

# ASSOCIATION BETWEEN BODY MASS INDEX AND LIVER FUNCTION AMONG GASOLINE STATION WORKERS IN BANGKOK, THAILAND

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## Abstract:

The body mass index (BMI) is an important biomarker for adiposity in the population, while glutamic oxaloacetic transaminase (SGOT), glutamic pyruvic transaminase (SGPT) and alkaline phosphatase (ALP) are biomarkers of liver function. This study aimed to evaluate the association of body mass index (BMI) and liver function of 105 gasoline station workers in Pathumwan district area, central Bangkok, Thailand. All workers were interviewed and provided blood samples for liver function analysis. The statistical analyses were performed by one-way analysis of variance to compare characteristics among BMI groups, and by linear regression to assess associations between biomarkers and BMI. BMI was significantly associated with SGPT and SGOT to SGPT ratio (SGOT/SGPT) ( $p < 0.001$  and  $p < 0.05$ , respectively). In addition, the obese group had significantly higher SGPT level and lower SGOT/SGPT ratio than the normal weight and underweight groups. Also, the obese group had significantly lower ALP than the underweight group. SGOT and the SGOT to SGPT ratio could prove to be useful markers of chronic liver disease in gasoline station workers; further research is required to confirm this.

**Keywords:** Body mass index, Liver function, Occupational worker, Thailand

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## INTRODUCTION

The body mass index (BMI) is generally calculated by weight/height<sup>2</sup>. It is a reliable indicator of body fat for most people and is used to screen for weight categories that may be a risk factor to health problems. Although the BMI is a scientifically accepted measurement, however, it is not a direct measure of excess body fat. The BMI does not take body composition into account. For people who are particularly muscular, the BMI may overestimate obesity, and on the contrary underestimate the catabolic effect of heavy smoker and drinker. While, the weight ratio can be referred to as "underweight", "normal", "overweight" and "obesity. Several studies reported that the obese ones were significantly exposed to health problems like diabetes, hypertension, cardiovascular disease, gall bladder disease, ischemic stroke, osteoporosis, sleep apnea and some types of cancers [1-4].

The liver is the largest glandular organ of

human body. It serves to eliminate harmful biochemical waste products and detoxify alcohol, certain drugs, and environmental toxins. Liver also has many other functions, such as to produce substances that break down fats, to convert glucose into glycogen, to produce urea, to make certain amino acids, to filter harmful substances from the blood (such as alcohol), to store some vitamins (vitamins A, D, K and B<sub>12</sub>) and minerals and finally to maintain a proper level of glucose in the blood. On the other hand, the liver is also responsible for producing cholesterol. It produces about 80% of the cholesterol in our body. Several diseases are involved with the liver, for examples hepatitis (an inflammation of the liver), liver cancer, and cirrhosis (a chronic inflammation that progresses ultimately to organ failure) [5]. Therefore, the liver function analysis is crucial in determining its status. Such laboratory analyses are involved the assays on the clinical biochemistry of blood samples, which commonly are the glutamic oxaloacetic transaminase (SGOT), glutamic pyruvic transaminase (SGPT) and alkaline phosphatase (ALP). They were designed to

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**Table 1** Characteristics of gasoline station workers

Characteristics	Total n(%)	Men N(%)	Women n(%)	Mean±SD	Range	p-value*
Workers n(%)	105 (100.0)	80(76.2)	25 (23.8)	-	-	-
Age (year)	105 (100.0)	29.4	31.3	29.9±9.3	15.0-59.0	NS
BMI (kg/m <sup>3</sup> )	105(100.0)	22.5	25.3	23.2±4.9	6.3-41.2	<0.05
Obesity (>27.5 kg/m <sup>3</sup> )	14(13.30)	13(12.4)	1(1.0)	31.5±4.5	27.5-41.2	<0.001
Overweight (23.0-27.4 kg/m <sup>3</sup> )	47(44.8)	38(36.2)	9(8.6)	24.9±1.1	23.0-27.3	<0.001
Normal weight (18.5-22.9 kg/m <sup>3</sup> )	26(24.8)	19(18.1)	7(6.7)	20.7±1.1	18.5-22.8	0.001
Underweight (<18.5 kg/m <sup>3</sup> )	18(17.1)	10(9.5)	8(7.6)	17.6±0.6	6.3-18.4	<0.001
Cigarette smoking	36(34.3)	56 (53.3)	7(6.7)	-	-	<0.001
Alcohol drinking	63(60.0)	35 (33.3)	1(1.0)	-	-	<0.001

\*Significant difference between men and women

**Table 2** Biochemical levels of liver function of gasoline station workers

Biochemical levels	Normal reference	Men	Women	Mean±SD	Range	p-value*
SGOT (U/L)	0.0-40.0*	28.1	19.5	26.0±18.8	1.0-150.0	<0.05
SGPT (U/L)	0.0-40.0*	34.0	21.0	30.9±25.6	2.0-165	<0.05
ALP (U/L)	26.0-117.0*	78.1	51.6	71.8±38.0	26.0-298	<0.01
SGOT/SGPT	1 <sup>+</sup>	1.2	1.2	1.2±1.1	0.01-10.0	NS

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#The Singapore Asian BMI (<http://asianbmi.blogspot.com/>)

<sup>+</sup> MediLexicon International Ltd, 2004-2012

give information about the state of a patient's liver. The SGOT is normally found in a variety of tissues including liver, heart, muscle, kidney, and brain while the SGPT is, by contrast, normally found largely in the liver. The ALP is an enzyme in the cells lining the biliary ducts of the liver which is also presented in bone and placental tissue [6]. The SGOT to SGPT ratio is a biomarker of liver injury in a patient with some degree of intact liver function. This study aimed to find the association between BMI and liver function tests in gasoline station workers who were exposed at high risk to volatile organic compounds (VOCs).

## MATERIAL AND METHODS

### Study population

A cross sectional study was conducted in 105 gasoline station workers, from 11 gasoline stations in Pathumwan District, Bangkok, Thailand. The subjects who were voluntarily to participate in the study must be healthy without congenital diseases, age 15 year-old or older and had been worked in the gasoline station for more than 3 months.

Permission to conduct human subjects in this study was approved by the Ethical Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (COA No. 048/2553).

### Data collection

All participants were interviewed face to face on their personal data such as age, cigarette smoking, alcohol drinking, etc. Their height and weight were measured for the body mass index (BMI) calculation. Their blood samples were collected by the registered nurse for the liver function analysis.

### Biological analysis

The biological analyses of liver function [serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT) and alkaline phosphatase (ALP)] were performed using spectrophotometry at the laboratory of the Faculty of Allied Health Sciences, Chulalongkorn University.

### Statistical analysis

All the statistical analyses were performed by SPSS 17.0 for Windows Program licensed by the University. The average biological levels comparison was done by Independent t-test between men and women workers. The biological levels of liver function were compared by One Way ANOVA (Post Hoc Multiple Comparisons) between each of the BMI groups. The linear regression was used for the association between the BMI and biological parameters of gasoline station workers. A statistically significant difference was

**Table 3** Association between BMI and characteristics in gasoline station workers

Parameters	Mean	Linear regression analysis			p-value*
		B	SE	95% CI	
BMI (kg/m <sup>3</sup> )	23.2				-
Age (year)	29.9	0.151	0.050	0.052 to 0.249	<0.01
	Ratio or %	Logistic regression analysis			p-value*
		B	SE	95% CI	
Sex	3.2:1	0.108	0.046	1.019 to 1.218	<0.05
Cigarette smoking	34.3%	-0.084	0.049	0.835 to 1.013	0.091
Alcohol drinking	60.0%	-0.050	0.041	0.878 to 0.031	0.221

**Table 4** Association between BMI and liver function in gasoline station workers

Parameters	Mean	Reference	Linear regression analysis			p-value*
			B	SE	95% CI	
BMI (kg/m <sup>3</sup> )	23.2	18.5-22.9 <sup>#</sup>				-
SGOT (U/L)	26.0	0.0-40.0*	0.328	0.388	-0.441 to 1.097	0.399
SGPT (U/L)	30.9	0.0-40.0*	1.678	0.497	0.691 to 2.665	0.001
ALP (U/L)	71.8	26.0-117.0*	-0.520	0.713	-1.935 to 0.894	0.467
SGOT/SGPT	1.2	1 <sup>+</sup>	-5.14E-02	0.023	-0.097 to -0.006	0.028

Adjust for age, sex, cigarette smoking and alcohol drinking

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<sup>#</sup>The Singapore Asian BMI (<http://asianbmi.blogspot.com/>)

<sup>+</sup> MediLexicon International Ltd, 2004 – 2012

accepted at a *p*-value of < 0.05.

## RESULTS

Of the total participated subjects (105), 76.2% were men and 23.8% were women, with the average age of 29.9 years, 34.3% were smokers and 60.0% were alcohol drinkers. The smoker and alcohol drinkers were significantly higher in men than in women (Independent t-test, *p* < 0.001).

The determination of the BMI was calculated by weight/height<sup>2</sup> and categorized to underweight, normal weight, overweight and obese, followed the Singapore Asian BMI 2012 [7]: obesity > 27.5 kg/m<sup>2</sup>, overweight 23.0 - 27.4 kg/m<sup>2</sup>, normal weight 18.5 - 22.9 kg/m<sup>3</sup> and underweight < 18.5 kg/m<sup>2</sup>, respectively. The average BMI was recorded as 23.2 kg/m<sup>2</sup> (Table 1). Most of workers (44%) were overweight.

For the liver function analysis, the average SGOT, SGPT and ALP were 26.0, 30.9 and 71.8 U/L respectively (Table 2). They were significantly higher in men than in women workers (Independent t-test, *p* < 0.05, *p* < 0.05 and *p* < 0.01 respectively).

The data on the BMI indicated a significant association with age (Linear regression, *p* < 0.01) and sex (Logistic regression, *p* < 0.05) but it was not associated with cigarette smoking and alcohol drinking (Table 3). In addition, the BMI also showed an association with SGPT and SGOT/SGPT ratio (Linear regression, *p* = 0.001 and *p* < 0.05) but it was not associated with SGOT

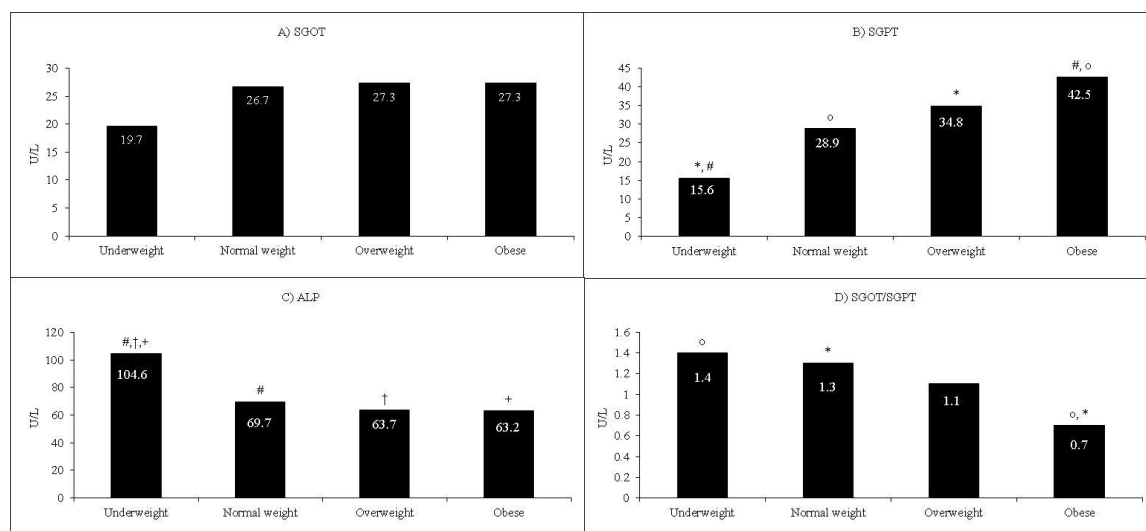
and ALP levels (Table 4).

The mean of SGOT levels was not different between each BMI group. However, the SGPT levels showed that the obese group was significantly higher than the normal and underweight group (*p* < 0.05 and *p* < 0.001) (Figure 1A and 1B), while the SGPT of the overweight group was significantly higher than the underweight group. The mean of the ALP levels was significantly higher in the underweight workers than in the normal weight, overweight and obese groups (*p* < 0.001) (Figure 1C). Furthermore the mean ratio of SGOT/SGPT of the obese group was significantly lower than in the normal and underweight group (*p* < 0.05 and *p* < 0.05) (Figure 1D).

The BMI showed a significant association with characteristics of age (Linear regression, *p* < 0.01) and sex (Logistic regression, *p* < 0.05) but it was not associated with cigarette smoking and alcohol drinking of gasoline workers (Table 3).

In addition, BMI also showed an association with SGPT and SGOT/SGPT ratio (Linear regression, *p* = 0.001 and *p* < 0.05) but it was not associated with SGOT and ALP levels (Table 4).

The mean of SGOT levels was not different between each BMI group but SGPT levels showed that the obese group was significantly higher than the normal and underweight group (*p* < 0.05 and *p* < 0.001) (Figure 1A and 1B). While the SGPT of overweight workers was also significantly higher than SGPT in the underweight group. The mean of



\*<sup>o</sup> Significant difference between BMI groups at  $p < 0.05$   
 #, †, †† Significant difference between BMI groups at  $p < 0.001$

**Figure 1** Liver enzyme levels of underweight, normal weight, overweight and obese groups

**Table 5** Predicted outcome of liver function defects in workers

Worker group	SGOT (U/L)	SGPT (U/L)	SGOT/SGPT Ratio	ALP (U/L)	Predicted outcome
Underweight	↔	↔	<1 to >1 (1.4)	↔ to ↑↑	Mild chronic bone disease or malnutrition
Normal weight	↔ to ↑	↔ to ↑	<1 to >1 (1.3)	↔ to ↑	Mild chronic liver disease
Overweight	↔ to ↑	↔ to ↑↑	<1 to >1 (1.1)	↔ to ↑	Mild chronic intrahepatic cholestasis
Obese	↔ to ↑	↔ to ↑↑↑	<1 (0.7)	↔	Mild nonalcoholic steatohepatitis

↔ within reference limits; ↑ slightly increased; ↑↑ moderately increased; ↑↑↑ markedly increased

ALP levels was significantly higher in underweight workers than in the normal weight, overweight and obese groups ( $p < 0.001$ ) (Figure 1C). Furthermore the mean ratio of SGOT/SGPT of the obese group was significantly lower than in the normal and underweight group ( $p < 0.05$  and  $p < 0.05$ ) (Figure 1D).

Finally, the predicted outcomes in participated subjects (gasoline station workers) could be drawn from our data on the association between their BMI and liver function analysis as followed: the normal weight group is likely to have mild chronic liver disease, the overweight group is likely to diffuse chronic hepatic cholestasis, the obese group is likely to have mild nonalcoholic steatohepatitis and the underweight group is likely to have chronic bone disease and malnutrition (Table 5).

## DISCUSSION

Our findings on the BMI in the underweight, normal, overweight and obese groups of those who were cigarette smokers and alcohol drinkers were significantly higher in men than in women which

concluded with the other studies [8-10]. Similar outcomes were demonstrated in the biochemical levels of liver function which were significantly higher in men than in women. The BMI was significantly associated with age ( $p < 0.01$ ) and sex ( $p < 0.05$ ) as reported by previous studies [11-13]. Ramalh [14] and Pulzi et al. [15] also confirmed that the BMI correlates with the degree of liver damage: the greater the BMI the greater the liver damage. However, Limdi and Hyde in 2003 [16] found that that BMI does not associate with cigarette smoking and alcohol drinking, which was in contradiction to the study by Puukka et al., [17] Pranjić et al, [18,19]. Saadat and Ansari-Lari [20] reported that the gasoline station workers may have liver function damage even in the normal weight group, due to toxic chemical pollutants exposures. Other reports [21-23] had confirmed that the population trend towards permanently increased liver enzyme levels whose activities were also linked with oxidative stress process by ethanol and/or being overweight that promoted liver damage.

Our results also concurred with the study by Piton et al. [24] on the SGOT and SGPT levels which showed that the increasing trend with the increasing of the BMI among the obese group which were significantly higher than in the normal group (of 1.7 times, 95% CI = 0.691 to 2.665). The SGPT level is more specific and quite sensitive bio-marker for the liver disease, had exhibited its association with the prediction of mortality in patient with liver disease as demonstrated in the underweight subjects [25, 26].

For the SGOT to SGTP ratio which is used to interpret the liver damage between the alcoholic and non-alcoholic group, the SGOT/SGTP ratio from our study was 1:1. Most non-alcoholic liver disease patient showed ratios less than one (1) but elevated the SGOT/SGPT ratios were found in the non-alcoholic steatohepatitis (NASH) patients with high risk of fibrosis [27] and it was over two in alcoholic aetiology of liver disease [28]. In the obese group, our SGOT/SGPT ratio was less than one (1) and was significantly lower (0.7) than in the normal weight group (1.3,  $p < 0.05$ ). While in the normal weight group, this ratio was more than 1 which could lead to a risk of mild chronic liver disease. However, the BMI showed inverse association with this ratio ( $p < 0.05$ ). Thus, the increasing BMI showed the decreasing SGOT/SGPT ratio, in which it could be implied a risk for non-alcoholic fatty liver disease (NAFLD), a cause of mild aminotransferase increase [29,30] as had reported in the Asia-Pacific Region for the last 10 to 15 years [31]. In addition, the increased of SGOT/SGPT ratio was unrelated to liver disease include developing liver cancer (hepatocellular carcinoma, HCC) [32], celiac [33] hyperthyroidism and hypothyroidism [34].

Regarding the ALP level, which is used widely in the diagnosis of hepatobiliary disease and various bone disorders [35, 36], it was significantly higher level in the underweight workers than the other groups (normal weight, overweight and obese groups) ( $p < 0.001$ ). This result was in opposite to the ones done by Schiele et al. [37] and Ali et al. [38] in which they demonstrated that the ALP levels were higher in the obese than in the lean subjects. Anyhow, some researcher recommended that an additional investigation should be required with other biological tests such as albumin, bilirubin [39, 40]. It had also been reported that taking some certain medications and alcohol consumption may cause acute injury to the liver that in turn increased the ALP levels, which presumably associated with cholestatic liver disease, pregnancy, bone disease, and occasionally

with inflammatory bowel disease [41].

Most gasoline workers may have affected liver function even in the normal weight group, due to toxic chemical pollutants exposures as previous studies have shown [18-20].

### LIMITATIONS

The limitation of this study was the small sample size, due to the limited funding and time to conduct the study. A larger sample size would be suggested for the future study. The addition of a physician and nutritionist would be recommended and required for the further study which dealing with the BMI and also providing the awareness on occupation health risk and care.

### CONCLUSION

Our results exhibited a strong association between the BMI and liver function, especially in the SGPT level which has a potential to be utilized as a bridging marker to monitor chronic liver damage in early detection. Meanwhile, the SGOT to SGPT ratio could be helpful in determining the liver disease, especially when the participated subjects were categorized in the underweight group. However, a more effective interpretation on liver function analysis should require the knowledge in pathophysiology and additional laboratory investigations. In conclusion, the gasoline station workers have a high risk of liver abnormality not only due to effects of organic compounds but as a consequence of obesity. The men workers exhibited higher percentage of overweight and obesity than the women workers and with their behaviours of alcohol drinking and cigarette smoking they increased their chance of obtaining the liver disease. However, the diagnosis of liver disease should be relied on the liver function tests (LFTs). Generally, the results of LFTs can be influenced by age, gender, alcohol drinking, cigarette smoking, malnutrition, presence of extrahepatic diseases such as cardiac, musculoskeletal or endocrine diseases and status of liver health in itself. Therefore, a thorough clinical investigation must be required in order to make any clinical conclusion.

### CONFLICT OF INTERESTS

There was no conflict of interest from this study.

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