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Screening for Hearing Loss in Juvenile Detention Centers

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Abstract

Results of hearing screenings for 226 incarcerated adolescents are presented. Screenings consisted of visual otoscopy check, pure-tone screening, and tympanometry. Failures were defined as excessive cerumen impeding a clear view of the tympanum, failure to respond at 25 dB HL for 1000 through 6000 Hz, or a Jerger Type B or C tympanogram. An overall failure rate of 35.5 percent was found, with 9.8 percent failing otoscopy, 7.5 percent failing tympanometry, and 25.3 percent failing pure-tone screening. Implications for medical and audiologic evaluation in the population are discussed.

Key Words: Adolescents, detainees, hearing loss, hearing screening, juvenile delinquent

The study of hearing loss and the risk factors involved in hearing loss in adult penal systems has engaged the attention of researchers in the field of communicative disorders since the early 1970s (Bountress and Richard, 1979; Melnick, 1979; Belenchia and Crowe, 1983). Surprisingly, the adolescent counterparts of the adult detainees have attracted very little attention from researchers in the area of audiology (Couzad and Rousey, 1966). The adolescent detained population, operationally defined as all incarcerated males and females between the ages of 5 and 17 years, largely have been neglected by our profession.

A task force to determine prison needs estimated that the prevalence of communication disorders among the adult and juvenile detained populations to be between 10 percent and 15 percent (ASHA, 1973). The 1973 committee report goes on to suggest that the prison populations are likely to have two to five times the prevalence of hearing disorders than noninstitutionalized populations. This assumption was based on the high-risk factors for communication disorders associated with this population.

Although the literature recognizes a higher prevalence of hearing impairment in the prison populations, there is very little agreement among studies. Studies on hearing impairments among prison populations have reported prevalence ranging between 16.8 percent and 48.5 percent (Couzad and Rousey, 1966; Bountress and Richard, 1979; Melnick, 1979; Belenchia and Crowe, 1983; Jacobson et al, 1989). The discrepancy among the data could be attributed to differences in subject response criterion, test environments, calibrated equipment, and subject instructions.

Melnick (1979) administered a pure-tone hearing screening using a 30 dB HL cut-off to 4858 adult inmates with a 40 percent failure rate. In a study of 184 incarcerated adults (Bountress and Richard, 1979), 31 (16.8%) failed pure-tone hearing screenings using a 20 dB HL criterion for failure. Jacobson et al (1989) screened the hearing of 34 incarcerated male drug users using a test battery approach that included pure-tone air audiometry, immittance, and short-latency auditory brainstem responses.

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Twenty-nine percent presented with some degree of hearing impairment.

The detained adolescent population and adult detainees experience similar risk factors. They are known drug users, generally come from a poor socioeconomic environment, and, as a result, often receive deficient health care, are exposed regularly to noise, suffer a variety of head traumas (Palfrey et al, 1983), and have higher rates of sexually transmitted diseases (National Institute of Law Enforcement and Criminal Justice, 1975). These risk factors associated with possible hearing impairment would lead one to surmise that the prevalence of hearing loss among juvenile detainees could be greater than the prevalence of hearing loss among the nondetained adolescent population.

The implications for service providers are confounded by the number of detained adolescents and the demographics of the group. There are 3036 juvenile facilities in the United States. In 1985, there were 83,402 juveniles in custody of privately and publicly run facilities throughout the United States (US Department of Justice, 1989). There are approximately 3335 juveniles in the custody of privately and publicly run Florida facilities. In the state of Florida, juvenile institutions are the responsibility of the Department of Health and Rehabilitative Services (HRS) Children, Youth and Families programs office (American Correctional Association, 1988).

Juveniles in correctional facilities are predominantly male (> 85%) and are of a racial or ethnic minority (> 55%). Eighty-two percent of the youths in correctional facilities are between the ages of 14 and 17 years, with the average age of first arrest being 12.8 years (Council of Scientific Affairs, 1990). The average length of time a juvenile was detained in 1984 was 41 days (American Correctional Association, 1988). The recidivism rate for this population in Florida is reported to be 83 percent (HRS, 1991).

Despite the apparent risk factors, there is a paucity of literature focused on the hearing of incarcerated youths. Couzad and Rousey (1966) reported a hearing screening failure rate of 24.3 percent at two reform schools for detained adolescents in Kansas. This rate was noted to be five times higher than that of the nondelinquent adolescent population at the time. The authors noted that the boys had a much higher prevalence of screening failure at 29.2 percent, compared to 12.5 percent for the girls. This study is limited, however, due to the use of a restrictive 10 dB HL pass criterion for the hearing screening. It should be noted that this screening was completed prior to the current calibration standards (ANSI, 1969). Test environments are described as "adequate" in terms of noise levels for testing.

There has been no recent comprehensive, controlled study done on hearing screening in a delinquent population, and there is a critical need for such a study. The reported hearing screening failure rates in adult penal institutions are two to five times that in the general population. The adolescent population is in the same high-risk group as the adult population. If, indeed, this population has a higher prevalence than the normal adolescent population, a great need for medical care may be going unnoticed. The purpose of the present paper is to report the results of a hearing screening completed within two adolescent penal institutions based on brief case history, otoscopic inspection, pure-tone air-conduction screening, tympanometry, and medical record review.

METHOD

Subjects

A total of 226 juvenile detainees (173 males and 53 females) were screened over an 8-month period. Subjects were incarcerated in two separate regional juvenile detention centers in north central Florida, and they ranged in age from 9 to 18 years, with a mean age of 15.3 years. Specific information regarding the subjects is shown in Table 1. Permission to test the detainees was obtained through the Department of Health and Rehabilitative Services (HRS), State of Florida. Each subject was given an identification number in order to protect anonymity, and only subjects who willingly agreed to be tested participated.

Table 1 Study Demographics

	Both Centers	*Center 1*	*Center 2*
Males	173	41	132
Females	53	34	19
Mean age	15.33	15.06	15.46
Number of subjects	226	75	151

Instrumentation, Materials, and Setting

Screenings consisted of an orally presented yes/no questionnaire, otoscopic inspection, tympanometry, pure-tone screening, and medical record review. Pure-tone screenings were completed with portable audiometers (Maico models 24 and 39). The outputs of the audiometers were routed to TDH-39 earphones housed in 41/AR cushions. The audiometers were electroacoustically calibrated at biweekly intervals according to ANSI standards (ANSI, 1969). Daily subjective listening checks preceded the testing. All auditory stimuli were presented monaurally to each ear. Tympanometry was completed using an American Electromedics 85AR tympanometer. Materials for the study included a 14-item questionnaire (Appendix).

All testing was completed in a quiet detention center classroom or in a corner of a cafeteria (when not in use) treated with sound reduction tile. Sound field measurements were taken with a sound level meter (Quest Model 215, ANSI S1.4 Type 2) and were in accordance with the Occupational Safety and Health Act standards for permissible ambient noise levels for audiometric testing in both centers (Williams-Steiger, 1970). All testing was administered by graduate clinicians in audiology who were supervised by a certified audiologist.

Procedures

Subjects were informed of all aspects of the screening and were instructed prior to each portion. First, the clinician informed the subject of the confidentiality of all questions on the questionnaire. The clinician then asked the subject the 16 questions on the questionnaire, to which the subject could reply yes or no. If the reply was yes, they were asked to elaborate on the response. Otoscopy followed the completion of the questionnaire. Tympanometry and pure-tone air-conduction screening were then completed.

Failures consisted of an inability to view the tympanum on otoscopy, a negative pressure peak (≤ -200 mm H_2O) or noncompliant middle ear system (Jerger Type C or B tympanogram) (ASHA, 1978), or no response at 25 dB HL to pure-tone stimuli at any frequency (1000, 2000, 4000, and 6000 Hz) in either ear. Subjects who failed the screening were referred to the medical staff at the center. Following completion of the screening, subjects' detention center files were examined for possible risk factors for hearing impairment.

RESULTS

Questionnaire

Thirty-one of the subjects noted that they felt they may have a hearing loss. One hundred and thirty of the subjects (58%) reported some type of head trauma (concussion or hard blow to the head) during their lifetimes. Noise exposure would appear to be endemic in this population, with over 70 percent of the subjects reporting listening to music with a boom box or "loud" car stereo often and over 40 percent note using firearms. Thirty percent admitted to working in noisy environments, with 42 percent stating that they engaged in noisy hobbies. Thirty-seven percent reported using street drugs. A positive family history of hearing loss was reported by 22 percent of the subjects.

Audiologic Screening

Subjects were screened with visual otoscopy, tympanometry, and pure-tone evaluation. A total audiologic screening failure (failing one, two, or all tests) rate of 35.4 percent (80 subjects) was found. Twenty-two subjects (9.7%) failed the otoscopic inspection, 17 subjects (7.5%) failed tympanometry, and 59 subjects (26.1%) failed the pure-tone screening. Table 2 shows the failure rates by frequency. It should be noted that 6000 Hz accounted for most of the pure-tone failures. Different types of failure combinations can be found in Table 3.

Medical Record Review

The medical records of 212 subjects were reviewed. Fourteen records were not reviewed as they were unavailable at the time of the review. Of the 212 records reviewed, 76 (36%) had reported a history of drug use, 40 (19%) reported a history of physical abuse, and 32 (15%) had a sexually transmitted disease (chlamydia, gonorrhea, genital warts). Employment history was

Table 2 Total Number of Pure-tone Failures by Ear and Frequency

	Frequency (Hz)			
	1000	*2000*	*4000*	*6000*
Left	9	7	12	35
Right	11	7	7	29

Table 3 Screening Results Delineated by Procedure

Screening Results	*Number of Subjects*	*%*
Pass all	122	54
Pass PT and tympanometry, fail otoscopy	6	2.7
Pass PT and otoscopy, fail tympanometry	5	2.2
Pass PT, fail tympanometry and otoscopy	3	1.3
Pass PT and otoscopy, CNE tympanometry	9	4.0
Pass PT, CNE tympanometry, fail otoscopy	1	0.44
Pass PT and otoscopy, CNE 1 ear tympanometry/pass other ear tympanometry	15	6.6
Pass PT and otoscopy, CNE 1 ear tympanometry/fail other ear tympanometry	1	0.44
Pass PT, CNE 1 ear tympanometry/pass other ear tympanometry, fail otoscopy	5	2.2
Fail PT, pass tympanometry and otoscopy	32	14.2
Fail PT and tympanometry, pass otoscopy	7	3.1
Fail PT, CNE tympanometry, pass otoscopy	6	2.7
Fail PT, CNE 1 ear tympanometry/pass other ear tympanometry, pass otoscopy	7	3.1
Fail PT, pass tympanometry, fail otoscopy	4	1.8
Fail all	1	0.44
Fail PT, CNE tympanometry, fail otoscopy	1	0.44
Fail PT, CNE tympanometry 1 ear/pass other ear, fail otoscopy	1	0.44
Total	226	

PT = pure-tone screening; CNE = could not evaluate.

found in only 100 of the 212 records reviewed. Of the 100 records reviewed for history of a noisy work environment, 23 of the subjects had worked in a noisy environment (lawn mowing, auto mechanic). The results of the medical record review and the case history questionnaire were compared. No significant association could be found between questionnaire responses on the case history and information in the record review for questions related to drug abuse, head trauma, and medication. A significant relation ($p < .01$) was found between the questionnaire and the record review for history of noise exposure at work for those records containing work history data (46% of the subjects). No association was found between audiologic screening results and the questionnaire.

DISCUSSION

The nondetained adolescent population has a reported hearing loss prevalence of 2.63 percent to 8 percent (Lundeen, 1991; Holmes et al, in press). When using similar criteria, the adolescent detained population, as established by this study, has a hearing loss prevalence of 10 percent pure-tone screening at 25 dB at 1000, 2000, and 4000 Hz, which is 10 times the prevalence of the nondetained population and very similar to the results found by Couzad and Rousey (1966), who found an overall failure rate of 24.0 percent. The 1973 ASHA report estimated the detained population to have two to five times the prevalence of hearing disorders than the nondetained population. According to the current investigation, they have underestimated the prevalence of hearing loss in the adolescent detainees. The ASHA report also concluded that the prevalence of communicative disorders in incarcerated juveniles and adults was between 10 percent and 15 percent, again reflecting an underestimation.

The audiologic screening found the most failures occurring at 6000 Hz (see Table 2). This finding is in agreement with a Swedish study conducted on 538 young men aged 17 to 20 years enrolled in vocational school classes. Using a 20 dB HL (International Standards Organization) criterion, 15.5 percent failed the pure-tone screening, with the greatest number of failures noted at 6000 Hz. Six thousand Hz was suggested as an early marker for noise-induced hearing loss (Axelson et al, 1981). The detained population has a greater risk of noise exposure than does the nondetained population, illustrated by the case history questionnaire and record review (noisy work environments, firearm use, loud music, detention centers). Holmes et al (in press) found a failure rate at 6000 Hz of 15.2% in a nonincarcerated sample of 342 high school students. A significant relation was found between a loss at 6000 Hz and admitted firearm use for their subjects.

The current investigation found an immittance failure rate of 7.5 percent and an otoscopic failure rate of 9.7 percent. The combined failure rate for middle ear abnormalities was 15 percent. In a study of 342 nondetained adolescents from the same geographic region, only 4.7 percent failed tympanometric screenings and 9.1 percent failed otoscopy (Holmes et al, in press). A corresponding study performed on adult inmates found a 5.4 percent failure rate attributed to middle ear problems (Bountress and Richard, 1979); however, the authors of this study reported only performing immittance testing on those subjects who had failed the pure-tone screening. When analyzing only those subjects who had failed the pure-tone portion and then also failed the immittance or otoscopic portions in the current investigation, only 7.9 percent of the total population failed. Therefore, the difference in the two investigations' data may be a reflection of different test criteria.

Researchers have found that the rate of otitis media decreases as age increases. For example, a pediatric practice followed the number of otitis media cases by age and found that from birth to 1 year of age, 140 children of 488 had at least one documented case of otitis media, while by the age of 12, only 12 children had a documented case of otitis media (Bess and McConnell, 1981). Based on the current investigation, the detained adolescent population has a much higher than normal failure rate for immittance screening, which may be associated with otitis media.

Approximately 10 percent of the population evaluated failed the screening for cerumen impaction and/or an abnormal appearing ear canal/tympanum. In the 1960s, otoscopy screening was included in the Health Examination Survey (Leske, 1981). Fifteen percent of their subjects aged 12 to 17 years presented with abnormality of at least one tympanic membrane and 10 percent presented with occlusion of the external ear canal for a 25 percent overall failure rate. The difference in results between studies may be a result of the training levels of the examiners. While graduate students in audiology were used in the current study, otoscopy in the Health Examination Survey was conducted by pediatricians trained in otolaryngologic evaluations (Roberts and Ahuja, 1975). The 9.7 percent failure rate is, however, similar to the 9 percent otoscopic failure rate found by Holmes et al (in press) in a nondetained adolescent population from the same geographic area as that of the current study.

Previous studies on the incarcerated adult and juvenile populations revealed varying results. These studies, however, have demonstrated a much higher than "normal" failure rate of audiologic screening within this population. All reported failure rates for audiologic screening within the normal population and incarcerated adult and juvenile populations can be seen in Table 4.

Although a great deal of pragmatic information was obtained by the case history questionnaires and medical record reviews, it was readily apparent that the subjects in this study were poor historians. All medical case history information is obtained from the detainees upon entry to the center. The fact that there appears

Table 4 Comparison of Studies

	Melnick, 1979	*Couzad and Rousey, 1966*	*Bountress and Richard, 1979*	*Axelson et al, 1981*	*Belenchia and Crow, 1983*	*Jacobson et al, 1989*	*Lundeen, 1991*	*Holmes et al, in press*	*Current Study, 1994*
Total subjects	4885	300	184	538	136	34	38,000	362	226
Ages (yr)	16–71+	10–18	16–58	17–20	16–60	18–35	5–17	10–20	12–18
Tests used	Pure tone > 30 dB HL	Pure tone > 10 dB HL	Pure tone > 20 dB HL immittance	Pure tone > 20 dB HL	Pure tone > 20 dB HL	Pure tone > 20 dB HL ABR immittance	Pure tone > 25 dB HL	Pure tone > 25 dB HL immittance otoscopic	Pure tone > 25 dB HL immittance otoscopic
Failures (%)	40.0	24.0	16.8	15.5	48.5	29.4	2.63	21.3	35.4
Population	Inmates	Juvenile detainees	Inmates	Non-detainees	Inmates	Inmates	Non-detainees	Non-detainees	Juvenile detainees

to be a discrepancy in their responses to similar questions over time emphasizes the difficulty in obtaining pertinent and accurate medical history information in order to appropriately treat these young men and women in penal institutions.

Despite the above-noted poor reliability of the questionnaire, 130 (53%) of the 226 subjects reported some type of head trauma (concussion, hard blow) in their lifetime. This number lends additional significance to the assumption of periodic physical abuse sustained by this population, as discussed in the report by the Councils on Scientific Affairs on Health Status of Detained and Incarcerated Youths (Council of Scientific Affairs, 1990). A second study (Palfrey et al, 1983) found that 57 percent of delinquent boys "had experienced two or more adverse health events (such as hospitalization, loss of consciousness, or an automobile accident)." These adverse health events may be one reason that this population has such a high failure rate in hearing screening. No one causal factor can be pinpointed; however, the various risk factors may be the justification for such high screening failure rates.

This study has established that there is a definitive need for increased health care within the centers and that further research is needed to determine why there is a high failure rate in audiologic screenings within this population. Future research and intervention should focus on obtaining more complete, objective data ideally including a comprehensive audiologic examination and a parent/guardian interview to corroborate the subjects' interview responses.

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APPENDIX

Case History Interview Form

NAME: ID#: DOB: DOE:

1.	Do you feel you have a hearing loss? Circle: Right Left Both Describe:	YES	NO
2.	Do you have ringing or buzzing in your ears? Describe:	YES	NO
3.	Do you have a cold or ear infection at the present?	YES	NO
4.	Do you have or have you ever had any earaches?	YES	NO
5.	Are you dizzy? Describe:	YES	NO
6.	Have you ever had a skull fracture?	YES	NO
7.	Have you ever had a concussion or a hard blow to the head?	YES	NO
8.	Are you on any medications? List:	YES	NO
9.	Do you use or have you ever used drugs? List: How often?	YES	NO
10.	Do you use firearms? How often?	YES	NO
11.	Do you listen to music through headphones?	YES	NO
	Do you use a boom box?	YES	NO
	Through a car stereo?	YES	NO
12.	Have you ever worked in a noisy place? Describe:	YES	NO
13.	Do you have any noisy hobbies? List:	YES	NO
14.	Does anyone in your family have a hearing loss or wear a hearing aid?	YES	NO