Association of Stress with Temporomandibular Disorder in Indonesian Air Force Pilots

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Abstract

Indonesian Air Force pilots have a high stress profession. Fighter pilots experience high g-force due to constant changes in the aviation environment making them vulnerable to temporomandibular disorder (TMD). The association of stress, bruxism and tooth wear with TMD, among the Indonesian Air Force pilots unclear.

This study analyzed the association of stress, bruxism and tooth wear with TMD among transport and fighter Indonesian Air Force pilots.

This cross-sectional study assessed data of 50 transport and 50 fighter Indonesian Air Force pilots. Subjects underwent clinical examination using the Axis I DC/TMD form for TMD diagnosis and for estimating the extent of the tooth wear. Next, each subject was asked to fill the bruxism questionnaire from the American Academy of Sleep Medicine and Emotional Stress Questionnaire from the TMD etiology index.

Mann Whitney test revealed significant differences in the association of stress with TMD p= 0.018 vs. p= 0.010; bruxism with TMD p= 0.000 vs. p= 0.000; tooth wear with TMD p= 0.000 vs. p= 0.000 among the transport and fighter pilots. Stress, bruxism, and tooth wear were associated with TMD in the transport and fighter Indonesian Air Force pilots.

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Introduction

The aviation working environment of a pilot can affect his or her oro-facial regions. Environmental differences during the flight include changes in the barometric pressure, oxygen supply, temperature and acceleration. Some problems and complaints related to the health of pilots are mostly related to changes in the barometric pressure and acceleration occurring during a typical flight.[1] The working environment of Indonesian Air Force pilots represent differences, which indicate the stress levels that may induce diverse problems, including health issues. Even during peacetime, the Indonesian Air Force pilots are exposed to occupational stress.[2] Their bodies response to stimulant, which may be favorable or unfavorable, that results in rapid, frequent, and unexpected changes in the body environment, causing stress. This situation pushes a pilot to make adjustments or adaptations. Errors in speed and flight due to stress and fatigue by Indonesian Air Force aviators can result in accidents. Aviation environments include constantly changing parameters, such as a change in barometric pressure, oxygen supply, temperature, and acceleration, which result in the creation of high-risk and potentially high-stress environments. Stress experienced by pilots can reduce their performance and safety.[3]

The Indonesian Air Force includes fighter and transport corps. A fighter pilot in the Indonesian Air Force is trained in skills of air combat battles while sitting in the cockpit of a fighter aircraft. Fighter pilots undergo specialized training in aerial warfare and dogfighting (close-range aerial combat) and they usually have an outstanding academic records, physical fitness, excellent physical health, and strong mental health. They are also expected to demonstrate strong leadership and teamwork skills and are expected to be in their best health conditions to deal with the physical demands of modern air

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warfare. When intensely maneuvering during flights, fighter pilots suffer from high g-force. The fighter pilot's physical body is often depressed to the maximum extent because of the g-force. Fighter pilot experience increased g's in modern fighter aircraft because of the need for highly agile and sharp maneuvers to be made, which induce stress on their cardiovascular system, thus requiring them to be in excellent heart conditions. They also need strong muscle tissues along the extremities and abdomen for performing anti-G straining maneuvers when making sharp turns and highly accelerated maneuvers.[4] A transport pilot in the Indonesian Air Force controls and handles the flight of a transport aircraft by operating its directional flight controls as a captain (Pilot-in-Command/PC). Some other aircrew members, such as copilot (First Officer/FO) and navigators (Flight Engineer/FE), are also considered aviators, because they are similarly affected in performing the aircraft's navigation and engine systems. Transport pilots do not undergo acceleration changes or g-force, unlike fighter pilots.[5]

Changes in the aviation environment is a stress factor that can trigger temporomandibular disorder (TMD) in the pilot.[1] An index of international standard references for the diagnosis of TMD that is widely used by clinicians and researchers in various countries is the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). DC/TMD is a dual-axis approach to the diagnosis of TMD. Axis I concentrate on clinical examination, and Axis II focuses on psychosocial effects of the condition. Axis I with diagnostic algorithm includes the simplest classification groups of TMD. This group is classified further into pain-related TMD and headache, intra-articular joint disorders and degenerative joint disorders.[6]

The importance of stress as an etiological factor of TMD has been extensively reported. Emotional centers of the central nervous system inside the brain affect muscle functions. The tonicity of the head, neck muscle, and para-functional muscle activity, such as bruxism or tooth clenching, can be increased when the emotional stress level increases. Initiating, predisposing, and perpetuating factors for bruxism have been increasingly considered as psychology factors of general stress, occupational stress, and personality traits.[7]

Bruxism can be defined as a prophylaxis system for situations associated with stress. A person's ability to restrain stress can be significantly contributed to occlusion of the masticatory organ. The para-functional activity related to important exhaustion of the induced stress enhances nor-adrenalin hormone alteration in the brain. Bruxism is usually explained as a deleterious activity of the para-functional movement during nocturnal or diurnal grinding and clenching actions between the occlusal surfaces teeth.[2]

Bruxism is unrelated to local factors, but it is centrally induced symptom that is common to all people. Through bruxism, strong loads can be put to practical use for time periods greater than those of functional movement mastication. These para-functional biomechanical forces generate several dental diseases, including abfractions, tooth wear, hypersensitivity, irreversible tooth injury, periodontal tissue, masticatory muscles, and TMD. Tooth wear is usually related to bruxism, which may be severally visually affected by psychology factors (e.g., total and average perceived stress, and state and trait anxiety).[2,3]

The association between stress and TMD, as well as bruxism in response to stress and tooth wear as a result of bruxism against TMD in the Indonesian Air Force pilots has never been studied in Indonesia. This study aimed to analyze the association of stress, bruxism, and tooth wear with TMD in transport and fighter Indonesian Air Force pilots.

Materials and methods

This cross-sectional study assessed data of 50 transport and 50 fighter Indonesian Air Force pilots. Informed consent was obtained from all subjects and procedures were approved by the Ethics Committee Faculty of the Dentistry Universitas Indonesia.

TMD assessment was conducted as follows: All subjects underwent clinical examinations by a dental practitioner using the Axis I DC/TMD form and diagnostic algorithm to diagnose TMD. TMD was classified into the simplest groups comprising pain-related TMD and headache and/or/ intra-articular joint disorders.[6]

Dental assessment was conducted as follows: One dental operator estimated tooth wear by visual inspection using identical criteria

with a number 4 dental mirror and a head lamp. Tooth wear was measured using a 6 scoring scale: 0-: -no wear, 1-: –slight/little wear, 2-: -wear of the enamel only, 3-: -wear of dentin at one point, 4-: –wear into the dentin in an area of >2 mm^2, 5-: -wear of > 1/3 of the clinical crown. On the tooth wear scale, every subject had 8 scores on the crown surfaces of incisors, canines, premolars, and molars in all regions. A score ≥ 3 indicated suffering from tooth wear.[3]

Bruxism evaluation was conducted as follows: Each subject filled the bruxism questionnaire from the American Academy of Sleep Medicine. Questions on the questionnaire referred to events that occurred during the last 6 months and contained 3 questions related to bruxism and the third question had 6 sub-questions. Subjects answering with "yes" to question 1 and/or 2, with the addition of at least one "yes" answer to the symptoms listed in sub-question number 3, were considered to have bruxism.[8]

Stress evaluation was conducted as follows: Each subject filled the emotional stress questionnaire from the TMD etiology index. Questions in the questionnaire included 18 questions on the emotional stress experienced. This emotional stress questionnaire was divided into 3 scoring scales: 0 never; 1 rarely; and 2 often. The score for the emotional stress index was 0 - 36. The cut-off point was set at 15. Subjects with a score of 0-14 were included in the group not experiencing emotional stress, whereas those with a score of ≥15 were included in the group experiencing emotional stress.[6]

For statistical analysis, data were collected and analyzed using SPSS 20.0. The difference in the association of stress, bruxism and tooth wear with TMD among the transport and fighter pilots was analyzed using Mann Whitney test for independence. This test had the degree of freedom of 2 and p = 0.05.

Results

Stress was determined in 34% (n = 17) of transport pilots and in 26% (n = 13) of fighter pilots. Bruxism was recorded in 26% (n = 13) of transport pilots and in 38% (n = 19) of fighter pilots. Tooth wear was determined in 62% (n = 31) of both transport and fighter pilots. Pain-related TMD and headache were determined in 46% (n = 23) of transport pilots and in 36% (n = 18) of fighter pilots. Intra-articular joint disorders TMD was recorded in 8% (n = 4) of transport pilots and in 20% (n = 10) of fighter pilots. The combination of both pain-related TMD and headache as well as intra-articular joint disorders TMD was found in 18% (n = 9) of transport pilots and in 16% (n = 8) of fighter pilots.

The *p*-value for transport pilots was 0.000 and that for fighter pilots was 0.000, indicating a statistically significant difference ($p < .05$) in the association of bruxism with TMD among the pilots.

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The *p*-value for transport pilots was 0.018 and that for fighter pilots was 0.010, indicating a statistically significant difference ($p < .05$) in the association of stress with TMD among the pilots.

Pilot Corp	Stress	TMD				Total	p-value
		Non TMD	Pain-Related TMD and Headache	Intra-articular Joint Disorders TMD	Combination		
Transport Pilot	No	14 (28%)	11 (22%)	4 (8%)	4 (8%)	33 (66%)	.018*
	Yes	0 (0%)	12 (24%)	0 (0%)	5 (10%)	**17 (34%)**	
	Total	14 (28%)	23 (46%)	4 (8%)	9 (18%)	50 (100%)	
Fighter Pilot	No	14 (28%)	11 (22%)	10 (20%)	2 (4%)	37 (74%)	.010*
	Yes	0 (0%)	7 (14%)	0 (0%)	6 (12%)	**13 (26%)**	
	Total	14 (28%)	18 (36%)	10 (20%)	8 (16%)	50 (100%)	

* Mann-Whitney test

Table 1. Association of stress with TMD among transport and fighter pilots.

Pilot Corp	Bruxism	TMD				Total	*p*-Value
		Non TMD	Pain-Related TMD and Headache	Intra-articular Joint Disorders TMD	Combination		
Transport Pilot	No	14 (28%)	23 (46%)	0 (0%)	0 (0%)	37 (74%)	0.000*
	Yes	0 (0%)	0 (0%)	4 (8%)	9 (18%)	**13 (26%)**	
	Total	14 (28%)	23 (46%)	4 (8%)	9 (18%)	50 (100%)	
Fighter Pilot	No	14 (28%)	17 (34%)	0 (0%)	0 (0%)	31 (62%)	0.000*
	Yes	0 (0%)	1 (2%)	10 (20%)	8 (16%)	**19 (38%)**	
	Total	14 (28%)	18 (36%)	10 (20%)	8 (16%)	50 (100%)	

* Mann-Whitney test

Table 2. Association of bruxism with TMD among transport and fighter pilots.

Pilot Corp	**Tooth Wear**	**TMD**				Total	*p*-Value
		Non TMD	Pain-Related TMD and Headache	Intra-articular Joint Disorders TMD	Combination		
Transport Pilot	No	14 (28%)	3 (6%)	2 (4%)	0 (0%)	19 (38%)	0.000*
	Yes	0 (0%)	20 (40%)	2 (4%)	9 (18%)	31 (62%)	
	Total	14 (28%)	23 (46%)	4 (8%)	9 (18%)	50 (100%)	
Fighter Pilot	No	14 (28%)	3 (6%)	2 (4%)	0 (0%)	19 (38%)	0.000*
	Yes	0 (0%)	15 (30%)	8 (16%)	8 (16%)	31 (62%)	
	Total	14 (28%)	18 (36%)	10 (20%)	8 (16%)	50 (100%)	

* Mann-Whitney test

Table 3. Association of tooth wear with TMD among transport and fighter pilots.

Discussion

An Association of stress with TMD was noted in transport and fighter pilots. In this study, an association of stress with TMD was recorded in 34% (n = 17) of transport pilots and in 26% (n = 13) of fighter pilots. Desiyanti et al., studied 318 aircrews, of which 84 showed high stress with TMD (69.6% - 82.1%).[9] According to Andarmawanti et al., pain in TMD and tooth wear can be caused by anxiety while flying at high altitudes as a perceived stress relay.[1]

Tanti et al., reported that stressful life incidents trigger TMD in approximately 50% of patients. TMD patients also suffered from twice as many stressful life incidents in a 6-month period than did the controls in their study. Increased stress level stimulates the limbic portions and the hypothalamic -pituitaryadrenal (HPA) axis. In such a scenario, inducing the gamma efferent system, produces partial stretching of the sensory regions of the muscle spindles, which in turn enhances the muscle tonus to, further increase the muscle tonicity and inter articular pressure of the TMJ.[6,7]

Jones et al., proposed an association between TMD symptoms and stress response. They revealed that the TMD classification was heterogeneous; and a group whose response to stress was hyper secreted cortisol, and another group whose cortisol response was not significantly different from the control group. Another study reported that the salivary cortisol levels on waking did not differ between TMD patients and controls. Cortisol is a hormone that is secreted when the body encounters a physical or a psychological stressor. Cortisol is a physiological marker of stress. When a stressor is recognized, the HPA axis is stimulated, finally resulting in the secretion of cortisol from the adrenal glands.[10]

Bruxism with TMD between transport and fighter pilots was related. In this study, stress and TMD was recorded in 26% (n = 13) of transport pilots and in 38% (n = 19) of fighter pilots. The increased presence of painful TMD due to awake and sleep bruxism observed was essentially in accordance with those observed in other studies. Fernandes et al., reported an increased presence of myofascial pain (OR = 5.9) and arthralgia (OR = 2.3) in TMD patients with sleep bruxism compared with that in those without sleep bruxism. Michelotti et al., observed an increased presence in myofascial pain (OR = 4.9) in TMD patients with awake bruxism compared with that in controls without TMD and in controls without

awake bruxism.[11]

Widmalm et al., cautiously interpreted their results and recognized that the presence of a significant association does not prove causation but that significant associations may indicate possible common risk factors.[12] As an alternative, it is suggested that pain related to bruxism can be a manifestation of post exercise muscle soreness (PEMS), which represents muscle fiber micro trauma induced by excessive loading and pain and by dysfunction that gradually develop over several hours following the exercise. The PEMS hypothesis was further proved by the observation of 83.3% of bruxers experiencing uncomfortable pain upon awakening in the morning, subsequent to exercising. In addition, 19.7% of myofascial pain patients without any clinical sign or symptom of bruxism experienced their worst pain during morning. These reports suggest that pain related to bruxism and myofascial pain are 2 different entities.[13]

An association of tooth wear with TMD was thus noted in transport and fighter pilots. In this study, an association of tooth wear with TMD was found in 62% (n = 31) of both transport and fighter pilots. The etiology of tooth wear predominantly strens from the para-functional activity, which can be verified by merely observing the location of most wear facets. In a careful examination of 168 general dental patients, 95% showed some form of tooth wear. This finding suggests that nearly all patients experience some level of para-functional activity. Tooth wear can be an extremely destructive process, which can eventually lead to functional problems. Tooth wear is usually related with bruxism, which is severally affected visually by psychology factors (total and average perceived stress, state, and trait anxiety).[3]

According to Michelloti et al., a positive report of daytime clenching or /grinding was twice more frequent among TMD patients than among control subjects (66.1% vs 30.6%) representing a significant risk factor for both myofascial pain (OR = 4.9) and disk displacement (OR = 2.5). The relationship between tooth clenching and muscle pain led to either reduction in the blood supply or damage of muscle fibers. It has been previously described that the perfusion of masseter is significantly impaired in individuals performing voluntary isometric contractions. The relationship between disk displacement and longstanding clenching has shown an abnormal distribution of stresses in the disk because clenching may facilitate and induce disk displacement in symptomatic TMJs.[13]

Conclusions

A Positive association of stress, bruxism and tooth wear with TMD was noted in in the transport and fighter Indonesian Air Force pilots. The Preventive measures to minimize the incidence of tooth wear due to bruxism as well as stress respone include the conscious awareness and training to resist from prolonged clenching when the pilots consider the value of para-functional activity. The Indonesian Air Force pilots can wear occlusal splints and resilient synthetic wafers during their flying duties to avoid physical contact of the upper and lower teeth surfaces and thus, preventing tooth wear.

Declaration of Interest

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