

Effectiveness of Hearing Conservation Program in F-35 Pilots at a Large Federal Logistics Center, a Case Control Study

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Background

- Hearing loss is common among active duty and veteran pilots
- F-35 pilots suspected to have more frequent rates of hearing loss compared to other fighter pilots
- F-35 pilots frequently state the plane is “extremely loud”
- Current hearing conservation program only focuses on ruling out neurological disease processes
- This pilot study was conducted to test the effectiveness of the current hearing conservation program



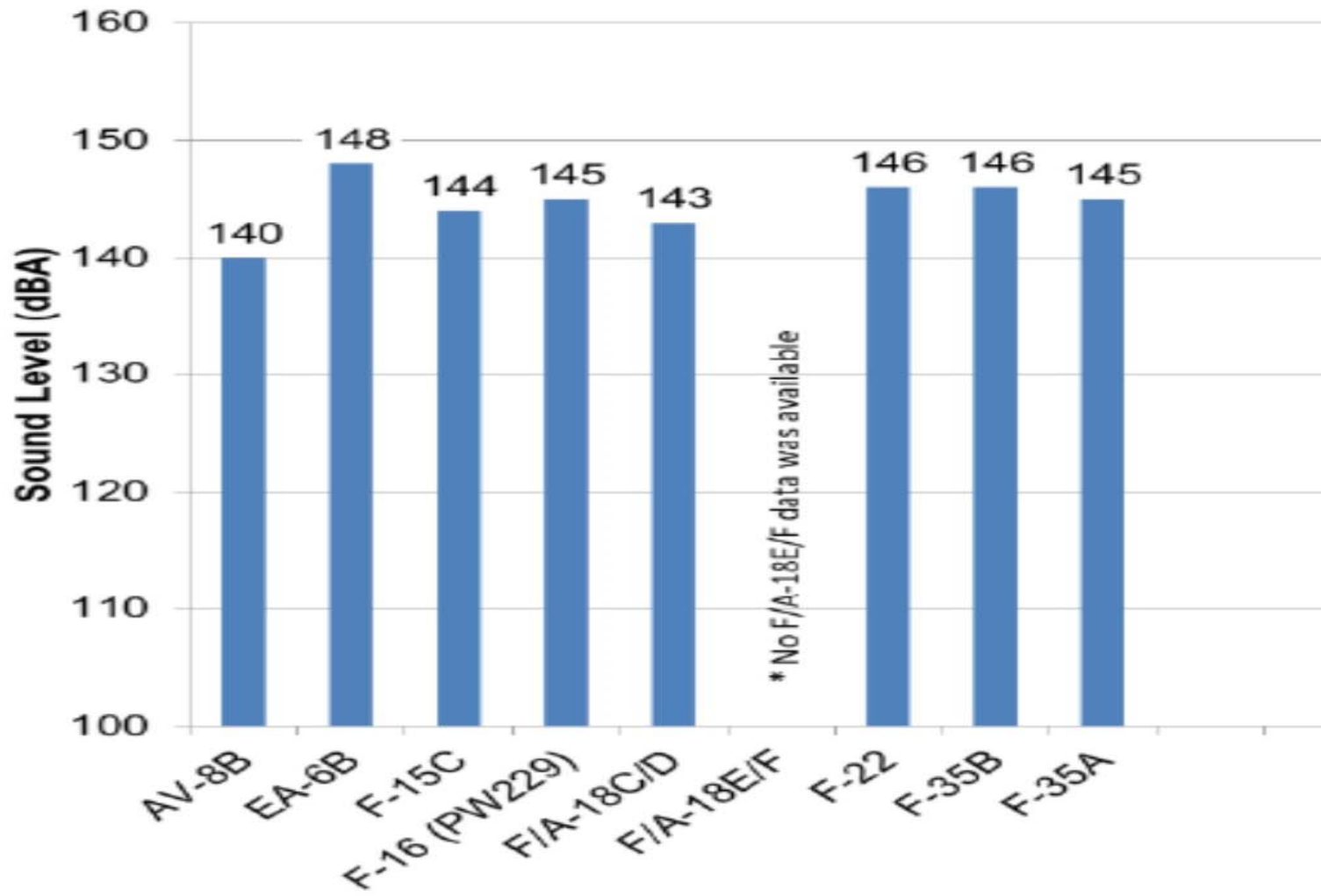
Goal

- To determine if pilots suffer from hearing loss more frequently compared to the control group

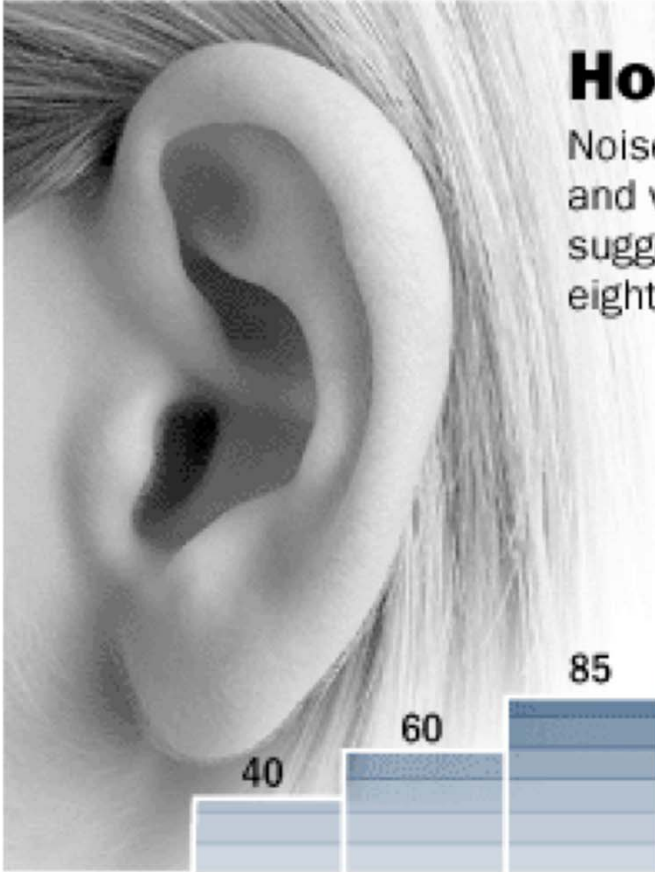


Aircraft Ground Noise

Figure 1

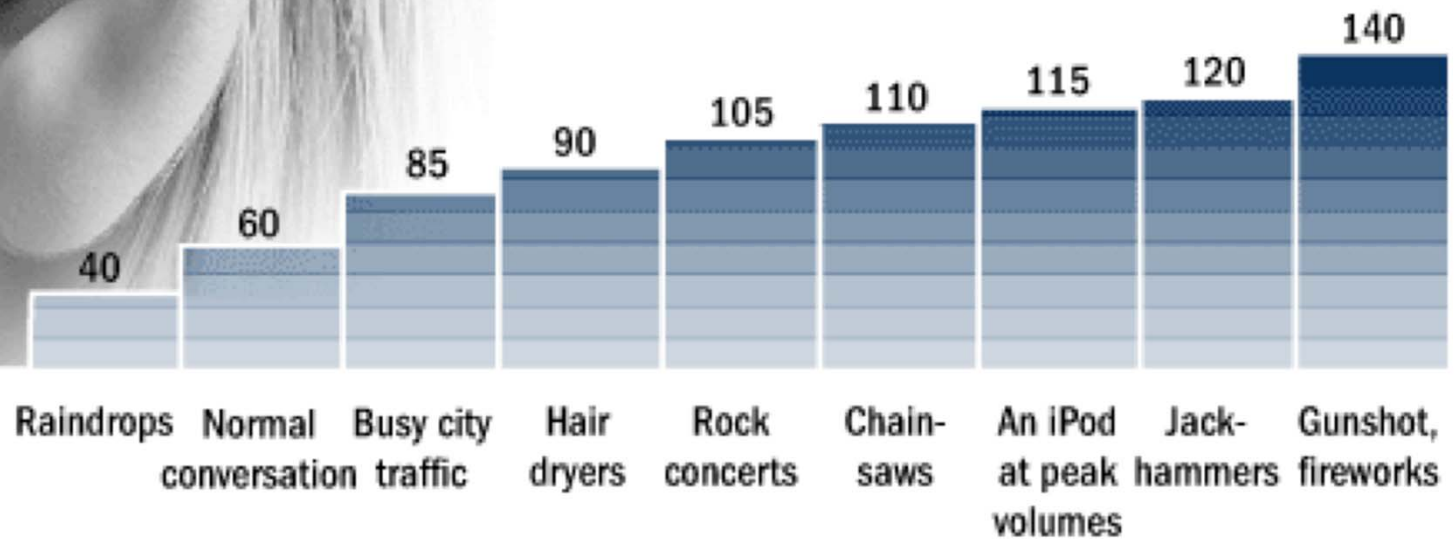


PictureQuest



How Loud Is Too Loud?

Noise-induced hearing damage is related to the duration and volume of exposure. Government research suggests the safe exposure limit is 85 decibels for eight hours a day. Some common decibel levels:



Sources: dangerousdecibels.org; WSJ research



Methods

- A federal DoD facility was chosen for the study
- Cases (N=23)
 - F-35 pilots
- Controls (N=27)
 - Non-Destructive Ionization
 - Composite Lab
 - Electricians shop
- Case control design

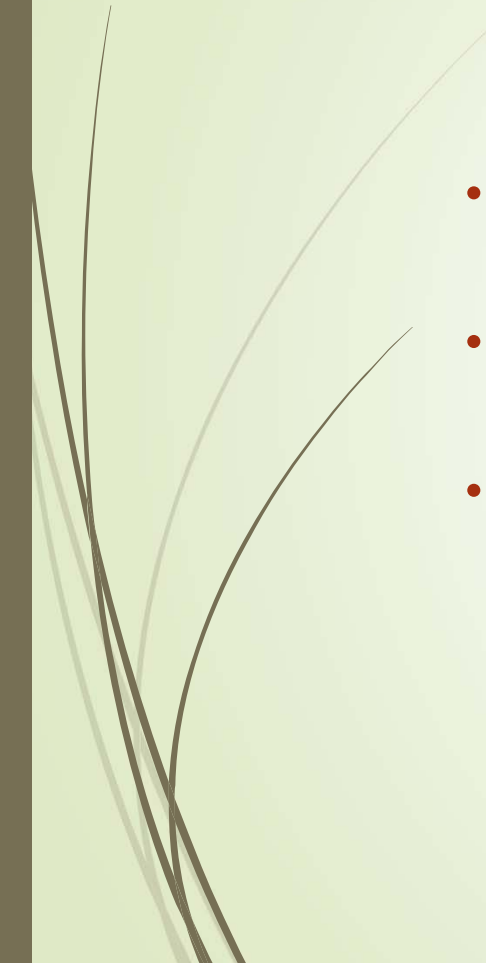


Methods continued

- The audiograms obtained from Defense Occupational Health Readiness System (DOHRS)
- Sensitive information redacted prior to analyses
- Audiograms of study participants were obtained up to September 2017
- Oldest initial audiogram was completed in 1996



Inclusion and Exclusion

- Anyone with less than 1 year of enrollment was removed due to lack of appreciable noise exposure
 - Initial audiograms were retrieved for comparison if participants had re-baselined hearing tests
 - If initial audiograms were not available, the participants were removed from the study
- 



Results

- A standard threshold shift (STS) per OSHA definition in 29 CFR 1904.10(b)(1) is defined as a 10 decibel average change across 2,000, 3,000, and 4,000 Hz when compared to baseline exam
- That is if the sum of the shifts at 2,000, 3000, and 4,000 Hz equals or exceeds 30 dB in either ear, an STS has occurred
- Two out of 23 pilots were found to have an STS
- None of 27 controls was found to have an STS

Fisher's Exact Test for STS

	Fisher Exact Test for Significant Threshold Shifts		Total
	+STS	-STS	
Pilot	2	21	23
Control	0	27	27
Total	2	48	50

P = 0.2



Results, Pilot 16

- OSHA 1910.95 App F to estimate hearing loss due to presbycusis
- Pilot 16
 - 43 year old male whose baseline audiogram was done when he was 24
 - Baseline: 0, 0, 15 dBA at 2,000, 3,000, and 4,000 Hz respectively (average 5)
 - 2016 audiogram: 15, 15, 25 dBA (average 18.3)
 - $18.3 - 5 = 13.3$ threshold shift \longrightarrow STS

Results, Pilot 16

TABLE F-1 - AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	5	3	4	5	8
21	5	3	4	5	8
22	5	3	4	5	8

TABLE F-2 - AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequency (Hz)				
	1000	2000	3000	4000	6000
20 or younger.....	7	4	3	3	6
21	7	4	4	3	6
22	7	4	4	4	6

TABLE F-1 - AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequency (Hz)				
	2000	3000	4000		
24	3	5	6	4.7	
43	7	12	16	11.7	
	<u>4</u>	<u>7</u>	<u>10</u>	<u>7</u>	
54	10	10	18	26	31
55	10	11	19	27	32
56	10	11	20	28	34
57	10	11	21	29	35
58	10	12	22	31	36
59	11	12	22	32	37
60 or older	11	13	23	33	38
54	13	11	13	14	19
55	13	11	14	14	19
56	13	11	14	15	20
57	13	11	15	15	20
58	14	12	15	16	21
59	14	12	16	16	21
60 or older	14	12	16	17	22



Results, Pilot 16

$13.3 - 7 = 6.3$ → less than 10 average change across 2k, 3k, and 4k Hz, so no STS with age correction

43 Y/O Male	Left		
	2000 Hz	3000 Hz	4000 Hz
Baseline Audiogram (age 24) dBA	0	0	15
Predicted Hearing (Baseline + Age correction)	4	7	25
Actual 2016 Annual Audiogram	15	15	25



Results, Pilot 23

- Pilot 23
 - 41 year old male whose baseline audiogram was done when he was 25
 - Baseline: 0, 0, -5 dBA at 2,000, 3,000 and 4,000 Hz respectively (average -1.7)
 - 2016 audiogram: 15, 15, 15 dBA (average 15)
 - $15 - (-1.7) = 16.7$ threshold shift \longrightarrow STS




Results, Pilot 23

16.7 - 5 (average of 3, 5, and 7) = 11.7 → more than
10 average change across 2k, 3k, and 4k Hz, so still has STS
with age correction

41 Y/O Male	Right		
	2000 Hz	3000 Hz	4000 Hz
Baseline Audiogram (age 25) dBA	0	0	-5
Predicted Hearing (Baseline + Age Correction)	3	5	2
Actual 2016 Annual Audiogram	15	15	15



Implications

- Not statistically significant findings
 - Suggestive of a hearing loss trend that may exist on a larger scale
 - Current hearing conservation program may not be completely protective
- 




Strength

- First study to examine F-35 pilots' current hearing status at a federal logistic center
- May be suggestive of an ineffective hearing conservation program that requires revision and modification



Weaknesses

- Could not account for confounders
 - Time spent in F-35 airframe
 - Time spent in other fighter airframes
 - Number of total hours spent in flying
 - Small sample size
 - Other occupational or personal noise exposures
- 



Conclusion

- Statistically insignificant findings do not necessarily mean no findings
- May require a larger prospective study that controls for confounders



Acknowledgements

- Capstone peers
 - Alice Choi, Amanda Walker, Chelsea Peters, Kateri Evans, Mary Kohrman, Morgan Heine, Olivia Kenney
- Madiha Abdel-Maksoud, MD, PhD
- Roxana Witter, MD, MSPH



OSHA 3074 – Hearing Conservation

- Employers must provide hearing protectors to all workers exposed to 8-hour TWA noise levels of 85 dB or above.
- This requirement ensures that employees have access to protectors before they experience any hearing loss.

Employees must wear hearing protectors:

- For any period exceeding 6 months from the time they are first exposed to 8-hour TWA noise levels of 85 dB or above, until they receive their baseline audiograms if these tests are delayed due to mobile test van scheduling;
- If they have incurred standard threshold shifts that demonstrate they are susceptible to noise
- If they are exposed to noise over the permissible exposure limit of 90 dB over an 8-hour TWA.