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The Relationship between Individual Characteristics Factors and Occupational Factors with Testosterone Hormone Levels in Metal Casting Industry Workers

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The working environment in the metal casting industry has a risk of being exposed to free radicals which affects a decrease in testosterone levels. This study aims to measure workers' testosterone levels and determine the relationship of individual characteristics and occupational factors with testosterone levels in the metal casting industry. This type of research is explanatory research with analytic survey design with cross sectional approach. The variables of this

study include the dependent variable namely testosterone levels while the independent variables are age, years of work, type of work, nutritional status, marital status, and smoking habits. The research sample of 34 workers was taken by total sampling technique. Data analysis used univariate, bivariate and multivariate. The results showed that respondents who had abnormal testosterone levels were 4 or 11.8% while normal testosterone were 30 or 88.2%. Body Mass Index is related to testosterone levels but age, years of service, type of work, marital status, and smoking habits are not related to testosterone levels in metal casting industry workers CV. Bonjor Jaya Klaten.

Keywords: Individual Characteristics, Work Environment, Testosterone, & Metal Casting

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INTRODUCTION

The testosterone hormone is an androgen hormone that is owned by men, but with levels that decline when there is aging. Testosterone levels that decrease to normal can cause problems that are both physical and psychological. The results showed that there were 16% of men with testosterone levels below normal experiencing sexual disorders, osteoporosis as much as 2% and who experienced depression as much as 25%. The factors that influence testosterone levels vary. As the study found that in men who are overweight (obese), a low proportion of the hormone testosterone is greater in those who do not smoke, but, in men who are of normal weight. Men who have the habit of smoking generally have higher levels of the hormone testosterone than men who do not smoke. This shows the existence of an antagonistic relationship, namely between excess body weight with smoking, where the effect of excess weight is to reduce testosterone levels, but the effect of smoking instead increases testosterone (Sudharma, 2012).

Interviews conducted by researchers on 7 workers CV. Bonjour Jaya related to oxidative stress and testosterone levels can be seen that 5 workers expressed less passionate about having marital relations, work fatigue and work stress so less interest in sex. Workers also often feel tired when working so they have to rest to restore body condition and return to work. The results of the preliminary study show that there are signs of a decrease in the hormone testosterone in workers, namely lack of passion in sexual life, easy to forget and reduced muscle mass or muscle strength so that workers are unable to carry loads in large quantities and easily feel tired.

Low testosterone levels contribute to loss of sexual drive and some secondary sexual characteristics (Jamela Jouda et al, 2017). The impact of lead on the decline in the health level of these workers is mainly on increasing mda and decreasing levels of the hormone testosterone, so efforts are needed to ward off free radicals in the form of lead. Personal effort that can be done by workers is by increasing the consumption of vitamin E in nuts which also functions to reduce oxidative stress. In addition, workers need to apply the use of personal protective equipment properly during activities in their work environment (Klopfleisch et al, 2017)

Factors thought to be related to worker testosterone hormone levels as previous research findings include age, years of service (Yalçın Duydu, 2018), type of work (Sudharma, 2012), nutritional status (Ibrahim, 2015), Tom et al (2011) , marital status (Hirokawa, 2016) and smoking habits (Sudharma, 2012).

Based on a preliminary study that there are signs of decreased testosterone hormone levels from interviews with workers became the reason researchers to analyze the relationship of individual characteristics and occupational factors to worker testosterone levels in CV Bonjour Jaya Klaten.



METHOD

This research is an explanatory research that aims to analyze the relationship of individual characteristics and occupational factors to testosterone hormone levels. The design of this study is an analytical survey with a cross sectional research approach or research in one time observation (Sudiono, 2008). Notoadmojo (2004) states that the population is all the objects in the study which in this study are workers CV. Bonor Jaya Klaten as many as 34 people. Researchers took the sample with a total sampling technique because the number of workers is below 100 people.

The independent variables of the study consisted of age, marital status, smoking habits, nutritional status, type of work and years of service while the dependent variable was the hormone testosterone.

Table 1. Operational Definitions

Age	Age of the respondent at the time of the study
Nutritional status	Figures that indicate the nutritional status of respondents using the BMI formula: $IMT = \frac{\text{Weight}}{\text{Height}^2}$
Years of service	The time is calculated in the year the respondent has used to work in welding
Type of work	Specifications of the work carried out by the respondent
Marital status	Status indicating that the respondent is married
Smoking habit	The habits of the respondents in consuming cigarettes



Testosterone levels	Testosterone levels taken from blood serum measurements are measured by the Enzyme-Linked Immunosorbent Assay (ELISA) method, the results of which are expressed in ng / ml.
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¹ Data obtained from the field through the distribution of questionnaires and from the Biotechnology Laboratory of Gajah Mada University in Yogyakarta were further analyzed by univariate analysis (to see the characteristics of each variable) and bivariate analysis (to see the relationship between variables) (Notoatmodjo, 2004). Bivariate analysis using chi square test using $\alpha = 0.05$ and Confidence Interval (CI) of 95%.

RESULTS

This research was conducted ¹ on workers at CV Bonjor Jaya Klaten, located on Jalan Raya Batur Ceper, Batur, Kurung, Cepe ³ District, Klaten Regency. The following are the characteristics of respondents viewed from age, years of service, type of work, nutritional status, marital status and smoking habits.

Table 2. Descriptions of Individual Characteristics of Metal Casting Industry Workers

No	Description	Total	
		N	%
1.	Age		
	≤ 30 years	12	35.3
	> 30 years	22	64.7
2.	Years of service	20	58.8
	≤ 5 years	14	41.2
	> 5 years	20	58.8
3.	Type of work		
	Casting	20	58.8
	Finishing	14	41.2
4.	Nutritional status		
	Normal	24	70.6
	Abnormal	10	29.4
5.	Marital status		



Married	25	73.5
Single	9	26.5
6. Smoking habit		
Smoker	21	61.8
Not a smoker	13	38.2

Table 2 shows that there were 22 workers (64.7%) with age over 30 years and 12 workers (35.3%) who were under 30 years old. A total of 20 workers (58.8%) have worked more than 5 years and 14 workers (41.2%) have not worked for 5 years. Respondents work in the casting department as many as 20 workers (58.8%) while respondents who work in the finishing section there are 14 workers (41.2%). Based on its nutritional status, there are 24 workers (70.6%) with normal nutritional status and 10 workers (29.4%) with abnormal nutrition. Then the respondents were married as many as 25 workers (73.5%) while the respondents who were not married there were 9 workers (26.5%) and respondents as active smokers as many as 21 workers (61.8%) while respondents who did not smoke there were 13 workers (38.2%).

Distribution of test results of testosterone hormone levels of CV Bonjor Jaya Klaten workers, as shown in table 3 below.

Table 3. Hormone Testeron Levels in Metal Casting Industry Workers

No	Inspection Results Criteria	Total	
		N	%
Testoron Hormone Levels			
1	Normal (3,0-9,5)	30	88.2
2	Abnormal (<3,0 atau >9,5)	4	11.8
Total		34	100.0

The results of the examination of 34 respondents CV. Bonjor Jaya Klaten obtained examination results of MDA levels below the average of 24 workers (70.6%) while MDA levels above the average of 10 workers (29.4%). While the results of examination of normal testosterone levels were 30 workers (88.2%) while abnormal testosterone levels were 4 workers (11.8%). Bivariate testing between variables can be seen in Table 4. below.



Table 4. Relationship between Individual Characteristics Factors and Occupational Factors
Testosterone Hormone Levels

Variabel	RP & CI	P value
Age	RP= 1,833 95% CI = 0,294 – 11,422	0,602
Years of service	RP= 0,467 95% CI = 0,055 – 4,119	0,627
Type of work	RP= 1,429 95% CI = 0,228 – 8,969	1,000
Nutritional status	RP= 0,139 95% CI = 0,016 – 1,180	0,033
Marital status	RP= 0,926 95% CI = 0,110 – 7.800	1,000
Smoking habit	RP= 4,846 95% CI = 0,562 – 41,807	0,274

Table 4 shows that the Chi-square test of the relationship of age with testosterone hormone levels obtained p value of 0.602, years of service with p value of 0.627, type of work with p value of 1,000, marital status with p value of 1,000 and smoking habits with p value of 0.274 . The p value > 0.05 can be interpreted that age, years of service, type of work, employment status, marital status and smoking habits do not have a significant relationship with testosterone levels. While the nutritional status with a p value of 0.033 < 0.05, it can be interpreted that there is a significant relationship between nutritional status and testosterone levels. Results RP = 0.139 with 95% confidence interval (CI) (0,016 - 1,180) so workers who have poor nutritional status have a risk of 0.139 times with abnormal testosterone levels.

DISCUSSION

This study found no significant relationship between the age of respondents with testosterone levels in CV workers. Bonjor Jaya Klaten. The results of this study are in line with the findings of Sudharma (2012), Duydu (2018) and Panuwet (2018) that no significant relationship was found between age and testosterone. The decrease in sex hormones by age is sharper or more visible in free testosterone measurements compared to total testosterone, so that measurements with total testosterone may not show a striking difference. Bioavailable



testosterone decreases more significantly 0.7% / year compared to total testosterone (0.4% / year).

Decreased testosterone is associated with decreased hypothalamic function. The hypothalamus plays an important role in maintaining one's energy homeostasis. As we get older, there are degenerative changes in the hypothalamus and testes, which are caused by the failure of the hypothalamus to produce the amount of GnRH secretion. The hypothalamus secretes GnRH and subsequently GnRH binds gonadotropic cells and stimulates the release of Follicle Stimulating Hormone and Luteinizing Hormone (Vifta, 2015). LH then stimulates Leydig cells to produce testosterone. So the decrease in the number and volume of Leydig cells is a factor that contributes to the inhibition of testosterone production.

This study found that there was no significant relationship between years of service and testosterone levels in CV workers. Bonjor Jaya Klaten with the prevalence of respondents who have abnormal testosterone levels tend to occur in respondents with a service life of more than 5 years. The results of this study are in line with research by Duydu (2018) that the length of service is not related to testosterone levels. However, another study by Zhaopin (2016) found that there was a significant relationship between working period and the levels of the hormone testosterone in power plant workers on exposure to electromagnetic fields.

This study found that there was no significant relationship between the type of work with testosterone levels. These results are consistent with Sudharma's (2012) study that the type of work is not related to testosterone levels. In this case, both heavy and light working activities cannot increase or decrease one's testosterone levels.

The casting work environment is dangerous and is characterized by several simultaneous chemical, physical and mechanical hazards, which can cause injury or illness to casting workers. Health risks from working in the metal casting industry include exposure to hot molten metal smoke in addition to these hazards; some casting workers work with dust produced from casting silica-containing sand and, when dry, produces silica dust (Keman, 2014).

The casting process basically consists of pouring molten metal into a mold containing the desired mold. The metal is extracted and produced from ore by various metallurgical processes for the process of molding, smelting and casting, and is accompanied by hot, noisy work environment conditions, and many fine dust particles, fly ash, to gases such as Nitrogen, Sulfur oxides and metal. So that pollutants are obtained from all work processes.

Workers CV. Bonjor Jaya Klaten has the majority of normal nutrition and the percentage shows that the prevalence of respondents with abnormal nutritional status have more abnormal testosterone levels compared with respondents who have normal nutritional status. Nutritional status is not related to testosterone levels because many other factors that cause a decrease in



testosterone hormones such as age and lifestyle such as smoking also have an influence on testosterone levels.

Workers CV. Bonjor Jaya Klaten, which has an abnormal nutritional status, affects its testosterone levels. Abnormal nutritional status such as obesity or obesity is associated with a decrease in total testosterone; whereas, free testosterone levels remain especially in younger men. The decrease in total testosterone levels is largely a consequence of a decrease in sex hormone-binding globulin due to obesity-related hyperinsulinemia. Measurement of free testosterone levels can provide a more accurate assessment of androgen status than measuring total testosterone in situations where SHBG levels are outside the standard range.

This study found that nutritional status was significantly related to testosterone hormone levels in line with the research of Tom et al (2011) that men who have problems with obesity tend to have decreased testosterone hormone levels compared to men who have ideal body weight. However, in contrast to the findings of Ibrahim (2015) who found that there was no significant relationship between obesity and testosterone levels.

The relationship between obesity and decreased testosterone levels is bidirectional (bidirectional). Obese men, their adipose tissue is in a state of inflammation and there is a state of insulin resistance. This condition expresses the aromatase enzyme which will convert testosterone to estradiol. Increased concentrations of estradiol in adipose tissue provide negative feedback on the hypothalamic-pituitary axis, resulting in a decrease in the secretion of the gonadotropin hormone. LH secretion will also decrease which ultimately causes a decrease in steroidogenesis by Leydig cells (Fidiyatun, 2013).

This study found no significant relationship between marital status with testosterone levels in CV workers. Bonjor Jaya Klaten. This study is in line with research by Hirokawa 2016 that marital status is not related to changes in testosterone levels. Another study by Stine (2017) that there was no difference in changes in the Testosterone / LH ratio between the four groups, which indicated that lower Testosterone levels were not compensated for by increased levels of LH. Thus, it cannot be said that the difference in the decrease in Testosterone levels in the marital group reflects the difference in testicular function. The possibility that there is a modification of the gonadostat due to adaptation to changes in living conditions.

This finding shows that both married and unmarried men cannot increase testosterone levels. Married men have a greater prevalence because they tend to feel happier, can channel their sexual desires and with regular sexual activity tend to be able to increase levels of the hormone testosterone.

This study found that there was no significant relationship between smoking habits with testosterone levels in CV workers. Bonjor Jaya Klaten. The results of the study were different,



Sudharma (2012) who found a ¹ relationship between smoking habits and testosterone levels. Syarifah's research (2018) also shows that smoking habits affect the incidence of andropause, which is a testicular condition of a man who is old so that the production of the hormone testosterone decreases.

The effect of smoking on men, can cause a decrease in testosterone biosynthesis caused by inhibition by carbon monoxide from hydrocarbons hydrocondria Leydig cells. Direct toxic testicular damage to smokers can interfere with endocrine and testicular spermatogenic function. The two main roles of the testes are spermatogenesis and androgen hormone secretion. The process of spermatogenesis requires a high metabolism. However, the testes are physiologically susceptible to hypoxia. Therefore, lack of oxygen, which is caused by smoking, is thought to negatively affect testicular function because vascular blood supply to the spermatic cord is inadequate. Some evidence shows that smoking affects the function of Sertoli and Leydig cell secretions in the testes, thereby causing sperm quality to be impaired.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this study are (1) respondents who have abnormal testosterone levels are 4 or 11.8% while respondents who have normal testosterone levels are 30 ³ 88.2%. (2) Nutritional status has a significant relationship with testosterone levels while age, years of service, type of work, marital status and smoking habits are not related to testosterone levels. Therefore the research suggestion is that metal casting industry ¹ companies should conduct evaluation activities to control air pollution so as to minimize the impact of the work environment on MDA levels and testosterone levels. Workers in the metal casting industry make efforts to prevent and control the impact of MDA levels and abnormal testosterone levels by exercising regularly and reducing foods that cause obesity. Researchers then need to add independent variables that are thought to have an effect on testosterone levels.



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