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EDITORIAL

Medical Ethics Education: Bridging the Gap Between Theory and Practice

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Medical ethics plays a critical role in the healthcare field, providing healthcare professionals with a framework for making morally sound decisions in complex, high-stakes situations. While ethical theory provides essential guidance, the application of these principles in real-world scenarios can be challenging. Bridging the gap between theoretical knowledge and practical application is crucial in medical education, ensuring that healthcare providers not only understand ethical principles but also know how to apply them in clinical practice. This editorial explores the importance of medical ethics education, the challenges in integrating theory with practice, and strategies for enhancing the teaching and application of medical ethics in healthcare.

Keywords: Medical Ethics Education, Ethical Decision-Making, Healthcare Professional Development.

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Medical ethics education provides healthcare professionals with the foundational knowledge of ethical principles such as autonomy, beneficence, non-maleficence, and justice. These principles form the backbone of ethical decision-making in healthcare settings. Autonomy refers to a patient's right to make informed decisions about their healthcare, beneficence emphasizes the healthcare provider's duty to act in the best interest of the patient, non-maleficence stresses the importance of doing no harm, and justice ensures fairness in the distribution of healthcare resources.[1] While these principles are widely recognized and accepted, applying them in practice is often complicated. In real-world healthcare settings, situations arise where ethical principles conflict, and healthcare professionals must navigate these conflicts with careful consideration. For example, respecting a patient's autonomy may conflict with the healthcare provider's judgment about what is in the patient's best interest. Ethical education must not only convey the importance of these principles but also prepare healthcare providers to manage such ethical dilemmas in diverse clinical environments.[2]

Several challenges hinder the integration of theoretical ethics into practical decision-making in medical education and practice. While ethical principles are crucial in guiding decision-making, they can often appear abstract when taught in the classroom. For example, autonomy is an essential principle in medical ethics, yet respecting autonomy can be difficult when a patient's decision contradicts the healthcare provider's professional judgment or when the patient lacks the capacity to make informed decisions. Similarly, balancing beneficence and non-maleficence can be complex when a treatment that benefits a patient may also cause harm. In such situations, ethical principles are not clear-cut and require nuanced interpretation.[3] Although medical ethics is a core component of medical education, many students and trainees have limited exposure to real-world ethical dilemmas until they begin practicing. While ethics courses often include theoretical discussions and case studies, these rarely replicate the pressures and complexities of clinical practice. As a result, healthcare professionals may be ill-prepared to address ethical dilemmas when they arise in practice, leading to moral distress or suboptimal decision-making.[4]

The quality and scope of medical ethics education vary widely across institutions. While some medical schools provide extensive training in ethics through dedicated courses and ethics rounds, others treat ethics as a peripheral subject with limited classroom time. This inconsistency means that healthcare professionals may have differing levels of ethical competence, leading to variability in how ethical dilemmas are addressed in practice.[5] Ethical decision-making in healthcare is heavily influenced by

cultural, societal, and personal factors. For instance, while many Western healthcare systems prioritize individual autonomy, some cultures place a higher value on familial or community decision-making. This cultural variation can lead to ethical dilemmas when healthcare professionals' values clash with those of the patient or their family (Saha et al., 2008). Medical ethics education must include training on cultural competence to help healthcare professionals navigate these challenges effectively.[6] Healthcare professionals often work under significant time pressures and heavy workloads, which can hinder their ability to engage in ethical reflection. In busy clinical settings, the urgency of patient care may lead providers to prioritize technical tasks over ethical considerations. These pressures can cause healthcare professionals to overlook or neglect the ethical dimensions of their decisions, potentially leading to moral distress.[7]

To effectively bridge the gap between theoretical knowledge and practical application, medical ethics education must incorporate strategies that promote critical thinking, practical experience, and cultural competence. One of the most effective methods for bridging the theory-practice gap is through case-based learning. Case studies allow students to examine real-world ethical dilemmas and engage in discussions about possible courses of action. This method helps students develop critical thinking skills and provides them with opportunities to practice ethical decision-making in a controlled environment.[8] Ethical simulations, such as role-playing exercises, offer an interactive approach to learning where students can take on various roles and make decisions in real-time scenarios, promoting a deeper understanding of how ethical principles are applied in practice.[9] Ethics rounds, which involve discussions among a team of healthcare professionals, ethicists, and legal experts, are a valuable tool for enhancing medical ethics education. These rounds allow students and professionals to collaboratively analyze ethical dilemmas and consider different perspectives. Interdisciplinary ethics rounds help students understand the complexity of ethical decision-making in clinical practice and develop the skills to work effectively as part of a team.[10] Mentorship is essential in the development of ethical competence. Experienced healthcare professionals who serve as ethical role models can guide students and trainees in applying ethical principles to real-world situations. Through mentorship, students can observe how experienced practitioners navigate ethical dilemmas and receive feedback on their own decision-making. Mentorship also provides an opportunity for students to reflect on their ethical beliefs and values and to receive guidance on how to align their actions with ethical principles in practice.

Cultural competence is an essential component of medical ethics education. Healthcare professionals must be equipped to understand and respect the cultural beliefs, values, and preferences of their patients. Cultural competence training helps students recognize the influence of culture on healthcare decisions and prepares them to navigate ethical dilemmas that arise from cultural differences. This training is particularly important in diverse healthcare settings, where patients may have differing expectations of care based on their cultural backgrounds.[11,12]

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RESEARCH ARTICLE

Serum Creatinine and Estimated Glomerular Filtration Rate (eGFR) In Elderly Male Persons

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ABSTRACT: Prevalence of chronic kidney diseases increases with age. This study was done to observe some aspects of renal function status in elderly male in comparison to younger male. This analytical type of cross-sectional study was carried out in the Department of Physiology, Mymensingh Medical College, Mymensingh, Bangladesh from January 2019 to December 2019. A total number of 140 male subjects were included in this study. Among them seventy (70) younger males were taken as control group (Group I), and seventy (70) elderly males were taken as study group (Group II). Serum creatinine was measured by kinetic colorimetric method and estimated glomerular filtration rate (eGFR) by using Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. Data were expressed as mean (±SD) and statistical significance of difference among the group was calculated by unpaired student's t-test. Pearson's correlation coefficient test was done to find the correlation of eGFR with age. In this study we found that eGFR of elderly male was significantly decreased than younger male. serum creatinine was slightly higher in elderly male persons in comparison to younger male. Although the magnitude of correlation differed, eGFR was negatively correlated with age of the subjects. Based on the study carried out it can be concluded that due to the aging process geriatric populations are more prone to the development of kidney diseases than younger individuals.

Keywords: Elderly Male, Serum Creatinine, Estimated Glomerular Filtration Rate (eGFR).

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INTRODUCTION

Aging, an inevitable and extremely complex, multifactorial process, is characterized by the progressive degeneration of organ systems and tissues. It is largely determined by genetics, and influenced by a wide range of environmental factors, such as diet, exercise, exposure to microorganisms, pollutants, and ionizing radiation.[1] The United Nations uses 60 years to refer to older people and taken to be elderly segment of the population of a country.[2] According to the long questionnaire survey, census 2011, the percentage of elderly in Bangladesh is 7.7 percent.[3] The statistical data of Bangladesh represent the number of aged populations has increased from 1.38 million to 7.59 million from the year of 1974-2001 and projected figure difference from 2000 to 2025 will be 10.37 million.[4] This should be seen as an emerging challenge as the elderly will have special needs and require different care-giving services.

Physiological and pathological changes impair the ability of the kidney to withstand and recover from injury, contributing to high susceptibility of the aged population to AKI (Acute kidney injury) and their increased propensity to develop subsequent progressive CKD (chronic kidney disease).[5] Based on Medicare (age> 65 years) claims data for 2011 prevalent US population, CKD was noted to be about 10% in older in contrast to 1.5% of the younger employed population suggesting that the elderly carried the overall burden of CKD.[6] Huda *et al.*, reported that the prevalence of CKD was higher among elderly people aged more than 40 years (16.5%) than their counterparts whose age was between 25 and 40 years (10.7%).[7] Bambui study, conducted in a small city in southeast Brazil showed that 5.1% of the residents aged > 60 years had an increased serum creatinine value.[8] Zhang et al, showed that 4.6% of normotensive elderly people had higher serum creatinine level than normal.[9]

In a study of primary care practices across Britain, Roderick *et al.*, conducted a multidimensional assessment of adults 75 years and older of whom more than half had an eGFR of less than 60 ml/min/1.73m.[2, 10] A cross-sectional study in Greek among participants aged 65 years old and over found eGFR level between 60 ml/min and 89ml/min. This study also reported that age was negatively associated with the value of eGFR.[11] Impaired kidney function is

highly prevalent in elderly and is a risk factor for cardiovascular disease, adverse health outcome and death. Because kidney function is a major determinant of health in the elderly, it is important to understand the expected rate of change in kidney function.[12]

METHODS

The present study was a cross-sectional analytical study. It was conducted in Department of physiology, Mymensingh Medical College, Mymensingh from January 2019 to December 2019. Ethical permission was taken from the Institutional Review Committee of Mymensingh Medical College. The subjects were obtained from the Department of Medicine, Mymensingh Medical College & Hospital and from the locality of Mymensingh. The subjects were selected by purposive sampling. After proper counseling, written informed consent was taken. A total number of 140 male subjects were included in this study. Among them seventy (70) younger males were taken as control group (Group I), and seventy (70) elderly males were taken as study group (Group II). Serum creatinine was measured by kinetic colorimetric method and estimated glomerular filtration rate (eGFR) by using Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation based on serum creatinine. Data were expressed as mean (±SD) and statistical significance of difference among the groups was calculated by unpaired student's t-test. Pearson's correlation coefficient test was done to correlate the relationship of eGFR with age of the subjects. Statistical analysis was done by using Statistical package for social science (SPSS) for windows version-21. P value <0.05 was considered as significant.

RESULTS

In this study the mean age of control group (Group I) was 31.90±6.35 years & the mean age of study group (Group II) was 66.84±5.54 years. The mean (±SD) of serum Creatinine of control group (younger male) and study group (elderly male) were 0.81±0.10 mg/dl & 0.84±0.16 mg/dl respectively. In the study group, serum Creatinine was slightly increased in comparison to the control group. The mean (±SD) of eGFR level of control group (younger male) and study group (elderly male) were 117.21±9.63 mg/dl & 89.9±11.43 mg/dl respectively. In study group serum eGFR level was decreased in comparison to control group. Result is highly significant (p<0.001). eGFR (r= -0.830) was negatively correlated with age and this relationship was statistically significant. (The results are shown in figure 1, 2 and 3).

Table 1: Comparison of Serum Creatinine and eGFR Between Two Groups

Parameters	Group I (n=70) Mean±SD	Group II (n=70) Mean±SD	P value
S. Creatinine (mg/dl)	0.81±0.10	0.84±0.16	0.186
eGFR (ml/min/1.73m2)	117.21±9.6	89.9±11.43	0.00**

n = Total number of subjects in each group, Data are expressed as mean±SD. Statistical analysis were done by unpaired student's 't' test. *= significant at 0.05 level. ** = Significant at p < 0.001.

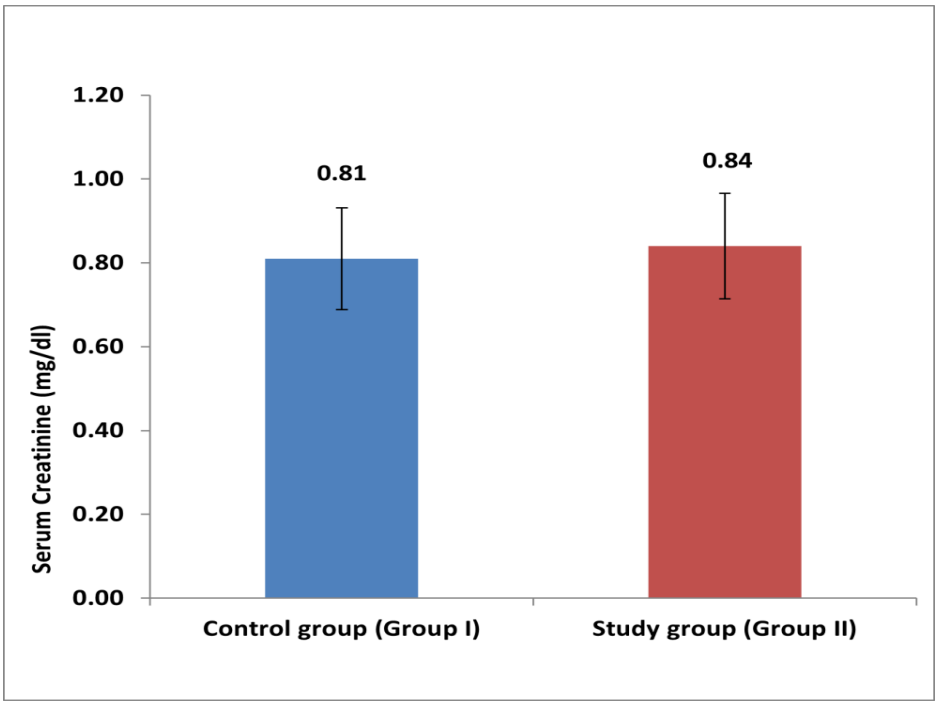

Figure 1: Bar Diagram Showing Mean Value of Serum Creatinine in Both Control and Study Groups

Group I: Control group (younger male), Group II: Study group (elderly male).

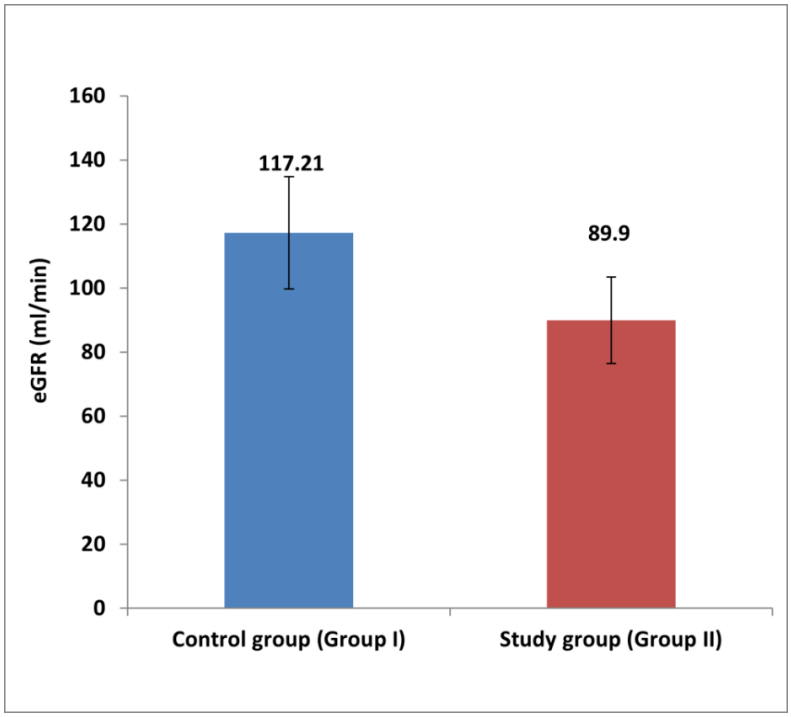

Figure 2: Bar Diagram Showing Mean Value of eGFR in Both Control and Study Groups

Group I: Control group (younger male), Group II: Study group (elderly male).

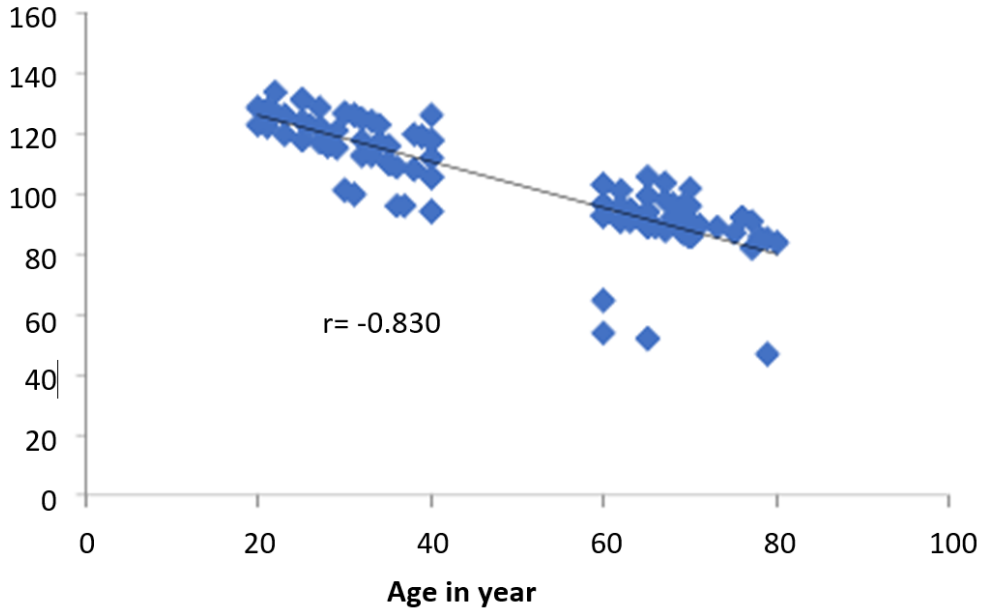

Figure 3: Scatter Diagram Showing Negative Correlation of Estimated Glomerular Filtration Rate (eGFR) With Age

r = correlation coefficient

Control group (Group I): Younger male group (20-40 years), Study group (Group II): Elderly male group (60-80 years).

DISCUSSION

In this study serum creatinine was slightly increased (non-significant) in the study group in comparison to the control group. Similar findings were obtained from the study of Rowe *et al.* and Culleton.[13, 14] Teitz *et al.*, showed serum creatinine remains unchanged in

healthy elderly persons due to the progressive decrease in muscle mass.[15] Some researchers suggested that the cause of decline in serum creatinine in elderly is a protein- and meat-reduced diet, increased excretion by tubular secretion or gastrointestinal elimination16. In this study, there was significantly decreased eGFR in study group in comparison to control group and the result was highly significant at 1% level of probability ($p<0.001$). Similar findings were obtained from study of Cohen *et al.*, Fehrmen-Ekholmn I & Skepplohmn L, Musab, Coresh *et al.*[17-20] A series of studies by Fliser *et al.*, proposed that age-related decline in GFR is largely driven by a vascular (arterial) process.[21] It was tempting to speculate that nephrosclerosis and GFR decline are linked. There is evidence that cortical atrophy with aging is linked to the same process that causes GFR decline.[22]

With normal aging, the number of nephrons gradually decreases. After age 40 years, the number of functioning nephrons usually decreases about 10 percent every 10 years; thus, at age 80 years, many people have 40 percent fewer functioning nephrons than they did at age 40 years.[23] Huber *et al.*, Wiggins *et al.*, Zhang *et al.* hypothesized that progressive reduction in number of viable and normally functioning podocytes, along with decreased capacity for their regeneration and repair, ultimately lead to glomerular obsolescence and also subtle deterioration of the integrity of slit pore membrane in glomeruli, affecting whole kidney GFR.[24-26] Hoang *et al.* demonstrated reductions in GFR and RBF and a significant reduction in kf (Filtration coefficient) as compared with subjects under the age of 40, those over the age of 55.[27] The reduction in Kf was calculated to result from reductions in both the glomerular capillary permeability and the surface area available for filtration. In addition, a primary reduction in afferent arteriolar resistance is associated with an increase in glomerular capillary hydrostatic pressure. These hemodynamic changes occur in concern with structural changes, including loss of renal mass; hyalinization of afferent arterioles and in some cases, development of aglomerular arterioles; an increase in the percentage of sclerotic glomeruli and tubulointerstitial fibrosis.[28] Abdulkader *et al*. suggested that a decreased GFR in the elderly is strongly indicative of the presence of hypertension and other comorbidities.[29]

CONCLUSION

From the present study it can be concluded that age has an appreciable effect on renal function status. Although age related decline in GFR was formerly considered part of normal aging, decreased GFR in the elderly is an independent predictor of adverse outcomes such as death and cardiovascular disease. Older age is a risk factor for development of chronic kidney disease, most likely reflecting both lower mean level of eGFR and higher rate of renal function loss in older compared with younger. So early detection of impairment of kidney function can prevent severe age-related complications of kidney.

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RESEARCH ARTICLE

Change in Serum Iron Level in Patients with Type 2 Diabetes Mellitus

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ABSTRACT: ***Background:*** Type 2 diabetes mellitus (T2DM) is a growing global public health concern of new era, with prevalence steadily increasing especially in Bangladesh. Disturbance of serum iron metabolism causes several biochemical reactions those may be related with subsequent disruption in glucose metabolism and glycemic control. ***Methods:*** This cross-sectional analytical type of study was performed from July 2023 to June 2024, in the Biochemistry department of Mymensingh Medical College and samples were collected from the Endocrinology department of Mymensingh Medical College Hospital, Mymensingh. Purposive non-random sampling technique was used to select study subjects according to inclusion and exclusion criteria. Total 132 subjects were included. Among them, 66 subjects were selected as Group-I (case) patients with type 2 diabetes mellitus, diagnosed according to ADA criteria, aged from 30 to 65 years of both male and female. Another 66 subjects were selected as Group-II (control) non diabetic apparently healthy individuals of the same age & sex matched. Informed written consents were obtained. Baseline parameters were recorded in pre-designed data collection sheets. Fasting serum glucose and serum iron were analysed, mean ± SD was used to express all values. ***Results:*** Following comprehensive analysis, it was revealed that highly significant ($P < 0.001$) raised of serum iron level in patient with T2DM (140.27 ± 20.45 µg/dl) case group when compared with non-diabetic apparently healthy individuals (86.61 ± 19.34 µg/dl) control group. Also showed that, highly significant positive correlations of fasting serum glucose with serum iron in patients with T2DM ($r = 0.432$, $P < 0.001$). ***Conclusion:*** This study will provide facility to the clinicians to improve their knowledge to overall management of T2DM. So, it is recommended early evaluation & monitoring of serum iron in T2DM.

Keywords: Type 2 Diabetes Mellitus, Serum Iron, Fasting Serum Glucose.

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INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders of multiple aetiology characterized by hyperglycemia with disturbances of carbohydrate, protein and fat metabolism resulting from defects in insulin secretion, action or both.[1] Type 2 diabetes mellitus (T2DM) precisely involves progressive decline in insulin secretion, results from ineffective use of insulin characterized by insulin resistance (IR) and often accompanied by metabolic syndrome.[2] Globally DM is most prevalent non communicable disease, around 537 million adult population in 2021, that is projected to reach 783 million in 2045.[3] T2DM is the account of 90% to 95% of all diabetes cases, almost 1 in 2 people with this disease, don't aware that they have it. Each year persons with this disease are increasing gradually.[4] The position of Bangladesh was 8th in number in the world, with 13.1 million diabetic people, prevalence 14.2% in 2021. By 2045 this number is projected to 22.3 million with prevalence 15.3% and 7th in position globally.[3] The consequences of this disease & related complications have an extremely undesirable influence on the socio-economies conditions. Prevalent of the disease is spreading progressively, posing major challenges for health policy planners.[5] T2DM is related to many risk factors like high calorie diet, obesity, sedentary life style, genetic predispositions, metabolic and environmental influence. In addition to known risk factors, the role of different micronutrients increase incidence of

T2DM has been proposed.[6] Serum iron is the highly significant micronutrient for human life.

It is related with many metabolic and cellular processes including oxygen transport, mitochondrial respiration and structural component of different proteins. Proper balance within iron intake, metabolism, utilization & loses is needed for homeostasis.[7] Disturbance of serum iron metabolism causes several biochemical reactions those may be related with subsequent disruption in glucose metabolism and glycemic control.[8] In T2DM, because of hyperglycemia blood osmolarity is changed. That may cause more hemolysis due to increase fragility of red blood cells, can interfere with iron metabolism and changes serum iron level.[9] Unregulated iron can lead to oxidative stress by Haber-Weiss & Fenton reactions, may contribute to β-cell dysfunction, insulin resistance and subsequent disruption in glucose metabolism.[10] Highly toxic free iron deposition in the liver may lead to abnormal metabolic processes in the liver and adipose tissue, that causes decrease insulin extraction and increase hepatic gluconeogenesis.[11] Association with some genetic factors, dietary more iron intake, excess parenteral iron therapy, obesity and inflammation may be role in pathogenesis & progression of T2DM.[12] Thus, in T2DM alteration of iron may effects on glucose dysregulations and glucose on iron vice-versa, with bi-directional relationship.[13] Appropriate monitoring & regulation of iron level along with glycemic control of T2DM is useful for homeostasis. The present study was undertaken to evaluate the changes of serum iron in patients with type 2 diabetes mellitus (T2DM) and compared with non-diabetic apparently healthy individuals.

METHODS

This was cross sectional analytical type of study was performed in the Biochemistry department of Mymensingh Medical College & samples were collected from the Endocrinology department of Mymensingh Medical College Hospital, Mymensingh, from July 2023 to June 2024. The study was reviewed and approved by Institutional review board (IRB) of MMC, Memo no: IRB/24/628, Date: 04.12.23. Total 132 subjects were included. Out of them, 66 subjects were selected as Group-I (case) patients with type 2 diabetes mellitus, diagnosed according to ADA criteria serum glucose (fasting) level ≥7.0 mmol/L or ≥126 mg/dl, aged from 30 to 65 years of both male and female. Another 66 subjects were selected as Group-II (control) non diabetic apparently healthy individuals of the same age & sex matched. Exclusion criteria were persons receiving iron supplementation, chelating agents and other drugs those alter test parameter. Known case of iron related disorders, chronic kidney disease, chronic liver disease, patients with prediabetes and other types of DM also excluded. On the base of inclusion and exclusion criteria, study objectives were described to the study subjects and who gave written consent consciously and voluntarily were enrolled. Baseline parameters were recorded in pre-designed data collection sheets. For laboratory investigations, under aseptic precaution 05 ml of fasting venous blood was collected, processed and preserved for estimation of serum iron by photometric colorimetric test for iron with lipid clearing factor (LCF) by chromazurol B (CAB) method 14 and serum glucose by enzymatic colorimetric test for glucose, glucose oxidase - peroxidase with amino phenazone & phenol (GOD-PAP) method 15. By using SPSS (statistical product and service solutions) version 26.0. windows package; statistical analysis was done. Qualitative variables were presented by percentage (%) and compared between groups by Chi-square test. Quantitative continuous variables were presented by Mean ± SD and compared between groups of subjects by using Student's unpaired 't' test. Correlations were done by using Pearson's correlation coefficient test. Level of significance was defined as ($P < 0.05$) at the level of 95 % confidence interval (CI), ($P > 0.05$) was taken as not significant and ($P < 0.001$) was considered as highly significant result.

RESULTS

Total study subjects were 132, In group-I (case) subjects were 66, among them 29 (43.94 %) were female and 37 (56.06 %) were male. And in group-II (control) subjects were 66, among them 31(46.97 %) were female and 35 (53.03 %) were male. The subjects were ranged from 30 to 65 years, Mean ± SD of age was 49.27 ± 8.74 years in group-I (case) and 48.67 ± 8.87 years in group-II (control). The analysis showed that the difference in the demographic characteristics (age and sex) was not significant (NS) ($P > 0.05$) in patients with T2DM compared to that of the control group. Comparison of mean value of demographic characteristics among the study subjects were presented in Table 1.

Table 1: Demographic Characteristics Among the Study Subjects

Variables	Group I (Case) n=66	Group II (Control) n=66	P value
Age (years) Mean ± SD	49.27 ± 8.74	48.67 ± 8.87	0.693 NS [a]
Sex n (%)			
Male	37 (56.06 %)	35 (53.03 %)	
Female	29 (43.94 %)	31 (46.97 %)	0.727 NS [b]

To measure the level of significance in Table 1, a = Student's unpaired 't' test, b = Chi- square test Group- I (case): Patients with T2DM. Group- II (Control): Non diabetic apparently healthy individuals. NS = (P > 0.05) Not significant result, SD = standard deviation.

It also observed that, The Mean ± SD values of serum iron were 140.27 ± 20.45 µg/dl in group-I (case) and 86.61 ± 19.34 µg/dl in group-II (control). The Mean ± SD values of fasting serum glucose were 8.63 ± 1.17 mmol/L in group-I (case) and 4.91 ± 0.40 mmol/L in group-II (control). This study revealed that, serum iron and fasting serum glucose were higher in group-I (case) than that of group-II (control) significantly. The analysis showed that the difference in mean values of serum iron and fasting serum glucose was statistically highly significant (P < 0.001) in patient with T2DM compared to that of the control group. Comparison of mean serum iron & fasting serum glucose levels in the study subjects was presented in Table 2.

Table 2: Comparison of Mean Serum Iron & Fasting Serum Glucose Among the Study Subjects

Variables	Group I (Case) Mean ± SD n=66	Group II (Control) Mean ± SD n=66	P value
Serum iron (µg/dl)	140.27 ± 20.45	86.61 ± 19.34	< 0.001**
Fasting serum glucose (mmol/L)	8.63 ± 1.17	4.91 ± 0.40 mmol/L	< 0.001**

To measure the level of significance in Table 2, Student's unpaired 't' test was done. Group- I: Patients with T2DM. Group- II: Non diabetic apparently healthy individuals. ** = (P < 0.001) considered as highly significant result. SD = standard deviation.

Table 3: Correlations Between Fasting Serum Glucose and Serum Iron in Patients With T2DM

Dependent	Independent		Co-efficient value (r)	P value
Glucose (fasting) (mmol/L)	Serum iron (µg/dl)		0.432	< 0.001**

To measure the level of significance in table-3, Pearson correlation co-efficient test was done. ** Correlation is highly significant when P < 0.001 r = Pearson correlation co-efficient test, which ranges from -1 to +1. Positivity indicates direct or positive relation. Negativity indicates indirect or negative relation.

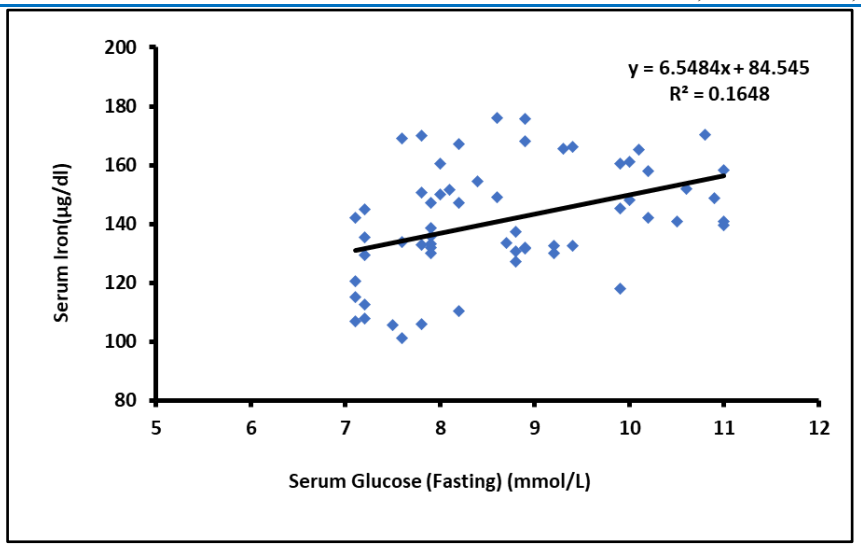

Figure 1: Correlation Between Fasting Serum Glucose and Serum Iron in Patients with T2DM

In this study also showed that, highly significant positive correlations of fasting serum glucose with serum iron in patients with T2DM (r = 0.432, P < 0.001). Pearson correlation coefficient test was done to see the relation & level of significance. That is presented in table-3 and Figure 1.

DISCUSSION

The present study revealed that there was, no statistically significant (P > 0.05) difference in demographic characteristics (age and sex distribution) between the patients with T2DM group and non-diabetic apparently healthy group. The present study revealed that, highly significant (P < 0.001) increase of serum iron in case compared to that of the control group. This finding agreed with the studies of Saha *et al*., Zerin *et al*., Akhter *et al*. and other studies.[7, 9, 11, 13, 16, 17] They observed that, serum iron level was raised in patient with T2DM (case) when compared with non-diabetic apparently healthy individuals (control) group. Disturbance of iron metabolism causes several biochemical reactions those may be related with disruption in glucose metabolism.[8] Thus, in T2DM subsequent alteration of iron level effects on glucose dysregulations and glucose on iron vice-versa, with bi-directional relationship.[13] Because of hyperglycemia blood osmolarity is changed in T2DM.

That may cause more hemolysis due to increase fragility of red blood cells, can interfere with iron metabolism and increase serum iron level.[9] Low level of hepcidin may be linked to insulin resistance, for this increased iron absorption and elevated serum iron level in T2DM.[18] Increased iron levels might be role in pathogenesis in T2DM by oxidative strain, beta cell distraction & impairment of insulin function. That exacerbating insulin resistance and related metabolic syndrome.[19] Association with some genetic factors, dietary more iron intake, excess parenteral iron therapy, obesity and inflammation that is contributing to the development of neurological and vascular complications with T2DM.[12] However, some conflicting studies conducted by Lagisetty *et al.,* and Manikandan *et al*., observed that serum iron was decreased in patients with T2DM.[20, 21] Chronic duration of diabetes, inadequate daily nutritional supply of iron, malnutrition or other associated complications may be related with low level of serum iron in T2DM.[20] Although, in contrast to this result some studies conducted by Kuba et al., and Sowjanya et al., were reported that no significant change of serum iron in T2DM compared to control.[22, 23] For this situation possible reason may be all patients involved in those studies were almost stable diabatic state or under control by proper treatment. Pearson's correlation coefficient test also done between fasting serum glucose and serum iron in patients with T2DM. Highly significant positive correlation of fasting serum glucose with serum iron in patients with T2DM (r = 0.432, P < 0.001) This finding was well correlated and supported by most of the previous studies Zerin *et al*., Akhter et al., Zimiao *et al.* and Dhakad *et al*.[7, 13, 16, 24] However, controversial studies conducted by Saha *et al.*, & Sharifi *et al*., reported that correlation between fasting serum glucose and serum iron was not significant.[11, 25] The observed variations may be attributed to differences in study groups, methodologies or other related factors that influence

iron metabolism in the context of type 2 diabetes mellitus.

CONCLUSION

Accordingly, this study revealed that serum iron level was significantly elevated in type 2 diabetes mellitus and positive correlation with fasting serum glucose. This study sheds light on the bi-directional interplay between iron and glucose dysregulation, emphasizing the importance of these parameters for effective disease management and control of associated complications for homeostasis.

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Conflict of Interest: The authors declare no conflicts of interest related to this study.

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RESEARCH ARTICLE

Study of Position Mental Foramen in Relation with Lower Teeth of Dry Adult Human Mandible in Bangladeshi Population

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ABSTRACT: The mental foramen is the opening through which mental nerve passes from the mandible and usually located either between the roots of the first and the second premolar or apical to the second premolar. The aim of the study was to analyze different positions of mental foramen in Bangladeshi population. This cross-sectional descriptive study was done on 150 fully ossified dry human mandibles in the department of Anatomy, Mymensingh Medical College, Bangladesh between July 2019 to June 2020. A non- random purposive sampling technique was adopted. Study was carried out by observations only. In total samples, 131 (87.33%) samples showed this foramen on the longitudinal axis of second molar tooth and 19 (12.66%) samples showed this foramen in between the longitudinal axis of first and second molar teeth. Knowledge of these variations helps the dental and maxillofacial surgeons to do any interventional surgeries in this region of mandible.

Keywords: Mental Foramen, Dry Adult Mandible, Mental Nerve.

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INTRODUCTION

The mandible, the largest, strongest and lowest bone in the face, has a horizontally curved body, convex forwards and two broad rami, ascending posteriorly. The mandibular body, somewhat U-shaped, has external and internal surfaces, separated by upper and lower borders.[1] The mental foramen is located in the outer surface of the body of the mandible, midway between the inferior and the alveolar margin of body. It is present between premolars, in a vertical line with the supraorbital notch. It provides passage for the exit of mental nerves and vessels. Most of the mental foramina are oriented postero-superiorly. Variations in position of the mental foramina have been reported by many authors in different ethnic groups. The precise knowledge on the variation in the position of the mental foramen would be of much use for dental surgeries like curettage of premolar, filling procedure, dental implant, root canal treatment, orthognatic surgeries and nerve block anesthesia.[2]

MATERIALS AND METHODS

The cross-sectional descriptive study was performed between July 2019 to June 2020 in the department of anatomy, Mymensingh Medical college, Mymensingh, Bangladesh. Samples were collected from department of anatomy, Mymensingh Medical college and Community Based Medical College, Bangladesh. After all formalities from the Institutional Review Board (IRB) of Mymensingh Medical College (Memo no. MMC/IRB/2019/206 Dated. 11.11.2019), one hundred and fifty fully ossified dry human mandibles were collected by non-random purposive sampling technique. Unossified, broken and abnormal bones are excluded. Position of mental foramina was observed and noted whether it was just under the second premolar tooth or between the first and second premolar teeth. All the data were double checked, compiled and sorted properly. Analyzed data were displayed in table and pie diagram.

RESULTS

There were variations in position of mental foramen. In total samples, 87.33% (131) cases, the foramina were found on the longitudinal axis of 2nd premolar tooth. The rest, 12.66% (19) cases were found in between the longitudinal axis of 1st and 2nd premolar teeth.

Table 1: Incidence of Different Positions of Mental Foramen

Position of Mental Foramen	Frequency	Percent (%)
Below 2nd premolar	131	87.33
Junction between 1st and 2nd premolar	19	12.66

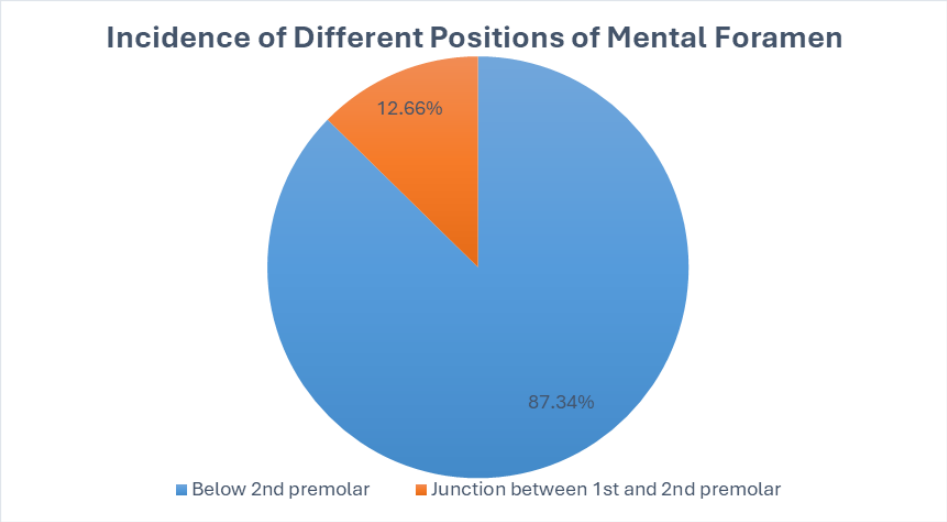

Figure 1: Incidence of Different Positions of Mental Foramen

DISCUSSION

In the present study there were variations in the position of mental foramina. In total samples, 87.33 % (131) cases, the foramina were found on the longitudinal axis of 2nd premolar tooth. The incidence of position of mental foramina below the 2nd molar tooth was higher than those of Alias *et al.*, Roy *et al.*, Karmali & Modi, Budhiraja *et al.*, Hoque *et al.*, Nanayakkara *et al.*, Singh & Srivastav as 44.3%, 52% 64.82%, 61%, 35.6% (Right) and 36.2% (Left), 63.6%(Right) and 45.4%(Left), 68.8% respectively.[3-9] In total samples, the incidence between the longitudinal axis of 1st and 2nd premolar tooth was 12.66% (19) in this study. The incidence was nearer to Singh & Srivastav as 17.8% but lower than those of Roy *et al.*, Karmali & Modi, Budhiraja *et al.*, Hoque *et al.* as 23.33%, 26.37%, 20%,42.2% (Right) and 42.7% (Left) respectively.[4-7, 9]

CONCLUSION

The knowledge on the positions of mental foramen is very much important for dental surgeons when they perform various form of surgeries. Our present study aims at acknowledging these positions and prevent complications and providing better outcome of the surgical procedures related to the mental foramen.

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ORIGINAL ARTICLE

Breast Self-Examination (BSE): Knowledge & Practice Among Rural and Urban Women in Selected Area in Kishoreganj

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ABSTRACT: ***Background:*** Breast cancer is the most common and deadly cancer among women worldwide, with rising incidence rates in both developed and developing nations, including Bangladesh, where late diagnosis is prevalent. Breast Self-Examination (BSE) is a simple, affordable, and accessible method for early detection, especially in resource-limited settings. Global initiatives like WHO's breast cancer framework and national strategies emphasize early detection through BSE to reduce mortality and improve survival rates. ***Materials & Methods:*** A descriptive cross-sectional study was conducted with a purposively selected sample of 189 from Mithamoiin, Kishoreganj, Bangladesh. Data was collected by the researcher using a face-to-face interview with a standard Breast Self-Examination scale of 22 items in two dimensions of BSE Knowledge and Practice. Data were analyzed using descriptive statistics (frequency, percentages, mean, SD). ***Results:*** The mean age was 27.78 years, most of them were Muslim (87.30%), 29.63% had no formal education. Majority (83.06%) of the participants were married and (74.07%) were housewife and their mean monthly family income was 22142.86 BDT. In this study, among all participants majority of the participants had poor level of knowledge (95.8%) and only 2.1% of participants had a good level of BSE practice. ***Conclusion:*** The study found that most women had poor knowledge about Breast Self-Examination (BSE), including its procedure, importance, and timing, with very few practicing it regularly. There is an urgent need to enhance knowledge and practice of BSE to promote early detection and prevention of breast cancer.

Keywords: Breast Self-Examination, Knowledge, Practice, Bangladesh.

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INTRODUCTION

Breast cancer is a serious, life-threatening public health issue. The disease's incidence has steadily increased in both developed and developing countries.[1] It is the most common type of cancer among females, and the risk increases with age.[2] In 2020, it was anticipated that the global cancer rate had climbed to 19.3 million new cases and 10 million fatalities.[3] In terms of incidence, the three most common cancer kinds are lung, colorectal, and female breast cancer. They rank in the top five (first, second, and fifth, respectively) in terms of mortality. These three cancer forms account for one-third of all cancer incidence and mortality globally[4]. Breast cancer is more common in women than other cancers worldwide. Furthermore, breast cancer is the most frequently diagnosed cancer in women (24.2%), and it is the most common in 154 of the 185 countries. Breast cancer remains the greatest cause of cancer mortality in females (15%)[4]. The incidence of breast cancer in Bangladesh is unclear because there is no national cancer registry. However, the Global Cancer Observatory anticipated a 5-year breast cancer frequency of 38.35 per 100,000 people, and 8.3% of the 156,775 new cancer cases in 2020 were caused by breast cancer.[5] The World Health Organization (WHO) has created a worldwide breast cancer initiative framework, with the goal of saving approximately three million lives by 2040.

This framework focuses on health promotion to ensure early detection, quick diagnosis, and adequate care of breast cancer cases[6]. Secondary prevention is the most effective way to reduce breast cancer mortality. Breast Self-Examination (BSE), Clinical Breast Examination (CBE), and mammography are essential, widely available, and recommended procedures for detecting breast cancer in its early stages[7]. Several randomized studies have established the efficacy of breast cancer screening with mammography [8]. However, it is expensive and demands significant financial and human resources. As a result, routine mammography screening is impractical and generally unavailable in developing nations. BSE is a simple, affordable, and safe examination procedure that does not require any invasive intervention or apparatus, respects

women's privacy, and can be performed comfortably at home.[7]

Breast cancer patients in Bangladesh and other underdeveloped nations are typically diagnosed late and at an advanced stage, resulting in a dismal outcome. Breast cancer mortality in the Western world is reducing due to early discovery through screening and better management.[9, 10] Breast cancer screening tests serve an important contribution in lowering breast cancer-related mortality.[11] According to a recent study, breast cancer is becoming more common in younger age groups in Bangladesh than in Western countries, and the disease is more aggressive during the reproductive period, indicating the need for changes in early cancer detection modalities as well as adjustments to preventive and therapeutic efforts.[12]

Breast cancer is a dreaded disease not only because it can be fatal, but also because it can alter a woman's sense of self, sexuality, and femininity. Furthermore, breast cancer is a taboo subject that is rarely discussed, and its documentation in the rural population is often overlooked [6]. The American Cancer Society also suggests that women perform breast self-examination (BSE) to become familiar with how their breasts generally feel and report any breast abnormalities to their health care professionals as soon as possible [13]. The 'National Cancer Control Strategy and Plan of Action 2009-15' in Bangladesh promotes clinical breast examination (CBE) and BSE as early detection methods for breast cancer to reduce disease stage and enhance survival [14]. Furthermore, the Breast Health Global Initiative (BHGI) recommendation for low- and middle-income countries recommends BSE as the first step toward preventing breast cancer [15].

However, according to my knowledge assessment published in Bangladesh, women's awareness and practice of BSE screening procedures are inadequate. Self-practice is impossible if one's knowledge is weak. As a result, the goal of this study is to determine the understanding and practice of BSE as a breast cancer screening approach for early detection.

MATERIALS AND METHODS

A cross-sectional study was conducted from November to December 2024 among rural women from selected Upazila (Mithamoiin) in Kisahoreganj District, Dhaka, Bangladesh. Total 189 rural women (20 – 45 year) were participant in this study. Both the study place and participants were selected purposively. The predesigned, pretested semi structured questionnaire were used as tool for data collection through face-to-face interview, it took 15-20 minutes. Informed consent was obtained prior to the interview from study participants. Privacy and confidentiality of the participants were maintained. The participation of the women was voluntary, and participants could refuse and withdraw from the study at any time without any penalty. Women who were diagnosed cancer patient, and pregnant women were excluded. Breast self-examination was measured by 3 parts questionnaires. (1) Socio-demographic Characteristics Questionnaire, (2) BSE Knowledge Scale, and (3) BSE Practice Scale.

Socio-demographic Characteristics Questionnaire

Based on a review of the literature, the researcher created the Socio-demographic Questionnaire (SCQ), which had seven items, including one about disease-related characteristics: age, religion, marital status, education, occupation, monthly income, and family history of breast cancer.

BSE Knowledge Scale

There are a total of 15 items of question to assess the knowledge of participants about breast self – examination. For positive Knowledge, items score '2' was used for correct answer (true response), '1' for don't know and '0' for incorrect that means (false responses) was applied. The negative question was reversed. The item number was one (1). Bloom's classification was used to assess the level of knowledge; a score below 60% indicated poor knowledge, while a score between 60 and 100 percent indicated positive knowledge, which was further divided into the following categories: 60 to 86 percent indicated satisfactory knowledge, and 86% to 100 percent indicated good knowledge.

BSE Practice Scale

There are a total of 7 questions to explore the practice of participants of breast self-examination. Practice similar ordinals (never/seldom/neutral/frequently/always) was applied. For practice an item score of 0, 1, 2, 3, 4, was given for never, seldom, neutral, frequently, and always respectively. The level of practice was score out of 28. A score of 15-28 indicates good practice while a score of 0-14 indicates poor practice. Data analysis was done by using a scientific calculator after entering in a master sheet. Quantitative variable was analyzed by mean while qualitative variable was summarized by percentage.

RESULTS

Socio-Demographic Characteristics and Disease Related Characteristics of Participants

A total of 189 participants were recruited for this study. The mean age of the participants was 27.78 years (SD= 7.2) with the range of 15 - 45 years of age. Most of them were Muslim (87.30%) by their religion. Only 10.05% of participants had higher secondary school education and 29.63% of them had no formal education. The majority (83.06%) of the participants were married. Most of participants (74.07%) were housewife and their mean monthly family income was 22142.86 BDT. Among all participants only 5.82% had a history of breast cancer in their family (Table 1).

Table 1: The Distribution of Socio-Demographic Characteristics and Disease Related Characteristics of the Participants (n=189)

Variable	Category	Frequency	Percentage
Age	15 – 24	67	35.45%
	25 – 34	89	47.09%
	35 – 45	33	17.46%
Religion	Muslim	165	87.30%
	Hindu	24	12.70%
Marital status	Married	157	83.06%
	Unmarried	23	12.17%
	Widowed	9	4.76%
Education	Illiterate	56	29.63%
	Primary	73	38.63%
	SSC	41	21.71%
	HSC	19	10.05%
Occupation	Housewife	140	74.07%
	Private job	25	13.21%
	Govt. job	7	3.70%
	Student	17	8.99%
Income	< 20000 BDT	98	51.85%
	20001 to 40000 BDT	69	36.51%
	40001 to 60000 BDT	20	10.58%
	>60000 BDT	02	1.06%
Family History Breast cancer	Yes	11	5.82%
	No	178	94.18%
Total		**189**	**100.0%**

Breast Self-Examination Knowledge of Participants

Table 2 showed the findings that among all participants, most of them 174 (92%) did not know about the duration of BSE and only 8 (4.1%) were aware of the exact time of BSE procedure. More than 90% women did not know about the position, techniques and methods of BSE (item no. 3 to 11). On the other hand, only 55 (29.1%) participants reported that during BSE they need to press on the nipple to check any unusual discharge from the breast. Majority of the women 173 (91.3%) reported that they 'need to observe any unusual change in the shape and size of the breast'. Although most of the participants 161 (85.5%) were aware about 'the retraction of the nipple is a warning sign that should be observed' but only 88 (46.5%) of the women knew about the statement of "lump is the early sign for cancer".

Table 2: Breast Self-Examination Knowledge of Participants (n=189)

Items	True Response	
	n	%
BSE should be done every 2 months	15	8%
BSE must be done between days 7 until 10 after menses	8	4.1%
BSE should be done in front of the mirror	9	4.7%
Undress until the waist when doing the BSE	7	3.5%
Hands should be raised up alternately above the head when doing the BSE in front of the mirror	2	1.2%
BSE should be done from the front view only	18	9.3%
BSE can be done in a supine position	18	9.3%
Palpate in the right breast while left-sided lying when doing the BSE	4	2.3%
Use finger pulps to examine any lumps of the skin	7	3.5%
BSE can be done using vertical strip and circular technique	8	4.1%
Need to press on the nipple to check for any unusual discharge	55	29.1%
BSE includes the arm-pit examination to check for any lump	65	34.3%
Need to observe any unusual change in the shape and size of the breast	173	91.3%
Retraction of the nipple is a warning sign that should be observed	161	85.5%
Lump is the early sign for cancer	88	46.5%

Breast Self-Examination Practice of Participants

Table 3 showed the findings that among all of the participants only 11 (6.4%) were practiced BSE once in a month, among them only 3 (1.7%) were practiced always BSE in a month. The majority 182 (95.9%) of the participants never learnt the correct method of BSE and 174 (91.9%) never discussed the importance of BSE with friends. Most 187 (98.8%) of the women never got advice

from parents, partner to do BSE. But among them only 3 (1.7%) of participants were indicated that they had been taught BSE by health staff. About 110 (58.2%) of the women never went to public health care directly, if notice any breast abnormality.

Table 3: Breast Self-Examination Practice of Participants (n=189)

Item	Never n (%)	Seldom n (%)	Neutral n (%)	Frequently n (%)	Always n (%)
Do BSE once a month	148 (78.5)	29 (15.1)	0	9(4.7)	3 (1.7)
Learning the correct method of BSE	182 (95.9)	3 (1.7)	0	1 (0.6)	3 (1.7)
Parents or partners advise me to do BSE	187 (98.8)	2 (1.2)	0	0	0
Advise friends to do BSE	182 (95.9)	0	0	4 (2.3)	3 (1.7)
Discuss the importance of BSE with friends	174 (91.9)	3 (1.7)	0	9 (4.7)	3 (1.7)
Have been taught BSE by health staff	184 (97.1)	2 (1.2)	0	3(1.7)	0
If notice any breast abnormality, directly go to public health care	2 (14)	84 (44.2)	1 (0.6)	43 (22.7)	35 (18.6)

Level of Breast Self-Examination Knowledge and Practice of Participants

The result showed that among all participantsmajority of the participants had poor level of knowledge (95.8%) and only 2.1% of participants had good level of BSE practice (Table 4).

Table 4: Level of Breast Self-Examination Knowledge and Practice of Participants (n=189)

Variable	Level	Score	n	%
Knowledge	Poor	<60%	181	95.8%
	Satisfactory	60-85%	8	4.2%
	Good	86 -100%	0	0.0%
Practice	Poor	<14	185	97.9%
	Good	14 – 28	4	2.1%
Total			189	100.0%

DISCUSSION

The present study involved women with the mean age was 27.78 years as it was reproductive age group, thus can motivate them for practicing BSE regularly to identify any abnormality in their breast as early as possible. Almost similar observation was revealed in study conducted in Bangladesh and Nepal but more in India.[16-18] Current study showed most of the participants were Muslims, married and more than three quarters of participants were at least primary education which was close to a study reported by Khatun, (2023) in Bangladesh.[16] Disease related characteristics in the present study very few participants only had history of breast cancer in their family which is consistent to another studies of Bangladeshi.[16, 19]

The finding of this study indicates that most of the reproductive age group women had poor knowledge of BSE. Only 4.2% had satisfactory knowledge of BSE. A similar study conducted in Bangladesh showed about the same proportion of women had good knowledge.[16] In this study most of the population had poor knowledge about BSE which is similar to Pakistani, Indian and Malaysian women 80.7%, 61.6% and 69.11% respectively.[20-22] In India slightly more than half 58.42% of the subjects had average knowledge and awareness and 17.62% had poor knowledge and awareness regarding BSE.[23] And another study in 87(35%) were aware about Breast Self-Examination (BSE).[24] The reason of lower mean score of knowledge in present study because of educational background of the participants, who had no any medical science background and very few participants had tertiary level of education. Poor knowledge was also found to be related to the methods, position, techniques of BSE and the exact time to perform it in current study. Similar observations were also found in Malaysian women, and also had poor knowledge on a breast lump is the early sign for breast cancer and method of early detection.[21] The reason for the difference in knowledge in different studies from different countries might be due to the difference in the study setting and sociocultural factors across the world.

The practice of BSE reflects the practical application of the knowledge of BSE. According to the current study among all of the participants very few participants (2.1%) were practiced BSE. This finding indicated that awareness and health education programs can improve the poor practice to regular practice towards BSE.

Poor practice of participants may be due to some reasons. Firstly, participants never learnt the correct method and importance of BSE. Secondly, parents, partners or friends did not give any advice to do BSE. Finally, students who were never taught BSE by health staff which are also supported by different studies in different countries.[20, 21, 25] Studies from various countries showed somehow differences in the practice of BSE. The reason for this might be due to the difference in knowledge of study participants and the difference between study areas.

CONCLUSION

The study concludes that most of the women had poor knowledge. Also, very few women demonstrated poor practice. Majority of the women did not know about the BSE procedure, importance and exact time to do BSE. Though most of the women were agreed that 'all women should do BSE' but near about two third of women were felt uncomfortable to do BSE once in a month. Very few women practiced BSE regularly due to lack of BSE knowledge towards the BSE. There is an immediate need to increase the knowledge and practice of breast self-examination to prevent and detect breast cancer in its early stage.

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REVIEW ARTICLE

Unlocking the Secrets of Coronaviruses: A Comprehensive Analysis

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ABSTRACT: Coronaviruses are a large family of viruses that can cause illness in animals and humans. These viruses are zoonotic, meaning they can be transmitted between animals and people. The outbreak of the coronavirus disease, also known as COVID-19, in late 2019 has had a significant impact on the world, spreading rapidly across countries and causing widespread illness and death. Coronaviruses are characterized by their crown- like spikes, which can be seen under an electron microscope, hence their name "corona." The symptoms can range from mild to severe, and in some cases, it can be fatal. Common signs of infection include fever, cough, shortness of breath, fatigue, and body aches. The virus primarily spreads through respiratory droplets generated when an infected person coughs, sneezes, or talks. It can also spread by touching surfaces contaminated by the virus and then touching the face, mouth, or eyes. As of now, there is no specific treatment for COVID-19, although various vaccines have been developed and are being distributed worldwide to mitigate the impact of the virus. The COVID-19 pandemic has brought about numerous challenges across the globe. Governments have implemented strict measures such as lockdowns, travel restrictions, and mask mandates to limit transmission and prevent healthcare systems from becoming overwhelmed. The pandemic has also highlighted the importance of public health practices such as hand hygiene, social distancing, and wearing masks. As scientists and researchers continue to study coronaviruses, efforts are being made to develop effective treatments and preventive measures to tackle future outbreaks. The ongoing pandemic serves as a reminder of the need for global cooperation and preparedness against infectious diseases.

Keywords: Medical Ethics Education, Ethical Decision-Making, Healthcare Professional Development.

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INTRODUCTION

Coronaviruses (CoVs) have traditionally been regarded as insignificant pathogens, causing illnesses in mammals and birds. However, in humans and birds, they can lead to respiratory tract infections that range from mild to fatal.[1] CoVs are the largest group of viruses responsible for respiratory and gastrointestinal infections. Morphologically, CoVs are enveloped viruses that contain non-segmented positive- sense, single-stranded ribonucleic acid (RNA).[2] In humans, mild cases of CoVinfections manifest as common colds, which can also be caused by other viruses, primarily rhinoviruses. On the other hand, more severe forms of CoV infections can result in diseases such as SARS, MERS, and COVID-19.[3] In livestock like cows and pigs, CoVs cause diarrhea, while in mice, they induce hepatitis and encephalomyelitis.[4] From the animals to humans can occur through direct contact with infected animals or through the consumption of contaminated animal products. It is crucial to implement strict hygiene measures and surveillance systems to prevent the spread of CoVs and mitigate the potential risks they pose to both animal and human health.[5]

History

The history of the coronavirus dates back to the 1930s when scientists first identified a group of viruses that caused respiratory diseases in animals.[6] Fast forward to 2002, the world witnessed the emergence of severe acute respiratory syndrome (SARS), caused by a novel coronavirus known as SARS-CoV. This outbreak, originating in China, spread to over 20 countries, affecting thousands of individuals and causing hundreds of deaths.[7] Moreover, in 2012, the Middle East Respiratory Syndrome (MERS) outbreak occurred, also caused by a coronavirus originating from Saudi Arabia. These events set the stage for the recent COVID-19 pandemic, caused by a novel strain known as SARS- CoV-2.[8] The disease quickly spread globally, leading to millions of infections and deaths, devastating healthcare systems, and triggering a wide range of economic and social consequences. The history of coronaviruses is characterized by sporadic but significant outbreaks, emphasizing the need for enhanced surveillance,

preparedness, and global cooperation to effectively address future threats.[9]

Coronavirus Genome and Structure

The coronavirus, also known as SARS-CoV-2, is an enveloped, positive-sense RNA virus that belongs to the family Coronaviridae. Its genome consists of a single-stranded RNA molecule, of approximately 30,000 base pairs in length, which encodes several structural and non-structural proteins. The genome is arranged into several open reading frames (ORFs), each responsible for the synthesis of a specific protein. These proteins play crucial roles in the viral life cycle, including virus entry, replication, assembly, and release.[10] The genome structure of the coronavirus is highly complex and organized. It starts with a 5' untranslated region (UTR) followed by the ORF1a and ORF1b, also referred to as the replicase gene. These two ORFs produce two large polyproteins, pp1a and pp1ab, which are then further processed by viral proteases into 16 non-structural proteins (NSPs).[11] These NSPs form the replicase complex responsible for genome replication and other critical functions within the virus. The remaining genome encodes the structural proteins such as the spike (S), envelope (E), membrane (M), and nucleocapsid (N) proteins, as well as accessory proteins that play various roles in viral pathogenesis. Understanding the genome and structure of the coronavirus is essential for the development of effective therapeutic interventions and vaccines against this devastating viral infection.[12]

Classification

The classification of coronaviruses is based on a variety of factors that encompass their genetic makeup, antigenic properties, and biological characteristics. Currently classified into four genera, namely Alphacoronavirus, Beta coronavirus, Gamma coronavirus, and Delta coronavirus, these diverse viruses are further divided into several distinct species.[2] Specifically, the Beta coronavirus genus is subdivided into lineages A, B, and C, with the latter containing the notorious severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), and the recently emerged and highly contagious SARS-CoV-2 causing the ongoing COVID-19 pandemic.[13] Although sharing common traits, the classification of coronaviruses allows for a comprehensive understanding of their pathogenicity, transmission dynamics, and potential vaccine and therapeutic development, laying the foundation for effective global public health responses.[14]

Transmission

Coronaviruses constitute a vast family of hundreds of viruses. The transmission of coronaviruses involves an intricate interplay of biological and environmental factors. Primarily, these viruses infect animals, including bats, chickens, camels, and cats. On rare occasions, a virus that infects one species can undergo mutations that enable it to infect another species. This phenomenon is known as "cross-species transmission" or "spillover".[4] Coronaviruses, including the recent SARS-CoV-2, primarily spread through respiratory droplets generated by infected individuals during activities such as coughing, sneezing, and talking. These droplets can infect nearby individuals who come into close contact, typically within a distance of about six feet.[15] Moreover, recent studies suggest that aerosol transmission of smaller virus-containing particles may also occur in specific circumstances, particularly in poorly ventilated indoor settings. Additionally, fomite transmission, where individuals touch contaminated surfaces and then touch their face, is considered a potential but less common route of infection.[16] Overall, understanding the mechanisms and modes of transmission is crucial for implementing effective preventive measures, such as maintaining physical distancing, practicing good hand hygiene, wearing masks, optimizing ventilation systems, and regularly disinfecting surfaces.[17] The interaction between the coronavirus spike protein and its corresponding cell receptor plays a crucial role in determining the tissue tropism, infectivity, and species variation of the released virus.[18] Epithelial cells are primarily targeted by coronaviruses. Human coronaviruses infect the epithelial cells of the respiratory tract, while animal coronaviruses generally infect the epithelial cells of the gastrointestinal (GI) tract.[19]

Pathogenesis

The pathogenesis of coronaviruses involves multiple steps, starting with viral entry into the host's cells. Studies have shown that coronaviruses primarily target cells expressing angiotensin-converting enzyme 2 (ACE2) receptors, which act as a gateway for viral entry. Once inside the host cells, coronaviruses utilize their spike (S) proteins to bind with the ACE2 receptors, facilitating fusion between the viral envelope and the host cell membrane.[20] After viral entry, the coronaviruses undergo replication and transcription within the host cells. This process leads to the production of viral proteins and the assembly of new viral particles, which are then released from the infected cells to infect adjacent cells or spread to other individuals. The release of inflammatory mediators and cytokines during infection contributes to the pathogenesis of coronaviruses, leading to tissue damage, inflammation, and in severe cases, organ dysfunction.[14] Moreover, the ability of some coronaviruses to evade the host's immune response further enhances their pathogenicity.[21]

Infections in Human

Following infection, a wide range of symptoms may manifest, ranging from mild and asymptomatic cases to severe respiratory distress and multi-organ failure. Vulnerable populations, such as the elderly and those with pre-existing medical conditions, are at a higher risk of developing severe symptoms and complications.[9]

Infections in Human are as Follows:

Common Cold

The common cold, caused by a family of viruses known as coronaviruses, poses a significant global concern which merits scholarly attention. While often regarded as mild, this widespread infectious disease should not be

underestimated due to its capacity to afflict populations worldwide.[22] With symptoms including sneezing, coughing, and fever, the coronavirus-driven common cold poses a relentless challenge to public health systems (15). It is crucial to recognize the impact of this seemingly innocuous ailment and contribute to the advancement of knowledge surrounding its prevention, treatment, and management.

Severe Acute Respiratory Syndrome (SARS)

Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus known as SARS-CoV. First identified in 2002 in the Guangdong Province of China, SARS quickly spread to over two dozen countries, causing a global epidemic.[23] The disease primarily affects the respiratory system, leading to severe respiratory distress and in some cases, organ failure. SARS is transmitted through respiratory droplets when an infected person coughs or sneezes or through direct contact with contaminated surfaces.[24] The incubation period for SARS is typically between 2 to 7 days, during which an individual may remain asymptomatic but contagious. While efforts to contain the spread of SARS and develop effective treatments have improved since the initial outbreak, its potential for rapid transmission and high mortality rate make it a significant concern for global health authorities.[13]

Middle East Respiratory Syndrome (MERS)

Middle East respiratory syndrome (MERS) is a highly infectious and potentially fatal disease caused by a coronavirus. This viral respiratory illness was first reported in Saudi Arabia in 2012 and has since spread to several other countries.[25] Similar to other coronaviruses, MERS is believed to have originated in animals and then transmitted to humans. While there have been sporadic cases of MERS around the world, the majority of reported cases have been in the Middle East, particularly Saudi Arabia and the United Arab Emirates.[26] MERS is of great concern due to its high fatality rate and its potential to cause large-scale outbreaks. The symptoms of MERS are similar to those of other respiratory illnesses and may range from mild to severe. Patients typically experience fever, cough, and shortness of breath, which may progress to severe pneumonia and even respiratory failure.[27] Although the exact source and transmission routes of MERS remain uncertain, dromedary camels have been identified as carriers of the virus, suggesting that direct or indirect contact with these animals may be a possible mode of transmission to humans.[28]

Coronavirus Disease 2019 (COVID-19)

Coronavirus disease 2019 (COVID-19) has emerged as a global health crisis, unparalleled in recent history. This novel respiratory illness, caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China in December 2019. Since then, it has rapidly spread across the globe, leading to millions of infections and hundreds of thousands of deaths.[8] COVID-19 primarily spreads through respiratory droplets when an infected individual coughs, sneezes, or talks, making it highly contagious. The virus presents a wide range of symptoms, from mild flu-like symptoms to severe respiratory distress, often requiring hospitalization and intensive care.[29] The pandemic has compelled governments worldwide to implement strict containment measures, including nationwide lockdowns, travel restrictions, and social distancing protocols, to slow down the virus's transmission and prevent healthcare systems from becoming overwhelmed.[30] The risk of transmission depends on the type of exposure. It varies based on the duration of exposure, the use of preventive measures, and individual factors such as the amount of virus in respiratory secretions.[31] Multiple studies have identified a high genetic similarity between SARS- CoV-2 and coronaviruses found in horseshoe bats, suggesting that they were the original hosts of the virus.[32, 33] However, the exact mechanism through which the virus was transmitted to humans remains unknown. Investigation efforts have focused on animal markets, with evidence suggesting that an intermediate host, such as the pangolin, may have played a role in amplifying and transmitting the virus to humans.[34] The devastating impact of COVID-19 extends beyond the realm of public health, cascading into unprecedented economic and sociopolitical consequences. The pandemic has disrupted global supply chains, causing a significant economic downturn
and massive job losses in various sectors.[35]

Diagnosis of Coronavirus

There are several diagnostic methods used to identify coronaviruses, including COVID- 19. The most common and reliable method is the RT-PCR test, which detects the genetic material of the virus using a lab technique called reverse transcription polymerase chain reaction (RT-PCR). A health care professional collects a fluid sample by inserting a long nasal swab (nasopharyngeal swab) into the nostril and taking fluid from the back of the nose, or by using a shorter nasal swab (mid-turbinate swab) or a very short swab (anterior nares swab).[36] Another diagnostic method is the antigen test, which detects certain proteins in the virus. Using a long nasal swab to get a fluid sample, some antigen tests can produce results in minutes.[37]

Prevention and Treatment

The prevention and treatment of the coronavirus, also known as COVID-19, are vital in curbing the spread and minimizing the impact of this global pandemic. Firstly, prevention measures have played a crucial role in containing the virus. Public health guidelines such as hand hygiene, wearing face masks, practicing social distancing, and frequent sanitization have been emphasized to reduce the transmission of the virus.[38] Additionally, widespread vaccination campaigns have been launched to provide immunity against COVID-19. Vaccines have proven to be effective in preventing severe illness, hospitalization, and death caused by the virus.[39] Furthermore, timely testing, contact tracing, and isolation measures are necessary to identify and contain potential outbreaks, ultimately preventing the further spread of the disease.[40] In terms of treatment, early detection of COVID-19 cases is vital to

ensure timely and appropriate treatment. Various antiviral drugs, such as Remdesivir, have been authorized to treat hospitalized patients with severe symptoms.[41] Additionally, supportive care, such as oxygen therapy for respiratory distress, is crucial in managing severe cases. Innovative treatments like monoclonal antibody therapy have shown promising results in reducing the severity of symptoms and preventing hospitalization in high-risk individuals.[42] Research is ongoing to develop more effective therapies, including the use of convalescent plasma and immune-based treatments. Overall, a combination of preventive measures and efficient treatment strategies play a significant role in combating COVID-19 and protecting the global population from this highly contagious virus.

Global Efforts and Research

Scientists and healthcare professionals from around the world are working tirelessly to understand the virus, develop effective treatments, and create vaccines. This collective effort has led to a wealth of knowledge about the virus's transmission, symptoms, and impact on the human body.[43] Additionally, international cooperation has facilitated the sharing of data, resources, and best practices to better equip countries in their fight against the pandemic. These global efforts and research are crucial in controlling the spread of the virus, mitigating its devastating effects, and ultimately finding a lasting solution to this global health crisis.[44]

CONCLUSION

In conclusion, coronavirus diseases, particularly COVID-19, have presented substantial challenges for human health and society at large. With the constant developments in the understanding of the virus and the measures taken to combat it, it is essential to stay updated on the latest information and guidelines provided by reputable health organizations and authorities. By staying informed, individuals can make informed decisions regarding personal protective measures, preventive actions, and any necessary adjustments to their daily routines. Additionally, being well-informed enables individuals to effectively contribute to the efforts aimed at curbing the spread of the virus, fostering a stronger and more unified response within their communities and beyond. By staying informed and adhering to public health guidelines, we can collectively contribute to overcoming this global crisis and work towards a healthier future.

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