

Total flying hours and risk of high systolic blood pressure in the civilian pilot in Indonesia

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Abstrak

Latar belakang: Tekanan darah sistolik tinggi di antara pilot sipil antara lain akan menyebabkan gangguan kardiovaskular sehingga akan mengganggu kelancaran penerbangan. Tujuan penelitian ini ialah untuk mengetahui faktor-faktor dominan terhadap tekanan darah sistolik tinggi pada pilot sipil.

Metode: Penelitian potong lintang dengan metode sampling purposif pada pilot yang melakukan pemeriksaan kesehatan berkala di Balai Kesehatan Penerbangan pada tanggal 18-29 Mei 2015. Data yang dikumpulkan adalah karakteristik demografi dan pekerjaan, klinis, kebiasaan olahraga, kebiasaan makan, indeks massa tubuh dan riwayat penyakit. Tekanan darah sistolik tinggi ialah tekanan darah sistolik 140 mmHg atau lebih.

Hasil: Dari 690 pilot yang melakukan pemeriksaan kesehatan berkala, 428 pilot laki-laki bersedia berpartisipasi mengikuti penelitian ini. Usia dan riwayat penyakit hipertensi merupakan faktor risiko dominan yang berhubungan dengan tekanan darah sistolik tinggi. Jika dibandingkan dengan pilot usia 19-39 tahun, yang berusia 40-65 tahun mempunyai 15,1 kali lipat lebih besar risiko terkena tekanan darah sistolik tinggi [rasio odds suaian (ORa)= 15,12; p= 0,001]. Pilot dengan riwayat penyakit hipertensi dibandingkan dengan yang tidak ada riwayat memiliki risiko tekanan darah sistolik tinggi 93,2 kali lipat lebih besar (ORa= 93,21; p= 0,001)

Kesimpulan: Usia 40-65 tahun dan memiliki riwayat hipertensi meningkatkan risiko tekanan darah sistolik tinggi di antara pilot sipil di Indonesia. (*Health Science Journal of Indonesia 2016;7:54-8*)

Kata kunci: tekanan darah sistolik, total jam terbang, pilot sipil, Indonesia.

Abstract

Background: Systolic high blood pressure among civilian pilots among others will cause cardiovascular disease and this condition will disrupt the flight. The purpose of this study was to identified the dominant factors related to high systolic blood pressure in the civilian pilots.

Methods: A cross-sectional study with a purposive sampling method on a pilot who performed periodic medical examinations in the Civil Aviation Medical Center on 18 to 29 May 2015. Several data among other, others, were on demographic and job characteristics, clinical, exercise habits, eating habits, and history of the disease. High systolic blood pressure defined as systolic blood pressure 140 mmHg or more.

Results: Of the 690 pilots who conduct periodic health examinations, 428 male pilots willing to participate this study. Age and history of hypertension is the dominant risk factor associated with high systolic blood pressure. When compared with the pilot age 19-39 years, 40-65 years old had 15.1-fold greater risk of high systolic blood pressure [odds ratio (adjusted ORa)= 15.12; p= 0.001]. Pilot with a history of hypertension compared to those without a history of having high systolic blood pressure risk 93.2 times larger (ORa= 93.21; p= 0.001).

Conclusion: Age of 40-65 years and had history of hypertension increased the riskj of systolic blood pressure among civilian pilot in Indonesia. (*Health Science Journal of Indonesia 2016;7:54-8*)

Key words: systolic blood pressure, total flight hours, civilian pilot, Indonesia

The high SBP also can occur between civilian pilots. The prevalence of high systolic blood pressure (SBP) among military pilots in Indonesia was 4.7%.¹ Research on high blood pressure also established that pilots with prehypertension will develop hypertension greater than normal blood pressure.²

High SBP associated with several risk factors, including age, gender, smoking habit, alcohol intake, body mass index and salt intake.³ A previous study found that military pilots in Indonesia with average flight hour over 300 hours per year than below 300 hours per year had more risk for high SBP. Moreover, those who had total flight hours 1400 hours or over than under 1400 hours had higher risk having SBP.¹ Another study in Greek military pilots found that the risk related to SBP were body mass index, flight hours and HDL rate.⁴

Another study in 113 male aviators (pilots, system operators, navigators, and flight engineers) aged 35-44 years in Sweden showed that aviators than general population had three times of having high SBP.^{5,6}

The objective of this study was to identify several risk factors related to high SBP in pilots in Indonesia.

METHODS

This study used cross-sectional design. Subjects were civilian pilots who conduct periodic health examinations from 18 to 29 May 2015 (in 12 days) at Aviation Medical Center Jakarta (*Balai Kesehatan Penerbangan*). The data collections of demographic characteristic, exercise habit, eating habit, body mass index, past medical history and family history of disease, used questionnaires through interview and physical examination by researcher and health workers. While laboratory data was obtained from the results of laboratory tests.

The measurement of SBP has used calibrated sphygmomanometers. Measurements were performed by health workers and they were given a briefing on how to conduct the measurements. SBP was considered normal if under 120 mmHg, prehypertension if 120-139 mmHg and high if 140 mmHg and more.

The main risk factor in this study was total flight hours. Total flight hours are number of flight hours from the first responder to fly until the time of this study. Total flight hours were divided into 2 categories: 46-3399 hours and 3400-30285 hours. The partition of this category was based on the intersection of

the total flight hours using the Receiver Operating Characteristics (ROC) method, which calculated the value of accuracy, sensitivity and specificity.

Age was divided into two categories: 19-39 years and 40-65 years. The partition of this category was also obtained by ROC. Clinical risk factors in this study were hematocrit rate and pulse rate. Hematocrit rate is percentage (%) of red blood cells volume in the blood. The partition of this category was based on the value of men normal range (0.40 to 0.48). Pulse rate is sum of pulse obtained on the subject in 60 seconds. Both data were categorized into two groups: low and high.

Several habit factors in this study were exercises and eating fast food. Exercise habits were assessed in respondents for the last 6 months. These data were categorized into 3 groups: appropriate, inappropriate and never. The appropriate group was subjects with cardio/aerobic exercise at least 3 times a week with duration more than 30 minutes or muscle exercises/anaerobic at least 2 times a week. The inappropriate group was subjects still do sports but do not accomplish the previous criteria and the last group was subjects do not exercise at all. Nonetheless the eating fast food data were categorized into 3 groups: almost never - 1-2 times per week, 3-4 times per week and almost every day.

Other risk factor in this study was body mass index. The partition of this category consisted of four groups based on WHO Asia-Pacific.⁷ The partitions were normal (18.5 to 22.9 kg/m²), underweight (below 18.5 kg/m²), overweight (23.0 to 24.9 kg/m²) and obesity (25.0 kg/m² and more). Other risk factors in this study were past medical history and family history of hypertension. Both were separated into 2 groups: yes and no.

This research analyzes using logistic regression.⁸ The data were processed using STATA version 9. Ethical approval was obtained from Health Research Ethics Committee of the Faculty of Medicine, University of Indonesia. This study was conducted after obtaining the approval from the Chief of the Aviation Medical Centre.

RESULTS

Among 690 pilots who conducted routine medical examinations in Aviation Medical Centre, 257 male pilots neglected to participate due to personal reasons. We excluded 5 female pilots therefore pilots

who are agreeable to participate in this research were 428 pilots. Consequently, prevalence for the pilots who have high SBP is 6.28%.

In the table 1 is presented the relationship between age and clinical characteristics. Compared to the 19-39 year-old subjects, older subjects were more likely to have high SBP. Furthermore, compared with subjects who had total flight hours < 3400 hours, the subjects who had ≥ 3400 hours total flight hours were more likely to have high SBP. Compared with

subjects with pulse 50-80 times per minute, subject with higher pulse rate had greater risk of suffering from high SBP.\

Table 2 shows subjects with high SBP had the same distribution terms of body mass index and fast food habits. When compared with subjects who rarely eat fast food (hardly ever - 1-2 times per week), subjects who regularly consume fast food (almost every day) were more likely to suffer from high SBP.

Tabel 1. The relationship between age and several clinical characteristics on the risk of high SBP

	Systolic blood pressure				Crude odds ratio	95% confidence interval	p
	Normal (n = 224)		High (n = 15)				
	n	%	n	%			
Age							
19-39 year	163	98.2	3	1,8	1.00	Reference	0.000
40-65 year	61	83.6	12	16,4	10.69	2.92-39.18	
Total flight hours							
46-3399 hours	145	98.6	2	1.4	1.00	Reference	0.001
3400-30285 hours	79	85.9	13	14.1	11.93	2.63-54.21	
Hematocrit							
Low (≤ 48%)	213	93.4	15	6.6	1.00	Reference	n/a*
High (≥ 49%)	11	100	0	0			
Pulse pressure							
50-80 times/minute	120	97.6	3	2.4	1.00	Reference	0.020
81-110 times/minute	104	89.7	12	10.3	4.62	1.27-16.80	

* n/a: not applicable

Tabel 2. Factors exercise habits, eating habits and body mass index on the risk of high SBP

	Systolic blood pressure				Crude odds ratio	95% confidence interval	p
	Normal		High				
	(n = 224)		(n = 15)				
	n	%	n	%			
Exercise							
Appropriate	74	92.5	6	7.5	1.00	Reference	0.634
Inappropriate	144	94.1	9	5.9	0.77	0.26-2.25	
Never	6	100	0	0	n/a*		
Fast food							
Almost never – 1-2 times/week	119	94.4	7	5.6	1,00	Reference	0.701
3-4 times/week	87	95.6	4	4.4	0.78	0.22-2.75	
Almost everyday	18	81.8	4	18.2	3.78	1.01-14.21	
Body mass index							
Normal	47	100	0	0	1.00	Reference	n/a*
Underweight	7	100	0	0	n/a*		
Overweight	70	95,9	3	4,1	n/a*		
Obese	100	89,3	12	10,7	n/a*		

* n/a: not applicable

Tabel 3. Past medical and family against the risk of high SBP

	Systolic blood pressure				Crude odds ratio	95% confidence interval	p
	Normal		High				
	(n = 224)		(n = 15)				
	n	%	n	%			
History of hypertension							
No	223	94.5	13	5.5	1.00	Reference	0.005
Yes	1	33.3	2	66.7	34.31	2.92-403.47	
Family history of hypertension							
No	213	93.8	14	6.2	1.00	Reference	0.764
Yes	11	91.7	1	8.3	1.38	0.17-11.49	

Tabel 4. Age and history of the disease on the risk of high SBP

	Systolic blood pressure				Adjusted odds ratio*	95% confidence interval	p
	Normal (n = 224)		High (n = 15)				
	n	%	n	%			
Age							
19-39 year	163	98.2	3	1.8	1.00	Reference	0.001
40-65 year	61	83.6	12	16.4	15.12	3.27-69.90	
History of hypertension							
No	223	94.5	13	5.5	1.00	Reference	0.001
Yes	1	33.3	2	66.7	93.21	5.76-1507.67	

* Adjusted each other between the variables in this table

In table 3 appears that there were no differences between subjects with high and normal SBP in terms of family history of hypertension. Furthermore, when compared with subjects who did not have hypertension, subjects with a history of a greater likelihood of high SBP.

Table 4 is the final model, shows that the age and history of hypertension were the two dominant risk factors that influence the incidence of high SBP. Compared with subjects aged 19-39 years, subject aged of 40-65 years had a risk of 15.1 times greater risk of high SBP ($p = 0.001$). Furthermore, compared to subjects with no history of hypertension, subject had a history of having 93.2 times greater risk of high SBP ($p = 0.001$).

DISCUSSION

This study had limitations, which did not represent the population because the sample was taken purposively during the medical examination in Flight Health Center. Determination of the research carried out by random sampling and the number of times to overcome bias.

In this study, there were 15 pilots with high SBP (6.28% of the total sample). In the final model, shows

that the total flight hours did not affect the high SBP. Whereas in bivariate calculation, total flight hours showed an association with the risk of high SBP ($p = 0.001$). This was due to a small number of subjects of high SBP, but it was also caused by other risk factors were dominant against high SBP and affected the results.

Result of this study differed from previous studies that proved the existence of a relationship the average flying hours per year with high SBP. The study was conducted on 336 military and civilian pilots who perform an annual physical examination at the Health Institute of Aeronautics and Space (LAKESPRA) Saryanto in 2003-2008. The study design was a nested case-control and retrieval of data through medical records. Subjects who had average flight hours per year 300-622 hours per year (ORA = 5:05; 95% CI = 1:16 to 22:04).¹ This difference was due to the fewer number of subjects, different research designs and the numbers of flight hours on average are different.

By altitude in civil aviation, the maximum altitude leads to hypoxia in pilots thus affecting high SBP. In the sensor of blood vessels in the lungs, hypoxia would lead to hypoxic pulmonary vasoconstrictor response (HPVR) increases so that hypertension

might occur. While the general blood vessel sensors would increase the production of hypoxia-inducible factor 1 (HIF1) which mediated vascular endothelial factor 1 (VEGF1) to initiated the angiogenesis so that blood volume increased and high SBP might occur.⁹ In addition to hypoxia, cosmic radiation was one of the physiological environments in the aviation world. Accumulation of cosmic radiation by higher total flight hours, the dose of radiation exposure would be increased. This condition would increase lipogenesis and inhibit the lipolysis.¹⁰ Therefore NaCl reabsorption would increase and SBP might occur.¹¹

Age was a risk factor affecting SBP. The process of aging caused the breakdown of elastin in the vessel wall. This solution would lead to reduced compliance power for blood vessels to distended and then systolic blood pressure would rise.¹² Other studies found that with aging, the buildup of membrane lipid peroxidation result was 4-hydroxynonenal (HNE) in the brain resulting in atherosclerosis with the formation of lipoproteins.¹⁰

A history of hypertension was also affects the SBP. This was supported by research conducted to 19661 people over 18 years in the population in the United States were indicating that the subject of old age who had not received treatment and had received treatment but did not suitable, would suffer from high SBP at $p = 0.0001$.¹³ This showed that the presence of previous history of hypertension would experience high SBP. Age of 40-65 years and had history of hypertension increased the risk of systolic blood pressure among civilian pilot in Indonesia.

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