

# Correlation between haemoglobin concentration and oxygen saturation (SpO<sub>2</sub>) in elderly professors

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## ABSTRACT

The aging process is recognized by the decreases of the body functions which is caused by molecular and cellular damages. The population which is mostly affected by this aging process is elderly. In elderly, it is most likely that tissue oxygenation decreases due to the reduction of haemoglobin level and oxygen saturation (SpO<sub>2</sub>). This study aimed to evaluate the correlation between the hemoglobin concentration and SpO<sub>2</sub> in the elderly professors in Universitas Padjadjaran (UNPAD), Bandung. This was cross sectional study using secondary data from medical records of the elderly professors. One hundred and eight data of the professors (84 males and 24 females) who met the inclusion and exclusion criteria were used in this study. Spearman's Rank correlation test was used to analyze the data of total subjects and male professors group, while Pearson correlation test was used to analyze the data of female professors group. Correlation test between hemoglobin concentration and SpO<sub>2</sub> resulted in an insignificant results in male professors ( $r = 0.028$ ;  $p = 0.801$ ), female professors ( $r = 0.132$ ;  $p = 0.538$ ), and total subjects ( $r = 0.036$ ;  $p = 0.712$ ). In conclusion, there is no correlation between hemoglobin concentration and SpO<sub>2</sub> in the elderly professors of UNPAD, Bandung.

## ABSTRAK

Proses penuaan ditandai dengan penurunan fungsi tubuh yang disebabkan kerusakan molekular dan selular. Usia lanjut merupakan populasi yang banyak terpengaruh oleh proses penuaan. Pada usia lanjut, proses penuaan disebabkan oleh berkurangnya oksigen dalam jaringan karena menurunnya kadar hemoglobin dan saturasi oksigen (SpO<sub>2</sub>). Penelitian ini bertujuan untuk mengkaji korelasi antara konsentrasi hemoglobin dan SpO<sub>2</sub> pada profesor senior Universitas Padjajaran (UNPAD), Bandung. Penelitian ini merupakan penelitian potong lintang menggunakan data sekunder dari hasil pemeriksaan kesehatan professor tersebut. Sebanyak 108 data kesehatan profesor (84 laki-laki, 24 perempuan) memenuhi kriteria inklusi dan eksklusi digunakan pada penelitian ini. Uji korelasi rank Spearman digunakan untuk menganalisa data dari total subjek kelompok profesor laki-laki, sedangkan uji korelasi Pearson digunakan untuk menganalisis data kelompok profesor perempuan. Pengujian korelasi antara konsentrasi hemoglobin dan SpO<sub>2</sub> menunjukkan hasil yang tidak signifikan pada kelompok profesor laki-laki ( $r = 0,028$ ;  $p = 0,801$ ),

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kelompok profesor perempuan ( $r = 0,132$ ;  $p = 0,538$ ), dan subjek total ( $r = 0,036$ ;  $p = 0,712$ ). Dapat disimpulkan, tidak terdapat korelasi antara konsentrasi hemoglobin dan  $SpO_2$  pada profesor senior di UNPAD, Bandung.

**Keywords:** hemoglobin - oxygen saturation – professors – elderly - immunity

## INTRODUCTION

Elderly is one of risk factors for deterioration of body function and immunity in human due to aging process which causes molecular and cellular damage.<sup>1</sup> The level of haemoglobin concentration could decrease in addition to deterioration of body function and immunity.<sup>2,3</sup> A epidemiology study concerning anemia in the elderly in 2008 reported that the proportion of anemic patients were approximately 9.2% - 23.9% in men and 8.1% - 24.7% in women for the age group of below 85 years old, and approximately 29.6% - 30.7% in men and 16.5% - 17.7% in women for age group above 85 years old.<sup>4</sup> The three main causes of anemia in the elderly are lack of nutrition, chronic diseases and unknown causes.<sup>5</sup>

One of the major hemoglobin function is binding, distributing and releasing oxygen to tissues.<sup>6</sup> If there is a decrease in the level of hemoglobin concentration, the process of oxygenation of the muscles and tissues will be reduced.<sup>7</sup> The level of oxygen concentration circulating in the body could be measured by oxygen saturation ( $SpO_2$ ). The  $SpO_2$  is the percentage of hemoglobin that binds the oxygen in the arteries. The normal value of  $SpO_2$  in arteries was 95-100%. One of the most common practical way to measure  $SpO_2$  is using pulse oximetry.<sup>8</sup> Meanwhile, hemoglobinsianida photometric method is a common method to measure the levels of hemoglobin concentration in the blood.<sup>9</sup> Although there are differences in the function

and basic mechanism of pulse oximetry and hemoglobinsianida photometric method, both methods assess the adequacy of oxygen supply in organs. Unfortunately, studies on the correlation between the levels of hemoglobin concentration and  $SpO_2$  are very rare. The aim of this study was to evaluate the correlation between the level of hemoglobin concentration and  $SpO_2$  in elderly professors in Universitas Padjadjaran (UNPAD), Bandung, Indonesia.

## MATERIALS AND METHODS

### Subjects

It was analytical cross-sectional study conducted between September and November 2016 using secondary data from the health examinations of elderly professors in *Unit Pelaksana Teknis*, UNPAD, Dipatiukur Street 46, Bandung. Subjects were collected using a consecutive sampling method. Out of 163 professors who participated in this study, there were 108 professor (male = 84 subjects, female = 24 subjects) who met inclusion criteria. The inclusion criteria were professor, elderly and having complete data in regard to age, gender, hemoglobin concentration and  $SpO_2$  concentration.

### Procedure

Data of sex, age, hemoglobin level and  $SpO_2$  level were taken from the medical records in *Unit Pelaksana Teknis*, UNPAD, Bandung. Haemoglobin level was measured using standard haematology analyser, whereas

SpO<sub>2</sub> concentration was measured using pulse oximeter by examiner. The study was approved by Health Ethical Committee Faculty of Medicine, UNPAD, Bandung (Number: 1035/UN6.C1.3.2/KEPK/PN/2016).

### Statistical analysis

The data were analyzed using SPSS. Kolmogorov-Smirnov test was used for the normality test for the data of all professors

and male professors, while Shapiro-Wilk test was used for the normality test for the data of female professors. A p value < 0.05 was considered to be statistically significant.

### RESULTS

The percentage of male professors was 77.8% and female ones was 22.2%. The average age of the subjects was approximately 71 years old (TABLE 1).

**TABLE 1 Correlation between hemoglobin concentration and SpO<sub>2</sub>**

Characteristic	Man	Woman	Total
Frequency	84	24	108
Percentage (%)	77.8	22.2	100
Age (years)			
Mean (SD)	71.86 (± 6.036)	69.25 (± 6.354)	71.28 (± 6.175)
Min-Max	61-85	61-81	61-85
Hb (gram/dL)			
Mean (SD)	14.825(± 1.2968)	13.546 (± 0.8398)	14.541 (± 1.3197)
Min-Max	9.9-18.1	11.8-14.9	9.9-18.1
SpO <sub>2</sub> (%)			
Mean (SD)	95.87 (±2.301)	95.75 (±1.595)	95.84 (± 2.158)
Min-Max	80-99	93-99	80-99
z (Hb ; SpO <sub>2</sub> )	0.200 ; 0.00	0.582 ; 0.272	0.200 ; 0.00
p	0.801	0.538	0.712
r	-0.028	0.132	0.036

Note : z = value for normality test ; p = p-value; r = correlation of coefficient

The mean haemoglobin level in male professors and female professors were normal, which were 14.8 and 13.5 g/dL, respectively. However there were cases in which subjects had a lowest minimal haemoglobin level that may be categorized as moderate anemia.<sup>106</sup> The mean SpO<sub>2</sub> of the professors was approximately 95-100% (normal). Minimal value for oxygen SpO<sub>2</sub> of the professors was about 80% which would cause very low haemoglobin concentration and cyanosis.<sup>8</sup>

Kolmogorov-Smirnov test showed that the p-value of the data of haemoglobin concentration were > 0.05. This means that the data of all professors and male professors were normally distributed. Meanwhile the p-value of the data of SpO<sub>2</sub> were <0.05. This means that the data of all professors and male professors were not normally distributed. Shapiro-Wilk test showed the p-value for the data of haemoglobin concentration and SpO<sub>2</sub> of female professors were >0.05. Therefore

the data were normally distributed. Spearman correlation test for all professors was 0.036 with a significance of 0.712, and group of male professors was 0.028 with a significance of 0.801. Pearson correlation tested for the data of female professors resulted in 0.132 with a significance of 0.538. The results showed that no correlation between haemoglobin concentration and SpO<sub>2</sub> in elderly professors in UNPAD was observed ( $p > 0.005$ ).

## **DISCUSSION**

No correlation between haemoglobin concentration and SpO<sub>2</sub> in elderly professors in UNPAD was observed in this study. This result is similar with the previous study conducted in Tetralogy of Fallot patients although the level of correlation was higher ( $r = -0.329$ ).<sup>11</sup> Several factors such as age and type of disorders can affect the correlation between haemoglobin concentration and SpO<sub>2</sub>. The SpO<sub>2</sub> indicates the percentages of haemoglobin bound to oxygen in arteries. One haemoglobin molecule could bind 4 oxygen molecules. If the four binding-site of haemoglobin could carry 4 oxygen molecules, the saturation would be 100%.<sup>8</sup> The major function of haemoglobin is binding and distributing oxygen to tissues. When the pressure of oxygen is low, tetramer chain of haemoglobin will be completely deoxygenated. Conversely, the affinity of haemoglobin increases when the pressure of haemoglobin is high and thus haemoglobin will be able to bind more oxygen.<sup>6</sup>

In anemic condition, the value of SpO<sub>2</sub> could have been in normal range as long as all of haemoglobin molecules bind the oxygen which can be observed in electrophoresis examination.<sup>12-14</sup> Abnormal haemoglobin which affects SpO<sub>2</sub> are methaemoglobin, sulfhaemoglobin and sickle cell anemia. Methaemoglobin causes Hb unable to bind

the oxygen. In normal condition, the body consists of less than 1 % of methaemoglobin. Methaemoglobin level can increase in the body due to the exposure of substances such as drugs. Sulfhaemoglobinemia appears in haemoglobin-sulfur ion binding due to exposures to drugs and foreign substances. Sulfhaemoglobinemia causes deoxygenation and cyanosis. Sickle cell anemia is abnormal red blood cells inherited disorder which disrupts circulation function and reduces haemoglobin capacity for carrying oxygen. This condition causes hypoxemia. The quantity of carboxyhaemoglobin may affect the value of SpO<sub>2</sub>.<sup>6,15-17</sup>

The decrease of SpO<sub>2</sub> or hypoxemia is frequently caused by conditions or diseases involving the ventilation-perfusion in lung, hypoventilation, right to left shunt, reduced diffusion capacity, and reduced partial pressure of oxygen. A study conducted in Norway from 2001 to 2002 which involved 5.152 subjects had compared SpO<sub>2</sub> variable to several variables such as age and haemoglobin. The results showed that in elderly (age  $\geq 70$ ) there were 1.9% subjects with the level of oxygen concentration below 92%, and there were 13.6% with SpO<sub>2</sub> in a range of 93-95%. Meanwhile the ratio between SpO<sub>2</sub> and haemoglobin level below upper limit only 1.0% with SpO<sub>2</sub> below 92%.<sup>18</sup>

Some limitations of this study can be identified. Unknown factors could affect the data collection such as ventilation-perfusion condition and physical activity of subject that might affect the pulse oximetry records. The researchers also did not have any data from electrophoresis examination at the time of blood sampling. In addition, this study did not examine the possibility of the presence of abnormal haemoglobin (haemoglobinopathies), heart and lung conditions, and other diseases that may

affect the SpO<sub>2</sub>. This study only focus on the correlation between the hemoglobin concentration and SpO<sub>2</sub>. Further study to evaluate the effect of haemoglobinopathies that could affect SpO<sub>2</sub> is suggested.

## CONCLUSION

In conclusion, there is no correlation between the hemoglobin concentration and SpO<sub>2</sub> in the elderly professors in UNPAD, Bandung.

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