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Comparative comprehensive statistical modeling in different stage of blood pressure based on high density lipoprotein cholesterol level

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ABSTRACT

Atherosclerosis is a condition when the arteries become narrowed and hardened due to the excessive of plaque which is made of fat, cholesterol, calcium and other substances. It is also known as arteriosclerotic vascular disease. The aims of this study were to examine the factors that are associated directly or indirectly with a triglycerides level in three distinct phases of blood pressure. We employed structural equation modeling (SEM) method in order to know the associated factors of triglycerides level in three distinct phases of blood pressure which are normal, borderline and hypertensive. The statistical analysis revealed that body mass index [(β = 0.924, p < 0.001), (β = 0.924, p < 0.001) and (β = 0.937, p < 0.001)], weight [(β = 0.962, p < 0.001), (β = 0.925, p < 0.001) and (β = 0.940, p < 0.001)] and hip circumference [(β = 0.903, p < 0.001), (β = 0.910, p < 0.001) and (β = 0.897, p < 0.001)] were statistically significant across the three distinct phases of blood pressure. This finding shows that the triglycerides might be a valuable marker of atherosclerosis in three distinct phases of blood pressure.

Keywords: Atherosclerosis, Triglycerides, Structural Equation Modeling (SEM), Bmi, Weight, Hip

1. INTRODUCTION

Cardiovascular disease is a type of diseases which commonly occur in hypertension patients due to the atherosclerosis. In epidemiologic studies, the risk factors of atherosclerosis and hypertension still controversial and complex [5], [7]. Both of risk factors might be attributed to the heart attack, stroke, peripheral arterial disease, erectile dysfunction and kidney disease [13]. Mostly, higher triglyceride level and low HDL cholesterol were one of the factors which attributed to the pathogenesis coronary artery disease [12]. Besides that, high density lipoprotein (HDL) cholesterol act as a maintenance function for the inner wall of blood vessels which prevent the atherosclerotic cardiovascular complication by scavenges and removes low density lipoprotein (LDL) cholesterol or bad cholesterol [10], [11]. This study was continued from the previous study on high density lipoprotein cholesterol predict triglyceride level predict in three distinct phases of blood pressure by Amir and Shafiq [1]. We hypothesized that a strong association between triglycerides and HDL cholesterol level might exist in three distinct phases of blood pressure which normal, borderline and hypertensive. This study to examine the examine the factors that are associated directly or indirectly with triglycerides in three distinct phases of blood pressure.

2. MATERIALS AND METHODS

The participants are patient diagnosed clinically with triglycerides and HDL-Cholesterol with three distinct phases of normal, borderline and hypertensive among blood pressure patients between 1st January 2009 and 31st December 2011. A total of 1000 registered patients from Hospital University Sains Malaysia (HUSM) were screened and met the inclusion and exclusion criteria (Table 1). The main outcome evaluated is the association of the triglyceride level which was evaluated by using structural equation modeling with AMOS version 18.0 program. All subjects were assigned to blood pressure level categories which are systolic blood pressure level which are normal, borderline and hypertensive. Normal systolic blood pressure classification is less than 120 mmHg, borderline is 120-139 mmHg and hypertensive is more than 140 mmHg [14]. Power and Sample Size Calculation (PS) software are used to calculate sample size of the analysis with significance level (α) 0.05 and the power of the study $(1-\beta)$ of 80% [2]-[4], [9]. Parameter involved: (i) Type 1 Error = 5.0%, (ii) Power = 80.0%, (iii) M = 1, (iv) P_0 = Based on literature review, and (v) P_1 = Based on Expert Opinion. The largest size sample was taken to start the analysis. From the Table 2, we choose n = 161 patients. One way ANOVA analysis is used to test the differences among the three distinct conditions, which is normal, borderline and hypertensive. It has been shown by the previous study by Amir and Shafiq [1], the systolic blood pressure differed significantly F ((2, 997) = 3.595, p = 0.028) across the three distinct phases normal, borderline and hypertensive.

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria
a) From Malay population
b) Blood pressure is divided to normal (<120), borderline (120-139) and hypertension (>140)
c) Any other condition which recommended by the physician
Exclusion Criteria
a) Breast feeding or pregnant women
b) The presence of chronic disease such as kidney disease, liver disease and serious injuries
c) Any other condition which not recommended by the physician

Table 2: Sample Size Calculation

No. Variables	*P_1	P_o	Sample Size
Systolic blood pressure [11]	0.29	0.16	161
Diastolic blood pressure [11]	0.23	0.11	153
HDL-Cholesterol [11]	0.51	0.35	149
Hypertension [17]	0.54	0.38	151

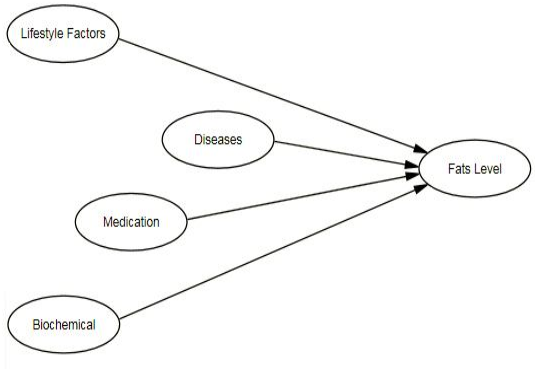

Figure 1: Conceptual Framework of SEM analysis

From the figure above the fats level present as unobeserved and endogenous variable, where the others such as lifestyle factors, diseases factors, medication factors and biochemical factors are represent as unobserved and exogenous variable. The error variance such as e1-e19 and z1 also represent as unobserved and exogenous variables. The description of variables which are observed and endegenous variables represent by height, body mass index (bmi), weight, Kilo-calories of physical activities per week (kcal), smoke, pack per years of smoking (pkyrs), waist circumference (waist), hip circumference (hip), systolic blood pressure, triglycerides (trig), total cholesterol (choltot), HDL cholesterol, glucose, proconvertin (f7), fibrinogen (fib), family history of heart attack (fhha), diabetes, incident new coronary heart disease during 6 years of follow up (incchd), insulin, taking anti hypertensive medication (htnmed) and taking lipid lowering medication (lipid). Structural equation modeling was used to evaluate the goodness of fit of the model. Several measures is being used such as Chi-square/degree of freedom (CMIN), Goodness of fit index (GFI), Normalized fit index (NFI), Incremental fix index (IFI), Tucker-Lewis index (TFI), Comparative fit index (CFI), Akaike

information criterion (AIC) and Root mean square error of approximation (RMSEA). CMIN is the ratio of Chi-square statistics and degree of freedom. Value of CMIN 3 or less than is assumed to be good fit with observed data [15]. The values of GFI, NFI, IFI, TLI and CFI was ranging from 0 to 1, the value GFI, NFI, IFI and TLI greater than 0.90 and value greater than 0.95 for CFI indicated as a good fit [6], [8], [16]. The range value for RMSEA indicated as the value 0 interperated as an exact fit, values less than 0.05 are close fit, where value between 0.05-0.08 are a fair fit, values between 0.08 and 0.10 are mediocre fit and the values more than 0.10 are presented as a poor fit [8]. The AIC value indicates that the smaller value the more better the model for the comparison of the model [16].

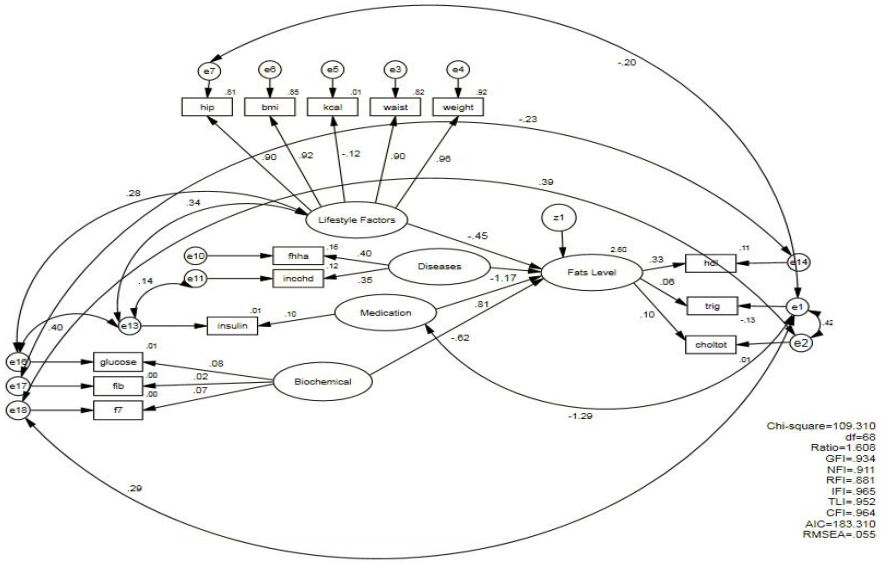

Figure 2: Modification modeling normal systolic blood pressure

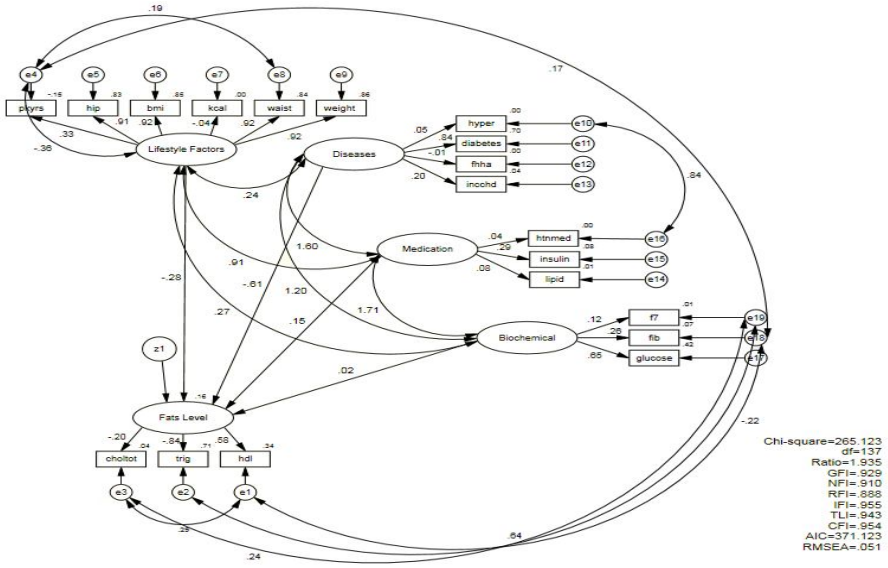

Figure 3: Modification modeling borderline systolic blood pressure

3. RESULT AND DISCUSION

Based on Figure 2 the modification index (MI) provided by statistical software (AMOS 18.0) indicates that error covariance should be added are insulin-lifestyle factors, triglycerides-total cholesterol, total cholesterol-proconvertin, HDL cholesterol-fibrinogen, triglycerides-proconvertin, triglycerides-medication, insulin-glucose, glucose-lifestyle factors, triglycerides-hip circumference and incident coronary heart disease-insulin. The model was modified according to MI, as model 2 (Fig. 2). The Chi square value was reduced from model 1 to model 2 as Figure 2, 631.162 to 109.310 and CMIN value was reduced from 5.094 to 1.608, GFI value index increased from 0.762 to 0.934, NFI increased from 0.598 to 0.911, IFI value increased from 0.647 to 0.965, TLI value increased from 0.592 to 0.952, CFI value increased from 0.643 to 0.964, AIC value decreased from 699.162 to 183.310 and RMSEA value decreased from 0.147 to 0.055. The attribute to the lipid showed three variable in term of standardized regression weights that contribute to these dimensions which shown by Table 2 is bmi (β = 0.924, p < 0.001), hip circumference (β = 0.903, p < 0.001) and weight (β = 0.962, p < 0.001).

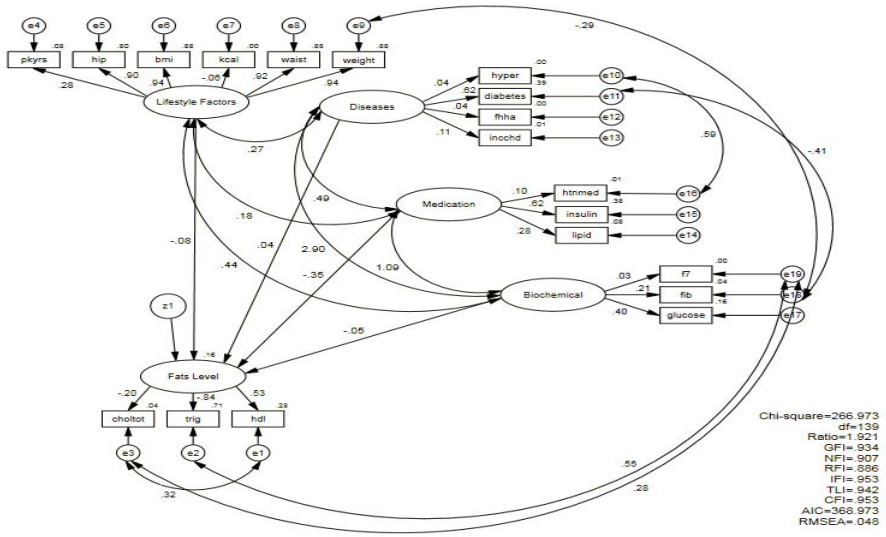

Figure 4: Modification modeling hypertensive systolic blood pressure

Based on Figure 3 the modification index (MI) provided by statistical software (AMOS 18.0) indicates that error covariance should be added are lifestyle factors-biochemical, diseases-medication, disease-biochemical, medication-biochemical, lifestyle factors-medication, lifestyle factors-diseases, pack per year of smoking-waist cirumference, pack per year of smoking-fibrinogen, hyper-hypertension medication, proconvertin-total cholesterol, proconvertin-triglycerides, fibrinogen-HDL cholesterol, lifestyle factors-pack years of smoking and total cholesterol-HDL cholesterol. The model was modified according to MI, as model 4 (Fig. 3). The Chi square value was reduced from model 3 to model 4 as Figure 3, 1152.033 to 265.123 and CMIN value was reduced from 7.629 to 1.935, GFI value index increased from 0.784 to 0.929, NFI increased from 0.610 to 0.910, IFI value increased from 0.643 to 0.955, TLI value increased from 0.593 to 0.943, CFI value increased from 0.641 to 0.954, AIC value decreased from 1230.033 to 371.123 and RMSEA value decreased from 0.135 to 0.051. The attribute to the lipid showed seven variable in term of standardized regression weights that contribute to these dimensions which shown by Table 2 is triglycerides (β = -0.841, p < 0.001), total cholesterol (β = -0.203, p < 0.001), hip circumference (β = 0.910, p < 0.001), bmi (β = 0.924, p < 0.001), insulin (β = 0.287, p < 0.010), proconvertin (β = 0.117, p < 0.028) and weight (β = 0.925, p < 0.001).

Based on Figure 4 the modification index (MI) provided by statistical software (AMOS 18.0) indicates that error covariance should be added are lifestyle factors-biochemical, diseases-medication, disease-biochemical, medication-biochemical, lifestyle factors-medication, lifestyle factors-diseases, weight-fibrinogen, hyper-hypertension medication, diabetes-fibrinogen, proconvertin-triglycerides, proconvertin-total cholesterol and HDL cholesterol-total cholesterol. The model was modified according to MI, as model 6 (Fig. 4). The Chi square value was reduced from model 5 to model 6 as Figure 4, 834.978 to 266.973 and CMIN value was reduced from 5.567 to 1.921, GFI value index increased from 0.832 to 0.934, NFI increased from 0.711 to 0.907, IFI value increased from 0.750 to 0.953, TLI value increased from 0.712 to 0.942, CFI value increased from 0.748 to 0.953, AIC value decreased from 914.978 to 368.973 and RMSEA value decreased from 0.107 to 0.048. The attribute to the lipid showed six variable in term of standardized regression weights that contribute to these dimensions which shown by Table 2 is triglycerides (β = -0.840, p < 0.007), total cholesterol (β = -0.205, p < 0.004), hip circumference (β = 0.897, p < 0.001), bmi (β = 0.937, p < 0.001), insulin (β = 0.618, p < 0.002) and weight (β = 0.940, p < 0.001).

Based on the Figure 2, 3 and 4 above and description of the result of the three modification model of systolic blood pressure, it is seen that all of the model shows a good fit. All the three of the modification model shows the CMIN value of 3 or less is acceptable and the model is assumed to be a good fit with the observed data (Fig. 2; 1.608, Fig. 3; 1.935 and Fig. 4; 1.921). Besides that, all of the three modification model shows the value of GFI, NFI, IFI and TLI greater than 0.90 wherelse the value of CFI shows greater than 0.95. The range value for RMSEA indicated as the value 0 interperated as an exact fit, values less than 0.05 are close fit, where value between 0.05-0.08 are a fair fit, values between 0.08 and 0.10 are mediocre fit and the values more than 0.10 are presented as a poor fit. Present study also shows that both value of RMSEA modification model of normal and borderline are a fair fit. Wherelse, the value of RMSEA for modification model of hypertensive is a close fit.

Table 3: Estimates of standard regresion weight by structural equation modeling for normal, borderline and hypertensive systolic blood pressure

Variables	Normal < 120 mm Hg, (β)	Borderline 120 – 139 mmHg, (β)	Hypertensive > 140 mm Hg, (β)
Lifestyle factors			
Body Mass Index	0.924**	0.924**	0.937**
Hip circumference	0.903**	0.910**	0.897**
Waist circumference	0.904	0.917	0.921
Weight	0.962**	0.925**	0.940**
Fats level	-0.446*	-0.278**	-0.084*
Fats level			
Triglycerides	0.060	-0.841**	-0.840**
Total cholesterol	0.096	-0.203**	-0.205**
HDL cholesterol	0.335	0.580	0.531
Biochemical			
Proconvertin	0.066	0.117*	0.028
Medication			
Serum Insulin	0.103	0.287**	0.618**
Fats level	0.812	0.153	-0.349*

*Note: Significant levels: **p < 0.01, *p < 0.05*

Finding from the present study found that there are three factors which are significantly across the different phases of blood pressure: normal, borderline and hypertensive (see Table 3). Body mass index [(β = 0.924, p < 0.001), (β = 0.924, p < 0.001) and (β = 0.937, p < 0.001)], weight [(β = 0.962, p < 0.001), (β = 0.925, p < 0.001) and (β = 0.940, p < 0.001)] and hip circumference [(β = 0.903, p < 0.001), (β = 0.910, p < 0.001) and (β = 0.897, p < 0.001)] were main significant factor across the different blood pressure phases. Previous study by Amir and Shafiq [1], pointed that total cholesterol [(β = 0.420, *p*-value < 0.01), (β = 0.248, *p*-value < 0.01) and (β = 0.577, *p*-value < 0.01)], high density lipoprotein cholesterol [(β = -2.373, *p*-value < 0.01), (β = -2.805, *p*-value < 0.01), and (β = -2.962, *p*-value < 0.01)] and proconvertin [(β = 0.572, *p*-value < 0.01), (β = 1.123, *p*-value < 0.01) and (β = 0.842, *p*-value < 0.01)] were main significant across the three distinct phases of blood pressure. Present study also reported that, the comparison between borderline and hypertensive systolic blood pressure phases based on triglycerides, total cholesterol and insulin are main factors which are significant. Where else, the triglycerides, total cholesterol and insulin for normal systolic blood pressure not significant.

Present study also shows that mainly all the lifestyle factors contribute to the fats level from the all different phases of blood pressure were negatively associated with the fats level [(β = -0.446, p < 0.001), (β = -0.278, p < 0.001) and (β = -0.084, p < 0.001)]. Beside that, medication hypertensive systolic blood pressure contribute to the fats levels (β = -0.349, p < 0.001) where else normal and borderline doest not contribute to the fats levels. Moreover, waist circumference and HDL cholesterol were not significant in all three phases of blood pressure. The comparison between borderline systolic blood pressure with normal and hypertensive blood pressure shows that proconvertin were statisfically significant in borderline where else the proconvertin does not significant in normal and hypertensive blood pressure.

4. CONCLUSION

This paper examines the regulatory roles of triglycerides level in three distict phases of blood pressure. The main purpose of this paper is to demonstrate using structural equation modeling in the three different phases of systolic blood pressure in order to identify the factors that associated with triglycerides in normal, borderline and hypertensive. Body mass index, weight and hip circumference were main significant across the three distinct phases of blood pressure. This factor might contribute to the increase in triglycerides level which increase the risk of cardiovascular and increase the risk of atherosclerosis. Hence, trglycerides might be a valuable marker to be monitored in normal, borderline and hypertensive systolic blood pressure.

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