

Role of Lifestyle Modification in the Prevention of Atherosclerosis

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ABSTRACT

Background: Literature has shown that globally the incidence of atherosclerosis is increasing every year, which is an alarming situation. Atherosclerosis affects all arteries in the body, especially the arteries in the heart, brain, and kidneys. Diseases secondary to atherosclerosis are the leading cause of death. Management for atherosclerosis includes lifestyle changes, medicine, and surgery. Fortunately, most people can prevent or delay the initiation and progression of atherosclerosis by lifestyle modifications, such as maintaining a healthy diet, engaging in regular physical activity, getting adequate sleep, and managing smoking and stress.

Aim: To assess the level of awareness of Saudi community regarding the risk factors for atherosclerosis.

Methods: Study design was analytical cross-sectional. Inclusion criteria was all residents of Saudi Arabia above the age of 18 years while exclusion criteria were those who belonged to medical background as their preexisting knowledge could confound the results. Sample size was 542. Data was collected by a structured questionnaire. The questionnaire was fed on Google Form and the link was sent to participants on Whatsapp. Non-probability convenience sampling technique was adopted.

Results: Results revealed that despite knowing that obesity (76%) and physical inactivity (66%) are risk factors for atherosclerosis, the overall study participants were overweight. Fifty percent did not do any sort of exercise. Dietary history revealed that the majority of the respondents (54%) consumed red meat and dairy products. Forty-two percent consumed fried items. Consumption of olive oil, fish oil, fruits, and vegetables was very low (<20%). The majority did not screen themselves for atherosclerosis (99%), cholesterol levels (95%), and blood pressure (92%).

Conclusions: Modifiable risk factors in prevention of atherosclerosis were poor diet quality, smoking, obesity and sedentarism. Majority of study populations did not know their cholesterol profile and blood pressure level due to lack of awareness.

Keywords: Atherosclerosis, Cardiovascular Disease, Lifestyle, Risk Factors, Prevention

INTRODUCTION

Atherosclerosis defined as a complex inflammatory disorder of the arterial wall characterized by the accumulation of lipid, macrophages and smooth muscle cells in artery walls; this buildup is called "plaque"¹. All the arteries of the body get narrowed due to plaque which reduces the supply of oxygen-rich blood to vital organs of the body². Atherosclerosis remains clinically silent until become large enough to impair tissue perfusion^{2,3}.

Atherosclerosis affects all arteries in the body². When heart is affected, it causes angina, myocardial infarction and sudden death. Stroke and transient ischemic attack are secondary to atherosclerosis in brain. Similarly, every organ has ischemic effects secondary to atherosclerosis³. Diseases secondary to atherosclerosis are the leading cause of death⁴.

Management for atherosclerosis includes lifestyle changes, medicine, and surgery^{3,5}. The good news is that atherosclerosis could be prevented or delayed by simple cost-effective life style modification like; eating healthy diet, exercise on a routine basis, quit smoking, and maintaining the ideal weight^{4,5}.

There are broadly 2 types of cholesterol; low density lipoprotein (LDL) and high-density lipoprotein (HDL). HDL helps cleanse LDL cholesterol in the liver, where the liver eliminates it. LDL attaches itself to arterial walls and causes plaques, which can narrow the arteries. This plaque causes heart diseases such as atherosclerosis⁵.

Regarding foods, red meat and high fat dairy products have high content of saturated fat, which causes the liver to produce more LDL^{4,5}. Physical activity increases HDL levels in the body which minimizes the risk of heart diseases. Regular physical activity (a short walk, bike ride, or a 30-minute swim 2-3 times/week) has a protective effect that is associated with elevated serum HDL-cholesterol, low blood pressure, and the development of collateral vessels, and helps to reach normal body weight⁶.

Overweight (BMI 25–30 kg/m²) and obesity (BMI > 30 kg/m²) are associated with an increased risk of metabolic risk factors (high blood pressure, blood lipids, type-II diabetes) and atherosclerotic cardiovascular disease (ASCVD)^{7,8}.

Diabetes mellitus is a potent risk factor for atherosclerosis which increases the risk for coronary heart disease⁷⁻⁹.

Literature has shown that in Saudi Arabia the prevalence of atherosclerosis is increasing every year, which is an alarming situation^{2,3}. According to a recent study, around 5601-6600 per 100,000 cases were diagnosed having atherosclerosis and related cardiovascular complication in Saudi Arabia².

Hence, atherosclerosis a significant health concern in Saudi Arabia³. The country faces a high burden of cardiovascular diseases, and atherosclerosis plays a major role in its development due to modifiable risk factors^{2,3}.

The rapid socioeconomic and lifestyle changes in Saudi Arabia have led to an increased consumption of processed foods, high in saturated fats and cholesterol^{2,9}. This shift, coupled with a decrease in traditional diets rich in fruits, vegetables, and whole grains, has contributed to the rise of risk factors such as obesity, high blood pressure, and diabetes⁶⁻⁸.

Literature from western countries has revealed that morbidity and mortality secondary to atherosclerosis could be prevented by simple, cost-effective measures, such as diet and lifestyle modification^{1,4,6}. In the Arabian part of the world, the research data on this issue is limited^{2,3}.

Hence, the study was designed with the aim to assess the level of awareness in the Saudi community regarding the risk factors for atherosclerosis.

MATERIALS AND METHODS

The study was conducted between February to November 2023. Study duration was 7 months. Study design was analytical cross-sectional. Study was multicentered, i.e., data was collected from cities of Ha'il, Riyadh, and Jeddah, Kingdom of Saudi Arabia. Inclusion criteria was all residents of Saudi Arabia above the age of 18 years while exclusion criteria were those who belonged to medical background as their preexisting knowledge could confound the results.

Proposal was accepted by Research Ethics Committee, University of Ha'il, on Feb. 06.2023. Ethical approval number was H-2023-058.

Received on 12-12-2023

Accepted on 02-02-2024

Questionnaire along with informed consent form was first written in English then translated by a language expert in Arabic. When no ambiguity was found in understanding the questions and face validity was verified, the questionnaire was fed on Google Form and the link was sent to participants on Whatsapp. It was pretested on 10 random people. Participation was voluntary, and no incentives were provided to participants. Non-probability convenience sampling technique was adopted.

Data was collected from 550 participants. There were 8 missing values so after data cleaning and editing sample size came out 542. Only those who were willing to consent filled the form. Incompletely filled forms were excluded. Personal identity of the respondents was kept confidential.

Regarding dietary history, participants were guided to fill a 7-day food history. Dietary assessment included intake of seven dietary components; red meat, dairy products, fried meals, olive oil fish, fruits and vegetables.

Regarding life style and other variables, data on smoking, educational level, height, weight, diseases (like diabetes mellitus, hypertension, heart disease, thyroid disease, and hypercholesterolemia) and physical activity was collected. Smoking was categorized as never, or current smoking. Attained educational level was defined as less than 9 years, elementary school (9–10 years), upper secondary school (11–13 years), university degree (>13 years). Body mass index (BMI) < 25 kg/m², 25–29.99 kg/m² and ≥30 kg/m² defined normal weight, overweight and obesity, respectively. Diabetes mellitus was defined as having a measured fasting whole blood glucose ≥6.1mmol/L. Hypertension was defined as systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90mmHg or current use of antihypertensive medication. For thyroid disease and hypercholesteremia, latest T3, T4 and TSH and Lipid Profile results were asked. Physical activity level was measured in task hours per week.

Data were extracted, coded, and analyzed using the SPSS Version 25 on Mac. Data were cleaned for missing values and inconsistencies. Descriptive statistics such as frequency tables were used to summarize the study variables. Quantitative data was displayed in mean and standard deviation while qualitative data was shown in percentages.

P-value of <0.05 was used for statistical significance in all tests. Chi-Square Test and Fischer Exact results were used to correlate between categorical variables. A Pearson Correlation Analysis was conducted. Cohen's standard was used to evaluate the strength of the relationships, where coefficients between .10 and .29 represent a small effect size, coefficients between .30 and .49 represent a moderate effect size, and coefficients above .50 indicate a large effect size.

RESULTS

In the study, 542 participants were enrolled. Majority of the gender category was females 460(84.9%) and most of the cohort was from the eastern province 392(72.3%). Majority (84.5%) of the respondents were university students. The prevalence of atherosclerosis in this analysis was 1.5%. Half of participants (50%) did not do any sort of exercise while 22% did exercise for 30 minutes once weekly. Detail about the demographics of the cohort is shown in table 1.

Table 2 shows mean values of weight, height and BMI of participants. Mean BMI (27.27) reflects that overall study participants were overweight.

Table 3 shows participant perspective about risk factors for atherosclerosis. Most of the participants have chosen obesity 414(76.4%) followed by physical inactivity 360(66.4%) and smoking as the risk factors 302(55.7%). Advance age was not labelled as a risk factor by 73.6%. Similarly, 94% did not label gender as one of the risk factors for atherosclerosis.

Participants' medical information is shown in table 4. Among the participants, diabetes mellitus and hypertension were the most common diagnosed diseases 42(7.7%). Majority 500(92.3%) did not know about their blood pressure status. Hypercholesterolemia was diagnosed among 28(5.2%), while majority 514(94.8%) did not ever screen themselves for cholesterol profile.

Table 5 shows the dietary pattern (7- day food history) of respondents. Majority of the respondents consumed red meat 292(53.9%) and dairy-products 263(48.5%). Forty two percent (226) consumed fried items. Just 20.7% used olive and fish oil. Just 55.9 (303) consumed fruits and vegetables.

Table 6 shows the relationship of gender with participants' perspective about risk factors for atherosclerosis. It is revealed that females have significantly higher perception that obesity leads to atherosclerosis (p-value <0.001). However, other factors were not significantly associated with the gender of the participants.

Figure shows awareness of screening against atherosclerosis in relation to gender. Majority did not screen themselves for atherosclerosis; (99%, 455/460) among females and (96%, 79/82) among males. Just 5 females and 3 males screened themselves for atherosclerosis and were found positive.

A non-significant difference was found between the level of awareness of getting screened for atherosclerosis and the gender (p=0.075), meaning that in both the genders the awareness level is equally very low.

Table1: Socio-Demographic Data of Participants (n=542)

Characteristics	No.	%
Gender		
Male	82	15.1
Female	460	84.9
Age (in years)		
18-29	250	46.1
30-39	120	22.1
40-49	136	25.1
50-59	23	4.2
60-69	12	2.2
80 or more	1	0.2
Nationality		
Saudi	509	93.9
Non-Saudi	33	6.1
Province		
Central	42	7.7
Eastern	392	72.3
Northern	76	14
Southern	22	4.1
Western	10	1.8
Educational level		
Illiterate	3	0.6
Elementary school	1	0.2
Intermediate school	2	0.4
High school degree	78	14.4
University stage	458	84.5
Physical activity		
I do not perform any exercise	271	50.0
> 30 minutes, once weekly	120	22.0
> 30 minutes, twice weekly	57	10.5
> 30 minutes, 3-4 times weekly	94	17.5
Smoking		
No	355	65.5
No, but I get exposed to smoking	144	26.6
Yes	43	7.9
Have you been diagnosed with atherosclerosis?		
Yes	8	1.5
No	534	98.5

Table 2. Mean Values of Weight, Height & BMI of Participants (n=542)

Variable	Mean	SD
Weight (kg)	88.157	16.33
Height (cms)	161.01	7.86
BMI	27.27	5.93

Table 3. Participants' information regarding Risk Factors for Atherosclerosis (n=542)

Risk Factors	No.	%
Obesity		
Yes	414	76.4
No	128	23.6
Physical Inactivity		
Yes	360	66.4
No	182	33.6
Chronic Disease		
Yes	204	37.6
No	338	62.4
Smoking		
Yes	302	55.7
No	240	44.3
Advance Age		
Yes	143	26.4
No	399	73.6
Gender		
Yes	33	6.0
No	509	94.0

Table 4: Participants Medical Information (n=542)

Diseases	No.	%
Hypercholesterolemia		
Yes	28	5.2
No (do not know)	514	94.8
Diabetes mellitus		
Yes	42	7.7
No	500	92.3
Hypertension		
Yes	42	7.7
No (do not know)	500	92.3
Heart disease		
Yes	12	2.2
No	530	97.8
Thyroid disease		
Yes	7	1.3
No	535	98.7

Figure: Awareness Atherosclerosis in relation to Gender

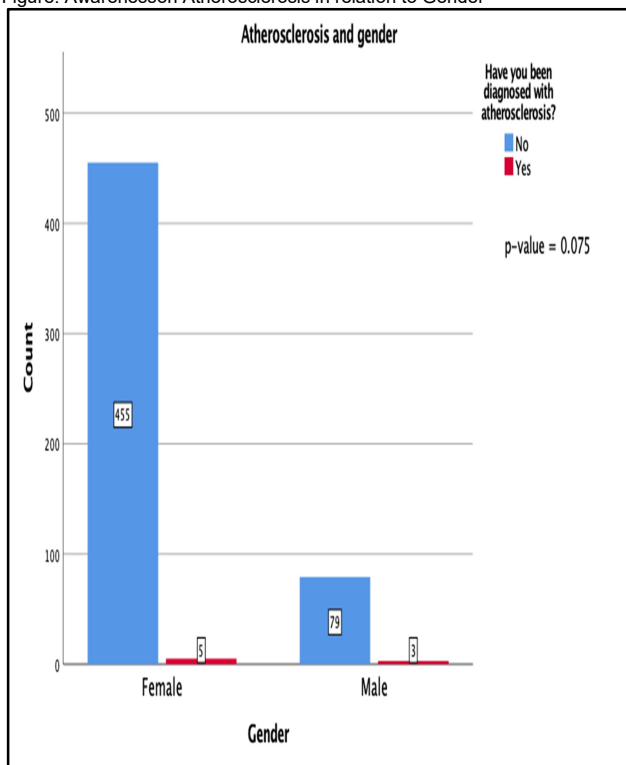


Table 5. Participants' Dietary Information (n=542)

Dietary Items	No.	%
Read Meat		
Yes	292	53.9
No	250	46.1
Salty Diet		
Yes	124	22.9
No	418	77.1
Dairy Products		
Yes	263	48.5
No	279	51.5
Fried Meals		
Yes	226	42.0
No	316	58.0
Olive and Fish Oils		
Yes	112	20.7
No	430	79.3
Fruits and Vegetables		
Yes	303	55.9
No	239	44.1

Table 6. Relationship of Gender with Risk Factors for Atherosclerosis (n=542)

Variables	Gender		r	P value
	Male	Female		
Obesity				
Yes	49 [62.6]	365 [351.4]	-0.165	<0.001*
No	33 [19.4]	95 [108.6]		
Physical Inactivity				
Yes	47 [54.5]	313 [305.5]	-0.081	0.058
No	35 [27.5]	147 [154.5]		
Chronic Disease				
Yes	25 [30.9]	179 [173.1]	-0.062	0.147
No	57 [51.1]	281 [286.9]		
Smoking				
Yes	43 [45.7]	259 [256.3]	-0.028	0.516
No	39 [36.3]	201 [203.7]		
Advance Age				
Yes	19 [21.6]	124 [121.4]	-0.031	0.474
No	63 [60.4]	336 [338.6]		

- Observed [expected] * Significant at level of 0.05 or less

DISCUSSION

Literature has revealed that there is an increasing trend of obesity, sedentarism and type 2 diabetes mellitus which in turn leading to enormous increase in the cases of ASCVDs globally^{9,10}. Exposure to risk factors like; poor diet quality, sleep deprivation, sedentarism, and psychosocial stress ha a positive correlation with ASCVD⁷⁻¹⁰..

Obesity is recognized as one of the leading risk factors for disability and death worldwide secondary to Cardio-Vascular Diseases (CVD)[9]. Latest research has revealed that dietary pattern has a more significant association with body composition than to body weight and total fat mass per se suggesting that BMI is no more the only measure for assessing the effects of diet on health¹¹.

A diet low in carbohydrate was found to have a strongly significant association ($p < 0.05$) in mobilizing atherogenic and diabetogenic fat depots from viscera than a low fat diet, as revealed by CENTRAL-MRI trial¹². Hence, the combination of laboratory markers and anthropometric measurements (triglycerides and waist circumference) are more reliable indicators of visceral adiposity than BMI¹³.

Studies have found a strong evidence that sound cardiovascular health is significantly associated with intake of plant-based foods hence it is recommended to minimize the consumption of foods having sugar, refined grains and trans-fatty acids^{9,11,13}. The so-called Mediterranean dietary pattern which is supplemented by nuts and extra virgin olive oil is the only best tested dietary pattern in reducing the risk of atherosclerosis and cardiovascular diseases^{14,15}.

Smoking is identified as one of the risk factors for ASCVD in present study, this finding is similar to the result of study done by LeBlanc S et al in 2018 where smoking and passive smoking were identified as risk factors for ASCVD¹⁶. Studies have reported that even a brief exposure to passive smoking increases the risk of myocardial infarction by 30%^{17,18}. Further, data shows 17% reduction in hospital admission following bans on smoking in public areas^{8,17}.

Previous studies have reported plausible evidence that a sedentary lifestyle independently contributes to ASCVD risk, present study results are consistent with the same findings¹⁵⁻¹⁷.

A study done by Ferrucci L in 2018 revealed that after controlling the confounding effect of smoking, obesity, hypertension and diabetes; increased physical activity has a positive correlation with decrease in the cases of atherosclerosis¹⁷. This finding is consistent with the result reported by Owen N et al, who also reported the association of sedentary life style with cases of cardiovascular diseases¹⁸. Similarly, in the present study a significant association is found between atherosclerosis and sedentarism. Its documented that physical activity promotes anti-atherogenic effects in the human body. This reflects importance of restriction of sedentarism as an independent factor in cardiovascular incident prevention^{19,20}. It is recommended to promote 'sitless move more' as an important public health intervention against ASCVD[18-20]. Life style modification is the most cost-effective strategy to decrease the prevalence of ASCVD in population.

CONCLUSIONS

Modifiable risk factors in prevention of atherosclerosis were poor diet quality, smoking and sedentarism while diabetes and hypertension act as intermediary pathways related to ASCVD. Majority of study populations did not know their cholesterol profile and blood pressure levels. Awareness regarding healthy diet is very low as majority consume red meat and dairy items.

Ethical Approval: Research proposal was accepted by Research Ethics Committee, University of Hail, Saudi Arabia (H-2023-058).

Authors' Contribution: FHK- wrote proposal, got ethical approval, wrote discussion and references. GK- generated idea, wrote abstract, introduction and results. GM- generated idea, wrote methodology, discussion, conclusion and references

Conflict of interest: There is no conflict of interest among authors.

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This article may be cited as: Khan FH, Khalid G, Dhairi GMA: Role of Lifestyle Modification In The Prevention Of Atherosclerosis. *Pak J Med Health Sci*, 2024;18(2):2-5.