

## Pengaruh uji latih hipoksia terhadap HSP 70 dan HIF-1 serum pada penerbang militer = Effect of hypoxia training test on serum HSP 70 and HIF-1 in military pilots

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### Abstrak

Latar Belakang: Penerbang militer berisiko mengalami hipoksia selama melaksanakan tugas terbang oleh karena penurunan tekanan parsial oksigen (O<sub>2</sub>) yang terjadi seiring pesawat mencapai ketinggian. Tubuh beradaptasi terhadap hipoksia dengan berbagai mekanisme seperti menjaga kestabilan kadar hypoxia inducible factor (HIF) dan merangsang pelepasan heat shock protein (HSP) untuk menjaga kondisi homeostasis. Penelitian ini bertujuan untuk mengetahui respons tubuh terhadap kondisi hipoksia hipobarik dikaitkan dengan kadar HIF-1 dan HSP 70 serum pada penerbang militer yang melaksanakan uji latih hipoksia di Lembaga Kesehatan Penerbangan dan Ruang Angkasa (Lakespra) dr. Saryanto.

Metode: Penelitian ini merupakan penelitian eksperimental dengan pendekatan one group pretest-posttest design yang dilaksanakan pada bulan Mei sampai dengan bulan Juli 2023. Subjek penelitian adalah penerbang militer aktif yang terjadwal melaksanakan uji latih hipoksia, memenuhi kriteria inklusi dan eksklusi serta bersedia menandatangani informed consent. Oksigenasi diberikan setelah pajanan hipoksia sebagai bagian dari prosedur latihan. Pengambilan darah diambil sebelum dan sesudah uji latih hipoksia selanjutnya diperiksa dengan metode enzyme linked immunosorbent assay (ELISA).

Hasil: Sebanyak 31 orang penerbang militer diikutsertakan dalam penelitian ini dengan rincian 13 (41,9 %) penerbang pesawat angkut, 7 (22,6%) penerbang pesawat helikopter, 6 (19,4%) penerbang pesawat tempur dan 5 (16,1%) penerbang pesawat tanpa awak. Analisis dengan uji t berpasangan mengungkapkan bahwa tidak terdapat perbedaan yang bermakna ( $p = 0,910$ ) antara kadar HSP 70 serum sebelum (5,59 (1,88- 20,17) ng/dl) dan sesudah (5,59 (1,88-20,17) ng/dl) uji latih hipoksia. Analisis dengan uji Wilcoxon mengungkapkan bahwa terdapat perbedaan yang bermakna ( $p = 0,008$ ) antara HIF-1 serum sebelum ( $534,03 \pm 261,48$  pg/dl) dan sesudah ( $465,48 \pm 209,83$  pg/dl) uji latih hipoksia.

Kesimpulan: Uji latih hipoksia tidak memengaruhi kadar HSP 70 serum pada penerbang militer. Terdapat penurunan kadar HIF-1 serum yang bermakna pada penerbang militer setelah melaksanakan uji latih hipoksia.

.....Background: Military pilots are at risk of experiencing hypoxia during flight duties due to the decrease in oxygen partial pressure that occurs as the aircraft reaches altitude. The body adapts to hypoxia through various mechanisms, such as stabilizing the levels of hypoxia inducible factor (HIF) and stimulating heat shock protein (HSP) release to maintain homeostasis. This study aims to determine physiological response to hypobaric hypoxia conditions in relation to serum HIF-1 and HSP 70 levels in military pilots who carry out hypoxia training tests at Lembaga Kesehatan Penerbangan dan Ruang Angkasa (Lakespra) dr. Saryanto. Methods: This research is an experimental study with a one group pretest-posttest design conducted from May to July 2023. The research subjects were active military pilots who were scheduled to carry out hypoxia training tests, met the inclusion and exclusion criteria and were willing to sign informed consent. Oxygenation is administered after hypoxic exposure as part of the training procedure. Blood samples were taken before and after the hypoxia training test and then examined using the enzyme linked immunosorbent

assay (ELISA) method.

Result : A total of 31 military pilots were included in this study, consist of 13 (41.9%) transport aircraft pilots, 7 (22.6%) helicopter pilots, 6 (19.4%) fighter aircraft pilots and 5 (16.1%) unmanned aircraft pilot. Paired t test revealed that there was no significant difference ( $p = 0.910$ ) between serum HSP 70 levels before (5.59 (1.88-20.17) ng/dl) and after (5.59 (1.88 -20.17) ng/dl) hypoxia training test. Data analysis using the Wilcoxon test revealed that there was a significant difference ( $p = 0.008$ ) between serum HIF-1 before ( $534.03 \pm 261.48$  pg/dl) and after ( $465.48 \pm 209.83$  pg/dl) hypoxia training test.

Conclusion: Hypoxia training test did not affect serum HSP 70 levels in military pilots. There was a significant decline in serum HIF-1 levels in military pilots after performing hypoxia training test.