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Is hypercholesterolemia adequately covered in medical schools? A cross-sectional study on knowledge levels among Saudi medical students

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ABSTRACT

Background: Cholesterol is a fatty substance that is essential to performs several functions in the body. Hypercholesterolemia is a term prescribing the presence of high levels of cholesterol in the blood. It is a major risk factor for coronary heart disease (CHD) and stroke. CHD is the most common cause of mortality and morbidity worldwide. The goal of this research is to assess knowledge levels regarding hypercholesterolemia and its complications among medical student in Riyadh. *Methods:* Cross-sectional study design by using an anonymous questionnaire distributed in soft copy to a sample of 417 medical students in Riyadh, Saudi Arabia. The questions are based on the basic principles and knowledge that a person should know about hypercholesterolemia. The questions were simple and direct to remove any biases in conducting the survey and rule out any blank or false answers. *Results:* The study sample included 417 medical students (42%) females and 58 % males). The majority of the participants were Saudi (99.3%). (44.8%) of students' family members had cholesterol history. (61.3%) reported that they did not know about the level of triglyceride. (57.6%) reported that they did not know about the level of LDL. *Conclusion:* Our survey shows there is a lack of knowledge about normal range of cholesterol levels. There is a visible lack of knowledge regarding cholesterol-related cardiovascular complications, even though the majority of our sample reported a positive family history of hypercholesteremia. Future research should focus more about ways to increase the knowledge about cholesterol normal levels and complications and how does it relate to family history.

Keywords: Saudi Arabia, Medical Student, Knowledge, Medical Education, Hypercholesterolemia, Knowledge

1. BACKGROUND

Cholesterol is a fatty substance that is essential to perform several functions in the body. For example, it is converted to make certain hormones and vitamins, but in higher levels, it tends to be harmful. The human body is making a healthy amount of cholesterol by itself in the liver by consuming a small amount of fat in the diet. Moreover, consuming food that is high in saturated and trans fats, such as animal meat and dairy products, causes your liver to make more cholesterol than normal. This increase in production means they go from healthy cholesterol levels to unhealthy. There are two types of cholesterol: high-density lipoprotein or HDL cholesterol, and low-density lipoprotein or LDL cholesterol. When there is too much of the LDL or too less of the HDL, this increases the risk of building up cholesterol in the inner wall of the arteries that supply vital organs such as the heart and brain.

Hypercholesterolemia is a term prescribing the state of high levels of cholesterol in the blood. It is a risk factor for coronary heart disease (CHD) and stroke (National Heart Foundation of Australia, 2018). CHD is the most common cause of mortality and morbidity worldwide (Duvall & Vorchheimer, 2004). In addition, hypercholesterolemia is linearly related to CHD mortality (Verschuren, 1995). It is the cause of almost 19,000 deaths in 2017, and the stroke added 1,250. Economic losses are massive from coronary heart disease, which costs $112 billion so; reducing hypercholesterolemia offers significant health and economic benefits (National Heart Foundation of Australia, 2018; Stuart-Shor, 2004; Satcher, 2000; Burt et al., 1995; Johnson et al., 1993).

The economic burden of hypercholesterolemia is significant. It is divided into the economic burden that associated with hypercholesterolemia itself and the economic burden that associated with diseases caused by hypercholesterolemia. The economic burden of hypercholesterolemia is $92.5 million associated with the diagnosis and treatment with lipid-modifying medication (National Heart Foundation of Australia, 2018). The economic burden of diseases related to hypercholesterolemia, such as heart diseases, is an estimated $7,334.0 million in 2017-2018, with an addition of $1,293.7 million in costs due to stroke (National Heart Foundation of Australia, 2018). Moreover, one possible egregious example of the global burden of cardiovascular diseases (CVDs) is the fact that around 61,800,000 American citizens are affected with one type or more of CVD, as well as being responsible for approximately 958,775 deaths every year at the cost of approximately $329.2 billion annually (Duvall &Vorchheimer, 2004).

Hypercholesterolemia does not appear with symptoms and can only be diagnosed by laboratory examination. Screening is the only way to detect people at risk and apply preventive measures effectively, so screening for hypercholesterolemia can be an effective way to improve public health. It is necessary to identify those patients who are at risk of hypercholesterolemia in order to start lifestyle modification advice (Mannu et al., 2013). For example, A study was conducted in seven Country reported that the significant difference at a set cholesterol level and CHD mortality rates might be due to other factors, such as diet, that are typical for cultures with a low CHD risk (Verschuren, 1995), weight control and losing weight therapy for overweight or obese patients, will lower LDL and modifying other lipid and non-lipid risk factors (Mannu et al., 2013), and smoking cessation is the most important change an individual can do as it is an important risk factor for CVD that can be modified (Clark & Felsenfeld, 1972). Therefore, treating asymptomatic hypercholesterolemia patients early as primary prevention of cardiovascular disease (CVD) is an important step in reducing coronary morbidity and mortality (Lenfant, 1984).

Physicians have an important role in public health to reduce the burden of (CAD) and atherosclerosis (McBride et al., 1992) by identifying and treating high-risk patients. There were deficits in the knowledge, practice, and attitude of familial hypercholesterolemia among Saudi medical interns, show the importance of constant and extensive medical education programs to close the gap in Coronary artery disease prevention (Alzahrani et al., 2020; Browner et al., 1994). The target of our study is to demonstrate the relationship between knowledge levels of hypercholesterolemia among medical students and family history of cholesterol.

2. METHODS

Design

The study design was cross-sectional by using an anonymous questionnaire which was answered by individuals living all around Saudi Arabia that is posted online. The questions were collected over a span of 2 months, and the sample size was 417 medical students were included. The questions are based on the basic principles and knowledge that a person should know about hypercholesterolemia. The questions were direct with no branching logic to simplify the survey and rule out any blank or false answers.

Study questionnaire

The questionnaire contained twenty-eight questions, starting with a cover message that specified the details on the aims of the study, declarations concerning the confidentiality and anonymity of collected data. Participants then continued to questions of the first part, starting with socio-demographic information; the second part was about general knowledge of cholesterol and asking if any of the family members of the participant is diagnosed with hypercholesterolemia the third part was about the causes of hypercholesterolemia the fourth part was about knowledge of normal ranges of lipid profile the fifth part was about Singh and symptoms of hypercholesterolemia the sixth part was considering the prevention of hypercholesterolemia, the questionnaire ended by asking the participants from where they got their knowledge about hypercholesterolemia. Data gathering took place between 1st October 2020 and 30th November 2020. Sharing of the questionnaire was through online correspondence through WhatsApp and social media.

Statistical analysis and sample size calculation

Statistics were scrutinized using SPSS 23.0. The frequencies, percentage, mean and standard deviation were conducted to describe the tool; Chi square (X2) were chosed to examin the differences of the study statements. The differences in mean scores of the knowledge were inspected using an independent t test in terms of gender and study level. A p value less than 0.05, 0.01 and 0.001 were considered statistically significant.

The target population of the study was medical students studying in three major universities in Riyadh, Saudi Arabia, as they are the intended population to serve. Only responders who are 18 years or older are included for ethical reasons. The survey was posted online using Google Forms (Supplements 1) that was shared online on different social media platforms, which cover multi-category populations with different levels of education, social-economical status, and backgrounds. The posted survey had the instructions needed to ease the sample undertaking the questionnaire. The survey also is provided with a message to disclose that results will be used in the research to imply consent to individuals that the results will be used in the study — also, a completion message at the end of the survey.

3. RESULTS

As shown in Table 1, 417 medical students participated in the current study including 242(58%) male and 175(42%) female. The mean score for age was (20.95±1.01%). The majority of the participants were Saudi (414/99.3%). 176(41.2%) were pre clinical students, 152(36.5%) were clinical students and 89(21.3%) were foundation students. 235(56.4%) were from Imam Mohammed bin Saud University, then 67(16.1%) from King Saud University, then 61(14.6%) from Princess Norah bint Abdurrahman University, and then 54(12.9%) from King Saud University for medical science. The level of GPA was great, 187(44.8%) got 4-4.74 GPA, then 173(41.5%) got 4.75 and over, then only 15(3.6%) were below 3.49.

Table 1 Demographic information (N=417)

Demographic Factor		N/M	%/SD
Gender	Male	242	58
	Female	175	42
Age		20.95	2.01
	Saudi	414	99.3
	Non-Saudi	3	.7
Study level	Foundation year	89	21.3
	Pre Clinical years	176	42.2
	Clinical years	152	36.5
University	King Saud University	67	16.1
	Imam Mohammed bin Saud University	235	56.4
	King Saud University for medical science	54	12.9
	Princess Norah bint Abdurrahman University	61	14.6
GPA	Below 3	5	1.2
	3-3.49	10	2.4

	3.50-3.99	42	10.1
	4-4.74	187	44.8
	4.75 and over	173	41.5
Keys: N=Number, M=Mean, SD=Standard deviation , %=Percent			

As in Table 2, Cholesterol history of the family member was presented. 187(44.8%) of students' family members had cholesterol history (X2=4.43, p<0.05=0.03). fathers were the highstfamily members who had increased livel of cholesterol by (108/25.9%) (X2=96.89, p<0.001), then 41(9.8%) mothers had cholesterol (X2=269.13, p<0.001), then 33(7.9%) grandparntes had cholesterol (X2=295.45, p<0.001), then 13(3.1%) uncles had cholesterol (X2=366.62, p<0.001), 6 brothers (1.4%) and 6 sisters (1.4%) had cholesterol (X2=393.35, p<0.001), and finally 4 (1%) aunts hadcholesterol (X2=401.62, p<0.001).

Table 2 The Cholesterol history of the family members (N=417)

Statement		N	%	X^2 /*p value*
Family member has Cholesterol	No	230	55.2	4.43*/0.03
	Yes	187	44.8	
Father	No	309	74.1	96.89***/<0.001
	Yes	108	25.9	
Mother	No	376	90.2	269.13***/<0.001
	Yes	41	9.8	
Brother	No	411	98.6	393.35***/<0.001
	Yes	6	1.4	
Sister	No	411	98.6	393.35***/<0.001
	Yes	6	1.4	
Grands	No	384	92.1	295.45***/<0.001
	Yes	33	7.9	
Aunt	No	413	99	401.15***/<0.001
	Yes	4	1	
Uncle	No	404	96.9	366.62***/<0.001
	Yes	13	3.1	
*** (p<0.001) ,** (p<0.01) , * (p<0.05)				

As shown in Table 3, genral knowledge of hypercholesterolemia was presented. 323(77.5%) students agreed that cholesterol can be diagnosed (X2=4.43, p<0.001). 227(54.4%) students reported that there is a relation cholesterol and genetics (X2=96.52, p<0.001). 98(23.5%) students reported that cholesterol normal level was below 160 (X2=556.51, p<0.001). 255(61.3%) reported that they did not know about the level of triglyceride, while 116(27.8%) students reported that triglyceride normal level was below 150 (X2=733.55, p<0.001). 240(57.6%) reported that they did not know about the level of LDL, while 148(35.5%) students reported that LDL normal level was below 130 (X2=541.62, p<0.001). 237(56.8%) reported that they did not know about the level of HDL, while 140(33.6%) students reported that HDL normal level was between 35-100 (X2=500.16, p<0.001). 218(52.3%) students reported that LDL was signs of vascular disease (X2=203.04, p<0.001).

As in Table 4, ways to prevent hypercholesterolemia were presented. Students reported that low-fat diet, regular physical activity for 30 mints, maintaining healthy weigh, Smoking cessation and Eating a low-salt diet that emphasizes fruits, vegetables, and whole grains, can respectively prevent the Cholesterol from increasing (p<0.05). However, Alcohol defiantly was not. As in Figure 1, knowledge regarding risk factors that can lead tohigh cholesterol level were presented. Students reported that smoking, a high saturated fat diet, and sedentary lifestyle can cause hypercholesterolemia (p<0.05), while healthy food, physical activity do not play a role in increasing cholesterol (p<0.05). As in Figure 2, side effects of high Cholesterol level were presented. Students reported that Heart attack, Stroke can be side effects of hypercholesterolemia (p<0.05), while Ulcerative colon, diabetes and diarrhea cannot be side effects of hypercholesterolemia (p<0.05).

Table 3 General knowledge of hypercholesterolimia (N=417)

Statement		N	%	X^2 /p value
Cholesterol Medicine	Yes	323	77.5	377.45***/<0.001
	No	18	4.3	
	I don't know	76	18.2	
Cholesterol related to Genetic	Yes	227	54.4	96.52***/<0.001
	No	65	15.6	
	I don't know	125	30	
Cholesterol Normal level	Below 160	98	23.5	556.51***/<0.001
	160-199	74	17.7	
	200-239	11	2.6	
	240-280	4	1	
	More than 280	1	0.2	
	I don't know	229	54.9	
Triglyceride Normal level	Below 150	116	27.8	733.55***/<0.001
	150-199	38	9.1	
	200-239	6	1.4	
	240-280	1	0.2	
	More than 280	1	0.2	
	I don't know	255	61.2	
LDL Normal level	Below 130	148	35.5	541.62***/<0.001
	130-199	20	4.8	
	200-239	6	1.4	
	240-280	3	0.7	
	I don't know	240	57.6	
HDL Normal level	Below 35	24	5.8	500.16***/<0.001
	35-100	140	33.6	
	240-280	5	1.2	
	More than 280	11	2.6	
	I don't know	237	56.8	
Vascular disease signs	LDL	218	52.3	203.04***/<0.001
	HDL	25	6	
	Triglyceride	61	14.6	
	I don't know	113	27.1	
*** (p<0.001) ,** (p<0.01) , * (p<0.05)				

Table 4 ways to prevent hypercholesterolemia (N=417)

Statement		N	%	X^2 /p value
Eating a low-salt diet that emphasizes fruits, vegetables, and whole grains	No	167	40	16.52***/<0.001
	Yes	250	60	
low-fat diet	No	49	11.8	244.03***/<0.001
	Yes	368	88.2	
maintaining healthy weigh	No	65	15.6	197.53***/<0.001

	Yes	352	84.4	
Smoking cessation	No	117	28.1	80.31***/<0.001
	Yes	300	71.9	
regular physical activity for 30 mints	No	57	13.7	220.17***/<0.001
	Yes	360	86.3	
Alcohol	No	417	100	NA
	Yes	0	0	
*** (p<0.001) ,** (p<0.01) , * (p<0.05)				

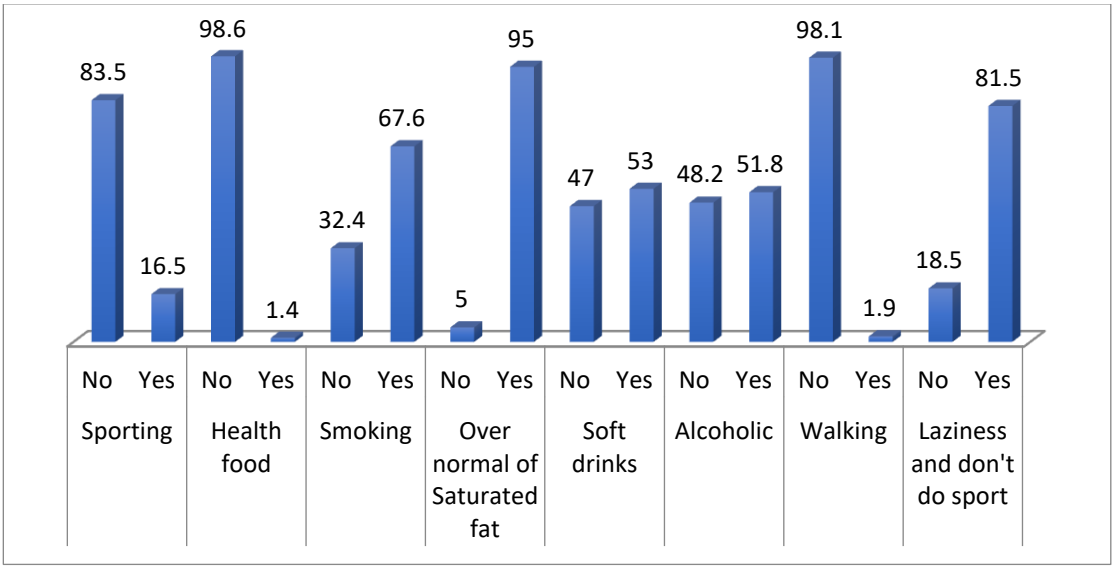

Figure 1 Risk factors that can lead tohigh Cholesterol level

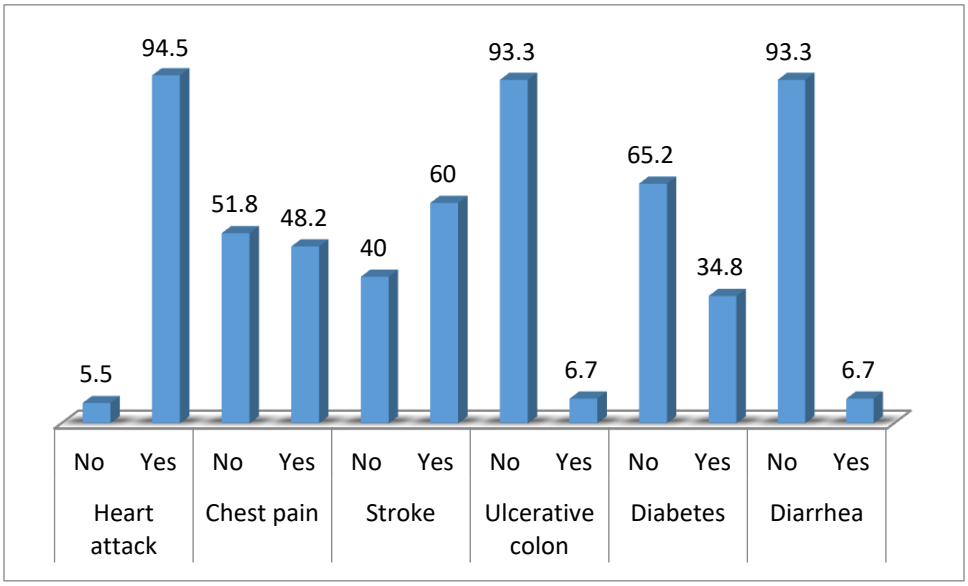

Figure 2 Complications of high Cholesterol level

As shown in Figure 3, Results and types of Cholesterol were presented. 275(65.9%) had not have a Cholesterol check up (X2=42.42, p<0.001), of those who cheked there cholesterol 107(67.3%) were within normal level (X2=82.57, p<0.001). 281(67.4%) students reported that HDL is the good cholesterol (X2=225.89, p<0.001), and 278(66.7%) students reported that LDL is bad cholesterol (X2=220.19, p<0.001).

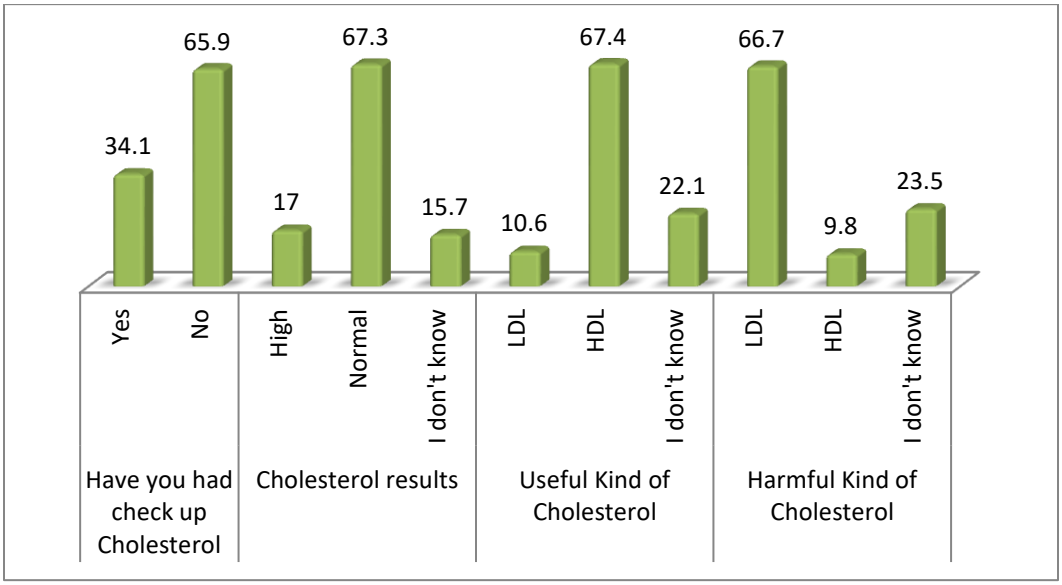

Figure 3 Results and types of Cholesterol

4. DISCUSSION

Our study provides valuable information on the current level of cholesterol knowledge of medical students in Riyadh, Saudi Arabia, as well as sheds light on its relationship to family history of hypercholesterolemia. Ensuring adequate medical knowledge regarding hypercholesterolemia among medical students has been stressed as early as 1990 (López Miranda et al., 1990), yet literature demonstrates that there are shortcomings regarding the awareness, knowledge, identification, and detection of cholesterol-related disorders and cardiovascular risk factors among medical students (Maksimović et al., 2017; Güneş et al., 2019). Furthermore, knowledge deficits have been recorded even among Saudi physicians, who are already far past medical school (Alzahrani et al., 2020). Examining this issue first-hand requires an understanding of the most basic knowledge level of medical students and how it correlates to other variables such as their school level, university, GPA, and presence of family history.

More than half of the 417 medical students from four well-established universities in Riyadh that were enrolled in this study reported not knowing the normal levels of Cholesterol (54.9%), Triglycerides (61.2%), LDL (57.6%), and HDL (56.8%) levels. Only 52.3% of the participants correctly answered that elevated LDL levels associate with coronary vascular disease. Similar findings have also been observed among Saudi medical interns in Jeddah, where only half (52.40%) of the 170 interns were able to correctly identify the lipid profile in familial hypercholesterolemia, and a staggering 100% of the interns had poor awareness regarding familial hypercholesterolemia (Batais et al., 2017). Our aforementioned findings demonstrate significant ($P = <0.001$) deficits in knowledge as well and signify an important oversight by medical school curriculums in some of the top universities in Riyadh, especially when taking into consideration the fact that most participants (86.3%) had either a Very Good or Excellent GPA. Such clear contrast between the student's high performance in medical school and their knowledge deficit on basic lipid profile values demonstrate a need to emphasize basic objectives and to ensure that they've been met. Interestingly, more than half (55.2%) of the participants reported a positive family history of hypercholesterolemia, with parents accounting for 36% of the affected. These findings may suggest that knowledge levels among medical students regarding hypercholesterolemia proportionally increases when there is an associated family history, especially among first-degree relatives.

In the current study, we have found that two thirds (67%) of medical students in Riyadh agreed that smoking increases the risk of hypercholesterolemia, a correlation that has been demonstrated in the extant literature (Nakamura et al., 2009). This perception is not just limited to medical students, as a study conducted on physicians in Riyadh showed that smoking was the most selected among lifestyle choices (69%) that can increase CVD risk in patients with hypercholesterolemia (Batais et al., 2017). In our survey, nearly all of the students (95%) choose saturated fats as a cause of increasing cholesterol and one of the main reasons for hypercholesterolemia. A previous study in Singapore that surveyed the public population showed that 88% of the participants agree that unhealthy food is one of the main causes of high cholesterol levels, whereas in our study, 99% of the medical students stated that healthy food doesn't count as a risk factor for hypercholesterolemia (Aung et al., 2013).

When it comes to symptoms of high blood cholesterol levels, we have found that nearly half (48.2%) of the students chose chest pain, whereas higher levels of knowledge among Singaporean population can be observed, since 64.9% of the respondents agreed that patients with high cholesterol usually have symptoms such as chest pain or breathlessness (Aung et al., 2013). Another

interesting comparison to our current study is that nearly one-third of medical students agreed that diabetes could be one of the complications of high cholesterol, which presents a similar level of knowledge to diabetic patients who were surveyed regarding their knowledge level of their conditions, where one-third of the participants knew the effects of cholesterol limitations on their condition (El-Khawaga & Abdel-Wahab, 2015).

According to the study, one-third of the students have checked up their cholesterol, very few (17%) of them found their total cholesterol level was high. In a study conducted on Serbian medical students, only 28% of students were found to have correct knowledge regarding cholesterol levels (Maksimović et al., 2017). Majority of the pre-clinical students knew what is good cholesterol (74.4 %) and bad cholesterol (72.7%) by associating with HDL and LDL respectively, while clinical year students performed noticeably better in identifying HDL as good cholesterol (90.1%) and LDL as bad cholesterol (90.8%). Similarly, the Serbian study found comparable results with the exception of better performance by younger students in identifying HDL as good cholesterol (91.2%) and LDL as bad cholesterol (91.2%) (Maksimović et al., 2017).

Blood lipid levels that are too high are well-known risk factors for heart disease. The knowledge about the role of physical activity in the prevention of elevated cholesterol was high, similar to a study that was done in Cario (Amin et al., 2017). Reducing the number of harmful fats was identified for risk of elevated cholesterol by a majority of the students (88.2%), Keeping on healthy weight (84.4%), and smoking (71.9%); these results are in agreement with several studies (Baig et al., 2015). In our study, there is total agreement that alcohol cannot prevent high cholesterol levels.

Limitations in this study include the inability to collect data through physical visitations to different medical schools, since lockdown restrictions rendered such a collection method unfeasible, and we thus opted for electronic collection. Another barrier was the fact that our respondents were from public universities, which may not reflect the knowledge levels of private uinversities. Non-response bias is particularly susceptible among medical students, who may feel ashamed to submit wrong answers, however since we already had this fact in mind, we made sure to avoid any tone that may feel judgemental by making the questions as direct as possible. Future studies should tackle poor knowledge level and to examine the possibility of curriculum change with an emphasis on achieving basic objective.

5. CONCLUSION

Our study reveals that there is a lack of knowledge regarding the normal range of cholesterol levels, as well as a lack of knowledge regarding cholesterol cardiovascular complications, even though the majority of our sample reported a positive family history of hypercholesteremia. Future research should focus more about ways to enhance curriculums in order to increase the knowledge level of medical students regarding cholesterol normal levels.

Abbreviations

CHD: Coronary heart disease
CVD: Cardiovascular disease
CAD: Coronary artery disease
LDL: low-density lipoprotein
HDL: high-density lipoprotein

Ethics approval and consent to participate

The study protocol was approved by the institutional review board at the College of Medicine in Imam Muhammad ibn Saud Islamic University, Riyadh, Saudi Arabia (P.N. 80-2020).

Consent for publication

All authors provide consent for publication.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

All authors designed the study and collected and analyzed the data. FA wrote the manuscript. MA supervised the study. All authors read and approved the final manuscript.

Data and materials availability

All data associated with this study are present in the paper.

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