How to Cite:
Hamid, S., Waheed, Q., Saleemullah, S., Butt, T. M., Sarfaraz, A., & Salman, R. (2023). Micronutrients and cardiovascular health: A cross-sectional survey among medical students of Pakistan. *International Journal of Health Sciences*, *6*(S8), 6722–6732. https://doi.org/10.53730/ijhs.v6nS8.13977

Micronutrients and cardiovascular health: A cross-sectional survey among medical students of Pakistan

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***Abstract*---**Introduction: Health authorities particularly World Health Organization emphasize upon the role of nutrition (macronutrients and micronutrients) in prevention of CVD (Cardiovascular Diseases). Objectives: The study aimed to assess knowledge on risk factors of cardiovascular diseases and diverse role of micronutrients in their prevention amongst undergraduate medical students in Pakistan. Methodology: A cross-sectional survey was carried out among students of third, fourth and final year MBBS across various medical colleges in Pakistan. Consecutive non-probability sampling was employed and self-reported questionnaire was used for collection of data. A total of 381 students were recruited and majority (n=213; 55.9%) were females. Largest number of respondents belonged to third year of MBBS (n=160; 42%). Nearly 66% (n=250) medical students had adequate knowledge on cardiovascular diseases' risk factors. Results: Around 31% (n=117) had adequate while 69% (n=264) had

sub-optimal knowledge on benefits of micronutrients in cardiovascular diseases. Chi-square test of association showed statistically significant relationship (P-value <0.05) between demographic variables and knowledge of students. Conclusion: Medical students being the future healthcare professionals can contribute effectively and efficiently to reducing risks of cardiovascular diseases by having an up-to-date knowledge. Future large-scale and in depth studies can further probe the issue.

***Keywords*---**knowledge, micronutrients, cardiovascular diseases, undergraduate medical students, Pakistan.

Introduction

Cardiovascular diseases (CVD) consist of myocardial infarction, stroke, heart failure, atherosclerosis, hypertension, cardiac arrhythmias, sudden cardiac arrest and a wide number of other vascular and cardiac conditions(1). Globally CVD accounts for 31% of mortality. According to a survey, ischemic heart disease (IHD) contributed to 49% primarily, followed by cerebrovascular accidents with 33% of total burden of CVD(2). An estimated 1.13 billion people have hypertension worldwide, two-thirds of them live in LMICs (low- and middle-income countries)(3).Almost 9 million deaths are associated with hypertension. The global prevalence for hypertension has drastically been increasing in Southeast Asian countries for the past two decades. Total prevalence of hypertension for Southeast Asian urban population was estimated to be 33.82%. The community was reported to have 33.98% of hypertension whereas 32.45% was prevalent among adolescents studying in school(4).

Atrial fibrillation is the most frequently occurring cardiac arrhythmia. By 2050, it has been estimated that 6-12 million population will acquire this condition in United States and 17.9 million in Europe by 2060. Atrial fibrillation predisposes for ischemic stroke causing huge financial burden with significant morbidity and mortality(5). The magnitude of total CVD burden was studied utilizing estimates from the Global Burden of Disease (GBD) Study 2019, using records of population-level data source from 1990 to 2019. The trends for years of life lost due to CVD and (DALYs) disability-adjusted life years increased significantly, years lived with disability increased twice from 17.7 million to 34.4 million over that period(6).

Nutrition is one of the major elements of guidelines to cardiovascular risk reduction and management. Although not much is known whether cardiologists, trainees, and general physicians have the education related to nutrition, necessary to practice these guidelines. The recent 2015-2020 Dietary Guidelines for Americans recommend healthy dietary patterns, including a Healthy Mediterranean Style Eating Pattern and Healthy Vegetarian Eating Pattern.(7).Among the top risk factors, poor quality of diet has been identified by the US Burden of Disease Collaborators as the leading cause of premature deaths and disability in the United States(8).

There is a compelling evidence that cardiovascular diseases may result due to deficiencies of certain micronutrients including vitamins, minerals and antioxidants(9).These deficiencies can result from reduced dietary intake, increased losses resulting from certain medical conditions, medical treatment, diuretics, renal dialysis or increased requirements due to greater level of oxidative stress(10).

Vitamin and mineral supplements are not a substitute for a balanced and nutritious diet, but the deficiencies can be compensated with therapeutic intervention. In a recent study, findings in meta-analysis suggest that circulating Mg levels are inversely associated with incidence of chronic heart disease and hypertension. Magnesium is naturally present in many food groups and available as a synthetic dietary supplement. It functions as cofactor in almost three hundred enzymatic reactions, being responsible for regulating heart rate and rhythm, controlling blood pressure, lipid metabolism and glycemic control. In short, it is critically essential for cardiovascular health(11). In observational studies carried on treated ambulatory hypertensive patients, the hypomagnesemic group required a greater number of antihypertensive medications than the non-hypomagnesemic patients to maintain their blood pressure in the normal range. This suggests that magnesium presumably plays role in blood pressure control and indicate the need for further studies(12). Evidence has emerged over the years supporting magnesium supplementation when trying to prevent or treat cardiac arrhythmias particularly atrial fibrillation. Magnesium is viewed to act as a calcium channel blocker, therefore it theoretically functions as an AV nodal blocker (13)(14)(15)(16)(17).

Long term treatment with diuretics results in potassium and magnesium deficiency causing significant implications in patients with cardiovascular diseases. Patients receiving thiazides diuretics are vulnerable to develop hypokalemia and thus causing life-threatening arrhythmias especially in those with ischemic heart disease. Hypomagnesemia is also identified in 42 percent of patients with hypokalemia. Magnesium is essential for maintenance of cellular potassium.Rise in muscle potassium and magnesium levels have been linked with infusions of magnesium alone and this has been reported to benefit in decreasing the frequency of ventricular ectopic beats(18)(19)(20).A diet low in sodium and repleted with potassium and magnesium, popularly known as DASH diet (Dietary Approaches to Stop Hypertension), is the new recommendation as a standard lifestyle modification for patients with hypertension or other cardiovascular risk factors(21).

A role of vitamin D in regulating endothelial function has been well established in many experimental studies. One of the proposed mechanisms of action is renin–angiotensin– aldosterone (RAAS) activation. Vitamin D signaling may influence the pathophysiology of atherosclerosis through modulation of the inflammatory response by decreasing the expression of Tumour Necrosis Factor-α, Interleukins-6,1 and 8 in isolated blood monocytes(22).Studies indicated that a genetically predicted increase in serum 25-hydroxy vitamin D is protective against cardiovascular diseases including myocardial infarction in high risk hypertensive-diabetic patients. Moreover, it is a driving force for achieving guideline-directed

blood pressure control resulting in reduced CVD events. However, these facts need to be established with further studies(23)(24).

The concentration of trace elements such as selenium and zinc in the body affects morphology and function of the cardiovascular system by production of Nitric Oxide and prevention of atherogenesis by reducing oxidative stress. Selenoproteins formed by selenium cause relaxation and remodeling of smooth muscles of the vessels (25).Pathological selenium deficiency was first discovered eighty years ago as Keshan disease named after Chinese region in which there is progressive cardiomyopathy due to extensive fibrosis and degeneration(26)(27). The aim of the study was to assess the level of knowledge about risk factors of cardiovascular diseases and the diverse role of micronutrients in their prevention amongst undergraduate medical students of Rawalpindi City, Pakistan.

Methodology

It was a descriptive cross-sectional study conducted over a period of four months from June 2021 to September 2021. The study population comprised of male and female medical students of third, fourth and final year MBBS studying in different medical colleges of Rawalpindi. The study was carried out after ethical considerations and approval by ethical committee of institutes. The sample size was calculated using single proportion formula by taking 95% confidence interval with 5% margin of error and 54% prevalence of outcome variable in a previous similar study on medical students. Consecutive non-probability sampling was employed.

A self-reported questionnaire comprising of three sections was used for the purpose of data collection. Section A comprised of demographic details. Section B was adapted from a validated tool, Heart Disease Facts Questionnaire (HDFQ) used in a previous similar study to assess the knowledge about the risk factors of cardiovascular diseases. Section C was developed with censuses of authors of article and validated by the senior faculty members of Al-Shifa School of Public Health, Rawalpindi. In this study, knowledge is the dependant variable whereas demographics are the independent variables of the study. All the participants were briefed about the study and informed consent was taken from each participant. The questionnaires were distributed and were returned back at completion of responses.

Statistical Analysis

Data was entered, processed and analysed using the software Statistical Package for Social Sciences SPSS (IBM Version 20). Data was analysed descriptively whereby frequencies and percentages were run for all the demographics in Section A.Percentages for dependant variables of Section B and Section C were calculated separately. In the next step, to label the respondents' knowledge as adequate or inadequate, the scores for all the 8 variables of Section B and 10 variables of Section C were computed as a quantitative variable separately. Finally mean was taken as a cut off value for both sections separately. Chi square test of association was run between demographic variables and dependant variables to determine if there is any influence at 0 .05 level of significance or not.

Results

Using SPSS version 20.0, frequencies and percentages were run for all demographic variables. A total of 381 medical students were recruited. Majority (n=213; 55.9%) were females. Most of the students studying in third year MBBS, (n=160; 42%) having no personal (n=370;97.1%) or family history of CVD (n=287;75.3%). Majority of them belonged to urban areas (n=289; 97.1%) and (n=267;70%) claimed to have interest in reading health literature. (Table 1)

Table 1. Demographic variables of medical students

Variables	n (%)
Gender	
Males	168(44.1%)
Female	213(55.9%)
Academic Year	
3rd Year	160(42%)
4th Year	142(37.3%)
Final Year	79(20.7%)
Area of Origin	
Rural Area	92(24.1%)
Urban Area	289(75.9%)
Personal History CVD	
Yes	11(2.9%)
No	370(97.1%)
Family history of CVD	
Yes	94(24.7%)
No	287(75.3%)
Interest in reading health literature	
Yes	267(70%)
No	114(29.9%)

Knowledge on risk factors of cardiovascular diseases was assessed. Majority of the students knew that people of young age can be vulnerable to develop CVD(n=328;86%).Most of the students reported that quitting on habit of smoking (n=362;95%) and keeping blood pressure under control can reduce risk of CVD (n=362;95%).The response to query that arrhythmias can cause sudden cardiac arrest in both young and old age, was in high numbers.(n=322;84.5%). A large number of students knew that stress and inflammation increase risk of Ischemic Heart Disease (n=362;95%).

After computing all the 8 variables of Section B, mean was found to be 7.5. Using mean as the cut-off point, scores of less than or equal to 7.5 were considered as inadequate. However, scores of greater than 7.5 were considered as adequate. Results showed that nearly 66% (n=250) medical students had adequate knowledge about CVD risk factors. The knowledge on benefits of micronutrients in prevention of CVD was assessed in Section C of questionnaire. The students (n=342;89%) agreed to fact that balanced diet containing essential micronutrients can prevent CVD. They agreed to the fact that potassium has a major role in

regulating hypertension (n=217;57%). Least number of medical students (n=10;2.6%) knew about the role of magnesium in heart diseases. A few only knew that severe magnesium deficiency can lead to tachyarrhythmias and even sudden cardiac arrest(n=10;2.6%).The(n=122; 32%) students reported that Vitamin D has numerous benefits in heart diseases. (Table 2)

Table 2 Knowledge of the medical students on risk factors of cardiovascular diseases and benefits of micronutrients in their prevention

SECTION B: Knowledge of Risk Factors of CVD.	Yes n (%)	No n (%)
1.CVD can occur at young age.	328(86.1%)	53(13.9%)
2. Quitting smoking can lower risk of CVD.	362(95%)	19(5%)
3. Management of hypertension can reduce risk of CVD.	362(95%)	19(5%)
4. Obesity predisposes to CVD.	362(95%)	19(5%)
5. Arrhythmias cause sudden cardiac arrest in young and old aged people.	322(84.5%)	59(15.5%)
6. Stress and inflammation causes Ischemic Heart Disease .	362(95%)	19(5%)
7.Hyperlipidemias can exacerbate atherosclerosis.	381(100%)	0(0%)
8. Chest pain can be sign of Ischemic Heart Disease.	381(100%)	0(0%)
SECTION-C Knowledge on benefits of micronutrients in prevention of CVD	Yes n (%)	No n (%)
1.Balanced diet containing essential micronutrients can prevent cardiovascular diseases.	342(89.8%)	39(10.2%)
2. I have knowledge about the specific micronutrients that can be beneficial for heart health.	198(52%)	183(48%)
3. I have knowledge about the recommended daily allowances of such micronutrients.	2(0.5%)	379(99.5%)
4 .Potassium can regulate hypertension.	217(57%)	164(43%)
5. Magnesium has infinite benefits in heart diseases.	10(2.6%)	371(97.4%)
6. Hypomagnesemia causes tachyarrhythmias.	10(2.6%)	371(97.4%)
7. Severe magnesium deficiency can lead to sudden cardiac arrest .	10(2.6%)	371(97.4%)

8. Vitamin D has numerous benefits in prevention of cardiovascular diseases.	122(32%)	259(68%)
9. Calcium causes hardening of blood vessels and can cause atherosclerosis in established heart disease.	95(24.9%)	286(75.1%)
10. Selenium can stop free radical damage and prevent heart disease.	95(24.9%)	286(75.1%)

After computing all the 10 variables of Section C, mean was found to be 3. Using mean as the cut-off point, scores of less than or equal to 3 were considered as inadequate. However, scores of greater than 3 were considered as adequate. Results showed that only 31% (n=117) had adequate knowledge about role of micronutrients in prevention of cardiovascular diseases. Chi square test of association was run between demographic variables and knowledge of medical students. Significant association was found between knowledge and demographics variables of medical students like gender, academic year and interest in reading health literature. (Table 3)

Table 3 Chi square Test of Association between level of knowledge and demographic factors of medical students: Table displays variables having significant association.

Demographic Variables	Knowledge on benefits of micronutrients in cardiovascular diseases. ADEQUATE INADEQUATE		Chi-square (df)	P-value
Gender				
Male	61(36.3%)	107(63.7%)	4.430(1)	0.035
Female	56(26.3%)	157(73.7%)		
Academic Year				
3rd Year	33(20.6%)	127(79.4%)	24.328(1)	0.000
4th Year	43(30.3%)	99(69.7%)		
Final year	41(51.9%)	38(48.1%)		
Interest in reading Health Literature				
Yes	44(38.6%)	70(61.4%)	4.757(1)	0.029
No	73(27.3%)	194(72.7%)		

Discussion

The knowledge to understand and apply information in medical practise to make decisions in terms of health care and disease prevention is of utmost importance. The knowledge of medical students about preventive medicine and nutrition is usually suboptimal. During clinical years of undergraduate studies, maximum awareness can change their attitude and perspectives as future physicians. Various studies have been conducted on medical students and physicians to examine the perceived importance of knowledge and confidence in nutritional management across the globe. Majority of students as well as medical practitioners agreed that health care professionals should understand nutritional issues in managing diseases(28)(29)(30).

In the past, numerous surveys were conducted among medical students in different regions of the world including Pakistan, to assess knowledge on the risk factors of cardiovascular diseases. However, there is scarce literature available in which the knowledge on importance of micronutrients in prevention of CVD was assessed. The students had optimal knowledge about risk factors but inadequate knowledge about the therapeutic as well as preventive aspects of nutrients(31)(32)(33).

In the present study, the two-third of medical students were well aware of the risk factors of cardiovascular diseases because of the fact that they have appropriate knowledge about the physiological aspects of different systems of the body as well as diseases related to them. However, only one-third of medical students had knowledge about the role of micronutrients in maintaining cardiovascular health. Nutrition education for training physicians (NEP 2013 survey) was conducted from February 2013 till July 2013 through email to Dean/Principal, Head of department of Biochemistry in all medical colleges of Pakistan. Survey was designed to capture and quantify the instruction that occurs in different types of courses across the five years of undergraduate medical curriculum of Pakistan Ethical approval for this study was taken by College of physicians and surgeons-Health professional education department (CPSP-HPE). 14 out of the 15 medical colleges responded that some form of nutrition education was given to the students; however, only 1 school is running a planned nutrition course. Only 1 college was meeting the requirement as recommended by the American National Academy of Sciences(34).

Conclusion

Being well aware about the preventive aspects of nutrition is the crucial barrier to health education. This can leave a lasting impact on changing the attitude, behaviour and clinical practice of medical students, the future clinicians with an active role not only in the treatment but also in the prevention of the disease. This can contribute in reduction of medical costs, morbidity and mortality due to cardiovascular diseases.

Limitations of study

The limitation of this study is inclusion of only one city, Rawalpindi. More data from all over the Pakistan, would be generalizable to the medical students of our country. Moreover the intervention could not be adopted to appraise the pre-and post-intervention level of knowledge of medical students.

Ethical approval

The study was conducted after getting letter from Institutional Review Board of Al-Shifa School of Public Health, Pakistan Institute Of Ophthalmology,Rawalpindi.

Conflict of interest

Authors declared no conflict of interest.

Authors'contribution

SH: Conception, design, analysis, interpretation of data, drafting and proof reading of paper
QW: Conception, design, proof reading, revision of paper, advices.
SU: Conception, design, proof reading, revision of paper, advices.
MTB: Statistical analysis, proof reading, revision of paper, advices.
AS: Literature search, data collection, advices.
RS: Literature search, data collection, advices.

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