Mining Workers, Administrative Task, Obesity, Hypertriglyceridemia, and Young Workers Increased Risk Liver Function Elevation among Indonesian Male Workers

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Abstract

Introduction: Mining workers have potential risks to be exposed by many toxicants. Due to the majority of toxicants metabolised through the liver this may be high risk of the liver function alteration due to occupational and non-occupational health hazards exposures. The purpose of this study was to explore the risk of mining worker to have liver function elevation (LFE) adjusted by other risk factors.

Methods: A comparative cross sectional study was conducted to examine the secondary data of 2016 annual medical examination results of 5634 workers from six various industries in Indonesia. The data subjects consisted of 447 of those who had a LFE compared with 1341 subjects were randomly chosen from those data whose were normal in liver function enzyme. Liver function elevations were considered on the basis of serum aspartate aminotransferase and/or alanine aminotransferase level more than 5 points above reference levels. The risk of mining workers to have liver function elevation were calculated using Odds Ratios and adjusted by Type of Task, Chemical Exposure History, Age, Body Mass Index, Medical History and Triglyceride Level.

Result: This study analysed 1781 male workers (31.0±7.4 year). No significant associations were observed between outcome and medical history of diabetes mellitus and liver disease as well as alcohol consumption, smoking, physical exercise, and chemical exposure history. Risk factors associated with LFE were identified including obesity (OR 4.0, 95% CI: 3.1 to 5.0), work in mining sector (OR 2.0, 95% CI: 1.6 to 2.6), role as administrative worker (OR 1.4, 95% CI: 1.0 to 1.8), age <35 years (OR 1.4, 95% CI: 1.1 to 1.9), and hypertriglyceridemia (OR 1.6, 95% CI: 1.3 to 2.1) respectively.

Discussion: Attributed risk factors of LFE among worker were identified including occupational, individual and modifiable metabolic risk. Further research is needed to explain the role of occupational exposures in LFE among miners.

Keywords: mining workers, liver function, occupational hazards

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INTRODUCTION

Up to 9% of people without symptoms have elevated liver enzymes, and failure to evaluate minor elevations could mean missing the early diagnosis opportunity.[1,2]Serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are the most common liver enzymes tested and well-known as markers of liver damage.[3]Prior study suggest that nonalcoholic fatty liver disease (NAFLD) is representing the leading cause of asymptomatic elevated aminotransferase level.[4,5]NAFLD itself is associated with other medical conditions such as metabolic syndrome and diabetes mellitus following the obesity epidemic due to consumption of high-calorie diet and sedentary lifestyle.[5-7]

Mining workers havepotential risks to be exposed by many toxicants such as silica dust, metal fumes, fuels, and solvents. Due to the majority of toxicants metabolized through the liver this may be high risk of the liver function alteration due to occupational and non-occupational health hazards exposures. The purpose of this study was to explore the risk of mining worker to have liver function elevation (LFE) adjusted by other risk factors.

METHODS

We conducted a comparative cross-sectional study using secondary data from 2016 worker's annual medical examination report. We excluded incomplete data together with female subject from 6,067data population, resulted to 5,000 eligible data. Four hundred and forty seven data subjects who were considered LFE are included in this study to compare with 1341 data subjects who were randomly chosen from those whose were normal in liver function enzyme.

According to the Steering Committee of the Regional Office for the Western Pacific Region of the World Health Organization (WPRO), the Asian standards for BMI (kg/m2) were as follows: underweight <18.5; normal 18.5 – 22.9; overweight 23 – 24.9; obese >= 25.

Hypertriglyceridemia was defined as triglyceride level ≥ 200 ug/dL.Liver function elevations were considered on the basis of serum aspartate aminotransferase (AST) and/ or alanine aminotransferase (ALT) level more than 5 points above reference levels (AST ≥ 38 U/L; ALT ≥ 55 U/L). Both AST and ALT was measured using IFCC method while triglyceride was measured using a GPO-PAP method at the accredited clinical laboratory.

Statistical analysis was performed using STATA version 10 software and $p<0.05$ indicates statistical significance. We measure central tendency for continuous variables and presented it as mean and standard deviations. On the other hand, categorical data will be presented as proportion and percentage. We used X^2-test to define the variable candidates for multivariate analysis model based on the p-value <0.25 and calculate the crude odds ratios (crude ORs). Multiple logistic regression were used to estimate the odds ratios (ORs) and 95% CIs for elevated liver enzymes after adjustment for age, BMI, work sector, type of task and triglyceride level.

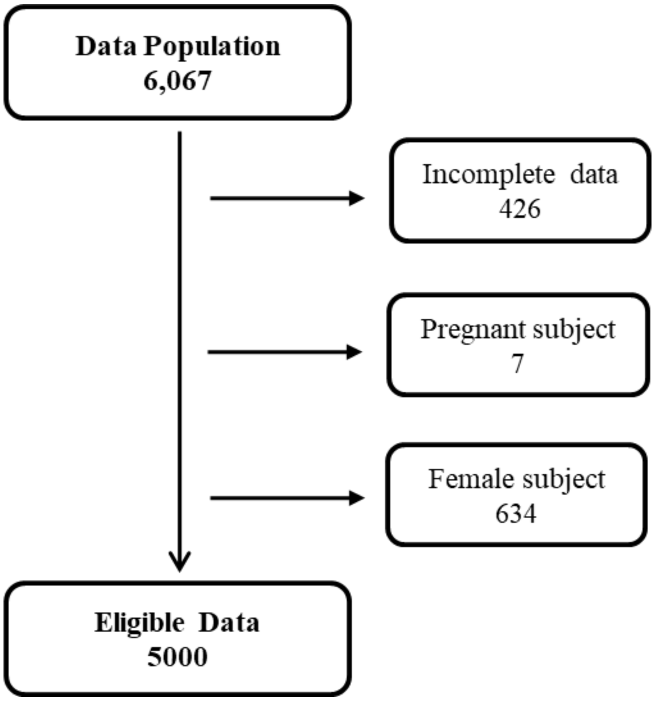

Figure 1. Derivation of study population

RESULTS

The data subjects consisted of 447 of those who had a LFE and 1341subjects with normal liver function. The mean age of data subjects was 31 years, all male, 83% were technical workers, and 23% work in mining sectors. Baseline characteristics of study data are given in table 1 and 2 for numerical and categorical data respectively.

Table 1. Basic characteristics of numerical data subjects

Variables	**Liver Function**	
	Normal (n=1,341)	**Elevated (n=447)**
Age (years) [Mean ± SD]	30.63 ± 7.66	31.95 ± 6.60
AST (U/L) [Mean ± SD]	21.45 ± 5.08	45.58 ± 35.12
ALT (U/L) [Mean ± SD]	23.59 ± 11.32	79.26 ± 52.80
Triglyceride (mg/dL) [Mean ± SD]	147.10 ± 99.85	186.14 ± 104.74
BMI (kg/m^2) [Mean ± SD]	23.56 ± 3.98	26.69 ± 4.05

Table 2. Characteristic of dichotomous variables in association with liver function

Variables	Liver Function		p - value
	Normal (n=1,341)	Elevated (n=447)	
Age < 35 years [n (%)]	986 (73.5)	323 (72.3)	0.600
Work in mining sector [n (%)]	266 (19.8)	143 (32.0)	< 0.001
Task as technical worker [n (%)]	209 (15.6)	92 (20.6)	0.014
History of chemical exposure [n (%)]	492 (36.7)	171 (38.3)	0.553
Not exercising [n (%)]	433 (32.3)	147 (32.9)	0.816
Smoking [n (%)]	570 (42.5)	201 (45.0)	0.363
Consuming alcohol [n (%)]	41 (3.1)	29 (6.5)	0.001
History of liver disorders [n (%)]	10 (0.7)	8 (1.8)	0.095*
History of Diabetes [n (%)]	18 (1.3)	4 (0.9)	0.457
Obese [n (%)]	424 (31.6)	295 (66.0)	< 0.001
Hypertriglyceridemia [n (%)]	259 (19.3)	145 (32.4)	< 0.001

* Fisher's exact

Table 3.Adjusted Odds Ratios and 95% Confidence Intervals for LFE

Variables	p - value	aOR	95% CI
Obesity	< 0.001	3.97	3.13 - 5.04
Miners	< 0.001	2.03	1.57 -2.63
Hypertriglyceridemia	< 0.001	1.63	1.26 - 2.12
Age < 35 y.o	0.006	1.44	1.03 - 1.85
Administrative workers	0.031	1.38	1.11 - 1.88

No significant associations were observed between outcome and medical history of diabetes mellitus and liver disease as well as alcohol consumption, smoking, physical exercise, and chemical exposure history. Risk factors associated with LFE were identified in our logistic models including obesity, work in mining sector, role as administrative worker, age < 35 years, and hypertriglyceridemia respectively.

DISCUSSION

Both aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are normally present in serum at low levels.[1] Elevated serum liver enzymes can reflect abnormalities in liver cells. Predominant elevation of aminotransferases typically indicates hepatocellular injury because both AST and ALT are released into blood in greater amount when hepatocytes are damaged. AST is present in blood cells and many tissues including liver, muscle, and brain. ALT found primarily in hepatocytes, making it more specific indicator of liver disease.[8]

In this sample of male Indonesian workers, we investigated the elevated serum ALT and AST elevation with its attributed risk factors. Our findings showed that workers with elevated liver enzymes were more likely to be young (under 35 years of age), obese, have hypertriglyceridemia, working in mining sector, and have role as administrative worker.

Work in mining sector with roster schedule, the average workers will spend approximately between 10-12 hours on duty with little or no time for exercise. And role as administrative worker are indicates less physical activity during working time, and in the other word sedentary worker. Sedentary work includes prolonged sitting at work and notable amount of time using long screen or working with Visual Display Terminal (VDT) coupled with leisure time after working time.[9] In line with daily regularity on mining sites, workers tend to get privileges with abundant food availability that may lead to over-nutrition, and in addition with physical inactivity, these are significant contributing factors to obesity.

With available data, the most probable and reasonable explanation for our results of elevated aminotransferases is nonalcoholic fatty liver disease (NAFLD). Recent epidemiologic studies have reported that fatty liver, resulting either from alcohol use or from NAFLD is a major cause of mildly elevated aminotransferases. However, NAFLD is the most common cause of asymptomatic elevated aminotransferase levels.[5,7,8]The prevalence of nonalcoholic fatty liver in the general US population is about 25%, but is much higher in groups at risk, such as patients with type 2 diabetes and morbidly obese patients.[7] NAFLD is considered to be associated with metabolic disorders, including obesity and hypertriglyceridemia.[8]

The two main sources of plasma triglycerides are exogenous i.e. from dietary fat and endogenous from the liver.[10] People with excess visceral adipose tissue often experienced hypertriglyceridemia which is associated with fatty liver. Some metabolic conditions are frequently associated with hypertriglyceridemia, and obesity is known to be the metabolic stressor most frequently associated with, although associations with poorly controlled type-2 diabetes and excessive alcohol consumption are also common.[10,11]

Physical inactivity and elevated liver enzymes related to NAFLD are intimately linked. Decreased levels of daily physical activity were associated with increased incidence of NAFLD. Other studies reported similar finding of higher intrahepatic fat and significantly elevated liver enzymes in subject who reported reduced physical activity. Observational data also suggest that individuals who do not engage in the upper end of moderate or vigorous physical activities have increased metabolic risk, adiposity, and also incidence and severity of NAFLD.[5,6]

The strength of this study is its large sample size that comes from various industrial sectors. However, several limitations in this study need to be acknowledged. First, because of its cross-sectional design, we were unable to determine whether or not there was causal association, hence the result should be considered with caution. Second, there are few common causes of elevated liver enzymes that were not evaluated in our study, such as viral hepatitis and other illness including the potential effect of chemical exposure in the workplace. Third, with respect to the use of secondary data in this study, we have limited usable information such as medical history and lifestyle.

CONCLUSION AND SUGGESTION

Mildly elevated liver enzymes are common and potentially important, yet very few well-designed prospective studies have addressed the issue of what should be done once they are identified. Attributed risk factors of LFE among worker were identified including occupational, individual and modifiable metabolic risk.

Reflecting on the results, the occupational health services has not been oriented to prevention program. To prevent future deterioration, prevention oriented program shall be promoted and implemented in the company including the healthy and balanced diet and physical exercise facility as well.

Further research is needed to explain the role of occupational exposures such as shift work and chemical exposures in LFE among miners.

Competing interests

The Authors have no conflict of interest to declare.

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