

# Correlation between Plasma Level of Superoxide Dismutase and Catalase with the Degree of Severity in Vitiligo

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**Abstract:** Vitiligo is a common depigmentation disorders of the skin that can affecting all age and genders. This entity has a complex pathogenesis, as one theory emphasize in the role of oxidative stress. *Superoxide dismutase* (SOD) and catalase are thought as principal enzymatic antioxidant, but increased activity of SOD and lack activity of catalase were thought to play a role in melanocyte damage by accumulation of hydrogen peroxide ( $H_2O_2$ ). The aim of this study is to assess the correlation between SOD and catalase with the degree of severity in vitiligo patients. This is a cross-sectional study involving 49 patients with vitiligo at Sanglah General Hospital Denpasar Bali in period of August – November 2017. *Superoxide dismutase* and catalase level were examined in blood plasma to assess its activity whereas degree of severity were determined clinically using scoring system of Vitiligo Area Severity Index (VASI). This study found that the mean of SOD in plasma of vitiligo patients was 0,638 U/ml with the lowest value was 0,49 U/ml and the highest value was 0,75 U/ml. Whereas catalase level was 64,07 U/ml with the lowest value was 55,86 U/ml and the highest was 72,99 U/ml. This study found significant positive correlation ( $r = 0,473$ ;  $p < 0,01$ ) between plasma SOD level and VASI score and significant negative correlation ( $r = - 0,597$ ;  $p < 0,01$ ) between plasma catalase level and VASI score. *Superoxide dismutase* catalyzes superoxide anion into oxygen and  $H_2O_2$ , in which  $H_2O_2$  subsequently breaks into oxygen and water by the action of catalase. Increased activity of SOD with decreased activity of catalase would lead to accumulation of hydrogen peroxide that could cause melanocyte death that seen clinically as vitiligo.

## 1 INTRODUCTION

Vitiligo is still a challenge in Dermatology. It is the most common depigmentation disorder that can be occurred in all ages and both gender (Alikhan et al., 2011). Although not causing mortality, vitiligo came with a big burden of morbidity because of the stigma from uneven skin appearances. Chronically lasting disease, prolong duration of therapy with unsatisfying result, and unpredictable outcome had a huge impact in the patient's quality of life (Parsad et al., 2003).

The exact mechanism how selective damage of melanocyte occur in vitiligo has not yet been elaborated. One hypothesis is the imbalance of oxidant and antioxidant that caused accumulation of oxidative stress that in turn have impact in melanocyte death (Arican & Kuruta, 2008). This hypothesis arise based on the fact that melanin synthesis process itself would generate abundant amount of reactive oxygen species (ROS).

Superoxide anion ( $O_2^-$ ) and hydrogen peroxide ( $H_2O_2$ ) are some ROS that produced during melanin synthesis process that have destructive effect to cells, specifically melanocytes (Denat et al., 2014). Superoxide dimutase (SOD) and catalase are the main antioxidant defense against radical superoxide in order to reduce the toxicity to cells (Le Quere et al., 2014). The aim of this study is to determine the correlation between plasma SOD and catalase with severity of vitiligo using scoring system *Vitiligo Area Severity Index* (VASI).

## 2 METHOD

This was a observational analytic study with cross-sectional design that had been done in Dermato-Venereology Outpatient Clinic at August-November 2017. Sampling of study subject were done using consecutive technique sampling by taking all vitiligo diagnosed patients that met the sample requirement

criteria that came to Dermato-Venereology Outpatient Clinic during study period. Inclusion criteria including vitiligo patients that came to Dermato-Venereology Outpatient Clinic, Indonesian, male and female under 60 years old, in good condition, and willing to participate in this study. Exclusion criteria including subject that already received both topical and systemic treatment or phototherapy 2 weeks before, smoking, pregnancy, history of tuberculosis, cardiovascular disease, rheumatoid arthritis, diabetes mellitus, asthma and atopy, malignancy, and had history of taking

antioxidants or non-steroidal anti-inflammatory drugs in 1 month before. Plasma SOD and catalase were examined using spectrophotometric method. Correlation were analyzed using analysis software SPSS Ethical clearance for study protocol was obtained from Ethical Study Commission Faculty of Medicine Udayana/Sanglah Hospital before the study begin. Subject fulfilled inclusion and exclusion criteria will be explained about the goal and procedure of the study before the informed consent signed. Subject have full right to refuse to participate in this study.

Table 1. Characteristic Distribution of Study Subject

No	Characteristic	Vitiligo (n=49)	Percentage (%)
1.	Gender		
	Male	24	49
	female	25	51
2.	Age (years)		
	≤ 15	4	8,2
	16 – 25	3	6,1
	26 – 35	9	18,4
	36 – 45	11	22,4
	46 – 55	9	18,4
	56 – 65	12	24,5
	≥ 66	1	2,0
3.	Diagnosis Vitiligo		
	Non Segmental	41	83,7
	Segmental	8	16,3
4.	Family History		
	Yes	7	14,3
	No	42	85,7

### 3 RESULT

This study involved 49 vitiligo patients consist of 49% male and 51% female. Based on age distribution, the youngest subject was 15 years old and the oldest was 66 years old with the mean age 42,31 years old. Characteristic of the study subject were listed in table 1.

This study found the mean of plasma SOD level from the study subject was 0,638 U/ml with the lowest value was 0,49 U/ml and the highest was 0,75 U/ml. Whereas for plasma catalase level, the mean was 64,07 U/ml with lowest value was 55,86 U/ml and the highest value was 72,99 U/ml. Correlation analysis using Spearman's rho test because the VASI score data were not normally distributed. From this statistical analysis significant positive correlation ( $r = 0,473$ ;  $p < 0,01$ ) between plasma SOD level and severity based on VASI score and significant negative correlation ( $r = - 0,597$ ;  $p < 0,01$ ) between plasma

catalase level and severity based on VASI score were found.

### 4 DISCUSSION

This study found significant positive correlation between plasma SOD level and VASI score and significant negative correlation between plasma catalase level and VASI score. This result implied that the higher plasma SOD level and the lower plasma catalase level, the more severe vitiligo would be. Previous study showed similar result. Study by Sravani in 2009 about activity of SOD and catalase in skin tissues showed a significant increase of SOD activity and decrease of catalase activity both on lesional and normal skin of vitiligo patients (Sravani et al., 2009). Briganti et al in 2012 found an increase of SOD activity on depigmented skin tissue that correlate with the increase of SOD in mononuclear

cells of peripherally circulating blood which indicate a functional relation among endogenous antioxidants and the occurrence of systemic oxidative stress (Briganti & Picardo, 2002). Arican et al in 2008 and Agrawal et al in 2014 also found the mean of catalase level in erythrocytes on vitiligo patients were significantly lower than normal controls (Arican et al., 2008; Agrawal et al., 2004).

Superoxide dismutase is the first line enzymatic antioxidant transforming a reactive superoxide anion  $O_2^{\cdot-}$  to become hydrogen peroxide  $H_2O_2$  that subsequently will be turned into  $H_2O$  and  $O_2$  with the activity of catalase that act as the second line enzymatic antioxidant (Le Quere et al., 2014, Sravani et al., 2009). The accumulation of  $H_2O_2$  can cause inactivation of catalase enzyme that will result in more  $H_2O_2$  excess and damage to the cells (Hazneci et al., 2004; Dammak et al., 2009). This disturbed antioxidant activity showed by increase of SOD and decrease of catalase had been proved both in the lesional and non-lesional skin of vitiligo patients and also in melanocytes *in vitro* (Schallreuter et al., 1999; Maresca et al., 1997). Accumulation of  $H_2O_2$  will undergo a Fenton and Haber-Weiss reaction to produce a very reactive hydroxyl radical ( $OH^{\cdot}$ ) that very toxic to melanocytes and considered as the cause of melanocyte deaths so that the increase of SOD and decrease of catalase are related to the progressivity and severity of vitiligo (Laddha et al., 2014).

## 5 CONCLUSIONS

There were significant positive correlation between plasma SOD level and severity of vitiligo based on VASI score and significant negative correlation between plasma catalase level and severity of vitiligo based on VASI score.

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