Adolescents and Hearing Impairment

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In Argentina, a high percentage of young people —between 20 to 25 years of age— are rejected in the pre-occupational medical examination because of hearing loss, despite their not having hearing diseases.

The World Health Organization (WHO), during its 48th Annual Meeting, created a document about hearing damage, its prevention and rehabilitation due to the impact of hearing disorders in the whole world. Argentina is no exception since a high percentage of young people —between 20 to 25 years of age— are rejected in pre-occupational medical examinations because of different degrees of hearing impairment. As an example, around 10% of 5000 applicants to a new factory in our city (Cordoba) were rejected due to hearing loss. This prompted our center to start looking for scientific answers to the current problem in the field of hearing conservation in our country.

It is a well-known fact that young people are exposed to high levels of music during their recreational activities —what is known as non-occupational noise. Yet, not all researchers consider loud music as a cause of hearing loss among non-professional listeners. In order to measure the effect of loud music on the ears of the young, we devised a research program, divided into two stages. The first has been completed.

In the first stage (supported by the German government) we applied a measurement model in accordance with national and international standards for the development of an interdisciplinary long-term study with adolescents of middle socio-economic level, over a period of four years. Nearly 200 adolescents between 14 and 17 years of age were examined annually in order to learn about the effects of non-occupational noise on hearing while taking into account acoustical and psychosocial (psychological and social) variables.

For that purpose, we developed a Psychosocial Study, an Acoustic Study and a Hearing Study. The Psychosocial Study enabled us to know about the adolescents’ recreational habits, their evolution and changes during the four-year period. The findings in the Acoustic Study have revealed the actual sound emission levels which the adolescents were exposed to while participating in typical recreational activities: levels of up to 112.4 dBA in some discos.

In addition, the Hearing Study showed that as of the third year of the study, some of the adolescents in the study group--21 boys and 10 girls--showed evidence of a hearing threshold shift, more than 30 dB in some cases, not observed in the previous years. In
other words, the softest sound they could hear by the third year was in some cases 30
decibels louder than the quietest sound they could hear in the first year. Put simply, they
were already showing signs of hearing impairment. These shifts tended to increase in the
fourth year of the study.

The findings in the third year led us to divide the study group into two subgroups (Figures
1 and 2): Subgroup 1 With Small Shifts (WSS) and Subgroup 2 With Larger Shifts
(WLS).

The figures illustrate mean hearing thresholds (the softest sound a person can hear)
across all sound frequencies (or pitches) tested in the study. Frequencies (measured in
Hertz [Hz]) are represented horizontally across the graphs with low pitches on the left
and increasingly higher pitches on the right. Hearing Level (HL) (measured in decibels
[dB]) is represented vertically down the side of the graph with higher (better) hearing
level towards the top and lower (worse) hearing level farther down.
We have tested the “conventional range of frequencies” (250 – 8000) Hz (necessary for
speech understanding, and measured by the clinical audiometric test) as well as the
“extended high frequency range” (8000 – 16000) Hz, as the human ear is capable of
hearing high pitches (not necessary for the understanding of the spoken word).
We consider a “Normal Hearing Threshold” when the hearing level between
250 Hz and 2000 Hz is ≥ 16 dBHL and when between 3000 Hz and 16000 Hz is ≥ 22
dBHL. Any hearing threshold higher than 16 dBHL and 22 dBHL respectively indicates a
threshold shift.

Figures 1 and 2 below compare the mean hearing threshold of Subgroup 1 and of
Subgroup 2, for the boys and for the girls respectively. Subgroup 2 (WLS) shows a
hearing threshold shift in the extended high frequency range while Subgroup 1 does not.
A mild shift begins to appear in the conventional range for both genders.

![Graph showing mean hearing threshold for both ears of the boys in Subgroup 1 (WSS) and in Subgroup 2 (WLS)]
Figure 2. Mean hearing threshold for both ears of the girls in Subgroup 1 (WSS) and in Subgroup 2 (WLS).

As an example, the following (figure 3) shows the hearing threshold shift of one adolescent of Subgroup 2 observed as from the third year of the study.
Figure 3. Hearing threshold of an adolescent with high participation in music-related and non-music-related activities.

Figure 4 shows the audiogram of an adolescent of Subgroup 1 with high exposure to music: frequent attendance at discos and loud music at home, which had no shift during the four-year study.

It is important to point out that standard clinical hearing tests performed by an audiologist typically measures the hearing thresholds up to 8000 Hz. Therefore, we would recommend to extend the test frequency measurement range to 16000 Hz since hearing changes in this range could act as an early predictor of future development of hearing loss in the speech-understanding frequency range (250 – 8000) Hz and thus prevent “noise induced hearing loss” (NIHL).

The findings have led us to conclude that the exposure to non-occupational noise can seriously damage the ears of adolescents with sensitive ears, thus decreasing their hearing capability at the early ages of only 17/18 years. However, exposure to the same sound levels did not cause hearing damage to other adolescents with less sensitive ears.

Therefore, it would be of vital importance to identify the cause or causes that originate a higher sensitivity of the ears which result in earlier damage by the action of environmental agents. Could this susceptibility of the ears be associated with genetic factors? A great step forward in this area would be to implement special screenings for...
the early detection of hearing disorders triggered by non-occupational noise and to determine their relationship with genetic factors.

In the second stage (supported by the Argentinean Government) we aim at the early detection of hearing disorders and their relationship with the causes which trigger them: acoustic, psychosocial and/or genetic, by means of an Audiological Psycho-Acoustic Screening (APAS) and a Genetic Study; an early intervention by means of counselling, assistance and adequate medical treatment once the disorder has been detected; the prevention of hearing impairment among healthy individuals by means of educational campaigns and the setting up of scientific guidelines of standards and bylaws related to the hearing health.

In May 2006, we started with the Screening of all the third form adolescents (around 200 between 14/15 years of age) attending one of the technical high schools selected, and the same adolescents will be re-tested at the age of 17/18 when finishing high school. The same procedure will be repeated each year upon incorporating new schools to the project, and the educational campaigns will be organized.

When a hearing disorder is detected, the adolescent undergoes a genetic study in order to complete the diagnosis and to receive adequate medical treatment.

Taking the WHO document into consideration and the alarming increase of hearing impairment among the young, we have devised a seven-year program with the idea of making it a permanent one.

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1 The Audiological Psycho-Acoustic Screening was built up on the basis of the tests carried on during the first stage while adding new tests in order to get a more complete and reliable diagnosis and prognosis.