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EXTERNAL AND MIDDLE EAR CONDITIONS ASSOCIATED WITH DISEASE AND DYSFUNCTION IN AFRICAN-AMERICAN AND EUROPEAN-AMERICAN CHILDREN IN A HEAD START PROGRAM

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Jeanine Angela Jackson

December 1992

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DEDICATION

This thesis is dedicated to my parents,
Mr. Alfred Jackson and Mrs. Ella Phillips Jackson,
for their continued encouragement, guidance, love, and
support throughout all my educational milestones.
I am eternally grateful to you for providing me with
quality education, and teaching me all the things that
formal education cannot.

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"Thank you Lord for giving me strength"

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ABSTRACT

The prevalence of external and middle ear conditions associated with disease and dysfunction was investigated in seventy-four 3-5 year old children from a Head Start preschool program, forty-five African-Americans (23 males, 22 females) and twenty-nine European-Americans (14 males, 15 females). The prevalence of abnormality was determined from ear histories reported by the parent or guardian of the subject and by an otoscopic screening/ tympanometry.

When compared to African-American children, European-American children showed a greater percentage of external and middle ear abnormality as indicated by reported ear history and otoscopic screening/tympanometry. Fifty-one percent of African-Americans compared to 62% of European-Americans were abnormal by ear history. Earaches were the most common symptom reported by the parents. Ear drainage/fluid and PE tubes were the most common conditions detected by the otoscopic screening. Forty-nine percent of African-Americans compared to 59% of European-Americans were abnormal by otoscopic screening/tympanometry.

In the present study, European-Americans were abnormal 1.2 times as often as African-Americans. This was true for ear history and for otoscopic screening/tympanometry. However, these differences between European-Americans and African-Americans

were not significant. Other investigators found that European-Americans are more likely to be abnormal by ear history and by otoscopic screening/tympanometry, but the differences they report are larger than those obtained in the present study and are also significant. The small differences obtained in the present study may be due to the following factors: subject age and/or socioeconomic class, or the size of the sample in the present study.

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CHAPTER I

INTRODUCTION

In an attempt to understand health care needs in a modern world, the contribution of ethnic differences needs to be recognized in order to provide appropriate medical treatment. Ethnic differences between African-Americans (AAs) and European-Americans (EAs) are evident in cases of sickle cell anemia and hypertension. These diseases occur more frequently in AAs than EAs. Sickle cell anemia is a genetic disease recognized as being a major public health problem in Africa, the United States, and other parts of the world. It is estimated that there are two million AAs with the disease and 50,000 to 100,000 affected AAs in the United States (Cerami and Washington, 1974). Hypertension kills 13,500 AAs annually and affects 100 in every 500 AAs (sickle cell anemia affects 1 in every 500). It is estimated that forty percent of all AAs over the age of forty are hypertensive (Cerami and Washington, 1974).

In recent years, ethnic differences have been demonstrated for hearing and ear-related disorders. The prevalence of middle ear abnormalities is less for AAs than for EAs (Marchant, Shurin, Turczyk, Wasikowski, Tutihasi, & Kinney, 1984; Robinson & Allen, 1984; Robinson, Allen, & Root, 1988; United States National Center for Health Statistics, 1972). However, there are several other ethnic

groups which are at greater risk for middle ear disease than EAs, for example, Eskimos, Native Americans, and Mabaans (Griffith, 1979; Post, 1962).

Tympanometry has been performed on middle and lower socioeconomic class infants and preschool children to determine the presence or absence of middle ear disease and dysfunction (Robinson & Allen, 1984; Robinson et. al, 1988). The results of these studies showed that the prevalence of tympanometric abnormality indicating middle ear dysfunction was less for AA children than EA children.

It has been hypothesized that individuals in lower socio-economic classes may be subjected to conditions that cause middle ear disease more than individuals in middle or upper socioeconomic classes. The interactions of poverty, increased susceptibility to disease, and reduced access to health care place individuals at a risk for developing communication disorders (American Speech-Language-Hearing Association, 1991). The Surgeon General of the United States and others have addressed the issue of environmental pollution and its effect on the respiratory health of children. The evidence indicates that the effects of cigarette/tobacco smoke and the exposure to air pollution on health can be manifested in the form of increased respiratory infections, chronic middle ear effusions, and otitis media (Feagans & Proctor, in press; Novello, 1992).

The purpose of the present study was to compare the prevalence of external and middle ear abnormality conditions associated with disease and dysfunction in AA and EA children in a Head Start preschool program. Secondly, the study was conducted to

determine if the differences present in middle socioeconomic class children between the ags of 2 1/2-4 years as in Robinson & Allen's (1984) study are present in lower socioeconomic class children between the ages of 3-5 years.

In the present study, the prevalence of ear problems was studied using reported ear history information from a parent or guardian (questionnaire), direct observation of external and middle ear function (otoscopic screening), and measurement of middle ear function (tympanometry). The specific objectives of the study were as follows: (1) to determine if the prevalence of ear conditions associated with disease was different for AA and EA preschool children as reported by the parent or guardian on a seven question history of ear problems and external and middle ear disease, and (2) to determine if the prevalence of external and middle ear conditions associated with disease between AAs and EAs was different as determined by screening otoscopy and tympanometry.

CHAPTER II

REVIEW OF LITERATURE

Recent evidence has shown that AAs and EAs differ with respect to hearing thresholds, prevalence of middle ear disease, and failure rate on tympanometric tests. This literature review will focus on ear and hearing differences between AAs and EAs. Since the present study is involved with middle ear function, it will include a discussion on the medical aspects of otitis media, and tympanometric measurement techniques.

ETHNIC DIFFERENCES IN HEARING AND EAR RELATED DISORDERS

HEARING THRESHOLDS IN ADULTS

Royster and Thomas (1979) and Royster, Driscoll, Thomas, & Royster (1980) measured hearing thresholds for nonindustrial noise exposed populations (NINEPs). The NINEPs were defined as individuals who had not worked in a noisy industry for more than two weeks, but who may have had prior military service, civilian gun exposure, and pathological ear problems. The results were analyzed separately for AAs and EAs. The AAs and EAs were not equated on any socioeconomic basis. The results showed that AAs had better mean hearing thresholds than EAs for pure-tones from 500-6000 Hz, for each decade age group from 20-60 years. The differences were present for males and females considered separately.

REPORTED EAR DISEASE AND HEARING PROBLEMS FOR CHILDREN

Prevalence of middle ear disease and hearing loss for children 6-11 years has been described by the United States National Center for Health Statistics (1972). Self-administered medical histories relating to the child's hearing and ear conditions were obtained from each child's parent. The medical history questionnaire is shown in Figure 1. The questionnaire did not require the person completing the history to provide separate information for right and left ears. Table I shows the results obtained using the self-administered medical history. For questions #43-#48, in every one year age group from 6 to 11 years, for five physical ear related conditions (earaches, running ears, ear injury, drum opened, and other ear trouble), the prevalence of abnormality was less for AAs than for EAs. For question #43 (Does your child have any trouble hearing?), there was a partial reversal of the results. For children aged six years, the direction of the ethnic differences were the same as for all the other reported ear conditions: more abnormality was reported for EAs than for AAs. However, for children aged seven to eleven years, greater abnormality was reported for AAs than for EAs. This finding was unexpected because it suggests that a greater percentage of AAs report difficulty hearing, even though they report having fewer physical ear problems.

MIDDLE EAR FUNCTION MEASURED BY TYMPANOMETRY

Only two studies have been performed measuring middle ear function comparing AAs and EAs with respect to tympanometry. The

CONFIDENTIAL – *The National Health Survey is authorized by Public Law 652 of the 84th Congress (70 Stat. 489; 42 U.S.C. 242c). All information which would permit identification of the individual will be held strictly confidential, will be used only by persons engaged in and for the purposes of the survey and will not be disclosed or released to others for any other purposes (22 FR 1687).*

FORM APPROVED
BUDGET BUREAU NO. 68-R620-34.6

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
NATIONAL HEALTH SURVEY

HES-256

(1-5) _____

CHILD'S MEDICAL HISTORY - Parent

NAME OF CHILD *(Last, First, Middle)* (6-11)	SEGMENT	SERIAL	COL. NO.

43. DOES YOUR CHILD HAVE ANY TROUBLE HEARING?
1 ☐ Yes 2 ☐ No 3 ☐ Don't know

44. DOES HE(SHE) EVER HAVE EARACHES?
(34) 1 ☐ Yes 2 ☐ No 3 ☐ Don't know

45. HAS YOUR CHILD EVER HAD ANY INJURY OR DAMAGE TO HIS(HER) EARS?
(35) 1 ☐ Yes 2 ☐ No 3 ☐ Don't know
IF YES, in what way was his(her) ear injured?_____

46. HAS HE(SHE) EVER HAD HIS(HER) EAR DRUMS OPENED OR LANCED?
1 ☐ Yes 2 ☐ No 3 ☐ Don't know
IF YES, how many times?
1 ☐ Once only 2 ☐ Twice only 3 ☐ Three times or more

47. HAS HE(SHE) EVER HAD ANY OTHER KIND OF OPERATION ON THE EARS?
36) 1 ☐ Yes 2 ☐ No 3 ☐ Don't know
IF YES, what was it for?_____

48. HAS THIS CHILD EVER HAD A RUNNING EAR OR ANY DISCHARGE FROM HIS EARS (Not counting wax in the
39) ears)? 1 ☐ Yes 2 ☐ No 3 ☐ Don't know
IF YES:
A. How often has he(she) had this?
1 ☐ Once only 2 ☐ Twice only 3 ☐ Three or more times 4 ☐ Don't know
B. Was this his(her) left ear, right ear, or both ears?
1 ☐ Left 2 ☐ Right 3 ☐ Both 4 ☐ Don't know

49. HAS HE(SHE) EVER HAD ANY OTHER KIND OF TROUBLE WITH HIS(HER) EARS?
1 ☐ Yes 2 ☐ No 3 ☐ Don't know
IF YES, what kind of trouble?_____

Figure 1. Medical questionnaire obtained by the United States National Center for Health Statistics (1972).

Table I. Prevalence rates per 100 children with history of trouble hearing and other ear problems by race and age: United States National Center for Health Statistics, 1972. Results for questions #43-#46 and #48-#49.

Medical history item and race	Ages 6-11	6	7	8	9	10	11
Question #43 Trouble hearing							
	Rate per 100 children						
White	4.0	3.8	4.4	3.2	4.6	4.1	4.2
Black	5.0	2.4	5.5	3.6	6.0	6.7	6.0
Question #44 Earaches							
White	27.9	30.1	32.6	26.5	26.9	26.8	24.5
Black	18.3	16.0	18.4	18.0	15.8	22.5	19.5
Question #48 Running Ears							
White	12.5	12.6	15.4	11.9	12.0	13.2	9.5
Black	7.4	9.4	10.0	6.6	7.2	7.0	3.8
Question #45 Ear Injury							
White	2.6	1.3	2.8	2.5	3.2	2.8	3.0
Black	1.1	---	2.0	---	1.2	0.6	3.0
Question #46 Drum Opened							
White	3.2	3.6	3.4	3.0	3.2	3.6	2.6
Black	1.3	3.2	0.8	1.2	0.8	0.5	1.4
Question #49 Other Ear Trouble							
White	5.2	6.2	5.0	5.8	5.0	5.1	4.2
Black	2.1	2.6	3.0	1.6	1.0	2.4	2.4

results in these two studies utilized tympanometric pass/fail criteria described by Paradise, Smith, and Bluestone (1976). The criteria used for the classification of tympanograms are displayed in Figure 2. Each tympanogram was classified into one of fifteen categories by two independent judges. Tympanogram types 1, 2, 3, and 15 were considered normal, types 4 through 11 was considered to indicate suspected otitis media with effusion, and types 12 through 14 were considered to be indicative of otitis media with effusion. A child passed the evaluation only if the tympanograms were classified as normal for both ears.

Robinson & Allen (1984) compared tympanometric results of 103 AA and 150 EA middle-class preschool children aged 2 1/2 to 4 years. They reported that the failure rate was significantly lower for AA children (23.3%) than for EA children (38%). In a second study, Robinson, Allen, & Root (1988), evaluated 63 AA and 74 EA lower socioeconomic class children ages 6-13 months. Again a significantly smaller percentage of AA children failed the screening (33%) compared to EA (57%) children.

MIDDLE EAR DISORDERS AND TYMPANOMETRY

Tympanometry, a test of middle ear status, is one method of evaluating middle ear dysfunction. Tympanometry is most sensitive to middle ear dysfunction associated with otitis media and insensitive to uncommon diseases, such as ossicular discontinuity or ossicular abnormality.

In ossicular disorders, it is possible that the ossicles do not

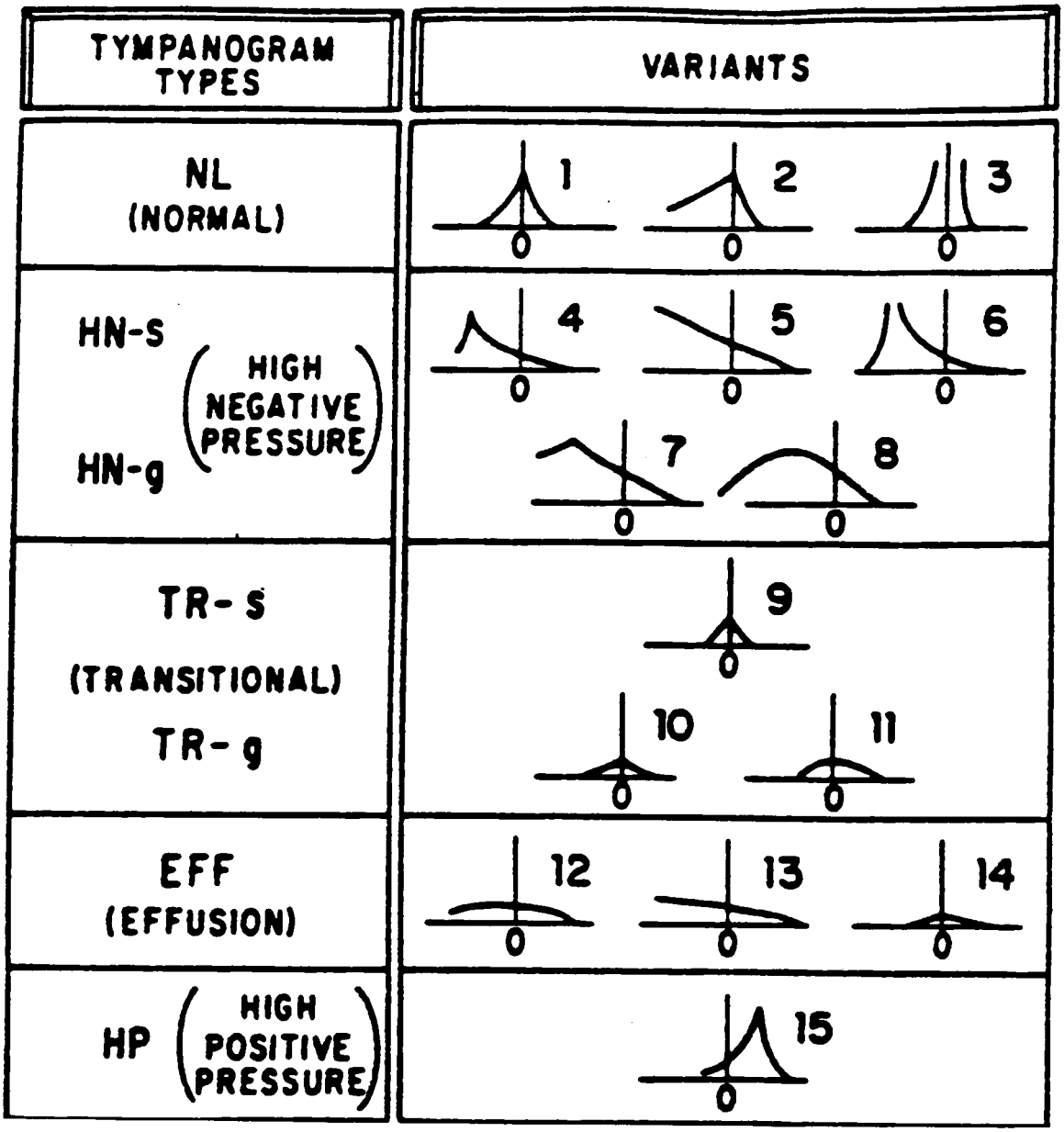


Figure 2. Criteria used for the classification of tympanograms by Robinson & Allen (1984) and Robinson, Allen, and Root (1988) from Paradise, Smith, and Bluestone (1976).

move freely because they are fixated to the skull. This condition is usually a congenital anomaly and occurs rarely. The presence of this condition may result in a shallow tympanogram or one that is normal in depth. With ossicular fixation, it is possible that otoscopy and tympanometry are normal in the presence of significant conductive hearing loss (Bluestone, 1978).

Ossicular discontinuity is a rare condition with an associated conductive hearing loss and may not be detectable by otoscopy. Ossicular discontinuity commonly manifests itself with a very deep tympanogram, conductive hearing loss, and, very often, with normal otoscopy. In order to detect ossicular discontinuity, however, tympanometry alone is not sufficient because very deep tympanograms can also be obtained with hypermobile tympanic membranes that do not cause hearing loss (Bluestone, 1978; Hodgson, 1980).

Tympanometry is most sensitive to identifying the middle ear conditions associated with otitis media. Negative middle ear pressure is manifested by a tympanogram that peaks at negative ear canal pressure. The negative middle ear pressure causes retraction of the tympanic membrane, with resultant stretching and reduction in compliance. The presence of middle ear effusion is represented by reduced static acoustic immittance, reduced gradient, or increased tympanometric width. A perforation of the tympanic membrane is shown by a large ear canal/middle ear volume (Paradise et al., 1976).

MEDICAL ASPECTS OF OTITIS MEDIA

COMMON CAUSES OF OTITIS MEDIA

Otitis media is an "inflamation of the middle ear that can occur with or without effusion in the middle ear cavity" (Dorland's Medical Dictionary, 1974). Otitis media is the second most frequently diagnosed disease of childhood and often occurs secondary to upper respiratory infections (Klein, 1986). In Figure 3 from Kessner, Snow, & Singer, 1974, the prevalence of ear pathology as a function of age is shown graphically. The prevalence rates peak at age 2 years when 30% are abnormal and decline to about 15% by age 11 years. This estimate is based on acute episodes accompanied by symptoms and signs of infections lasting two to six weeks (Feagans, 1986).

Marchant, Shurin, Turczyk, Waikowski, Tutihasi, & Kinney (1984) conducted a longitudinal study of otitis media in children under 5 years of age by examining them on a regular basis, whether signs of illness were present or not. Seventy-five percent of children experienced one or more episodes of otitis media and between 50 to 75% of these episodes were asymptomatic.

Eustachian tube function is thought to be the key in the pathogenesis of otitis media. Organisms gain entrance into the middle ear from the nasopharynx. Although the eustachian tube is usually closed, it opens with swallowing, yawning, or sneezing. Its main function with respect to the middle ear is to equalize air pressure and secretions, and drain middle ear secretions. When there is dysfunction of the eustachian tube during an upper respiratory infection, the tube may swell and close so that it does not

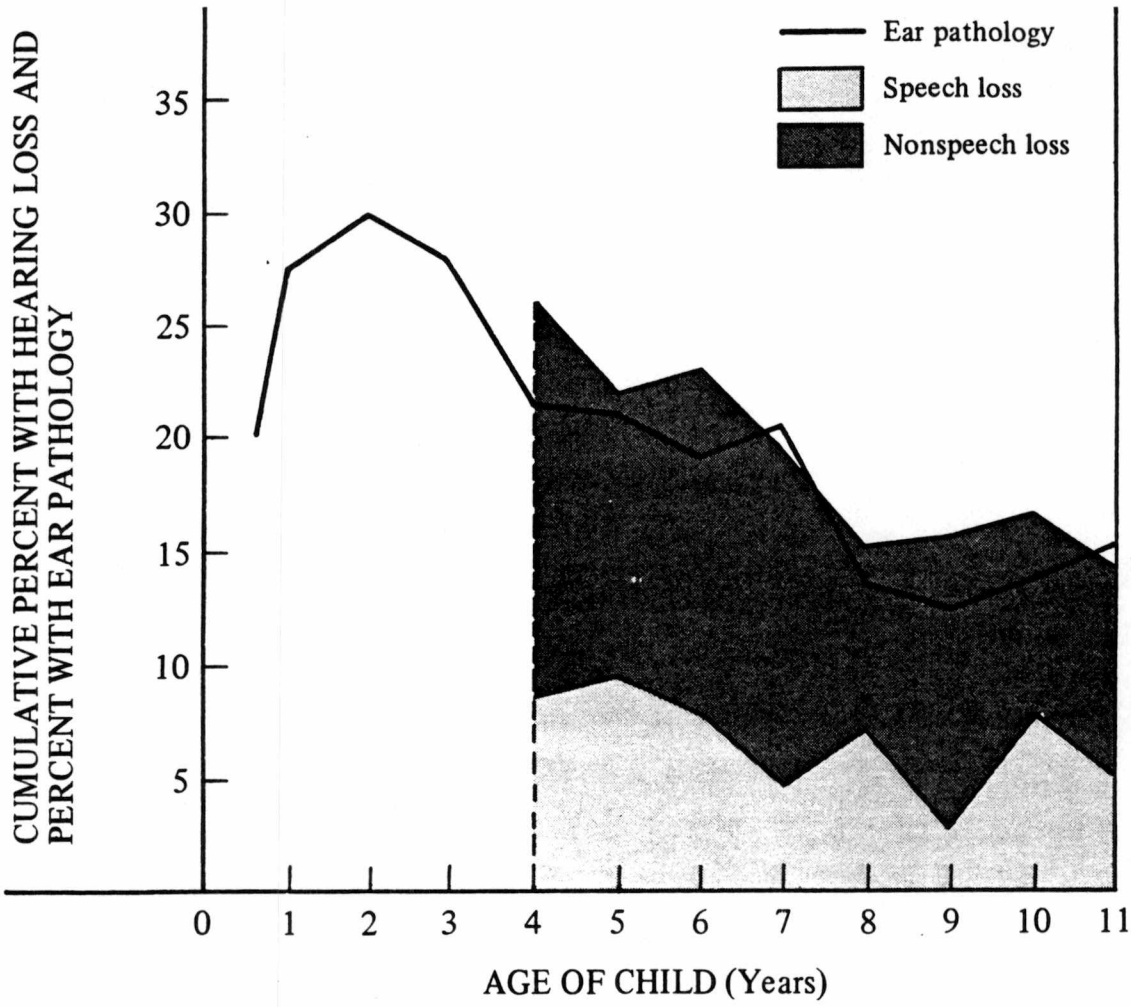


Figure 3. Prevalence of ear pathology in children 6 months through 11 years of age and prevalence of hearing loss by type of loss in children 4-11 years of age (Kessner, Snow, and Singer, 1974).

equalize pressure or allow drainage. In these cases, the fluid in the middle ear as well as viruses and bacteria may increase, causing middle ear effusion that can become acutely infected (Stool, 1989).

OTHER CAUSES OF OTITIS MEDIA

Other possible causes of otitis media are discussed below. Some of these causes have been documented and some have been proposed, but not documented as factual causes.

ETHNIC GENETIC FACTORS. Ethnic differences in the structure or function of the eustachian tube have been reported as a possible reason for an increase in otitis media in some groups. Doyle (1977) reported differences between angles, widths, and lengths of eustachian tubes of AAs and EAs that may result in functional differences. These may be mechanical and/or anatomical differences that allow the middle ear to drain more readily in AAs (Robinson et al., 1984).

Kessner, Snow, & Singer (1974) reported a higher incidence of ear pathology in EA children as compared with AA children aged 6 months through 11 years who lived in Washington, D.C. Ear pathology was noted in 35% of 112 EA children and 18% of 2,031 AA children.

ENVIRONMENTAL FACTORS. The conditions in which children live have been linked to otitis media. Family size, crowding, cigarette smoking by parents, air pollution, and poor ventilation of homes may

play a role in increased incidence of respiratory infections, including otitis media. Family size and crowding expose children to more and different bacteria and viruses. Smoking, air pollution, and poor ventilation of homes may trigger or enhance upper respiratory infection. Children living in households with many members were more likely to have otitis media than were children in households with fewer members (Feagans & Proctor, in press; Klein, 1978; Paradise, 1980).

Klein (1986) reported that tympanometry results showed the failure rate of children attending day care centers to be approximately twice as high as for children being cared for at home. In the day care setting, coughing and sneezing at close range was frequent and epidemics of respiratory disease more common.

INFANT FEEDING FACTORS. Beauregard (1971) found breast milk to be a protective factor from otitis media for infants. However, he found that bottle propping, bottle held in upright position by an infant also may lead to increased otitis media. This is due to the supine position, which can cause milk to stay in the back of the throat that may in turn promote infection. In 1971, Schaefer noted an inverse relationship in the incidence of middle ear disease and the duration of breast feeding in infancy among Canadian Eskimo children. However, Cunningham (1977) found no difference in the incidence of otitis media between breast-fed and artificially fed infants.

SEASONAL FACTORS. The seasonal incidence of the middle ear diseases parallels the seasonal variations of upper respiratory tract infections (Feagans & Proctor, in press; Klein, 1978). Acute episodes peak during the winter season and are least frequent in the summer season. The incidence of episodes of otitis media also increases during out-breaks of viral infections of the respiratory tract, which are more likely to occur in the winter and spring seasons of the year (Feagans & Proctor, in press).

SOCIOECONOMIC STATUS. Socioeconomic factors related to an increase of otitis media in children have only been hypothesized (Feagans & Proctor, in press). Cambon, Galbraith, and Kong (1965) noted a strong relationship between middle ear disease and poor social conditions among Indians of British Columbia. The specific reasons for the high incidence and severity of disease were not identified, but several factors were considered: crowded living conditions, poor sanitation, and inadequate medical care. Preliminary data from studies of urban children suggest that the incidence of ear pathology is lower among AA children than EA children of similar socioeconomic status.

HEARING LOSS ASSOCIATED WITH OTITIS MEDIA

Otitis media in children can cause temporary and/or permanent hearing loss. The presence of fluid in the ear and the repeated episodes of otitis media can cause a mild to moderate conductive hearing loss. Conductive hearing loss is the most common

type of hearing loss in young children. With the exception of some rare congenital malformations of the ear and accumulation of cerumen in the external ear canal, middle ear infection is the most frequent cause of conductive hearing loss (Kessner, Snow, & Singer, 1974).

Fluctuant or persistent loss of hearing is associated with acute or chronic middle ear effusions. The presence of high negative middle ear pressure, in the absence of effusion, can also be associated with a significant hearing loss (Bluestone, 1978). However, significant hearing loss does not necessarily occur with every episode of otitis media. The degree of conductive hearing loss varies considerably and can range from levels of normal sensitivity to hearing loss as great as 50 dB HL (Bess, 1986). The hearing loss is usually conductive, but sensorineural involvement can also occur. It appears that some of the conductive hearing losses are transient; they occur concurrently with ear infection and normal acuity is restored when the infection clears up (Bess, 1986).

CHAPTER III

PROCEDURES

This study was designed to investigate the prevalence of external and middle ear abnormality conditions associated with disease and dysfunction of AA and EA preschool children in a Head Start population. The prevalence of abnormality was determined from: ear histories reported by a parent or guardian and from otoscopic screening and tympanometric measures of the two groups.

SUBJECTS

The subjects for this study were obtained from Knox County's Community Action Committee Head Start program in Knoxville, Tennessee. Otoscopy and tympanometry were performed on one hundred ninety-three preschool children as a part of the Head Start screening program. Of these, parents and guardians of ninety subjects consented to their children's participation in this study (consent form shown in Appendix A). Sixteen subjects were eliminated from this study for the following reasons: three due to technical errors in recording tympanometric data, twelve due to the presence of impacted cerumen in one or both ears (6 AA subjects and 6 EA subjects), and one due to a craniofacial anomalies (cleft palate). Seventy-four subjects, forty-five AAs (23 males, 22 females) and twenty-nine EAs (14 males, 15 females) were selected for the final subject pool based on the following selection criteria: (1)

of AA or EA ethnicity as determined from Head Start classification records, (2) age between three to five years (36 to 60 months), (3) no reported or identified craniofacial anomalies, (4) no known cognitive impairment as identified by cognitive and developmental tests as administered by Head Start, and (5) no congenital ear abnormalities as identified by visual examination by the principal investigator.

Robinson & Allen (1984) compared the rate of occurrence of possible middle ear dysfunction between AA and EA children in a middle socioeconomic class. In the present study, the prevalence of external and middle ear abnormality was determined for AA and EA children in a lower socioeconomic class. A population of Head Start children was selected for this study because these children are considered to be below middle class status. Families with children in a Head Start program are from a lower socioeconomic class.

In 1984, Robinson & Allen defined children in a middle socioeconomic class based on enrollment in a day care setting and source of tuition funding paid by a parent or guardian. They excluded children defined as lower socioeconomic class if all or part of their tuition was paid by public or third party support. All subjects in the present study were from a Head Start program, in which tuition was partially or totally funded by public sources. Each subject in the present study met Robinson & Allen's (1984) criteria for a lower socioeconomic class. Admission to the Head Start program is granted to children in the age group from three to five years who come from families in which the per capita income is

below identified criterion levels. The criteria for eligibility are shown in Tables II, III, and IV.

METHODS

EAR HISTORY

In order to determine the history of external and middle ear abnormality and disease, information was obtained from each subject's parent or guardian in the form of a questionnaire (see Appendix B). The purpose of the questionnaire was to determine if the parent or guardian was aware of any past or present external ear and/or middle ear problems. Answers to seven questions pertaining to ear problems were obtained through personal interviews with the parent for three subjects and by written response for seventy-one subjects. Written responses were obtained by sending questionnaires home with the children having the parent complete the questionnaire and returning the questionnaire to the Head Start program.

OTOSCOPIC SCREENING

An otoscopic screening was performed on each subject before the tympanometric evaluation to: (1) detect external ear disease or abnormality, (2) obtain gross evidence of middle ear disease, and (3) determine if tympanometry was contraindicated. A Welch Allyn clinical otoscope was utilized. The results of the otoscopic screening were recorded on the otoscopy check-list (see Appendix C). If any of

Table II. Knoxville-Knox County, Community Action Committee, Head Start income guidelines used to determine family eligibility for the 1992-93 school year.

Size of family unit	Income
1	$ 6,810
2	9,190
3	11,570
4	13,950
5	16,330
6	18,710
7	21,090
8	23,470
(Add $2,380 for each additional family member)	

Table III. Knoxville-Knox County, Community Action Committee, Head Start criteria used in assigning 25%, 50%, and 75% points on the Summary Selection Criteria forms.

Size of family	Give 25% points if income is at or below:	Give 50% points if income is at or below:	Give 75% points if income is at or below:
1	5,107	3,405	1,702
2	6,892	4,595	2,297
3	8,677	5,785	2,892
4	10,462	6,975	3,487
5	12,247	8,165	4,082
6	14,032	9,355	4,677
7	15,817	10,545	5,272
8	17,602	11,735	5,867

Table IV. Knoxville-Knox County, Community Action Committee, Head Start Selection Criteria Summary.

Point Value	Criteria	Assigned Points
4	Current income at or below poverty guidelines	_____
4	Bonus/Low income/25% below poverty guidelines	_____
5	Bonus/Low income/50% below poverty guidelines	_____
6	Bonus/Low income/75% below poverty guidelines	_____
2	Age 4 by October 1, 1992	_____
3	Age 5 by January 1, 1992	_____
2	Prior Head Start family (parent/sibling was in HS)	_____
3	Serious health problems or diagnosed/suspected disability	_____
4	History of abuse/neglect/protective services	_____
1	Family crisis (terminal illness, death in family)	_____
3	High risk family (mental illness, disabled parent)	_____
1	Outside agency referral	_____
1	Single parent family	_____
2	JTPA / JOBS / Even Start parent	_____
Center	Total points	Option

the following otoscopic findings were detected, tympanometry was not performed and the subject was classified as abnormal because of potential risk to the subject: blood, effusion, drainage or soreness in the external auditory canal, bulging or inflamed eardrum,and fungus. If cerumen was impacted or if a foreign body was present in the ear canal, tympanometry was not performed, and the subject was eliminated from the study without being classified as abnormal and was referred for care using established Head Start program procedures. If any of the following conditions were present, the subject was classified as abnormal, however, tympanometry was performed: PE tubes, collapsed ear canal, and perforation of the eardrum.

Inter-experimenter test reliability was evaluated by comparing the findings of the co-principal investigator with the findings of the principal investigator for one ear on six subjects. For each of the six ears, the co-principal investigator and the principal investigator provided the similar descriptions of all ears (see Table V).

TYMPANOMETRY

A portable automatic tympanometer (Madsen Zodiac 901, Model 34586) was used for testing the middle ear function of each subject. The tympanometer had a lightweight hand-held probe which delivered a 226-Hz probe signal. This probe frequency was used because of its sensitivity in detecting the types of middle ear dysfunction that are most common in children. Tympanometric measurements were made over a pressure range from +200 to -400

Table V. Otoscopic screening: validity check between principal investigator (PI) and the co-principal investigator (CoPI) on six subjects (S).

	Right Ear		Left Ear	
	PI	CoPI	PI	CoPI
S1	Normal	Normal	Normal	Normal
S2	Normal	Normal	Normal	Normal
S3	Normal	Normal	Normal	Normal
S4	Normal	Very slightly misshapen pinna; otherwise normal	Normal	Very slightly misshapen pinna; otherwise normal
S5	Perf-oration	Perforation; maybe PET	PE Tubes	PE Tubes
S6	Normal	Normal	Normal	Normal

daPa and the pressure was varied at a rate of 400 daPa/s. Tympanograms were plotted showing the acoustic admittance (specified in ml equivalent volume of air) as a function of air in the external canal (specified in daPa). Tympanograms were obtained for both ears on each subject.

The results of the tympanometric measures were classified according to Margolis & Heller's (1987) tympanometric norms for a 226-Hz probe tone and a pump speed of 400 daPa/s. The test results were recorded using the tympanometer's built-in printer. Calibration of the tympanometer was performed before and after the study. Calibration checks were also made at the beginning and end of each day of testing. The following tympanometric measures were made on each subject:

(1) Ear canal volume: the absolute value of the acoustic admittance at 226-Hz at +200 daPa air pressure in the external auditory canal expressed in equivalent volume of air in ml.; normal range = 0.42-0.97 ml (however, larger values were considered normal if the tympanogram has a peak).

(2) Static acoustic admittance of the middle ear: the acoustic admittance at the maximum of the tympanogram minus the acoustic admittance of the ear canal expressed in equivalent volume of air in ml.; normal range = 0.22-0.92 ml.

(3) Tympanometric peak pressure: an indirect measure of the air pressure in the middle ear in which the ear canal pressure at the maximum of the tympanogram measured in daPa; normal range = -139 to +11 daPa. Tympanometric peak pressure was recorded but not used as a criterion for abnormality in accordance with

the ASHA Guidelines for screening for hearing impairments and middle ear disorders (1990).

(4) Tympanometric width: is used as a descriptor of the tympanogram in the vicinity of the peak; the tympanometric width is the pressure interval corresponding to a 50% reduction in peak; normal range = 59 to 151 daPa.

Inter-experimenter test reliability for tympanometry was determined by comparing the results of the principal investigator with results of the co-principal investigator for six ears (see Table VI). For each of the six ears, the co-principal investigator and the principal investigator provided the same descriptions of all ears. For 23 of 24 measures obtained, the results were classified identically using Margolis & Heller's (1987) criteria. For one ear (E2), the tympanometric width obtained by the principal investigator was within normal limits (139 daPa), while the tympanometric width measured by the co-principal investigator was abnormal (157 daPa).

Table VI. Tympanometry test: reliability check between principal investigator (PI) and the co-principal investigator (CoPI) on six ears (E).

	Ear canal volume (ml)		Middle ear pressure (daPa)		Static Admittance (ml)		Tympanometric Width (daPa)	
	PI	CoPI	PI	CoPI	PI	CoPI	PI	CoPI
E1	0.76	0.73	5	-20	.22	.26	157	179
E2	0.68	0.60	5	10	.26	.30	139	157
E3	0.63	0.67	0	5	.52	.56	136	142
E4	0.58	0.63	-20	-20	.50	.51	116	118
E5	2.10	2.20	N/A	N/A	N/A	N/A	N/A	N/A
E6	1.90	1.91	N/A	N/A	N/A	N/A	N/A	N/A

CHAPTER IV

RESULTS

REPORTED EAR HISTORY

The responses from the ear history questionnaire are shown separately for AA subjects and EA subjects in Table VII. EA subjects had a greater percentage of abnormality than AA subjects for history of earaches, drainage from the ears, swimmer's ear, and ear operation. EA subjects had a smaller percentage of abnormality than AA subjects for ear injury, perforated eardrum, and other ear trouble. For questions dealing with ear injury, perforated eardrum, and swimmer's ear, abnormality was reported for no more than one person in each group. Based on the percentages of abnormality, the sample sizes were not large enough to make valid comparisons between these groups for these conditions.

On item #6 of the questionnaire (see Table VII), a greater percentage of AA subjects than EA subjects reported experiencing other ear trouble. Twelve out of sixteen responses in the "other ear trouble" category were "ear infections" which the reporting parents/guardians differentiated from earaches:

(1) The single response for "earaches" reported for item #6 was also reported for item #1 of the questionnaire by the parent.
(2) The "tubes in the ear" response reported by parents on the questionnaire would have been more appropriately indicated as a response to item #7 of the questionnaire.
(3) One parental response was obtained indicating that the doctor reported that the child's "ears were red."

Table VII. Percentage of subjects with abnormality reported on the ear history questionnaire.

	African-Americans (N=45)	European-Americans (N=29)
1. Earaches	42%	59%
2. Ear injury	2%	0%
3. Drainage from ears	11%	31%
4. Perforated eardrum	2%	0%
5. Swimmer's ear	2%	3%
6. Other ear trouble	24%	17%
(Ear infections)	(N=7)	(N=5)
(Earaches)	(N=1)	
(Tubes in ears)	(N=1)	
(Doctor said ears were red)	(N=1)	
(Infant)	(N=1)	
7. Ear operation	7%	17%
Total Abnormality: Ear History		
Abnormal on any of the conditions in questions #1-7	51%	62%

(4) The response "infant" reported by the parents was interpreted as indicating ear problems during infancy.

Total abnormality was computed for reported ear history of AA and EA subjects; see Table VII. Any subject was considered abnormal if he/she was abnormal for any one of the conditions in questions #1-#7. Total abnormality on the ear history was 51% for AA subjects and 62% for EA subjects. The comparison of the results between these two groups was made using a chi-square analysis (Walpole, 1982). The results comparing males, females, and males and females combined are shown in Table VIII. Though the percentage of abnormality was lower for AA subjects than for EA subjects in each group, the differences between groups were not significant ($p>0.05$).

OTOSCOPIC SCREENING/TYMPANOMETRY

The otoscopic screening results for external ear and middle ear abnormalities, as well as for tympanometry, are shown in Table IX. The only external ear abnormality detected with the otoscopic screening was drainage in the ears of two EA subjects. (As described in the Procedures, there were six AA subjects and six EA subjects who were not included in this study because of impacted cerumen in one or both ears). With the otoscopic screening, the only middle ear abnormalities detected were the presence of PE tubes. Two percent of the AA subjects had bilateral PE tubes (one subject) and seven percent of the EA subjects had bilateral PE tubes (two subjects).

Table VIII. Percentage of subjects with abnormal ear histories (HX) for African-American (AA) and European-American (EA) subjects using chi-square analysis.

	Male	Female	Combined
AA Abnormal HX	52% (12/23)	50% (11/22)	51% (23/45)
EA Abnormal HX	71% (10/14)	53% (8/15)	62% (18/29)
X^2 (AA vs EA)=	1.34*	0.04*	0.85*

* (df=1, p>0.05, not significant)

Table IX. Percentage of subject ears with abnormality reported on the otoscopic screening and tympanometry for African-American and European-American subjects.

	African-Americans N=45		European-Americans N=29	
Ears:	Right	Left	Right	Left
OTOSCOPIC SCREENING: External Ear Abnormalities				
1. Blood (effusion)	0%	0%	0%	0%
2. Drainage (fluid)	0%	0%	0%	7%
3. Soreness	0%	0%	0%	0%
4. Collapsed ear canal	0%	0%	0%	0%
5. Fungus	0%	0%	0%	0%
6. Impacted/excessive cerumen	0%	0%	0%	0%
7. Foreign body in ear canal	0%	0%	0%	0%
8. Trauma	0%	0%	0%	0%
OTOSCOPIC SCREENING: Middle Ear Abnormalities				
9. PE tubes	2%	2%	7%	7%
10. Bulging eardrum	0%	0%	0%	0%
11. Perforation	0%	0%	0%	0%
12. Inflammation	0%	0%	0%	0%
TYMPANOMETRY				
13. Ear canal volume	7%	9%	3%	21%
14. Static admittance	11%	13%	21%	10%
15. Tympanometric width	29%	29%	31%	31%
TOTAL ABNORMALITY: Otoscopic Screening/Tympanometry Abnormal for either ear on any of the conditions in items #1-15		49%		59%

For individual tympanometric measures, there was no consistent trend in the prevalence of abnormality between AA and EA subjects, for right and left ears considered separately. However, the prevalence of abnormality was consistently less for AA subjects for right and left ear combined: ear canal volume: AA=8%, EA=12%; static admittance: AA=12%, EA=16%; and tympanometric width: AA=29%, EA=31%.

Total abnormality was computed for otoscopic screening/ tympanometry; see Table IX. However, abnormality was not calculated for the fifteen conditions on Table IX separately. Any subject was considered abnormal if he/she was abnormal in any one of the conditions in items #1-#15. Total abnormality on the otoscopic screening/tympanometry was 49% for AA subjects and 59% for EA subjects. The comparison of the results between these two groups was made using a chi-square analysis (Walpole, 1982). The results comparing males, females, and males and females combined are shown in Table X. Though the percentage of abnormality was lower for AA subjects than for EA subjects in each group, the differences between males, females, and males and females combined were not significant ($p>0.05$).

ASSOCIATION BETWEEN RESULTS FOR EAR HISTORY AND OTOSCOPIC SCREENING/TYMPANOMETRY

The association between ear history and otoscopic screening results was examined to determine if the information obtained on the history was closely related to the information obtained by

Table X. Percentage of subjects with abnormal findings on otoscopic screening (OS) or tympanometry (T) and a comparison of findings for African-American (AA) and European-American (EA) subjects using chi-square analysis.

	Male	Female	Combined
AA Abnormal OS/T	52% (12/23)	45% (10/22)	49% (22/45)
EA Abnormal OS/T	57% (8/14)	60% (9/15)	59% (17/29)
X^2 (AA vs EA)=	0.01*	0.75*	0.67*

* (df=1, $p>0.05$, not significant)

examination and measurement. The association between results obtained by reported ear history and by otoscopic screening/ tympanometry are shown in Table XI. The results are shown separately for AA and EA subjects. The associations were evaluated using chi-square analyses (Walpole, 1982). The association between ear history and otoscopic screening/tympanometry was not significant for AA or EA subjects ($p>0.05$). The lack of association indicates that reported ear history and otoscopic screening/ tympanometry measure substantially different aspects of auditory abnormality.

Table XI. Association between abnormal ear history (HX) and abnormal otoscopic screening/tympanometry (OS/T) evaluated using chi-square analysis for African-American (AA) and European-American (EA) subjects.

AA Subjects

		HX	
		Normal	Abnormal
OS/T	Normal	13	10
	Abnormal	9	13

58% agreement between HX and OS/T

X^2 (df=1) = 1.10, p>0.05, not significant.

EA Subjects

		HX	
		Normal	Abnormal
OS/T	Normal	4	8
	Abnormal	7	10

48% agreement between HX and OS/T

X^2 (df=1) = 0.18, p>0.05, not significant.

CHAPTER V

DISCUSSION

REPORTED EAR HISTORY

In the present study the ear history questionnaire was patterned after the U.S. Public Health Survey (1972). The experimental subjects in the present study were lower socioeconomic class children in the age range of 3-5 years, whereas the subjects in the U.S. Public Health Survey were children in the age range of 6-11 years from mixed socioeconomic classes. The results of the present study were compared to the results of the U.S. Public Health Survey for six year olds--the age group closest to the age group in the present study; see Table XII.

The data on the drum opened/perforation condition and the data on the "other ear trouble" condition was reported, but will not be discussed because for the drum opened condition the sample size obtained in the present study was insufficient and for the "other ear trouble" condition, there is the possibility that the question was interpreted differently by respondents in the two studies.

For the two remaining questions (earaches and running ears/ drainage) considered for AA and EA subjects, the reported abnormality was greater in every case in the present study. If this were due to the age of the subjects, it would be expected that the six year olds would have more reported past and/or present ear abnormalities because they had lived longer. However, the results of

Table XII. Percentages of abnormalities reported on ear histories. A comparison of U.S. Public Health Survey (USPHS), 1972 and the present study for African-American (AA) and European-American (EA) subjects.

	USPHS (1972) Mixed Class 6 year olds	Present Study Lower Class 3-5 year olds
Reported Condition	% Abnormal EA/AA	% Abnormal EA/AA
Earaches	30.1%/16.0%	59%/42%
Running Ears/ Drainage	12.6%/9.4%	31%/11%
Drum Open/ Perforation	3.6%/3.2%	2%/0%
Other Ear Trouble	6.2%/2.6%	17%/24%

the present study indicate the opposite: the percentage of 3-5 year olds with abnormalities is substantially greater than 6 year olds in the U.S. Public Health Survey. Instead, it is hypothesized that this large difference is due to socioeconomic factors: the mixed class in the U.S. Public Health Survey study may have less abnormality than the lower socioeconomic class in the present study.

COMPARISON OF TYMPANOMETRY

To compare the results of the present study with those of Robinson & Allen (1984) and Robinson et al. (1988), it was necessary to compare results based on tympanometric classification alone. This was necessary because the Robinson & Allen (1984) and Robinson et al. (1988) did not use otoscopic screening as a part of their criteria for abnormality. The results of this comparison are shown in Table XIII. Two generalizations can be made: (1) within either ethnic group, the prevalence of tympanometric abnormality is greater in the lower class than in the middle class; and (2) for the three age groups studied, the prevalence of tympanometric abnormality is greater for EA subjects than AA subjects.

When comparing the present study with Robinson et al. (1988) based on the same socioeconomic class, the percentages of abnormality for EAs are similar in the two studies. The percentage of abnormality for AAs are different. This suggests that lower socioeconomic class AAs experience more abnormality with increased age, while the prevalence of abnormality for lower socioeconomic class EAs remains constant. In a comparison between the present

Table XIII. Percentages of abnormality reported by tympanometry for three studies.

Robinson, Allen & Root (1988) Lower Class 6-13 months	Robinson & Allen (1984) Middle Class 30-48 months	Present Study Lower Class 36-60 months
% Abnormal EA/AA	% Abnormal EA/AA	% Abnormal EA/AA
57%/33%	38.0%/23.3%	58%/49%

study and Robinson & Allen (1984) based on similar age ranges, the percentage of abnormality of lower socioeconomic class AAs is higher than that of middle socioeconomic class AAs. This suggests that the prevalence of lower socioeconomic class AAs percentage of abnormality appears to increase.

The effect of socioeconomic class on tympanometric abnormality was determined by comparing the results obtained in the two studies using children in the 30-60 month age range (Robinson & Allen, 1984; present study). The prevalence of abnormality was greater for children in the lower socioeconomic class. This finding was obtained for both AA and EA subjects.

The results for the two studies in tympanometry conducted on lower socioeconomic class children (Robinson et al., 1988; present study), suggest that there may be differences between AAs and EAs with respect to age. The percentages of tympanometric abnormality for 6-13 month old EAs and 36-60 month old EAs was 57% and 58% percent respectively. However, for the same age groups of AAs the percentage of abnormality increased from 33% to 49%. These data suggest that AAs have an advantage early in life that they may lose over time, if exposed to disadvantages common in a lower socioeconomic class. Those disadvantages may be poor environment and poor medical care.

CONCLUSION

In the present study there was an ethnic advantage for AAs for both reported ear history and otoscopic screening/tympanometry.

For both procedures EAs were 1.2 times as likely to be abnormal than AAs. Though previous investigators have reported significant differences between EA and AA subjects, the differences obtained in the present study between the two groups were not statistically significant. The major finding of the present study may be that factors associated with socioeconomic class affect the ethnic advantage observed for AAs. The present study suggests that the ethnic advantage present near birth is not maintained for lower socioeconomic class AA children as it is for middle socioeconomic class AA children.

IMPLICATIONS FOR FUTURE RESEARCH

The following areas of investigation are suggested for further research:

(1) Study of AA and EA children and the prevalence of external and middle ear abnormality regarding the effect of socioeconomic factors on the occurrence of external and middle ear abnormality.

(2) Longitudinal study that investigates AA children at various socioeconomic levels, considering Doyle's theory (1977) that there may be mechanical and/or anatomical differences that allow the middle ear to drain more readily in AAs.

(3) An examination of hearing threshold levels between AA and EA children, considering Royster & Thomas (1979) and Royster et al.'s findings (1980) that AAs had better mean hearing thresholds than EAs for pure-tones.

(4) An examination regarding the mechanical and/or anatomical differences between eustachian tubes of AA and EA children and their relation to differences in the prevalence of ear disease and abnormality.

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APPENDICES

APPENDIX A

SUBJECT CONSENT FORM

INFORMED CONSENT FORM FOR STUDY

I. DESCRIPTION

This research is for the preparation of a master's thesis titled **"External and Middle Ear Disease and Dysfunction in African-American and European-American Children in A Head Start Program".** I would like to include your child in my research. Your permission is requested for your child to participate in this study on ear problems in preschool children.

The study has three parts and will take about 5 minutes:
1) You will be asked to answer several questions about your child's ears and ear problems.
2) Your child's ears will be examined with an otoscope. An otoscope is an instrument that a doctor would use to examine a person's ear.
3) An ear test called tympanometry will be performed.

Tympanometry measures the movement of the eardrum and middle ear. This test is done as part of the regular Head Start screening program. The purpose of the study is to determine how common ear problems occur in Head Start children.

All of the above tests are routine clinical procedures that have very few risks. Your child may not benefit directly from this study, however, you and your child will have contributed to the understanding of middle ear function.

II. CONFIDENTIALITY

Any information obtained about your child in this study will be confidential. Records with your child's name will be kept in locked files. Your child's research records, just like hospital records, may be subpoenaed by court order. Your child's identity will not be revealed in any description or publication of this research.

III. RIGHT TO REFUSE OR TO END PARTICIPATION

You are free to refuse your child's participation in this study or to withdraw at any time without having it affect your child's care in the Head Start Program.

IV. VOLUNTARY CONSENT

A. Personal Interview

Any questions you may have about the above materials will be answered by the principal investigator of this study, Jeanine Jackson, at 974-1785. If you have further questions, you may contact the co-principal investigator, Dr. James W. Thelin, at 974-1796. A copy of this consent form will be given to you. Your signature below means that you have freely agreed that your child may participate in this experimental study.

_____

signature of parent or guardian date

_____

signatur of witness date

B. Telephone Interview

I, Jeanine Jackson, certify that I have explained to the above individual the nature and purpose, the potential benefits, and the possible risks associated with his or her child's participation in this research study. I have answered any questions that have been raised.

Consent was obtained over the telephone on _____ (date) at _____ (time). Approval was obtained from _____ (relation to child) _____. The telephone conversation was recorded. A copy of the consent form will be mailed to each parent or guardian, and will be returned to me signed by each parent or guardian.

_____

Jeanine A. Jackson, Principal Investigator date

APPENDIX B

EXTERNAL AND MIDDLE EAR QUESTIONNAIRE

EXTERNAL AND MIDDLE EAR QUESTIONNAIRE

Child:_____ Date of birth:_____
Date:_____ Sex:_____
Parent:_____ Guardian:_____

HAS YOUR CHILD EVER HAD ANY OF THE FOLLOWING IN EITHER EAR:

CIRCLE YOUR ANSWER

1. EARACHES	YES	NO	DON'T KNOW
2. EAR INJURY OR DAMAGE	YES	NO	DON'T KNOW
3. DRAINAGE FROM EARS	YES	NO	DON'T KNOW
4. PERFORATED EARDRUM	YES	NO	DON'T KNOW
5. SWIMMER'S EAR	YES	NO	DON'T KNOW
6. OTHER EAR TROUBLE	YES	NO	DON'T KNOW

IF YES, EXPLAIN_____

7. EAR OPERATION	YES	NO	DON'T KNOW

IF YES, WHAT OPERATION_____

APPENDIX C

OTOSCOPY CHECK-LIST

OTOSCOPY CHECK-LIST

SUBJECT #_____ DATE_____

A. External Ear Abnormalities:

_____ **Blood or effusion

_____ Pressure-equalization (PE) tubes

_____ **Drainage or fluid

_____ **Soreness _____Pinna _____EAC

_____ Collapsed

_____ **Fungus

_____ ***Impacted/excessive cerumen

_____ ***Foreign body in ear canal

_____ ***Trauma

B. Middle Ear Abnormalities:

_____ **Bulging eardrum

_____ Perforation

_____ **Inflammation

** MEANS FAIL - DO NOT PROCEED WITH TYMPANOMETRY

*** ELIMATE

APPENDIX D

RAW DATA FOR EAR HISTORY

Table D1. Ear history data for African-American male (AAM) subjects. The presence of any of the following conditions is indicated by an X: earache (EA), ear injury (EI), drainage (D), perforated eardrum (PE), swimmer's ear (SE), other ear trouble (OET), and ear operation (EO).

Subject	Age (months)	EA	EI	D	PE	SE	OET	EO
AAM 1	56							
AAM 2	51							
AAM 3	54							
AAM 4	59	X						
AAM 5	54	X						
AAM 6	50	X		X			X	
AAM 7	37							
AAM 8	54	X					X	
AAM 9	51	X						
AAM 10	52	X		X				X
AAM 11	36							
AAM 12	49							
AAM 13	58							
AAM 14	52							
AAM 15	52	X		X			X	X
AAM 16	42	X						
AAM 17	50	X						
AAM 18	53							
AAM 19	57	X	X				X	
AAM 20	51							
AAM 21	51	X		X				X
AAM 22	51	X					X	
AAM 23	51	X					X	
AAM 24	57							

Table D2. Ear history data for African-American female (AAF) subjects (see Table D1 legend).

Subject	Age (months)	EA	EI	D	PE	SE	OET	EO
AAF 1	47	X						
AAF 2	52							
AAF 3	57	X		X				
AAF 4	55							
AAF 5	49						X	
AAF 6	58	X					X	
AAF 7	49							
AAF 8	48						X	
AAF 9	52	X				X		
AAF 10	53							
AAF 11	56							
AAF 12	54						X	
AAF 13	60	X						
AAF 14	40							
AAF 15	54						X	
AAF 16	52	X						
AAF 17	50						X	
AAF 18	52							
AAF 19	52							
AAF 20	53							
AAF 21	50							
AAF 22	50	X			X			

Table D3. Ear history data for European-American male (EAM) subjects (see Table D1 legend).

Subject	Age (months)	EA	EI	D	PE	SE	OET	EO
EAM 1	37							
EAM 2	59	X					X	
EAM 3	59	X		X				
EAM 4	49							
EAM 5	58			X				
EAM 6	46	X		X				X
EAM 7	54	X		X				
EAM 8	59							
EAM 9	54	X		X		X	X	X
EAM 10	58	X						
EAM 11	52	X					X	X
EAM 12	53	X						X
EAM 13	57							
EAM 14	60	X		X				

Table D4. Ear history data for European-American female (EAF) subjects (see Table D1 legend).

Subject	Age (months)	EA	EI	D	PE	SE	OET	EO
EAF 1	51							
EAF 2	50							
EAF 3	54							
EAF 4	58	X						
EAF 5	55	X						
EAF 6	59	X		X				
EAF 7	56	X						
EAF 8	55	X						
EAF 9	59	X						
EAF 10	40							
EAF 11	40							
EAF 12	56							
EAF 13	59							
EAF 14	49	X		X			X	X
EAF 15	49	X		X			X	

APPENDIX E
RAW DATA FOR
OTOSCOPIC SCREENING

Table E1. Otoscopic screening data for African-American male (AAM) subjects for left and right ears. Abnormality is indicated by an X for two conditions: PE tubes and drainage or fluid. No listing was made for the following external conditions because none of these conditions were present in the experimental group: blood or effusion, soreness, collapsed ear canal, fungus, impacted/excessive cerumen, foreign body, trauma amd the following middle ear conditions: bulging eardrum, perforation, and inflammation.

Subject	Age	PE tubes		Drainage or fluid	
		L	R	L	R
AAM 1	56				
AAM 2	51				
AAM 3	54				
AAM 4	59				
AAM 5	54				
AAM 6	50				
AAM 7	37				
AAM 8	54				
AAM 9	51				
AAM 10	52				
AAM 11	36				
AAM 12	49				
AAM 13	58				
AAM 14	52				
AAM 15	52	X	X		
AAM 16	42				
AAM 17	50				
AAM 18	53				
AAM 19	57				
AAM 20	51				
AAM 21	51				
AAM 22	51				
AAM 23	57				

Table E2. Otoscopic screeing data for African-American female (AAF) subjects for left and right ears (see Table E1 legend).

Subject	Age (months)	PE tubes L	PE tubes R	Drainage or fluid L	Drainage or fluid R
AAF 1	47				
AAF 2	52				
AAF 3	57				
AAF 4	55				
AAF 5	49				
AAF 6	58				
AAF 7	49				
AAF 8	48				
AAF 9	52				
AAF 10	53				
AAF 11	56				
AAF 12	54				
AAF 13	60				
AAF 14	40				
AAF 15	54				
AAF 16	52				
AAF 17	50				
AAF 18	52				
AAF 19	52				
AAF 20	53				
AAF 21	50				
AAF 22	50				

Table E3. Otoscopic screening data for European-American male (EAM) subjects for left and right ears (see Table E1 legend).

Subject	Age (months)	PE tubes L	PE tubes R	Drainage or fluid L	Drainage or fluid R
EAM 1	37				
EAM 2	59				
EAM 3	59				
EAM 4	49				
EAM 5	58				
EAM 6	46				
EAM 7	54				
EAM 8	59				
EAM 9	54	X	X		
EAM 10	58				
EAM 11	52	X	X	X	
EAM 12	53				
EAM 13	57				
EAM 14	60				

Table E4. Otoscopic screening data for European-American female (EAF) subjects for left and right ears (see Table E1 legend).

Subject	Age (months)	PE tubes (L)	PE tubes (R)	Drainage or fluid (L)	Drainage or fluid (R)
EAF 1	51				
EAF 2	50				
EAF 3	54				
EAF 4	58				
EAF 5	55				
EAF 6	59			X	
EAF 7	56				
EAF 8	55				
EAF 9	59				
EAF 10	40				
EAF 11	40				
EAF 12	56				
EAF 13	59				
EAF 14	49				
EAF 15	49				

APPENDIX F

RAW DATA FOR TYMPANOMETRIC MEASURES

Table F1. Tympanometric data for African-American male (AAM) subjects for left and right ears.

Subject	Age (months)	Ear canal volume (ml) L/R	Static admittance (ml) L/R	Tymp. width (daPa) L/R	Middle ear pressure (daPa) L/R
AAM 1	56	1.14/.97	.36/.21	186/152	20/40
AAM 2	51	.80/.72	.44/.48	140/144	-85/-125
AAM 3	54	.61/.77	.39/.32	161/171	-210/-90
AAM 4	59	.71/.59	.62/.29	227/163	-100/-175
AAM 5	54	1.20/1.24	.64/.83	161/124	-35/-30
AAM 6	50	.79/.82	.29/.24	190/198	-50/-20
AAM 7	37	.70/.72	.37/.34	173/204	-80/-175
AAM 8	54	.63/.61	.08/.11	30/20	-305/65
AAM 9	51	.85/.87	.99/1.08	126/127	-160/-75
AAM 10	52	.81/.74	.92/.50	76/91	-55/5
AAM 11	36	.99/.76	.57/.53	255/153	-205/-185
AAM 12	49	.89/1.12	.41/.49	127/184	-5/-45
AAM 13	58	.86/.80	.51/.35	100/125	-45/-25
AAM 14	52	.58/.67	.31/.31	145/144	-10/-80
AAM 15	52	6.77/5.39	NA/NA	NA/NA	NA/NA
AAM 16	42	.68/.67	.82/.72	120/112	5/-65
AAM 17	50	.55/.71	.35/.36	142/153	-25/0
AAM 18	53	.58/.50	.40/.42	140/166	-15/10
AAM 19	57	.63/.69	.61/.84	146/144	-185/-90
AAM 20	51	.60/.55	.36/.45	148/137	-60/-60
AAM 21	51	6.65/.90	NA/.52	NA/164	NA/10
AAM 22	51	.73/.74	.61/.87	176/117	-195/-65
AAM 23	57	.56/.66	.58/.41	122/133	-25/-10

Table F2. Tympanometric data for African-American female (AAF) subjects for left and right ears.

Subject	Age (months)	Ear canal volume (ml) L/R	Static admittance (ml) L/R	Tymp. width (daPa) L/R	Middle ear pressure (daPa) L/R
AAF 1	47	.76/.62	.35/.36	138/129	-125/-30
AAF 2	52	.59/.58	.47/.50	129/140	-15/-25
AAF 3	57	.58/.57	.45/.34	142/143	5/-5
AAF 4	55	.46/.51	.54/.77	163/121	-95/5
AAF 5	49	.85/.79	.49/.66	141/134	0/-45
AAF 6	58	.61/.53	1.05/.75	95/116	-235/-205
AAF 7	49	.73/.72	.35/.32	135/132	35/25
AAF 8	48	.55/.43	.72/.50	149/100	-165/-40
AAF 9	52	.54/.61	.23/.28	163/152	-10/10
AAF 10	53	.96/1.25	.66/.44	128/137	10/10
AAF 11	56	.65/.70	.93/.79	121/123	-20/20
AAF 12	54	.91/.85	NA/NA	NA/NA	NA/NA
AAF 13	60	.77/.57	.46/.41	126/146	-20/-30
AAF 14	40	.92/.86	.52/.57	138/140	-35/-30
AAF 15	54	.66/.72	.18/.34	169/140	10/-35
AAF 16	52	.78/.65	1.10/.99	131/129	-35/-110
AAF 17	50	.57/.56	.45/.31	80/139	-5/-15
AAF 18	52	.77/.82	.24/.15	171/154	5/-5
AAF 19	52	.57/.59	.14/.20	208/205	-55/-110
AAF 20	53	.66/.65	.49/.55	111/117	20/-25
AAF 21	50	.56/.61	.38/.39	176/178	-50/-25
AAF 22	50	.83/1.00	.36/.41	141/192	-40/-30

Table F3. Tympanometric data for European-American male (EAM) subjects for left and right ears.

Subject	Age (months)	Ear canal volume (ml) L/R	Static admittance (ml) L/R	Tymp. width (daPa) L/R	Middle ear pressure (daPa L/R
EAM 1	37	.77/.72	.23/.29	177/157	-5/10
EAM 2	59	.66/.73	.50/.43	125/135	-140/-125
EAM 3	59	.75/.84	.28/.64	165/263	-30/-30
EAM 4	49	.65/.64	.14/.16	162/163	15/10
EAM 5	58	.77/.74	.43/.72	127/121	-40/-30
EAM 6	46	.96/.80	.68/.50	161/134	5/-5
EAM 7	54	.66/.65	.11/.25	192/149	-5/-15
EAM 8	59	.57/.57	.31/.30	145/134	-80/-115
EAM 9	54	8.76/9.03	NA/NA	NA/NA	NA/NA
EAM 10	58	.71/.71	.49/.46	147/134	-25/-20
EAM 11	52	7.75/CNT	NA/CNT	NA/CNT	NA/CNT
EAM 12	53	.81/.76	.45/.29	157/177	-115/-270
EAM 13	57	.68/.77	.62/.56	133/127	-160/-55
EAM 14	60	.91/.83	.27/.34	136/143	-20/-5

Table F4. Tympanometric data for European-American female (EAF) subjects for left and right ears.

Subject	Age (months)	Ear canal volume (ml) L/R	Static admittance (ml) L/R	Tymp. width (daPa) L/R	Middle ear pressure (daPa) L/R
EAF 1	51	.63/.59	.33/.23	160/156	-5/-35
EAF 2	50	1.24/.86	.89/.52	168/104	-235/-19
EAF 3	54	.73/.82	.78/NA	140/NA	-5/NA
EAF 4	58	.74/.77	.26/.14	151/192	-85/-60
EAF 5	55	.86/.92	.33/.96	89/81	-235/75
EAF 6	59	CNT/.83	CNT/.56	CNT/80	CNT/-120
EAF 7	56	1.06/.88	.68/.48	120/147	-50/-245
EAF 8	55	.65/.65	.34/.33	120/136	-25/-10
EAF 9	59	.81/.70	.75/.45	182/184	-5/30
EAF 10	40	.76/.76	NA/NA	NA/NA	NA/NA
EAF 11	40	1.14/.73	.59/.40	142/163	-140/-155
EAF 12	56	.97/.89	.40/.40	148/114	30/5
EAF 13	59	.84/.79	.43/.44	105/90	-40/35
EAF 14	49	.76/.71	.35/NA	185/NA	-30/NA
EAF 15	49	.68/.62	.51/.27	118/148	10/-10

APPENDIX G

RAW DATA SUMMARY FOR ABNORMALITIES ON MIDDLE EAR HISTORY AND OTOSCOPIC SCREENING/TYMPANOMETRY

Table G1. Data on abnormality for African-American male (AAM) subjects on ear history (HX) and otoscopic screening/ tympanometry (OS/T). Abnormality is indicated by an X.

Subject	HX	OS/T
AAM 1		X
AAM 2		
AAM 3		X
AAM 4	X	X
AAM 5	X	X
AAM 6	X	X
AAM 7		X
AAM 8	X	X
AAM 9	X	X
AAM 10	X	
AAM 11		
AAM 12		X
AAM 13		
AAM 14		
AAM 15	X	X
AAM 16	X	
AAM 17	X	X
AAM 18		
AAM 19	X	
AAM 20		
AAM 21	X	X
AAM 22	X	
AAM 23		

Table G2. Data on abnormality for African-American female (AAF) subjects on ear history (HX) and otoscopic screening/tympanometry (OS/T). Abnormality is indicated by an X.

Subjects	HX	OS/T
AAF 1	X	
AAF 2		
AAF 3	X	
AAF 4		X
AAF 5	X	
AAF 6	X	X
AAF 7		
AAF 8	X	
AAF 9		X
AAF 10		
AAF 11		
AAF 12	X	X
AAF 13	X	
AAF 14		
AAF 15	X	X
AAF 16	X	X
AAF 17		X
AAF 19		X
AAF 20		
AAF 21		X
AAF 22	X	X

Table G3. Data on abnormality for European-American male (EAM) subjects on ear history (HX) and otoscopic screening/tympanometry (OS/T). Abnormality is indicated by an X.

Subject	HX	OS/T
EAM 1		X
EAM 2	X	
EAM 3	X	X
EAM 4		X
EAM 5	X	
EAM 6	X	X
EAM 7	X	X
EAM 8		
EAM 9	X	X
EAM 10	X	
EAM 11	X	X
EAM 12	X	X
EAM 13		
EAM 14	X	

Table G4. Data on abnormality for European-American female (EAF) subjects on ear history (HX) and otoscopic screening/tympanometry (OS/T). Abnormality is indicated by an X.

Subjects	HX	OS/T
EAF 1		X
EAF 2		X
EAF 3		X
EAF 4	X	X
EAF 5	X	
EAF 6	X	X
EAF 7	X	
EAF 8	X	
EAF 9	X	X
EAF 10		X
EAF 11		X
EAF 12		
EAF 13		
EAF 14	X	X
EAF 15	X	

VITA

Jeanine Angela Jackson was born in New Orleans, Louisiana on November 4, 1969. She attended Cabrini High School in New Orleans, graduating in May 1987. She received her Bachelor of Science degree in Speech-Language Pathology with a minor in Psychology from Xavier University of Louisiana in August 1991. In December 1992, she received a Master of Arts degree from the University of Tennessee, Knoxville. While at the university, she was employed as a graduate assistant in the Department of Audiology and Speech Pathology. Future plans include completing a Clinical Fellowship Year in Audiology, and pursuing certification in Educational Audiology and a doctoral degree in Audiology or Speech and Hearing Sciences