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Lipid Profile and Other Measures of Cardiovascular Disease Risk among Anemic Individuals with and without Thalassemia in Metro Manila, Philippines

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Authors' contributions

This work was carried out in collaboration between both authors. Author MSA conceptualized the paper and wrote the manuscript. Author FDLR provided the statistical analysis, edited and approved the final version of the manuscript. Both authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

Objectives: The present study examined biochemical, clinical, and anthropometric factors that influence cardiovascular disease risk among anemic individuals with and without thalassemia. The objectives were to analyze and compare the following conditions in subjects with anemia due to alpha or beta thalassemia and those with anemia due to iron deficiency or other causes: 1) lipid profile, blood pressure, and fasting blood sugar; 2) anthropometric measurements (BMI, waist circumference, waist-hip ratio); and 3) identify significant cardiovascular risk factors that characterize anemic subjects with and without thalassemia.

Methodology: Randomly selected anemic individuals (n=101) were tested for presence of iron deficiency, hemoglobinopathy, or anemia due to other (unidentified) causes. Anemia was determined using cyanmethemoglobin method. Genetic hemoglobin disorders were examined using capillary electrophoresis. Iron deficiency was determined using immunoradiometric assay for serum

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ferritin. Differences in mean values of biochemical, clinical, and anthropometric measurements by cause of anemia were analyzed using ANOVA. The same test was used to determine the association of age with these cardiovascular risk factors. The likelihood of adverse biochemical, clinical, and anthropometric measurements among thalassemic and non-thalassemic subjects was examined using logistic regression.

Results: Non-thalassemic subjects were more likely to have reduced HDL-C (OR 0.09; 95% CI 0.02, 0.39; *P*<0.001) and increased VLDL-C (OR 5.6; 95% CI 1.32, 23.8; *P*<0.020) compared to thalassemic subjects. Majority of anemic individuals had high blood pressure and central obesity. Older age was associated with high blood pressure and increased total cholesterol and LDL-C.

Conclusion: Thalassemic subjects had better lipid profile than those with anemia due to iron deficiency and other causes, but were similar in terms of blood pressure and central adiposity. Further investigation using larger sample sizes is needed to confirm these results and determine their impact on CVD development.

Keywords: Thalassemia; iron deficiency; anemia; lipids; cardiovascular disease; body mass index; anthropometry.

1. INTRODUCTION

Anemia, defined as low hemoglobin concentration, is considered a global public health problem [1]. Health consequences of anemia include fatigue, low productivity, impaired cognitive and motor development in children, low birth weight and increased risk of maternal and perinatal morbidity [1]. Anemia may result from a number of causes, with the most significant contributor being iron deficiency. Other causes of anemia include other micronutrient deficiencies (e.g., folate, riboflavin, cobalamin, vitamin A), acute and chronic infections (e.g., malaria, cancer, tuberculosis, HIV), and inherited disorders that affect hemoglobin synthesis, red blood cell production or red blood cell survival (e.g., hemoglobinopathies) [1]. In Southeast Asia, the top 3 causes of anemia among both males and females were iron deficiency anemia, followed by hookworm disease, and thalassemias [2].

Thalassemia is an inherited hemoglobin disorder, characterized by impaired synthesis (i.e., decreased or absent production) of one or more globin chains (alpha or beta chain) resulting in insufficient production of hemoglobin [3]. There are two types of thalassemia depending on the globin chain that is not produced – alpha-thalassemia and beta-thalassemia. Other forms of thalassemia can occur when the gene for alpha or beta thalassemia combines with an abnormal or mutant gene [4]. The failure in hemoglobin synthesis is a main cause of microcytosis and anemia. Homozygous patients show more severe symptoms characterized by moderate to severe microcytic, hypochromic, hemolytic anemia that is alleviated by blood transfusion and iron chelation. Heterozygotes may be asymptomatic (i.e. silent carriers) or exhibit mild anemia (thalassemia trait) [3].

Hemoglobinopathies are the most common genetic disorders among people living in Southeast Asia [5], and most common among these are the thalassemias. In the Philippines, it is estimated that there are approximately 21,034,408 carriers of α-thalassemia and 1,649,758 carriers of β-thalassemia and Hb E [6]. Very little data exist on the most frequent mutation. A study on 65 α-thalassemia patients found a high prevalence of cis two gene deletion of *HBA1* and *HBA2* which may increase the risk of Hb H and Hb Bart's hydrops fetalis cases in the population [7]. A Thalassemia International Federation (TIF)-ASEAN report [8] stated that "the Philippines have yet to survey large parts of its territory, before any reliable information (on the true size of the problem) becomes available." At present, very little is known about thalassemia in the Philippines, including the health characteristics of thalassemic patients.

The Asian Network for Thalassemia Control (ANTC) was established in 2004 to work towards the prevention and control of thalassemia in Asia [6]. Its goals include examining the extent of the problem in individual countries and managing the different forms of thalassemia in each country [6]. Since iron is toxic in excess amounts, it is important to distinguish between iron deficiency anemia vs. thalassemia and anemia due to other causes, to prevent potentially harmful iron treatment in non-iron deficient anemic individuals.

In 2018, coronary heart disease (CHD) and stroke were the top 2 leading causes of death in the Philippines [9,10]. CHD deaths reached 120,800 or 19.83% of total deaths. The age-adjusted death rate of 197.08 per 100,000 population ranks Philippines no. 32 in the world [10]. Atherosclerosis-related risk factors that were identified in the country include hypertension, diabetes, dyslipidemia (defined as high total cholesterol, triglycerides, or LDL-C, low HDL-C), and obesity [11]. Sy et al.[11] noted that over time, the prevalence of these atherosclerosis risk factors, especially central obesity, increased among women.

The goal of the present study was to examine biochemical, clinical, and anthropometric factors that influence cardiovascular disease risk among anemic individuals with and without thalassemia, on a sample of non-transfusion dependent anemic individuals. The objectives were to compare the following:1) lipid profile, blood pressure, and fasting blood sugar levels of anemic individuals whose anemia is due to iron deficiency, thalassemia, and other (unidentified) causes; 2) anthropometric measurements (BMI, waist circumference, waist-hip ratio) that define obesity risk in these individuals; and 3)identify cardiovascular risk factors (abnormal lipid levels, impaired fasting blood sugar, elevated blood pressure, obesity) that characterizeanemic individuals with and withoutthalassemia.

2. METHODS

The present study is an extension of a previous paper [12] that examined the underlying causes of anemia in a group of non-transfusion dependent anemic individuals in Metro Manila participating in the 2013 National Nutrition Survey. This earlier study showed that the underlying causes of anemia were iron deficiency (37.6%), thalassemia (27.8%), and other (unidentified) causes of anemia (34.7%). The combination of thalassemia and other causes of anemia requiring non-iron interventions (as shown by normal to high serum ferritin concentrations) comprised a total of 62.5%, making these the dominant cause of anemia in the sample. Among the thalassemias, α-thalassemia was the most frequent (20.8%), followed by β-thalassemia (5.0%), IDA (iron deficiency anemia)/HbE interacting (1.0%), and HbE-β thalassemia (1%) [12].

Data were requested from the Food and Nutrition Research Institute (FNRI) for the biochemical, anthropometric, and clinical characteristics of these same individuals. Since secondary data was used, ethical approval was not needed. Participants and methods of the national survey were described previously [12]. The sample comprised individuals aged 6 to 59 years living in Metro Manila. Anemia was determined using cyanmethemoglobin method. Cut-offs for anemia followed WHO recommendations for hemoglobin levels to diagnose anemia at sea level [13]. Serum ferritin was determined using an immunoradiometric assay kit. Cut-offs followed WHO recommendations for adequacy of iron stores [14].

Out of a total 400 anemic individuals identified in Metro Manila, a random sample of 101 individuals were selected for testing for the presence of genetic hemoglobin disorders**.**Capillary electrophoresis of whole blood was performed by an ISO15189 accredited laboratory using Sebia Fully Automated Capillary Separation System. Resulting hematograms were sent to a consulting hematologist for interpretation.

Information on blood lipids, glucose, and anthropometry were collected on the same individuals as part of the survey. Blood lipids and glucose were collected after respondents fasted for 10 to 12 hours. Venous blood was centrifuged to separate plasma, packed, labeled and frozen at -20 degrees C until ready for analysis in the laboratory [15]. Plasma samples were analyzed by enzymatic colorimetric method using Roche COBAS Integra and Hitachi 912. Fasting blood glucose was classified based on Philippine practice guidelines, while dyslipidemia was classified based on the National Cholesterol Education Program (NCEP)-ATP III criteria [15].

BMI was calculated by dividing weight in kilograms over height in meters squared. The weight and height of subjects was measured using a Detecto platform beam balance weighing scale with 160-kg capacity. Weight was recorded to the nearest 0.1 kg. Standing height was measured using a Seca microtoise and recorded to the nearest 0.1 cm. A 5-kg metal weight was used to calibrate the platform beam at the beginning of each weighing activity. Waist and hip circumferences were measured using a calibrated tape measure following standard anthropometric techniques. All measurements were taken twice [16].

Data were analyzed using SPSS version 17. Individuals were grouped according to cause of

anemia (i.e., thalassemia, iron deficiency, and other unidentified causes). Differences in mean values of lipid profile, fasting blood glucose, blood pressure, and anthropometric measurements were analyzed using ANOVA. The same test was used to determine the association of age with lipid profiles and anthropometric values. The contribution of lipids, blood pressure, fasting blood sugar, and anthropometric measurements to potential CVD risk in thalassemic and non-thalassemic anemic subjects was examined using logistic regression.

3. RESULTS

Table 1 shows the characteristics of subjects. Out of 101 anemic subjects, 38 subjects (37.6%) were iron deficient, 35 (34.7%) had anemia due to other causes, 28 (27.8%) had hemoglobinopathy. Majority (67%) of anemic subjects were women, with most (70%) belonging to upper income quintiles. Subjects with anemia due to other causes were older compared to those with iron deficiency anemia and thalassemia. Majority of those with thalassemia and anemia due to other causes presented with mild anemia (64.3% and 68.6%, respectively). In contrast, 67.5% of those with iron deficiency had moderate to severeanemia. Majority of thalassemic subjects (67.9%) and those anemic due to other causes (68.6%) had normal iron stores, while all iron-deficient individuals had depleted iron stores.

Table 2 shows the lipid profile, fasting blood sugar, blood pressure and anthropometric measurements of subjects by cause of anemia. Mean LDL-C levels of thalassemic subjects were significantly lower than those with anemia due to other causes, and their HDL-C levels were significantly higher than those with iron-deficiency and anemia due to other causes. In terms of frequency, a greater proportion of thalassemic individuals had normal triglycerides (TG) (61%), normal LDL-C (55.6%) and VLDL-C (55.6%), and increased HDL-C (55.6%). A greater proportion of iron-deficient subjects had normal TG (88%), normal total cholesterol (83.3%), normal LDL-C (84%) and VLDL-C (88%), but most had low HDL-C (76%). Subjects with anemia due to other causes showed the least favorable lipid profile with a greater proportion having normal TG (59%) and VLDL-C (59%), but increased total cholesterol (56.4%) and LDL-C (53.8%), and low HDL-C (70.7%).

All three anemic groups showed a tendency towards elevated blood pressure (59.4% of iron deficient, 73.9% of thalassemic, 69% of anemic due to other causes) and differences were not significant. Majority of individuals in all groups had normal fasting plasma glucose levels.

Thalassemic subjects had significantly lower mean BMI compared to the other two groups. However, central obesity (high waist-hip ratio) was prevalent in all groups. High waist-hip ratio (WHR) was present in 64% of iron deficient subjects, 60.6% of those with anemia due to other causes, and 50% of thalassemic subjects (Table 2). Inthis entire group of anemic individuals, high WHR was found in 59.4% of subjects with normal BMI and in 22% of those with low BMI (Table 2).

Table 3 shows the association of age with lipid profile and other cardiovascular risk factors. Older age was significantly associated with increased total cholesterol particularly among thalassemic subjects, increased LDL-cholesterol, and increased blood pressure. No associations were found between age and anthropometric measures.

Logistic regression analysis (Table 4) showed that the likelihood of an individual being non-thalassemic (i.e., having anemia due to iron deficiency or other causes) is reduced when HDL-C level increases, and increased when VLDL-C increases. In other words, CVD risk factors that tend to characterize non-thalassemic subjects were reduced HDL-C (P<0.001) and increased VLDL-C (P<0.020). Conversely, thalassemic subjects were characterized by increased HDL-C and reduced VLDL-C. Fasting blood sugar, blood pressure, BMI and waist-hip ratio did not account for CVD risk in these two groups.

4. DISCUSSION

4.1 Lipid Profile

In the present study, HDL was significantly lower and VLDL significantly higher in non-thalassemic anemic subjects compared with thalassemic subjects. This suggests a potentially lower risk for cardiovascular disease (CVD) in mildly anemic thalassemic Filipinos compared to those whose anemia is due to iron deficiency or other causes. These findings are similar to those of Pedram et.al. [17] showing that beta-thalassemia trait patients had significantly lower mean total cholesterol and LDL cholesterol, and higher HDL cholesterol compared to a control group. Levels

of HDL in thalassemic patients were higher than normal, producing a low risk factor for atherosclerosis as determined by the ratio of total to HDL cholesterol [17]. Thalassemia is characterized by a reduced rate of synthesis of one or more of the globin chains, leading to imbalanced globin chain synthesis, defective hemoglobin production, red cell damage, and chronic hemolysis. The authors suggested that mild hemolysis may have a protective effect against development of atherosclerosis, probably due to phagocytosis of damaged red cells and increased ingestion of LDL by macrophages. They hypothesized that mild and chronic hemolysis can have a protective effect to reduce risk of atherosclerosis, ischemic heart disease, and myocardial infarction.

Other studies also showed better lipid profile of thalassemic subjects with mild anemia, particularly lower total cholesterol and LDL-C in β-thalassemia minor compared with healthy controls [18,19,20,21]. A systematic review and meta-analysis on the association between beta-thalassemia trait and arterial cardiovascular disease [22] showed a reduced risk of arterial cardiovascular disease (OR 0.45; 95% CI 0.45-0.60) in thalassemic male subjects.

Freisleben et al. [20] observed that Indonesian β-thalassemia trait carriers had low LDL-C. The authors hypothesized that the LDL-lowering effect of β^{o}-thalassemia may be related to the following: 1) mild erythroid hyperplasia, which would increase LDL-removal by bone marrow; 2) chronic activation of the monocyte system, causing increased secretion of some cytokines (IL-1, IL-6, TNF-α) which reduce hepatic secretion and increase receptor-mediated removal of apolipoprotein B-containing lipoproteins; 3) increased LDL catabolism especially by the reticuloendothelial system (RES). Other suggested mechanisms include plasma dilution because of anemia, accelerated erythropoiesis resulting in increased cholesterol uptake by macrophages and histiocytes of RES, defective liver functioning because of iron overload, and hormonal disturbances [18].

The present study showed that older age was associated with increased total cholesterol and LDL-cholesterol in Filipino thalassemic subjects. In contrast, Amendola et al.'s [23] study among Italian subjects with thalassemia intermedia showed no age association with these same variables, suggesting possible ethnic differences. Lampropoulos et al. [24] found lower values of inflammatory markers (homocyteine, C-reactive protein, fibrinogen) in patients with β-thalassemia minor compared with non-thalassemic controls regardless of BMI, and suggested this may be linked to reduced cardiometabolic risk. Similarly, Gozashti et al. [25] found a lower prevalence of metabolic syndrome in patients with minor thalassemia compared with a healthy control group (12.7% vs. 36.7%, respectively; $P<0.0001$), in spite of thalassemic patients having higher BMI. The authors proposed that minor thalassemia might be a protective factor in metabolic syndrome and investigations are needed to determine the mechanisms of this potentially protective effect. However, one adverse implication of reduced plasma cholesterol is its effect on the biosynthesis of steroids, which authors hypothesized may explain why thalassemic patients often exhibit deficits in cholesterol-derived hormonal and neuronal transmitters [20].

4.2 Anthropometric Measures

In the present study, thalassemic subjects had significantly lower BMI compared to the other two groups. Reduced overall adiposity is considered protective against CVD. However, central obesity (high waist-hip ratio) was common in all three anemic groups even at normal BMI (Table 2). Nazare et al. [26] examined the distribution of abdominal visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) in 5 different ethnic groups including Southeast Asians using computed tomography. Results showed that abdominal adiposity was associated with increased visceral adipose tissue (VAT) stores, and increased VAT was in turn associated with increased liver fat deposition. Southeast Asian women had the highest VAT/SAT ratio, after adjustments for BMI. Both abdominal obesity and liver fat deposition were positively associated with deteriorated cardiometabolic risk profile (type 2 diabetes, metabolic syndrome, hypertension) in all ethnic groups. Compared with Caucasians, Asians were more susceptible to excess VAT storage and were more likely to have high hsCRP (C reactive protein) concentrations with increasing amounts of VAT despite having lower levels of BMI. The authors proposed that excess VAT may be a major cause of insulin resistance in Asians, but this was not examined in the present study.

Table 1. Characteristics of study subjects

	With iron deficiency (n=38)		With thalassema (n=28)		With anemia due to other causes(n=35)		Total(n=101)	
Mean age (y)	35.86		38.32		54.77		44.38	
	No.	%	No.	%	No.	%	No.	%
Sex/physiological status								
Male	1	3.1	9	33.3	18	42.9	28	28
Female (non-pregnant)	31	96.9	18	66.7	19	45.2	68	67
Female (pregnant)	---	---	---	---	5	11.9	5	5
Income quintile								
Low/lowest	5	16.2	6	22.2	12	30.7	23	24
Middle	2	6.5	2	7.4	2	5.1	6	6.2
Rich/richest	24	77.5	19	70.3	25	64.1	68	70
Severity of anemia*								
Mild	15	39.5	18	64.3	24	68.6	57	56
Moderate	17	46.9	9	32.1	9	25.7	35	34
Severe	6	18.8	1	3.6	2	5.7	9	8.9
Serum ferritin**								
Normal	0	0	19	67.9	24	68.6	43	100
Depleted	38	100.0	1	3.6	0	0	39	100
Severe risk of iron overload	0	0	8	28.6	11	31.4	19	100

** Based on WHO cut-offs [13]** WHO cut-offs [14]*

Table 2. Measures of cardiovascular disease risk by cause of anemia

	Anemia due to Fe-deficiency (n=38)	Anemia due to thalassemia (n=28)	Anemia due to other causes(n=35)	Sig. level
Biochemical & clinical measures**				
Triglycerides				
Mean (SE) mg/dL	109.0 (9.3)	136.6 (13.8)	146.9 (11.2)	NS
% Normal (<150 mg/dL)	88	61.1	59	
% High	12	38.9	41	
Total cholesterol				
Mean (SE) mg/dL	180.9 (7.0)[b]	203.3 (8.5)	219.6 (9.4)[a]	.010*
% Normal (<200 mg/dL)	83.3	50	43.6	
% Moderate to high	16.7	50	56.4	
LDL-cholesterol				
Mean (SE) mg/dL	113.1 (6.5)[b]	121.2 (7.8)[b]	147.8 (8.8)[a]	.008*
% Normal (<130 mg/dL)	84	55.6	46.2	
% Moderate to high	16	44.4	53.8	
VLDL-cholesterol				
Mean (SE) mg/dL	21.8 (1.9)	27.3 (2.8)	29.4 (2.2)	NS
% Normal (≤30 mg/dL)	88	55.6	59	
% High	12	44.4	41	
HDL-cholesterol				
Mean (SE) mg/dL	45.9 (1.7)[b]	54.7 (3.4)[a]	42.3 (2.3)[b]	.005*
% Normal (≥50 mg/dL)	24	55.6	20.5	
% Moderate to low	76	44.4	70.7	
Fasting blood sugar				
Mean (SE) mg/dL	95.1 (9.6)	83.3 (3.8)	87.9 (3.4)	NS
% Normal (<100 mg/dL)	92	82.4	81.6	
% Impaired to high FBS	8	17.6	18.4	
Blood pressure				
% Normal (<120/80 mmHg)	40.6	26.1	31	NS
% Elevated to hypertensive	59.4	73.9	69	
Anthropometric measures**				
BMI (Asia-Pacific cut-offs)				
Mean (SE) kg/m^2	22.1 (0.8)[b]	19.2 (0.9)[a]	21.9 (0.7)[b]	.027*

	Anemia due to Fe-deficiency (n=38)	**Anemia due to thalassemia (n=28)**	**Anemia due to other causes(n=35)**	**Sig. level**
% Low (<18.5)	18.8	43.5	32.4	
% Normal (18.5-22.9)	43.8	47.8	35.3	
% Overweight (23 – 24.9)	12.5	4.3	14.7	
% Obese (≥ 25)	25	4.3	17.6	
Waist circumference†				
Mean (SE) cm	80.5 (2.8)	73.9 (2.1)	78.2 (2.0)	NS
% Normal	48	83.3	63.6	
% Obese	52	16.7	36.4	
Waist-hip ratio ‡				
Mean (SE) cm	0.88 (.02)	0.87 (.01)	0.89 (.01)	NS
% Normal	36	50	39.4	
% Obese	64	50	60.6	
Waist-hip ratio (WHR) by BMI level	Normal WHR	Obese WHR		
BMI level	No. (%)	No. (%)		
Underweight	14 (77.8)	4 (22.2)	Sig. 0.000	
Normal	13 (40.6)	19 (59.4)		
Overweight/ obese	3 (12.0)	22 (88.0)		

*[a,b] significantly different from each other, * statistically significant, NS not significant, †waist circumference cut-off: ≥90 cm (men); ≥80 cm (women), ‡waist hip ratio cut-off: ≥0.90 cm (men); ≥0.85 cm (women), ** Some respondents had missing data*

Table 3. Mean age of anemic subjects by lipid profile, fasting blood glucose, blood pressure, and anthropometric measurements

	Anemia due to Fe deficiency (n=38)	Anemia due to thalassemia (n=28)	Anemia due to other causes (n=35)	
Biochemical & clinical measures**	**Mean age y (SD)**	**Mean age y (SD)**	**Mean age y (SD)**	**Sig. Level**
Triglycerides				
Normal	39.4 (9.6)	49.9 (23.7)	62.8 (16.7)	0.952
High	56.9 (14.2)	55.5 (20.8)	48.5 (19.1)	
Total cholesterol				
Normal	40.7 (12.1)	39.8 (19.2)	57.2 (18.6)	0.012 *
Moderate to high	43.1 (8.8)	64.4 (18.3)	56.8 (19.5)	
LDL cholesterol				
Normal	41.2 (12.1)	42.7 (20.4)	54.7 (19.9)	0.005*
Moderate to high	43.1 (8.8)	63.8 (19.4)	58.9 (18.3)	
VLDL cholesterol				
Normal	39.4 (9.6)	47.2 (23.1)	62.8 (16.7)	0.703
High	56.9 (14.2)	58.2 (20.7)	48.5 (19.1)	
HDL cholesterol				
Normal	38.8 (10.4)	53.9 (25.0)	55.1 (23.4)	0.846
Moderate to low	42.3 (11.9)	49.9 (19.4)	57.4 (17.9)	
Fasting blood sugar				
Normal	41.4 (11.8)	54.7 (22.6)	55.9 (20.0	0.325
Impaired to high	42.3 (10.1)	50.9 (16.6)	63.2 (14.0)	
Blood pressure				
Normal	28.9 (12.4)	34.1 (24.8)	42.4 (12.5)	0.001*
Elevated to high	40.6 (14.6)	47.1 (25.4)	60.3 (20.8)	
Anthropometric measures**				
BMI				
Low to normal	29.6 (13.4)	44.7 (26.4)	57.8 (19.8)	0.444
Overweight & obese	46.4 (10.6)	33.9 (0.5)	53.5 (18.2)	
Waist circumference				
Normal	36.2 (10.3)	50.7 (22.7)	63.2 (15.8)	0.726
Obese	46.3 (10.6)	59.1 (21.6)	54.0 (18.2)	

** Significant, ** Some respondents had missing data*

Table 4. Logistic regression analysis of factors that influence CVD risk in thalassemic and non-thalassemic Filipinos

							95% CI for Exp(B)	
Risk factor P(non-thalassemic)	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Odds ratio Exp(B)**	**Lower**	**Upper**
HDL-C	-2.35	0.73	10.46	1	0.001	0.095	0.02	0.39
VLDL-C	1.723	0.738	5.45	1	0.02	5.604	1.32	23.82
Constant	0.94	0.51	3.4	1	0.065	2.56		

4.3 Fasting Blood Sugar

The present study showed that fasting blood sugar was in the normal range and did not differ among groups. Tong et al. [27] found that individuals with thalassemia minor and a family history of diabetes exhibited normal glucose tolerance but had insulin resistance. The authors suggested that glucose tolerance was maintained in thalassemic subjects by hypersecretion of insulin. However, insulin resistance was not examined in the present study. Tests are needed to confirm whether this holds true for thalassemic Filipinos with mild anemia.

4.4 Blood Pressure

In the present study, majority of subjects in all three anemic groups had elevated blood pressure. Higher blood pressure was seen among older individuals regardless of the cause of anemia. Lampropoulos et al. [24] showed that hypertensive patients with β-thalassemia minor had lower levels of inflammatory markers compared to hypertensives without thalassemia regardless of BMI. The authors concluded that the thalassemia carrier state provided a favorable cardiovascular profile beyond the well known differences in serum lipids or ambulatory blood pressure, and this was explained by a less inflammatory profile among hypertensive patients with thalassemia. It is not known whether the same conditions exist among thalassemic Filipinos. Further studies are needed to determine the inflammatory profile of these subjects.

5. CONCLUSION

In summary, Filipinos with non-transfusion dependent thalassemia tend to have better lipid profile characterized by higher HDL-C and lower VLDL-C than non-thalassemic individuals (i.e., those with iron deficiency or anemia due to other causes), suggesting potentially reduced CVD risk. The present study also showed that anemic Filipinos, regardless of the cause of anemia, tend to have normal fasting blood sugar, high blood pressure, and central obesity characterized by high waist-hip ratio despite normal BMI. Older age was associated with increased total cholesterol, LDL-C, and high blood pressure. Studies with larger sample sizes are needed to confirm these results and determine their impact on chronic disease risk among anemic populations whose anemia is due to different causes. Interventions to reduce central obesity and high blood pressure (such as increased physical activity to reduce visceral fat and healthy diet to reduce blood pressure, while avoiding iron supplementation for those whose anemia is not due to iron deficiency) can further reduce CVD risk in both thalassemic and non-thalassemic anemic Filipinos, leading to improved quality of life comparable to that of normal healthy individuals.

CONSENT

The Food and Nutrition Research Institute obtains consent from all respondents prior to their participation in the survey.

ETHICAL APPROVAL

The Philippines National Nutrition Survey is approved by the Institutional Ethics Board of the Food and Nutrition Research Institute.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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