AN OTOLARYNGOLOGICAL AND AUDIOLOGICAL EVALUATION OF CHICANO MIGRANT AGRICULTURAL WORKERS IN MICHIGAN

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BEVERLY ANN HERN GOLDSTEIN
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ABSTRACT

AN OTOLARYNGOLOGICAL AND AUDIOLOGICAL EVALUATION
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IN MICHIGAN

By

Beverly Ann Hern Goldstein

Sixty Chicano migrant agricultural workers, 37 children and 23 adults, served as subjects to determine: (1) if there is a higher incidence of middle ear pathology among Chicano migrant workers than in the general population; (2) if there is a higher incidence of hearing loss; (3) if the incidence of middle ear problems decreases as a function of age in the Chicano population; and, (4) how the air-conduction hearing threshold levels of the children and adults in this population compare with threshold data from previous studies on children (Eagles et al., 1963 and the United States Health Education Welfare study, 1970) and adults (Corso, 1963).

All tests were administered in a mobile hearing testing trailer in two different migrant housing camps. All sixty subjects initially responded orally to a questionnaire; parents responded for the younger children. The subjects then received an ear, nose, and throat (ENT) examination by an otolaryngologist, and finally an air- and bone-conduction hearing threshold test by an audiologist.

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The interviews were recorded both on tape and also in written form. The interviewers (two) were bilingual, capable of communicating in English and in Spanish.

The audiometric testing was conducted in a one room test suite housed in the testing trailer. Pure-tone air- and bone-conduction thresholds were measured in 5 dB steps using the Hughson-Westlake ascending technique. Masking, according to the Studebaker technique, was employed whenever an air-bone gap equal to or greater than 10 dB was noted.

A high incidence of middle ear pathology was noted for both children (60%) and adults (80%). This incidence is much greater than that found by Eagles et al. (1963), Cambon, Galbraith, and Kong (1965), Ling, McCoy, and Levinson (1969), and Fay et al. (1970). For children the incidence of pathology manifested itself audiologically in the form of air-bone gaps, while for adults clinically insignificant air-bone gaps were noted. Middle ear problems did not decrease as a function of age.

This investigation demonstrated that although mean and median air-conduction hearing threshold levels were within normal ISO (1964) limits bilaterally, thresholds for Chicano children were poorer at most frequencies than thresholds obtained by Eagles et al. (1963) and the United States Health, Education, and Welfare (1970) study. Hearing thresholds for Chicano adults became poorer as a function of age, as

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as expected, but the adults in this study also demonstrated poorer thresholds than those found by Corso (1963). Generally, the Chicanos in this study had essentially borderline normal hearing for their age groups.

The results of this investigation may not be applicable to all Chicano migrant workers nor to the total United States migrant population. However, the data does suggest that there is a need for improved otolaryngological and audiological services for migrants living in Michigan. A full-scale investigation, possibly coordinated by the United States Public Health Service, appears necessary in order to determine the general incidence of middle ear problems among migrant agricultural workers in the United States.

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By

Beverly Ann Hern Goldstein

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CHAP

I

II

TABLE OF CONTENTS

TAB

CHA

F

LIS

APP

TABL

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

LIST OF TABLES

LIST

TABL

11.

12.

A 1.

C 1.

C 2.

D 1.

E 1.

E 2.

E 3.

E 4.

LIST OF FIGURES

LIS

FIG

9

10

11

12.

B 1.

B 2.

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CHAPTER I

INTRODUCTION, REVIEW OF THE LITERATURE, AND STATEMENT OF PURPOSE

Introduction

Several studies have been reported in the literature concerning the incidence of middle ear problems in various socio-economically depressed communities. High percentages of middle ear abnormalities and conductive hearing losses have been found in the following six populations: (1) Canadian Indians (American Indians native to Canada) living on the Mount Currie Reservation in British Columbia (Cambon, Galbraith, and Kong, 1965); (2) School children of India, ages 5-15 years (Kapur, 1965); (3) American Indian children in South Dakota (Clifford, Hull, and Gregg, 1966); (4) School children in Vancouver, British Columbia (Robinson, Anderson, and Moghadam, 1967); (5) The entire Eskimo population of Cape Dorset, Baffin Island (Ling, McCoy, and Levinson, 1969); and (6) An inner-city population of children residing in the New York City Department of Social Services Children's Center (Fay et al., 1970). Most of the above investigators concluded that the socio-economic environment of a community can influence the incidence of middle ear problems.

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At present, there is a subculture of Chicano migrant agricultural workers (persons of Mexican extraction who live in and are citizens of the United States and who migrate throughout the United States harvesting crops) for which no published data presently exists relative to incidence of middle ear problems. The Chicano migrant workers live and travel with their children under adverse conditions. The possibility exists that they also exhibit a high incidence of middle ear pathology. The interest in this study was to investigate middle ear problems of both Chicano adults and children traveling in the migrant agricultural stream through the central region of Michigan during August, 1971.

Review of the Literature

Normal Incidence of Hearing Loss for Children and Adults

Before it is possible to determine whether Chicano children and adults in the migrant stream have an incidence of hearing loss and/or middle ear disease that is higher than in the general population, it is necessary to become familiar with what has been found to be "normal" incidence of hearing loss. Farrant (1960, p. 23) in Australia, suggested that the "incidence of measurable hearing defects can be expected on the order of about 5% of ears or 3% of children audiometrically screened, incidence varying considerably with popu

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population characteristics such as socio-economic status and probably with seasons." He felt that once these children have been detected, it is necessary to communicate and explain the audiometric data to parents, teachers, and medical practitioners, and ultimately develop an informed community.

Eagles et al. (1963) reported the results of an extensive study involving 4078 children conducted in Pittsburgh, Pennsylvania between June, 1958 and August, 1960. The children ranged in age from five to fourteen years and adequately represented age and sex distribution and socio-economic characteristics of school-age children in Pittsburgh. These investigators found that 2891 children (70.9%) had ears which were otoscopically normal, while 622 children (15.2%) had otoscopically abnormal ears. Due to impacted cerumen, 565 children (13.9%) had inconclusive otoscopic examinations. The abnormalities found included tympanic membrane perforation with and without discharge, impaired mobility with discoloration and retraction of Pars Tensa, retraction of Pars Tensa as a single sign and with other signs, retraction of Pars Flaccida, bulging, impaired mobility, increased vascularization, scars, and calcium plaques. In the group with abnormalities (15.2%), Eagles et al. reported 3% to have active middle ear disease and 12% to have evidence of past disease.

Approximately 75% of all the children tested by Eagles et al. had thresholds more sensitive than audiometric 0 re:

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ASA (1951). Girls were found to have more sensitive hearing than boys except at the frequency 250 Hz. The differences, however, were not large; the greatest being 2 dB at 6000 Hz. The differences between white and non-white children with respect to threshold were found to be on the order of 1-2 dB with no consistent trend. During the winter months there were two periods when the children tended to show a loss in threshold sensitivity. These phases coincided with epidemics of acute respiratory infection. Most categories of abnormal ears had significantly less sensitive hearing levels when compared with those children with normal ears, but this was not true in all cases. Eagles et al. suggested that case-finding should take place early, hopefully in the pre-school years.

The United States Department of Health Education and Welfare (1970) reported on an even more comprehensive study of hearing threshold levels of children conducted from July, 1963 to December, 1965. The national sample of 7119 children examined were "representative of the roughly 24 million non-institutionalized children 6-11 years of age in the United States with respect to age, sex, race, region, size of place of residence, and change in size of place of residence from 1950-1960." (p. 1) It was found that for the better ear, more than 70% of the children had hearing thresholds better than 0 dB Hearing Level (HL) re: ASA (1951). Thresholds were somewhat poorer at 3000, 4000, 6000, and 8000 Hz than for the lower test frequencies. Most children were found to have similar hearing thresholds in both ears; little difference was noted between boys' and girls' threshold levels. At the frequencies 250-2000 Hz, hearing sensitivity of children appeared to increase with advancing age. The estimated prevalence of hearing loss in this survey was found to be quite low. The percentage of pure-tone averages (500, 1000, and 2000 Hz) of 15 dB or greater re: ASA (1951) was judged to be slightly less than 1% of the children tested. The number of children in this age group in the United States with hearing handicaps was then estimated to be 213,000.

Although audiometric zero re: ISO (1964) has been generally accepted as the adult norm for hearing threshold levels, this norm was based on the hearing ability of individuals 18-24 years of age. Corso (1963) found that hearing acuity for adults decreases with advancing age. He recommended that the reference for normal hearing during a person's twenties should not be used as the criteria to determine normal hearing of persons in their thirties and older. Corso found the hearing of women to be on the average more acute than that of men. The differences between sexes were most marked at the higher frequencies with the crossover point in the region of 1000 Hz. Both men and women had hearing loses which progressively spread from the higher to the lower frequencies. Men were affected earlier, beginning on the average at age 32 years; presbycusis for women proceeded at a faster rate although it did not begin until age 37.

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Incidence of Middle Ear Pathology in Socio-economically Depressed Populations

Investigators have recently examined the hearing levels and incidence of middle ear disease of three socio-economically depressed populations in North America. Cambon, Galbraith, and Kong (1965) tested Indians on the Mount Currie Reservation in Vancouver, British Columbia. Of the 504 persons tested, 79 (15.7%) had active middle ear pathology, and 226 (44.8%) had signs of previous disease. Twenty-one (4.2%) had active bilateral middle ear disease. Formal testing was done on 364 persons, 112 (37.9%) of whom showed losses greater than 15 dB re: ASA (1951) for the speech frequencies. The authors felt that poor housing conditions, poor housekeeping, low income, poor family functioning and the presence of nasal discharge were influencial in the high incidence of hearing loss. The investigators reported: "Among those living under the most desperate social situations, active ear disease was present in more than one in three." (p. 1304) Middle ear disease was found to begin early in life and recur frequently. Cambon, Galbraith, and Kong concluded that "the incidence of ear disease is significantly higher where social conditions are poor." (p. 3105)

Ling, McCoy, and Levinson (1969) studied the Eskimo population in Cape Dorset, Baffin Island. Active ear pathology revealed by otoscopic examination was found to be present in 30.8% of the 525 individuals ages birth to 79 years. They did not find any significant decrease in the incidence of active ear disease with increasing age. Chronic rhinitis characterized by massive mucoid or mucopurelent nasal and post-nasal discharge was commonly found and frequently associated with hypertrophy and/or infection of the adenoid tissue. (p. 385) Also seen was a high proportion of middle ear discharge. The standards of hygiene were found to be poor: homes were not clean; children frequently went unwashed; food was prepared, served, and eaten with dirty hands; children had inadequate clothing for the weather; and diets were basically ill-balanced. These factors were seen as substantially contributing to the incidence of middle ear disease. Ling, McCoy, and Levinson suggested that early identification of conductive deafness in preschool children could best be carried out by otoscopic examination. They further recommended intensive education programs for the Eskimo population in the areas of hygiene and diet.

Live-voice speech stimuli were used by Ling, McCoy, and Levinson (1969) for testing hearing acuity because their audiometer needed recalibration. Significant hearing impairment, using live-voice whisper testing, was found to occur very rarely in children 5-17 years old as compared with the high incidence of middle ear disease. A child who could repeat English syllables whispered at a distance of 15 feet was considered to have normal hearing. Nine children demonstrated hearing loss; three required and obtained hearing aids. It is unfortunate that these investigators were not able to obtain pure-tone threshold data. The employment of live-voice whisper testing is an inappropriate method for detecting hearing loss. Empirical evidence has demonstrated that persons with normal hearing in the low frequencies and a loss in the high frequencies will not be detected with this method. According to Newby (1964, p. 59) this technique is only "useful in detecting gross deviations from normal hearing."

Fay et al. (1970) conducted a hearing screening investigation of a sample of inner city children in New York. A total of 461 children, ranging in age from 2-16 years, residing at that time in the New York City Department of Social Services Children's Center, were tested; 19.8% failed the final screening. The investigators suggested that this is an accurate estimate of the incidence of hearing impairment in this population. Fay et al. suggested that this incidence exceeds that found by Farrant (1960), Melnick et al. (1964), and Robinson et al. (1967). Otoscopic examinations were also performed by Fay et al. on 225 children: 46% were found to have positive ear, nose, and throat pathology while only 24% were found to be otoscopically abnormal. Many were found to have multiple pathological conditions of the ear. The investigators did not find a decrease in ear pathology as a function of increased age. Of the 225 children, only 175 had received the hearing screening test. In reviewing the literature, Fay et al. discussed the Clifford et al. (1966) study conducted in

South Dakota on a population of Indian children. In this investigation the final incidence of threshold failures of the Indian population was 27.2%. Fay et al. concluded that all of these studies, when reviewed as one problem, indicate relatively high incidence of middle ear problems among disadvantaged children from both rural and urban populations. They indicated that these findings might be accounted for on the basis of inadequate medical attention and that an urgent need existed for increased otological and audiological services to individuals from low socio-economic areas throughout the United States and Canada.

A review of the literature points out that children with otologic abnormalities are not always detected by hearing screening examinations and that hearing impairments cannot be readily diagnosed solely through otologic examinations. Jordan and Eagles (1961) found data which indicated that audiometric testing, however complete, cannot identify all physical abnormalities of the ear which warrant medical treatment. Eagles et al. (1963, p. 142) further stated that "despite the less sensitive average hearing levels in children with otoscopic evidence of disease, many of them have hearing as sensitive as children without such evidence." They mentioned that audiometric testing may show normal hearing, even though the child may have abnormalities of the ear.

Melnick, Eagles, and Levine (1964) were also in favor of both otological and audiological evaluation in diagnosing problems of the middle ear. They found that threshold tests did not identify children with active otoscopic evidence. Following these investigations, Kapur (1965) did an extensive study of 857 children representing various socio-economic backgrounds in India. He found a high incidence of conductive hearing loss and also found that between 7.3% and 9.2% of the children with normal hearing had otologic abnormalities. Kapur suggested that "in a hearing-survey program, audiometry should be accompanied by an ear, nose and throat examination to uncover otologic abnormalities which do not show a hearing loss." (p. 321) Fay et al. (1970, p. 369) believed that their data supported the notion that "neither hearing screening nor otological examination is sufficient alone to identify both hearing impairment and ear pathology."

Various investigators have studied the amount of loss which usually accompanies middle ear disease. Jordan and Eagles (1961) found the mean hearing levels for 82 ears which showed a combination of signs suggesting secretory otitis media to range from -21 to +39 dB HL re: ASA (1951). Kapur (1964) found that children who have middle ear effusions may have a hearing loss in the range of 10-40 dB HL re: British Audiometric Zero.

Various investigators have concerned themselves with climatic variability. Farrant (1960) found a greater incidence of hearing loss during the winter months, and Eagles et al. (1963) also noted decreased hearing sensitivity in winter. Anderson (1965) looked at the difference in incidence of conductive hearing loss between persons living in several arid counties and coastal counties in Oregon. The findings indicate that a higher incidence of conductive hearing loss is found in the coastal counties; this has been linked to the climatic conditions, rainfall, and humidity.

To date, there has not been any indication in the literature that would lead to an expectation of poorer auditory acuity for the Chicano population. Eagles et al. (1963) did not find significant differences in the hearing acuity of white and non-white children. It is not known if Chicanos were represented in their sample population. Shepherd, Goldstein, and Rosenblüt (1964) tested adults to determine if differences in auditory sensitivity existed between white and black populations of the same socio-economic background. No differences were noted between males; white females showed minimally better thresholds than black females.

General Living Conditions of Chicano Migrant Agricultural Workers

In order to assist the reader in understanding the author's interest in investigating the incidence of middle ear problems among Chicano migrant agricultural workers, it is necessary to describe the migrant's present social and economic position in the United States.

Most migrant farm workers are individuals who move regularly or irregularly following the crop harvests, living every year in various areas of one or more states often with varying climates. According to the Michigan Governor's Task Force on Migrant Labor (1969), the problems migrants face are also tied to various other aspects of rural poverty. Minority groups that are most often affected by the problems inherent in rural poverty are the American Indians, the Blacks, the Puerto Ricans, the Chicanos, and white individuals from various regions of Appalachia.

There are approximately 400,000 to 450,000 migrants traveling in three main streams throughout the country. The Pacific Coast stream begins the agricultural picking season in Texas, moves on to southern California, and works up through Oregon and into Washington. It then turns back and heads south. The middle migrant stream begins in the central regions of Texas and works up through Oklahoma north to Minnesota, Wisconsin, Ohio, and Michigan. Along the Atlantic Coast can be found the third stream. Consisting mostly of Black families, it begins in Florida about mid-May or June, and passes through Georgia, the Carolinas, Virginia, Delaware, New Jersey, New York, and into the New England states. These workers remain for the summer and early fall, and then work their way south back to Florida. According to Koch (1966, p. 172), Director of the Migrant Citizenship Education Project, "the large majority of those who work seasonally in the crops would remain stable if the economy permitted them to do so." As many as 60% of the Chicanos from south Texas who were formerly in commercial crews now travel independently in extended family groups. The main concerns of those traveling in the streams are survival and security.

The Field Study of Migrant Workers in Michigan (1969) sampled 41 families for a total of 334 people. The extended family was found to be common in the migrant stream. Extended family groups are defined as father, mother, siblings, grandparents, married sons and their wives and children, aunts, uncles, and cousins living together as a family unit. They found that "the migratory work force was composed basically of very young and older people in large family groupings." (p. 9) Most migrant farm workers were not the tough younger workers so often visualized, but rather those still too young to become independent and seek improved job opportunities or those too old to leave the stream, inhibited by their inability to speak English and by poor health and a lack of other work skills. Migrant streams lacked workers between the age range 20-35 years. This Field Study found that the number of persons in a family ranged from 1-17 people with a mean size of 8.1 persons. Sixty-three percent of all workers were under 20 years of age and of these, 53% were 18 years and younger. Thirty percent of the total workers were 35 years and older.

Sandage (1968), working as the Executive Director of Migrant Action programs in Iowa and southern Minnesota, showed that in 1966 the migrants who worked in Texas worked in 36 other states in the same calendar year, and that Michigan and Ohio were the largest users of these individuals. She also found that the industries which rely heavily on the work of the migrants are: fruit and nut orchards, cotton, tobacco, and vegetable fields. Migrants have been found by the Report and Recommendations on the Status of Migratory Farm Labor in Michigan (1968) to have severe problems such as: (1) poor health due to poor or nonexistent medical facilities; (2) improper nutrition; (3) substandard wages in relation to the wages of various other unskilled laborers; (4) poor housing conditions at most migrant camp sites; (5) inelegibility for most federal assistance programs due to their mobility and lack of state residency; and (6) low average levels of education. These six problem areas are described in greater detail below.

Child labor is prevalent, according to Sandage (1968), and it has been excused as necessary in the migrant culture by migrants themselves and by many other individuals who have refused to see the problem as it exists today. Bowles (1967), the Supervisory Statistician for Economic Research for the United States Department of Agriculture, has suggested that it is the heavy proportion of children living and working within the migrant streams that has created such a great concern over the welfare of the total population. At an early age migrant children have been expected to contribute to the family income by working in the fields along with the other members of the family. Agricultural work is an extremely hazardous job from the viewpoint of accidents for all workers, and it becomes even more dangerous for young children. Child labor has also been excused in the past and somewhat in present times, for it has helped to minimize farm production costs. Many of the children in the migrant stream grow up to become adult workers, and eventually migrant parents. These children who remain in the stream are no further ahead economically, socially, educationally, or culturally than were their parents.

Public aid has not always been available to the migrant workers due to residence requirements, so migrants have generally been ineligible for treatment at public hospitals and for general medical care. Many have not been made aware of the health services for which they are eligible. A United States Public Health Survey conducted in 1967 found that the death rate of migrants as a sub-group was much higher than the national average. Broken down into categories (Sandage, 1967, p. 13), infant and maternal mortality were both 125% higher than the national average, influenza and pneumonia were 200% higher than the national average, and tuberculosis and other infectious diseases were 260% higher than the national average. More specifically (Journal of American Medical Association, 1971, p. 521), tuberculosis has been found to occur in the general United States population in 21.3 persons per 100,000. Epidemics are frequent, and they are difficult to control due to the high mobility of the workers.

Preventative medical measures have seldom been taken such as immunization, chest X-rays, and regular check-ups. Quite recently in Michigan, a program to arrest infectious diseases in the migrant population using antibiotics was initiated. A description of the program is available in the Migrant Health Program Annual Progress Report (1970). Of the 2881 total visits to the combined clinics of the East Central Michigan Health Service, 791 (27%) were to treat diseases of the respiratory system. Thus, over one quarter of the visits were to treat physical problems which could contribute to conductive hearing loss. Indian Health Trends and Services found otitis media to be the most common notifiable disease among North American Indians, occurring in 9,115.2 per 100,000 (Journal of American Medical Association, 1971, p. 521). Ear pathology appeares to be extremely common among both of these groups. There were 338 visits to the East Central Michigan Health Service by Chicanos for symptoms and ill-defined conditions, 297 visits for cure of diseases of the skin and subcutaneous tissue, 240 visits due to diseases of the nervous system and sense organs, 198 visits due to diseases of the digestive system, 167 visits necessary because of accidents, poisonings, and violence, and 161 visits to treat endocrine, nutritional and metabolic diseases. (p. 3-5) Other migrants who also required these various health services were not treated if they were not in an area with a clinic, not aware of the available service, or not able to reach the clinic due to lack of transportation.

Allen (1966), Ruel (1967), and Sandage (1968), although not citing any statistical data, have written lengthy narratives on the nutritional trends of migrant workers. Because migrants have low incomes and the money cannot all be spent on food, migrant workers spend much less on groceries per week than the average American family of equal size. Dairy products are consumed in less quantity, for most families have no refrigeration facilities. Children are generally breast-fed until 18-24 months of age, but following this period of time, consume less milk than other children their age. Since the cost of meat is higher than other food products, there is a trend among migrant workers of eating more starches and less meat. Generally, they do not buy fruits and vegetables, although they do eat these products while working in the fields. Ling, McCoy, and Levinson (1969) have suggested that ill-balanced diets (such as those described above) substantially contribute to incidence of middle ear disease.

Migrant workers have been employed annually in 55 counties in Michigan. According to the Field Study of Migrant Workers in Michigan (1969, p. 10) "the migrant worker in Michigan has not been getting the legal minimum wage, he has gotten no unemployment benefits, he has been excluded from workmen's compensation and deprived of social security benefits." The rate of payment for migrant labor has usually been contracted by the acre, pound, or bushel. Thus, pickers must harvest rapidly, since their wages are directly dependent upon how much they are able to harvest in a day. The Field Study of Migrant Workers in Michigan (1969, p. 9) further reported that ". . . workers paid by piece-rate consistently failed to earn an amount equal to the minimum hourly wage of $1.25."

Many migrant camps are in poor condition with no indoor or outdoor plumbing, sometimes no electricity, clean water, shower facilities, or heat, and occasionally no windows or doors on the cabins. The lack of trash cans or other methods of eliminating trash cause a heavy concentration of flies and rodents. The homes are usually no larger than two rooms with one bed for every three or four persons. A few good migrant camps do exist, but according to the Report and Recommendations on the Status of Migratory Farm Labor in Michigan (1968), they are rare. Various explanations have been given by growers as reasons for not improving migrant housing: "'(1) Mechanical harvesters will replace workers in the near future; (2) Housing facilities are used only a few weeks out of the year; (3) Although the housing leaves something to be desired, it is at least equivalent to what workers have in their home-base areas; (4) All too often there has been willful destruction of very fine facilities that were provided.'" (p. 10)

According to Servin (1970), Chicanos have the poorest socio-economic record of all minority groups recorded in the 1960 United States Census. Outside of New Mexico, they are grossly under-represented and ignored in political appointments. The most significant offices held by Chicanos are in the Department of Education. Migrants have been specifically excluded from all major federal labor legislation, and due to a lack of residency, they are not eligible for much of the early 1960's poverty legislation.

The Michigan Civil Rights Commission in its Report and Recommendations (1968) concluded that there are three general ways by which the migrant population is systematically excluded from civil and legal rights, opportunities, and privileges. These are: (1) Inadequate protective legislation and enforcement of legislation; (2) Inadequate staff, information and outreach; they are left without information regarding rights and services of which they could take advantage; (3) Uncoordinated efforts; the amount of activity and responsiveness that does exist, although well-intentioned, remains uncoordinated. Therefore, non-cooperation exists, as does duplication, wasted effort in minor areas of need, and no effort in some major areas of need.

The average adult migrant has had the equivalent of a third grade education. Some of the older migrants actually have no formal education. According to Bowles (1967) it is the low education of the majority of the parents and the intermittent and seasonal nature of the farm work which produce conditions that help to perpetuate low educational aspirations from one generation to another.

The migrant child is strongly attached to his family, and he perceives school experiences and social relationships as having a secondary importance. Migrant children move frequently from school to school as they travel and are generally not in one school long enough to accept it as an integral part of their lives. Most schools have not adjusted to the situations which migrants face daily. The typical school program has not, in most cases, successfully integrated the strong social needs of the migrant child with his educational needs. The migrant child is not usually in the same grade as the other children his age. Chicano children are usually very self-conscious in school, for they make many mistakes in the use of the English language and are concerned about being ridiculed. Moore (1965, p. 56) explains that "when poverty is accompanied by language difficulties, small success with school work and rejection by other classmates, the situation [for the development of a positive self-concept] eventually grows hopeless." According to John and Horner (1970), if migrant children speak primarily Spanish, and teachers in school speak primarily English, these children are being taught all subject matter in an alien cultural and linguistic milieu.

Through the years educators have offered various explanations and solutions to the problem of educating the Chicano child. Few have provided the child with as beneficial an education as that received by the Anglo-American child. On one extreme, educators have chosen to completely disregard the cultural differences between the Spanish-speaking and the English-speaking children while others have assumed that the Spanish-speaking children in the United States are as foreign as the Mexican children of Mexico. Various investigators have studied the problems associated with bilingual education in the United States. Although most educators (Garretson, 1928; Haught, 1931;

Spoerl, 1943; Arsenian, 1945; UNESCO, 1951; Holland, 1960; and John and Horner, 1970) support the need for bilingual programs, few programs have as yet been initiated. Since the recognition of the need for bilingual programs in the late 1920's, Chicano children have continued to fear the lack of recognition and understanding from teachers whose backgrounds are dissimilar and who misinterpret many of the children's efforts to achieve success and accommodate themselves to basically alien demands.

One aspect which thus far has not been largely investigated is that many children who have language difficulties in school and who come from families of low-socio-economic backgrounds may also have a hearing loss. These children, as explained above, tend to receive poorer medical treatment than "middle class" and urban children; they tend to live in poorer housing conditions, and they usually lack proper nutrition. In view of the investigations presented earlier, many of these children could have difficulty learning English because of conductive hearing losses which, due to lack of medical attention, have gone undiagnosed.

Statement of Purpose

In view of the high incidence of middle ear problems detected in various socio-economically depressed communities, this study was undertaken to investigate the following questions: (1) Is there a higher incidence of middle ear pathology among Chicano migrant workers than in the general population? (2) Is there a higher incidence of hearing loss? (3) How do the hearing threshold levels of the children of Chicano migrant agricultural workers compare with the data presented by Eagles et al. (1963) and the United States Department of Health Education and Welfare (1970)? (4) How do the hearing threshold levels of the adult Chicano migrant workers compare with the data presented by Corso (1963)? and (5) If ear problems are found in this population, does the incidence decrease as a function of age?

CHAPTER II

EXPERIMENTAL PROCEDURES

Subjects

Sixty subjects, 37 children and 23 adults, selected from two migrant camps during August, 1971 participated in the study. The children ranged in age from 5-16 years with a mean age of 9.8 years. All children over the age of four years, living in these two camps, were tested. The adults ranged in age from 18-50 years with a mean age of 28.9 years. The adults sample, however, consisted of approximately 3/4 of the adult population in the camps. All adults who were willing to be examined were included in the study. The sixty subjects were members of thirteen different families. The size of the smallest family tested was one person while the size of the largest family was ten people, with a mean of 4.6 people. The subjects were living and working in typical conditions for Chicano migrant agricultural workers as described in Chapter I.

Equipment

All threshold tests were conducted in one room of a two-room testing suite with both the experimenter and the subject in a single-walled sound-treated room housed in a Vagabond trailer shell. The other room was used by the otolaryngologist for the medical examination. The single-walled room was sound treated with one layer of fiberglass, followed by a four inch dead space, covered with fiberglass and burlap material. The floor was also treated using dead air space and then covered with carpeting. The only exterior window contained three pieces of plexiglass separated from one another by one inch dead air spaces. The ambient noise level in the test chamber was 40 dB sound pressure level (SPL) measured on the C scale of a sound level meter (Brüel and Kjaer type 2204-S) using a sound-field condenser microphone (Brüel and Kjaer type 4145). This sound level meter was calibrated using a pistonphone (Brüel and Kjaer type 4220). Noise levels were also measured at octave intervals by attaching an octave band filter set (Brüel and Kjaer type 1613) to the above mentioned equipment. The ambient noise was sufficiently low at all test frequencies, according to the ASA (1960) Criteria for Background Noise in Audiometer Rooms, so as not to interfere with pure-tone threshold measurements. See Appendix A. The difference between the ASA and the ISO norms was used as a correction factor in determining acceptable levels of ambient noise.

Pure-tone air-conduction thresholds were obtained using a commercial audiometer (Beltone 15 C) with earphones (Telephonics TDH 39 10Z) mounted in MX 41/AR cushions. Bone-conduction thresholds were also obtained with the Beltone audiometer, employing a bone oscillator (Radioear B 70 A). Broad band white noise, calibrated in effective masking, was used whenever masking became necessary. The air-conduction system was calibrated daily during the course of the investigation with an artificial ear assembly (Brüel and Kjaer type 4152) and a condenser microphone (Brüel and Kjaer type 4144) with the associated sound level meter (Brüel and Kjaer type 2204-S) and octave band filter network (Brüel and Kjaer type 1613). The initial calibration of the bone oscillator was obtained using an artificial mastoid (Beltone type M5A), a mastoid amplifier (Beltone type M5A), and a microphone amplifier (Brüel and Kjaer type 2603). Thereafter, the bone-conduction system was calibrated biologically prior to each test session with one normal hearing subject to ascertain that the calibration of bone conduction was in agreement with air conduction. All threshold measurements (air- and bone-conduction) were made with 20 dB attenuation pads inserted in the system between the audiometer and the transducers. The attenuation of these pads was measured for both air and bone-conduction at each frequency, and the necessary corrections were then made. No systematic changes were found in the output of the audiometric equipment during the course of the investigation.

Tests and Procedures of Administration

Pure-tone air- and bone-conduction thresholds were measured in 5 dB steps using the Hughson-Westlake ascending technique recommended by Carhart and Jerger (1959). The following frequencies were tested by air-conduction: 1000, 2000, 4000, 6000, 8000, 1000, 500, and 250 Hz. Test-re-test was accomplished according to Witting and Hughson (1940) at 1000 Hz. Ears were alternated as to which ear was tested first. The frequencies tested by bone-conduction were 1000, 2000, 4000, and 500 Hz. Bone-conduction thresholds were obtained unmasked. If an air-bone gap of 10 dB or greater was obtained, the Studebaker (1964, 1967) method of masking the non-test ear was employed to obtain a masked threshold. Both ears were tested by air and bone-conduction for all subjects. The subjects responded by raising their hand whenever they perceived a tone through the earphone.

Otolaryngological Examination

The otolaryngologist conducted an ear, nose, and throat examination on 68% (N=25) of the children and 65% (N=15) of the adults who were audiometrically tested. These subjects were randomly selected from the total sample. This examination was conducted in the outer room of the two-room test suite.

Interview

Two bilingual individuals capable of speaking both Spanish and English, served as interviewers and interpreters. Almost all the interviews were tape recorded on compact cassette tapes using a tape recorder (Norelco Cassette EL 3302). Interview information was obtained for all subjects. Many of the conversations were in English while some were totally in Spanish. The interview was conducted immediately prior to both the otological and audiological examinations. The otolaryngologist was then able to refer to the interview sheet before proceeding with his examination. The audiologist did not refer to any of the already obtained information prior to the hearing test.

Forms

The packet of forms used for this investigation included: (1) and (2) a Questionnaire in both English and Spanish containing eleven questions, several questions having more than one section; (3) a Physical Examination check-off form; (4) a Physical Examination Impressions sheet to record the need for referral and brief description of the problem if one was observed; and (5) an Audiogram plotted in dB re: ISO (1964). See Appendix B.

CHAPTER III

RESULTS AND DISCUSSION

This investigation included an interview with each subject or subject's parent, an ear, nose, and throat examination of 68% of the children and 65% of the adults, and for all subjects a pure-tone air- and bone-conduction audiometric evaluation.

Interview

The initial data obtained was the subjective information supplied at the interview and can be found in Tables 1 and 2. According to the respondents, there was not thought to be a high incidence of hearing loss in the family. Of the children seen, 27% supposedly had hearing loss while only 13% of the adults said that a family member was experiencing hearing difficulty. It is necessary to recall at this time that all sixty subjects were members of only thirteen families, so if one member of the family had a hearing loss, all children and adults in that family might have answered "yes" to the question. When asked if they personally had difficulty with their hearing, 19% of the children and 13% of the adults answered in the affirmative. None of the

Table 1. Answers to questions posed to the parents of the children tested.

QUESTION	ANSWER			
	Yes		No	
	%	N	%	N
1. Is there any hearing loss in the family?	27	(10)	73	(27)
2. Does your child have a hearing loss?	19	(7)	81	(30)
3. Does your child have frequent colds (5 or 6 per year)?	19	(7)	81	(30)
4. Has a doctor ever looked into your child's ears?	65	(24)	35	(13)
5. Has any liquid run out of your child's ears?	16	(6)	84	(31)
6. Has your child ever had any severe earaches?	49	(18)	51	(19)
7. Has any medication been taken for an ear infection?	19	(7)	81	(30)
8. Does your child have trouble hearing speech?	27	(10)	73	(27)
9. Has your child ever worn a hearing aid?			100	(37)
10. Has your child ever had a hearing test where it was necessary to listen for tones through earphones?	49	(18)	51	(19)
11. Has your child ever worked around farm machinery?	46	(17)	54	(20)
12. Has your child ever driven farm machinery?	11	(4)	89	(33)
13. Did your child ever wear any ear protection while working around the machinery?	3	(1)	97	(16)

Table 2. Answers to questions posed to adult subjects.

QUESTION	ANSWER			
	Yes		No	
	%	N	%	N
1. Is there any hearing loss in the family?	13	(3)	83	(19)[1]
2. Do you have a hearing loss?	13	(3)	78	(18)[2]
3. Is there any ringing in your ears?	30	(7)	70	(16)
4. Do you have frequent colds (5 or 6 per year)?	26	(6)	74	(17)
5. Has a doctor ever looked into your ears?	61	(14)	39	(9)
6. Has any liquid run out of your ears?	4	(1)	96	(22)
7. Have you had any severe earaches?	39	(9)	61	(14)
8. Has any medication been taken for an ear infection?	9	(2)	91	(21)
9. Do you have trouble hearing speech?	26	(6)	74	(17)
10. Have you ever worn a hearing aid?			100	(23)
11. Have you ever had a hearing test where it was necessary to listen for tones through earphones?	30	(7)	70	(16)
12. Have you ever worked around farm machinery?	65	(15)	35	(8)
13. Have you ever driven farm machinery?	35	(8)	65	(15)
14. Did you ever wear any ear protection while working around the machinery?			100	(15)

[1]One subject answered maybe (4%)

[2]Two subjects answered maybe (9%)

children reportedly had experienced any form of tinnitus; 30% of the adults felt that some type of ringing in the ear(s) was noted. The tinnitus was reported to be both low and high pitched and of frequent and infrequent occurrence.

Frequent colds were defined as five to six colds per year; 19% of the children and 26% of the adults supposedly suffered from this difficulty. It was further recorded that prior to this study, only 65% of the children and 61% of the adults had ever had an otoscopic examination by a physician. Most parents reported that past otoscopic examinations of their children had taken place during school registration.

Pathology of the ears was also noted. Forty-nine percent of the children and 39% of the adults had previously had at some time in their lives severe earaches and 16% of children and 4% of adults had previously had liquid discharge from the ear. Although they were not able to identify the types of medication, 19% of the children and 9% of the adults had taken medication for the ear. Many families further explained that to cure severe earaches, they used warm olive oil and applied it in the ear with cotton.

Some individuals, 27% of the children and 26% of the adults, reported having difficulty hearing conversational speech. Although, as stated earlier, the percentages of children and adults who reportedly experienced general hearing difficulty were much lower than those who said they had a specific difficulty in hearing speech, it is the investigator's impression that some parents expressed concern because their children were not particularly attentive to verbal statements. None of the children or adults had ever worn a hearing aid. Forty-nine percent of the children and 30% of the adults had previously had their hearing screened or tested audiometrically. Most of the children who had had a previous hearing test were of school age and had been tested during school screening programs. The remainder of the people had been tested at state funded neighborhood clinics.

Finally, it was reported that 65% of the adults and 46% of the children had worked in the fields close to farm machinery. Thirty-five percent of the adults and 11% of the children had actually personally operated the equipment. Of the seventeen people who had worked in the vicinity of farm machinery, only one person, a teenage boy, reported wearing ear protection. He described the protectors as some form of earplugs.

Otolaryngological Examination

The otolaryngologist was able to examine only twenty-five children (68% of the total number) and fifteen adults (65% of the total number). The results of the physical examination are presented in Tables 3 and 4.

Table 3. Number and percentage of otolaryngological findings for 25 children ages 5-16 years for both unilateral and bilateral pathology.

	Unilateral N	Unilateral %	Bilateral N	Bilateral %
Ears				
Normal tympanic membrane (TM)	(1)	4	(10)	40
Obstructed TM	(1)	4	(1)	4
Retracted TM	(2)	8	(7)	28
Thickened TM	(0)		(1)	4
Thickened and retracted TM	(1)	4	(1)	4
Inflamed TM (including secretory otitis media)	(1)	4	(2)	8
Total	(3)	12	(22)	88
Nose				
Normal	(0)		(20)	80
Mucous membrane thickening	(0)		(5)	20
Total	(0)		(25)	100

	N	%
Neck Glands		
Not palpably abnormal	(18)	72
Palpably but not markedly enlarged	(7)	28
Total	(25)	100
Tonsils		
Normal	(17)	68
Hypertrophied	(7)	28
Scarring and retraction moderate	(1)	4
Total	(25)	100
Pharynx		
Normal	(21)	84
Chronic lymphoid hyperplasia	(4)	16
Total	(25)	100

Table 4. Number and percentage of otolaryngological findings for 15 adults ages 18-40[1] years for both unilateral and bilateral pathology.

	Unilateral		Bilateral	
	N	%	N	%
Ears				
Normal tympanic membrane (TM)	(1)	6.5	(3)	20
Obstructed TM	(1)	6.5	(0)	
Retracted TM	(2)	13.0	(9)	60
Thickened TM	(0)		(1)	7
Total	(2)	13	(13)	87
Nose				
Normal	(0)		(13)	87
Mucous membrane thickening	(0)		(2)	13
Total	(0)		(15)	100
Neck Glands				
Not palpably abnormal		(14)	93	
Palpably but not markedly enlarged		(1)	7	
Total		(15)	100	
Tonsils				
Normal		(12)	80	
Hypertrophied		(2)	13	
Scarring and retraction moderate		(1)	7	
Total		(15)	100	
Pharynx				
Normal		(13)	87	
Chronic lymphoid hyperplasia		(2)	13	
Total		(15)	100	

[1]No adults older than 40 years of age were examined by the physician.

Of those examined, normal tympanic membranes were noted bilaterally in 40% of the children and 20% of the adults and unilaterally in 4% of the children and 7% of the adults. Tympanic membranes obstructed by cerumen were seen only infrequently, bilaterally only 4% in children and unilaterally 4% in children and 7% in adults. Retracted tympanic membranes were, however, much more common. Twenty-eight percent of the children and 60% of the adults were found to have bilateral retractions, and 8% of children and 13% of adults had unilateral retraction. For adults, tympanic membrane retraction was the highest observed abnormal ear, nose, and throat condition while for children it was one of the three highest ENT abnormalities. Thickened membranes were noted bilaterally in 4% of the children and 7% of the adults. In children thickening and retraction were infrequently noted concurrently; 4% unilaterally and 4% bilaterally. Inflamed membranes including the possibility of secretory otitis media were not found for any adults and only infrequently in children. Eight percent demonstrated this pathology bilaterally and 4% unilaterally.

Ear involvement was the most frequent otolaryngological abnormality found in this investigation. Of the 25 children who received the otoscopic examination, 60% had at least a unilateral abnormality; forty-eight percent demonstrated bilateral pathology. Of the 15 adults who received the otoscopic examination, 80% had at least a unilateral abnormality; 67% demonstrated bilateral pathology.

Examination of the nose revealed that 80% of the children and 87% of the adults had normal conditions bilaterally. Mucous membrane thickening was noted bilaterally for 20% of the children and 13% of the adults.

Neck glands were found to be "not palpably abnormal" for 72% of the children and 93% of the adults. Twenty-eight percent of the children and 7% of the adults had glands which were palpably but not markedly enlarged.

Normal tonsils were noted in 68% of the children and 80% of the adults. Other conditions observed were hypertrophy occurring in 28% of the children and 13% of the adults and scarring and moderate retraction in 4% of the children and 7% of the adults. Total percentage of tonsils which showed other than normal conditions was 32% for the children and 20% for the adults.

The pharynx was found to be normal for 84% of the children and 87% of the adults. Chronic lymphoid hyperplasia was noted in 16% of the children and 13% of the adults.

Only one adult and one child who had been examined demonstrated an otolaryngological abnormality unaccompanied by otoscopic abnormality. Sixty-four percent (N=16) of the children and 87% (N=13) of the adults receiving the physical examination demonstrated some type of ear, nose, and throat pathology, at least unilaterally. Bilaterally, 52% (N=13) of the children and 73% (N=11) of the adults demonstrated pathology.

Audiological Evaluation

Children

The age distribution of the 37 children can be found in Table 5. All ages were represented from five to sixteen years, although no uniform number of children was tested at each age level. The reason for this was the limited number of children available for testing. Except for the children below age 5 years, all children living at both migrant camps were tested.

None of the mean or median air-conduction hearing thresholds in dB re: ISO (1964) for all children ages 5-16 years (refer to Table 6 and Figure 1) reached 0 dB HL at any frequency in either ear. The mean audiometric configurations appeared relatively flat for both ears, having exhibited an inter-frequency range of 8.9 dB (from 7.3 dB HL to 16.2 dB HL) for the right ear and an inter-frequency range of 5.7 dB (from 11.1 dB HL to 16.8 dB HL) for the left ear. It should be pointed out that Table 6 presents both mean and median data. Figures 1-6 display only means, while later comparisons are expressed using medians. This change in examination of the data was done in order to relate this investigation to the available data from the comparison studies (Eagles et al., 1963; United States Health Education and Welfare, 1970).

Table 5. Age distribution of children audiometrically tested.

Age in Years	Total Number
5	2
6	6
7	5
8	5
9	1
10	2
11	4
12	2
13	2
14	4
15	2
16	2
Total	37

Table 6. Mean, median, range, and standard deviation of air-conduction thresholds in dB re: ISO (1964) and air-bone gap data for all children ages 5-16 years classified by frequency and ear tested.

Frequency (Hz)	250	500	1000	2000	4000	6000	8000
<u>Right Ear</u>							
Mean	16.2	12.3	7.3	8.6	14.2	15.4	15.0
Median	15	10	5	10	15	15	15
Range	25	25	30	30	30	45	50
Standard Deviation	7.1	6.3	8.6	5.8	8.1	10.5	13
Air-bone gap		7.4	3.4	3.1	7.6		
<u>Left Ear</u>							
Mean	14.6	13.4	11.1	11.9	16.8	15.9	13.9
Median	10	10	10	5	15	15	10
Range	40	55	60	55	55	65	50
Standard Deviation	10.9	10.9	12.0	13.0	12.7	14.3	12.5
Air-bone gap		11.1	5.4	5.9	8.1		

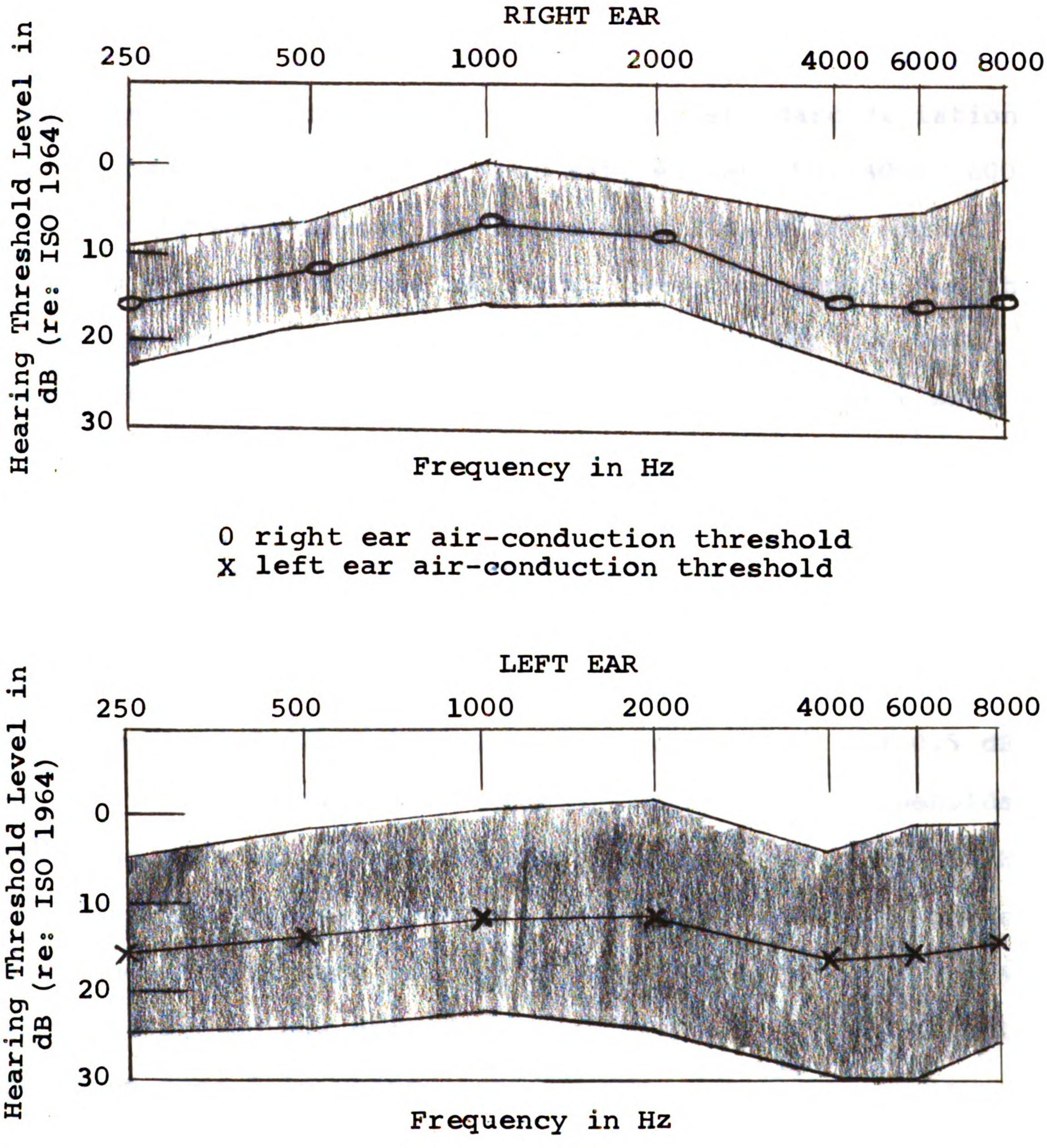
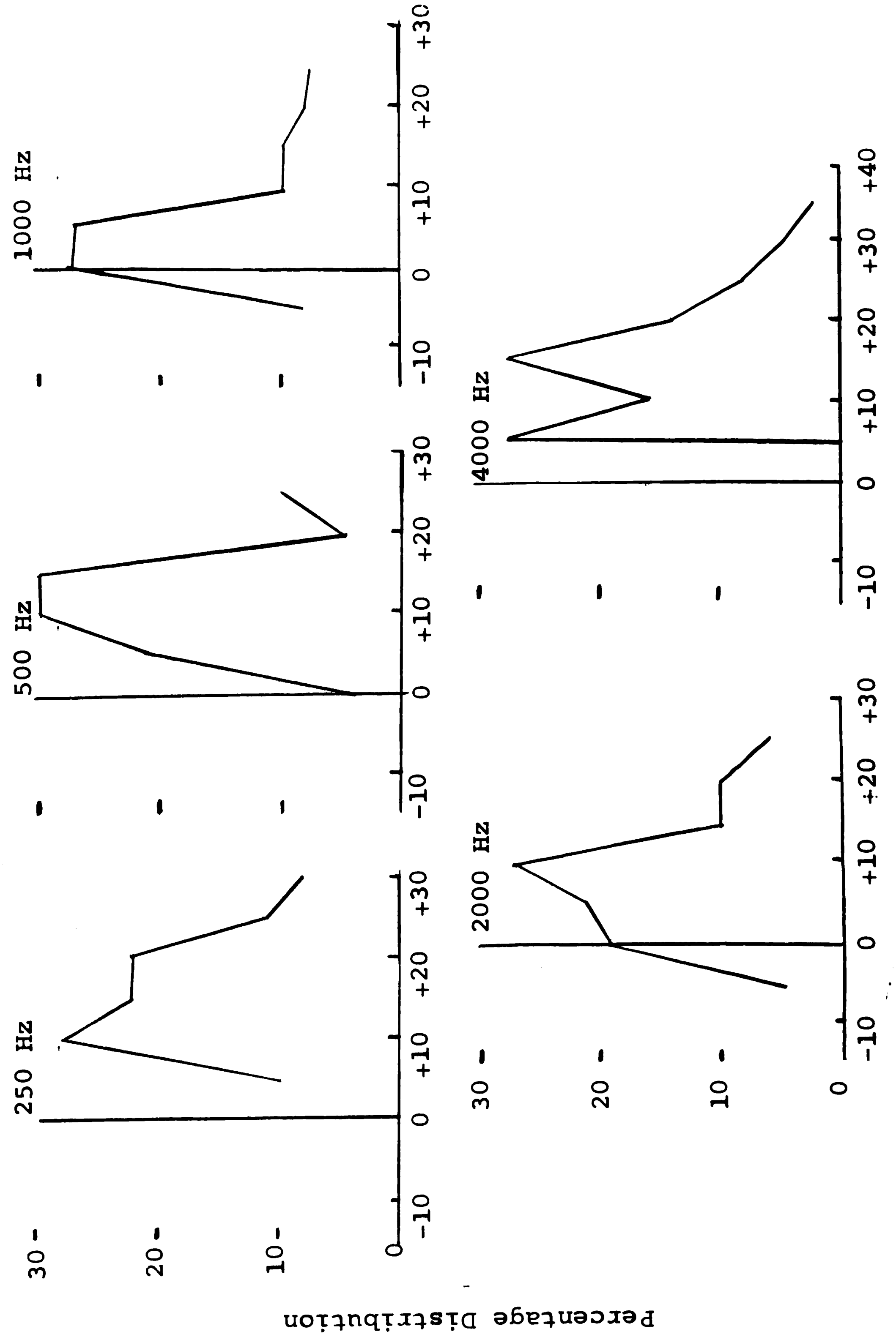


Figure 1. Mean air-conduction hearing threshold levels in dB re: ISO (1964) for all children ages 5-16 years, including one standard deviation, by frequency and ear tested.

Both right and left ear mean air-conduction audiograms for the children were within normal limits for all frequencies tested. Thresholds within one standard deviation of the mean for the right ear were within normal limits except at 6000 and 8000 Hz. Within one standard deviation of the mean, thresholds for the left ear at 250, 4000, 6000, and 8000 Hz were beyond the acceptable limits for normal hearing according to the ISO norm. Some thresholds for the speech frequencies (500, 1000, and 2000 Hz) for the left ear, within one standard deviation of the mean, were only within the limit for borderline normal hearing.

The air-conduction audiometric configuration for the left ear was flatter than the configuration for the right ear. Mean hearing threshold levels at all frequencies for the right and left ears were very similar. The largest difference was 3.8 dB at 1000 Hz, and the smallest was 0.5 dB at 6000 Hz. The right ear had minimally better thresholds than the left ear at all frequencies except 250 and 8000 Hz.

Very few children had air-conduction thresholds better than audiometric zero re: ISO (1964). Figures 2, 3, and 4 show the percentage distribution of hearing levels for all children ages 5-16 years classified by ear and frequency. Threshold curves at all frequencies were skewed to the right of 0 dB HL, indicating poorer hearing than the norm. Unlike the United States Public Health Study (1970, p. 8), the curves plotted in Figures 2 and 3 of this investigation did not follow similar patterns for each frequency. Even when



250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
Percentage Distribution

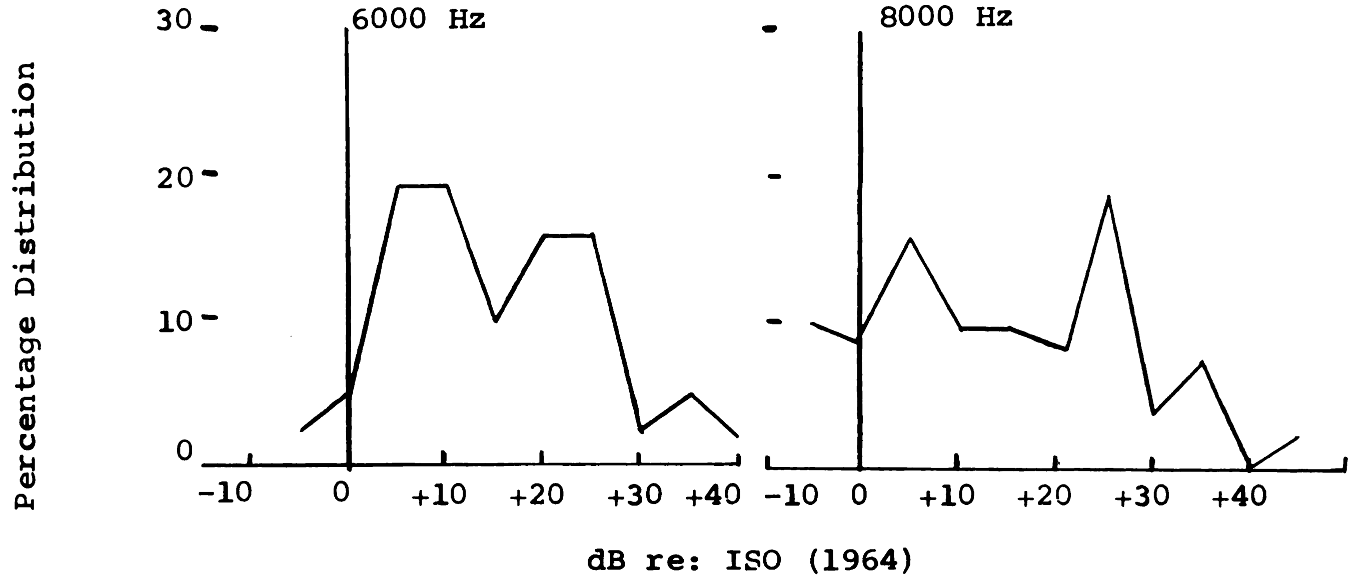
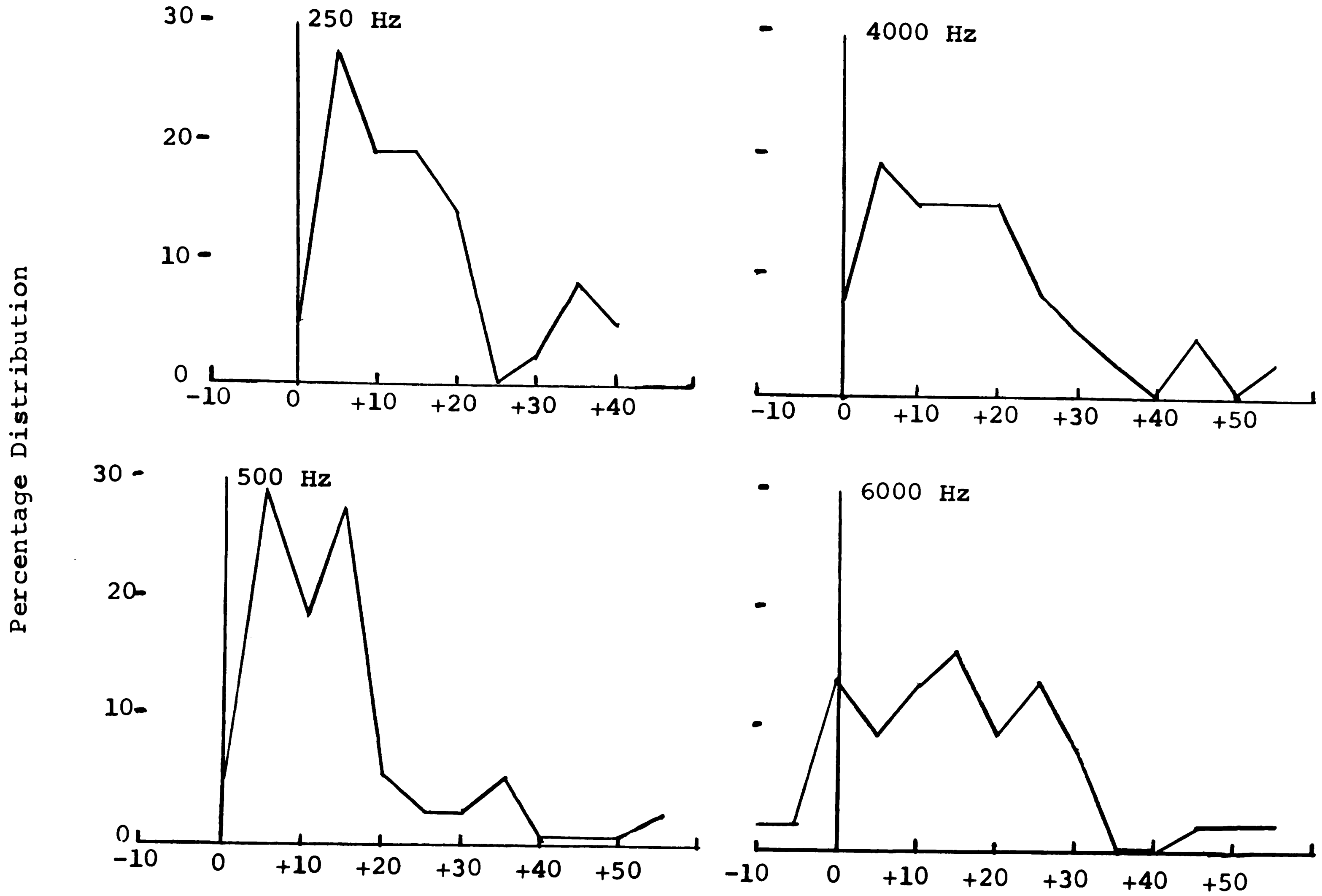


Figure 2. Percentage distribution of children 5-16 years, by hearing threshold levels in dB re: ISO (1964) for the right ear at each test frequency.



Percentage Distribution
250 Hz
4000 Hz
500 Hz
6000 Hz
30
20
10
0
-10
0
+10
+20
+30
+40
+50

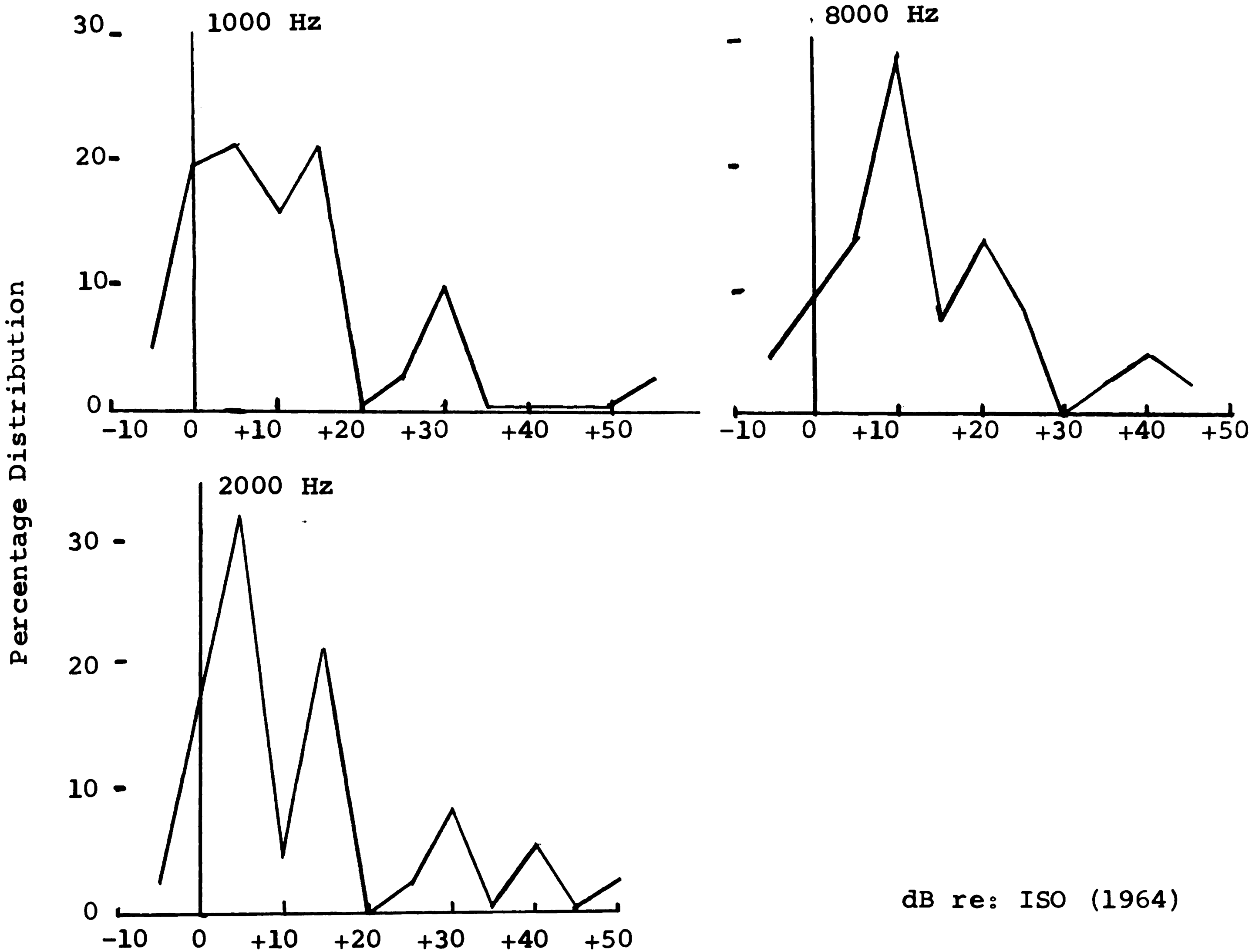
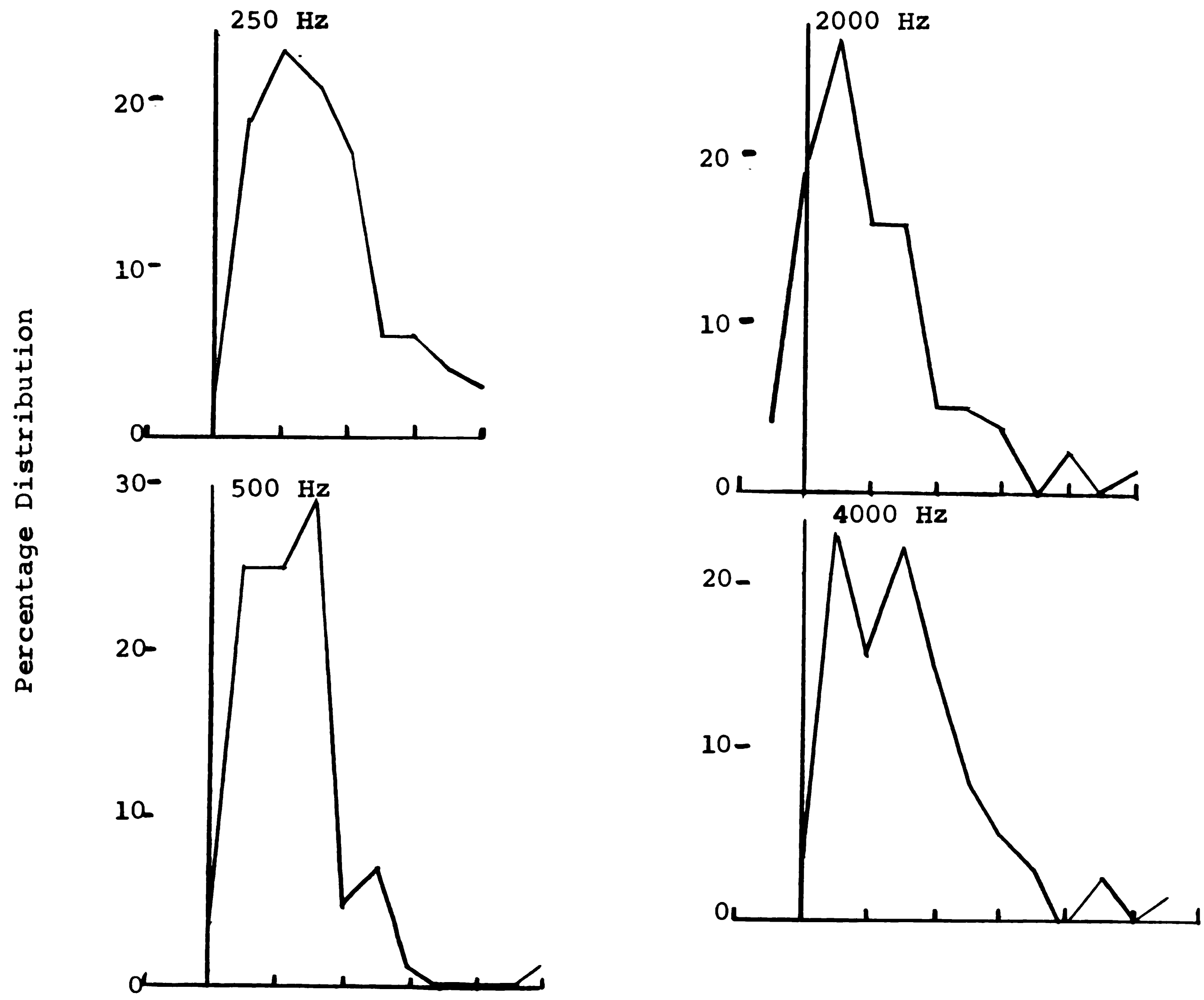


Figure 3. Percentage distribution of children 5-16 years, by hearing threshold levels in dB re: ISO (1964) for the left ear at each test frequency.


Percentage Distribution
250 Hz
500 Hz
2000 Hz
4000 Hz
30
20
10
0

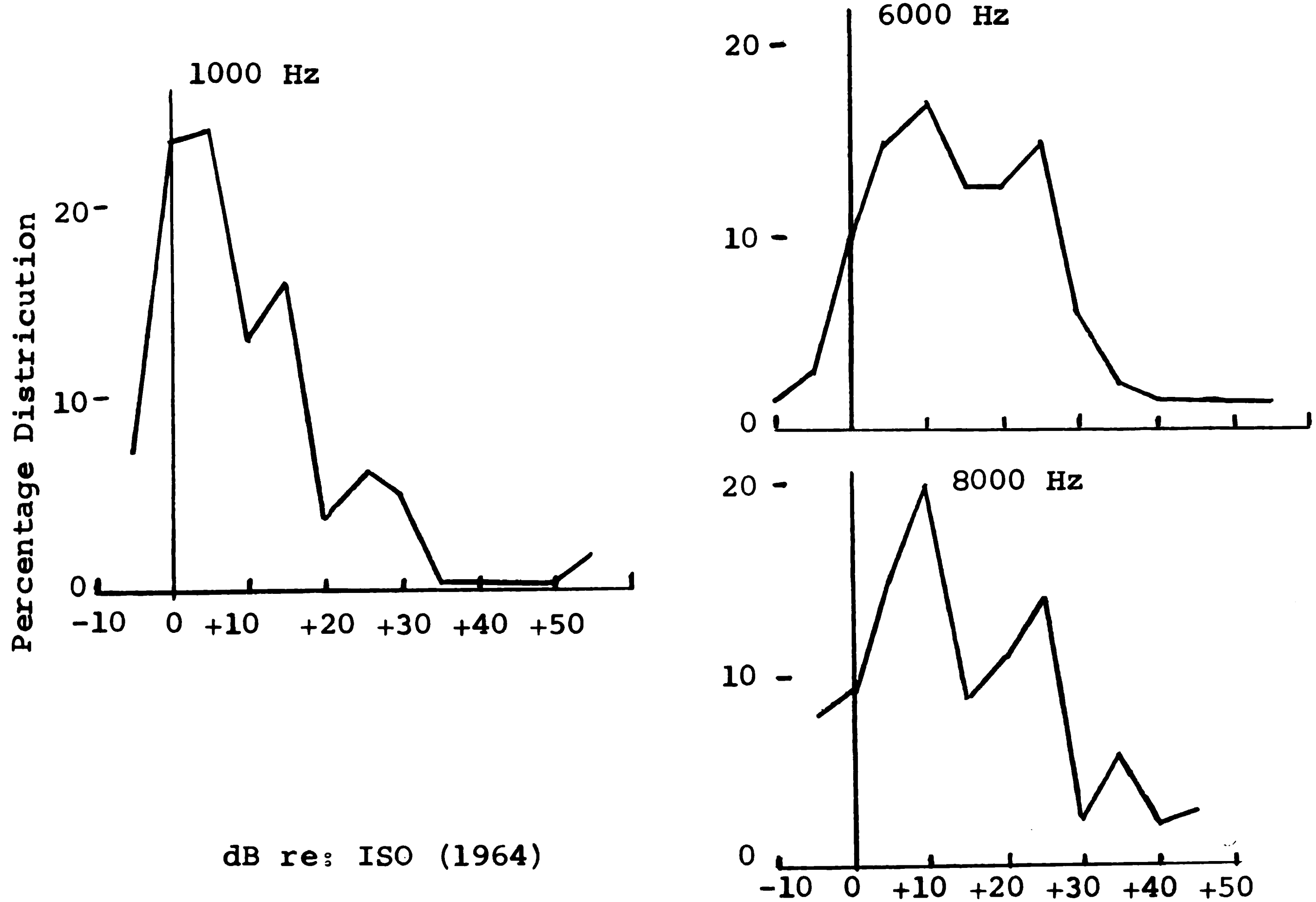
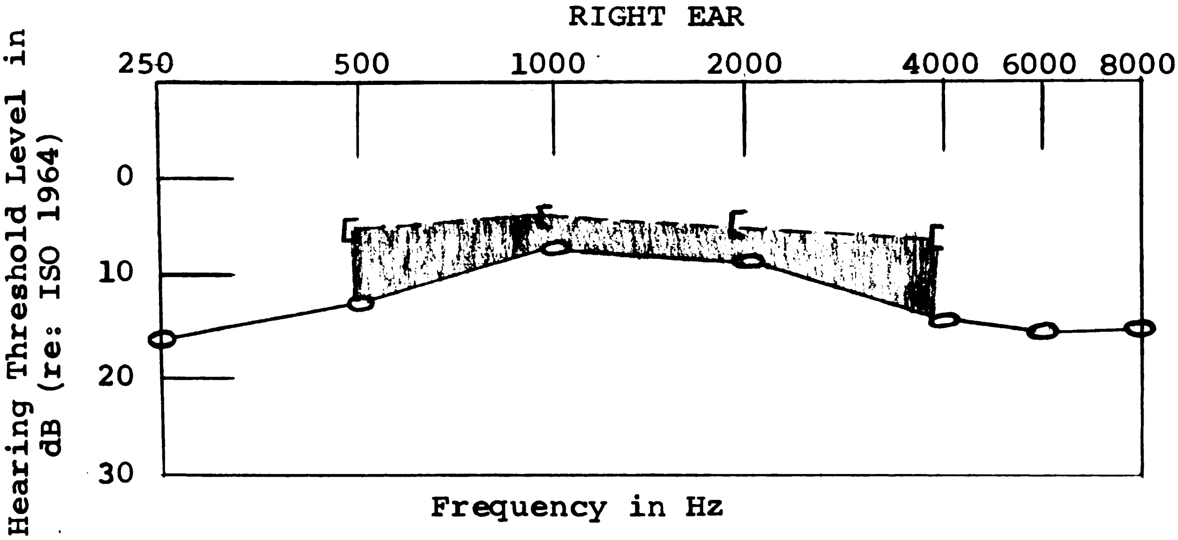


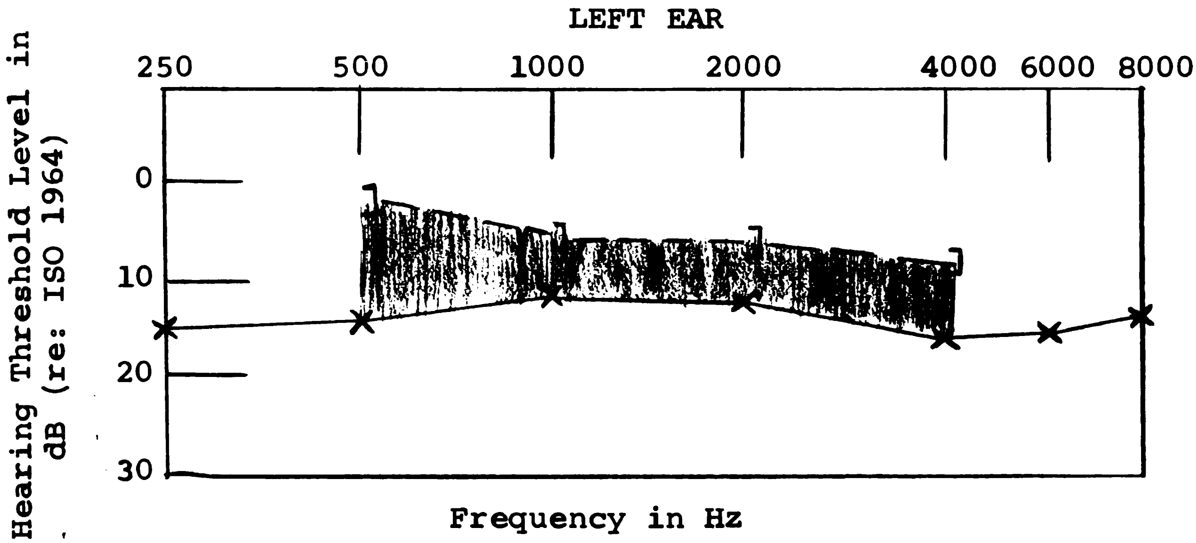
Figure 4. Percentage distribution of children 5-16 years, by hearing threshold levels in dB re: ISO 1964 for combined ears at each test frequency.

combining ears (see Figure 4) to obtain an N = 74 ears at each frequency, the curves still did not appear to have normal distributions. Perhaps more consistent inter-frequency results would have been obtained with a larger number of subjects.

Mean air-bone gaps were present for both ears at all frequencies 500-2000 Hz (Figure 5). Both right and left ears demonstrated clinically significant air-bone gaps (greater than 7 dB at 250 and 4000 Hz). Borderline significant gaps of 5.4 dB and 5.9 dB respectively at 1000 and 2000 Hz were also present in the left ear. At all frequencies, the left ear had greater air-bone gaps than did the right ear. For both ears, the air-bone gaps appeared to be greater at the low and high ends of the frequency region with less of a gap for the mid frequencies. Again, it should be mentioned that although mean air-bone gaps were present at each frequency for both ears, all mean air-conduction thresholds were within normal limits re: ISO (1964).

The 25 children ages 5-16 years who received the otolaryngological examination were divided into two groups, those with normal medical examination results (9 children) and those with abnormal results (16 children). Those children considered normal showed no signs of the following pathologies: (1) obstructed, retracted, thickened or inflamed tympanic membrane; (2) secretory, acute, or chronic otitis





0 right ear air-conduction threshold
X left ear air-conduction threshold
[right ear bone-conduction threshold
] left ear bone-conduction threshold

Figure 5. Mean hearing threshold levels in dB re: ISO (1964) by air- and bone-conduction for all children ages 5-16 years by frequency and ear tested. Shaded area is the air-bone gap.

media; (3) dry or wet perforation of the tympanic membrane; (4) congenital atresia; (5) external otitis; (6) nasal septum obstruction; (7) nasal mucous membrane thickening; (8) acute or allergic rhinitis; (9) purulent discharge of the nose; (10) polyps; (11) polyps and purulent discharge; (12) enlarged glands; (13) tonsil tags (infected or non-infected); (14) hypertrophy of the tonsils; (15) acute or chronic infection of the tonsils; (16) scarring and moderate retraction of the tonsils; (17) granular pharyngitis; and (18) chronic or severe lymphoid hyperplasia of the pharynx. All children with abnormal otolaryngological examination results showed at least one of the above described pathologies, while some children demonstrated up to six different pathological conditions. Six children showed one abnormal condition, two children each had two, three, four, and five pathologies, and one demonstrated six abnormal conditions.

Mean air-conduction hearing threshold levels for children with both normal and abnormal examination findings have been plotted in Figure 6 for separate ears. Both right and left ears showed better hearing at all frequencies for those children with no evidence of pathology. When comparing the audiometric configurations of the two sub-groups, the left ear thresholds at each frequency (refer to Figure 6) appeared to have more clinically significant threshold differences than the thresholds for the right ear. This was true

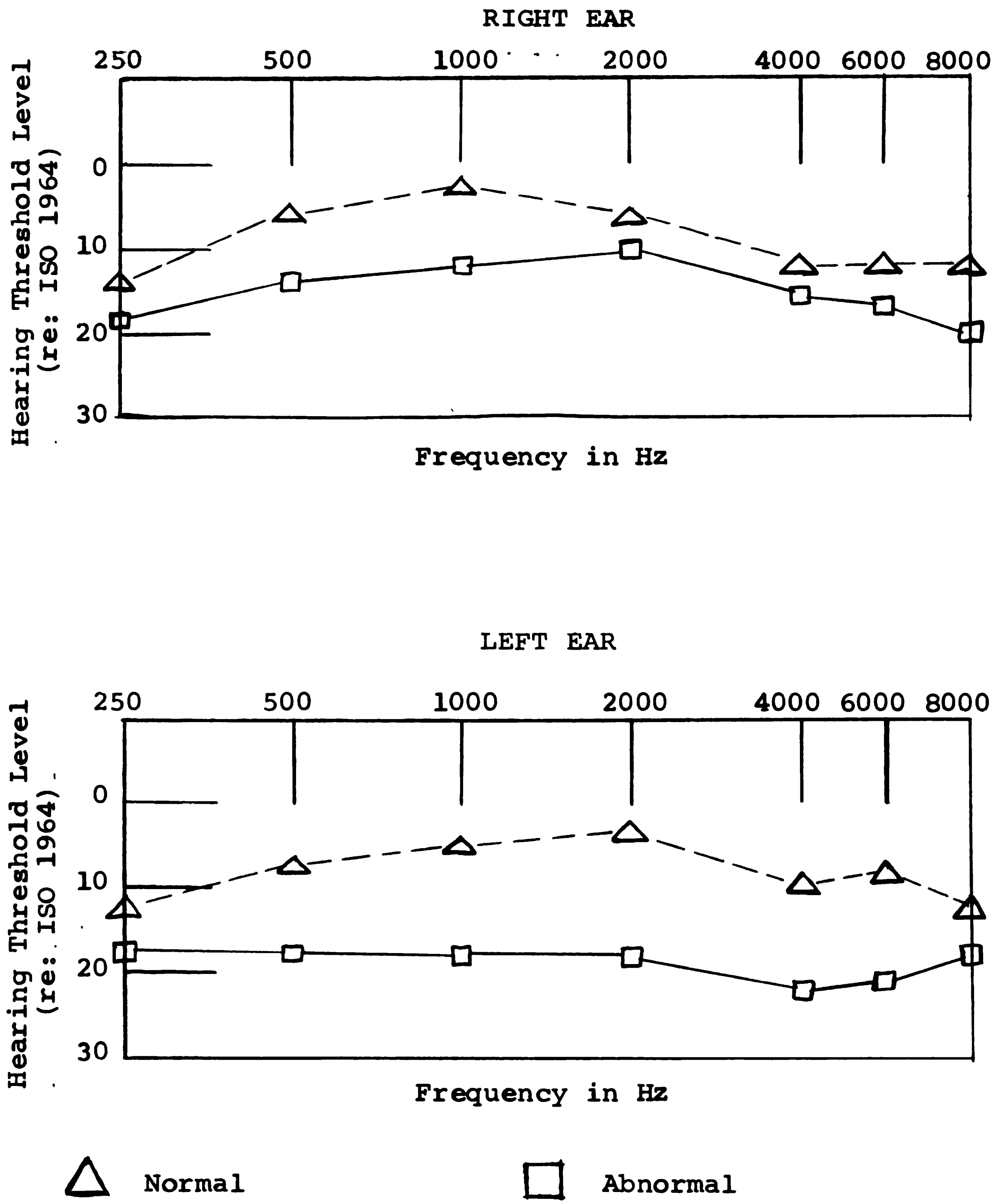


Figure 6. Mean air-conduction hearing threshold levels in dB re: ISO (1964) for the 25 children who received the otolaryngological examination, separated by ear into two groups: otolaryngologically normal and abnormal.

for all frequencies except at 8000 Hz where the right ear threshold showed a greater discrepancy.

Those children with normal otolaryngological findings did not have mean air-conduction hearing threshold levels for either ear at any frequency that were better than 0 dB HL re: ISO (1964). However, the mean threshold levels for both ears ranged from 2-14 dB HL, the best thresholds being at the frequencies 500-2000 Hz bilaterally. For those subjects with abnormal ear, nose, and throat findings, the mean threshold levels for both ears ranged from 10-22 dB HL. For the right ear, their mean hearing levels appeared best at frequencies 500-1000 Hz. The left ear, however, demonstrated a relatively flat configuration from 250-2000 Hz with a slight threshold dip at 4000 and 6000 Hz, recovering again at 8000 Hz.

To determine the relative significance of the air-conduction threshold data and the otolaryngological findings for the children of this investigation, the results were compared to the Eagles et al. (1963) and the United States Health, Education, and Welfare (1970) surveys. It is relevant to explain that these three studies were not conducted with the same audiometric norms nor the same earphones and cushions. The present investigation employed an audiometer calibrated to the ISO (1964) norm with the Telephonics TDH 39 earphone mounted in an MX 41/AR cushion. Eagles et al. (1963) determined all threshold levels re: ASA (1951) using the Western Electric 705 A earphone. The United States

Department of Public Health, Education, and Welfare study (1970) used, for its investigation, the ASA (1951) norm employing the TDH 39 earphone in the MX 41/AR cushion.

In order to compare these three different studies, all median air-conduction data was converted from hearing level to the sound pressure level scale re: 0.0002 dyne/cm^2. The median sound pressure level thresholds (refer to Table 7) were then converted once again to reach the values of the Western Electric 705 A earphone at each frequency according to Cox and Bilger (1960). (See Appendix C for the various SPL differences for both earphones and audiometric norms.) Median data were compared because there was no available mean air-conduction data for the United States Health Education and Welfare (1970) study. Comparative air-conduction audiograms in dB re: ISO (1964) using the values for the Western Electric 705 A earphone were then plotted for separate ears at each test frequency according to the conversion data presented by Davis and Krantz (1964). To compare the data of the three studies, refer to Figures 7 and 8.

The air-conduction thresholds of the Eagles et al. (1963) and the United States Health Education and Welfare (1970) studies were in agreement with one another within ± 2.5 dB bilaterally at all frequencies except 2000 and 6000 Hz for the right ear and 6000 and 8000 Hz for the left ear. For the right ear, the Eagles study showed a poorer median threshold by 3 dB at 2000 Hz, and the United States Health Education and Welfare study was poorer by 3.5 dB at 6000 Hz. For the

Table 7. Median air-conduction hearing threshold levels in dB re: 0.0002 microbar using values for the Western Electric 705 A earphone for the migrant children tested and for the children tested by Eagles et al. (1963) and the United States Department of Health Education and Welfare (1970), classified by frequency and ear tested.

Frequency (Hz)	Present Study	Eagles et al.	U. S. Dept. of Health
Right Ear			
250	39.5	30.8	31.2
500	21.0	17.9	17.2
1000	11.5	11.1	9.7
2000	18.5	12.3	9.3
4000	24.0	10.7	11.6
6000	23.0	13.4	16.9
8000	24.5	17.2	16.8
Left Ear			
250	34.5	29.9	31.5
500	21.0	17.9	17.4
1000	16.5	11.1	9.7
2000	13.5	11.8	9.6
4000	24.0	11.1	12.0
6000	23.0	14.0	17.8
8000	19.5	16.8	13.0

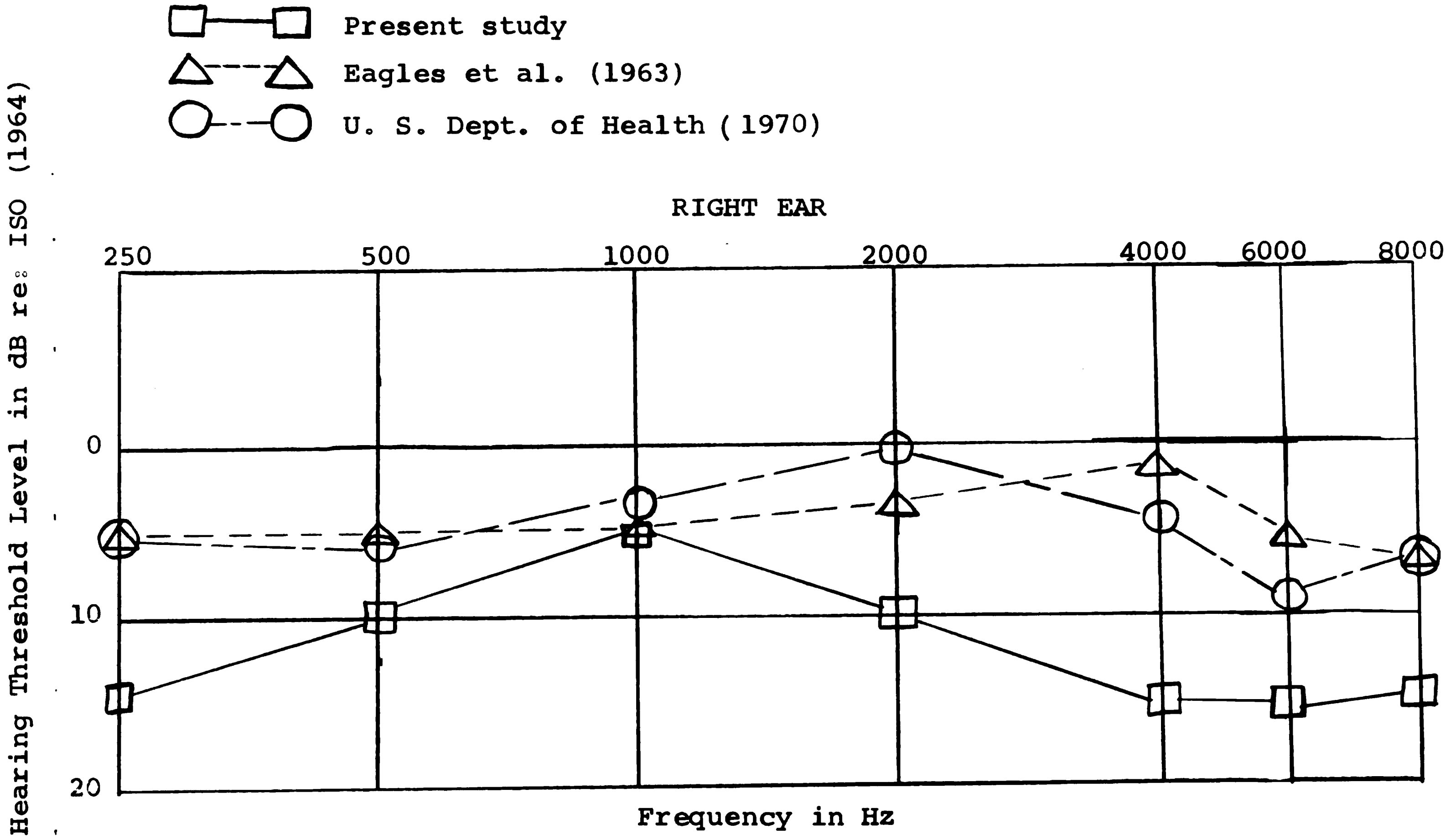


Figure 7. Median air-conduction hearing threshold levels in dB re: ISO (1964) for the right ear from the present study, the Eagles et al. (1963) and the U. S. Dept. of Health (1970) studies. Values are computed for the Western Electric 705 A earphone.

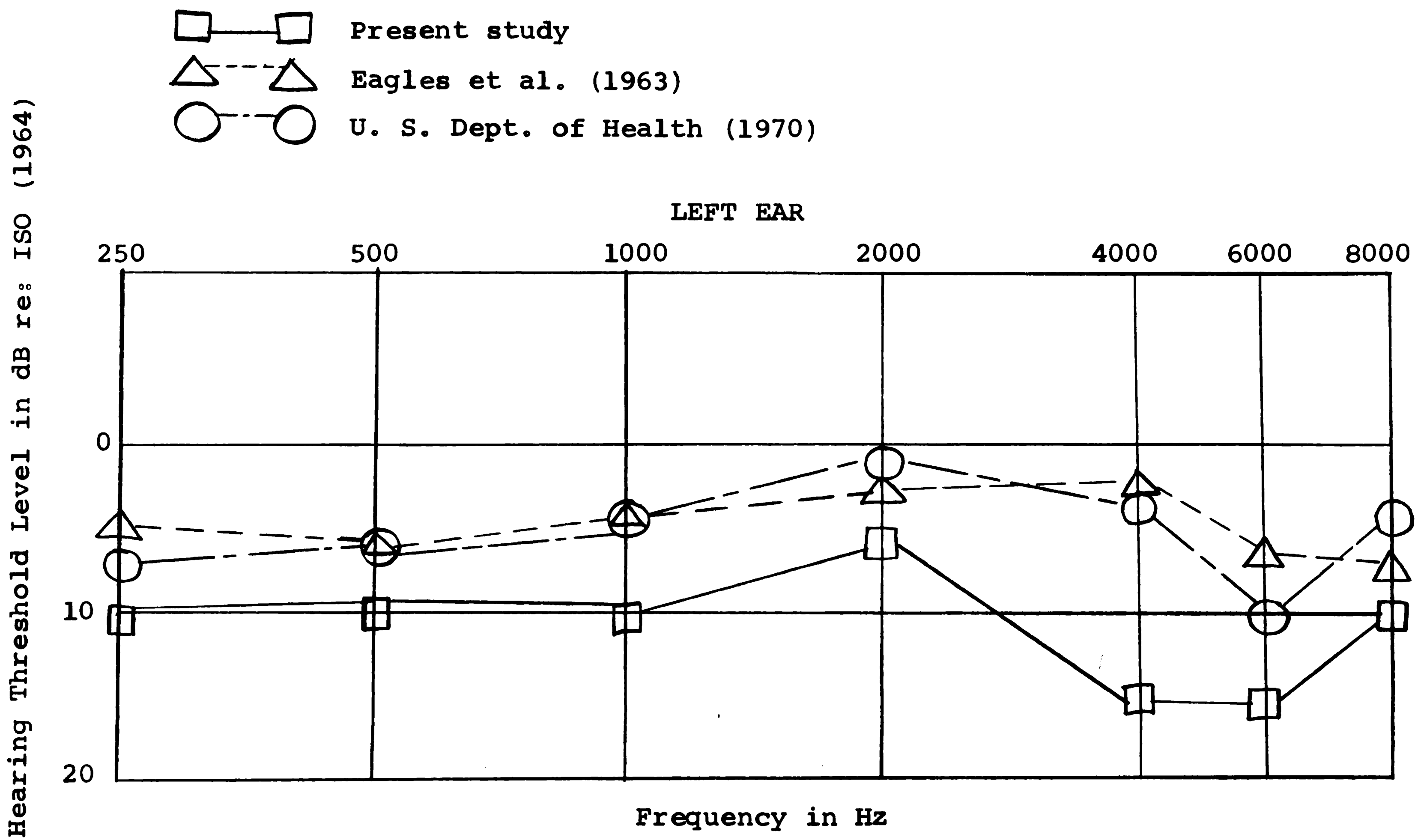


Figure 8. Median air-conduction hearing threshold levels in dB re: ISO (1964) for the left ear from the present study, the Eagles et al. (1963) and the U. S. Dept. of Health (1970) studies. Values are computed for the Western Electric 705 A earphone.

left ear, the United States Health Education and Welfare data was poorer by 3.8 dB at 6000 Hz and the Eagles data was poorer by 3.8 dB at 8000 Hz.

The air-conduction hearing levels of the present study, although within normal limits, generally fell below the threshold levels of the comparative studies. For the right ear, the only frequency which was not poorer than 2.5 dB was at 1000 Hz. This threshold was within 0.4 dB of the Eagles et al. (1963) study and 1.8 dB of the United States Health Education and Welfare (1970) study. For the left ear, data obtained at 2000 Hz for this investigation was close, within 2.0 dB, to Eagles' data.

The air-conduction thresholds presented above demonstrated that there were a few frequencies with agreement between this study and the two studies chosen for comparison. There were, however, other frequencies at which large discrepancies in thresholds occurred with poorer hearing for the present study. Observing the right ear thresholds (Figures 7 and 8), it is apparent at 2000 Hz that the median threshold was 9.2 dB poorer than the threshold for the United States Health Education and Welfare (1970) study and at 4000 Hz it was 13.3 dB poorer than the threshold of the Eagles et al. (1963) study. At 4000 Hz, for the left ear, the Eagles et al. (1963) threshold level was 12.9 dB better than the obtained median threshold for this investigation.

Adults

Four adult age groups, for a total of 23 subjects, were also tested audiometrically in this investigation (see Table 8). The groups were divided by age so that they resembled the age groups tested by Corso (1963). Nine people were tested in the age group 18-24 years, six in the age group 25-33 years, five at 33-40 years, and three at 43-50 years. None of these groups was divided equally by sex. The sample comprised all adults between the ages of 18-50 years that were willing to be tested in two migrant housing camps. Approximately 75% of the adults present in the camps were willing to be examined.

The pure-tone air-conduction thresholds for all adults, ages 18-50 years, are displayed in Tables 9, 10, 11, and 12 and Figures 9 and 10. The findings demonstrated that the best thresholds for all age groups were at 1000 and 2000 Hz bilaterally. None of the mean hearing thresholds in dB re: ISO (1964) reached 0 dB HL at any frequency in either ear. For those in the age group 18-24 years, the mean audiometric configurations were generally flat for both ears, although decreased hearing acuity was exhibited at the low and high frequencies. The right ear exhibited an inter-frequency range of 11.6 dB (from 5.0 dB HL to 16.6 dB HL) and the left ear an inter-frequency range of 15.1 dB (from 5.5 dB HL to 20.6 dB HL). The inter-frequency range for this age group was greater bilaterally than the range found for the children.

Table 8. Age distribution of adults audiometrically tested.

Age in Years	Total Number	
18	2	
19	2	
20	1	
21	1	
22	2	
24	1	
Sub Total	9	(5 female; 4 male)
25	2	
26	1	
28	1	
30	1	
32	1	
Sub Total	6	(5 female; 1 male)
33	1	
37	1	
38	2	
40	1	
Sub Total	5	(3 female; 2 male)
43	1	
45	1	
50	1	
Sub Total	3	(1 female; 2 male)
Total	23	

Table 9. Mean, median, range, and standard deviation of air-conduction thresholds in dB re: ISO (1964) and air-bone gap data for adults ages 18-24 years classified by frequency and ear tested.

Frequency (Hz)	250	500	1000	2000	4000	6000	8000
Right Ear							
Mean	16.6	13.8	5.5	5.0	10.0	13.8	11.1
Median	15	15	5	5	5	10	5
Range	20	20	20	20	20	55	40
Standard Deviation	7.1	5.7	6.0	7.8	4.6	15.4	11.0
Air-bone Gap		9.4	2.8	3.9	6.1		
Left Ear							
Mean	15.0	10.0	5.5	6.6	11.7	15.0	20.6
Median	15	10	5	10	15	15	20
Range	25	20	25	25	25	35	40
Standard Deviation	2.1	1.9	1.9	7.1	7.8	9.1	11.7
Air-bone Gap		10	3.9	7.2	7.2		

Table 10. Mean, median, range, and standard deviation of air-conduction thresholds in dB re: ISO (1964) and air-bone gap data for adults ages 25-32 years classified by frequency and ear tested.

Frequency (Hz)	250	500	1000	2000	4000	6000	8000
Right Ear							
Mean	13.3	10.8	5.0	5.0	12.5	15.0	15.8
Median	10	12.5	5	5	12.5	15	15
Range	20	20	20	20	15	20	20
Standard Deviation	6.9	7.1	6.5	5.7	4.8	5.7	7.3
Air-bone Gap		5.8	0	0	3.3		
Left Ear							
Mean	12.5	8.3	3.3	5.0	10.8	17.5	14.2
Median	12.5	5	2.5	7.5	12.5	15	12.5
Range	15	20	20	15	20	25	30
Standard Deviation	4.8	6.9	6.3	7.1	6.7	8.1	16.2
Air-bone Gap		7.5	1.7	1.7	0.8		

Table 11. Mean, median, range, and standard deviation of air-conduction thresholds in dB re: ISO (1964) and air-bone gap data for adults ages 33-40 years classified by frequency and ear tested.

Frequency (Hz)	250	500	1000	2000	4000	6000	8000
Right Ear							
Mean	23	22	14	17	34	35	27
Median	20	20	10	20	35	40	25
Range	35	45	35	20	50	45	55
Standard Deviation	12.1	16.3	12.4	8.1	17.7	15.8	19.1
Air-bone Gap		1	0	1	6		
Left Ear							
Mean	18	13	12	15	32	36	39
Median	15	10	15	15	25	35	40
Range	25	20	15	20	45	40	30
Standard Deviation	9.3	8.1	6	7.1	15.4	17	10.2
Air-bone Gap		1	0	4	2		

Table 12. Mean, median, range, and standard deviation of air-conduction thresholds in dB re: ISO (1964) and air-bone gap data for adults ages 43-50 years classified by frequency and ear tested.

Frequency (Hz)	250	500	1000	2000	4000	6000	8000
Right Ear							
Mean	10	6.7	6.7	3.3	11.7	16.7	5
Median	10	5	5	5	15	15	0
Range	10	5	5	5	10	15	15
Standard Deviation	4.1	2.2	2.2	1.0	4.7	5.8	5.7
Air-bone Gap		1.7	1.7	1.7	1.7		
Left Ear							
Mean	10	6.7	6.7	11.7	15.0	21.7	8.3
Median	10	5	5	10	10	25	15
Range	10	5	15	15	25	10	20
Standard Deviation	4.1	2.2	4.8	6.2	10.8	4.7	9.4
Air-bone Gap		1.7	3.3	1.7	5		

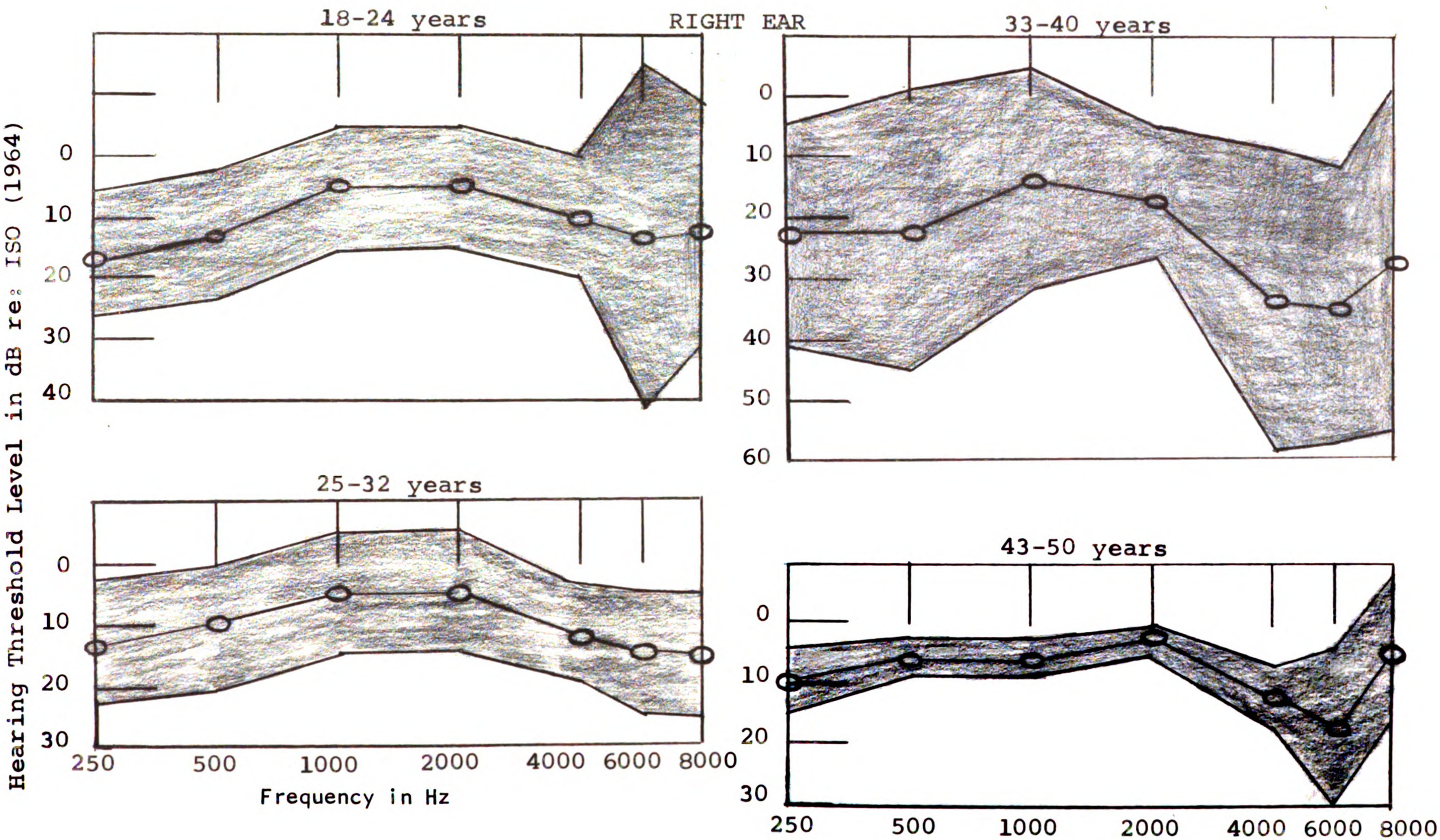


Figure 9. Mean air-conduction hearing threshold levels and range (shaded area) in dB re: ISO (1964) for the right ear at all frequencies for all adults ages 18-50 years separated into age groups.

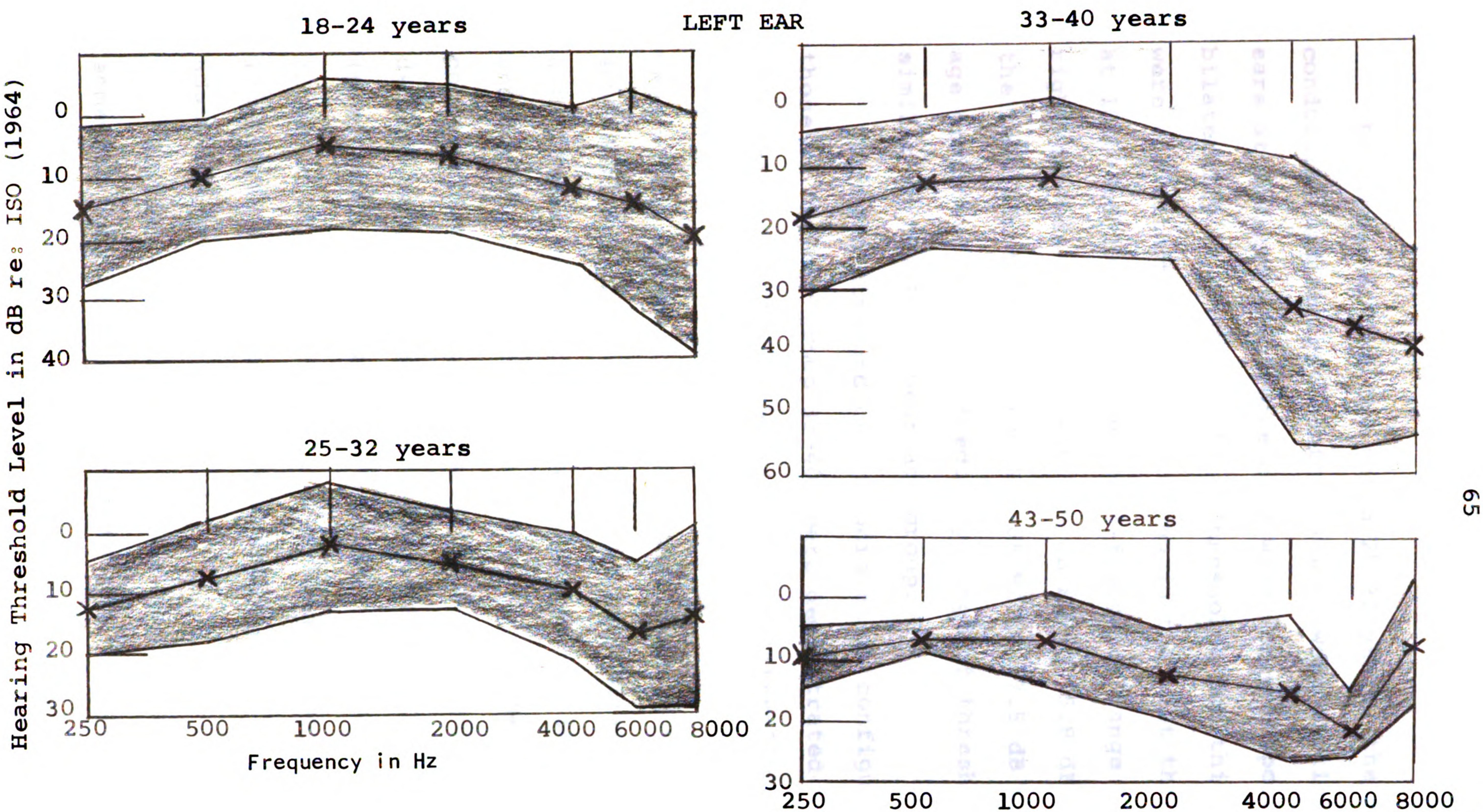


Figure 10. Mean air-conduction hearing threshold levels and range (shaded area) in dB re: ISO (1964) for the left ear at all frequencies for all adults ages 18-50 years separated into age groups.

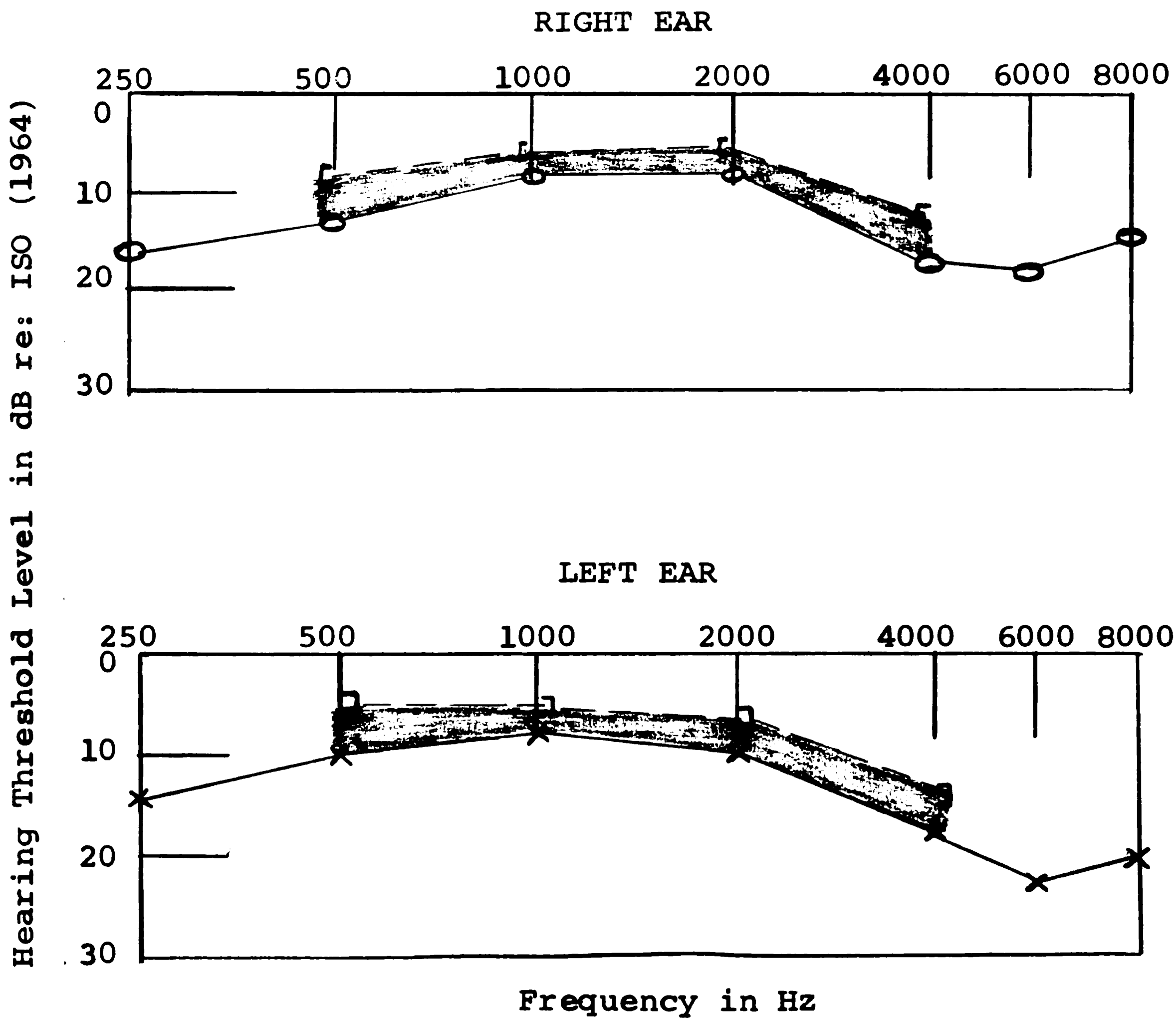
For those in the age group 25-32 years, the mean air-conduction audiometric configurations were similar for both ears at low and mid frequencies with somewhat poorer hearing bilaterally at 4000-8000 Hz. Thresholds for this age group were all within normal limits; again the best thresholds were at 1000 and 2000 Hz. The inter-frequency range for the right ear was 10.8 dB (from 5.0 dB HL to 15.8 dB HL) and for the left ear 12.5 dB (from 5.0 dB HL to 17.5 dB HL). This age group had an inter-frequency range of threshold levels similar to the 18-24 year age group.

The mean air-conduction audiometric configuration for those in the age group 33-40 years demonstrated a mild but clinically significant hearing loss bilaterally in the higher frequencies (4000-8000 Hz). All thresholds from 250-2000 Hz were within normal limits bilaterally while thresholds from 4000-8000 Hz showed a mild hearing loss bilaterally. Threshold levels were best for the right ear at 1000 and 2000 Hz and for the left ear at 500-2000 Hz. All hearing levels were poorer bilaterally than those for the younger adults. The decibel range between frequencies for the right ear was 20 dB (from 14 dB HL to 34 dB HL) and for the left ear 27 dB (from 12 dB to 39 dB HL). The inter-frequency range of threshold levels was larger for this group than for the previous two adult age groups.

Results for adults in the age group 43-50 years were somewhat unusual. All air-conduction thresholds were within normal limits bilaterally and the audiometric configuration was generally flat, dipping at 6000 Hz and recovering at 8000 Hz bilaterally. The best threshold for the right ear was at 2000 Hz while the better thresholds for the left ear were at 500 and 1000 Hz. The inter-frequency range for the right ear was 13.4 dB (from 3.3 dB HL to 16.7 dB HL) and for the left ear 15 dB (from 6.7 dB HL to 21.7 dB HL). These inter-frequency ranges more closely resembled those of the age groups 18-24 years and 25-32 years than that of the 33-40 year old group. It should be recalled, however, that there were only three subjects in this age group and that two of the subjects were from the same family.

Figures 9 and 10 display the mean air-conduction thresholds and the ranges for right and left ears for all adults separated by age groups. The ranges and standard deviations (see Tables 9-12) demonstrate the variability in thresholds for the various age groups. However, because of the small sample size, when the adult sample was broken into sub-groups, it is felt that the most appropriate analysis was simply to view the changes in hearing as a function of age.

Mean air-bone gaps were present for both ears at all frequencies 500-2000 Hz (see Figure 11). None of the mean air-bone gaps for either ear appeared clinically significant except at 500 Hz for the left ear. This one mean air-bone gap was minimally above the acceptable 5 dB test-retest variability at a level of 6.7 dB.



0 = air-conduction right ear

X = air-conduction left ear

[= bone-conduction right ear

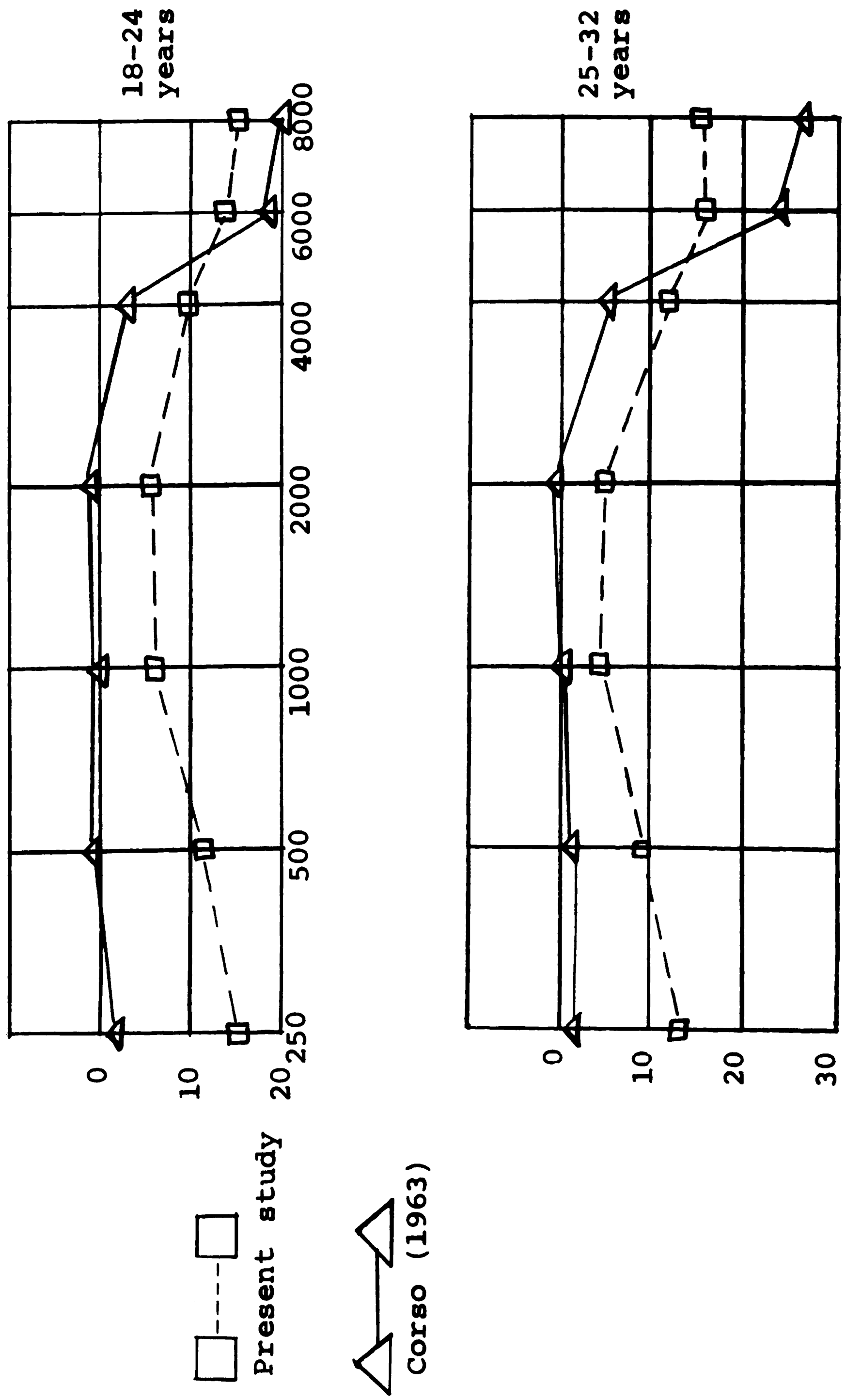
] = bone-conduction left ear

Figure 11. Mean thresholds in dB re: ISO (1964) by air- and bone-conduction for all adults ages 18-50 years by frequency and ear tested. Shaded area is the air-bone gap.

To determine the relative significance of the air-conduction threshold data obtained on adult subjects in this investigation, the Corso (1963) study was chosen for comparative purposes. Again, it is important to note that thresholds for the two studies were obtained using different norms and different earphones. As mentioned previously, this investigation was conducted using the ISO (1964) norm and Telephonics TDH 39 earphones mounted in MX 41/AR cushions. Corso employed the ASA (1951) norm and Permoflux PDR-8 earphones mounted in MX 41/AR cushions. When presenting the data, Corso (1963, p. 60) expressed his mean air-conduction values in dB re: 0.0002 dyne/cm^2 as measured according to the ASA (1951) standard in the NBS 9-A Coupler for the Western Electric 705 A earphone.

Right ear, left ear, male, and female air-conduction thresholds for Corso (1963), see Appendix D, were combined for each of the four age groups and expressed in dB re: 0.0002 dyne/cm^2. The Corso thresholds were then compared to the thresholds of the four separate age groups of the present investigation (see Figure 12) and expressed in dB re: ISO (1964) for the Telephonics TDH 39 earphone.

When comparing the mean air-conduction data for the age group 18-24 years, the subjects tested by Corso (1963) had thresholds that were at least 5.6 dB better at all frequencies 250-4000 Hz, ranging from 5.6 dB at 1000 Hz to 14.2 dB at 250 Hz, than the thresholds obtained during this investigation. The exceptions were at 6000 and 8000 Hz;


18-24 years
25-32 years
250
500
1000
2000
4000
6000
8000
0
10
20
30
Present study
Corso (1963)

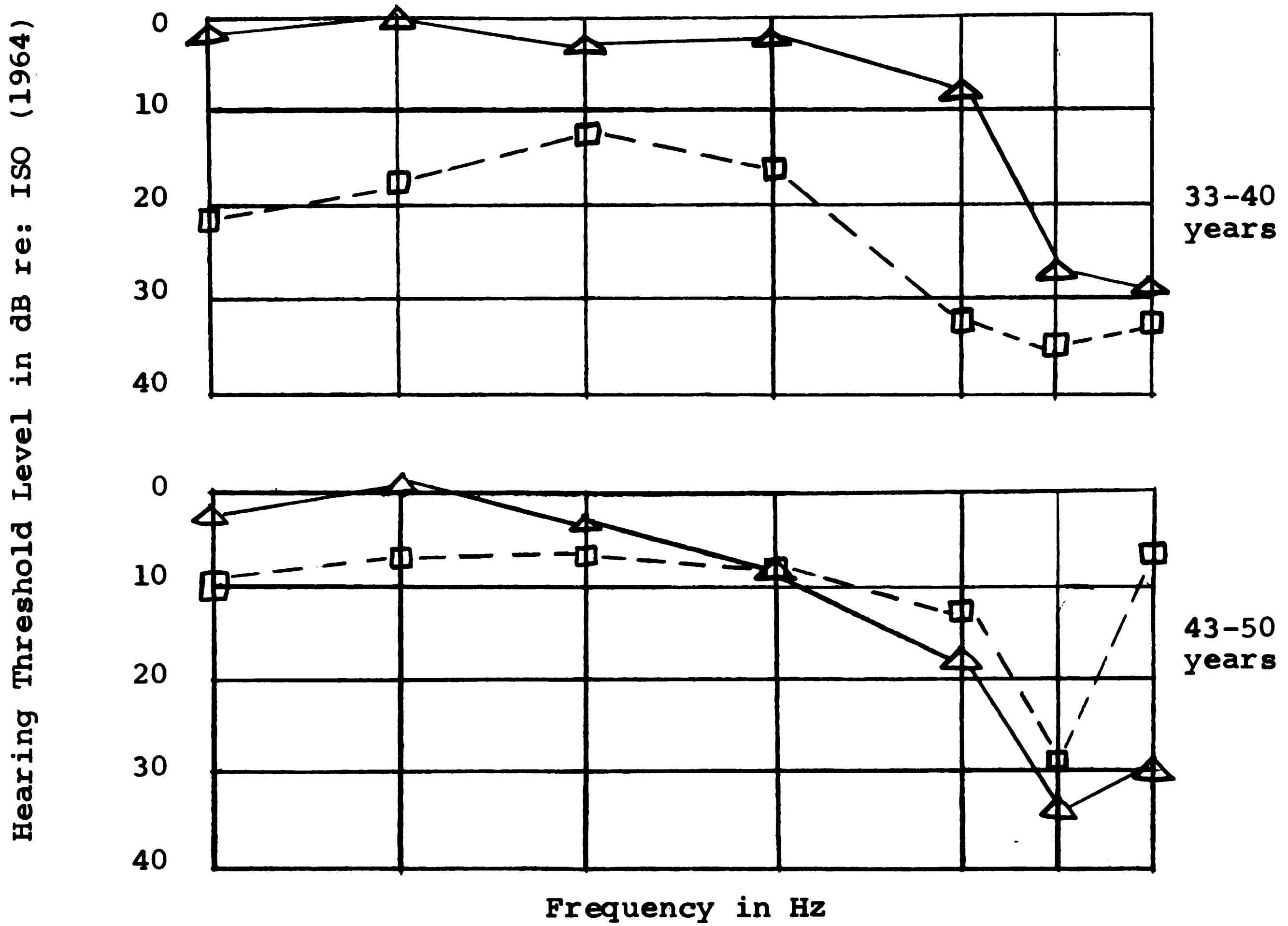


Figure 12. Mean hearing threshold levels in dB re: ISO (1964) for left and right ears and male and female combined from the present study and the Corso (1963) study, computed for the TDH 39 earphone housed in the MX 41/AR cushion.

subjects for this investigation had a mean threshold that was 5.4 dB better than that obtained by Corso at 6000 Hz and at 8000 Hz the mean threshold was 4.7 dB better for this study.

Air-conduction thresholds for the age group 25-32 years (Corso's data included ages 26-32 years) were again better at all frequencies 250-4000 Hz for Corso's study. The difference between thresholds at the above frequencies for the two studies ranged from 2.8 dB at 1000 Hz to 11.2 dB at 250 Hz. Again, thresholds at 6000 and 8000 Hz were better for this investigation, 8.4 dB and 11.6 dB respectively.

The age group 33-40 years (Corso's data included ages 34-40 years) showed the greatest mean air-conduction threshold discrepancies of the four age groups. Corso's subjects had better thresholds at all frequencies ranging from 4.0 dB at 8000 Hz to 24.1 dB at 4000 Hz.

When comparing the mean air-conduction data for the age group 43-50 years (Corso's data included ages 43-49 years), the subjects tested by Corso had better thresholds from 250-2000 Hz. The range for the above frequencies was 0.5 dB at 2000 Hz to 7.7 dB at 250 Hz. For the frequencies 4000-8000 Hz, the subjects of the present investigation had better thresholds than did those of Corso's study. These threshold differences ranged from 3.7 dB at 4000 Hz to 23.6 dB at 8000 Hz.

From the above discussion of the data it can be noted that generally the adults of all age groups tested in the present study had poorer mean air-conduction thresholds than did those individuals evaluated by Corso. This was most obvious for those persons 33-40 years and least obvious for those 43-50 years. The audiometric configuration trends generally obtained by Corso appeared flat from 250-2000 Hz, mildly-to-markedly sloping from 2000 to 6000 Hz, with some threshold recovery at 8000 Hz. This investigation demonstrated a stiffness tilt at the lower frequencies with the best threshold levels at 1000-2000 Hz. Mild-to-marked sloping also occurred in this study from 2000-8000 Hz, with a flattening of the configuration at 8000 Hz (except for the age group 43-50 years) rather than a recovery in threshold level. Thresholds at 6000 and 8000 Hz were generally better for this study than those thresholds obtained by Corso (1963).

Referrals

Following the otolaryngological and audiological examinations of all subjects various types of referrals were made. Five children and three adults were referred for otologic treatment. One adult was referred for an audiological evaluation; it appeared that he might possibly be a candidate for a hearing aid. Four adults were referred for annual audiological evaluations; their otoscopic examinations were essentially clear of pathology, but their audiometric configurations revealed loss of acuity for the higher frequencies.

Discussion

One of the purposes of this thesis was to determine whether there is a higher incidence of middle ear pathology among Chicano migrant agricultural workers than in the general population. Pathology of the ear was found to be the most frequent of the ear, nose, and throat pathologies in this investigation. Of the 25 children who received the otoscopic examination, 60% had at least active unilateral pathology while 48% demonstrated pathology bilaterally. This percentage was much higher than the 3.0% active pathology found by Eagles et al. (1963). Of the 15 adults examined, active unilateral abnormality was noted in 80% and bilateral pathology in 67%. It was not possible to compare the otolaryngological results for the adults of this investigation with those results obtained by Corso. Subjects tested in the Corso study did receive an otological examination; if they failed they were not included in the audiometrically screened sample. Corso did find though, that with advancing age, a progressive increase was noted in the percentage of persons who failed to qualify as subjects due to abnormal otological histories or disorders. This increase in middle ear pathology rather than a decrease was generally noted for the adults in this investigation. Both of the above age groups had higher percentages of active ear pathology than found in the Canadian Indian population (15.7%), in the Baffin Island Eskimo population (30.8%), or in the New York Children's Social Service Center (24%). It should be recalled that the studies referred to above had considerably larger samples than did the present investigation. This, in part, might account for the difference in incidence found.

The other major purpose of this study was to determine if there is a higher incidence of hearing loss among Chicano migrant agricultural workers than in the general population. Those studies chosen to represent "general" threshold hearing levels for children were the Eagles et al. (1963) and the United States Health Education and Welfare (1970) studies. The data of the three investigations were converted into ISO (1964) values for the Western Electric 705 A earphone and then compared. Although thresholds for this study were poorer than the threshold levels of the comparison studies, present median threshold hearing levels were within normal ISO (1964) limits bilaterally.

Since the children, ages 5-16 years, of this investigation were found to have median air-conduction hearing threshold levels within normal limits re: ISO (1964) at all frequencies bilaterally (see Table 6 and Figures 7 and 8), it is most likely not true that the majority of the children who are experiencing difficulty learning the English language are doing so because of poorer hearing acuity. The most common signs of secretory otitis media are hearing loss and inattention (Thorburn et al., 1965, p. 436). It can therefore be speculated that those few children who did demonstrate moderate conductive hearing losses due to secretory otitis media, may be experiencing a problem in English language acquisition which is related to a hearing loss. This, of course, would depend upon the time of onset of the hearing loss and the severity of the loss.

Threshold levels for adults were also investigated and compared to the Corso (1963) study. This study was considered to represent "general" threshold hearing levels for adults. Mean hearing threshold levels were compared using the ISO (1964) norm for the TDH 39 earphone mounted in the MX 41/AR cushion. Corso's data showed generally better hearing for all age groups from 250-4000 Hz. Better hearing was noted in the present study at 6000-8000 Hz for all age groups except the 33-40 year old group which demonstrated poorer thresholds at these frequencies. The largest discrepancies in the thresholds of the two studies were generally at 250 Hz and the smallest at 1000-2000 Hz. A stiffness tilt was generally apparent in the low frequencies for this study, while poorer thresholds were also noted in the high frequencies. These reduced thresholds in the high frequencies generally paralleled those thresholds obtained by Corso.

Air-bone gaps were generally noted for the children, while insignificant air-bone gaps were demonstrated by adults. Hearing levels of those with middle ear pathology were generally in agreement with Kapur (1964), between 10-40 dB HL re: ISO (1964). However, occasionally some subjects demonstrated air-conduction thresholds poorer than 40 dB HL with relatively normal bone-conduction.

The findings of this investigation relate closely to the conclusions of Ling, McCoy, and Levinson (1969) and Fay et al. (1970) who felt that poor general living conditions contributed substantially to the incidence of middle ear disease in children from both rural and urban communities. At the time of this investigation, the author lived at the migrant camps for several days. During this period of time, many poor living conditions were observed in the camps such as: (1) common showers and outhouses for a large number of families; (2) an abnormal amount of flies and insects; (3) running water in only some of the cabins; (4) insufficient sleeping accommodations for some families; (5) children eating meals without washing their hands and face; (6) the trash dump which was just behind the cabins was a health hazzard where children were able to hurt themselves on broken glass and sharp metal objects; and (7) occasional lack of child supervision when parents left the housing camp on days when children were not attending summer school. A further observation was that the privately owned camp was in much better condition than the state-run camp. The conditions listed above are similar to those noted by the studies cited in Chapter I and are possibly contributing factors to the poor general health conditions resulting in the high incidence of middle ear disease among Chicano migrants.

The present investigation did not attempt to trace each person's migratory pattern, so that the incidence of middle ear problems cannot be directly compared to climatic variability. Changes in climate, however, could be affecting the health of migrant workers due to: (1) insufficient clothing for cold weather; (2) a lack of heating and sufficient insulation in their temporary housing facilities; and (3) their continued traveling throughout the country where climatic conditions are known to differ from region to region.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

Summary

Sixty Chicano migrant agricultural workers, 37 children and 23 adults, were tested by pure-tone air- and bone-conduction audiometry, seen for an ear, nose, and throat examination by an otolaryngologist, and asked to respond orally to a questionnaire.

This investigation did not demonstrate that middle ear pathology decreased as a function of age for migrant agricultural workers. Sixty-four percent of the children and 87% of the adults demonstrated some type of ear, nose, and throat pathology. This finding was in agreement with Ling, McCoy, and Levinson (1969) who also found a high incidence and no significant decrease in otolaryngological pathology with increasing age.

Although the median air-conduction hearing threshold levels were within normal ISO limits bilaterally (refer to Table 7 and Figures 7 and 8), thresholds for the migrant children were generally poorer at all frequencies than those median threshold values obtained by Eagles et al. (1963) and the United States Health Education and Welfare (1970) study. At most frequencies, threshold differences between this investigation and the previous studies were found to be at least greater than 3.0 dB. At 4000 Hz, the difference was greater than 12 dB bilaterally.

In the adult sample, air-conduction hearing thresholds generally became poorer as a function of age, which is in agreement with results found by Corso (1963). Combined right ear, left ear, male, and female air-conduction thresholds for each adult age group were poorer for this investigation than for the Corso (1963) study. This was most obvious for the 33-40 year old age group. The audiometric configurations of the subjects in this study, although poorer, paralleled closely those found by Corso for the frequencies 1000-8000 Hz. The low frequencies, however, were not parallel, but showed a stiffness tilt for all age groups in the present study. Thresholds were consistently poorest at 6000 and 8000 Hz for the adults in both studies.

Conclusions

The results demonstrated that the majority of children who were found to be otoscopically abnormal had fairly sensitive hearing acuity. This was in close agreement with Eagles et al. (1963) who found most otoscopically abnormal children to have hearing more sensitive than 0 dB HL re: ASA (1951). The opposite was less frequently true. Only two subjects in this investigation, who had normal ENT findings, had air-conduction thresholds which were not within the normal ISO (1964) limits at some frequencies. However, all categories of otoscopically abnormal ears did demonstrate less sensitive hearing levels when compared with otoscopically normal children.

Similar to the findings of Jordan and Eagles (1961), Eagles et al. (1963), Melnick, Eagles, and Levine (1964), and Kapur (1965), if given alone, neither the otological examination nor the audiological evaluation provided an accurate estimate of the status of the middle ear for every subject in this investigation. Seventeen subjects found to be otoscopically abnormal had hearing levels within normal limits re: ISO (1964). There were 7 children and 5 adults who demonstrated bilaterally, and 3 children and 2 adults who showed unilaterally positive ENT findings accompanied by normal air-conduction thresholds.

Six children and one adult (8.6% of the total subjects) demonstrated at least unilaterally, pure-tone air-conduction averages in the frequency range 500, 1000, and 2000 Hz which exceeded the limits for normal hearing (25 dB HL re: ISO 1964). This percentage was considerably lower than the 37.9% found by Cambon, Galbraith, and Kong (1965), and 27.2% found by Clifford, Hull, and Gregg (1966), and the 19.8% found by Fay et al. (1970). Thus, although a higher than usual incidence of middle ear pathology was noted in this study, just the opposite was found for the incidence of hearing loss. Nevertheless, air-conduction thresholds for both children and adults in the present study were generally found to be poorer than the comparison studies (Eagles et al. [1963]; United States Health Education and Welfare [1970]; and Corso [1963]), but threshold averages for the speech frequencies poorer than 25 dB HL re: ISO (1964) were seen only infrequently.

In conclusion, there appears to be a high incidence of middle ear pathology but fairly normal hearing thresholds among Chicano migrant workers. The results of this investigation may not be applicable to all Chicano migrant workers nor to the total United States migrant population. The findings do, however, indicate that because of the high incidence of middle ear problems among this minority group, Hearing Conservation Health Programs need to be developed to prevent pathology from occurring. There is also a need to provide better otolaryngological and audiological services for migrant workers in Michigan.

Recommendations for Future Research

In view of the findings of the present study, further investigation concerning the incidence of middle ear problems of migrant agricultural workers appears necessary. Future investigations should be concerned with incidence of ear problems among other minority groups which migrate to harvest crops. Studies should be conducted in other areas of Michigan, in other states, and during other seasonal periods to evaluate threshold fluctuations and ear, nose, and throat pathologies. Newly obtained data could then be compared with the findings of the present investigation. It would also be of interest to obtain threshold levels and percentages of ear pathology for urban Chicanos who have never traveled the migrant streams and compare these findings to those of the present study. A full-scale otolaryngological/audiological investigation conducted by the United States Public Health Service would best determine the general incidence, in the United States, of middle ear problems of Chicano migrants as well as those of other migrant agricultural minority groups.

LIST OF REFERENCES

LIST OF REFERENCES

Allen, Steve, The Ground Is Our Table. New York: Doubleday & Co. (1966).

American Standard Criteria for Background Noise in Audiometer Rooms, S 3.1-1960. American Standards Association, 70 East 45 Street, New York, N. Y.

Anderson, D., The Effect of climate on the incidence of hearing loss. Journal of Speech and Hearing Disorders, 30, 66-70 (1965).

Arsenian, S., Bilingualism in the post war world. Psychology Bulletin, 42, 65-86 (1945).

Bowles, G. K., Farm labor adjustments to changing technology. In C. E. Bishop (Ed.), Farm Labor in the United States. New York: Columbia University Press (1967).

Cambon, K., Galbraith, J. D., and Kong, G., Middle-ear disease in Indians of the Mount Currie Reservation, British Columbia. Canadian Medical Journal Association, 93, 1301-1305 (1965).

Carhart, R., and Jerger, J. F., Preferred method for clinical determination of pure-tone thresholds. Journal of Speech and Hearing Disorders, 24, 330-345 (1959).

Clifford, S., Hull, R. H., and Gregg, J. B., Survey of disorders of speech and hearing and ear, nose, and throat pathology among children of the South Dakota Indian population. Read before the 42nd annual convention, American Speech and Hearing Association, Washington, D. C. (November 20, 1966).

Corso, J. F., Age and sex differences in pure-tone thresholds. Archives of Otolaryngology, 77, 385-405 (1963).

Cox, J. R. and Bilger, R. C., Suggestion relative to the standardization of loudness-balance data for the Telephonics TDH 39 earphone. Journal of the Acoustical Society of America, 32 (8), 1081-1082 (1960).

Davis, H. and Krantz, F. W., The international standard reference zero for pure-tone audiometry and its relation to the evaluation of impairment of hearing. Journal of Speech and Hearing Research, 7, 7-16 (1964).

Eagles, E. L., Wishik, S. J., and Doerfler, L. G., Hearing sensitivity and related factors in children. Laryngoscope Suppl., 73 (June, 1963).

Farrant, R. H., The audiometric testing of children in schools and kindergarten. Journal of Auditory Research, 1, 1-14 (1960-61).

Fay, T. H., Hochberg, I., Smith, C. R., Rees, N. S., and Halpern, H., Audiologic and otologic screening of disadvantaged children. Arch. Otolaryngology, 91, 366-370 (1970).

Field Study of Migrant Workers in Michigan: Report and Recommendations. Michigan Civil Rights Commission (1969).

Garretson, O. K., A study of causes of retardation among Mexican children in a small public school system in Arizona. Journal of Educational Psychology, 19, 31-40 (1928).

Haught, B. F., The language difficulty of Spanish-American children. Journal of Applied Psychology, 15, 92-95 (1931).

Holland, W. R., Language barrier as an educational problem of Spanish-speaking children. Exceptional Children, 27, 42-50 (1960).

John, V. P., and Horner, V. M., Bilingualism and the Spanish-speaking child. In F. Williams (Ed.), Language and Poverty. Chicago: Markham Publishing Co. (1970).

Jordan, R. E., and Eagles, E. L., The relation of air conduction audiometry to otological abnormalities. Annals of Otology, Rhinology and Laryngology, 70, 819-827 (1961).

Kapur, Y. P., Serous otitis media in children. Arch. Otolaryngology, 79, 38-48 (January, 1964).

Kapur, Y. P., A study of hearing loss in school children in India. Journal of Speech and Hearing Disorders, 30, 225-233 (1965).

Koch, Wm. H., Dignity of Their Own. New York: Friendship Press (1966).

Ling, D., McCoy, R. H., and Levinson, E. D., The incidence of middle ear disease and its educational implications among Baffin Island Eskimo children. Canadian Journal of Public Health, 60, 385-390 (1969).

Melnick, W., Eagles, E. L., and Levine, H. S., Evaluation of a recommended program of identification audiometry with school-age children. Journal of Speech and Hearing Disorders, 29, 3-13 (1964).

Migrant Health Program Annual Progress Report MG-210 (70). East Central Michigan Health Service, 319 McCoskry Street, Saginaw, Michigan (1970).

Moore, R., The Slaves We Rent. New York: Random House (1965).

Newby, H., Audiology. New York: Appleton-Century-Crofts (1964).

Report and Recommendations of the Status of Migratory Farm Labor in Michigan. Michigan Civil Rights Commission (1968).

Reul, M., Where Hannibal Led Us. New York: Vantage Press (1966).

Robinson, G. C., Anderson, D. O., Moghadam, H. K., et al., A survey of hearing loss in Vancouver school children: I. Methodology and prevalence. Canadian Medical Association Journal, 97, 1199-1207 (1967).

Sampson, P., Indian Health Service Modernizes Medical Care on Reservations. Journal of the American Medical Association, 218 (4), 511-524 (October 25, 1971).

Sandage, S. M., Child of Hope. New York: A. S. Barnes & Co. (1968).

Servin, M., The Mexican-American: An Awakening Minority. Beverly Hills: Glencoe Press (1970).

Shepherd, D. C., Goldstein, R., and Rosenblüt, B., Race difference in auditory sensitivity. Journal of Speech and Hearing Research, 7, 389-393 (1964).

Spoerl, D. T., Bilinguality and emotional adjustment. Journal of Abnormal Social Psychology, 38, 35-37 (1943).

Studebaker, G. A., Clinical masking of air- and bone-conduction stimuli. Journal of Speech and Hearing Disorders, 29 (1), 23-35 (1964).

Studebaker, G. A., Clinical masking of the nontest ear. Journal of Speech and Hearing Disorders, 32 (4), 360-371 (1967).

The Michigan Governor's Task Force on Migrant Labor. (October 9, 1969).

The Report of the UNESCO Meeting of Specialists, 1951. The use of vernacular languages in education. In J. A. Fishman (Ed.), Readings in the Sociology of Language. Paris: Mouton (1968).

Thorburn, I. B., Chronic Disease of the Middle Ear Cleft. In W. G. Scott-Brown (Ed.), Diseases of the Ear, Nose, and Throat. London: Butterworths & Co. (1965).

Vital and Health Statistics. Data from the National Health Survey, National Center for Health Statistics, United States Department of Health Education and Welfare, Series 11, No. 102, Washington, D. C. (1970).

Whitting, E. G., and Hughson, W., Inherent accuracy of a series of repeated clinical audiograms. Laryngoscope, 50, 259-269 (1940).

APPENDICES

APPENDIX A

AMBIENT NOISE LEVELS IN TEST ROOM

Table A 1. Acoustical survey[1] of the noise levels[2] in the test room used for audiometric testing.

Octave Band Center Frequency in Hz	Maximum allowable sound pressure for no masking above audiometric zero from 1951 American Standard in dB	Maximum allowable sound pressure for no masking above audiometric zero from the proposed 1964 International Standard in dB	Sound pressure level inside test room in dB
125	40	31	22
250	40	25	19
500	40	25	18
1000	40	25	<10
2000	47	38	<10
4000	57	51	<10
6000	62	55	<10
8000	67	55	<10
Over-all level weighted on the C scale			40

[1]August 11, 1971, at Hemlock, Michigan with the trailer parked at the migrant camp.

[2]Sound pressures in decibels re: 0.0002 $dynes/cm^2$.

APPENDIX B

PACKET OF FORMS USED TO RECORD TOTAL DATA
FOR EACH SUBJECT

QUESTIONARIO

Nombre______________________
Name

Edad__________Fecha_________
Age Date

Entrevistado por___________
Questioned by

Estas preguntas seran dirigidas a adultos y a los padres de los niños que serviran en este estudio.

These questions will be posed to the adult subjects and to the parents of the children who will serve as subjects.

1. Hay algúna deficiencia en el oir en la familia?
   Is there any hearing loss in the family?

2. Ud. (o su niño) padecen de los oidos?
   Do you (does your child) have a hearing loss?

3. Si padecen, que es lo que se sienten?
   If so, describe the loss.

   a. Qual oido tiene el problema?
      Which ear has the problem?

   b. Siente algún sonido en los oidos?
      Is there any ringing in the ears?

   c. Des de cuando padece de los oidos?
      Duration of loss?

4. Ud. (o su niño) tiene catarro frequentemente? (5 ó 6 catarros en el año)
   Do you (does your child) have frequent colds (5 or 6 colds per year)?

5. Le ha chequeado el doctor a Ud. (o a su niño) alguna vez los oidos?
   Has a doctor ever looked into your (your child's) ears?

6. Ha tenido Ud. (su niño) algun problems con los oidos?
   Has there ever been any problem with your (your child's) ears?

   a. Ha tenido liquido en los oidos?
      Has any liquid run out of the ears?

b. Ha tenido dolor de oidos?
Have there been any earaches?

c. Ha usado medicina para la infeccion de los oidos?
Has any medication been taken for an ear infection?

7. Ud. (su niño) tiene problema oyendo hablar?
Do you (does your child) have trouble hearing speech?

a. cuando   when

b. describe el problema   describe the problem

8. Ud. (su niño) ha trabajado cerca de maquinaria de agricultura?
Have you (has your child) worked around farm machinery?

a. cuando tienpo?   how often?

b. describa las condiciones   describe the conditions

9. Ha manejado Ud. alguna vez la maquinaria de agricultura?
Have you ever driven the farm machinery?

a. que tiempo?   how often?

b. Ha usado tapones en los oidos mientras trabajaba alrededor de la maquinaria?
Did you wear ear plugs while working around the machinery?

10. Ha tenido Ud. (o su niño) alguna vez un examen de los oidos para diferenciar tonos de sonidos con teléfonos?
Have you (has your child) ever had a hearing test where it was necessary to listen for tones through earphones?

11. Ha Ud. (o su niño) usado alguna vez un aparato para los oidos?
Have you (has your child) ever worn a hearing aid?

Figure B 1. PHYSICAL EXAMINATION

Subject's Name________________

Age_______Date________________

Physician_____________________

EARS (Circle one for each ear)

Rt.	Lt.	
0	0	Normal
1	1	Obstructed
2	2	Retracted Drum
3	3	Thickened Drum
4	4	Thickened and Retracted Drum
5	5	Inflamed middle ear (including secretory otitis media)
6	6	Dry perforation
7	7	Perforation with discharge
8	8	Acute Otitis Media
9	9	Chronic Otitis Media
10	10	Congenital Atresia
11	11	External Otitis

NOSE (Circle one for each side)

Rt.	Lt.	
0	0	Normal
1	1	Septal obstruction
2	2	Mucous membrane thickening
3	3	Purulent discharge
4	4	Acute rhinitis (watery discharge)
5	5	Polyps
6	6	Allergic rhinitis
7	7	Purulent discharge and polyps

continued

NECK GLANDS (Circle one)

0 Not palpably abnormal

1 Palpable but not markedly enlarged

2 Moderate to severe enlargement

TEETH AND MOUTH

0 Normal

1 Adentia

2 Dental caries: Slight

3 Dental caries: Severe

4 Severe gingivitis with dental caries

5 Severe gingivitis without caries

TONSILS (Circle one)

0 Normal

1 Cleanly removed

2 Tags, not infected

3 Tags, infected

4 Hypertrophied

5 Acute infection

6 Scarring and retraction moderate

7 Signs of severe chronic infection

PHARYNX (Circle one) (Larynx, if significant note on next page)

0 Normal

1 Acute granular pharyngitis

2 Chronic lymphoid hyperplasia

3 Chronic severe lymphoid hyperplasia

Subject's Name_________________

Age________Date_________________

Otolaryngologist__Y. P. Kapur__

Physical Examination Impressions:

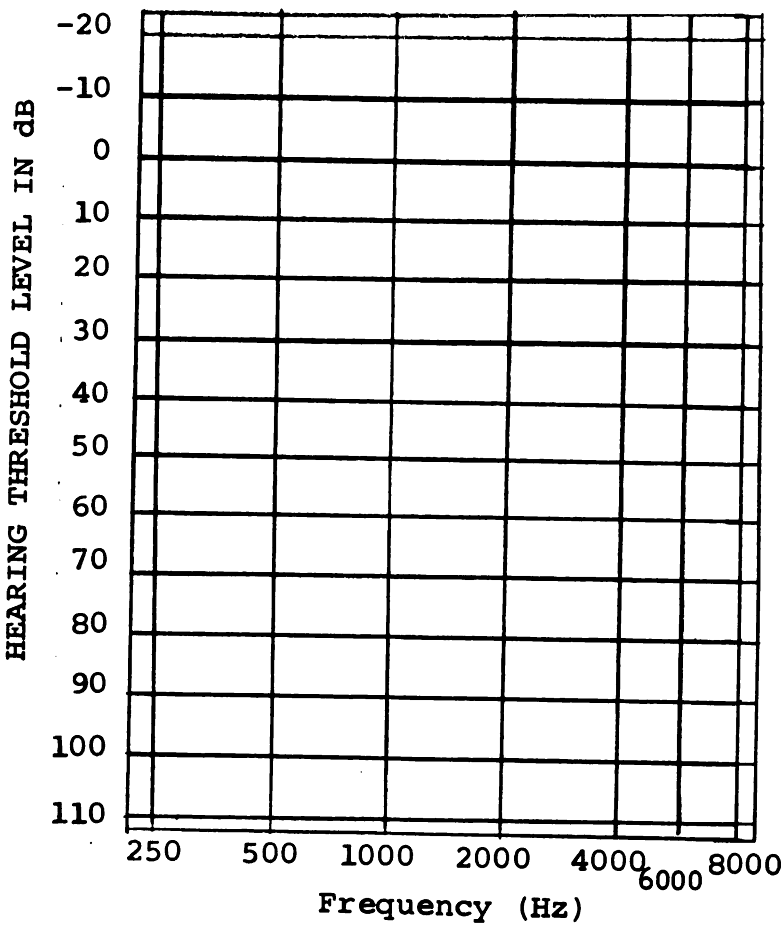
Figure B 2. AUDIOGRAM

Subject's Name________________

Age__________ Date________________

Audiometrist: Beverly Goldstein

ISO (1964)



ISO P/T Average
(3 frequency)

Right______________

Left______________

KEY TO AUDIOGRAM

		Air	Masked	Bone	Masked
Right	Red	O	△	[	◁
Left	Blue	X	□	]	▷

APPENDIX C

COMPARATIVE DATA OF AUDIOMETRIC NORMS AND EARPHONES

Table C 1. Sound pressure values in decibels re: 0.0002 microbar for each frequency classified by norms and type of earphone according to data presented by Davis and Krantz (1964) and Cox and Bilger (1960).

Frequency (Hz)	ASA 1951	ISO 1964	Differences
Reference Threshold Levels: WE 705 A earphone			
125	54.5 dB	45.5 dB	9 dB
250	39.5	24.5	15
500	25	11	14
1000	16.5	6.5	10
1500	(16.5)	6.5	(10)
2000	17	8.5	8.5
3000	(16)	7.5	(8.5)
4000	15	9	6
6000	(17.5)	8	(9.5)
8000	21	9.5	11.5
Reference Threshold Levels: TDH 39 with a MX-41/ARcushion			
125	51.8	42.8	9
250	39.5	24.5	15
500	24.1	10.1	14
1000	17.2	7.2	10
2000	18.0	9.5	8.5
4000	14.3	8.3	6
6000	19.5	10	(9.5)
8000	26.8	15.3	11.5

Note: The figures in parentheses are interpolations.

Table C 2. The sound pressure level difference in decibels for each frequency between the Western Electric 705 A earphone and the Telephonics TDH 39 earphone housed in the MX 41/AR cushion (Cox and Bilger, 1960).

Frequency in Hz	Difference in Sound Pressure
125	2.7 dB
250	0
500	0.9
1000	+0.7
1500	+1.5
2000	+1.0
3000	0.4
4000	0.7
6000	+2.0
8000	+5.8

\+ Indicates that the sound pressure value is higher by the listed amount for the TDH 39 earphone. Where no + sign is listed, the amount given is then greater for the WE 705 A.

APPENDIX D

CORSO (1963) MEAN AIR-CONDUCTION THRESHOLDS
IN SOUND PRESSURE LEVEL

Table D 1. Mean air-conduction hearing threshold levels in dB re: 0.0002 microbar for right and left ears and male and female combined for adults ages 18-49 years of age, Corso (1963).

Frequency (Hz)	Threshold	Frequency (Hz)	Threshold
Ages 18-24		Ages 26-32	
250	26.1	250	26.2
500	11.0	500	13.5
1000	5.8	1000	7.2
2000	6.8	2000	7.9
4000	12.2	4000	14.9
6000	25.8	6000	30.7
8000	23.7	8000	30.3
Ages 34-40		Ages 43-49	
250	26.0	250	26.8
500	12.6	500	11.7
1000	9.4	1000	9.3
2000	10.2	2000	14.5
4000	18.6	4000	26.7
6000	33.8	6000	40.2
8000	32.7	8000	34.0

APPENDIX E

RAW DATA OF AIR-CONDUCTION THRESHOLDS
FOR CHILDREN AND ADULTS

Air-conduction threshold levels in this appendix are listed for all subjects, both children and adults, in chronological order by age and separate ears. By referring to Tables 5 and 8, it is possible to determine the age of all subjects listed only by threshold in this appendix. For example, it is listed in Table 5 that two children at age five and six at age six were tested audiometrically. The first two thresholds in Tables E 1 and E 2 are the thresholds for the five year olds and the next six thresholds are thresholds for the six year olds. This same method can be used along with Table 8 to determine the age of the adult subjects listed only by threshold in Tables E 3 and E 4.

Table E 1. Air-conduction threshold levels in dB for the right ear for all children ages 5-16 years re: ISO (1964)

	250 (Hz)	500	1000	2000	4000	6000	8000
+	15	10	15	15	15	20	35
0	15	10	5	10	5	10	- 5
0	25	20	5	25	30	25	20
0	5	5	- 5	5	5	0	5
0	10	10	0	- 5	5	5	10
+	25	15	25	10	10	10	15
+	15	10	5	5	20	25	45
+	20	15	20	20	25	25	30
-	15	10	0	10	10	20	25
0	20	25	25	25	35	35	25
0	15	5	0	0	15	10	0
+	15	15	15	15	20	35	25
+	20	15	10	0	5	25	20
-	10	10	5	10	25	25	30
0	10	0	- 5	5	5	0	- 5
-	20	10	0	5	15	5	10
+	25	15	10	15	15	20	15
-	15	15	5	0	5	10	10
+	10	5	0	- 5	10	5	- 5
+	10	10	15	10	5	10	20
-	10	15	0	0	15	- 5	- 5
0	5	5	- 5	0	5	15	5
+	10	5	0	10	20	5	5
+	30	25	25	20	25	40	35
-	5	5	5	10	5	15	15
+	15	10	5	5	15	10	0
-	10	5	0	10	5	5	5
0	20	15	5	15	15	30	25
0	30	25	20	20	20	20	35
0	20	10	5	0	15	5	0
+	30	25	20	20	30	20	25
+	25	20	0	0	10	10	25
-	20	15	5	5	15	20	10
+	10	10	10	5	20	15	25
-	20	15	10	10	10	15	5
+	10	15	15	10	10	5	5
0	5	5	0	5	15	25	15

+positive ENT finding

-negative ENT finding

0 no ENT examination

Table E 2. Air-conduction threshold levels in dB for the left ear for all children ages 5-16 years re: ISO (1964)

	250 (Hz)	500	1000	2000	4000	6000	8000
+	5	15	15	10	25	25	20
0	20	15	5	10	5	5	10
0	15	10	0	15	20	15	5
0	5	5	0	5	15	0	0
0	10	15	5	5	25	20	5
+	35	35	30	30	35	50	45
+	10	5	15	25	20	25	15
+	15	15	15	15	15	15	5
-	20	15	10	5	5	- 5	10
0	40	15	25	40	45	25	20
0	10	5	5	5	10	15	10
+	40	55	55	50	55	55	40
+	10	10	10	5	15	15	15
-	5	5	10	5	20	20	10
0	5	10	- 5	5	0	-10	0
-	15	15	0	5	0	0	10
+	35	20	15	15	20	30	25
-	5	5	10	0	10	5	10
+	5	0	- 5	0	15	10	- 5
+	0	10	15	15	10	0	0
-	15	10	0	5	15	10	10
0	15	15	0	5	20	25	20
+	10	10	10	15	10	0	- 5
+	35	35	30	30	30	30	35
-	10	5	0	0	5	5	15
+	15	15	10	5	15	15	5
-	5	0	5	0	5	5	10
0	10	5	5	0	0	10	10
0	30	30	30	30	25	30	25
0	5	5	0	0	5	20	0
+	20	25	30	40	45	45	40
+	5	5	5	- 5	10	0	25
-	20	15	15	15	20	25	20
+	20	20	15	15	30	20	20
-	15	5	5	0	5	10	10
+	5	10	15	15	5	15	5
0	0	5	5	5	10	10	10

+positive ENT finding

-negative ENT finding

0 no ENT examination

Table E 3. Air-conduction threshold levels in dB for the right ear for all adults ages 18-50 years re: ISO (1964).

	250 (Hz)	500	1000	2000	4000	6000	8000	
-	10	15	5	10	15	0	5	
+	25	20	10	10	10	5	5	
0	10	10	10	5	5	5	5	18-24
+	20	15	- 5	- 5	5	10	- 5	years
+	30	25	10	15	25	55	35	
-	10	10	15	15	15	15	20	
+	20	15	5	- 5	5	15	15	
+	10	5	0	- 5	5	15	15	
0	15	10	0	5	5	5	5	
0	10	5	0	5	10	15	5	
+	20	15	5	5	10	15	15	
+	5	0	- 5	- 5	5	5	10	25-32
+	25	20	15	15	20	25	25	years
0	10	15	5	5	15	15	15	
+	10	10	10	5	15	15	25	
+	45	45	35	25	35	45	55	
+	15	0	0	5	10	10	0	
+	10	10	5	10	20	25	15	33-40
0	25	35	10	25	60	55	40	years
+	20	20	20	20	45	40	25	
0	5	5	5	0	5	10	0	43-50
0	10	5	5	5	15	15	0	years
0	15	10	10	5	15	25	15	

+positive ENT finding

-negative ENT finding

0 no ENT examination

Table E 4. Air-conduction threshold levels in dB for the left ear for all adults ages 18-50 years re: ISO (1964).

	250 (Hz)	500	1000	2000	4000	6000	8000	
-	15	10	5	5	15	0	0	18-24 years
+	15	10	5	10	5	10	5	
0	20	15	5	10	15	20	25	
+	10	10	- 5	- 5	15	10	15	
+	5	- 5	5	10	15	35	40	
-	10	10	15	10	15	20	25	
+	15	15	0	0	0	10	15	
+	15	10	0	0	0	15	30	
0	30	15	20	20	25	15	20	
0	15	5	0	10	10	25	- 5	25-32 years
+	15	15	5	10	15	15	30	
+	5	5	0	5	5	15	0	
+	20	20	15	10	20	15	25	
0	10	0	- 5	- 5	0	5	0	
+	10	5	5	0	15	30	35	
+	35	25	15	5	15	20	40	33-40 years
+	10	5	5	15	35	55	50	
+	15	5	5	20	25	35	40	
0	10	10	15	25	60	55	45	
+	20	20	20	10	25	15	20	
0	5	5	5	5	10	25	- 5	43-50 years
0	10	5	0	10	5	15	15	
0	15	10	15	20	30	25	15	

+ positive ENT finding

− negative ENT finding

0 no ENT examination

APPENDIX F

RAW DATA OF AIR-BONE GAPS FOR

CHILDREN AND ADULTS

The air-bone gaps for both children and adults are listed in this appendix by separate ears. These air-bone gaps are presented in chronological order of age and correspond directly to the air-conduction thresholds of Appendix E. To obtain the air-bone gap of any threshold in Appendix E, all that is necessary is to find the corresponding line for the correct ear and correct age group.

Table F 1. Air-bone gaps in dB for each frequency for the right ear on all children ages 5-16 years.

500 (Hz)	1000	2000	4000
15	15	10	5
5	0	5	0
10	0	15	25
15	0	5	20
0	0	0	10
10	30	0	0
10	0	0	5
10	15	15	10
10	0	5	10
30	25	15	40
0	0	0	15
0	5	0	5
10	5	0	0
10	0	0	15
5	0	0	0
15	0	0	5
0	0	0	0
20	0	0	5
5	0	0	10
0	5	0	0
10	0	0	10
0	0	0	5
0	0	0	0
0	0	10	0
0	10	10	5
5	0	0	0
5	0	0	0
10	0	10	15
5	5	0	5
5	0	0	10
10	0	5	15
15	0	5	5
5	0	0	0
0	0	0	5
10	0	0	5
10	10	5	10
5	0	0	10

Table F 2. Air-bone gaps in dB for each frequency for the left ear on all children ages 5-16 years.

500 (Hz)	1000	2000	4000
15	10	10	0
0	0	5	5
5	0	5	5
0	5	0	15
5	0	0	20
30	30	20	25
5	5	20	5
10	10	20	5
5	5	5	5
20	25	35	30
5	0	5	10
55	40	15	40
15	0	0	10
15	5	5	15
10	0	5	5
20	0	0	0
20	20	0	0
20	5	0	5
0	0	0	5
0	0	0	0
15	0	0	10
10	0	10	25
5	0	0	5
0	0	0	0
20	0	0	0
0	0	0	0
5	0	0	0
10	5	30	0
20	5	5	5
0	0	0	0
10	15	20	20
10	10	0	15
10	0	0	0
15	5	5	15
10	0	0	0
5	0	0	0
10	0	0	0

Table F 3. Air-bone gaps in dB for each frequency for the right ear for all adults ages 18-50 years.

500 (Hz)	1000	2000	4000	
15	5	15	15	
0	5	0	5	
10	5	0	0	
5	0	0	0	18-24 years
25	10	10	15	
5	0	10	10	
15	0	0	10	
10	0	0	0	
0	0	0	0	
10	0	0	10	
10	0	0	0	
10	0	0	10	25-32 years
5	0	0	0	
0	0	0	0	
0	0	0	0	
0	0	0	15	33-40 years
0	0	5	0	
5	0	0	0	
0	0	0	0	
0	0	0	15	
5	0	5	0	43-50 years
0	5	0	5	
0	0	0	0	

Table F 4. **Air-bone gaps in dB for each frequency for the left ear for all adults ages 18-50 years.**

500 (Hz)	1000	2000	4000	
20	5	5	0	
10	0	0	0	
15	5	0	10	
5	0	20	15	18-24 years
0	5	5	10	
15	5	5	10	
10	0	0	0	
15	0	0	0	
0	15	30	20	
5	5	5	5	
15	0	0	0	
15	5	0	0	25-32 years
10	0	0	0	
0	0	5	0	
0	0	0	0	
0	0	0	0	
5	0	15	10	
0	0	5	0	33-40 years
0	0	0	0	
0	0	0	0	
0	0	0	0	
0	0	0	5	43-50 years
5	10	5	10	