Journal of Research in Medical and Dental Science
2025, Volume 13, Issue 3, Page No: 01-13

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Measurement of Intima Media Thickness of Carotid Artery for Male Students at the College of Applied Medical Sciences

[1]Mashael S. Al-Toub*, [2]Aliyah S. Altuwalah, [2]Rana H. Aldahlawi, [3]Hala M. Alotaibi, [2]Mohammed A. Alnafea

[1]Clinical Laboratory Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia

[2]Department of Radiological Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia

[3]Department of Physics and Astronomy, College of Science, King Saud University, Riyadh, Saudi Arabia

ABSTRACT

Over 30% of young adults in Saudi Arabia are at risk of a cardiovascular disease. Early detection of asymptomatic illness reduces the mortality rate. This cross-sectional study aims to assess carotid intima-media thickness (CIMT) by measuring the inner two layers of the carotid artery-the intima and media. One-hundred students (age 18-24) standing for ~10% of the total number of 917 female students. The relationship between cigarette smoking, obesity, and lack of exercise with early changes in the carotid artery wall examined. Then high blood pressure, blood CBC and lipids profile with early changes in the wall of the carotid artery assessed. This cross-sectional study showed that threshold values above (0.06cm) i.e., CIMTmax considered, around 7% of total number of candidates have abnormal values. It also showed that in total around 93% of candidates were normal. The existing relationship between CIMT and blood pressure showed that all abnormal cases have elevated blood pressure. When addressing diet, cigarette smoking and obesity data with abnormal CIMT 7% and 3% were obese. Hypertension and arterial Vasculopathy may have mutual causes and effects. It is unknown whether CIMT is reliably predictive of the presence of newly developed hypertension in the young students. This study evaluated the impacts of CIMT on new-onset hypertension in 7% of the candidates and the results confirmed that all 7% have elevated CIMT.

Keywords: CHD, CVD, ultrasound, CAMS, age, carotid artery intima media thickness, ethnicity, normal healthy subjects, gender, KSU.

HOW TO CITE THIS ARTICLE: Mashael S. Al-Toub, Aliyah S. Altuwalah, Rana H. Aldahlawi, Hala M. Alotaibi, Mohammed A. Alnafea. Measurement of Intima Media Thickness of Carotid Artery for Male Students at the College of Applied Medical Sciences. J Res Med Dent Sci, 2025; 13(3):01-13.

INTRODUCTION

Cardiovascular disease (CVS) is a global health problem that kills around 17.3 million people annually. It is the most frequent cause of early death in the UK as it managed around 125 000 mortalities. In comparison to the former Eastern Bloc countries, which have seen a noticeable increase and today have the highest CHD death rates, the USA has significantly reduced coronary heart disease (CHD) mortality over the past 30 years. This disease cannot primarily be a genetic issue because of the large population fluctuations in disease mortality over a fleeting period. Cardiovascular diseases (CVD) are in fact predominantly an environmental disease. One in four men and one in six women die from it, and in 2000, it oversaw around 125 000 mortalities. Each year, there are about 274 000 myocardial infractions and 1% of the costs associated with CHD are spent to primary prevention by the National Health Service. Early detection and treatment of asymptomatic cardiovascular illness can thereby significantly reduce the chance of death [1-3]. A recent study [1] showed that over 30% of adults in the Kingdom of Saudi Arabia (KSA) are at risk of a CVD event. According to the American Heart Association, cardiovascular disease is a global health problem that kills an estimated 17.3 million people annually (AHA). The incidence of CVD is expected to rise rather than improve during the next 20 years, despite advances in the knowledge of its genesis and pathophysiology and increase ability to prevent it. The World Health Organization (WHO) ranked ischemic heart disease and stroke sixth

and seventh, respectively, in terms of the global burden of illness in 1999. However, by the next 20 years of 2000 they have risen to first and fourth, respectively. From 13.1 million in 1990 to 24.8 million in 2020, total cardiovascular fatalities from CHD, stroke, and other kinds of cardiovascular disease projected nearly double. Because of the world's growing population, the causes of mortality will also rise, but this rise (35%) will be modest in comparison to the rise in cardiovascular fatalities [3]. According to the studies, Atherosclerotic disease is one of the most important causes of CVD. In addition, cardiovascular disease and cerebral vascular disorders are mostly caused by atherosclerosis. Cerebrovascular and cardiovascular disorders are also the main causes of death in people and can have a big effect on morbidity. As a result, a major area of current research is the early prevention of CVD and cerebrovascular illnesses. Higher incidences of stroke and CHD linked to preclinical atherosclerosis [4, 5]. Before clinical events like myocardial infarction or stroke take place, atherosclerosis is hypothesized to start developing in childhood and go undiagnosed for decades. Preclinical atherosclerotic lesions often seen in autopsied children and adolescents, and investigations have linked them to ante-mortem vascular risk factors [6]. The identification of subclinical atherosclerosis helps the physician to start preventive measures before a catastrophic CVD occurrence, and to investigate potential causes of increased arterial thickening that will resolve this problem. Carotid intima-media thickness (CIMT) gives doctors a useful tool for figuring out a patient's CVD risk [4]. Imaging and prevention of Atherosclerosis will deal with subclinical atherosclerosis. CIMT gives doctors a useful tool for finding a patient's CVD risk. For the diagnosis of subclinical atherosclerosis, studies have shown that carotid ultrasonography is more sensitive than the coronary artery calcification score (CACS) [4, 5]. Therefore, CIMT ultrasonography may stand for a reliable and accessible method to detect subclinical atherosclerosis. CIMT is a marker of subclinical organ damage and is an early indicator of CV and cerebrovascular events [4, 5]. Large-scale follow-up studies have shown that elevated IMT predicts future vascular events independently of conventional vascular risk factors. CIMT is a good indicator of cardiovascular risk because it provides a graded estimate of vascular damage [4, 5]. Based on the studies atherosclerosis significantly linked to factors like age, sex, race, smoking, and alcohol usage. For people under 45 years old who are not yet eligible for conventional CV risk screening, CIMT may be a useful marker for CV risk. According to a number of research, CIMT and known risk factors are associated. We will combine the existing reports to provide an overview of the known risk factors for CIMT, including age, sex, smoking, alcohol use, blood pressure (BP), blood fat, blood sugar, lifestyle choices [4, 5].

MATERIALS AND METHODS

After obtaining the Institutional Review Board (IRB) from King Saud University Medical City (KSUMC) in Riyadh. Then the cross-sectional study conducted in the in-ultrasound section of radiological sciences department at the College of Applied Medical Sciences (CAMS) at KSU. In conjunction with the laboratory department in KSUMC. The study starts from December 2022 till May 2023 for a period of six months. This cross-sectional study aimed to use ultrasound to evaluate cardiac function and CIMT in 100 male bachelor's students. Candidates studying at the CAMS. Then will correlate environmental factors such as diet, cigarette smoking, obesity, and lack of exercise etc. with early changes in carotid artery wall. In addition, Blood Pressure (BP) and blood lipid profile in young healthy bachelor's male without any known cardiovascular disease. Finally, to find out whether CIMT used to supplement traditional cardiovascular risks to increase the probability of predicting CVD. The registration unit at the CAMS at KSU has been contacted. It is a unit responsible for counting the number of college students Based on the statistics, it was found that the number of male students is approximately and 846 male students. There were 100 students included, which constitutes to more than 10% of the total number of students.

Radiology Method

Two vascular ultrasound imaging techniques, measurement of carotid intima-media thickness (CIMT) and intravascular ultrasound (IVUS) of the coronary arteries increasingly used to assess in the diagnosis as well as novel cardiovascular therapies. The carotid intima-media thickness (IMT) is a widely used surrogate marker for atherosclerosis worldwide. In other word, it is a measure used to diagnose the extent of

carotid atherosclerotic vascular disease. The test measures the thickness of the inner two layers of the carotid artery. The intima and media alerts physicians to any thickening when patients are still asymptomatic. The CIMT can be simply, noninvasively, and reproducibly measured through B-mode carotid ultrasound. Philips medical iu22 (Figure 1) using a linear high frequency probe (L12-5) is the one used in this study. CIMT is observed as a double line pattern visualized between the intimal-luminal and the medial-adventitial interfaces of the carotid wall in a longitudinal view by B-mode ultrasound. Participant consent form was obtained from each patient prior to inducting them in.

The participants asked to lie on the examination table and the necessary pictures for the Carotid artery were taken. Participants lie down and the billow under the shoulder to extend the neck, after that the measurement taken 2 cm before the bifurcation in distal CCA. The maximal IMT at CCAs was measured by manual technique using electronic calipers. Three images were taken in deferent angles medial, 90 degrees, and laterally. The average of the three measurements were considered.

Laboratory method

Blood samples were drawn from the participant using BD vacutainer blood collecting set, vacuum blood collection tube (Gel & clot activator) yellow cap for the measurement of Lipid profile including: Serum total cholesterol (TC), Triglyceride (TG), High-density lipoprotein cholesterol (HDL) and low-density lipoprotein cholesterol (LDL) cholesterol. Sigma Centrifuges 4500 rpm for 10 minutes were used at the college to separate the blood samples as shown in Figure 2.

Figure 1: The Philips medical iu22 at KSU.

Figure 2: Sigma centrifuges.

After collecting all samples, we sent them to the laboratory department at King Saud university medical city KSUMC. Serum Low-density lipoprotein cholesterol (LDL-C) is a risk factor of coronary heart diseases. They used Cobas 8000 Roche diagnostic. Low-density lipoprotein cholesterol (LDL-C) is a risk factor of coronary heart diseases. LDL-C calculated from the estimated values of TC, TG and HDL, using Frieldwald's equation.

Questionnaire method

It is well known that high cholesterols, diabetes, blood pressure, lack of exercise and family history of CVD contribute to the risk of heart attack. All participants in this study given questionnaires that include all the above along with information about their smoking and alcohol consumption. We used Cronbach's alpha method to measure the reliability of the questionnaire. Anthropometric measurements like height, weight, and body mass index (BMI) were measured. Blood pressure measured per the American Heart Association. Measured as a means of three readings taken at 2 minutes. The reliability of the questionnaire, meaning that the scale gives the same results if it has re-applied to the same sample. The reliability was applied to the respondents for a survey of 20 students, using Cronbach's alpha coefficient. The researcher used Cronbach's alpha method to measure the reliability of the questionnaire, which was 0.860; this value means the reliability is high. To ensure the subjective validity of the questionnaire, the square root of the reliability coefficient was found to be 0.927 (Table 1 and Table 2).

RESULTS AND DISCUSSION

The extracted data evaluated, coded, and entered IBM SPSS version 26 statistical software (SPSS, Inc. Chicago, IL). All the statistical analyses were performed using two-tailed tests. P values less than 0.05 considered statistically significant. All variables, including sociodemographic and clinical data subjected to descriptive frequency and percentage distribution analyses. Pearson's chi-square and exact probability tests are used for minor frequency distributions to examine relationships. Logistic regression model was done to assess the predictive factors of abnormal CMIT in females. The statistical significance level was proved at a threshold of $p<0.05$. The present study showed the candidate CIMT, blood CBC and lipids profile as used as in routine clinical laboratories. Most of these factors will be investigated in this study (Table 3-Table 5).

In this study, we use a CIMT value of 0.06cm as the threshold because 0.06cm and above can be considered abnormal for this age group. We found that 8 out of 100 examined had intima-media thickness, which is 0.06 cm and above. This has been considered abnormal for young adults of these ages as proven in Figure 3. In this study, we will figure out if there are any

Table 1: Reliability statistics.

COEFFICIENT OF CRONBACH'S ALPHA	NUMBER OF ITEMS
0.86	20

Table 2: Item-total statistics.

QUESTION	CRONBACH'S ALPHA IF ITEM DELETED
Medical consultation during the last year	0.664
Does anyone in your family suffer from a chronic disease?	0.628
Have you had any chronic diseases?	0.632
Smoking status	0.637
Daily alcohol intake	0.699
Coffee (cups / day)	0.691
Changes in weight	0.688
Exercise	0.711
Number of meals a day	0.647
Number of snakes a day	0.696
Weekly consumption of fruits and vegetables	0.768
Amount consumed when drinking	0.667
Diet	0.725

Note: All the calculated values of the Cronbach's Alpha coefficient for all items of questionnaire shown below were dependable

Table 3: Relationship of carotid intima-media thickness with participants clinical parameter [5-9].

			MALE		
			CMIT		p VALUE
			NORMAL	ABNORMAL	
BMI	Normal	N	37	5	0.221
		%	88.10%	11.90%	
	Abnormal	N	55	3	
		%	94.80%	5.20%	
Hypertension	Normal	N	64	0	<0.001
		%	100.00%	0.00%	
	Stage 1 hypertension	N	6	3	
		%	66.70%	33.30%	
	Elevated BP	N	22	5	
		%	81.50%	18.50%	
Triglycerides	Normal	N	84	7	0.491
		%	92.30%	7.70%	
	Abnormal	N	8	1	
		%	88.90%	11.10%	
High-Density Lipoprotein	No risk	N	6	0	0.753
		%	100.00%	0.00%	
	Moderate	N	23	2	
		%	92.00%	8.00%	
	High risk	N	63	6	
		%	91.30%	8.70%	
Cholesterol	Desirable	N	88	7	0.425
		%	92.60%	7.40%	
	Borderline high	N	3	1	
		%	75.00%	25.00%	
	High	N	1	0	
		%	100.00%	0.00%	
LDL Calculated	Optimal	N	62	7	0.299
		%	89.90%	10.10%	
	Near best	N	25	0	
		%	100.00%	0.00%	
	Borderline high	N	4	1	
		%	80.00%	20.00%	
	High	N	1	0	
		%	100.00%	0.00%	
Smoking	No	N	69	7	0.427
		%	90.80%	9.20%	
	Yes	N	23	1	
		%	95.80%	4.20%	
Alcohol	No	N	91	8	0.767
		%	91.90%	8.10%	
	Yes	N	1	0	
		%	100.00%	0.00%	
Family history	No	N	55	5	0.88
		%	91.70%	8.30%	
	Yes	N	37	3	
		%	92.50%	7.50%	
Diabetes	No	N	91	8	0.767
		%	91.90%	8.10%	
	Yes	N	1	0	
		%	100.00%	0.00%	
Medical consultations	(1-3)	N	15	2	0.735
		%	88.20%	11.80%	
	>3	N	3	0	
		%	100.00%	0.00%	
	No	N	74	6	
		%	92.50%	7.50%	

Table 4: Relationship of CIMT with participants' diet and exercise [10-13].

			CMIT		p VALUE
			NORMAL	ABNORMAL	
Drinking	0-1 units	N	32	3	0.877
		%	0.914	0.086	
	3-4 units	N	60	5	
		%	0.923	0.077	
Vegetables	(1-3)	N	1	0	0.85
		%	1	0	
	<5	N	68	7	
		%	0.907	0.093	
	(5-7)	N	21	1	
		%	0.955	0.045	
	>7	N	2	0	
		%	1	0	
Snack	(1-3)	N	61	5	0.603
		%	0.924	0.076	
	>3	N	12	2	
		%	0.857	0.143	
	No	N	19	1	
		%	0.95	0.05	
Meals	<2	N	20	2	0.831
		%	0.909	0.091	
	(2-5)	N	72	6	
		%	0.923	0.077	
	>5	N	0	0	
		%	0	0	
Exercise	1/week	N	14	1	0.447
		%	0.933	0.067	
	2-3/week	N	37	5	
		%	0.881	0.119	
	Rare	N	20	0	
		%	1	0	
	Never	N	21	2	
		%	0.913	0.087	
Change in weight	decrease	N	20	4	0.198
		%	0.833	0.167	
	increase	N	33	2	
		%	0.943	0.057	
	same	N	39	2	
		%	0.951	0.049	
Coffee	<2	N	39	1	0.174
		%	0.975	0.025	
	(2-4)	N	23	4	
		%	0.852	0.148	
	>4	N	3	1	
		%	0.75	0.25	
	No	N	27	2	
		%	0.931	0.069	

associations between this way of thinking and any cardiovascular risk factors for those with aberrant measurements of CIMT [14-17].

Body mass index (BMI)

BMI is an estimate of body fat and a good gauge of a person risk for diseases that can occur with more body fat. The higher the BMI, the higher the risk for certain diseases such as heart disease, high blood pressure and breathing problems. The clinical recommendation statements of BMI for younger adults 18 and above is 18.5 to 24.9 as this falls within the healthy weight range [18-21]. If the BMI is 25.0 to 29.9, it falls within the overweight range. If the BMI is 30.0 or higher, it falls within the obese range. When we looked

Table 5: Logistic regression for risk factors of abnormal CMIT.

	ODD'S RATIO	95% CI FOR OR	p VALUE
BMI	0.45	0.35-3.15	0.953
Hypertension	0.33	0.01-3.55	0.983
Triglycerides level	4.31	3.35- 14.11	0.93
High-density lipoprotein	4.13	3.45- 5.34	0.941
Cholesterol=high	0.8	0.53-4.53	0.99
LDL Calculated	0.45	0.33-1.43	0.854
Smoking	0	0.31-1.41	0.454
Alcohol	3.43	1.13-5.43	0.958
Family history	3.89	3.13-5.44	0.345
Diabetes	3.51	1.11-5.31	0.94
Water units drinking	0.88	3.31-13.45	0.983
Vegetables	4.34	3.35-11.31	0.989
Snack	0.11	3.11-13.11	0.998
Meals >5	15.31	11.14-41.41	0.94
Coffee	34.1	3.41-131.54	0.99
Exercise	15.31	3.45-45.13	0.99
Increase in weight	3.91	3.35-5.54	0.945

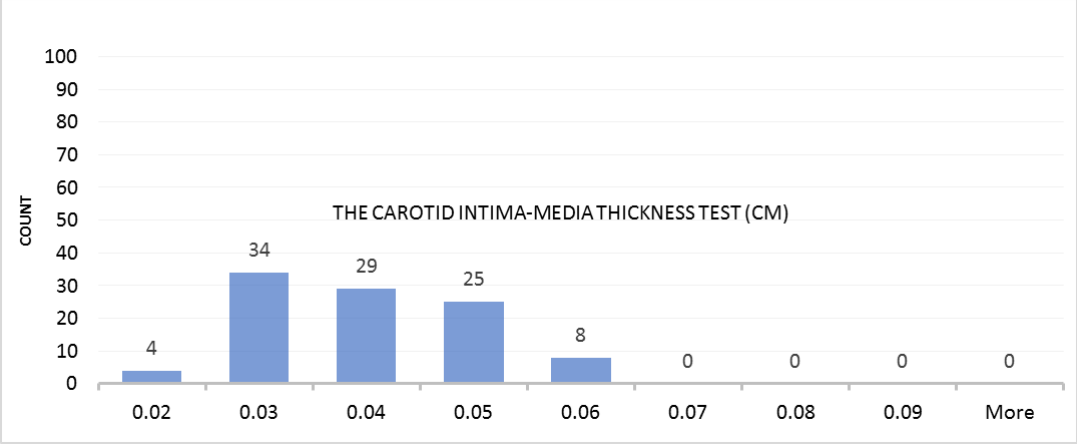

Figure 3: The measurements of CIMT for all participants.

at the BMI for the participants, we discovered that 58 cases were obese participants, while the other participants had BMIs that were within the normal range, which was approximately 42. We tried to compare the measurement of CIMT and BMI, and as a result, discovered that 3 of the 58 participants who were obese, or overweight had an increase in the measurement of CIMT. The others, with a BMI within the usual range of 5 out of 42, have an increase in CIMT as shown in Figure 4. It proves that BMI is a simple, inexpensive, and noninvasive surrogate measure of body fat [22-24].

Blood Pressure (BP)

Blood pressure measured for all participants at three different intervals and the average BP noticed and used in this study. A CIMT test was used to find the extent of plaque buildup in the walls of the arteries, i.e., cumulative exposure from childhood to adulthood. When we compared the abnormal BP readings with the abnormal CIMT values, we discovered that 2 of the 8 cases with abnormal CIMT measurements had stage 1 hypertension and 5 of them showed elevated BP as can be seen in Figure 5 and Figure 6 respectively. The above results confirmed that CIMT have garnered substantial scientific and clinical support as an early, preclinical, vascular endpoint [22-27].

Smoking and alcohol intake

None of the people in our tested sample had ever consumed alcohol but there were 24 smokers overall in the sample of 100 males, so when we compared the abnormal CIMT measurement to smoking status, we discovered just one instance of a smoker who had increased CIMT measurements. Therefore, we were unable to discover a connection between them as shown in Figure 7 and Figure 8, respectively.

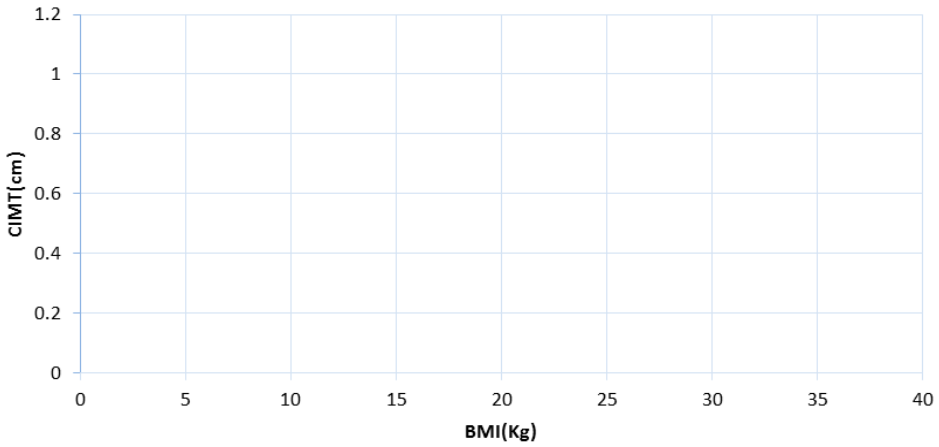

Figure 4: The relationship between BMI and CIMT. Demonstrating the differences between individual adults of the same, age, sex, and that are usually due to body fat

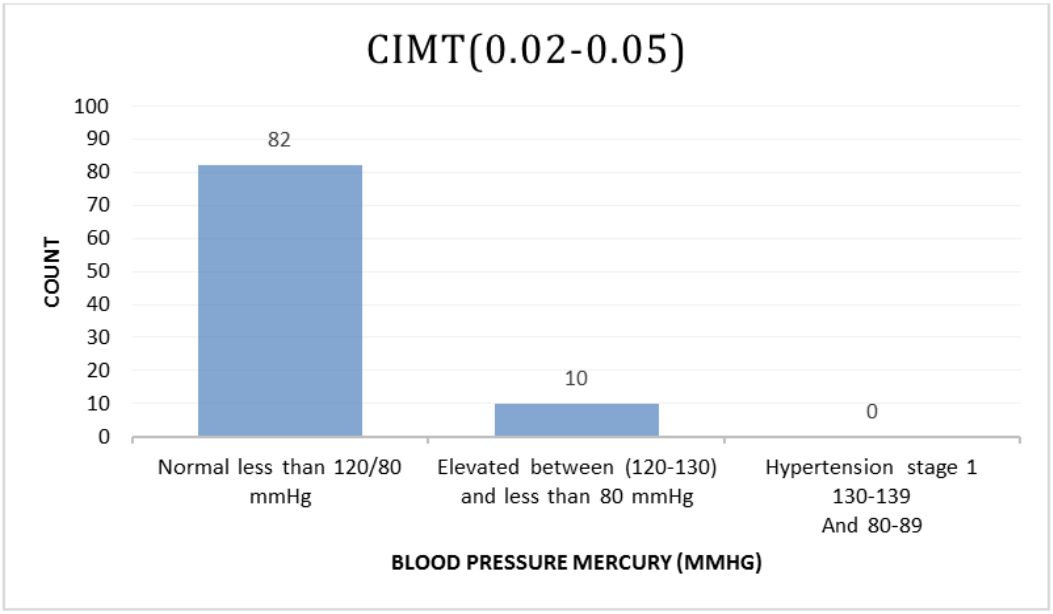

Figure 5: The reading for BP with participant with normal measurements of CIMT.

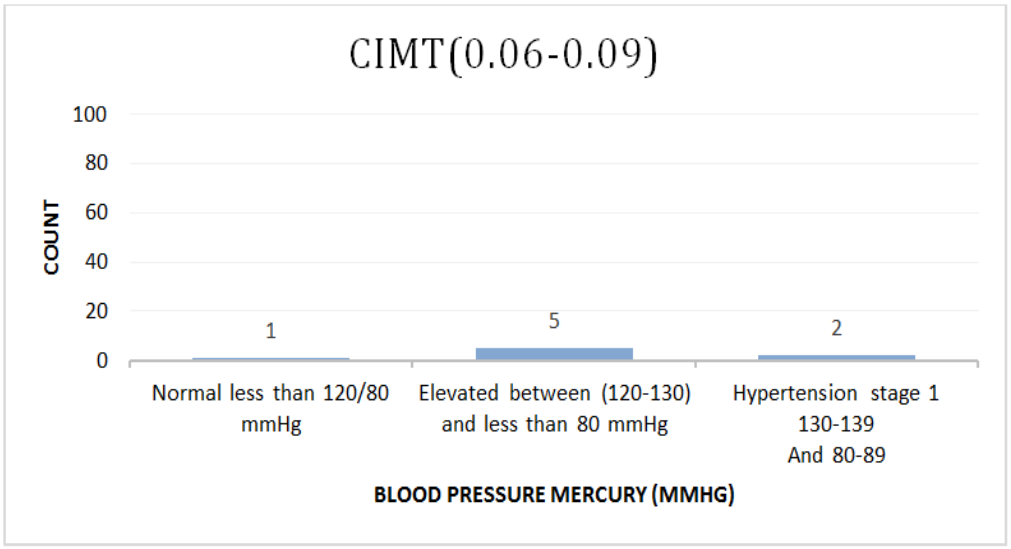

Figure 6: The reading for BP with participant with abnormal measurements of CIMT.

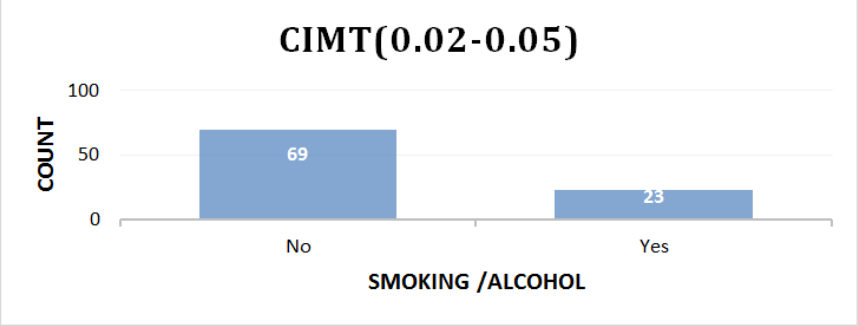

Figure 7: The normal measurement of CIMT with smoking status.

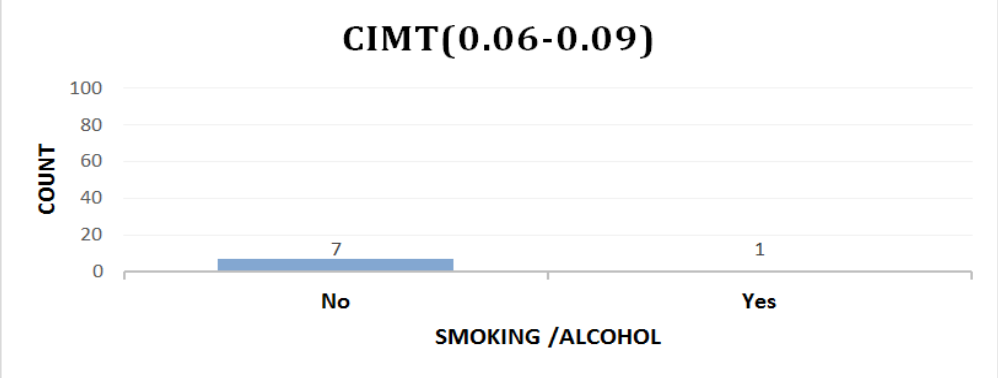

Figure 8: The abnormal measurement of CIMT with smoking status.

CIMT with high-density lipoprotein cholesterol (HDL-C)

Lipoproteins are divided into five subgroups, by density/size. Increasing concentrations of HDL-C particles are associated with decreasing accumulation of atherosclerosis within the walls of arteries. An inverse relationship), which also correlates with the function and incidence of cardiovascular events. For this reason, we investigated the associations between HDL-C and early vascular changes in male participants. There are three categories for HDL-C, the first one with no risk for cardiovascular illnesses (No risk 1.68 mmol/L), and only six cases from the sample were represented in this category. The others have a moderate risk of developing CVD (Moderate risk 1.15 -1.68 mmol/L) and there were about 25 participants in our sample; two of these 25 had an increase in CIMT. The last category with high risk for cardiovascular disease (High risk > 1.15 mml/L), which represents about 69 of the total number of cases in our sample, we found that 6 of these cases had an increase in CIMT as demonstrated in Figure 9 and Figure 10 respectively.

CIMT with cholesterol

The main goal of this part of the study is to decide the variations in CIMT) in familial hypercholesterolemia (FH) participants and its use as predictive marker for premature CVD. We examine the level of cholesterol in our sample since we are aware that when cholesterol levels rise, the risk of atherosclerosis rises. According to the King Khalid University Hospital's laboratory department, they have three categories for cholesterol. Desired cholesterol level (> 5.17 mmol/L), and we discovered that 7 of the 93 people in this group in our sample had a rise in CIMT. We have six people with borderline high cholesterol (5.17–6.18 mmol/L), five of whom have normal CIMT measurements, and only one shows an increase in CIMT. High cholesterol (≥ 6.21 mmol/L) in this group only have solitary case, and it is with the normal measurement of CIMT as proven in Figure 11 and Figure 12, respectively.

CIMT with LDL:

There are five categories in the male section for LDL. The first one is the greatest 2.59 mmol/L. We discovered that five of the 77 people in this group in our sample had increased CIMT. There were roughly 28 of them in the near optimal range (2.59-3.34 mmol/L); three of them had increased CIMT values than the others, which were measured normally. There are just five

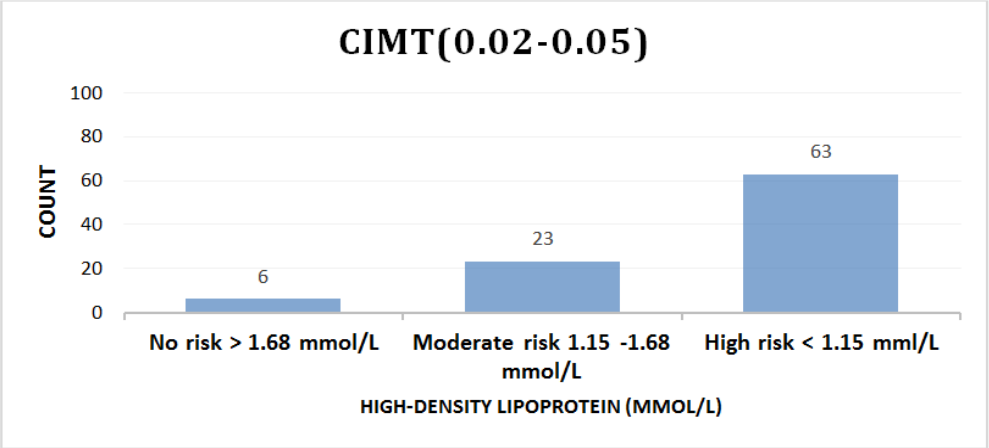

Figure 9: The normal measurement of CIMT with HDL.

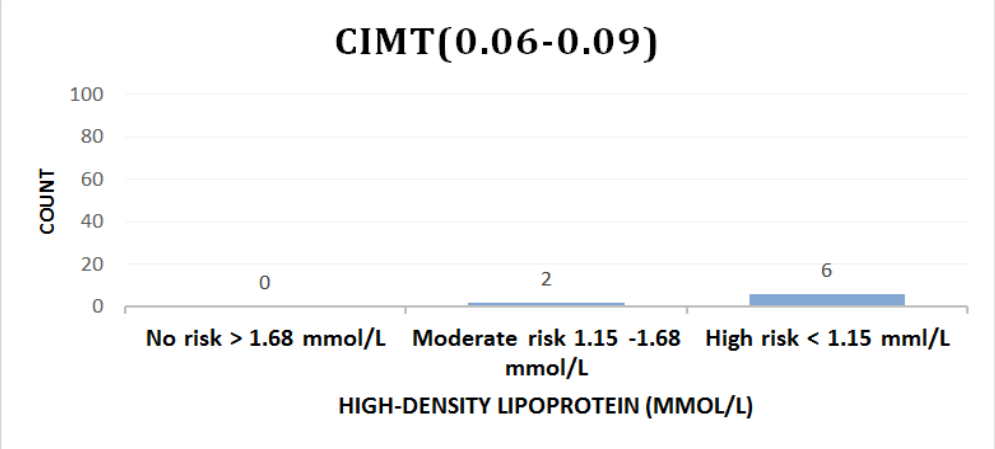

Figure 10: The abnormal measurement of CIMT with HDL.

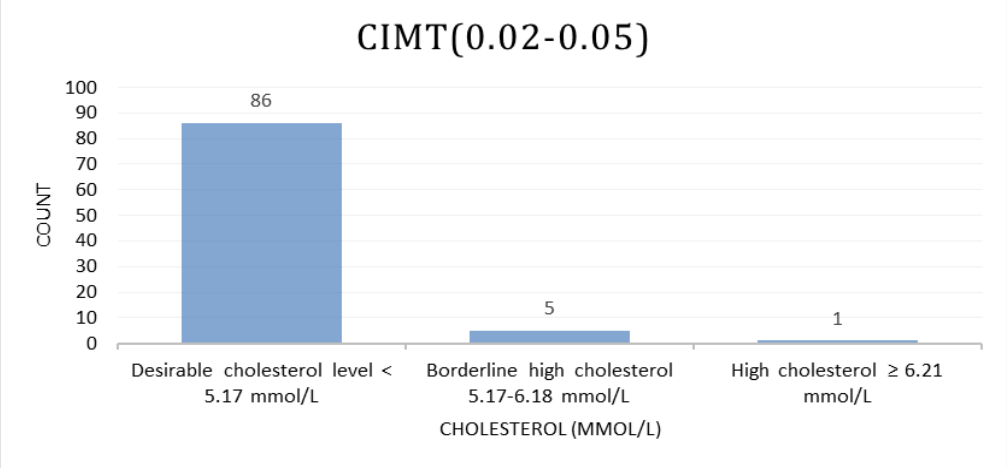

Figure 11: The normal measurement of CIMT with cholesterol in male.

occurrences with borderline high (3.37–4.12 mmol/L) CIMT in this group, and they all correspond to the usual CIMT measurement. We do not have any samples with elevated levels of LDL (4.14 to 4.89 mmol/L) or exceedingly high (4.92 mmol/L) as shown in Figure 13 and Figure 14.

CIMT with Triglycerides

Triglycerides levels either normal or abnormal results and compare it with the CIMT

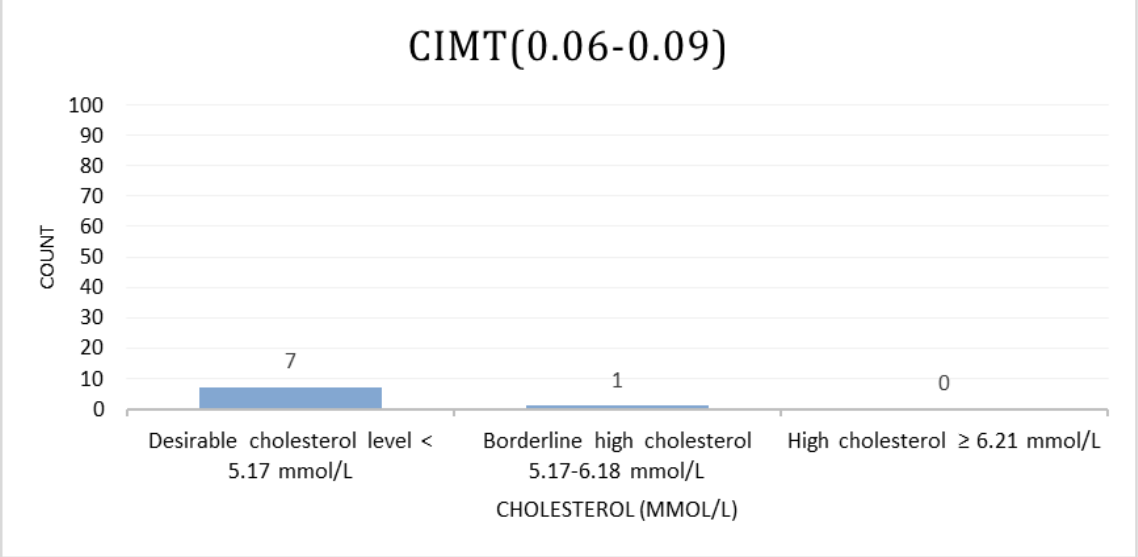

Figure 12: The abnormal measurement of CIMT with cholesterol.

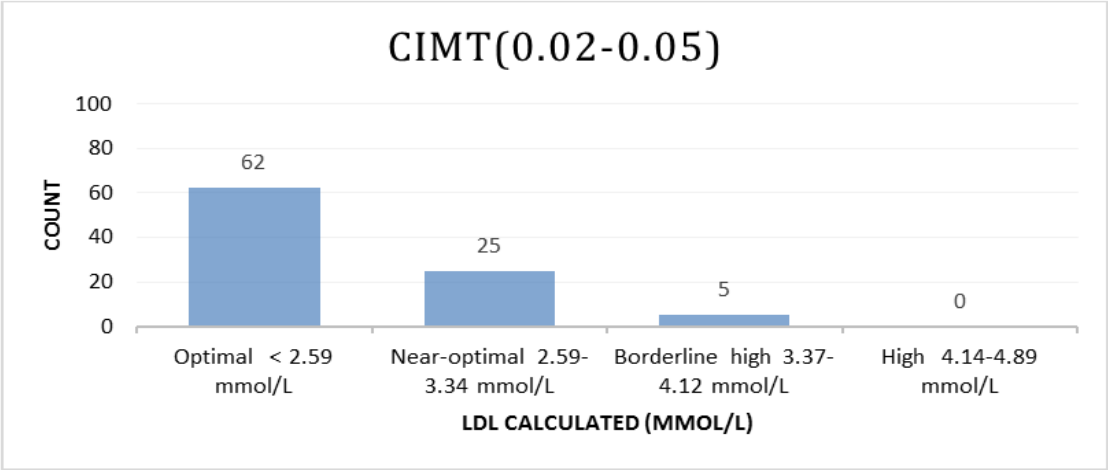

Figure 13: The normal measurement of CIMT with LDL.

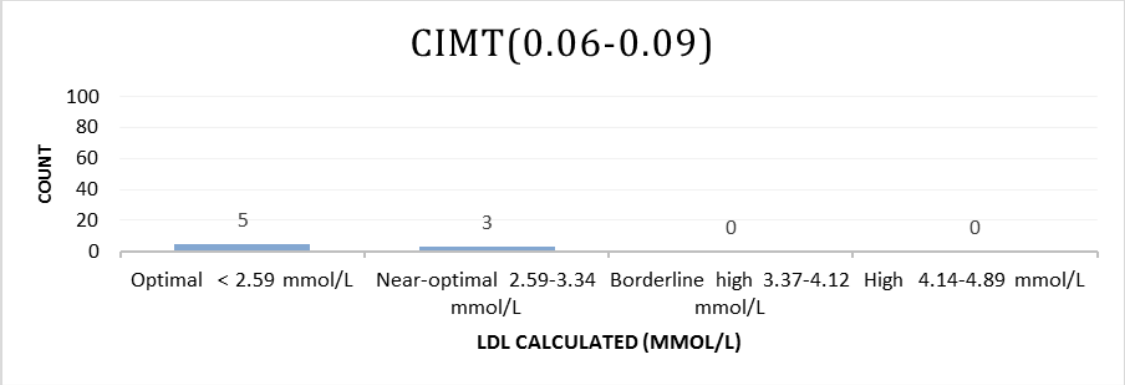

Figure 14: The abnormal measurement of CIMT with LDL.

measurements. First, this group's 91 male participant fall within the normal range of Tyga, which is 1.7 mmol/L. Seven of these participants show increasing CIMT readings. The rest of male participants with abnormal range of Triglycerides >1.7mmol/L, nine of the individuals in this part 1 have abnormal CIMT values as shown in Figure 15 and Figure 16.

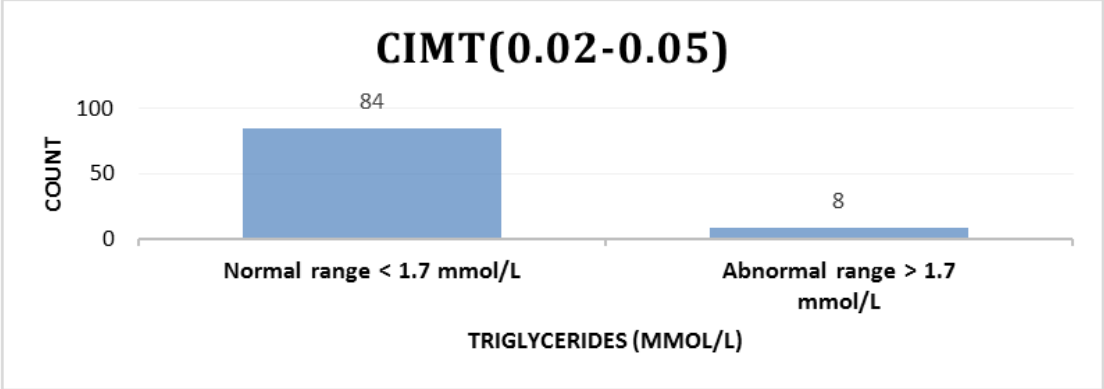

Figure 15: The normal measurement of CIMT with triglycerides.

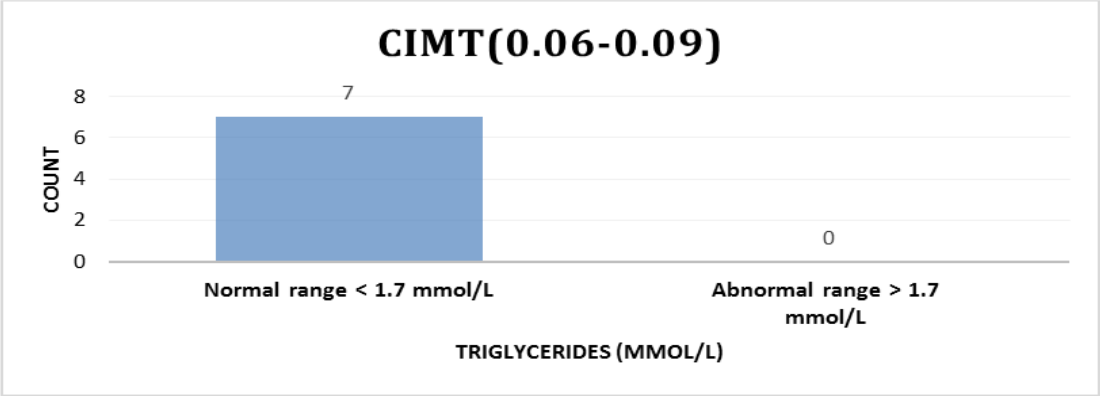

Figure 16: The abnormal measurement of CIMT with triglycerides.

CONCLUSIONS AND FUTURE PROSPECTS

This study tried to examine the risk factors for heart disease and how they relate to the carotid artery thickness in this age group. According to the sample examined, we discovered a correlation between blood pressure and carotid artery thickness. All abnormal samples for carotid artery thickness, which make 8% of the sample evaluated have abnormal blood pressure readings as well. No correlation between smoking status and carotid artery thickness in the sample investigated because most of the cases started smoking in less than three years and there weren't many smokers in this sample. BMI is a simple, inexpensive, and noninvasive surrogate measure of body fat and thus used to investigate the relationship between the CIMT and obesity, and found that the abnormal samples for the CIMT, which make up 8% of the males. It has been found that about half of the abnormal samples constitute about 3% of the total number of the sample. They have an increase in weight and an increase in the thickness of the carotid artery. The study discovered that all abnormal samples from CIMT also had abnormal levels of HDL.

AUTHOR CONTRIBUTIONS

Conceptualization, M.S.T., A.S. A., and R.H.A.; methodology, M.A.A and A.S.A.; validation, A.S.A., M.S. A., and M.A.A.; formal analysis, H.M.A., R.H.D., and M.A.A; writing—original draft preparation, A.S.A. and M.A.A.; writing—review and editing, M.S. A., M.A.A., and R.H.A. All authors have read and agreed to the published version of the manuscript.

Funding

This research study partially funded by the Saudi National institute of health. In addition, the authors also contributed to funding as well as using 65% of the resources available in the college and departments.

Institutional review board statement:

11.01.2023, Ref. No. 23/0001/IRB-A, this study abides by the rules and regulations of the Government of Saudi Arabia, the KSUMC IRB policies and procedures and the ICH-GCP Guidelines.

Data availability statement

The data presented in this study is available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Conflicts of Interest

The authors declare no conflict of interest.

REFERENCES

1. Alhabib KF, Al-Rasadi K, Almigbal TH, et al. Familial hypercholesterolemia in the Arabian Gulf region: Clinical results of the gulf fh registry. PLoS One. 2021;16:e0251560.
2. Sabab SA, Munshi MA, Pritom AI. Cardiovascular disease prognosis using effective classification and feature selection technique. In2016 international conference on medical engineering, health informatics and technology. MediTec. 2016:1-6.
3. Poulter N. Global risk of cardiovascular disease. Heart. 2003; 89:ii2-5.
4. Cobble M, Bale B. Carotid intima-media thickness: Knowledge and application to everyday practice. Postgrad Med. 2010; 122:10-8.
5. Qu B, Qu T. Causes of changes in carotid intima-media thickness: A literature review. Cardiovasc Ultrasound. 2015;13:1-0.
6. Raitakari OT, Juonala M, Kähönen M, et al. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study. JAMA. 2003; 290:2277-83.
7. Lorenz MW, von Kegler S, Steinmetz H, et al. Carotid intima-media thickening indicates a higher vascular risk across a wide age range: prospective data from the Carotid Atherosclerosis Progression Study (CAPS). Stroke. 2006; 37:87-92.
8. Jourdan C, Wühl E, Litwin M, et al. Normative values for intima–media thickness and distensibility of large arteries in healthy adolescents. J Hypertens. 2005;23:1707-15.
9. Pahkala K, Hietalampi H, Laitinen TT, et al. Ideal cardiovascular health in adolescence: effect of lifestyle intervention and association with vascular intima-media thickness and elasticity (the Special Turku Coronary Risk Factor Intervention Project for Children [STRIP] study). Circulation. 2013; 127:2088-96.
10. Lloyd-Jones DM. Cardiovascular risk prediction: basic concepts, current status, and future directions. Circulation. 2010; 121(15):1768-77.
11. Wenger NK. Prevention of cardiovascular disease: highlights for the clinician of the 2013 American College of Cardiology/ American Heart Association guidelines. Clin Cardiol. 2014; 37:239-51.
12. Kaptoge S, Pennells L, De Bacquer D, et al. World Health Organization cardiovascular disease risk charts: revised models to estimate risk in 21 global regions. Lancet Global Health. 2019; 7:e1332-45.
13. Baldassarre D, Amato M, Pustina L, et al. Measurement of carotid artery intima-media thickness in dyslipidemic patients increases the power of traditional risk factors to predict cardiovascular events. Atherosclerosis. 2007; 191(2):403-8.
14. December 2002-Volume 20-Issue 12. J Hypertens 2002: 20(12):2317-414.
15. Sciattella P, Mennini FS. PCV35-secondary prevention for cardiovascular disease: Definition of population and evaluation of outcomes using real world data. Value in Health. 2018; 21:S98.
16. Kaptoge S, Pennells L, De Bacquer D, et al. World Health Organization cardiovascular disease risk charts: revised models to estimate risk in 21 global regions. Lancet Global Health. 2019; 7:e1332-45.
17. Nambi V, Pedroza C, Kao LS. Carotid intima-media thickness and cardiovascular events. Lancet. 2012; 379:2028-30.
18. The Healthy People 2020.
19. JS T. Package of Essential Noncommunicable Disease Services at Peri-Urban Community Setting in Chandigarh, India-An Implementation Research Study. Indian J Public Health Res Dev. 2021; 12:1-8.
20. Lu Y, Ezzati M, Rimm EB, et al. Sick populations and sick subpopulations: reducing disparities in cardiovascular disease between blacks and whites in the United States. Circulation. 2016; 134:472-85.
21. Mancia G, De Backer G, Dominiczak A, et al. 2007 ESH-ESC practice guidelines for the management of arterial hypertension: ESH-ESC task force on the management of arterial hypertension. J Hypertens 2007; 25:1751-62.
22. Renford B, Bloor CM. Journal of Cardiovascular Risk. JAMA. 1995; 274:1724.
23. Ikeda N, Kogame N, Iijima R, et al. Carotid artery intima-media thickness and plaque score can predict the SYNTAX score. Eur Heart J. 2012; 33:113-9.
24. Costanzo P, Perrone-Filardi P, Vassallo E, et al. Does carotid intima-media thickness regression predict reduction of cardiovascular events? A meta-analysis of 41 randomized trials. J Am Coll Cardiol. 2010; 56:2006-20.
25. Gajanova L, Nadanyiova M, Moravcikova D. The use of demographic and psychographic segmentation to creating marketing strategy of brand loyalty. Sci Annal Economics Business 2019; 66:65-84.
26. Naqvi TZ, Lee MS. Carotid intima-media thickness and plaque in cardiovascular risk assessment. JACC Cardiovasc Imaging. 2014;7:1025-38.
27. Price JF, Tzoulaki I, Lee AJ, et al. Ankle brachial index and intima media thickness predict cardiovascular events similarly and increased prediction when combined. J Clin Epidemiol. 2007; 60:1067-75.