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Hearing Loss Among Alaska Native Schoolchildren of the Lower Yukon

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HEARING LOSS AMONG ALASKA NATIVE SCHOOLCHILDREN OF THE LOWER YUKON

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CHAPTER I

THE PROBLEM

Introduction

In 1963 the writer and her spouse were employed by the Bureau of Indian Affairs to teach school in the all-Eskimo village of Emmonak, on Alaska's lower Yukon River. Within a very short time after the opening of school, it became apparent that several of the children suffered hearing losses to an extent of impairment of social and academic adjustment and progress. However, the extent of hearing losses was not known. Hearing testing had never been conducted since school records had been kept, and nobody knew either the number of individuals having losses, nor the extent of impairment among the school population.

In 1966, the teachers were transferred to Mountain Village, about eighty river miles from Emmonak. Mountain Village was of the same cultural and socio-economic composition as was Emmonak. It was soon discovered that the hearing loss problem in Mountain Villege was approximately the same incidence and degree as that in Emmonak.

In the meantime, Arctic Health Research, a division of U. S. Public Health Service, had in 1964 begun a study of middle ear infections among Native children in seven Eskimo villages in Western Alaska.

Headquartered in Anchorage and with a field office in Bethel, Arctic Health sent to the villages a team of a doctor, a nurse, and an audiologist to conduct hearing screenings and otological examinations. Thus for the first time the school children in both Mountain Village and Emmonak received hearing tests. The data left to the schools, however, was vague and probably insufficient for the teachers to interpret. An entry of "Mild loss, R ear; Mod. loss, L ear" does not indicate to a teacher the profundity of a hearing problem.

The Arctic Health study was conducted for a period of two full years. At intervals of no longer than six weeks, nurses visited the villages and recorded each incidence of otitis media, its duration and treatment. During the visits to the villages, the nurses were guests of the teachers; and during the many discussions it soon became apparent that there was a definite interrelationship of medical and educational implications involved in hearing losses. It was obvious, too, that an effective teacher would need to know and understand medical pathologies and implications of exceptional children.

Arctic Health was dealing in the pathology of middle ear infection and not as a hearing screener nor as a special education consultant. It has been quite well established, however, that otitis media is a causal factor in hearing loss. Visiting doctors and nurses expressed their belief that the child who has had middle ear infection will almost always

have hearing impairment. Nevertheless, Arctic Health in its study dealt with incidences of otitis media per se, and thus there never were hearing tests conducted at the conclusion of the study.

Arctic Health Research, in its role as a data-gathering agency, provided the backbone of information pertinent and relevant to the writer's role as a special education teacher. As the revealed cases of hearing loss increased, so did the need for a special education program at Mountain Village, the current station assigned the writer. Since the Bureau of Indian Affairs is a government agency, and since the United States government is not easily persuaded concerning needs for budgetary funding of additional program, the need to provide documentary evidence of a village's special education requirements was the impetus which launched this study.

Statement of the Problem

The problem the writer is confronting is that of hearing impairment among Alaska's Eskimo school children of the Lower Yukon area. Since the hearing losses are of conductive type, which is a middle ear pathology, rather than sensoro-neural which indicates damage of neurological nature, it becomes apparent that an important aspect of the hearing problem is the prevalence of otitis media. We are assessing the quantitative and qualitative extent of hearing loss among Eskimo children of the Lower Yukon.

The writer is also seeking to establish that the prevalence of hearing loss among these children parallels the incidence of middle ear infection. In so doing, the investigator is pointing out a problem which has significance for both medical and education personnel because of the important implications for special programs for both.

In summary of the problem: Is there a significantly great incidence of hearing loss among the Eskimo children, and do those with impairments have a history of draining ears?

Limitations of the Study

Because data was to be procured from Arctic Health Research records, the first limitation of the study would be that only villages having participated in the AHR otitis media study would provide the subjects.

The greatest limitation, however, was involuntarily dictated by various agencies in Alaska. Only one audiometer was made available for the investigator's use during the year and one-half that the study was planned to span. Therefore, only one village, with a total of 76 school children participating, was able to be included in this investigation.

The nature of the statistical data was severely limiting in itself, it was discovered. Arctic Health relied primarily upon parents' information concerning prior histories of otitis media, and Native

parents were extremely reluctant to admit that their children ever had suffered the disease. Upon compilation of Arctic Health records, this investigator discovered several errors concerning episodes of otitis media among the children, with notations of zero episodes when it was known by the investigator, a teacher of the children in question, that the children had in fact experienced occurrences of ear drainage.

Another limitation of the study was that the hearing threshold levels as procured by Arctic Health in 1965 and by the investigator in 1967 are so diverse that the reliability of both may well be in question.

Definition of Terms

Since all data will be gathered and evaluated within the context of Arctic Health Research and Alaska Department of Health & Welfare criteria, we will accept their definitions where applicable in setting up the study.

Native: All persons of one-quarter or more Indian, Eskimo, or Aleut blood (now through a legal technicality all considered to be Indian; but this is for the legalities involved in land claims rather than to imply the rescindance of Aleut or Eskimo sub-racial stock).

Lower Yukon: The geographical area drained by the Yukon River delta. It is generally agreed that the area begins approximately at the Russian Mission and includes the delta and alluvial plain of the three mouths of the Yukon and terminates at the Bering Sea.

Otitis Media: Infection of the middle ear accompanied by earache and drainage. Drainage indicates rupture of eardrum.

Hearing Threshold: The least intensity of volume at which one can hear sound.

Decibel: A unit measuring sound intensity (volume). A low decibel (dB) numeration indicates low intensity; thus, the higher the dB numeral, the greater the loss.

Hearing Loss: An impairment in hearing as indicated by a finely-calibrated audiometer, an instrument to test hearing. We will use the following ISO 1964 Standards, recommended by Alaska State Health & Welfare, for determining level (degree) of hearing loss:

0 to 26 dB	Normal range of hearing	Normal
27 to 40 dB	Mild impairment	Mild
41 to 60 dB	Moderate impairment	Moderate
61 to 75 dB	Moderately severe impairment	Mod. Severe
76 to 90 dB	Severe impairment	Severe
91 to 98 dB	Profound impairment	Profound

Hearing is tested separately for each ear and loss computed unilaterally. Often, for brevity, the threshold is averaged for the various frequencies (pitches) in order to assign a range to each ear. An individual may have different degrees of hearing acuity in each

ear; thus, one may have a mild impairment in one ear and moderate loss in the other, or any combination of normal hearing and/or impairment.

Bilateral: In both ears.

The Hypotheses

1. A greater percentage of Eskimo children of the Lower Yukon area have hearing loss than is found among the general United States population.

2. Those children having had otitis media have a greater prevalence of hearing loss than have those who have had no pathology.

3. Children who have had otitis media during the two-year study period have lower hearing thresholds than they had at the outset of the study period.

4. Children having hearing impairment at the beginning of the study but who had no middle ear infection during the two-year period will have a higher threshold at the end of the period, because conductive-type losses associated with middle ear pathology tend to shift upward and improve if no further infection is involved.

CHAPTER II

SURVEY OF THE LITERATURE

Hearing Loss Among United States General Population

Several independent studies present estimates of hearing loss among the United States population, though they are not in agreement. In 1960 several different figures were compiled from various sources.

The U. S. Office of Education, Department of Health, Education, & Welfare, estimated that in 1960 there were about 40,000 deaf children and youth. The figure was based upon an estimated prevalence of about one deaf per 1,000 persons in the over-all school-age population (3:392).

Rusk (15:80) in the same year reported that there are 109,000 persons in the United States who are totally deaf, a rate of .6 per thousand; and that other hearing impairments affect 5,714,000 persons. Still amother estimate for 1960 was that there is one deaf in every 700 persons in the general population (17:viii).

A compilation of mass tests of school children showed "from 2% to 21% with defective hearing." The same report estimated that 5% of school age children have hearing levels outside the normal range, which here was defined at "15 dB speech frequency average in the worse ear" (16:416-417).

A report by Magary and Eichorn (11:286) states that from 4% to 5% of school-age children have hearing handicaps, but they give no definition of handicap. Glorig (6:25-26) reported a study of 6,204 boys from ages 10 to 19 of whom 1% had a 30 dB or greater loss at 1,000 cycles per second.

A weakness of all the preceding reports is that neither hard-of-hearing, hearing loss, nor deafness is given in terms of decibels (two exceptions). Furthermore, various agencies use various decibel numerations in their definition of degrees of losses, so that there is little wonder that diverse figures are used in measuring number of hearing-impaired persons. There is need for a national study of hearing levels (4:337) as well as general categorization of loss and standardized decibel levels indicating losses.

Hearing Impairment Among Population Segments

In addition to various attempts to estimate over-all prevalence of hearing impairments throughout the United States, a few studies have shown relationships among diverse strata of the population. Hearing losses among population segments are reported on bases of climate and its effects upon hearing, racial differences, and incidence of middle ear infection.

Anderson (1:66-70), in a recent study of 5,545 children in three Oregon coastal counties and 5,689 children in three Eastern Oregon counties, found significant climatic differences in the types of hearing

impairments encountered. There was a higher incidence of sensory-neural loss in the dry Eastern counties, and a greater percentage of conductive losses in wet Western counties.

Morgan (11:364-8) reports conclusions of a study and effects of temperature and humidity on hearing. Forty-two subjects were given hearing threshold tests in variously controlled temperature and humidity ranges. (a) At the extreme limits of temperature and humidity ranges (20%, 80%), thirty-three of 42 Ss showed a hearing loss of 5 dB below their normal range. (b) The hard of hearing group showed greater loss than did the normal group when exposed to climatic differentials. (c) Hearing acuity is generally highest at a temperature of 50° F. with a relative humidity of 70%. (d) In the extreme limits of temperature and relative humidity, Ss had delayed responses of three to eighteen seconds from the initial presentation of tone.

(Alaska's Lower Yukon area is one of low temperature and relatively high humidity. According to Bureau of Indian Affairs Station Information, the January mean temperature is approximately zero; July mean about 55°, with precipitation over 20 inches and constant wet fog in spring and winter.)

McCabe (10:471-7) reports a study of middle-ear infection and its relationship to hearing impairment. Senturia analyzed cultures from medial effusions (drainage from middle ear infections) of 159 patients. He found cell degeneration evident in 40% of the cases. In

30% of the cases, prevalent micrococci were found. Chronic middle ear effusions, adds McCabe, are a common cause of deafness in children.

Losses due to middle ear infections, however, seldom remain static, nor the losses necessarily permanent. There is a greater temporary shift over time in threshold level in persons with middle ear (conductive loss) involvement (5:81-96). This, of course, implies the definite probability of arresting hearing losses in children with middle ear infection when proper medical care is provided. It also points to implications for a school program of auditory training for children affected with loss of hearing during the childhood years.

In one of the few studies of racial differences in hearing loss, Post (12:65-81) in five studies found that (a) 4/5 of whites had higher frequencies of loss at higher tones; and that (b) 2/5 of Negroes had frequencies of loss at lower tones. Reed cites studies showing hearing losses found in 26% of Aleut children; 23% of a group of Alaskan Indians; and 31% of a group of British Columbia native Indians (14:7-8).

Hearing Loss Among Eskimo Children

Although very little data has been gathered and systematically analyzed concerning loss among Alaska's Native schoolchildren, those studies having been conducted and reported point with greatest emphasis to the fact that Eskimo children have overwhelmingly greater incidence of hearing impairment than does the general population, regardless of

which of varying population figures are accepted.

The only reported studies of hearing problems among Alaska Native children have been conducted by field doctors and by Arctic Health Research, a division of the United States Public Health Service. Arctic Health in 1964 sent teams of examiners to 24 villages to conduct hearing tests among 378 Eskimo children. Thirty-one per cent of the children tested had a hearing loss of 26 decibels or more (14:4; 13:1). Another survey of seven Eskimo villages reports that 13% of the children had a severe loss, 40 dB or more (2:2).

Both the above studies, in detailed and lengthy reports, emphasized the relationship between middle-ear infections and hearing loss. An Arctic Health study of a year's duration recorded incidents of otitis media among 724 Eskimo children in scattered, isolated villages of the Kuskoquim and Yukon River areas. Itinerant nurses recorded all reported incidents of otitis media for each study cohort; 59% of all children in the sample had draining ears one or more times during the year, reported the physicians (13:1, 3). All hearing losses reported by the audiometrist in one of the studies were of the conductive type, a loss associated with middle ear disease (14:5).

In surveying the literature in print--as well as some articles not yet published and available only as a photocopied, typed manuscript--it was interesting to note that the many articles sent the writer from cooperating area physicians were duplicates. In fact, the most recently

contributed articles were research papers in which the authors merely referenced the actual original papers having been read two years previously by this writer. Therefore, it could be concluded that the survey of literature presented herein represents all the study and research having been published and written about the hearing problems of Alaskan Native Eskimos.

CHAPTER III

PROCURING THE DATA

The study was a non-experimental hypothesis-testing research study. In that neither hearing loss nor the past occurrences of otitis media can be manipulated for experimentation, there were no independent variables involved. The hypotheses tested were therefore propositions of degree of occurrence rather than of results that may be contained under various controlled conditions.

Planning the Study

Originally, it was planned to limit the study to an assessment of hearing loss among Lower Yukôn schoolchildren. As planned, the subjects would be the entire school populations of the villages of Pitkas Point, Pilot Station, Mountain Village, Alakanuk, and Emmonak. This would be in excess of 400 children.

However, after several discussions with Arctic Health personnel, and after reading journal articles they provided, it was decided that the middle ear pathological aspect of the hearing problem was of such relevance that this must be included in the study. In discussing Eskimo children's hearing losses with colleagues and others, the perpetual

question regarding the extent of hearing impairment was, "Why?" Thus, the "why" and the assumption of the sometimes-temporary nature of conductive losses caused by middle ear pathology assumed its importance in framing the context for the problem of the hearing loss itself.

More reading and study polarized the fact that further significance would be added to the study if hearing threshold gains or losses could be assessed after the completion of the Arctic Health Research study. Support or discredit then may be lent to the position that losses due to middle ear infections are not static. The gains and losses would then be related to occurrences of otitis media. Thus, one more hypothesis in the whole spectrum of middle ear disease and hearing loss could be tested for this one population segment.

After it was decided to extend the study to include Arctic Health Research data, it was then necessary to modify the planned cohort sample. Only Arctic Health Research villages would be included, and only those children who had served as subjects for their study could be included, since much of the study would be based upon data from these subjects. This would limit the samples to Mountain Village and Emmonak, and add St. Mary's which is also in the Lower Yukon area.

Arctic Health Research was most cooperative in its provision of data. The entire battery of data was photocopied and sent to this researcher, at someone's considerable time and some expense to the

agency. Data consisted of the audiograms made before the start of their study, and the entire set of data sheets, two pages for each cohort in the study.

The only remaining set of raw data needed was the final, post-Arctic Health audiograms. This was to be made by this investigator in visits to the villages involved. This proved the most difficult and frustrating part of the entire study.

The geographical area of this study consists entirely of Eskimo settlements. To a large extent the villages are still in aboriginal stages of culture and economic development, and as such are still protectorates of the government, both Federal and State of Alaska. Those agencies whose task it is to serve the health and welfare of the Natives are, in addition to U. S. Public Health Service, the Bureau of Indian affairs, whose legal responsibility is the over-all program for Eskimo affairs including health, welfare, education, and economic development; and the State of Alaska Department of Health and Welfare which provides itinerant nursing service to the villages in the bush. Supposedly, each itinerant nurse's standard equipment includes a portable, battery-powered audiometer. This would imply an abundant supply of the instruments to be available, as well as the assumption of frequent testing of hearing in the villages. No so at all. In six years, no nurse calling at the station ever carried an audiometer, nor was any testing done as a part of the regular health program.

In all of Alaska, during a year and one-half period, there was no agency admitting to the responsibility of supplying an audiometer to a BIA school, and there was not an audiometer to be had. That there are so many agencies claiming that the Native is its benefactor and so few able or willing to deliver a single piece of equipment to implement its mission in Alaska is one of the frustrating paradoxes of working in rural Alaska.

In the early winter of 1967, Henrietta Krantz, then the director of the State of Alaska Department of Health Division of Speech & Hearing, became interested in the audiological testing aspect of the study after the investigator corresponded with her and explained the intent of the study. Krantz secured an audiometer, provided that a nurse traveling to the station would hand-carry it, and that it could be hand-carried back to her office in Juneau no later than January, 1968. Thus, the total time available to the investigator for its use was approximately three weeks. By testing children after school for as long as the batteries retained their strength each day, this was sufficient time to test all Head Starters and school children in Mountain Village, but not for other villages. Continuous requests by correspondence during the next year procured no other audiometer. Therefore, for the final study, only the children of Mountain Village were able to provide the complete data.

Procedures for Procuring Data

Data and procedures for procuring it has been implied, but specifically it will be as follows:

A. Audiograms procured in the fall of 1965 by Arctic Health personnel prior to its study of otitis media.

B. Otitis Media Transcript Sheets, indicating number of episodes in a twelve-visit program covering approximately a year and a half.

C. Post-study audiograms made by this investigator less than one month after the conclusion of the otitis media study.

D. Comparative audiograms for 1965 and 1967, showing hearing threshold levels prior to and after the conclusion of the Otitis Media Study, and including notation of the number of middle ear infections during the study period.

E. Computation of total threshold gains and/or losses, stratified according to number of reported incidences of otitis media during the study period.

F. Stratification of Mountain Village school children according to various levels of hearing acuity; i.e., the number of children with normal hearing, number having mild, moderate, severe, and profound loss.

G. Significant patterns of loss: greater percentage of left-ear involvement, or greater loss at higher frequencies, an average sharp gain or loss at the same cycle, or other statistics in a pattern.

CHAPTER IV

PRESENTATION OF DATA

Sources of Data

From Arctic Health Research records, three sets of data were obtained. For each subject, record sheets were kept. Each record indicated:

(1) general hearing range as obtained in the 1965 screenings, made prior to the otitis media study;

(2) the number of episodes of otitis media the child had experienced during the first year of life;

(3) presence or absence of evidence of the infection for each of twelve nurse visits to the village, and the total incidences for the study year.

From the audiograms made by the investigator in 1967 were procured hearing levels of the children at that time.

Varying Numbers of Subjects Included in Data

Differing numbers of subjects are computed among various tables of data in this report. This lack of uniformity needs to be explained.

Children whose hearing levels appear in Tables 1 through 4 were those whose audiograms and Arctic Health data sheets were available. There were 47 children for whom the complete three sets of data had been secured. Table 5, September, 1965, Hearing Levels, includes all 51 children whose audiograms were available for that screening. Its comparative table, Table 6, December, 1967, Hearing Levels, reports 76 subjects. More children were tested the latter date, and they included many who were not Arctic Health Study Subjects.

TABLE 1

OTITIS MEDIA INCIDENCE AND THRESHOLD SHIFTS:
ZERO EPISODES

Identification	Threshold Level 1965[1]		Threshold Level 1967		Net Plus, Minus, Equal[2]
PJ	R 25	L 20	R 60	L52	Minus
AL	25	20	45	37	Minus
JB	20	23	45	47	Minus
CW	B 20		32	26	Minus
CW	B 20		20	26	Equal
JW	B 20		32	31	Minus
GK	B 20		24	26	Equal
CP	B 20		41	40	Minus
JP	B 20		46	35	Minus
RP	B 20		38	33	Minus
NL	"R < 27"		83	47	Minus
JS	B 20		30	25	Minus
DW	B 20		46	43	Minus
MW	B 20		30	26	Minus
SG	B 20		56	61	Minus
FJ	B 20		34	41	Minus
MJ	B 20		31	40	Minus

TABLE 1 (Continued)

Identification	Threshold Level 1965	Threshold Level 1967		Net Plus, Minus, Equal
BA	B 20	B 40		Minus
SA	B 20	R 30	L 40	Minus
OA	B 20	29	25	Minus
LA	B 20	43	39	Minus
DB	B 20	26	31	Minus
KB	B 20	30	26	Minus
WB	B 20	30	26	Minus
EB	B 20	30	32	Minus
RAC	B 20	29	20	Minus
HB	B 20	38	30	Minus
EW	B 20	30	35	Minus
TS	"L 27"	25	50	Minus

Number	Bilat. < 27 before	Bilat. > 27 after	Threshold shift gain	static	loss
29	27	2	0	2	27

[1] ISO 1964 audiometric standards used for all calibrations.

[2] Gain (plus) is considered to be a 7 dB or greater net gain bilaterally from 1965 to 1967;
Loss (minus) is considered a 7 dB or greater net loss bilaterally;
Static (equal) is a shift of less than 6 dB.

TABLE 2

OTITIS MEDIA INCIDENCE AND THRESHOLD SHIFTS:
ONE EPISODE

Identification	Threshold Level 1965	Threshold Level 1967		Net Plus, Minus, Equal
LG	B 27	46	46	Minus
PJ	B 20	60	32	Minus
TB	B 20	42	42	Minus
NJ	B 20	52	45	Minus
GB	R 20 L 27	43	47	Minus
XK	L 27	25	25	Plus
EM	L 27	30	37	Minus
RW	B 20	34	31	Minus
PL	B 20	42	42	Minus
TS	B 20	38	42	Minus

Number	Bilateral < 27 1965	Bilateral > 27 1967	Threshold shifts db		
			gain	static	loss
10	6	1	1	0	9

TABLE 3

OTITIS MEDIA INCIDENCE AND THRESHOLD LEVEL:
TWO EPISODES

Identification	Threshold Level before AHR	Threshold Level after AHR	Net Plus, Minus, Equal
EL	B 20	R 55 L 63	Minus
WL	R 20 L 27	29 30	Equal
BL	B 20	48 47	Minus
JL	B 20	25 18	Equal
DA*	23 25	32 36	Minus

Number	Bilateral $<$ 27 before	Bilateral $>$ 27 after	Threshold shifts db gain	static loss
5	5	1	0 2	3

* Perforation

TABLE 4

OTITIS MEDIA INCIDENCE AND THRESHOLD LEVEL:
THREE EPISODES

Identification	Threshold Level before AHR	Threshold Level after AHR		Net
EJ	Bilat 20	R 77	L 75	Minus
RK	R > 27	46	30	Minus
PJ	R > 27	57	45	Minus

Number	Bilateral < 27 before	Bilateral > 27 after	Shifts dB gain	static loss	
3	0	0	0	0	3

TABLE 5

HEARING LEVELS OF MOUNTAIN VILLAGE CHILDREN
December, 1967

	N	Percent
Bilateral Normal	2	2.62
Mild/Normal	7	9.2
Bilat. Mild	27	35.5
Moderate/Normal	1	1.31
Mod./Mild	15	20.0
Bilat. Mod.	9	11.9
Severe/Mild	4	5.3
Severe/Mod.	9	11.9
Bilat. Severe	1	1.31
Profound/Severe	1	1.31
Total	76	
Impairment Bilat. Mild or >	67	88.1

TABLE 6

HEARING LEVELS OF MOUNTAIN VILLAGE CHILDREN
September, 1965

	N	Percent
Bilateral Normal	45	88.2
Mild/Normal	0	0
Bilat. Mild	2	3.9
Moderate/Normal	2	3.9
Mod./Mild	1	2
Bilat. Moderate	0	0
Normal/Severe	1	2
Mild/Severe	0	0
Mod./ Severe	0	0
Bilat. Severe	0	0
Total	51	
Impairment Bilat. Mild or >	6	11.8

Table 7, 1965 Hearing Levels and Incidence of Otitis Media During the First Year of Life, included 67 subjects. This was the entire child population for whom transcript sheets were kept by Arctic Health. The audiograms were not used for this set of data, but rather the transcript sheet, which indicated not the exact decibel range of hearing, but rather the mere presence or absence of any impairment. Although 67 children are thus reported to have been tested, Arctic Health was able to furnish the actual audiograms for only the 51 children reported in Table 5. The absence of the additional sixteen audiograms from 1965 screenings cannot be accounted for.

Establishing Statistical Validity of Data

The most outstanding statistical element of the study is the extreme losses in hearing thresholds occurring between the 1965 screenings and the 1967 audiograms (Tables 1-4; 5, 6). So divergent are the two sets of hearing levels that establishing the validity of both statistics is imperative to the credibility of the entire study.

Prior to beginning its otitis media study, Arctic Health Research hired as its audiometrist Susan Struve of Northwestern University. Struve was then obtaining her doctorate in audiometry and audiology, and her engagement was part of her field work relative to her studies. Struve had previously worked as a public school audiometrist.

TABLE 7

1965 HEARING LEVELS AND INCIDENCES OF OTITIS MEDIA DURING FIRST YEAR OF LIFE

HEARING RANGE	NUMBER OF EPISODES			
	0	1-4	5-8	Unknown
Normal, Bilateral	34	10	0	7
One ear impaired	8	0	0	6
Both ears impaired	0	2	0	0

The writer, who made the 1967 audiograms, had taken course work in audiology and audiometric screening at Central Washington State College. The audiometer used was a portable Eckstein, furnished and serviced by the Alaska State Department of Public Health.

In May, 1967, Vernon Humble of Bethel State School special education had visited Mountain Village and done hearing screenings for EJ (Table 4, #1), RK (Table 4, #2), PJ (Table 1, #1), and two other children whose audiograms were not made by Arctic Health. Henrietta Krantz, then head of Alaska Public Health Department of Speech & Hearing, had made audiograms for several children when

they visited a clinic at Alaska Native Service Hospital in Bethel in the fall of 1967. These children were AL (Table 1, #2), EL (Table 3, #1), and three other youngsters not participating in the Arctic Health Study. In all cases, audiograms made by these two persons were nearly identical to the ones procured by the investigator in December, 1967. This is cited as evidence of the accuracy for the 1967 screenings.

Thus it appears that the statistics obtained in the 1967 audiograms are quite accurate, and that the statistical validity of the study can be considered acceptable.

Comparative Analysis

In the Arctic Health Research audiograms, two elements are extraordinary. First, of 47 children tested, 33 had bilateral, straight-across-the-range levels of exactly 20 dB. Second, there were no patterns of numerous children having extreme drops at any cycle range. However, in 1967, 14 of the 76 children tested showed a drop greater than 7 dB below any other cycle. This is not compatible with the general medical theory that impairment due to middle-ear infection is generally at higher ranges. There was a drop generally at 3000 or 4000 cps among the children. These drops were neither as regular nor as pronounced as for the 500-cps range. (Table 8)

TABLE 8

CYCLE RANGE OF EXTRAORDINARY IMPAIRMENT
AT WHICH CHILD SHOWS IMPAIRMENT
OF 7 BELOW ANY OTHER CYCLE

Total Number of Children Tested:	76
500 cps only	14
Drop at 3000 Maintained to 6000	5
Drop at 4000 only	3
No extraordinary cycle-drop or rise	54

In Mountain Village, Arctic Health found only six children among the 51 otitis media study cohorts to have hearing impairment (Table 5). This 11.8% was considerably below the 31% impaired they reported to have found among their over-all study of Eskimo children in twenty-four villages. There were two other children found to have serious impairments who were not among the research cohorts. Conversely, of the 76 children screened in 1967, 67 or 88.1% were found to have thresholds below 26dB bilaterally (Table 6).

Otitis Media and Hearing Loss

Medical people and audiologists are certain that much childhood hearing loss is directly correlated with incidences of middle ear infection, particularly when those infections occur in infancy. If a child experiences his first episode of Otitis media in the first year of life, they state, it is a particularly formidable situation since this early occurrence almost always leads to subsequent and perhaps chronic attacks. Therefore, the thesis has been formulated that those children having had episodes of otitis media in the first year of life would be those with the greatest incidences of hearing loss.

Among 42 children who experienced no otitis media during the first year of life, 34 had bilaterally normal hearing in 1965 and eight had an impairment of one ear. Ten of the twelve children having had one to four episodes during the first year had normal hearing, as did seven of the thirteen whose number of episodes was listed as "unknown" (Table 7).

Of the 14 children found to have impairment in one ear, eight had had no otitis media, and six "unknown" number of times. Both of the children having impairments in both ears had episodes from one to four times during their first year.

Of 51 children with normal bilateral hearing, 17 had had otitis media their first year; and of 14 having unilateral impairment, eight

had had no otitis media. From Table 7, therefore, we may well assume that if the no-incidence data is accurate, it is an indefinite conclusion that otitis media before age one is directly correlated to hearing loss.

Table 1 identifies those children never having experienced otitis media during the study year. Significantly, among those children never having had otitis during their first year, none experienced an incidence during the study year.

According to this thesis, threshold gains should have been indicated for children who had had ear drainage at any time prior to the study but not during the study year. The contrary is shown in Table 1. Of 29 children reportedly having had no episodes of otitis media, 27 showed a threshold shift downward, and two a negative shift; there were no gains.

Conversely, the only threshold gain in the study was XK, who had one episode during the year (Table 2). And Table 3 shows that, among the five children having had two episodes of draining ears, two retained a static threshold level. These two subsets of data show that there was actually a better shift prognosis among those children who did have otitis media than among those who did not. However, the total number of children showing a static threshold or gain was so small that they should be treated as instances and not as statistically significant.

Correspondingly, those children whose transcript sheets report no episodes of otitis media at any time during their lives have no statistical threshold advantage over those who have experienced episodes of otitis media (Table 9).

In Mountain Village 18/47 or 39% of children recorded in Tables 1 - 4 experienced draining ears during the year. This figure is considerably below the 59% reported among the 724 children in the entire Kuskoquim-Yukon area.

A Confounding Factor

There is one factor, however, which may well have served to confound Arctic Health's statistics, and one unknown to them and which would have been virtually impossible to control. That factor is the erroneous parental reporting of their children's draining ears.

The compilation of data of incidences prior to the study was based upon two facts. (1) In Alaska's isolated villages, medical care is provided by Native medical aides, employed and trained by U. S. Public Health Service. Illnesses and infection are reported by the patient to the aide; by means of a village two-way radio, the aide then discusses the case with a doctor at the U. S. Public Health Service Alaska Native Hospital at the nearest location. The doctor's prescribed treatment is then administered by the local aide. At the hospital, patient files are kept, so that those persons receiving medications and

TABLE 9

HEARING LEVELS OF CHILDREN NEVER HAVING OTITIS MEDIA

Identification	1965 Level	1967 Level
BC	Both > 27	Both > 27
OA	B < 26	B < 26
RAC	B < 26	R > 27
SA	< 26	B > 26
CP	< 26	B > 27
DW	< 26	B > 27
EB	< 26	B > 27
JS	< 26	R > 27
PL	< 26	B > 27
CW	< 26	B > 27
RP	< 26	B > 27
HB	< 26	B > 27
PJ	< 26	B > 27
FJ	< 26	B > 27
AS	< 26	B > 27
MW	< 26	R > 27
BA	< 26	B > 27
MJ	< 26	B > 27

TABLE 9 (Continued)

Identification	1965 Level	1967 Level
AA	B. < 26	n.a.
RA	< 26	B > 27
SS	< 26	n.a.
EW	< 26	B < 26
EB	R > 27	B > 27

shots have such indicated on their medical records. From these records came the primary source of data concerning prior incidences of draining ears.

The second source of information (2), in instances of episodes not having been reported and treated, was a parental statement that the child had had otitis media at a given age. Very understandably, a parent with several children is extremely unlikely to recall with accuracy which child had draining ears at what age.

The writer has strong reasons for suspecting the complete and thorough accuracy of all data relating to the incidence of draining ears. As a teacher of many of the children involved, the investigator was readily able to observe that some of the youngsters had draining ears

more frequently than the records indicated.

EL (Table 3, #3) suffered draining ears for much of the winter of the study year. RK (Table 4) was a chronic, continual victim of otitis media. An older sister of DA (Table 3) reported knowing of three episodes during the year, although his threshold reversal was very slight in spite of the perforated ear drum reported by a visiting doctor in the fall of 1967. JB (Table 1, #3), at the outset of Arctic Health's study, had no reported middle ear pathology; but in the fall of 1967 the doctor recorded 3 mm bilateral perforations, and his teacher stated that he had had draining ears which had not been reported to the Arctic Health study. WL (Table 3) had a chronic winter episode and scarred drums are reported.

The parental failure to admit and report accurately their children's draining ears is easily explainable and in fact quite understandable. The presence of draining ears has been made to be an undesirable stigma, a direct reflection upon parents' ignorance and neglect. The individual who served as village medical aide for over twelve years almost invariably treated a report of draining ears with a lecture concerning the parents' carelessness and neglect. In due time, it became much more dignified and face-saving not to report. The failure to report middle-ear infections for treatment meant the absence of recording, and no record was equated with no incidence.

On the whole, however, the Arctic Health data represents a fairly accurate recording of facts. Most of the recent episodes of middle ear pathology are detectable through examination, and the nurses visited most villages at least ten times during the year.

Empirical evidence from this study does point strongly to the fact that a disproportionate number of village children do have hearing impairments, regardless of correlation with incidences of otitis media.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary and Conclusions

Schoolchildren in the Eskimo settlement of Mountain Village, Alaska, were studied to determine the extent of hearing losses incurred and the relationship between hearing loss and the middle ear pathology of otitis media.

Audiological screenings taken in September, 1965, showed that only 6/51 of children tested, or 11.8%, had any degree of hearing loss. In December, 1967, hearing testing revealed that 67/76, or 88.1%, of the children then had hearing losses greater than bilaterally mild. Only five of the children who were tested both years failed to show a drop in hearing threshold levels from 1965 to 1967.

The report shows the relationship between otitis media and hearing loss to be an indefinite one, at least among those children in this study. Of twenty-three children never having experienced any incidence of otitis media, only two were found to have any hearing impairment in 1965, while in 1967 these children had impairments in all except three cases.

Among 29 children reporting no incidences of middle ear infection during a one-year-long Arctic Health Research study, all but two children were shown to have incurred a hearing loss during the same period. On the other hand, two of five children having reported two episodes of otitis media during the study experienced no further hearing loss.

The future hearing levels of children experiencing their first incidence of draining ears during the first year of life seems to be inconclusive, also, although those children not afflicted have some advantage over those who do not. Of the 42 children having reported no draining ears to age one, 34 had bilaterally normal hearing in 1965 and eight had unilateral impairment. However, among those having reported one to four episodes before age one, ten had normal hearing, with two having bilateral impairments. Of 51 children having normal, bilateral hearing threshold ranges, 34 had reported no incidences of otitis media during the first year; ten had had one to four incidences; and seven had an unknown number of occurrences. Thus, among 51 children with normal hearing threshold ranges, 17 had nonetheless suffered the disease before age one.

Recommendations

The most statistically conclusive aspect of the study is considered to be the extreme diversity between the hearing levels of 1965 and 1967 screenings. It seems scarcely credible that nearly all children

in a village could incur hearing losses in so short a time, when many were not compounded with middle ear infections. Therefore, it is strongly recommended that completely new screenings be administered to all Mountain Village children. Further, it is suggested that new hearing screenings be conducted in other villages. Compilation of data similar to that of this study will be the only means by which valid generalizations can be formulated concerning hearing threshold shifts and the occurrence of otitis media.

The second recommendation is the provision for a special education program for the hearing-impaired to be set up and operated in the village school.

Thirdly, since studies have now been added to studies regarding the medical and educational aspects of the hearing loss problem, the time is coming when amelioration and remediation must be instituted. Medical and educational problems implied herein are but a small share of the syndrome manifested by the tragic, impoverished plight of today's Alaskan Native people.

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APPENDIX I

OTITIS MEDIA TRANSCRIPT SHEET

ARCTIC HEALTH RESEARCH

For each child serving as cohort in the Arctic Health Research Otitis Media study, a three-page transcript was kept by the itinerant nurse visiting the village.

In addition to personal identification (Items 1-8), a survey was made of home conditions (Items 11-24), and personal medical history was recorded (Items 25-38). Examination was made by Arctic Health physicians for present otological condition (Items 39-45, including Hearing, Item 44, and larynological, Item 45). Thereafter, nurse visits were made at intervals of four to six weeks apart, at which time otological examination was made and recorded (Items 46-71). In addition, records of medication were kept (Items 72-75) for the purpose of carrying out research relative to effectiveness of medications (Bicillin and Ampicillin) in controlling and eliminating the disease.

Following are the Transcript Sheets from which some of the raw data for this study were procured.

AHRC-249
10/20/66

Otitis Media Study - Bethel

Transcript Sheet

ARCTIC HEALTH RESEARCH CENTER
U. S. PUBLIC HEALTH SERVICE
ANCHORAGE, ALASKA

1-5 IDENTIFICATION NUMBER
TYPE VILLAGE H.H. IND.
[1] [/] [ ] [ ]

6-7 AGE IN YEARS AT START OF STUDY [ ]

8 SEX
1 MALE 2 FEMALE

9-10 HOUSEHOLD SIZE [ ]

11-14 HOUSEHOLD TOTAL INDEX [ ]

15-17 HOUSING INDEX [ ]

18-20 SANITATION INDEX [ ]

21-23 AREA IN SQUARE FEET [ ]

24 WELFARE
1 YES 2 NO 9 UNKNOWN

25 SOURCE OF POS. HX. OF OTITIS M.
0 NO POSITIVE HISTORY
1 IMMS
2 HOSPITAL CHART
3 RMT
4 VILLAGE MEDICAL CARD
5 MOTHER ONLY
6 PHYSICAL EXAM
7 MULTIPLE SOURCES
9 SOURCE UNKNOWN

26-27 POSITIVE HX. OTITIS MEDIA [ ]

28 AGE EARLIEST REPORTED EPISODE
0 NONE 5 3 YRS.
1 < 6 MOS. 6 4 YRS.
2 6-11 MOS. 7 5 YRS.
3 1 YR. 8 6 YRS. & OLDER
4 2 YRS. 9 UNKNOWN

29 NO. EPISODES DURING FIRST YEAR OF LIFE [ ]

30 T & A
1 TONSILLECTOMY
2 ADENOIDECTOMY
3 BOTH
4 NEITHER
9 UNKNOWN

31 DEAFNESS
1 YES 2 NO 9 UNKNOWN

32-35 ALLERGIES
NONE [ ] ASTHMA [ ] ECZEMA OR HIVES [ ] OTHER [ ]

36-37 EPISODES REPORTED BY RMT [ ]

38 HOSPITALIZED EPISODES [ ]

39-43 O.M. PRESENT AT INITIAL VISIT
39 NO EVIDENCE OF PRESENT O. M. [ ]
40 OTITIS MEDIA BY SYMPTOM [ ]
41 OTITIS MEDIA BY OTOSCOPE [ ]
42 NOT SEEN PHYSICALLY [ ]

43 OTOSCOPE EXAM
0 NO EXAM 3 SCAR
1 NORMAL 4 ABNORMALITY
2 DULL

44 HEARING
0 NO TEST
1 BOTH EARS < 26 DECIBELS
2 RIGHT EAR ≥ 27 DECIBELS
3 LEFT EAR ≥ 27 DECIBELS
4 BOTH EARS ≥ 27 DECIBELS
9 UNKNOWN

45 TONSILS-ADENOIDS
1 TONSILS ABSENT
2 ADENOIDS ABSENT
3 TONSILS AND ADENOIDS ABSENT
4 BOTH PRESENT

46 VISIT #2
1 NOT SEEN 2 MOVED 3 SEEN

47 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

48 VISIT #3
1 NOT SEEN 2 MOVED 3 SEEN

49 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

50 VISIT #4
1 NOT SEEN 2 MOVED 3 SEEN

51 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

52 VISIT #5
1 NOT SEEN 2 MOVED 3 SEEN

53 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

54 VISIT #6
1 NOT SEEN 2 MOVED 3 SEEN

55 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

56 VISIT #7
1 NOT SEEN 2 MOVED 3 SEEN

57 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

58 VISIT #8
1 NOT SEEN 2 MOVED 3 SEEN

59 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

60 VISIT #9
1 NOT SEEN 2 MOVED 3 SEEN

61 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

62 VISIT #10
1 NOT SEEN 2 MOVED 3 SEEN

63 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

64 VISIT #11
1 NOT SEEN 2 MOVED 3 SEEN

65 STATUS
1 NO EVIDENCE OF OTITIS MEDIA
2 CONTINUING EPISODE
3 NEW EPISODE - STOPPED DRAIN.
4 NEW EPISODE - STILL DRAINING

66-70 FINAL EXAM - EARS
66 NO EVIDENCE OF PRESENT O.M. ☐
67 OTITIS MEDIA BY SYMPTOM ☐
68 O.M. BY OTOSCOPIC EXAM ☐
69 NOT SEEN PHYSICALLY ☐

70 OTOSCOPIC EXAM
0 NO SCAR 3 SCAR
1 NORMAL 4 ABNORMALITY
2 DULL

71 NO. O. M. EPISODES DURING STUDY YEAR ☐

72 NO. EPISODES PRECEDED BY URI OR ?RI ☐

73 NO. EPISODES PRECEDED BY LRI ☐

74 NO. EPISODES PRECEDED BY OTHER DISEASES ☐

75 NO. PROPHYLACTIC BICILLIN SHOTS GIVEN DURING STUDY YEAR ☐

76 COMMENTS-MATERNAL INT. & COOP.
1 BELOW AVERAGE
2 AVERAGE
3 ABOVE AVERAGE
9 NO COMMENT

ILLNESS EPISODE CARD

1 TYPE OF CARD
2 3 4 5 6 7 8 9

2-5 DUPLICATE FROM CARD 1

6-7 VISIT ON WHICH EPISODE OCCURRED [ ]

8-11 DIAGNOSIS BY
- 8 [ ] HISTORY
- 9 [ ] VISUAL EXAM
- 10 [ ] OTOSCOPIC EXAM
- 11 [ ] UNKNOWN

12 EAR INVOLVED
1 RIGHT 2 LEFT 3 BOTH

13-19 SYMPTOMS
- 13 [ ] NONE
- 14 [ ] FEVER
- 15 [ ] PAIN
- 16 [ ] DEAF
- 17 [ ] VISIBLE DRAINAGE
- 18 [ ] OTHER
- 19 [ ] UNKNOWN

20-29 OTOSCOPIC EXAM WHEN AVAILABLE
- 20 [ ] NO EXAM
- 21 [ ] NORMAL
- 22 [ ] PERFORATION, NO DRAINAGE
- 23 [ ] DRAINAGE
- 24 [ ] SCAR —
- 25 [ ] INFLAMMATION
- 26 [ ] FLUID
- 27 [ ] DULL —
- 28 [ ] OTHER
- 29 [ ] UNKNOWN

30-31 DURATION OF ILLNESS [ ]

32 NO KNOWN TREATMENT [ ]

33-34 DAYS OF DROPS OR POWDER [ ]

35-36 DAYS OF ORAL ANTIBIOTICS [ ]

37-38 DAYS OF PEN. SHOTS [ ]

39 BICILLIN (RX, NOT PROPHYLACTIC) [ ]

40 ADEQUATE OR PARTIAL TREATMENT
- 0 NO
- 1 YES, WAS ADEQUATE
- 2 PARTIAL COURSE

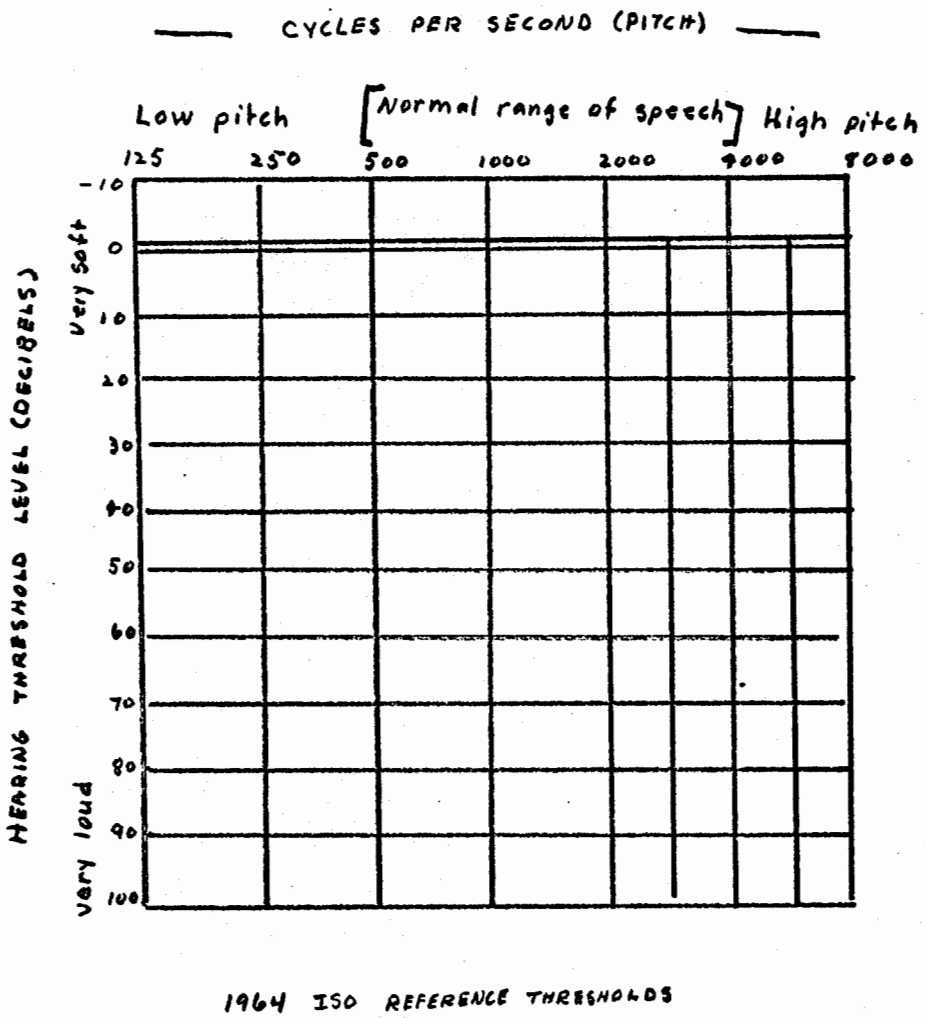
41-46 SOURCE OF ILLNESS INFORMATION
- 41 [ ] HOSPITAL CHART
- 42 [ ] NURSE VISIT
- 43 [ ] RADIO MEDICAL TRAFFIC
- 44 [ ] AIDE
- 45 [ ] PARENT
- 46 [ ] UNKNOWN

47-53 ILLNESS PRECEDING EPISODE
- 47 [ ] NONE
- 48 [ ] URI OR ?RI
- 49 [ ] LRI
- 50 [ ] TONSILLITIS
- 51 [ ] INF. DIS. WITH RESP.
- 52 [ ] OTHER INF. DISEASE
- 53 [ ] UNKNOWN

54 FOLLOW-UP AUDIOMETRIC TEST
- 0 NOT TESTED
- 1 BOTH EARS < 26 DECIBELS
- 2 RIGHT EAR ≥ 27 DECIBELS
- 3 LEFT EAR ≥ 27 DECIBELS
- 4 BOTH EARS ≥ 27 DECIBELS
- 9 UNKNOWN

APPENDIX II

HEARING TESTING FORM



1964 ISO REFERENCE THRESHOLDS

Right ear — O (usually marked red)

Left ear - X (usually marked blue)

↓ No response right
O

↓ No response left
X

APPENDIX III

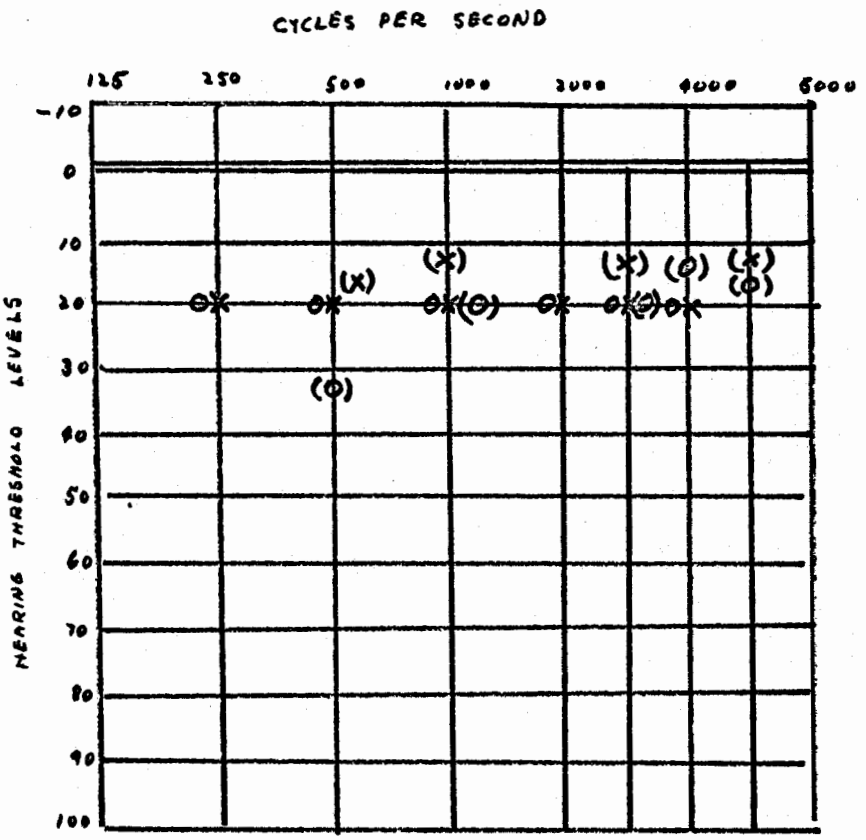
REPRESENTATIVE AUDIOGRAMS

1965 and 1967 Screenings

KEY

	1965 Screening	1967 Screening
Right Ear Marking	o	(o)
Left Ear Marking	x	(x)
Audiometer	Zenith A110T	Eckstein Portable
Audiometrist	Susan Struve, Arctic Health Research	Susan Henry, BIA Teacher
Audiometric Technique	Play Audiometry	Raised Hand
Reference Thresholds	1964 ISO	1964 ISO

Following are representative audiograms for Mountain Village children, showing hearing threshold levels in 1965 and 1967, and including information of occurrence of Otitis Media.



Audiogram I: Dorothy J.

Birthdate: 7/29/59

Age earliest reported episode: Unknown

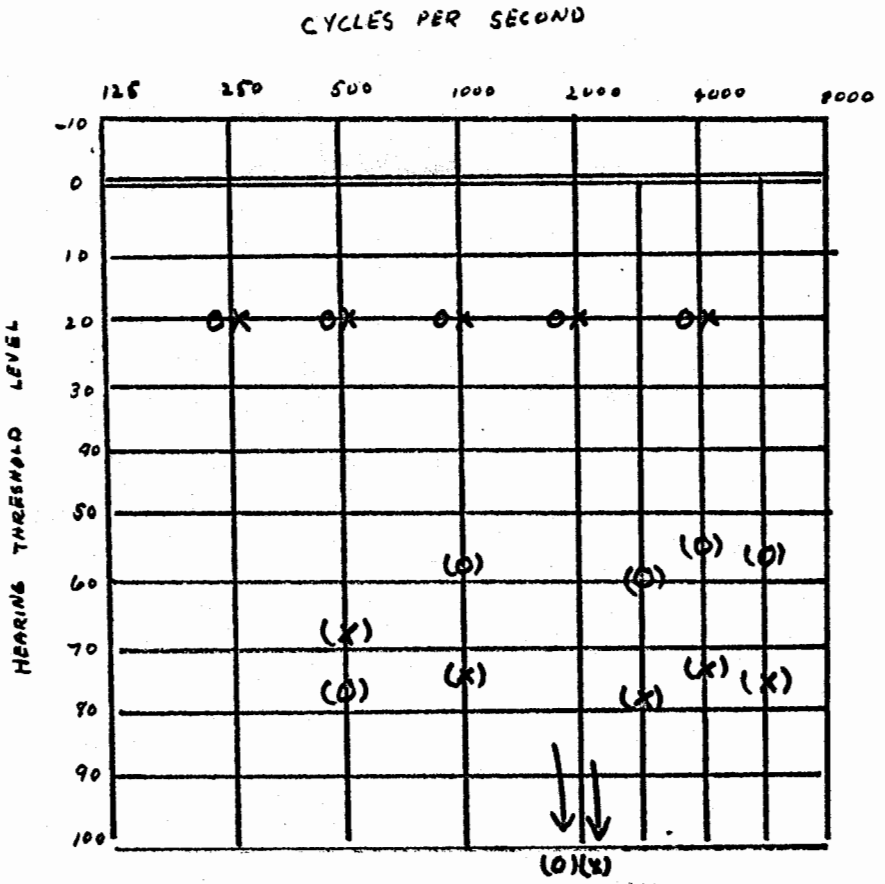
Number episodes first year of life: Unknown

Otoscope exam, 1965: Normal

Otoscope exam, 1967: Normal

Episodes during study year: 0

(Note: Although two episodes were reported, hearing threshold was actually improved in 1967.)



Audiogram II : Elizabeth J.

Birthdate: 7/5/59

Age earliest reported episode: Less than 6 mos.

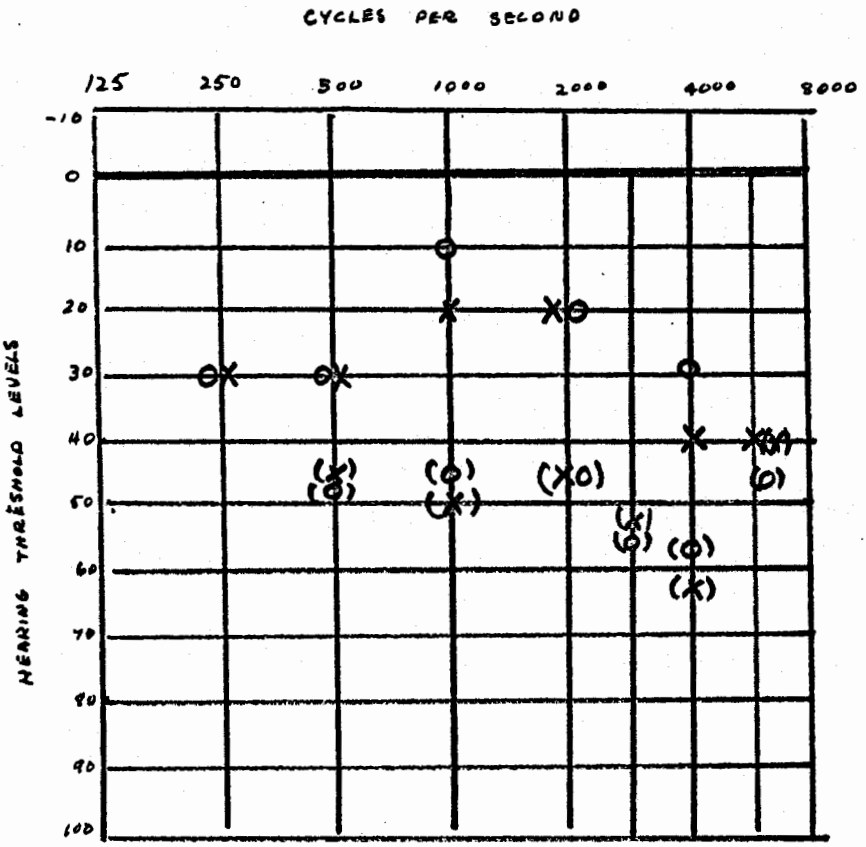
Number episodes first year of life: Unknown

Otoscope exam, 1965: Not available

Otoscope exam, 1967: Not available

Episodes during study year: 3

(Note: 1967 audiogram here is almost identical to one made in May, 1967 by V. Humble, Bethel special education.)



Audiogram III: Jacob B.

Birthdate: 1/22/61

Age earliest reported episode: 6-11 mos.

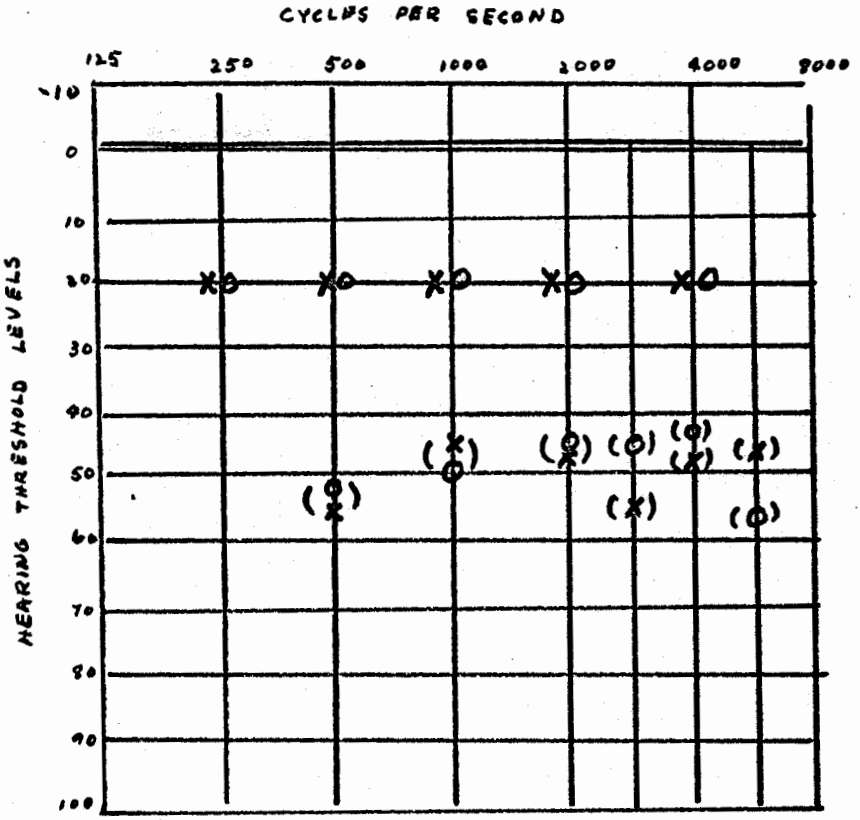
Number episodes first year of life: 1

Otoscope exam, 1965: Abnormality

Otoscope exam, 1967: 3 mm perforations bilaterally

Number episodes during study year:0

(Note perforations having been incurred although no episode of otitis media was reported during study year.)



Audiogram IV: Brenda L.

Birthdate: 11/9/61

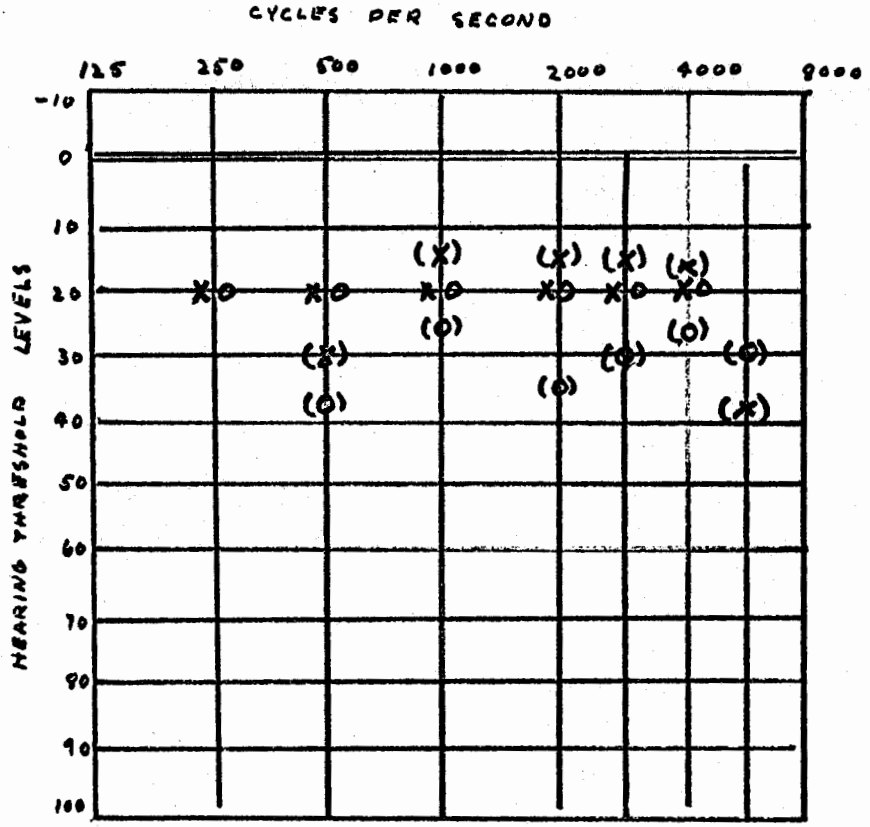
Age earliest reported episode: 1 year

Number episodes first year of life: 0

Otoscope exam, 1965: Abnormality

Otoscope exam, 1967: Dull

Episodes during study year: 2



Audiogram V: Rose Ann C.

Birthdate: 2/5/56

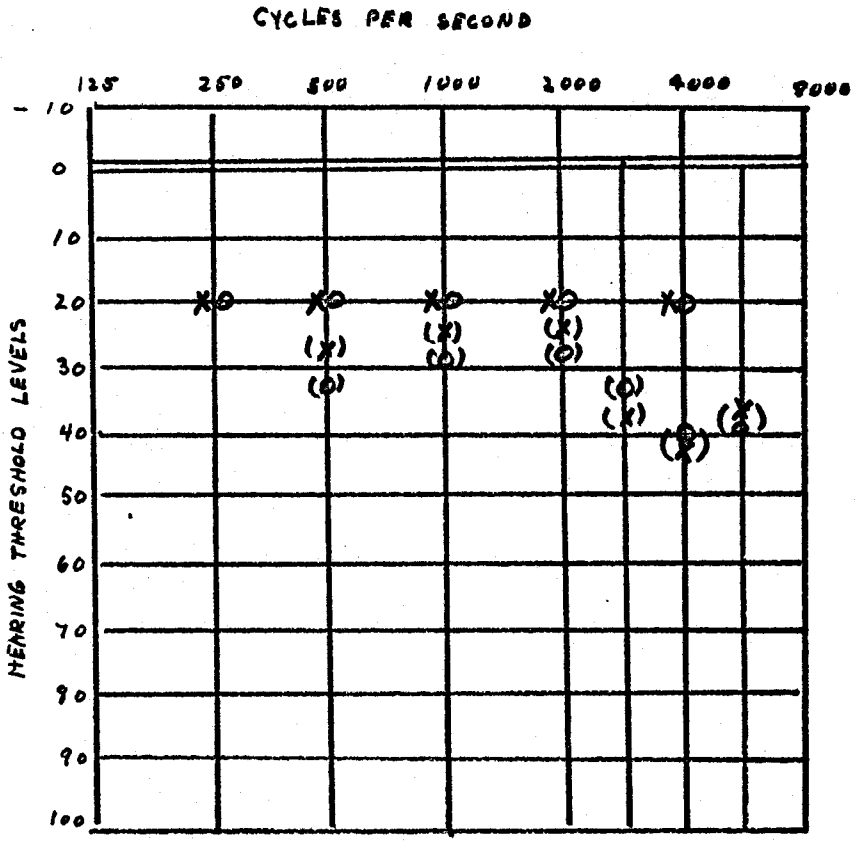
Age earliest reported episode: None

Number episodes first year of life: None

Otoscope exam, 1965: Normal

Otoscope exam, 1967: Normal

Episodes during study year: 0



Audiogram: VI; Kenneth B.

Birthdate: 2/12/58

Age earliest reported episode: Unknown

Number episodes first year of life: Unknown

Otoscope exam, 1965: Scar

Otoscope exam, 1969: Scar

Episodes during study year: 0