



THE INFLUENCE OF SHIFTWORK ON LIVER DYSFUNCTION OF WORKERS AT INALUM COMPANY KUALA ANJUNG, NORTH SUMATERA

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ABSTRACT

This study was conducted to determine the effect of the shiftwork system on liver dysfunction workers characterized by elevated of liver function enzymes SGOT (Serum Glutamic Oxaloacetic Transaminase) and SGPT (Serum Glutamic Pyruvate Transaminase) in the employees at Inalum Company at Kuala Tanjung. The research was derived from primary and secondary data. Primary data was conducted by a direct examination of SGOT and SGPT enzymes at liver (expressed in Unit units per liter of blood serum (U/L). The secondary data obtained from the Smelter Public Relations. All data obtained were analyzed using paired t-test analysis techniques by comparing SGOT and SGPT enzymes between 324 shift and non-shift workers. Results showed significant differences in SGOT and SGPT among 162 employees with shift work from the average SGOT period I 34.4 U/L rise to 42.0 U/L in period II and the average SGPT at period I was 62.5 U/L to 73.4 U/L in period II. While the average SGOT and SGPT among 162 non-shift employees also increased, but still in normal limit (SGOT <35 U/L and SGPT <45 U/L). Employees with a shift work system experienced an elevated of SGOT and SGPT which resulted impact on liver dysfunction caused by fatigue and no resting time. Whereas non-shift employees experienced an elevated of SGOT and SGPT but have no affect liver dysfunction.

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Introduction

Recently, industrialization is growing rapidly. High level of efficiency in industries was required to increase their productivity. To increase productivity and cost savings most company make some efforts by changing the working hours of its employees by applying a shift system. Shift system is a system in industry for workers to work within 24 hours to utilize their resources and increasing target production. Work shift arrangements are implemented to maintaining smoothness and fulfillment of production targets, while for workers it is a workload that

must be shouldered as workers (Suma'mur, 2013).

Human resources desired by the company are a healthy, efficient and productive workforce. But with the workload that is too heavy and shiftwork system can cause various problems for the worker. Koller's explains that various psychosocial and psychosocial symptoms were occurred. One of such study result such as fatigue and weak in workers who experience in shifts system (Kuswadji, 1997). According to Fish quoted by Firdaus (2005) suggested that the effects of shift work that can be felt include:

Physiological effects, namely decreased sleep quality: naps are not as effective as night sleep, many distractions and usually require rest time to compensate for lack of sleep during work nights. In addition, decreased physical working capacity due to the onset of feelings of drowsiness and fatigue and decreased appetite and indigestion. Psychosocial effects, these effects show problems greater than physiological effects, including the presence of family life disorders, loss of free time, small opportunities to interact with friends, and interfere with group activities in society (Saksono, 1991).

Psychosocial effects, these effects show problems greater than physiological effects, including the presence of family life disorders, loss of free time, small opportunities to interact with friends, and interfere with group activities in society. Saksono (1991) stated that night work affects people's lives which is usually done during the day or evening. While at that time for night workers used for rest or sleep.

Performance effects, which decrease performance during night shift work resulting from physiological and psychosocial effects. Decreased performance can result in decreased mental ability that affects occupational alertness behaviors such as quality of control and monitoring. 4) Health effects such as gastrointestinal disorders, this problem tends to occur at the age of 40-50 years. Shift work can also be a problem with the balance of blood sugar levels for diabetics and impaired liver function. Effect on work safety. Survey of the effect of work shifts on occupational health and safety conducted by Smith et. Al, reported that the highest frequency of accidents occurred at the end of the rotation of work shifts (nights) with an average number of accidents of 0.69% per man power. However, not all studies mention that the increase in the rate of industrial accidents occurs on night shifts. However, it tends to occur a lot during the morning shift and more in the night shift (Khairunnisa, 2001; Tilong, 2015; Sudoyo, et al., 2009). Lack of sleep frequency in night shift workers

becomes one of the causes of liver damage, because the work of the liver will be maximal at night in the process of detoxification of toxins, for that humans are encouraged to sleep at these hours. Because with sleep red blood cells will collect in the liver and the process of regenerating liver cells. Therefore sleeping at these hours is very important so that liver function is not disturbed. If the function is disrupted it can cause damage to liver cells so that defenses against disease seeds become weak (Tilong, 2015; Sudoyo, et al., 2009). Damage to hepar cells (liver) can be detected early using liver function tests. One of the liver function tests is to measure the levels of aminotransferase enzymes in serum. Aminotransferases measured are SGOT (Serum Glutamic Oxaloacetic Transaminase) and SGPT (Serum Glutamic Pyruvate Transaminase) (Sridianti, 2016). SGOT and SGPT are enzymes that are widely produced in the liver and produced slightly in the heart and skeletal muscles, whose function is to catalyze the transfer of α -amino groups from aspartate and alanine to the α -keto group of ketoglutaic acid, forming oxalacetate acid and pyruvate acid. PT Indonesia Asahan Aluminum (PT Inalum) is one of the state-owned companies in the field of hydroelectric power plants (PLTA) in Paritohan, Tobasa Regency and aluminum smelting plant in Kuala Tanjung Batubara Regency.

The workforce in the smelting operation works with a shift system, which is divided into three gilir (shift) work groups, namely shift I starting with the working time at 00.00-08.00 WIB, shift II starts with the working time at 08.00-16.00 WIB, shift III starts with the working time at 16.00-24.00 WIB., *shift II* dimulai dengan waktu kerja pukul 08.00-16.00 WIB, shift III starts with working time at 16.00-24.00 WIB. For employees who work in the company's smelting operations implement a 3-3-3 working system. This system is created where each shift works 3 days. Although it has implemented a 3-3-3 system with 4 teams, there are still complaints felt by employees due to working with the shift system such as muscle disorders, drowsiness and appetite disorders, especially

in employees in subsection reduction operations. As has been explained, employees of the aluminum smelting plant PT Inalum (Persero) Kuala Tanjung also work activities at night. It is necessary to examine whether the shift work system implemented at PT Inalum (Persero) Kuala Tanjung affects the liver function of workers in the company which is characterized by increased levels of SGOT and SGPT in the blood in workers.

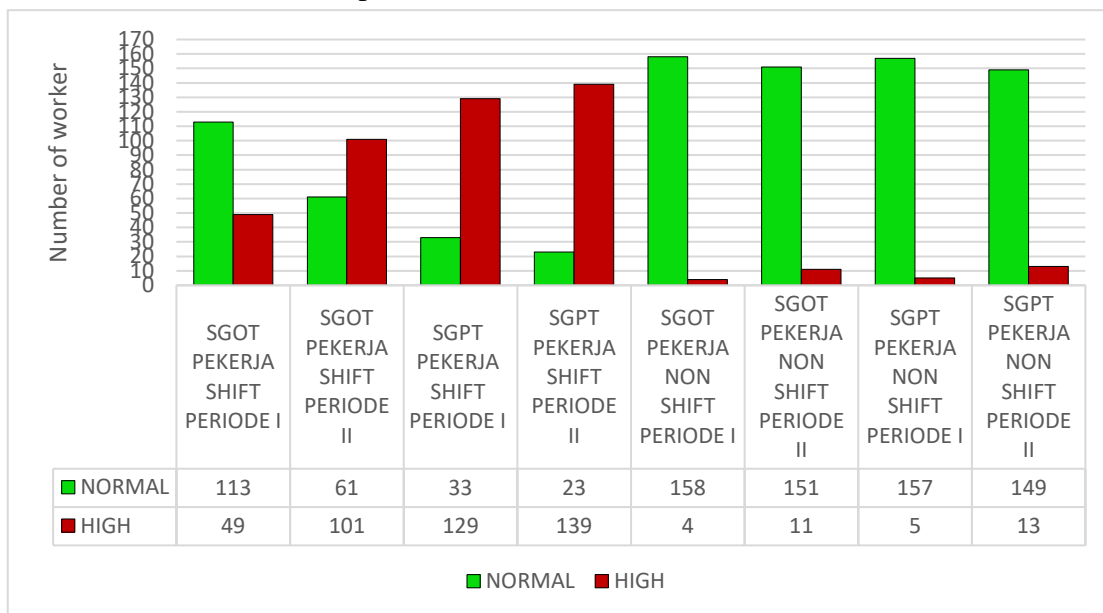
Materials and Methods

The research was conducted at the Smelter Occupational Health Section, Inalum Health Centre Laboratory Installation of PT Indonesia Asahan Aluminum (Persero), which is a section that monitors and checks the health of employees periodically. The data collected is primary and secondary data. Primary data is the levels of SGOT / AST and SGPT / ALT in the blood from the results of periodic health examinations of employees that can be obtained from the Laboratory Installation of Health Centre PT Indonesia Asahan Aluminum (Persero). The data to be taken is data on the results of periodic health

examinations during two periods of health examinations in march - May 2017 and direct examinations in October - December from 1701 employees. Secondary data obtained from PT Inalum section SPR (Smelter Public Relation), namely public relations section and SAW section (Smelter Administration and Welfare), which is staffing section, which includes: employee data who get shift and non-shift work system. Data analysis technique that tests T-paired (Paired T-Test) which compares the results of laboratory examinations of SGOT and SGPT levels of shift workers and non-shift (day shift) periodic examinations (medical check-ups) period March - May (period I) and September - November 2017 (period II).

Results and Discussion

Based on the results of research on liver function enzymes SGOT and SGPT in blood samples of employees of the Smelting plant PT INALUM (Persero) shift and day shift conducted in November 2017 obtained the following results.



Picture 1. the results of SGOT and SGPT levels

The above image shows the results of SGOT and SGPT levels in March - May (period I) and September - November 2017 (period II) in 324 samples of shift and non-

shift employees of PT Inalum (Persero), which are divided into 162 samples of shift employees and 162 samples of non-shift employees.

Table 1. Serum glutamic oxaloacetic transaminase of shift worker

Variable	Period I (U/L)	Period II (U/L)	U/L)
Average SGOT	5550	6809	1259
	34.3	42.0	7.8 = "μ"
SD	13.86	17.63	14.96

Number of shift workers (n) = 162

In Table 1 seem that of the 162 employees of THE Smelting plant OF PT INALUM (Persero) examined in the first and second periods, there was a significant increase in SGOT: t calculated = $\frac{\mu}{(Sd/\sqrt{n})} = \frac{7.8}{(14.96/\sqrt{162})} = 6.61 > t$ table = t 0.05 (df) = t 0.05 (161) = 1.98; because $t > t$ table then H_0 is rejected and H_1 is accepted. The average SGOT value in the first period was 34.3 U/L (SD = 13.86) and in the second period was 42.0 U/L (SD = 17.63) with the

average difference between periods I and II being 7.8 U/L (SD =14.96).

Based on the table and calculations above it can be concluded that from a sample of 162 employees who worked shifts examined in period I and period II, there was a significant increase in SGOT from an average of 34.3 U / L to an average of 42.0 U / L. The figures also show that the average SGOT which was originally within normal limits (<35 U /L) in period I, has increased in period II to above normal (>35 U / L).

Tabel 2. Serum Glutamic Pyruvate Transaminase) of shift workers

Variable	Period I (U/L)	Period II (U/L)	(U/L)
Average SGPT	10133	11883	1750
	62.5	73.4	10.8 = "μ"
SD	34.87	39.27	36.48

Table 2 showed that of the 162 employees of the Smelting plant of PT INALUM (Persero) examined in the first and second periods, there was a significant increase in SGPT t calculated = $\frac{\mu}{(Sd/\sqrt{n})} = \frac{10.8}{(36.48/\sqrt{162})} = 3.77 > t$ tabel = t 0.05 (df) = t 0.05 (161) = 1.98; because t calculates $> t$ table then H_0 is rejected and H_1 is accepted. Average SGPT value. In the first period it was 62.5 U/L (SD = 34.87) and in the second period it was 73.4 U/L (SD = 39.27) with the

average difference between periods I and II being 10.8 U/L (SD =36.48).

Based on the table and calculations above it can be concluded that from a sample of 162 employees who worked shifts examined in period I and period II, there was a significant increase in SGPT from an average of 62.5 to an average of 73.4. The figures also show that either period I or period II are above normal values (>45 U/L).

Table 3. Serum glutamic oxaloacetic transaminase) of non-shift worker (day shift)

Variable	Period I (U/L)	Period II (U/L)	(U/L)
Average SGOT	3463	4181	718
(U/l)	21.4	25.8	4.4 = "μ"
SD	5.25	8.47	8.09

Table 3 showed that of the 162 employees of THE Smelting plant PT

INALUM (Persero) examined in the first and second periods, there was a significant

increase in SGOT, namely $t \text{ count} = \frac{\mu}{(SD/\sqrt{n})} = \frac{4.4}{(8.09/\sqrt{162})} = 6.97 > t \text{ table} = t_{0.05} (df) = t_{0.05} (161) = 1.98$; because $t > t \text{ table}$ then H_0 is rejected and H_1 is accepted. The average SGOT value in the first period was 21.4 U/L (SD = 5.25) and in the second period it was 25.8 U/L (SD = 8.47) with the average difference between periods I and II 4.4 U/L (SD = 8.09).

Based on the Table 3 it can be concluded that from a sample of 162 employees who worked non-shifts (day shifts) examined in period I and period II there was a significant increase in SGOT from an average of 21.4 U / L to an average of 25.8 U / L, but the figures showed the value of SGOT within normal limits (<35 U / L).

Table 4. Serum glutamic pyruvate transaminase) of non shift worker (day shift)

Variable	Period I (U/L)	Period II (U/L)	(U/L)
Average SGOT	4248	5095	847
	26.2	31.5	5.2= " μ "
SD	11.35	18.57	13.68

Table 4 showed that of the 162 employees of the Smelting plant OF PT INALUM (Persero) examined in the first and second periods, there was a significant increase in SGPT, namely $t \text{ count} = \frac{\mu}{(SD/\sqrt{n})} = \frac{5.2}{(13.68/\sqrt{162})} = 4.86 > t \text{ table} = t_{0.05} (df) = t_{0.05} (161) = 1.98$; because $t > t \text{ table}$ then H_0 is rejected and H_1 is accepted. The average SGPT value in the first period was 26.2 U/L (SD = 11.35) and in the second period was 31.5 U/L (SD = 18.57) with the average difference between periods I and II being 5.2 U/L (SD = 13.68). Based on Table 4 can be concluded that from a sample of 162 employees who worked with non-shifts (day shifts) examined in period I and period II, there was a significant increase in SGPT from an average of 26.2 U / L to an average of 31.5 U / L, but the figures showed the value of SGPT within normal limits (<45 U / L).

Significant increases in SGOT and SGPT indicate damage to liver cells. This is due to lack of sleep rest and fatigue. Increase in SGOT and SGPT levels usually also occurs in people with hepatitis, fatty liver, pancreatitis. bile blockage, hepatic cirrhosis, excessive consumption of certain drugs (overdose) and other diseases of impaired liver function. In addition, the increase in SGOT and SGPT levels can also increase in people with impaired heart function, but SGOT levels are more elevated than SGPT (Pramudiantoro, 2013: 18).

Based on the results of the two-period SGOT and SGPT examination studies in a sample of 162 shift employees obtained an average SGOT and SGPT values there was a significant increase, namely the average SGOT value in the first period was 34.3 U / L, in the second period was 42.0 U / L and the average SGPT value in the first period was 62.5 U / L and in the second period was 73.4 U / L; The normal value for SGOT is < 35 Units per Liter (U / L) and SGPT <45 Units per Liter (U / L).

In shift employees, especially at night shift work, changes in body working hours (circadian rhythms) that should be at night usually have to sleep while employees are required to work. Sleeping 7-8 hours at night is very important so that liver function is not disturbed. In the early hours of the morning the liver increases which at that time there is a process of disposal of toxins (detoxification) or waste of the body's metabolism, in addition there is also regenerasi of liver cells. Heavy liver work at night coupled with strenuous physical activity will result in damage to liver cells (Tarwoto and Wartonah, 2004; Kuswadi, 1997; Tilong, 2015). If there is cell damage or increased permeability of the cell membrane, then many enzymes will come out to especially liver cells, liver enzymes will go a lot out into the extra cell space (extracellular) and into the bloodstream

including SGOT and SGPT which are enzymes produced in the liver. Therefore the increase in liver enzymes SGOT and SGPT can be used as a means to help the diagnostic of liver disorders (Sudoyo, 2009; Boyer, et al., 2012).

This is in line with research conducted by Rizky Febria Hada (2009) on 20 employees at the factory. The results found that there was an increase in the average value of SGOT and SGPT in employees who worked at night at PT. Semarang Autocamp Manufacturing Indonesia (SAMI) Tugurejo Semarang. Rising levels of SGOT and SGPT indicate damage to liver cells. This is because at night the performance of the liver is much greater so it is needed for rest. Similarly, research conducted by Fidiyatun, Setiani, and Suhartono (2013) confirms the same thing that indirectly the shift work system has an impact on the improvement of SGOT and SGPT. The study was conducted on lead smelting workers in Tegal Regency with a sample of 50 workers. The results found that there was an increase in SGOT and SGPT in 56% of workers due to lack of rest hours and fatigue. Examination of SGOT and SGPT two periods from a sample of 162 employees of non-shift (day shift) showed that the lowest period I SGOT was 13 U / L and the highest was 42 U / L. In SGOT period II the lowest was 13 U / L and the highest was 85 U / L. The lowest period I SGPT value was 13 U / L and the highest was 83 U / L. The lowest period I SGPT value was 13 U / L. The lowest period I SGOT was 13 U/L. The lowest is 15 U/L and the highest is 133 U/L.

Based on the average SGOT and SGPT values of non-shift employees (day shift) there was a significant increase, namely the average SGOT value in the first period of 21.4 U / L. While in the second period was 25.8 U / L. On the other hand, the average SGPT value in the first period was 26.2 U / L. While in the second period is 31.5 U / L. Thus it can be concluded that although there is a significant difference between the average value of SGOT and SGPT in non-shift employees but the value is still within the normal limit where

the normal value for SGOT is < 35 U / L and SGPT < 45 U / L.

The SGOT and SGPT that have increased in some non-shift employees are affected by fatigue which in certain sections or departments are obliged to make their employees work overtime from the morning work schedule to go home until night due to special tasks in the maintenance and repair of production equipment. Working overtime is defined as working more hours or working more than 8 hours per day. Overtime result in increased levels of SGOT and SGPT in the blood. This is because the enzymes SGOT and SGPT also play a role in the process of gluconeogenesis by facilitating the synthesis of glucose from non-carbohydrate materials (i.e. amino acids, lactic acids, non ester fatty acids and glycerol) into energy. In workers who overwork excessively (overtime) plus heavy physical activity will force the liver to replace sugar depleted due to fatigue from fatty compounds stored in the liver as to force enzymes excessively out into the extra space of cells and into the bloodstream (Boyer TD, et al., 2012; Luklukaningsih, 2014).

Conclusions

Based on the results the influence of shift work systems on the picture of liver function enzymes (SGOT and SGPT) in employees of the aluminum smelting plant of PT Inalum (Persero) Kuala Tanjung showed that there was a significant difference in SGOT and SGPT in employees with shift work from the average SGOT Period I which is 34.4 U / L rose to 42.0 U / L in period II and the average value of SGPT Period I which is 62.5 U / L to 73.4 U / L in period II. While the average of SGOT and SGPT in non-shift employees also increased, but still within normal limits, namely SGOT is <35 U / L and SGPT <45 U / L. Thus it can be concluded that working with shift hours (gilir) is greater its effect on the increase in SGOT and SGPT levels compared to working with the system of regular working hours (non-shift / day shift). Employees with shift work systems experience increased levels of SGOT and SGPT compared to working with a regular

system of working hours (non-shift / day shift). Employees with shift work systems experience increased levels of SGOT and SGPT which have an impact on impaired liver function caused by fatigue and lack of rest time. While regular work employees (non-shift / day shift) experienced an increase in SGOT and SGPT levels but did not have an impact on liver disorders.

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