International Journal of Medical Science and Clinical Research Studies

ISSN(print): 2767-8326, ISSN(online): 2767-8342

Volume 04 Issue 04 April 2024

Page No: 620-628

DOI: https://doi.org/10.47191/ijmscrs/v4-i04-06, Impact Factor: 7.949

High Decibels as Causing Deconcentration and Hearing Damage in Pilots, Crew Members and Passengers Passengers: Experimental Study in the Brazilian Air Force

João Paulo Pinelli Santos[1-8], Juliana Fontes Beltran Paschoal[1], Délio Tiago Martins Malaquias[1], Júlio Elias Calheiros[1], Ana Clara Felipe Parreira[1], Laíza Cavalcanti Rêgo[1], Hamilton Roberto Moreira de Oliveira Carriço[2], Liliana Martins Occulate[3], Cristiano Bento Alvarenga[3], Amanda Luiza Batista Cordeiro[4], Hiromi MK Fujishima[4], Natália Lopes Medici [5], Ana Laura Diniz Campozana[1], Elysa F. Camargo[1], Isabela Fagundes Krebs[1], Veridiana Tasqueti Porto Rizzi Soares[1], Danilo Almeida de Oliveira Panebianco[1], Victor Pagliarini Comelli[1], Lucas Vieira de Melo[1], Matheus Augustus Canossa Coutinho[1], Maria Paula Maciel Nogueira[1], Leonardo Tomé da Silva[1], Daniela Suriel Barbosa Lima dos Santos[1], Victória Benicio Soares Miguel[1], Jenyffer Victoria Cabrera Villca[1], Elisitt Escarlet Valencia Cabrera[1], Cristiana do Nascimento Oliveira[1], Rafael Pinheiro do Nascimento[6], Andreza Spinola Zaparoli[6], Suely Fernandes dos Santos[7], Thiago Augusto Rochetti Bezerra[1-9]

[1]Academic in Medicine, University of Ribeirão Preto, Guarujá, São Paulo, Brazil.

[2]Academic in Medicine, University of Southern Santa Catarina (Unisul), Tubarão, SC, Brazil.

[3]Academic in Medicine, Universidad Central del Paraguay, Paraguay.

[4]Academic in Medicine, University Potiguar, Natal, Rio Grande do Norte, Brazil.

[5]Academic in Medicine, Unoeste, Guarujá, São Paulo, Brazil.

[6]Academic in Medicine, Nove de Júlio University, São Paulo, Brazil.

[7]Physiotherapist. Nove de Júlio University, São Paulo, Brazil.

[8]Bachelor in Civil Aviation. Anhembi Morumbi University. São Paulo, Brazil.

[9]Brazilian Air Force Reserve Officer. MSc and PhD in Orthopaedics, Traumatology and Rehabilitation of the Locomotor System, Bachelor's degree in Physical Education, Ribeirão Preto Medical School, Federal University of São Carlos, University of São Paulo, Brazil.

ABSTRACT

Hearing is one of the main senses for aeronautical activities and plays a key role in the intelligibility of communications between pilots. Noise is a factor that impairs good hearing and can lead to various health problems, as well as impairing the performance of aviation cadets when they perform multiple tasks during flight. It is important to educate airmen about how noise can negatively affect instructional flights and the conditions that expose them to too much of a drop in concentration during flights. The sound pressure levels to which cadet airmen are exposed during their training is an aggravating factor for their communication and safety. The aim of this study was to determine whether there is a relationship between noise and loss of concentration during instruction in the Neiva T-25 aircraft, with the aim of collecting and analyzing data in order to improve air mission instruction in terms of health and flight safety by highlighting the harmful nature of noise in the Second Air Instruction Squadron (2º EIA). A questionnaire with eight questions about the influence of noise on the performance of aerial mission practices was administered to a sample of 20 Cadet Aviators from the Second Squadron who were taking part in the aerial instruction course in the Neiva T-25. The results of the questionnaires showed the importance of raising awareness about the harmful effects of noise in military activity, as it is a matter of flight safety.

KEYWORDS: Hearing Loss, Noise in Aviation, High Decibels.

ARTICLE DETAILS

Published On:
03 April 2024

Available on:
https://ijmscr.org/

INTRODUCTION

Noise can be defined as a type of sound. Sounds consist of vibrational disturbances that generate some auditory phenomenon. However, noise is a type of sound that originates from the superposition of several vibratory disturbances with different frequencies that do not have harmonic relationships with each other [1].

Noise usually originates from the collision between two bodies, oscillating movements or vibrations. Thus, noise is established when the sound produced by such movements becomes unpleasant or irritating for a physically unprotected or psychologically unprepared listener [1].

In this way, it should be emphasized that individuals exposed to pleasant or unpleasant sounds such as noise, at high intensity, can cause permanent hearing damage [2].

The Brazilian Association of Technical Standards (ABNT) has defined acceptable noise pollution levels. In urban residential areas, the limit is 55 db during the day and 50 db at night. In city centers, the limit is 65 db during the day and 60 db at night. In industrial areas, 70 db during the day and 65 at night [2].

The World Health Organization establishes that, in order to live healthily, an individual can receive an average hearing demand from noise equivalent to 55 decibels (dB) [3].FIGURE 1 shows the levels of decibels accepted by hours of daily exposure, tolerable by the human ear.

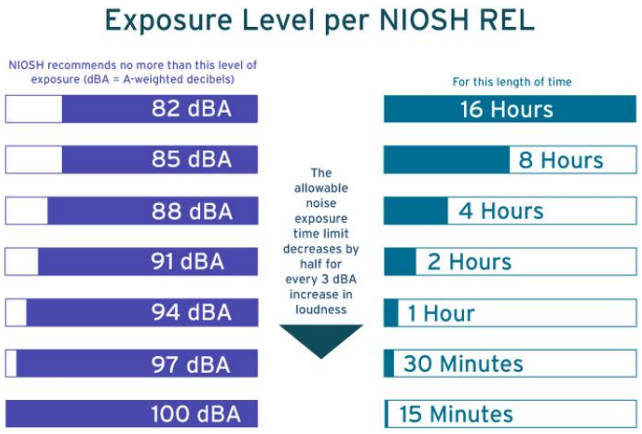


Figure 1. Decibel levels per hour. Loud noise can damage your hearing. Source: National Institute for Occupational Safety and Health (2022).

This figure shows the relationship between the level of exposure and the duration of exposure according to the National Institute for Occupational Safety and Health (NIOSH). As sounds become louder than 85 dBA, the duration of a daily exposure should be reduced. For every 3 dBA increase in noise level, NIOSH recommends reducing the duration of exposure by half. This is called the exchange rate. Similarly, if daily exposure is longer than 8 hours, the permitted noise level is lower [3 - 4].

NIOSH has established a recommended exposure limit of 85 A-weighted decibels (dBA) on average over an eight-hour working day. Workers who are exposed to noise equal to or greater than that recommended by NIOSH run the risk of developing significant hearing loss throughout their working lives [3 - 4].

Although NIOSH is based on an eight-hour exposure, susceptibility to noise differs from person to person. You can check the noise level using a sound level meter [3 - 4].

There are two definitions of noise, the first of which classifies noise subjectively, i.e. what makes a sound unpleasant and therefore defined as noise depends on the individual perception of each person [5].

Because it has a disharmonious composition, the undesirable effects of daily exposure to high decibels include psychological changes such as fatigue, anxiety, sadness, aggression and sleep disturbance, which are closely associated with stress [5].

Stress and irritability caused by exposure to noise are a major occupational problem in instructional flights, since during training a high level of concentration is essential for all airmen, especially pilots in the learning phase [6].

Acoustic discomfort occurs from prolonged exposure to levels of 75 Db or more [6].

The occurrence of accidents among professionals exposed daily to levels above 80 dB is considerably higher when compared to professionals who are not exposed to such levels of noise during their working day [7].

At the Brazilian Air Force Academy (AFA), second-year aviator cadets are subject to hazardous conditions, which can result in decreased concentration during instructional flights due to prolonged exposure to significant noise levels [2-3].

The Universal T-25 aircraft are used in the second year of the Air Officer Training Course (FIGURE 2).

Figure 2. Neiva T-25 Universal aircraft. Source: Brazilian Air Force (2023).

In view of the specificities of flight instruction at AFA, there is constant communication with the T-25 tower (ground tactical) and with Area Control [2-3].

This communication is carried out with background noise. Interference in communications also occurs during communication between Cadet and instructor, due to the eminent noise from the lycoming io540k1d5 piston engine of the Neiva T-25 aircraft, used to carry out air mission instructions in training, making them a potentially exposed group, since the intense instructions in unhealthy conditions cause exhaustion and decreased concentration at the end of each evaluation, since during instruction, they must perform multiple tasks and maintain the expected flight parameters in addition to carrying out verbal coordination with the instructor and control bodies [2-3].

Figure 3. lycoming io540k1d5 piston engine model of the Neiva T-25 aircraft. Source: Brazilian Air Force (2023).

In this way, concentration when carrying out maneuvers and procedures and the intelligibility of communications are important aspects of performance and have a direct impact on flight safety [2-3].

SFO (Initiatives to Tackle Noise) is a North American company that has championed the "Fly Quiet" program as a way of helping to reduce aircraft noise [14].

This company encourages airlines to use quieter planes and to fly them as quietly as possible. FIGURE 4 shows how much quieter airplanes are today compared to previous decades.

According to data from the American Aviation Federation (FAA), the US aviation industry has seen an 83% reduction in aircraft noise since 1955 [16].

Every quarter, the 50 busiest airlines are publicly ranked according to their noise performance, including efforts and noise in their operations. Fly Quiet is an initiative implemented to reduce aircraft noise. Its aim is to influence airlines to operate as quietly as possible [18].

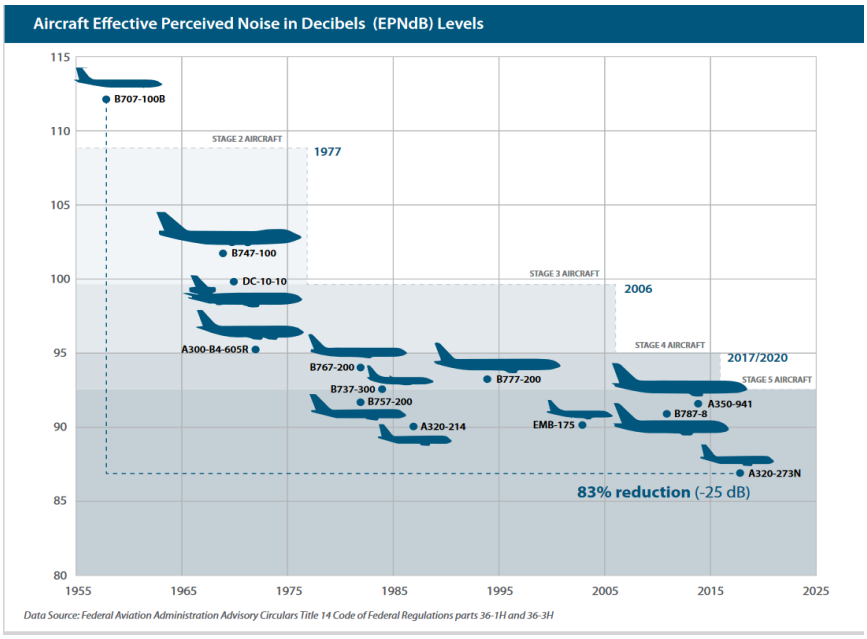


Figure 4. Effective Perceived Aircraft Noise in Decibel Levels (1955 to 2025). Source: flysfo.com

This research is relevant because of the importance of knowing how noise can negatively affect instructional flights. The sound pressure levels to which Cadet Aviators are exposed during their training is an aggravating factor for the communication and safety of airmen.

With this in mind, the aim of this study was to use a questionnaire to determine whether there is a relationship between noise and loss of concentration during instruction in the T-25.

METHODS

Participants The sample consisted of 25 Cadet Aviators from the Second Squadron who were part of the air instruction course in the Neiva T-25 at the Pirassununga Air Force Academy in 2023.

Before starting this work, the research project was submitted to and approved by the Research Ethics Committee of the Ribeirão Preto Medical School/USP - National Council for Ethics and Research, which approved it under Opinion No. 340.178/2023.

Location

The work was carried out at the Brazilian Air Force Academy in Pirassununga, São Paulo State, Brazil. This work was authorized by the Commander of the Air Force Academy.

Procedures

Firstly, the sound pressure levels received by the cadets during their flight in the T-25 were measured using a digital decibel meter captured by the digital decibel meter's sensor.

The decibel meter used was a B-Max model GM1351 (FIGURE 5). According to the manufacturer, it is a sound meter with a wide measuring range, from 30 to 130 decibels, with an accuracy of ±5 dB.

Figure 5. B-Max model GM1351 decibel meter

The decibel meter was positioned in different positions inside and outside the aircraft and at specific times during the flight. A checklist form was also used to record data (maximum, average and minimum noise values).

Questionnaires were then distributed to the cadet aviators of the 2nd Squadron of the Brazilian Air Force Academy. The questionnaire, of an empirical nature, was drawn up by the researcher and aims to collect information on the reality they experience.

The method applied addressed questions about the influence of noise on performance in air mission practices, the level of annoyance caused by noise, the intensity of noise perceived by the Cadets and the level of concentration impairment when exposed to sound pressure.

The questionnaire served as a basis for illustrating the Cadets' experiences in order to compile the results and then establish the discussions proposed in this paper.

Methodology for measuring decibel levels on the T-25 aircraft

The decibel meter, sound level meter or sound pressure level meter (SPLM) is a piece of equipment used to measure sound pressure levels and, consequently, the intensity of sound, since the sound pressure level is a quantity that represents the auditory sensation of sound volume reasonably well.

The background noise level survey was carried out by measuring the noise levels, recording the value of the level read every 10 seconds, until 30 readings were completed.

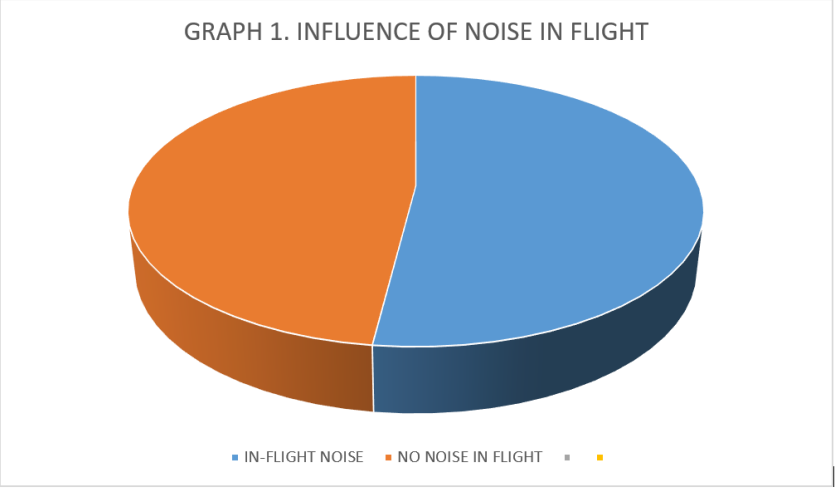
The sensor was positioned in five different positions: outside the aircraft when it was on and static (one meter away from the static aircraft); inside the aircraft when it was on and static; inside the aircraft during take-off; inside the aircraft during straight and level flight and inside the aircraft during landing.

RESULTS

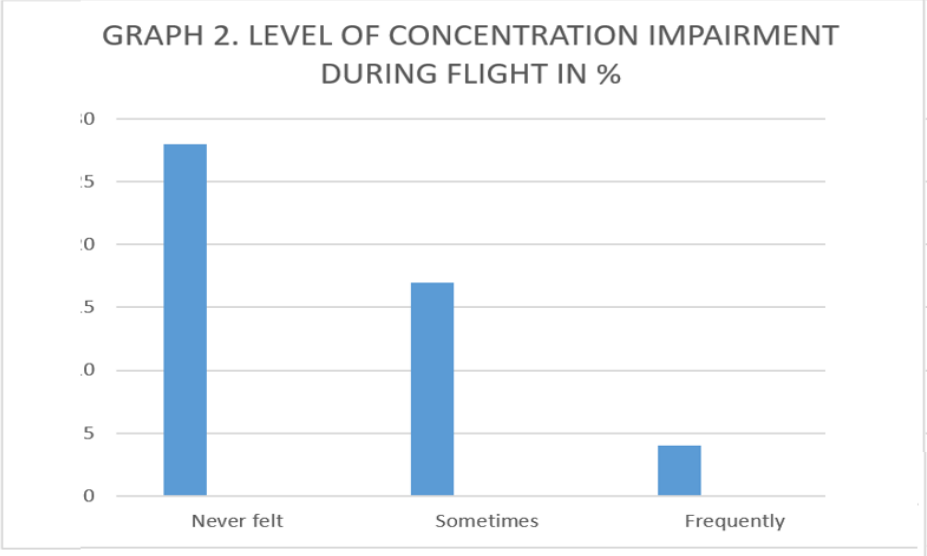
The first question asked whether the Cadet considers that noise in flight negatively interferes with his performance in air mission practices. This objective question, quantifies how many Cadets feel influenced by the effects of noise during the air instruction flight.

Of the 25 cadets who answered the questionnaire, 13 (52% of the total) said that noise interferes negatively with their flight performance, while 12 (48% of the total) said that they did not consider noise to be a factor that interferes negatively with flying missions. This shows that although noise is a relevant stress factor in various areas of work, especially aviation, opinions on its negative influence are balanced.

The second question shows the level of annoyance caused by noise perceived by the cadets during flight. Of the Cadets asked, 3 (12% of the total) replied that the level of annoyance caused by noise during flight instruction is nil, 16 (64% of the total) said that they feel little annoyance from noise in flight, and 6 (24% of the total) said that they feel a lot of annoyance from noise. Almost all the cadets reported feeling some level of discomfort when exposed to aeronautical noise, only 12% of the total considered the level of discomfort to be zero, mainly due to the fact that noise causes natural and expected discomfort during exposure to high levels (GRAPH 1).

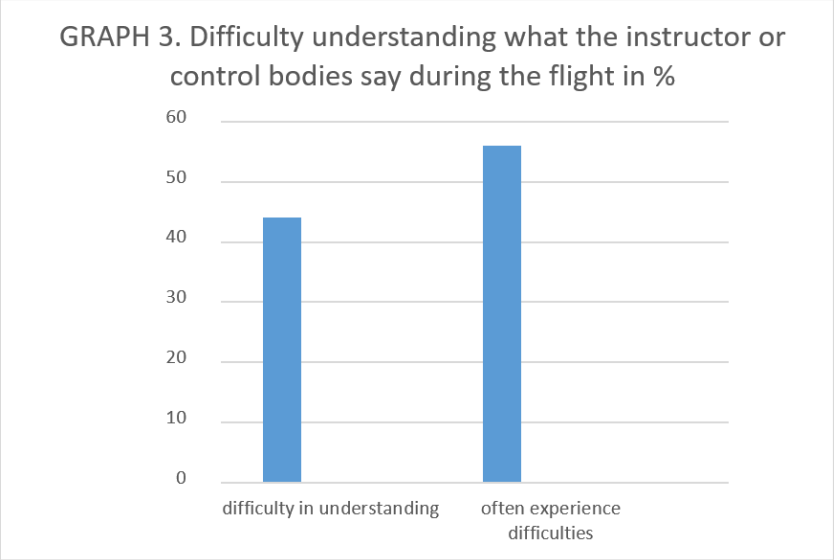


The third question asked how often the cadets felt their concentration was compromised during the flight. This question shows how common it is
deconcentration during flight due to influences from the external environment, including noise, which in some specific cases can compromise flight safety. Of the cadets asked, 7 (28% of the total) said they never felt their concentration was compromised, 17 (68% of the total) said they sometimes felt their concentration was compromised and only 1 (4% of the total) said they often felt their concentration was compromised. This feeling is common during exposure to loud noises and is not necessarily recurrent, but it shows how the vast majority have already been exposed to favorable conditions for a drop in concentration during the flight (GRAPH 2).



The fourth question asked whether the cadets had ever found it difficult to understand what the instructor or control bodies were saying during the flight. This question demonstrates the influence of excessive sound pressures making communications more difficult and unintelligible. Of the Cadets asked, 11 (44% of the total) said that they sometimes had difficulty understanding in-flight communications and 14 (56% of the total) said that they often had difficulty understanding communications.

Unintelligibility in communications is a cause for concern in aviation as it is a contributing factor to reduced flight safety and, in this specific case, all the Cadets asked had at least once had their communication or reception compromised by excessive noise during air instruction missions (GRAPH 3).



The fifth question asked how cadets rate the intensity of noise during their instruction at the 2nd EIA. This question asks about the intensity of sound pressure perceived and classified by those who receive it on a daily basis.Of the 25 Cadets asked, 2 (8% of the total) rated the intensity of the noise as weak, 8 (32% of the total) as moderate, 13 (52% of the total) as strong and 2 (8% of the total) as very strong. This shows that 92% of the Cadets asked rate the intensity of the noise at the 2nd EIA as considerable, varying between moderate, strong and very strong.

The sixth question asks whether the cadets have been given any advice about noise and its impact on flight safety. This question reveals the level of knowledge that the Cadets have about the influence of noise on aerial activities and the extent to which its effects affect flight safety. Of the Cadets asked, 18 (72% of the total) said that they had already been instructed about noise and its impact on flight safety, and (28% of the total) said that they had not been instructed about noise and its impact on flight safety.

Information about the harm caused by noise should be disseminated more effectively, especially to those potentially exposed to this aggressive agent.

The seventh and eighth questions ask about the use of hearing protectors. This question aims to reveal the degree of knowledge about the importance of using this additional equipment, as well as to quantify the Cadets who use it regularly or not during flights. Of the 25 Cadets asked, all said that they always use additional earplugs and only 2 (8% of the total) said that they had not been instructed on the use of earplugs.

The use of additional protectors among the Cadet Aviators and the awareness of their importance reveal a doctrinal character rooted in the routine of air instruction, so the effects of noise can be minimized according to the efficiency of the devices.

When comparing the tolerance limits for noise established by the NR-15 and the data obtained from the decibel measurements taken on the T-25 aircraft, it can be seen that there is a high level of noise present on instruction flights, taking into account the time the Cadets are exposed to this harmful factor on each air instruction mission. However, it should be borne in mind that the aircraft's crew members wear helmets and moldable earplugs on a continuous basis. The maximum and minimum attenuation from the proper use of the two pieces of safety equipment is around 39 dB to 58 dB respectively, according to the manufacturers' specifications.

DISCUSSION

The National Institute for Occupational Safety and Health states that noise in the workplace can lead to health problems that are triggered by stress, such as high blood pressure, heart disease, peptic ulcers and headaches. This is because excessive exposure to occupational noise intensifies stress and this prolonged exposure does not allow the worker to adapt to the presence of noise, in fact, the effects tend to worsen over time. In addition, some research suggests that the stress caused by exposure to noise inhibits certain brain activities, impairing decision-making and the proper functioning of memory, such as the ability to retain information and to learn [8 -10].
Learning [8 -10].

Noise, by definition, is an unpleasant acoustic effect or one that can cause sound intolerance in listeners [11].

The ISO 2204 (2019) standard, Acoustics - Guide to the measurement of airborne acoustical noise and evaluation of its effects on man, presents noise classifications according to exposure time. According to this standard, noise can be identified as Continuous Noise if there are insignificant variations in levels during the measurement, Non-continuous or Intermittent Noise if the noise level varies considerably throughout the measurements and, finally, Impact Noise, if it presents itself in acoustic peaks lasting less than a second [12 - 14].

Prolonged exposure to noise is usually associated only with permanent hearing loss, as this is the most well-known disease associated with this aggressive factor. However, there are many other disorders in the nervous, circulatory, digestive, endocrine and immune systems, sexual functions and sleep that are caused by environmental noise [15].

Therefore, the dangerous nature of excessive exposure to noise causes various health problems and it is clear that exposed workers can suffer the effects of noise to a greater or lesser degree depending on the job they do and their degree of vulnerability [16].

Thus, aircraft pilots are professionals who are vulnerable to noise and the risks vary for various reasons, for example, self-esteem, perception of stressors, social interaction, among others [15-18].

Professionals exposed to high levels of noise have their performance impaired due to the noise's contribution to accelerating tiredness, its interference with concentration and the ability to perform manual tasks. This causes their performance to drop over the course of their working time. Likewise, noise's ability to irritate increases the chances of a drop in mental concentration, interfering with the reaction to prevent an imminent accident and contributing to a greater likelihood of making wrong decisions in situations that require attention [19].

Although noise cannot be considered a causal factor in accidents, due to the lack of scientifically proven evidence, we can consider that noise is a favorable factor in the occurrence of errors and accidents since it can increase the likelihood of human error [20].

With regard to the effects of noise, it can be highlighted that noise causes a masking effect on sounds, communications and audible alarms that
warn of problems that could compromise safety. In addition, noise causes a decrease in human concentration and in the ability to remain attentive and focused [21].

Exposure to noise therefore becomes even more aggravating, mainly because it impairs mental activity, impairs vigilance and compromises decision-making in extreme cases, thus compromising safety [22-23].

CONCLUSION

The individual perception of the influence of noise on performance and the ability to concentrate is a variable with a significant effect in terms of preventive measures on the part of the Cadet Aviators.

In summary, the set of results obtained by analyzing the two methods used in the study demonstrates the complexity of human reactions to the same phenomenon such as noise. It also highlights the need for a more careful analysis

of each individual potentially exposed to noise and their individual experiences.

The dissertation exposes the difficult and insignificant ability of the Cadet Aviators to compensate for the deficiencies of a system through effort and dedication. In addition to their ability to assimilate the flight safety issues envisioned by the AFA and, through discipline, make use of the learning in their own reality in order to guarantee flight safety and mental concentration during instruction in the T-25.

REFERENCES

I. MONTEIRO, Raul Francé et al. Novas tecnologias de cabine em aviões do transporte aéreo regular e transformações na representação social dos pilotos. 2007.

II. BEZERRA, Thiago Augusto Rochetti et al. O RUÍDO COMO CAUSADOR DE DESCONCENTRAÇÃO DURANTE O VOO DOS CADETES NO T-25. Revista CPAQV-Centro de Pesquisas Avançadas em Qualidade de Vida, v. 12, n. 3, 2020.

III. BEZERRA, Thiago Augusto Rochetti et al. AVALIAÇÃO DA ACUIDADE VISUAL E SAÚDE OCULAR EM AVIADORES. Revista CPAQV-Centro de Pesquisas Avançadas em Qualidade de Vida, v. 15, n. 2, 2023.

IV. BEZERRA, Thiago Augusto Rochetti et al. In-flight analysis of intracranial pressure in pilots undergoing variation in Gz. Aeronautics and Aerospace Open Access Journal, v. 2, n. 3, p. 126-131, 2018.

V. RIBEIRO, Ana Maria Dutra; CÂMARA, Volney de M. Perda auditiva neurossensorial por exposição continuada a níveis elevados de pressão sonora em trabalhadores de manutenção de aeronaves de asas rotativas. Cadernos de Saúde Pública, v. 22, p. 1217-1224, 2006.

VI. BLOEDOW, Barbara Alice Carvalho; DE BARBA, Marion Cristine. A saúde auditiva de pilotos frequentadores de aeroclubes no Rio Grande do Sul. Revista Conexão SIPAER, v. 11, n. 1, p. 10-20, 2021.

VII. ATALAY, Hayriye; BABAKURBAN, Seda Türkoğlu; AYDIN, Erdinç. Evaluation of hearing loss in pilots. Turkish archives of otorhinolaryngology, v. 53, n. 4, p. 155, 2015.

VIII. GOMES, Virginia Silva; MACIEL, Daniele Pimentel; GIANVECCHIO, Daniele Muñoz. Papel da logoaudiometria na obtenção do certificado médico aeronáutico (CMA) na avaliação de pilotos da aviação civil com perda auditiva: relato de caso. Saúde Ética & Justiça, v. 20, n. 1, p. 37-42, 2015.

IX. FALCÃO, Taiana Pacheco et al. Perfil audiométrico segundo exposição de pilotos civis ao ruído. Revista de Saúde Pública, v. 48, p. 790-796, 2014.

X. KURONEN, Pentti et al. Modelling the risk of noise-induced hearing loss among military pilots. International journal of audiology, v. 43, n. 2, p. 79-84, 2004.

XI. AL-OMARI, Abdulrhman S.; AL-KHALAF, Hani M.; HUSSIEN, Naglaa Fayek Mohamed. Association of flying time with hearing loss in military pilots. Saudi Journal of Medicine & Medical Sciences, v. 6, n. 3, p. 155-159, 2018.

XII. RAYNAL, Marc; KOSSOWSKI, Michel; JOB, Agnes. Hearing in military pilots: one-time audiometry in pilots of fighters, transports, and helicopters. Aviation, space, and environmental medicine, v. 77, n. 1, p. 57-61, 2006.

XIII. NURFITRIYANA, Nurfitriyana; IVONE, July; ADHY, Pramusinto. Influencing factors of hearing disorder in helicopter and casa pilots. Journal of Medicine and Health, v. 2, n. 5, 2020.

XIV. MACHADO, Humberto César; VIEIRA, Danilo Pedrosa. Saúde auditiva na instrução aérea brasileira. Sociedade, saúde e meio ambiente. Aparecida de Goiânia: Faculdade Alfredo Nasser, p. 204-214, 2018.

XV. WAGSTAFF, Anthony S.; ÅRVA, Per. Hearing loss in civilian airline and helicopter pilots compared to air traffic control personnel. Aviation, space, and environmental medicine, v. 80, n. 10, p. 857-861, 2009.

XVI. JARUCHINDA, Pariyanan et al. Prevalence and an analysis of noise-induced hearing loss in army helicopter pilots and aircraft mechanics. JOURNAL-MEDICAL ASSOCIATION OF THAILAND, v. 88, p. S232, 2005.

XVII. BEGAULT, Durand R. et al. Survey of commercial airline pilots' hearing loss. Perceptual and motor skills, v. 86, n. 1, p. 258-258, 1998.

XVIII. ZHANG, Yange et al. Distortion product of otoacoustic emissions as a sensitive indicator of hearing loss in pilots. Aviation, space, and environmental medicine, v. 75, n. 1, p. 46-48, 2004.

XIX. LANG, Gregory T.; HARRIGAN, Michael J. Changes in hearing thresholds as measured by decibels of hearing loss in British Army Air Corps lynx and apache pilots. Military medicine, v. 177, n. 11, p. 1431-1437, 2012.

XX. VAN DEELEN, G. W.; BLOM, J. H. Hearing loss and radiotelephony intelligibility in civilian airline

pilots. Aviation, space, and environmental medicine, v. 61, n. 1, p. 52-55, 2016.

XXI. BÜYÜKÇAKIR, Cem. Hearing loss in Turkish aviators. Military medicine, v. 170, n. 7, p. 572-576, 2005.

XXII. NIE, V. M.; DEVEY, P.; BROWN, A. Noise exposures and risks of hearing loss in pilots of general aviation aircraft. Occupational Health and Industrial Medicine, v. 2, n. 37, p. 70, 1997.

XXIII. SCHULTHESS, G. V.; HUELSEN, E. Statistical evaluation of hearing losses in military pilots. Acta oto-laryngologica, v. 65, n. 1-6, p. 137-145, 2018.