Relation of pilot hours of flight to stress, bruxism, attrition and abfraction *in vivo* research

(Research at Aviation Health Center of the Directorate General of Transportation)

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ABSTRACT

Background: *Pilots are a very stressful job. As a consequence of stress, pilots practice bruxism. Common clinical manifestations due to bruxism are attrition and abfraction. To evaluate whether there is a relationship between pilot flight hours and job stress associated with the occurrence of bruxism, attrition and abfraction among domestic civil aviation pilots throughout Indonesia.*

Method: *The subjects of the study were 196 pilots who were undergoing routine annual dental examinations at the Aviation Health Center of the Directorate General of Transportation. The pilot's flying hours, pilot job stress, awareness of the occurrence of bruxism was evaluated using the questionnaires. Attrition and abfraction were calculated based on scoring.*

Results: *Most of the research subjects had flight hours of 5,000 to 10,000 hours, namely 44.4% (n = 87). Pilots who experienced stress were represented with at least 56.1% depression (n = 110) and minimal anxiety 49% (n = 96). Bruxism was found in 16.8% (n = 33) of all subjects. The highest attrition measurement was in enamel 47.4% (n = 93) and the most abfraction occurred in posterior teeth 8.2% (n = 16). The results of the Spearman correlation test show that there is no significant relationship between pilot flying hours with stress, bruxism with stress and stress on attrition.*

Conclusion: *The higher the pilot's flight hours, the lower the stress. The higher the pilot's stress, the lower the attrition. There is no relationship between bruxism and pilot stress. The attrition that occurs is not directly related to bruxism activity.*

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INTRODUCTION

Indonesia is the biggest archipelago country in the world. Aviation is an important means of connecting one island to another. Therefore, with a large population, the need for air transportation continues to increase. Challenges in Indonesian aviation include poor infrastructure, bad weather, smoke from forest fires, mountainous areas and volcanoes in Indonesia, volcanic ash to human error factors. Pilot is a profession that demands expertise or skills in piloting an airplane. Pilot is a job classified with a high-risk and high-stress job.[1] This is because the job of a pilot requires great responsibility for everything during the flight and if you make a mistake can have serious consequences. The performance of a pilot with this complex job requires both physically and mentally.There is research that says that 70 percent of aviation accidents are related to a pilot's lack of optimal performance.[1] To overcome this, a pilot is expected to be in optimal condition and prevent stress factors that can cause a decrease in his skills in carrying out his duties. Aviation environment is a high risk environment and potential stress factors such as temperature, acceleration, noise and communication, decompression sickness, vibration, hypoxia, exhaust fumes and motion sickness.[2] These things can cause stress to the pilot. Flying experience as measured by total flight hours is a determinant of accident risk compared to the age of the pilot. In-flight accidents are caused by the fatigue experienced by the pilots. In order to prevent fatal errors while the pilot is doing his job, it is necessary to limit the hours of flying regulated by law.[3]

Stress is a form of psychological, physical, emotional and mental tension. Anxiety is an individual reaction, both emotional and physiological to the threat experienced.[56] This form of tension which is expressed as bruxism can affect performance in one's activities. Bruxism is a repetitive jaw muscle activity characterized by clenching or grinding the teeth and pushing against the mandible with force. Bruxism has two distinct circadian manifestations: it can occur during sleep (indicated as sleep bruxism) or during wakefulness (indicated as awake bruxism) .[4]

Grinding and clenching of teeth usually has the manifestation of a parafunction wherein grinding of the teeth is associated with noise perception.[5] Bruxism is divided into two types, namely awake and sleep bruxism. Some people perform the bruxism movement when feeling anxious and experiencing tension during activities during the day and some do it while sleeping at night. Many dentists attribute the presence of bruxism to the severity of tooth wear such as attrition and abfraction. The causal relationship seems so clear that the diagnosis of bruxism is usually believed only on clinical symptoms.[5]

Bruxism can be recognized as a valid body prevention system for stress-related situations. Mastication organs greatly affect a person's ability to handle stress. This suggests that aggressive biting is associated with a significant increase in stress-induced nor-adrenaline onset in the brain.[2] Stressful experiences and psychosocial factors play an important role in the causes of bruxism. Permanent changes in tooth morphology can result from parafunctional activity or bruxism. The stress factor during pilots performing their duties at altitude is also a triggering factor for complaints of the temporomandibular joint and tooth wear. due to stress, we can use the Electromyography tool.[8]

Attrition can be defined as loss of tooth substance due to occlusal contact between teeth and teeth or teeth with restorations in the absence of food. Physiologically, attrition increases with age and is accompanied by a decrease in the height of

the cusp and occlusal incline plane due to loss of enamel and dentin structures. Attrition can also be caused by habitual parafunctions, clenching and bruxism, traumatic occlusion, grinding and malocclusion. The occlusal and incisal surfaces are affected by severe bruxism.[9] Smith, et al. Reported that bruxism itself is an etiological factor of tooth wear. The clinical picture of attrition is characterized by a flat facet area with clear boundaries on the cusps or ridges of the molars and the incisal edges of the anterior teeth. Attrition can cause esthetic disturbances due to loss of tooth structure, temporomandibular joint function and chewing disorders as well as dentin hypersensitivity.[9,10]

Based on the research by Kaushik, et al in Aviation Stress and Dental Attrition, the results show that there is a relationship between the occurrence of attrition and stress in pilots.[2] In addition to attrition in people with high stress levels, abfraction can also occur in their teeth. Some changes in the oral cavity can occur due to a relationship with behavior.[54] Abfraction can occur due to the presence of large lateral occlusal pressures during mastication, parafunctional movements or malocclusions that produce tensile stress which can cause cusp flexure and can transmit this pressure to the cervical area causing weakening of the tooth structure in the cervical area or cracking at the cementoenamel junction. When there is a combination of attrition and abfraction it can cause worsening loss of tooth structure due to friction, large occlusal stresses and accumulation of concentrated stress from loads on the weak area, which can cause tooth fracture.

There is a clinical picture in the form of facets, dentin hypersensitivity, poor esthetics due to the loss of part of the tooth structure, also a darker tooth discoloration, broken teeth and difficulty chewing due to changes in occlusion and vertical dimensions, pulpitis or tooth pain due to loss of tooth tissue so that attrition and abfraction should be investigated.[11] Research the relationship of pilot hours to stress, bruxism, attrition and abfraction to plan a comprehensive prevention and response program for safety and pilot health. This study aims to analyze the relationship between pilot hours of flight to stress, bruxism, attrition and abfraction.

RESEARCH METHOD

This research is an analytic observational study to determine the relationship between pilot hours of flight with stress, bruxism, attrition and abfraction. The research design used was a case control design. The research was conducted at the Aviation Health Center of the Directorate General of Civil Aviation from August to November 2019. The data were obtained after informed consent under a protocol reviewed and approved by the Dental Research Ethics Committee, Faculty of Dentistry, Trisakti University 252/S2-Sp/KEPK/FKG/5/2019.

The subjects of this study were male domestic civil aviation pilots aged 30-65 years who were measured for attrition and abfraction when the pilot carried out a routine medical examination at the Aviation Health Center of the Directorate General of Transportation. Subjects were evaluated based on a questionnaire containing awareness of the occurrence of bruxism, hypersensitivity and discomfort or pain in the temporomandibular joint. The subject's teeth were measured with a probe on the area subjected to attrition and abfraction and scored. The inclusion criteria for the study sample were male pilots with an age range of 30-65 years. The exclusion criteria of the study sample were pilots with flight hours of less than 5000 hours, tooth loss with more than 4 elements that were not replaced, remaining roots, using fixed dentures (crown, onlay, inlay, bridge) with no more than 4 elements, subject with dental structural

abnormalities and subjects with veneer restorations.

In this study, data collected from a questionnaire to obtain pilot flight hours, bruxism and stress levels. After that, the teeth that were subjected to attrition and abfraction were scored. To find out the percentage of each variable, a descriptive calculation was made. Data analysis using the Spearman correlation test to determine the relationship between pilot hours of flight with stress, bruxism, attrition and abfraction. The p value (significance value) was determined to be $p < 0.05$.

RESULTS

Most of the research subjects were aged 30-65 years (mean 45.57 ± 10.03). Most of the research subjects had flight hours of 5,000 to 10,000 hours, namely 87 research subjects (44.4%) (table 1).

Measurement of stress levels in pilots using the PHQ-9 and GAD-7 questionnaires (table 2). The results showed that the pilot experienced depression at least 56% (n = 110) and no anxiety at least 49% (n = 96). Pilot stress has a significant relationship with flight hours. This can be seen in the results of p = 0.037 and p = 0.042 on the two questionnaires, namely PHQ-9 and GAD-7 (P = 0.05).

Stress category if the questionnaire contains minimal depression and moderate to severe mild anxiety. No stress category if there is minimal depression and anxiety. The prevalence of bruxism from research on domestic civil aviation pilots is 16.8% (table 3).

The results of attrition measurements carried out on the anterior, posterior and anteroposterior teeth of the upper and lower jaws showed that the most attrition was in the anterior which affected the enamel, namely 93 study subjects (47.4%) and attrition to the posterior teeth which affected the enamel, namely 125 study subjects (63,8%) (table 4).

Table 1. Pilot flying hours in percentage

No	Flight hours	Amount(n)	Percentage(%)
1	5.000-10.000	87	44,4
2	>10.000-15.000	46	23,5
3	>15.000-21.000	35	17,8
4	>21.000	28	14,3

Table 2. Pilot stress levels of depression and anxiety were measured from the PHQ-9 and GAD-7 questionnaires

No	Depression level	Amount(n)	Percentage(%)
1	None	52	26,5
2	Minimal depression	110	56,1
3	Mild depression	32	16,3
4	Moderate depression	2	1

No	Anxiety Level	Amount(n)	Percentage(%)
1	Minimal anxiety	96	49
2	Mild anxiety	80	40,8
3	Moderate anxiety	19	9,7
4	Severe anxiety	1	0,5

Table 3. Bruxism on pilot

No	Findings Bruxism	Amount(n)	Percentage(%)
1	Bruxism	33	16,80%
2	Non- Bruxism	163	83,20%

Table 4. Attrition rate measured anterior, posterior, and anteroposterior

No	Anterior Attrition	Amount(n)	Percentage(%)
1	Wear email	93	47,4
2	Wear dentin < 1/3 crown height	90	45,9
3	Wear dentin > 1/3 - < 2/3 crown height	7	3,6
4	Wear dentin >2/3 crown height	3	1,5
5	No wear found	3	1,5
No	Posterior Attrition	Amount(n)	Percentage(%)
1	Wear email	125	63,8
2	Wear dentin < 1/3 crown height	17	8,7
3	Wear dentin > 1/3 - < 2/3 crown height	2	1
4	Wear dentin >2/3 crown height	0	0
5	No wear found	52	26,5
No	Antero-posterior Attrition	Attrition(n)	Percentage(%)
1	Wear email	68	34,7
2	Wear dentin < 1/3 crown height	71	36,2
3	Wear dentin > 1/3 - < 2/3 crown height	5	2,6
4	Wear dentin >2/3 crown height	3	1,5
5	No wear found	49	25

The results of abfraction measurements carried out on the anterior, posterior, and anteroposterior teeth of the upper and lower jaws showed that the most abfraction occurred in the anteroposterior without changing the contours of the teeth, as many as 187 study subjects (table 5). The relationship between pilot flight hours and stress, bruxism, attrition and abfraction was carried out by using Spearman's correlation test (table 6). Correlation analysis shows that there is a significant negative correlation between flight hours and stress. The relationship between flight hours and stress (PHQ-9 ($r = -0.149$; $p < 0.05$) and with GAD-7 ($r = -0.145$; $p < 0.05$) So the higher the pilot's flight hours, the lower the stress (table 7).

Correlation analysis shows no correlation between bruxism and stress. The relationship between bruxism and PHQ-9 ($r = 0.292$; $p < 0.01$) and with GAD-7 ($r = 0.250$; $p < 0.01$). Correlation analysis shows that there is a significant negative correlation between stress and attrition. The relationship between stress and anterior attrition ($r = -0.157$; $p < 0.05$) and with antero-posterior attrition ($r = -0.174$; $p < 0.05$). So the higher the stress, the lower the attrition (table 8).

Table 5. Abfraction rates measured anterior, posterior, and anteroposterior

Anterior Abfraction	**Amount(n)**	**Percentage(%)**
Minimal contour loss	3	1,5
Lession depth < 1 mm	6	3,1
Lession depth 1-2 mm	1	0,5
Lession depth > 2 mm	2	1
No contour changes	184	93,9
Posterior Abfraction	**Amount(n)**	**Percentage(%)**
Minimal contour loss	8	4,1
Lession depth < 1mm	16	8,2
Lession depth 1-2 mm	12	6,1
Lession depth > 2 mm	9	4,6
No contour changes	151	77
Antero-posterior Abfraction	**Amount(n)**	**Persentage(%)**
Minimal contour loss	0	0
Lession depth < 1mm	3	1,5
Lession depth 1-2 mm	2	1
Lession depth > 2 mm	4	2
No contour changes	187	95,4

Table 6. The relationship between pilot flight hours and stress

		PHQ-9	GAD-7
Flight hours	Spearman's Correlation	-.149*	-.145*
	Sig. (2-tailed)	0,037	0,042
	N	196	196

*Significance p<0,05

Table 7. Relationship of bruxism to stress

		PHQ-9	GAD-7
Bruxism	Spearman's Correlation	.292**	.250**
	Sig. (2-tailed)	0	0
	N	196	196

*Significance p>0,05

Table 8. Relationship of stress (depression to anxiety) to attrition (anterior, antero-posterior)

		GAD-7	Atrisi A	Atrisi AP
PHQ-9	Spearman's Correlation	.619**	-.157*	-.174*
	Sig. (2-tailed)	0	0,029	0,036
	N	196	193	147

*Significance p<0,05

DISCUSSION

The job of a pilot is classified as a high-risk and stressful job because it carries out aviation safety duties compared to other jobs and is required to always be in top performance.[1] Pilots work in an environment that has stressors that are obtained not only from the work environment but from psycosocial factors. Stressors can cause stress in a pilot depending on cognitive, personality and adaptation mechanisms in dealing with these stressors.[1]

In this study, pilot stress levels can be measured using the PHQ-9 and GAD-7 questionnaires and the results are that pilots with high flight hours have low stress, this is due to the workload management when pilots take flight education. In the study it is possible that the questionnaires used, namely PHQ-9 and GAD-7 are insensitive, but in the study of Kroenke et al.[50] Stated that the PHQ-9 questionnaire was valid in measuring the severity of depression, while Zhong et al[51] stated that the GAD-7 questionnaire provided validity among patients who have been screened.

This study found a high level of pilot stress but low attrition findings. The wear assessment can show the loss of tooth structure but cannot provide information about the exact time when attrition occurs, in other words it cannot be known whether the process is currently in progress or has been completed (as a result of previous losses).[47]

In this study, the results showed that 16.8% of the pilots who realized that they were suffering from bruxism, while 83.2% of the pilots who answered that they were not bruxism, others stated that they experienced sleep bruxism based on the interviews conducted. Previous studies on Indian air force pilots showed bruxism with a bruxism prevalence of 51%.[2] The weakness in bruxism research is that it is insensitive and difficult to do because it requires specific tools such as EMG and polysomnography.[52]

Subjective examination cannot show or exclude bruxism activity so approaches such as ecological momentary assessment (EMA) and EMG can be considered. EMA is a report that refers to the real-time of any behavior, feeling or condition being researched. Several studies on the natural course of awake bruxism can be carried out using the EMA strategy as an instrument to investigate the variability of daily behavior over several observation periods (for example, during periods of stress that may have an influence on the current psychological well-being of individuals).[53] Behavior is an individual response or reaction to stimuli or the enviorment.[55]

The mechanism of attrition and abfraction in teeth is multifactorial, there is a combination of mechanical and chemical. In healthy individuals, bruxism is not a disorder but a behavioral, physiological phenomenon that can lead to certain clinical consequences. Bruxism becomes pathological when the individual feels orofacial pain such as pain in the mastication system.[47] Based on the research of Machado et al., It is shown that there is a relationship between teeth that experience wear and bruxism, perimolysis, and corrosion from eating habits. Patient occlusion was evaluated clinically with decreased vertical dimension and enamel erosion. Decreased vertical dimensions and absence of anterior and lateral guidence were associated with muscular pain and difficulty moving the mandible.[48]

Limitations in this study include this research in the form of self-report so that interviews are needed to research subjects to support the results obtained. In research to assess awake bruxism, more accurate methods such as EMA and EMG should be used.

CONCLUSION

Most of the pilots experienced minimal depression (56.1%) and minimal anxiety (49%), but these two stress parameters had no correlation with pilot flight hours. The higher the pilot's flight hours, the lower the stress. This is because the higher the pilot's flight hours, the better his stress-coping ability. There is no relationship between bruxism and pilot stress. The higher the pilot's stress, the lower the attrition. The prevalence of bruxism that occurs in pilots is 16.8% of all subjects studied, this means that there is no direct correlation between the attrition that occurs in pilots with bruxism activity. In this study, there was no relationship between the occurrence of abfraction and the pilot's flight hours, stress or bruxism.

CONFLICT OF INTEREST :

The authors declare that there is no conflict of interests regarding the publication of this paper.

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