Does Age Affect Your Ability To Hear High Frequency Sounds?

By Joshua Vanderlaan

Aim

To investigate if age affects the ability to detect high frequency sounds (1500-20 000Hz)

Background Information

General hearing loss is related to the loss of hearing high frequency sounds. These hearing loss types aren't only affected by age but they may be affected by hearing loud sounds over a long period of time, diabetes or even blood pressure. This is due to the crippling of the hairs that aid you to hear sounds clearly. Presbycusis is the act of age reducing the effectiveness of your ears being able to detect sounds. This happens to 30%-40% of people over 65!

The process of hearing starts as sound waves. The outer ear transmits this wave in the ear canal to the eardrum. The eardrum vibrates and sends those vibrations to three bones (malleus, incus and staples). These bones transmit the air vibrations to fluid vibrations. They do this because the cochlea can only detect fluid vibrations. The vibrations ripple the fluid next to the cochlea, the wave that was made by the three bones goes on top of some microscopic hairs and then they bend. Bending causes the pores, below the hairs, to open up. Then the chemicals rush to our brain.

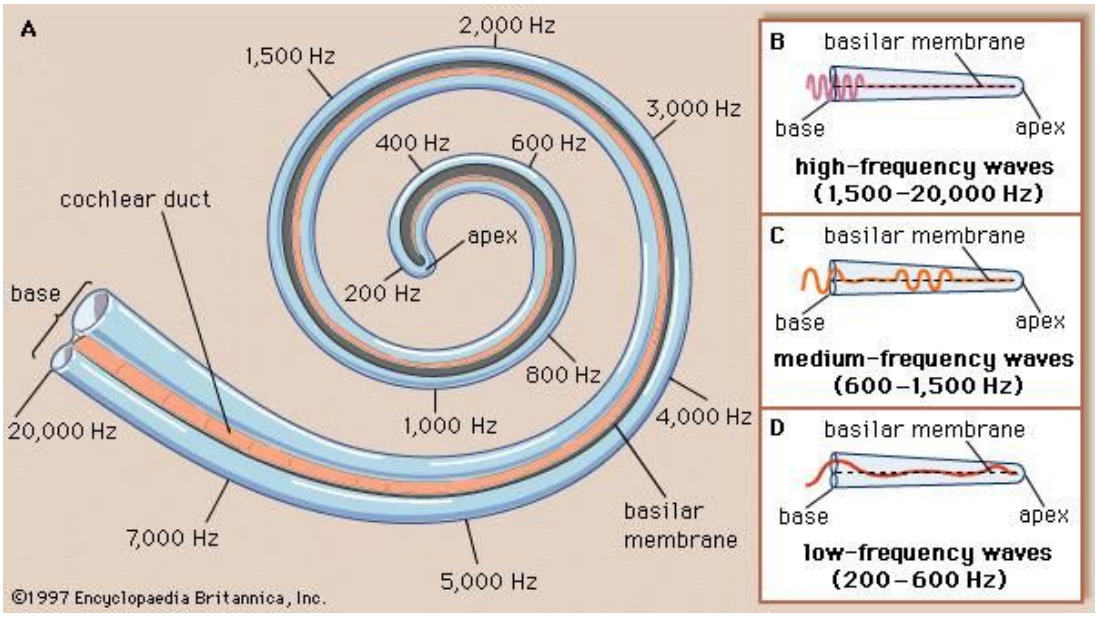


Photo From: https://www.britannica.com/science/presbycusis

This diagram shows that the further away the hairs are from the apex, the higher the frequency of detection. The outer hairs you can see in the diagram are the hairs that you lose when you age. This normally occurs around the age of sixty and is not currently able to be restored medically or surgically. The people who experience Presbycusis may also have trouble hearing 'S' or 'H' since 'S' and 'H' have a higher pitch.

Hypothesis

As people age, their ability to hear high frequency sounds (measured in Hz) decreases.

Risk Assessment

The only danger of this experiment is that the test subject may experience some ringing in their ears after being exposed to the high frequencies. This will be a very minor issue since he or she will be wearing headphones, therefore the frequencies will not affect others.

Materials/Equipment

Equipment used:

- 45 Consent Forms
- A set of Sony Headphones
- My Chromebook
- YouTube videos for the frequencies

5000 Hz
6000 Hz
7000 Hz
8000 Hz
9000 Hz
10 000 Hz
11 000 Hz
12 000 Hz
13 000 Hz
14 000 Hz
15 000 Hz
16 000 Hz
17 000 Hz
18 000 Hz

Method

1. I decided to sample 45 people across 9 different age brackets - 16 Male and 29 Female.
2. I made a document of who I was going to survey (family, friends, classmates and teachers) and put them into groups of 10-year age brackets.
3. I surveyed each member of the experiment using the following procedure:

- I asked them to consent to the experiment by signing the consent form (they did not have to participate in the experiment if they did not want to).

- Once I had their consent, I asked them to put on the headphones and listen to a variety of frequencies that I used on my Chromebook from YouTube.
- After listening to each frequency they were asked if they could hear it (I used a few pretend (silent) frequencies to see if they were telling the truth-my control).
- I recorded the hertz (Hz) of their last frequency they could hear.

4. Using the summary table of data, I calculated the average highest frequency each age bracket could hear.
5. I then constructed a line graph of Age Bracket vs Average Highest Frequency Heard. I also constructed a scatter graph of individual test subjects Age vs Highest Frequency Heard.

Results

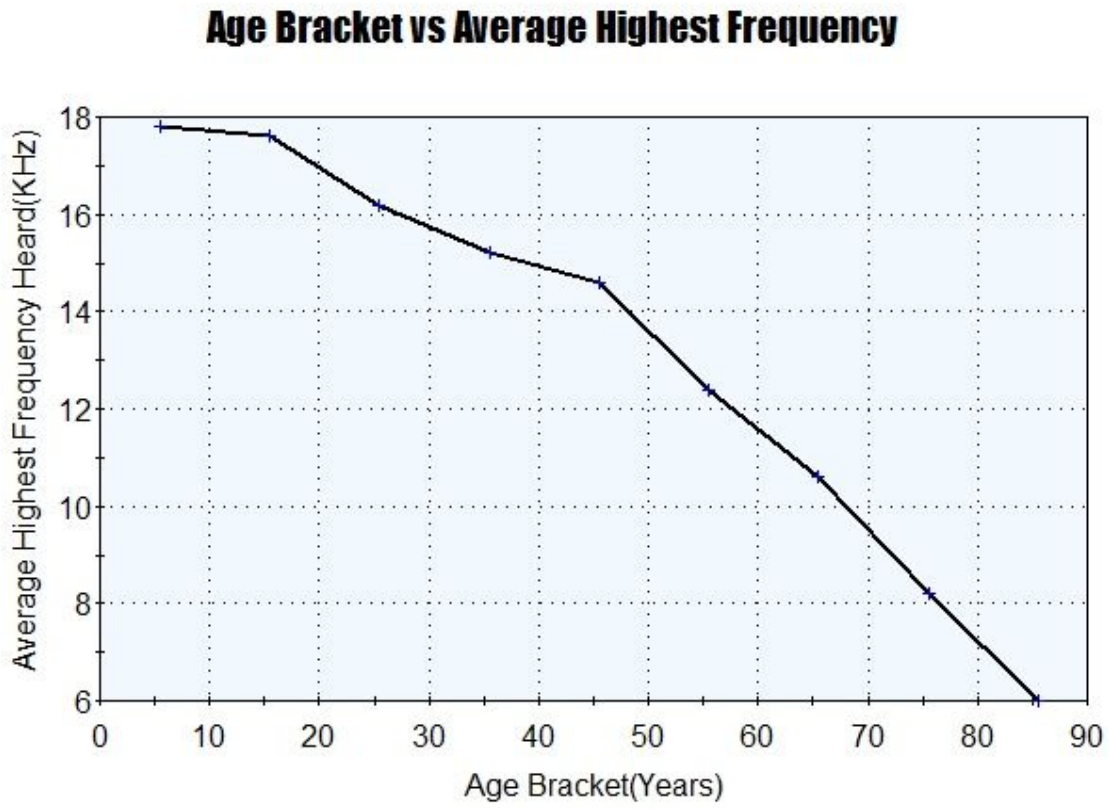
Highest Frequency Heard

Age Bracket	Person 1	Person 2	Person 3	Person 4	Person 5
1-10	Female 9 Year Old 18 000 Hz	Female 10 Year Old 17 000 Hz	Female 5 Year Old 19 000 Hz	Female 7 Year Old 18 000 Hz	Male 9 Year Old 17 000 Hz
11-20	Female 15 Year Old 17 000 Hz	Male 12 Year old 18 000 Hz	Male 12 Year Old 17 000 Hz	Male 12 year old 18 000 Hz	Male 12 Year Old 18 000 Hz
21-30	Male 28 Year Old 15 000 Hz	Female 27 Year Old 16 000 Hz	Female 21 Year old 17 000 HZ	Male 22 Year Old 17 000 Hz	Female 22 Year Old 16 000 Hz
31-40	Female 39 Year Old 16 000 Hz	Female 35 Year Old 16 000 Hz	Male 38 Year Old 14 000 Hz	Male 34 Year Old 15 000 Hz	Female 31 Year Old 15 000 Hz
41-50	Female 44 Year Old 16 000 Hz	Male 48 Year Old 16 000 Hz	Female Age unknown 13 000 Hz	Female 48 Year Old 16 000 Hz	Female Age unknown 12 000 Hz
51-60	Male 56 Year Old 10 000 Hz	Male 52 Year Old 12 000 Hz	Female 52 Year Old 11 000 Hz	Female 51 Year Old 11 000 Hz	Female Age unknown 18 000 Hz
61-70	Male 63 Year Old 11 000 Hz	Female 62 Year Old 9000 Hz	Female 62 Year Old 12 000 Hz	Male 61 Year Old 10 000 Hz	Female 64 Year Old 11 000 Hz
71-80	Female 75 Year Old 8000 Hz	Female 72 Year Old 9000 Hz	Male 72 Year Old 7000 Hz	Female 75 Year Old 9000 Hz	Female 79 Year Old 8000 Hz
81+	Female 86 Year Old 7000 Hz	Male 89 Year Old 5000 Hz	Female 93 Year Old 4000 Hz	Female 84 Year Old 6000 Hz	Female 82 Year Old 8000 Hz

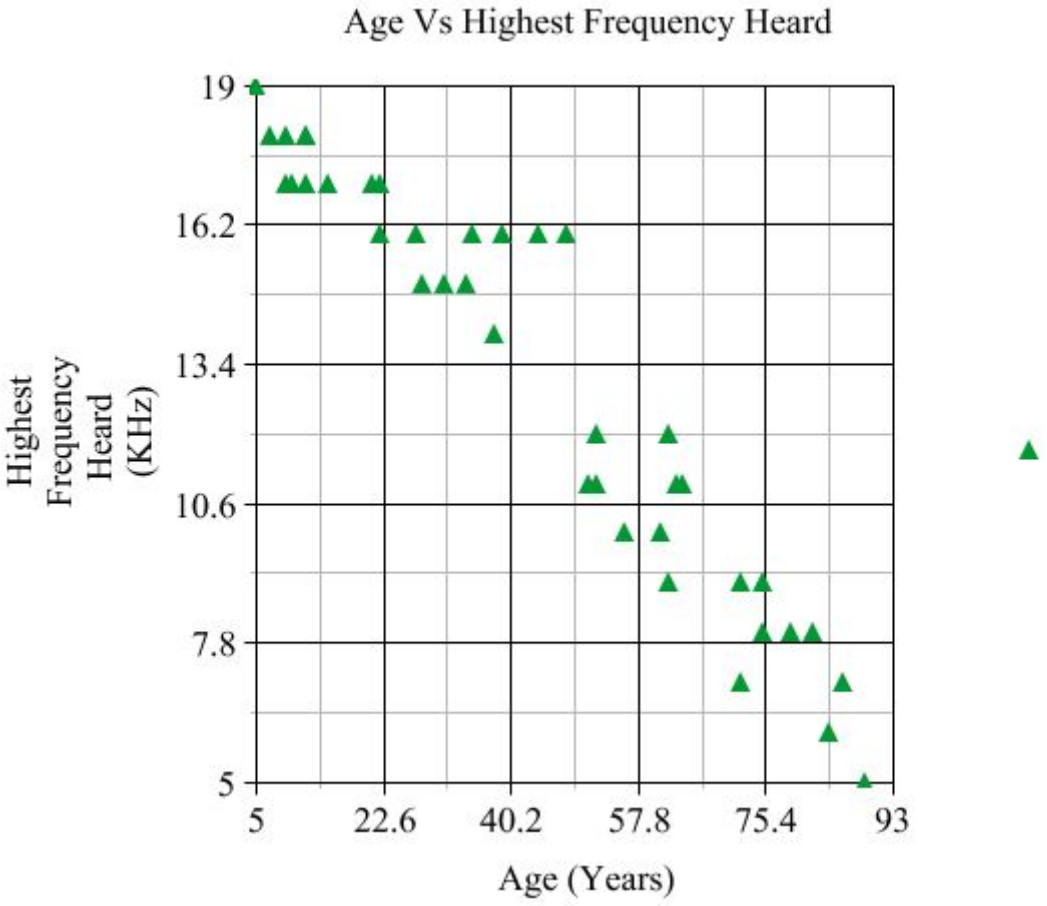
Summary Of Results

Age Bracket	Average Hz Of Highest Frequency Heard
1-10	17 800 Hz
11-20	17 600 Hz
21-30	16 200 Hz
31-40	15 200 Hz
41-50	14 600 Hz
51-60	12 400 Hz
61-70	10 600 Hz
71-80	8200 Hz
81+	6000 Hz

Line Graph



Scatter Graph



Discussion

The results showed that as you age, you are not able to hear higher frequency sounds. The hypothesis was chosen to see if this scientific theory could be validated. That is, as you age you lose some hairs within the ear canal - these hairs enable people to detect high frequency sounds. My hypothesis was definitely supported as the amount of Hz people could hear deteriorated with age. This can be seen by looking at line graph above which shows a negative relationship between Age Bracket and Average Highest Frequency Heard - meaning that as age increases the number of Hz detected decreases. Similarly, the Scatter Graph above shows this same strong negative relationship with Age and Highest Frequency Heard, further supporting the hypothesis.

When organising the number of people to be surveyed, it was difficult to find five subjects to represent each of the age brackets, with the additional consideration of gender equality. There may have been some inaccuracy in data collection for people who experienced 'ringing' in their ears from listening to previous high frequencies. This may have led them to think that they could hear the next level of frequency when actually they may not have been able to. The collection of an individual's age was a sensitive issue for some. Hence, there were three people omitted from the Scatter Graph as their age was not revealed.

The results are reliable as I used the same set of headphones and the same YouTube videos for all of those surveyed. The experiment was valid as it did investigate whether or not age affected the ability to detect high frequency sounds. The data collected did show clearly that the aim was achieved.

In the real world these results can be used to raise awareness of older people experiencing hearing difficulties with high frequency sounds. Maybe a system could be created to make hearing tests compulsory from the age of 70, to ensure that individuals can hear certain types of high frequency alarms and sirens which are often used to indicate emergencies.

The sample size could have been larger with more people sampled in each age bracket. The cross-section could have been more equal across gender and more widely spread within the age brackets. This may have given a more accurate set of data overall. With the possibility of some people experiencing 'ringing' in their ears from the exposure to previous high frequencies, perhaps an extended break between each level of frequency test would improve the accuracy of the results.

Conclusion

The experiment involving 45 people, (16 Males and 25 Females) across nine different age brackets, concluded that as age increases the ability to detect high frequency sounds decreases. This is in support of the hypothesis.

Bibliography

Websites For Information:

https://www.britannica.com/science/presbycusis

https://biology.stackexchange.com/questions/27822/why-do-adults-lose-hearing-at-high-frequencies

https://www.nidcd.nih.gov/health/age-related-hearing-loss

http://www.hopkinsmedicine.org/healthlibrary/conditions/otolaryngology/presbycusis_85,P00463/

https://my.clevelandclinic.org/health/articles/presbycusis-age-related-hearing-loss

https://hearnet.org.au/hearing-problems/presbycusis

YouTube Videos For The Frequencies:

5000 Hz
6000 Hz
7000 Hz
8000 Hz
9000 Hz
10 000 Hz
11 000 Hz
12 000 Hz
13 000 Hz
14 000 Hz
15 000 Hz
16 000 Hz
17 000 Hz
18 000 Hz

Acknowledgements

I would like to thank the following people for helping me with my experiment:

- Mrs Moulton for setting up the consent form and many templates.
- My Mum for photocopying the consent forms.
- All participants for taking part in my experiment and providing the data.