

# Impact of Aircraft Noise and Compliance with the Use of Personal Protective Equipment on Hearing Impairment in Pilot Cadets at Indonesia Civil Pilot Academy Banyuwangi

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## ABSTRACT

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Noise in the workplace is a health issue in several countries. Similarly, in the aerospace industry, advanced aircraft, whether for civilian transportation or military purposes, pose risks due to exposure to aircraft noise, which passengers are continuously subjected to at relatively higher intensities and for prolonged periods. **The problem** of this research is to identify, reduce, and prevent the impact of aircraft noise and compliance with the use of personal protective equipment (PPE) on hearing impairment among cadet pilots at the Indonesian Aviation Academy in Banyuwangi. The **research objective** includes collecting medical records of 57 cadets, measuring aircraft noise levels, and conducting a questionnaire survey. **The method** used in this study is descriptive quantitative, with 57 respondents. Data analysis was performed to determine the compliance of cadets with PPE usage at the Indonesian Aviation Academy in Banyuwangi. **The results** show that the noise produced by the aircraft operated by the academy exceeds the permissible noise level (PNL), and the questionnaire results indicate low compliance with PPE usage. However, medical record data reveal that the majority of cadets still have normal hearing, with only 12.3% or 7 respondents categorized as having mild hearing impairment. These findings imply a positive and significant influence of aircraft noise level and PPE compliance on hearing impairment among trainees.

### Recommended Citation:

APA Style

## INTRODUCTION

In Indonesia, the lack of awareness regarding hearing impairment has become a lesser-known issue, especially among workers who operate in environments that can potentially damage their hearing. This condition is influenced by workers' minimal knowledge of hearing impairment and its symptoms. The human hearing threshold ranges between 20-2000 Hz with sound intensities not exceeding 85 dB. If the sound heard remains within the normal range, there are no issues. However, when the sound exceeds 85 dB, it can affect the auditory receptors in the ear (Hamdali in Rosalia, 2019 ; Khorunzhii, 2023). According to the Minister of Manpower and Transmigration Regulation Number PER.13/MEN/X/2011, the threshold limit value (TLV) is the standard risk involved in potential hazards in the workplace environment, which includes the time-weighted average intensity that can be tolerated by workers without causing illness, over a period of 8 hours per day or 40 hours per week. In this case, the TLV is set at 85 decibels (dB).

Noise in the workplace is a health issue in several countries. Similarly, in the aerospace industry, advanced aircraft, whether for civilian transportation or military purposes, pose risks due to exposure to aircraft noise, which passengers are continuously subjected to at relatively higher intensities and for prolonged periods. The risk is sensorineural Noise Induced Hearing Loss (NIHL) (Pratiwi in Padoli, et al., 2018; Kleinjung, 2024). According to data from the World Health Organization in 2018, more than 5% of the population, approximately 430 million people, require rehabilitation for disabling hearing impairments, around 432 million adults, and 34 million children. Hearing impairments decrease by more than 34 decibels (dB). Nearly 80% of people with hearing impairments are located in countries with lower to middle-income levels. Hearing impairments may increase with age, up to over 60 years.

One previous study on ear impairments due to noise at Sultan Thaha Kota Jambi Airport in 2020 conducted medical check-ups on 3 informants, revealing that one of them was identified as suffering from noise-induced hearing loss (NIHL) in both ears. The second informant was identified as having NIHL in the right ear (Putri, et al., 2021). In aviation activities, especially flight training practices for flight cadets at the Indonesian Flight Academy in Banyuwangi, flight cadets are often exposed to aircraft noise, both during ground handling activities at Banyuwangi International Airport. This carries the risk of causing hearing impairments due to noise exposure. This is reinforced by flight cadets' activities during practice, without using ear protection devices amid the noise of training aircraft operating at Banyuwangi International Airport, as well as a lack of awareness or knowledge about hearing impairment issues due to noise. To reduce noise, research has been conducted on sound intensity reduction using several examples.

From experimental results, the measured sound intensity after passing through Styrofoam and sponge showed an exponential decrease pattern, which is consistent with the equation. By processing the data, it was found that the sound absorption coefficients for Styrofoam were 0.8 m<sup>-1</sup> and for sponge were 0.4 m<sup>-1</sup> (Sandi, 2020). The problem statement for this thesis focuses on the impact of noise from aircraft at the Indonesia Civil Pilot Academy - Banyuwangi apron and compliance with the use of personal protective equipment (PPE) on the occurrence of hearing impairments among the cadets of the Indonesia Civil Pilot Academy Banyuwangi during aircraft ground handling activities before and after flight practices conducted at Banyuwangi International Airport. The aircraft involved in this study are the Cessna 172 SP Skyhawk and Piper Seneca V owned by Indonesia Civil Pilot Academy - Banyuwangi.

The objectives of this research are to determine the level of noise generated by aircraft around Banyuwangi International Airport, to understand the impact experienced by flight cadets of the Indonesia Civil Pilot Academy Banyuwangi due to noise during ground handling activities, and to provide interventions or minimize the risk of hearing impairments experienced by flight cadets. Every day, flight cadets perform ground handling activities at the apron and hangar facilities available at Indonesia Civil Pilot Academy - Banyuwangi. It is feared that some cadets may be affected by hearing impairments due to the noise generated by operating aircraft engines. This thesis provides knowledge benefits to understand the health impacts of exposure to aircraft engine noise, especially when flight cadets are exposed to noise during ground handling. Additionally, it is expected that this research will contribute to evaluating safety regulations, aiming to raise awareness among flight cadets about the importance of hearing health and the use of personal protective equipment (PPE).

## **METHOD**

This research is conducted to enhance the safety of flight operations and to find answers to questions using systematic and scientific procedures. The research process is established to obtain both internal and external valid research results. Internal validity occurs when the research results have high accuracy and depiction with minimal or few errors. External validity occurs when the research results have conclusions that generally apply to all other members of the research population. The research design is a systematic and objective plan of activities for collecting, processing, analyzing, and presenting data, aimed at solving a problem or testing a hypothesis to develop general principles (Herdayanti, 2019; Rassel, G., et al 2020). The research begins with sound measurement using a Digital Sound Level Meter, which can capture sounds ranging from 40 to 130 dB. This device is used to record

sound levels at specific locations, namely, Hangar Alpha, Apron Indonesia Civil Pilot Academy - Banyuwangi, Flight Operation Room, and the closest classroom to the source of the generated sound. Subsequently, a questionnaire is administered to assess compliance with the use of personal protective equipment (PPE). Data are also obtained from the latest health records of trainees to ascertain the results of respondents' audiometry and the impact of noise exposure during training at Indonesia Civil Pilot Academy - Banyuwangi.

The research design flowchart outlines a process that begins with measuring the noise levels of aircraft, followed by administering a questionnaire to assess compliance with the use of personal protective equipment (PPE). Subsequently, medical records, specifically audiometry data, are collected. The collected data is then processed and analyzed. Finally, conclusions and recommendations are drawn based on the analysis. Research variables are attributes that are inherent to the subjects. Research objects can be individuals, objects, transactions, or events collected from research subjects that describe a condition or value of each research subject. The term "variable" originates from the fact that certain characteristics can vary among objects within a population (Ulfa, 2021). In this study, the researcher has two independent variables ( $X$  variables) and one dependent variable ( $Y$  variable). The variables in this study can be described as follows:

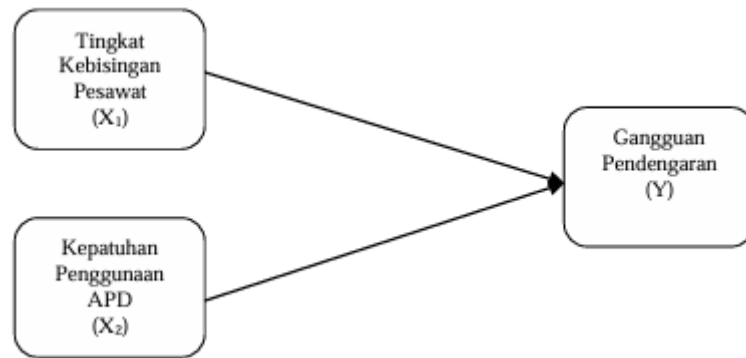


Figure 1. Research Variable

According to Sugiyono (2018), population refers to a generalization consisting of objects or subjects that possess specific qualities and characteristics and are designated for study and subsequent conclusion drawing. This study takes as its population the active or airworthy aircraft used by the cadets of the Indonesian Aviation Academy Banyuwangi, as well as the flight cadets who have undergone education for 1 year, 2 years, and 3 years at the Indonesian Civil Pilot Academy Banyuwangi.

According to Sugiyono, 2018 ; Prayitno et al 2023, a sample is a portion of the characteristics found within a population. What is learned from the sample, its conclusions will be obtained and applied to the population. Sample selection must be truly representative. Due to the small size of the population, the sampling technique used is saturation sampling or census. Saturation sampling is a sampling technique that uses the entire population. This saturation sampling technique is used because the population is relatively small, i.e., <100 respondents. In this study, the obtained population consists of 57 respondents, which is <100 respondents, thus this sampling technique can be utilized. According to Prayitno et al (2023), the definition of research object is an attribute or value of a person, object, or activity that exhibits certain variations and is determined by the researcher or author to be studied and learned thereafter.

In this study, the objects used are hearing impairment and compliance with the use of personal protective equipment (PPE) in carrying out ground handling activities, where the noise is generated by the aircraft engines used by the Indonesian Civil Pilot Academy Banyuwangi. These include the Cessna 172SP with a Lycoming IO-360-L2A engine producing 180 horsepower (134 kW), with a maximum engine rotation of 2,700 RPM (POH C172SP, 2017), and the multi-engine Piper Seneca V with Continental Motors engines, specifically a 6-cylinder, direct drive, horizontally opposed, and air-

cooled engine. The left engine is of type TSIO-360RB, and the right engine is of type LTSIO-360RB, capable of producing up to 220 BHP, with engine rotation speeds of up to 2600 RPM (POH PA-34-220T, 2013).

In completing this research, several procedures are needed to collect data, including: a) Observation; Observation is a technique for collecting data by observing ongoing activities. Observation is divided into two types: participatory (directly involved) or non-participatory (indirect). (Prayitno, et al., 2023). Observational data are obtained from measurements of sound levels using a sound level meter, where the sound source is generated by Cessna 172 SP Skyhawk and Piper Seneca V aircraft at specific distances and durations of sound production. Additionally, several medical records are included, which have been conducted by cadets according to the duration of education completed at Indonesia Civil Pilot Academy - Banyuwangi. b) Questionnaire; A questionnaire is one technique for indirectly collecting data. Its instrument and tools contain questions or statements to be answered by respondents. Questions in the questionnaire include open-ended questions, structured questions, and closed-ended questions (Prayitno et al., 2023). The distribution of the questionnaire aims to determine compliance with the use of personal protective equipment (PPE) during ground handling activities among the sample population under study.

This study employs a quantitative descriptive approach. This method describes, examines, and explains something studied as it is and draws conclusions from observable phenomena using numerical data (Sulistiyawati et al., 2021; Mojahan, H.K 2020). This technique occurs after all data are collected through observation and administered questionnaires. The sound noise data generated by Cessna 172 SP Skyhawk and Piper Seneca V aircraft are processed into a table based on noise threshold values. The sound recording data are then transformed into a table, wherein the hearing impairment experienced by respondents is categorized. Respondents' names and identities are kept confidential according to research guidelines to respect respondents' personal data (Wolters in Pramono, 2021).

The results from the questionnaires are processed using SPSS (Statistical Product and Service Solution). The obtained data are then analyzed using descriptive analysis methods assisted by SPSS. These results provide an overview of the data set based on mean values, standard deviations, variations, maximums, and minimums. This approach enables clearer and easier-to-understand data explanations (Ghozali, 2018: 19). Additionally, the data are tested for validity, reliability, and regression to determine the relationships among other variables. The research was conducted at the campus of the Indonesian Civil Pilot Academy Banyuwangi, specifically in the Indonesia Civil Pilot Academy - Banyuwangi Hangar, and several classrooms adjacent to the Indonesia Civil Pilot Academy - Banyuwangi Hangar. The time taken to complete this research required 3 weeks, starting from the first week of June until the last week of June 2023.

## **RESULTS AND DISCUSSION**

After outlining the research background, relevant theories, and methodologies employed, the research findings will be presented based on data collected through compliance questionnaires regarding the use of personal protective equipment (PPE), measurement of aircraft noise levels, and medical records of flight cadets. Analysis will involve compiling a list of questionnaire statements, documenting aircraft noise level measurements, and collating data from audiometry medical records. The researcher will then conduct data analysis to ascertain the impact of aircraft noise and compliance with PPE usage on hearing impairments among flight cadets at the Indonesian Civil Pilot Academy Banyuwangi.

The aircraft noise levels are measured based on the distance from the sound source, believed to be where the flight cadets spend more time and the duration of exposure received by the cadets. Recordings are taken from multiple points in the hangar, apron, and classrooms located at Indonesia Civil Pilot Academy - Banyuwangi, selecting the sound source closest to the location for sound level measurements. The layout of the Indonesia Civil Pilot Academy - Banyuwangi hangar and apron is provided below.



Figure 2. noise level taking location plan

The location layout above indicates Hangar Alpha, Hangar Charlie, Hangar Bravo, the apron, and Ops 2 building (Genteng class) based on satellite imagery and layout depiction. Once the locations are determined, sound level measurements are taken using a sound level meter with two types of aircraft, namely Cessna 172SP and Piper Seneca V. After recording the noise levels from the two types of aircraft, namely Cessna 172SP and Piper Seneca V, the average sound levels obtained from Cessna were at least 80.25 dB and at most 88.73 dB. The longest duration of noise exposure was 3 minutes and 22 seconds, while the shortest duration was 2 minutes. Subsequently, for the Piper Seneca V aircraft, the average noise level generated was at least 83.50 dB and at most 91.30 dB. The longest duration of exposure was 14 minutes and 39 seconds, with the shortest exposure duration being 5 minutes. Based on the threshold values set by the Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Safety and Health in the Workplace, the noise generated by both aircraft, taken from various locations, mostly exceeded the threshold limit values (TLV). However, during sound level measurements in the Genteng class classroom, the noise did not exceed the threshold limit value.

The audiometry results were obtained from the medical records of flight cadets at Indonesia Civil Pilot Academy - Banyuwangi. The number of respondents corresponds to the existing population, which is a total of 57 individuals. There are several characteristic differences among respondents, which are distinguished by the duration of education completed. Out of the total respondents, 29% of the flight cadets have completed a 3-year education program, 21% have completed a 2-year program, and the majority of respondents, accounting for 50%, have completed a 1-year program. The audiometry results were extracted from medical records conducted at the aviation health center, and they were retrieved based on the duration of education completed by the flight cadets during their time at Indonesia Civil Pilot Academy - Banyuwangi. From the collected audiometry data, it was filtered according to the indicators of each sound frequency. The obtained figures reflect the respondents' ear sensitivity in hearing sounds. Assessment indicators for respondents suffering from noise-induced hearing impairment are divided into several categories, as outlined by Hearing (2019):

1. Mild (21 – 45 dB) – Soft sounds may be difficult to distinguish.
2. Moderate (46 – 65 dB) – Conversation speech is difficult to hear, especially in the presence of background noise (such as television or radio).
3. Severe (66 – 90 dB) – It is very difficult to hear speech unless it is loud.

4. Profound (91 dB) – Almost all sounds are inaudible. Most individuals with severe hearing impairment benefit from hearing aids. Cochlear implants can assist these patients.

From the collected audiometry data of 57 flight cadets, 87.7% of the cadets' hearing can be categorized as normal, while 12.3% can be categorized as having mild hearing impairment. Among those with mild hearing impairment, the majority, accounting for 7% of the total respondents, are found among flight cadets who have only undergone training for 1 year.

Duration of Education	Number of Population	Percentage
1 Year	29 People	51%
2 Year	12 People	21%
3 Year	16 People	28%
TOTAL	57 People	100%

Figure 3. Characteristics of Respondents

Respondents in the compliance with Personal Protective Equipment (PPE) questionnaire exhibit different characteristics. Consequently, respondents need to be classified according to their characteristics. The duration of education completed is a factor considered in this study. The table above indicates that 51% of the respondents have completed education for 1 year. Based on this description, it can be inferred that the majority of respondents have completed education for 1 year.

Research instruments are used to assist researchers in systematically and simply collecting data. According to Aggara & Abdillah (2019), to obtain objective and valid data for research, researchers must develop test instruments consisting of questions that align with predetermined indicators. To facilitate the development of the instruments, it is necessary to use equipment guidelines. In this study, there is a questionnaire grid for compliance with Personal Protective Equipment (PPE). This analysis explains the data collected using the questionnaire. It provides an explanation of the tendencies of respondents' answers to each questionnaire item. This statistical analysis requires class intervals (Wicaksono, 2022). Class interval data can be calculated as follows:

$$\text{Class Interval} = \text{Highest Value (5)} - \text{Lowest Value (1)} / \text{Length of Class} = 5-1/5 = 0.8$$

The indicates that the average variable for compliance with the use of Personal Protective Equipment (PPE) is 2.71, showing respondents' responses to PPE usage compliance yielding a fair result. The value for P1.2 (I use ear protection when at the Indonesia Civil Pilot Academy - Banyuwangi apron) obtained the lowest score, namely 2.23, categorizing it as low. Furthermore, P1.1 (I use ear protection every time I perform ground handling activities) received a score of 2.42, also classified as low, and P3.2 (I use ear protection only when supervised by an officer) scored 2.26, also categorized as low. Additionally, there are three results with the highest scores, categorized as "fair," in indicator P5.1 (I feel disturbed by the noise generated by the aircraft) with a total average score of 3.33, P5.2 (I feel pain in my ears when hearing the noise generated by the aircraft) with an average of 3.30, and P5.3 (My hearing feels disturbed after receiving noise from the aircraft) with a result of 3.26.

The validity test is used to measure whether questionnaire data are valid or not. A questionnaire is considered valid when the questions or statements in the questionnaire can capture what is intended to be measured (Ghozali, 2018: 51). The method for conducting a validity test involves comparing the calculated r-value (r-calculated) with the critical r-value (r-table). If the calculated r-value is greater than the critical r-value, then the data can be considered valid; conversely, if the calculated r-value is smaller than the critical r-value, then it is considered invalid.

With a total of 57 respondents, referring to the previous table regarding the distribution of critical r-values, the obtained critical r-value is 0.226. Subsequently, based on the responses to all statements provided by the respondents, the calculated r-value (r-calculated) is greater than the critical r-value (r-table). Therefore, it can be concluded that the validity test results for the questionnaire are valid. According to Ghozali (2018: 45), reliability is a tool used to measure the level of consistency or stability of indicators within a variable presented in a questionnaire. A questionnaire can be considered reliable if each respondent's answer to a question or statement remains consistent or stable over time. To measure the reliability of a questionnaire, the threshold value of alpha is set at 0.70. Therefore, if the data yield a value  $> 0.7$ , it can be considered reliable, while if it is  $< 0.7$ , the data cannot be considered reliable.

Based on the results of the data analysis using the Cronbach Alpha ( $\alpha$ ) statistical test, the obtained results to determine the reliability of the data can be observed that the Cronbach's alpha value for the variable of APD usage is reliable. Therefore, it can be stated that the variables in this study are reliable or consistent. According to Ghozali (2018: 179), the t-test is a tool used to measure the extent to which the independent variable influences the dependent variable partially. The criteria for the t-test are as follows: a) If the significance value  $> 5\%$  or 0.05, then  $H_0$  is accepted and  $H_a$  is rejected. This means that the independent variable does not significantly affect the dependent variable. b) If the significance value  $< 5\%$  or 0.05, then  $H_0$  is rejected and  $H_a$  is accepted. This means that the independent variable significantly affects the dependent variable.

Based on the comparison of t-value with the t-table:

1. If the t-value  $>$  t-table, then  $H_0$  is rejected and  $H_a$  is accepted. This means that the independent variable affects the dependent variable.
2. If the t-value  $<$  t-table, then  $H_0$  is accepted and  $H_a$  is rejected. This means that the independent variable does not affect the dependent variable.

To obtain the t-table value, we can calculate the degrees of freedom ( $df = n - k - 1$ ) with  $\alpha = 5\%$  or 0.05. In this study,  $df = a/2 ; 57 - 1 - 1$  or  $df = 55$ . Thus, the t-table value is obtained as 1.679. Based on the analysis using SPSS version 25 software, the results can be interpreted that the t-value of the variable Noise Level (X1) is 23.714  $>$  t-table 1.679 and the significance value (sig.) is 0.000  $<$  0.05. Thus, it can be concluded that  $H_0$  is rejected and  $H_a$  is accepted. Based on this data, it can be interpreted that Noise Level has a positive and significant effect on Hearing Impairment among pilots at the Indonesian Flight Academy Banyuwangi. Next, to determine the variable of the use of Personal Protective Equipment (X2) on the dependent variable of hearing impairment (Y), the analysis results can be interpreted that the t-value of the second independent variable (X2) is 7.133, which is  $>$  1.679, and the significance value (sig.) is 0.000  $<$  0.05. Therefore, it can also be concluded that  $H_0$  is rejected and  $H_a$  is accepted. This indicates positively that the use of Personal Protective Equipment also affects the hearing impairment of cadets at the Indonesian Flight Academy Banyuwangi.

According to Mardiatmoko (2020), this test is used to determine whether variables collectively have a significant effect on the dependent variable (Y). The criteria for determining the effect of independent variables on the dependent variable are as follows:

1.  $H_0$ : There is no influence of X1 and X2 on Y.
2.  $H_a$ : There is an influence of X1 and X2 on Y.

Decision-making criteria:

1.  $H_0$  is accepted if Significance  $>$  0.05 (no influence)
2.  $H_0$  is rejected if Significance  $<$  0.05 (influence)

In analyzing the combined effect of the variables of noise level (X1) and the use of Personal Protective Equipment (X2) on the dependent variable of hearing impairment (Y), the critical value ( $f_{table}$ ) is determined by calculating the number of variables. In this test, there are 2 variables: X1 and X2, so  $DF_1$  is 2 and  $DF_2 = \text{sample size} - \text{variables} - 1$ , resulting in  $DF_2 = 57 - 2 - 1 = 54$ . After obtaining  $DF_1$  and  $DF_2$ , the f-table value is found to be 3.168. This means that the independent variables have a significant effect on the dependent variable. Based on the comparison of f-value with f-table:

1. If the  $f$ -value  $>$   $f$ -table, then  $H_0$  is rejected and  $H_a$  is accepted. This means that the independent variables collectively influence the dependent variable.
2. If the  $f$ -value  $<$   $f$ -table, then  $H_0$  is accepted and  $H_a$  is rejected. This means that the independent variables collectively do not influence the dependent variable.

Based on the analysis results using SPSS version 25, the analysis results can be interpreted that the  $f$ -value for the variables of Noise Level (X1) and the Use of Personal Protective Equipment (X2) collectively on hearing impairment (Y) is  $3.200 > f$ -table  $3.168$ , and the significance value is  $0.009 < 0.05$ . Therefore,  $H_0$  is rejected, and  $H_a$  is accepted. Based on this data, it can be concluded that the noise level and the use of Personal Protective Equipment collectively and significantly influence the dependent variable, which is the hearing impairment of trainees at Indonesia Civil Pilot Academy - Banyuwangi. Based on the results of the  $t$ -test and the  $F$ -test to determine the partial and simultaneous effects of the dependent variable with the independent variables, it shows that the aircraft noise level variable with a  $t$ -value of  $23.714 > t$ -table  $1.679$  with significance of  $0.000 < 0.05$ , and the Personal Protective Equipment (PPE) variable with a  $t$ -value of  $7.133 > t$ -table  $1.679$  with significance of  $0.000 < 0.05$ . Thus, both variables partially influence the dependent variable, namely hearing impairment in trainees. Furthermore, in the  $F$ -test, the noise level and PPE variables obtained an  $F$ -value of  $3.200 > F$ -table  $3.168$  with significance of  $0.009 < 0.05$ , indicating that both variables simultaneously influence the dependent variable, namely hearing impairment in trainees at Indonesia Civil Pilot Academy - Banyuwangi.

Regarding the aircraft noise level variable, the majority of the noise levels at the activity site comply with Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Health and Safety. The obtained values exceed the threshold limit values (TLVs), with minimum noise levels of  $83.50$  dB and maximum noise levels of  $91.30$  dB recorded during aircraft starting and taxiing for Cessna 172SP, and similar noise levels recorded during starting and taxiing for Piper Seneca V. The duration of noise exposure for Cessna 172SP ranged from 2 minutes to 3 minutes and 22 seconds, while for Piper Seneca V, it ranged from 5 minutes to 14 minutes and 39 seconds. Exposure time is calculated from aircraft starting, run-up, to taxiing. In terms of audiometry results, the majority of trainees did not experience hearing impairment. However,  $12.3\%$  or 7 out of 57 trainees were identified with mild hearing impairment, with most cases ( $7\%$ ) found among trainees who had been undergoing training for 1 year at Indonesia Civil Pilot Academy - Banyuwangi.

The results of the distributed questionnaire regarding the use of Personal Protective Equipment (PPE), analyzed descriptively, showed an average score of  $2.71$ , categorized as "sufficient". Statements with lower scores were related to indicators such as the use of PPE while at the Apron (P1.2), during ground handling activities (P1.1), and only when supervised by an officer (P3.2). These results indicate low compliance with PPE use. Additionally, statements categorized as "sufficient" include feeling disturbed (P5.1), experiencing ear pain (P5.2), and experiencing discomfort after exposure to aircraft noise (P5.3). The questionnaire underwent validity testing and was found to be valid overall. The reliability test yielded a value of  $0.769$  for the PPE variable, exceeding the threshold of  $0.7$ , indicating that the questionnaire is reliable and consistent. These findings imply a positive and significant influence of aircraft noise level and PPE compliance on hearing impairment among trainees.

## CONCLUSION

This research aimed to investigate the impact of noise exposure and compliance with Personal Protective Equipment (PPE) on the hearing impairment of flight cadets who have undergone training at Indonesia Civil Pilot Academy - Banyuwangi for 1 to 3 years. Based on the aircraft noise level measurements conducted by Indonesia Civil Pilot Academy - Banyuwangi, it can be concluded that the average noise level exceeds the threshold limit values (TLVs) for both types of aircraft, Cessna 172 SP and Piper Seneca V. The audiometry records of flight cadets categorized  $87.5\%$  as normal and  $12.5\%$  as having mild hearing impairment out of a total of 57 flight cadets. Furthermore, based on the analysis of the PPE usage questionnaire, compliance with PPE usage at Indonesia Civil Pilot Academy - Banyuwangi was categorized as sufficient with an average score of  $2.71$ . There were indicators of



PPE compliance that received lower scores, while the influence of noise exposure received the highest score and was categorized as sufficient. The questionnaire underwent validity testing and obtained valid results, with all indicators showing values higher than 0.226. In the reliability test, the questionnaire was categorized as reliable with a value exceeding 0.7, specifically 0.770. Additionally, hypothesis testing using t-tests and F-tests was conducted to determine the influence of noise exposure and PPE usage on hearing impairment in flight cadets. The results indicated a significant and positive influence, both partially and jointly, of the two independent variables. In conclusion, flight cadets at Indonesia Civil Pilot Academy - Banyuwangi, during activities in hangars and aprons, do not adhere to PPE usage or ear protection devices when exposed to noise levels exceeding the threshold limit values established by the Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Health and Safety in the Workplace, with a threshold value of 85 dB. This non-compliance can affect the sensitivity of hearing and may lead to hearing impairment in Indonesia Civil Pilot Academy - Banyuwangi flight cadets.

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