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## THE DEVELOPMENT OF NOISE INDUCED HEARING LOSS DURING THE 1980'S AND THE 1990'S IN THE SWEDISH COUNTY OF ÖSTERGÖTLAND

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**ABSTRACT**

The objective of this study was to investigate the change over time in hearing threshold levels (HTL: s) among employees in different occupations. The question was; does the improvement of HTL: s during the 1970's and 1980's shown in previous studies continue into the 1990's? The subjects were selected from the existing HTL database in the county of Östergötland in Sweden and separated in age groups of 30-39, 40-49 and 50-59 years old. The time periods for audiometry were 1971-1976, 1981-1986 and 1991-1996. The subjects had been exposed to occupational noise more than two hours a day and the categories of occupation were mechanical work and wood processing. A total number of 15054 audiograms were included in the statistical analysis. The results show that the HTL: s of people employed in these occupations have decreased between the 1980's and the 1990's and the trend with decreasing noise-induced hearing loss in Sweden during the 1970's and 1980's continues into the 1990's. The difference between the right and the left ear was also investigated and in all groups with side difference the HTL was larger at the left ear. Possible explanations to the improvement might be a wider use of hearing protectors at work and during military service. The results show that the hearing conservation programs still are meaningful and that the awareness of noise induced occupational hearing loss has improved.

**1 - INTRODUCTION**

In many countries the most prevalent irreversible industrial disease is noise-induced hearing loss [1]. According to the National Board of Occupational Safety and Health in Sweden [2] noise is the third most common cause of occupational disease for men in Sweden. It has been reported that the decrease in prevalence of noise-induced hearing loss in Sweden during the 1970's and 1980's has stopped during the 1990's [3].

The main aim of this study was to investigate the change over time in hearing threshold levels (HTL:s) among employees in different occupations in the Swedish County of Östergötland. The secondary aim was to compare the results to available reference material of normal hearing. The question was: has the improvement of hearing threshold levels during the 1970's and 1980's stopped during the 1990's?

**2 - METHODS**

The audiograms were selected from the existing HTL database in the county of Östergötland in Sweden. The selection criteria were:

- Category of occupation: mechanical work, wood processing
- Age at test: 30-39; 40-49; 50-59 years
- Time period for audiometry: 1971-01-01 to 1976-12-31; 1981-01-01 to 1986-12-31; 1991-01-01 to 1996-12-31

- Noise exposure: >2 hours/day
- Gender: male

The dependent variable was hearing threshold level by air conduction. The test frequencies included in the statistical analysis were 4, 6 and 8 kHz for right and left ears.

The data were summarised as median, 1<sup>st</sup> and 3<sup>rd</sup> quartile values for grouped distributions [4]. A total of 15058 audiograms were included in the statistical analysis unequally distributed over 18 groups. As reference data ISO 1999 database A for males [5] was used. The hearing threshold levels of this highly screened otologically normal population have been corrected according to Passchier-Vermeer [6].

To estimate the number of normal-hearing subjects a classification according to Klockhoff et al [7] was used. Normal hearing was defined as HTL:s less than or equal to 30 dB HL at 500 Hz and less than or equal to 25 dB HL at 1, 2, 3, 4 and 6 kHz.

### 3 - RESULTS

#### 3.1 - Improvement over time

The group of mechanical workers shows a continuing improvement of hearing threshold levels during the 1980's and 1990's for all three age-categories (figures 1, 2 and 3). The group working with wood processing shows an improvement from the 1980's to the 1990's in the youngest age group of 30-39 years (figure 4). The age group 40-49 years improves significantly from the 1970's to the 1990's (figure 5). The age group 50-59 years improves at 4 kHz from the 1970's to the 1990's (figure 6).

The statistically significant average decrease in median hearing threshold levels at 4 and 6 kHz from the 1980's to the 1990's in the youngest age group is 1 to 3 dB. In the age group 40-49 the average decrease is 3 to 6 dB. In the oldest age group the average decrease is 5 to 8 dB. The median hearing threshold levels at 4 kHz and 6 kHz in the 1990's do not differ significantly between wood processing workers and mechanical workers in any age group.

There are also improvements at the frequency 8 kHz. Both among mechanical workers and wood processing workers the youngest age group has improved by 1 to 3 dB. In the age groups 40-49 and 50-59 years only the mechanical workers have changed significantly from the 1980's to the 1990's. The 40-49 years old improve by between 3 and 4 dB and the 50-59 years old by between 5 and 9 dB. There is no significant difference between wood processing workers and mechanical workers at 8 kHz in any age group in the 1990's.

#### 3.2 - Frequency and side differences

All median threshold levels are significantly better at 8 kHz than at 6 kHz in the group of mechanical workers. In the group working with wood processing the result is the same during the 70's and 80's but there is no significant difference between 6 and 8 kHz in the 1990's. There is also a difference between the left and the right ear in many groups. For all groups with such a difference the median threshold level is poorer for the left ear than for the right ear.

#### 3.3 - Normal hearing

The results from the classification show that the percentage of normal hearing subjects increases over time. In the 1990's the percentage of mechanical workers classified as normal-hearing on both ears was 66% among the 30 to 39 year age group, 34% among 40 to 49 years and 13% among 50 to 59 years. In the group of wood workers the figure was 57% among 30 to 39 years, 28% among 40 to 49 years and 11% among 50 to 59 years. Expected percentages with normal hearing are 89% at an age of 39 years, 70% at an age of 49 years and 46% at an age of 59 years.

### 4 - DISCUSSION

#### 4.1 - Improvement over time

The youngest age groups in both occupational categories have median hearing threshold levels in the 1990's as low as is possible to measure at the mixed screening levels of 0, 10 and 20 dB HL which have been used on different occasions. The significant improvement from the 1980's to the 1990's in the youngest age group is probably partly an artefact caused by the increased use of screening level at 10 dB in the 1990's compared to the 1980's. Even if the significant improvements are small in median values the improvements in 3<sup>rd</sup> quartile, which reflects the most sensitive or most exposed part of the population, are obvious.

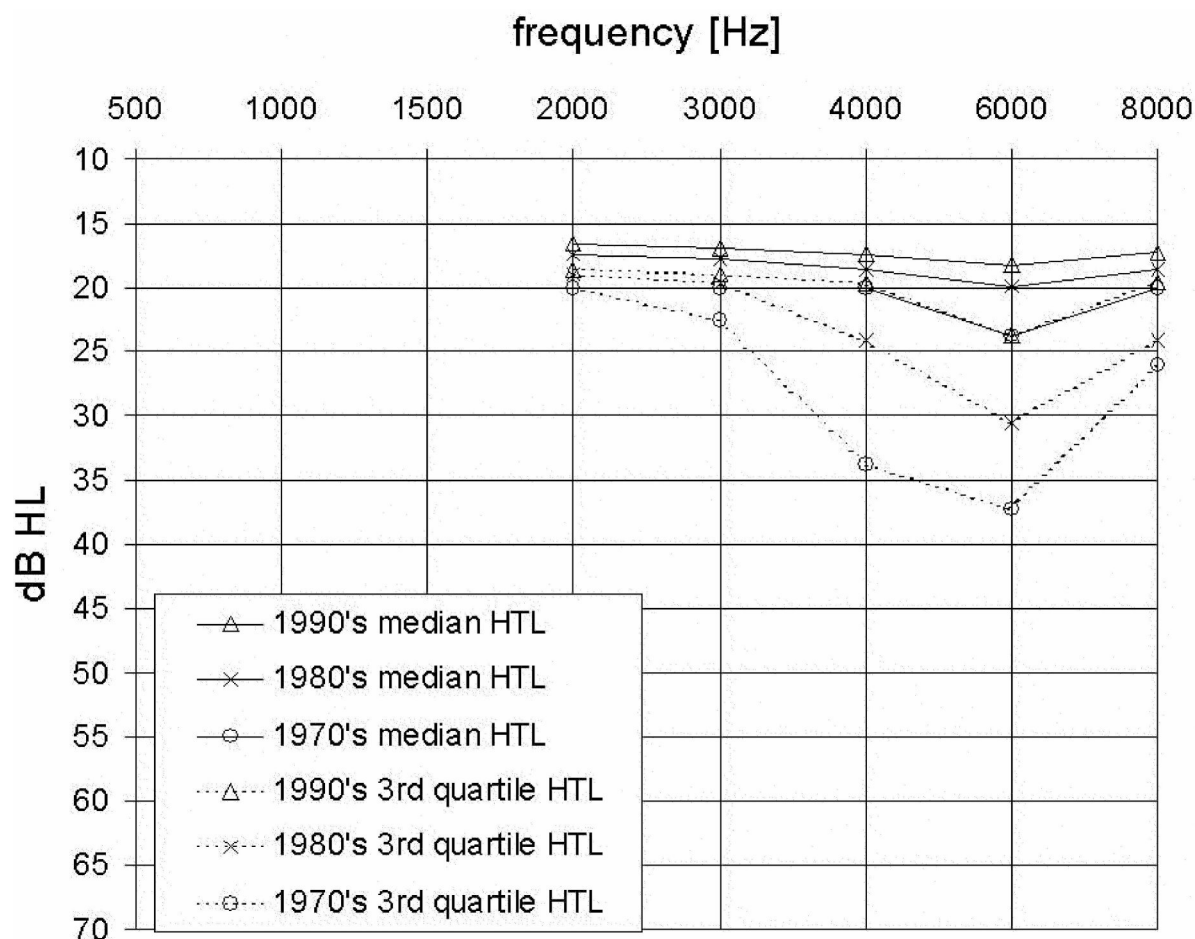


Figure 1: HTL for 30-39 year old men with mechanical work.

#### 4.2 - Normal hearing

In spite of the trend with continuing decrease in median HTL:s and percentage of subjects classified as normal-hearing there is still a large difference to the median HTL:s and estimated percentage of normal-hearing subjects in the reference material.

#### 4.3 - Future research

In the process of performing this study it became clear that the possibility of following population changes with regard to occupational hearing loss has become very limited. Several large databases that were kept active into the early 90's have since been closed down. Since prevention of occupational disease requires constant monitoring and feedback, the lack of such databases in the future may turn into a serious weakness already during the next few years with regard to the epidemiology of occupational noise-induced hearing loss.

### 5 - CONCLUSION

Noise-induced hearing loss is still significant among exposed groups. However, the improvement of hearing threshold levels during the 1970's and 1980's has continued into the 1990's.

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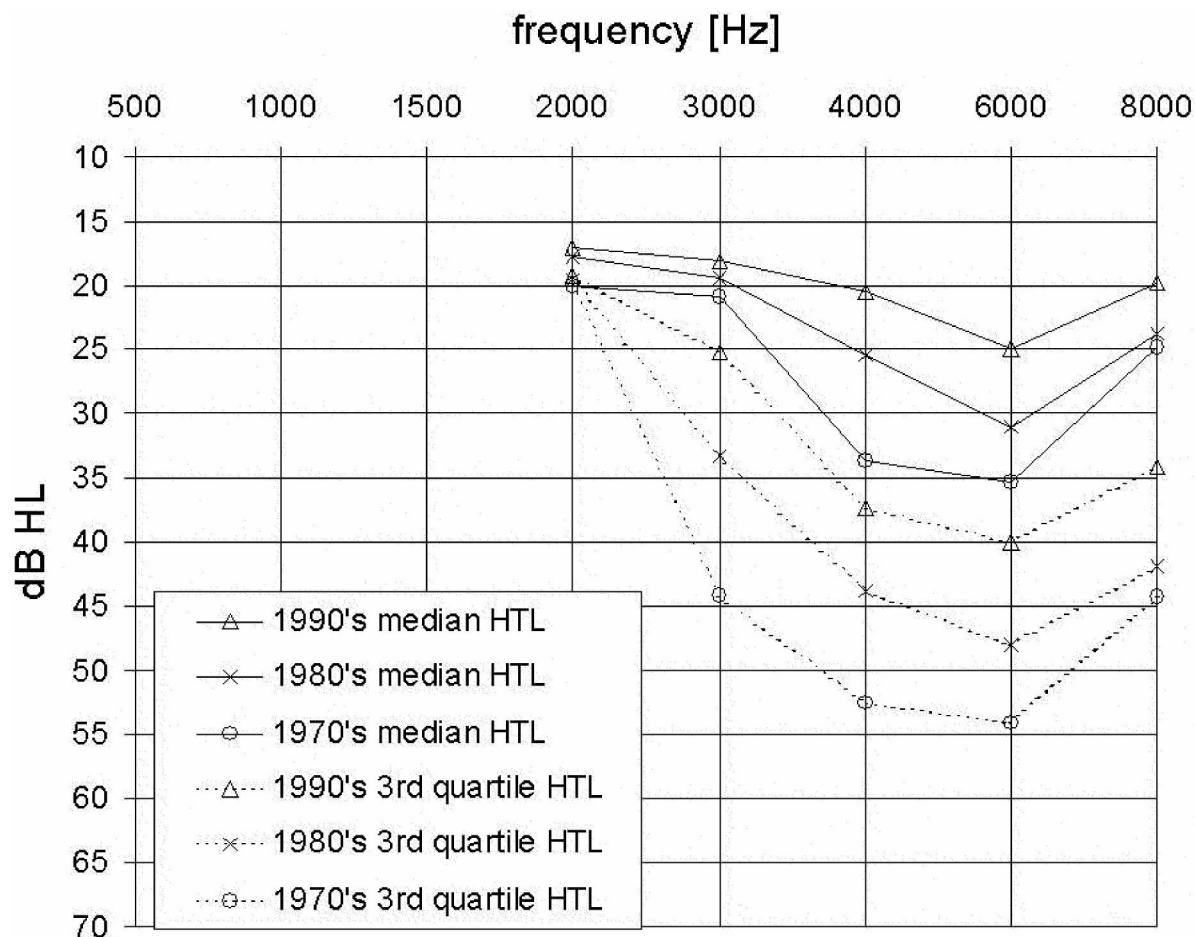


Figure 2: HTL for 40-49 year old men with mechanical work.

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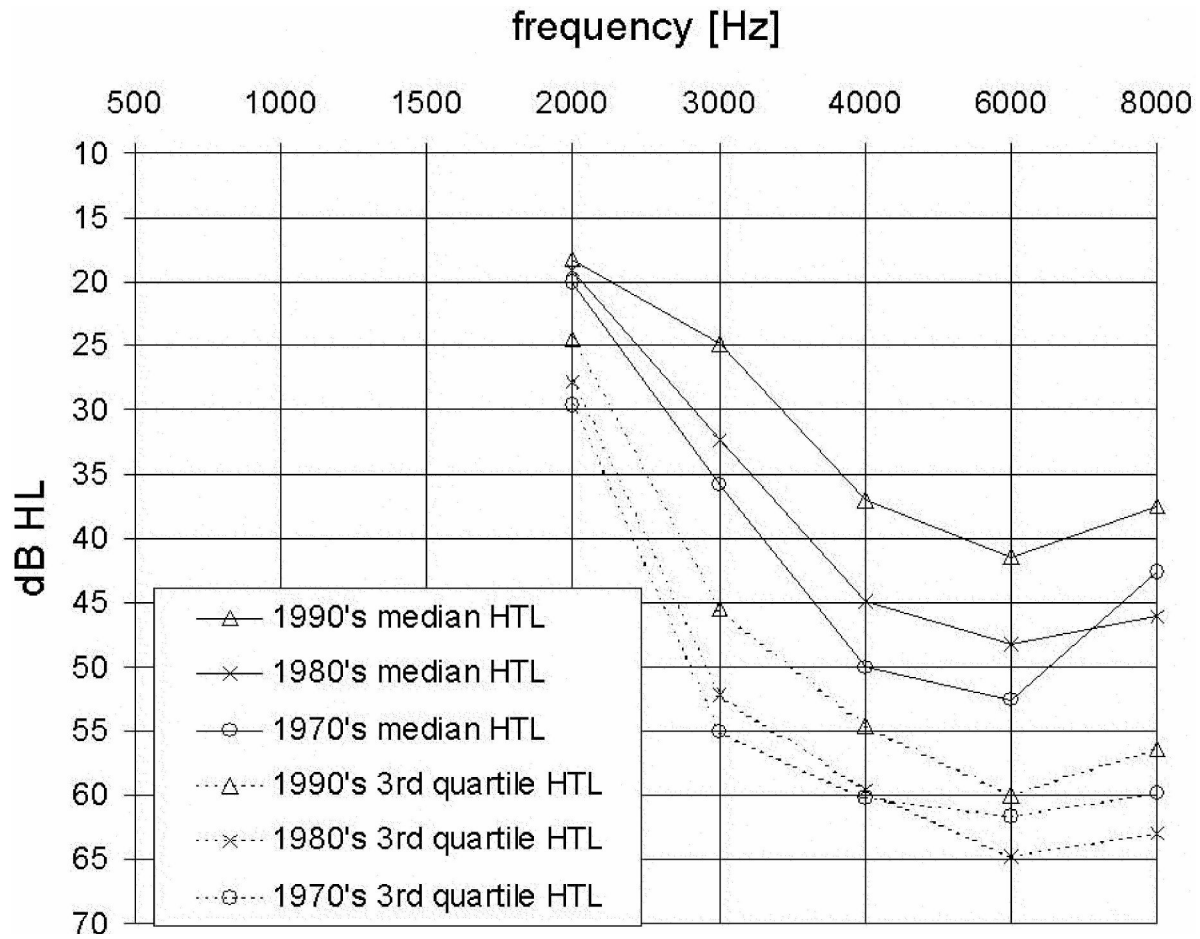


Figure 3: HTL for 50-59 year old men with mechanical work.

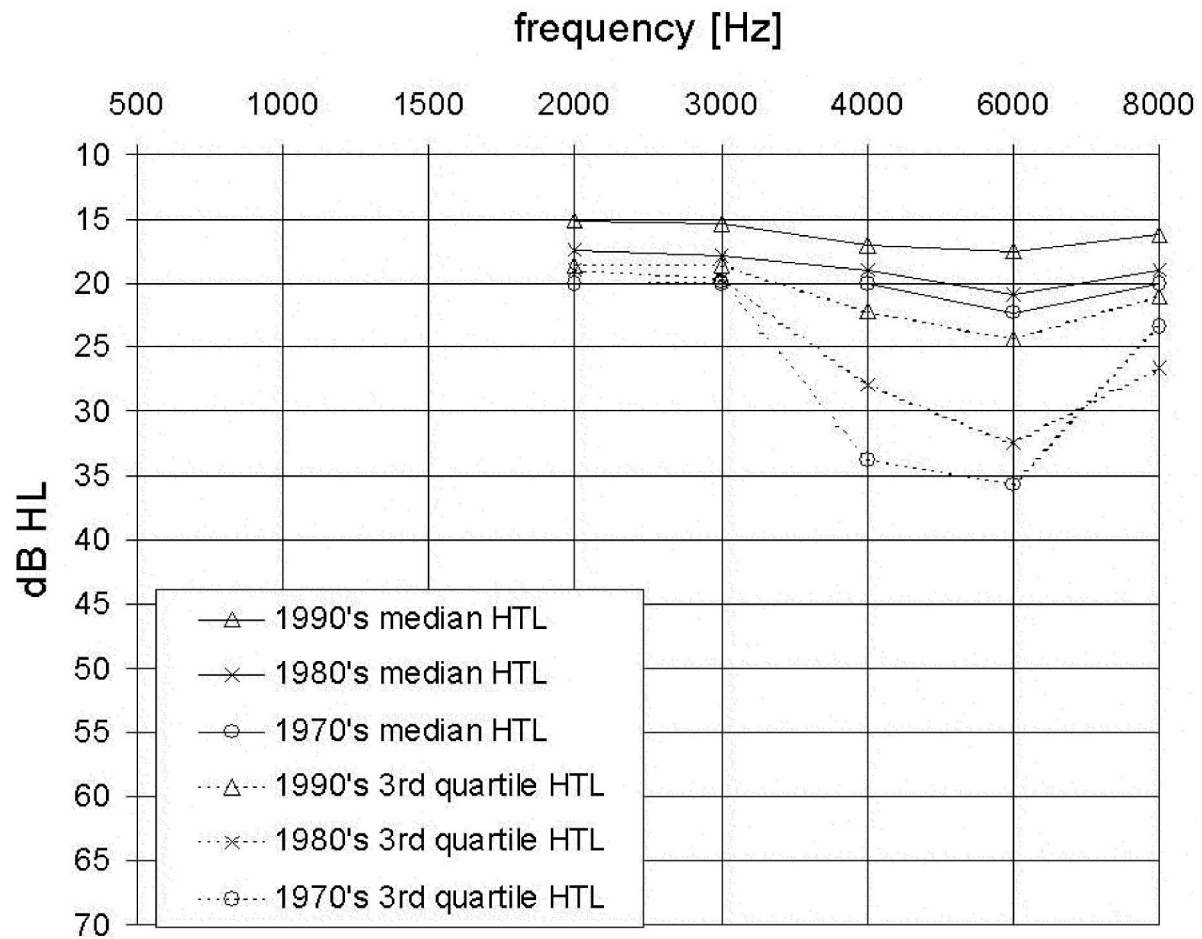


Figure 4: HTL for 30-39 year old men with wood processing work.

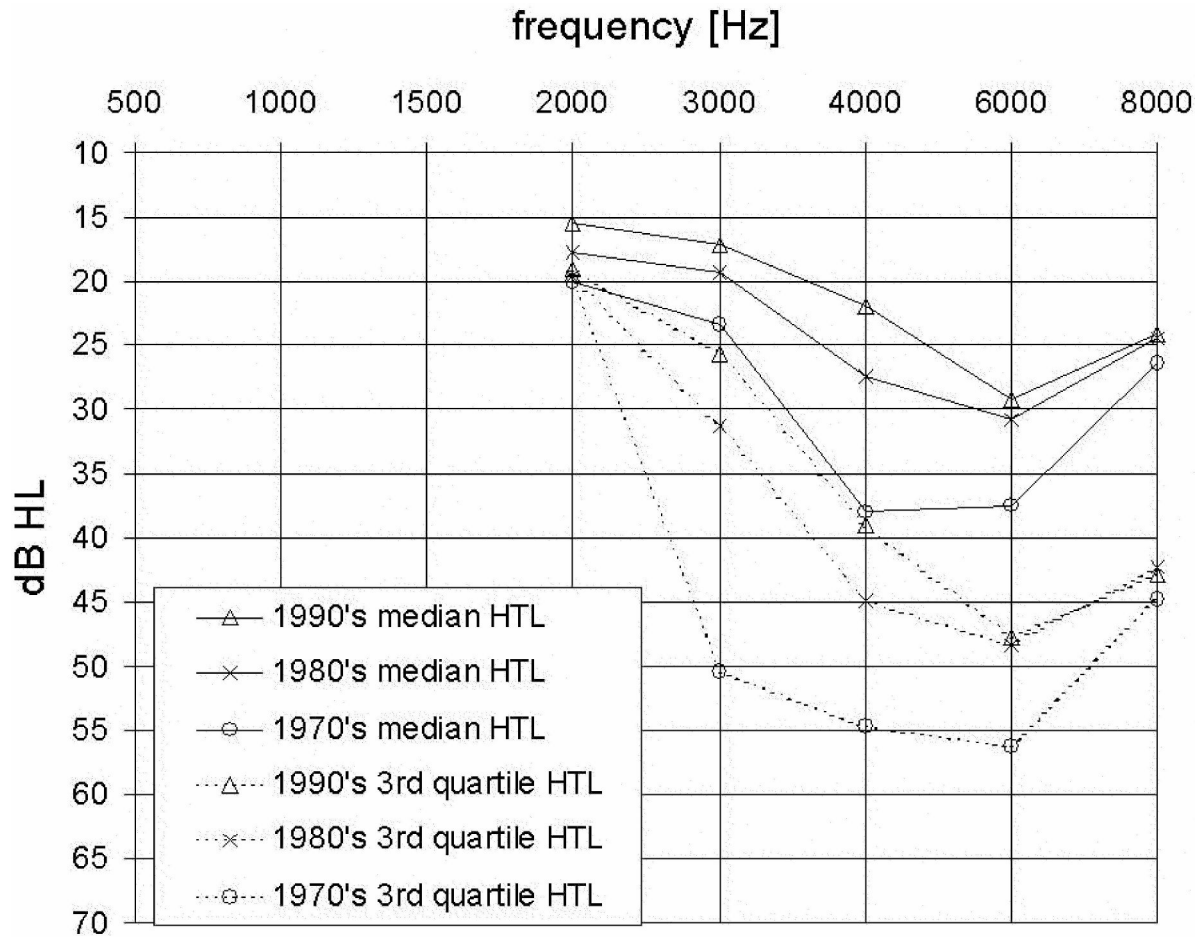


Figure 5: HTL for 40-49 year old men with wood processing work.

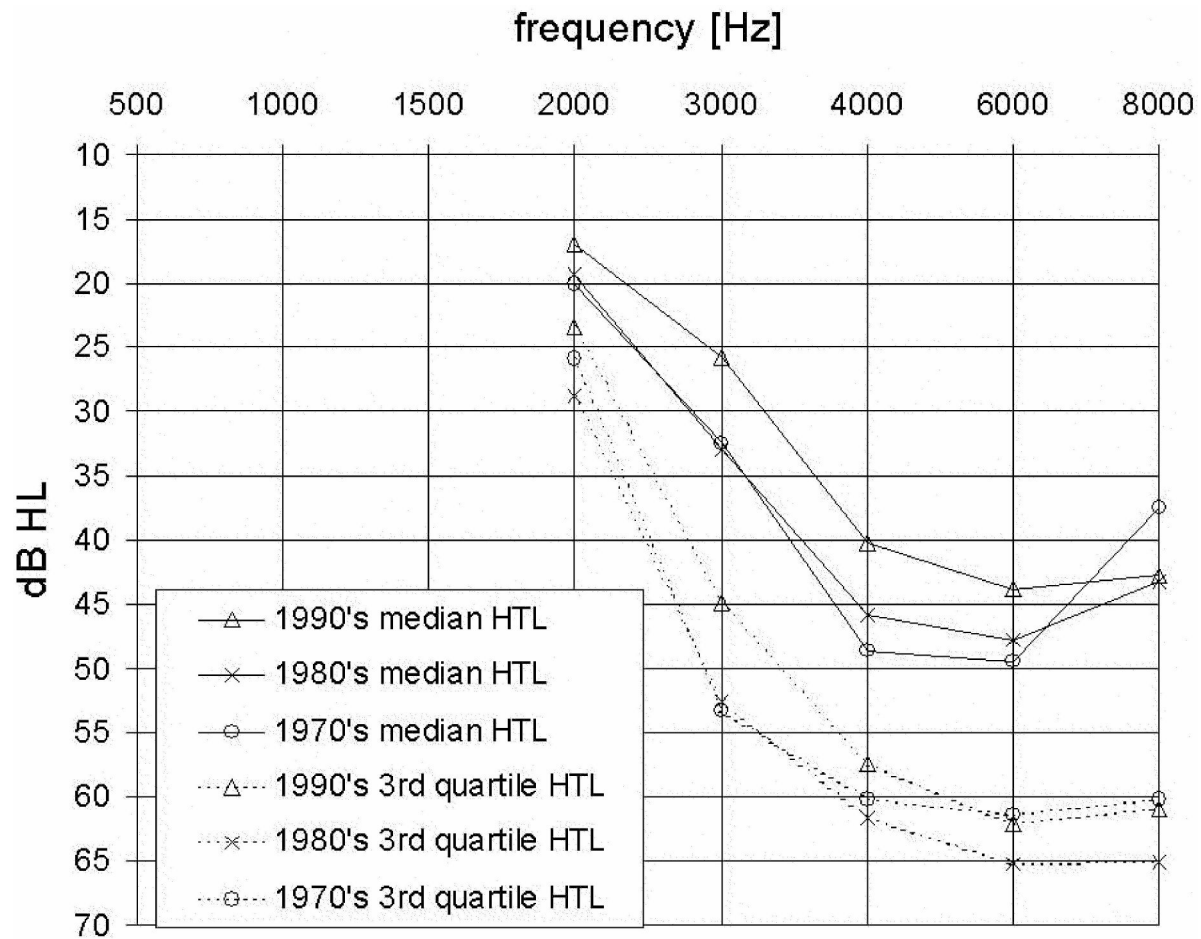


Figure 6: HTL for 50-59 year old men with wood processing work.