# Factors affecting high resting pulse rate in military pilots

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## Abstrak

***Latar belakang:*** *Pilot terpajan pada keadaan yang memerlukan kewaspadaan yang meningkatkan kegiatan sistem saraf simpatis. Hal ini dapat berdampak pada sistem kardiovaskular manusia, yang antara lain tercermin pada peningkatan frekuensi denyut jantung. Penelitian bertujuan untuk mengetahui pengaruh beberapa faktor yang meningkatkan frekuensi denyut jantung pada pilot.*

***Metode:*** *Penelitian nested case-control yang dilakukan pada pilot militer yang melakukan pemeriksaan fisik tahunan di Lembaga Kesehatan Penerbangan dan Ruang Angkasa (LAKESPRA) Saryanto dari tahun 2003 sampai 2008. Data yang diperoleh dari rekam medik berupa umur, pangkat, jumlah jam terbang, rata-rata jam terbang per tahun, dan jenis pesawat.*

***Hasil:*** *Dari 539 pilot, terdapat 155 pilot dengan frekuensi nadi istirahat tinggi. Dibandingkan dengan pilot berumur 23-29 tahun, pilot berumur 30-39 tahun mempunyai risiko 66% lebih banyak untuk frekuensi nadi istirahat tinggi [rasio odds suaian (ORa) = 1,66; 95% interval kepercayaan (CI) = 1,17-2,35, P = 0,004], sedangkan yang berumur 40-49 tahun berisiko 2,4 kali (ORa = 2,40; P = 0,000]. Dibandingkan pilot pesawat transport, pilot pesawat tempur berisiko 59% lebih banyak dengan frekuensi nadi istirahat tinggi (ORa = 1,59; P = 0,002).*

***Kesimpulan:*** *Umur pilot yang semakin tua dan jenis pesawat tempur meningkatkan risiko frekuensi nadi istirahat pada pilot. (**Health Science Indones 2013;2:51-4)***

***Kata kunci:*** *umur, jenis pesawat terbang, frekuensi nadi istirahat, pilot*

## Abstract

**Background:** Pilots are almost constantly exposed to emergency situations which increase sympathetic activity. This will affect the cardiovascular system, which among others will be reflected by increased resting pulse rate. The aim of this study was to investigate factors that increase resting pulse rate in pilots.

**Methods:** A nested case-control study was conducted on Indonesian Air Force military pilots doing annual medical check-ups at the Saryanto Institute for Medical and Health Aviation and Aerospace (LAKESPRA) from 2003 to 2008. The data extracted from medical records were age, rank, total flight hours, average yearly flight hours, and type of aircraft.

**Results:** Out of 539 pilots, there were 155 with high resting pulse rate. Compared to pilots aged 23-29 years, pilots aged 30-39 years had 66% more risk for high resting pulse rate [adjusted odds ratio (ORa) = 1.66; 95% confidence interval (CI) = 1.17-2.35, P = 0.004], and those aged 40-49 years had a 2.4 risk (ORa = 2.40; P = 0.000]. Compared to pilots of transport planes, jet fighter pilots had a 59% more risk for high resting pulse rate (ORa = 1.59; P = 0.002).

**Conclusion:** Older age and fighter jets increased the risk of high resting pulse rate in pilots. ***(Health Science Indones 2013;2:51-4)***

**Key words:** age, type of aircraft, resting pulse rate, pilots

Pilots are almost constantly exposed to emergency situations, take-offs and landings, which stimulate sympathetic activity. This stressful situation causing an increase in sympathetic activity will affect endocrine system and ultimately, the cardiovascular system.[1,2] Activation through the reticular activating system (RAS) to the hypothalamus, in turn will stimulate the endocrine system, particularly the axis hypothalamus-hypophisis-adrenal.[3] Hormones secreted by the adrenal medulla gland, such as norepinephrine, along with increased sympathetic activity will increase heart rate, or resting pulse rate. These will also cause vasoconstriction resulting in increased peripheral resistance. As a result, there may be an increase in blood pressure and heart rate.[4,5] These stress reactions may be a risk factor for cardiovascular diseases.[6]

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Increased age, or factors related to increasing age as higher rank, higher total flight hours, or higher average flight hours per year, may alter the elastic properties of the arterial wall. This change in elasticity will result in heightened arterial wall stiffness, reducing arterial compliance which will cause in an increase in pulse rate.[7,8]

These changes in the cardiovascular system may be reflected by increased resting pulse rate. It is therefore important to investigate factors that increase resting pulse rate in pilots.

## METHODS

The methods employed in this study were the same as the previous paper on high diastolic blood pressure.[9] The method was a nested case-control study on military pilots attending annual medical examinations during indoctrination and aerophysiologic training at the Saryanto Aviation and Space Medicine Institute from January 2003 to September 2008. The medical examinations were carried out by trained doctors and nurses, specialist in their respective fields, according to strict and detailed procedures laid down by the Indonesian Air Force Medical Guidebook.[10] Data were extracted from these records.

Resting pulse rate was the number of pulses per minute taken after resting for 15 minutes, and divided into 2 groups, 50-80/minute (controls) and 81-101/minute (cases). Selecting 80/minute as the limit was based on the ROC curve. With 75.5% sensitivity and 61.4% 1–specificity the value obtained was 79.5/minute which was rounded out to 80/minute.

The risk factors for this study were rank, average annual or yearly total flight hours, age on starting work, total flight hours, age group, and type of aircraft. Rank was the most recent obtained by the pilots. For analysis, rank was divided into 2 groups, first officers (from second lieutenant to captain) and middle-ranked officers (major to colonel). Annual average flight hours were calculated from total flight hours and were divided into 2 categories, 29-299 hours/year and 300-622 hours/year. Age on starting work was calculated from the birth year until the year becoming a military pilot. For analysis, it was divided into 2 groups, 19 – 22 years and 23 – 26 years. For analysis, total flight hours were divided into 2 categories, 147-1400 hours and 1401-11,125 hours. For the purpose of analysis, age was divided into 3 categories, 23-29 years, 30-39 years, and 40-48 years. The types of aircraft were transport planes, jet fighter planes, and helicopters.

Statistical analyses were done using STATA 9.0 software.[11] A number of risk factors were examined as to whether or not they were potential confounders and/or effect modifiers. Unconditional logistic regression analysis was used in order to determine the confounding effects and to determine the risk factors for high resting pulse rate. A risk factor was considered to be a potential confounder if it had a *P*-value <0.25 which would be considered as a candidate for the multivariate model.[12] Confounders were estimated by the method of maximum likelihood. Ninety-five percent confidence intervals were based on the standard error of coefficient estimates. Odds ratios (OR) were estimated by the methods of maximum likelihood.[12]

## RESULTS

In Table 1, when compared to reference, higher ranked pilots (middle officers) were more likely to have higher resting pulse rate. Pilots with an annual average flight hours of 29-299 hours per year and those with a total flight hours of 1401-11125 hours were more likely to have higher resting pulse rate than the reference.

Table 2 showed the result of the final model. This model showed that older aged pilots were to have higher resting pulse rate when compared to the reference. Those in the 30-39 year-age group were 66% to have higher resting pulse rate [adjusted odds ratio (ORa) = 1.66; 95% confidence interval (CI) = 1.17-2.35; P = 0.004]. Those in the 40-49 year-age group were even by 2.4 to have higher resting pulse rate (ORa = 2.40; 95% CI = 1.60-3.69; P = 0.000).

The type of aircraft also increased the likelihood of higher resting pulse rate. Jet fighter pilots were 59% more to have higher resting pulse rate (ORa = 1.59; 95% CI = 1.18-2.15; P = 0.002).

## DISCUSSION

This study has several limitations, one of them was the source of the data was records of medical examinations and indoctrination and aerophysiological training forms from 2003–2008. However the medical examinations followed the rigid instructions of the standardized Technical Guidelines for Medical Tests and Examinations of the IAF.[10] Another limitation was that work-related stress, exercise, and smoking were not included in this study.

Table 1. Some demographic and employment characteristics as the risk factor of high resting pulse rate

| | Pulse rate | | | | Crude odds ratio | 95% confidence interval | P |
|---|---|---|---|---|---|---|---|
| | 50-80 | | 81-101 | | | | |
| | n | % | n | % | | | |
| Rank | | | | | | | |
| First officers | 243 | 77.4 | 71 | 22.6 | 1.00 | Reference | |
| Middle officers | 141 | 62.7 | 84 | 37.3 | 1.65 | 1.21-2.26 | 0.002 |
| Annual average total flight hours | | | | | | | |
| 29-299 hours per year | 353 | 72.3 | 135 | 27.7 | 1.00 | | |
| 300-622 hours per year | 31 | 60.8 | 20 | 39.2 | 1.42 | 0.89-2.27 | 0.145 |
| Age on starting work | | | | | | | |
| 10-22 years | 249 | 72.4 | 95 | 27.6 | 1.00 | Reference | |
| 23-26 years | 135 | 69.2 | 60 | 30.8 | 1.11 | 0.81-1.54 | 0.512 |
| Total flight hours | | | | | | | |
| 147-1400 hours | 193 | 78.5 | 53 | 21.5 | 1.00 | Reference | |
| 1401-11125 hours | 191 | 65.2 | 102 | 34.8 | 1.62 | 1.16-2.25 | 0.005 |

Table 2. The dominant risk factors related to high resting pulse rate

| | Pulse rate | | | | Adjusted odds ratio* | 95% confidence interval | P |
|---|---|---|---|---|---|---|---|
| | 50-80 | | 81-101 | | | | |
| | n | % | n | % | | | |
| Age group | | | | | | | |
| 23-29 years | 152 | 81.7 | 34 | 18.3 | 1.00 | Reference | |
| 30-39 years | 192 | 68.1 | 90 | 31.9 | 1.66 | 1.17-2.35 | 0.004 |
| 40-49 years | 40 | 56.3 | 31 | 43.7 | 2.40 | 1.60-3.60 | 0.000 |
| Type of aircraft | | | | | | | |
| Transports | 182 | 76.8 | 55 | 23.2 | 1.00 | Reference | |
| Fighter jets | 104 | 61.5 | 65 | 38.5 | 1.59 | 1.18-2.15 | 0.002 |
| Helicopters | 98 | 73.7 | 35 | 26.3 | 1.05 | 0.74-1.50 | 0.777 |

*Adjusted each other between risk factors in this table

High resting pulse high rate reflects high sympathetic tone. Pilots are in a highly stressful work. This study found that older pilots tend to have a higher resting pulse rate. The older the age group, the greater the risk of high resting pulse rate in the pilots (P = 0.001). This is consistent age-related degenerative changes in the arterial wall.[7,8] Older pilots have also been cumulatively exposed to more work-related stress.[13]

Jet fighters pilots were also found to have a greater risk of high resting pulse rate compared to pilots of transport planes or helicopters (P = 0.002). Jet fighters pilots must always be on alert. This stimulates the "fight or flight" response of the hypothalamus-hypophysis-adrenal axis.[3]

In conclusion, older age and jet fighter planes increased the risk of high resting pulse rate in military pilots.

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