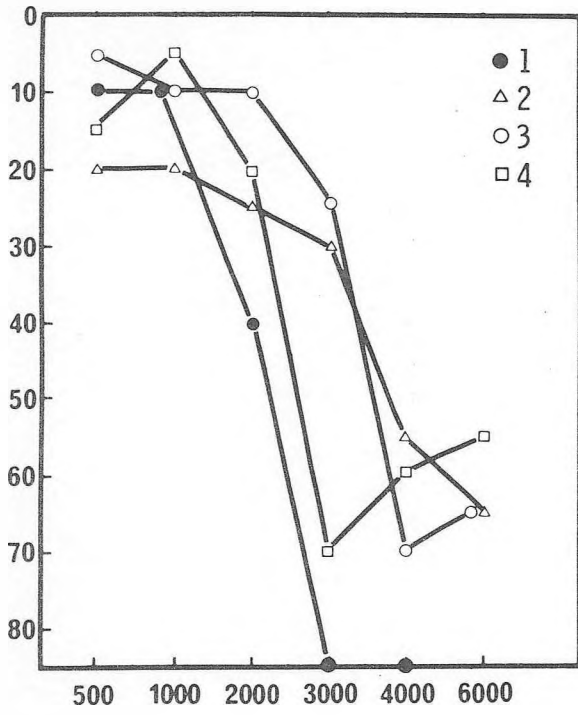


FIG. 3

DIESEL OPERATOR'S RIGHT EAR
4 SUBJECTS

