ISSN : 3080-1257

MARINE CITY MEDICAL COLLEGE

Marine City Medical College Journal

Volume 03 Issue 02 October 2024 Citation MCMCJ 2024 ; 3(2) : 1-32

Editorial

Review Article

Original Articles

Case Report

An Official Publication of Marine City Medical College
Chattogram, Bangladesh

www.mcmchedu.com

Marine City Medical College Journal (MCMCJ)

Correspondence
Managing Editor
Marine City Medical College Journal
Cell : +88 01711 76 25 82
Email : duttaprd@gmail.com
mcmchedu@gmail.com
Phone : +88 031 258 1040
Web : http://www.mcmchedu.com

Published by
Department of Publication & Research
Marine City Medical College
Chattogram, Bangladesh.

Printed by
New Computer Suporna
Chattogram
Cell : 01819 80 30 50
Email : abedulhuq1960@gmail.com
supornacomputer@yahoo.com

Editorial

Marine City Medical College Journal

Is Biostatistics Essential in Undergraduate Medical Education?

Pradip Kumar Dutta [1*]

Biostatistics is an essential discipline in modern medical education, providing future physicians with the skills to understand medical literature, evaluate evidence, and contribute to research. However, it often remains undervalued in undergraduate curricula. This editorialdiscusses the significance of biostatistics in undergraduate medical education, its role in evidence-based medicine, challenges in teaching, and strategies for improvement.

The medical profession increasingly depends on evidence-based practice, where clinical decisions are guided by data rather than solely by tradition or authority. Biostatistics, the cornerstone of medical research and critical appraisal, is therefore an essential component of undergraduate medical education. Despite its importance, the subject often remains underemphasized in many medical curricula worldwide, including South Asia.

Evidence Based Medicine

Medical students are expected to critically evaluate scientific literature, interpret research findings, and apply them in patient care. Without adequate grounding in biostatistics, future physicians risk misinterpreting results, overestimating treatment effects, or failing to recognize study limitations. This gap has direct implications for patient safety and healthcare quality.[1] Studies have shown that medical graduates frequently lack confidence in understanding statistical concepts, leading to poor engagement with research and difficulty in practicing evidence-based medicine.[2,3] Introducing biostatistics early in the curriculum, integrated with community medicine, epidemiology and clinical research, ensures that students can contextualize statistical principles with real-life clinical questions.[4] Institutions that integrate biostatistics into early training have reported better student engagement in research activities.[5]

Clinical Decision Making

The advent of artificial intelligence, big data and precision medicine demands stronger statistical literacy. Physicians are not expected to become statisticians but must acquire sufficient knowledge to collaborate with researchers, interpret findings and make informed clinical decisions.[6] Statistical reasoning is not confined to academia, it underpins diagnostic accuracy, risk assessment and treatment evaluation. For example, concepts such as sensitivity, specificity and predictive values are indispensable in interpreting diagnostic tests.[7]

Barriers

Perceived irrelevance : Many students perceive biostatistics as abstract and irrelevant, often due to traditional didactic teaching methods. Innovative approaches—such as case-based learning, problem-solving sessions, and integration with clinical case discussions—have been shown to enhance engagement and long-term retention.[8]

- ***Teaching Methods:*** Traditional lectures may fail to capture interest, leading to poor understanding.[8]
- ***Faculty Expertise:*** A shortage of trained biostatisticians in medical schools hinders effective teaching.[9]

Strategies for Improvement

i) Curriculum Integration

Embedding statistical concepts within clinical case discussions enhances relevance and retention.[10] For example, teaching diagnostic test interpretation alongside pathology improves application.

ii) Active and Problem-Based Learning

Interactive approaches, such as problem-based learning and case simulations, improve student engagement and comprehension.[11]

1. Professor of Nephrology
Marine City Medical College, Chattogram, Bangladesh.

*Correspondence : **Professor (Dr.) Pradip Kumar Dutta**
Email: duttprd@gmail.com
Cell : +88 01819 31 46 23

Date of Submitted : 10.08.2024
Date of Accepted : 28.09.2024

Volume 03 | Issue 02 | October 2024 | 1-2

iii) Faculty Development

Investing in training medical teachers in biostatistics ensures more effective teaching and mentoring.[12]

iv) Use of Technology

Statistical software and online modules can make learning more practical and interactive, preparing students for real-world data analysis.[13]

Biostatistics is not merely a supportive subject but a vital competency in undergraduate medical education. Strengthening its teaching, integrating it with clinical relevance, enhancing faculty expertise, adopting innovative pedagogical strategies and fostering statistical literacy among undergraduate students are essential steps toward producing physicians capable of practicing evidence-based medicine in the modern era.

REFERENCES

1. Windish DM, Huot SJ, Green ML. Medicine residents' understanding of the biostatistics and results in the medical literature. *JAMA*. 2007;298(9):1010–1022.

2. West CP, Ficalora RD. Clinician attitudes toward biostatistics and medical research: A survey of internal medicine residents. *Med Teach.* 2007;29(9):914–916.

3. Miles S, Price GM, Swift L, Shepstone L, Leinster SJ. Statistics teaching in medical school: opinions of practising doctors. *BMC Med Educ.* 2010;10:75.

4. Rao C, Richard J. An introduction to biostatistics: *A manual for students in health sciences.* 4th ed. New Delhi: Prentice-Hall. 2006.

5. Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. *Designing clinical research.* 4th ed. Philadelphia: Lippincott Williams & Wilkins. 2013.

6. Fuller CD, Thomas CR. Modern radiation oncology education and the emerging role of statistical literacy. *Am J Clin Oncol.* 2006;29(6):637–642.

7. Fletcher RH, Fletcher SW, Fletcher GS. *Clinical epidemiology: The essentials*. 5th ed. Philadelphia: Lippincott Williams & Wilkins. 2014.

8. Freeman JV, Collier S, Staniforth D, Smith KJ. Innovations in curriculum design: A multi-disciplinary approach to teaching statistics to undergraduate medical students. *BMC Med Educ.* 2008;8:28.

9. Ibrahim M, Baharuddin KA, Abd Rahman N, Ahmad M, Ismail R. Medical students' perceptions of statistical teaching in Malaysian medical schools. *J Taibah Univ Med Sci.* 2012;7(1):21–25.

10. Norman G. Research in medical education: Three decades of progress. *BMJ.* 2002;324(7353):1560–1562.

11. Bösner S, Pickert J, Stibane T. Teaching clinical epidemiology and biostatistics: a three-phase programme for undergraduate medical students based on problem-based learning and self-directed learning. *BMJ Open.* 2015;5(5):e006167.

12. Dawson-Saunders B, Trapp RG. *Basic & Clinical Biostatistics.* 4th ed. New York: McGraw-Hill. 2004.

13. Lahti M, Kontio R, Pitkänen A, Välimäki M. Knowledge transfer from an e-learning course to clinical practice. *Nurse Educ Today.* 2014;34(5):842–847.

Review Article

Marine City Medical College Journal

Medication Management and Drug Stewardship in Chronic Kidney Disease (CKD)

Dilip Kumar Roy[1*]

GRAPHICAL ABSTRACT

Medication Management and Drug Stewardship in Chronic Kidney Disease (CKD)

Cohort

RISK FACTORS
- Polypharmacy
- Comorbidities
- Altered pharmacokinetics
- Nephrotoxins.

STRATEGIES
- Digitial health toolds
- Interdisciplinary teams
- Shared decision-making.

OUTCOME
- Optimized therapy
- Reduced adverse events
- Equitable care.

Results

CORE PRINCIPLES
- Medication selection and avoidance of nephrotoxins
- Dose adjustment by eGFR
- Regular medication reconciliation
- Safe deprescribing
- Patient education (Sick-day rules, OTC/herbal risks).

BARRIERS
- Limited access to essential medicines
- Slow adoption of guidelines.

Conclusion: Drug stewardship in CKD is essential for minimizing larm and optimizing

Roy D K | *Graphical Abstract : Dutta P K* | *MCMC Journal. 2024;3(2) : 3-12*

ABSTRACT

Background: Patients with Chronic Kidney Disease (CKD) are at high risk of medication-related problems due to altered pharmacokinetics, polypharmacy and comorbidities. Drug stewardship aims to optimize therapy, minimize nephrotoxicity and improve patient outcomes. To summarize key principles of medication management and drug stewardship in CKD, highlighting strategies to optimize dosing, reduce harm and promote equitable access to essential therapies.

Methodology: A narrative review was performed using PubMed, Scopus, and Google Scholar for literature published between 2010–2025. Key words Chronic kidney disease; Deprescribing; Drug stewardship; Included and Medication reconciliation. Reference lists of key articles and KDIGO guidelines were reviewed.

Results: Effective stewardship involves medication selection, dose adjustment using eGFR, regular medication reconciliation, deprescribing when appropriate

1. Professor of Nephrology
National Institute of Kidney Disease and Urology (NIKDU)
Dhaka, Bangladesh.

*Correspondence **Professor (Dr.) Dilip Kumar Roy**
Email: drdiliproy@gmail.com
Cell : +88 01711 74 90 62

Date of Submitted : 02.09.2024
Date of Accepted : 28.09.2024

Volume 03 | Issue 02 | October 2024 | 3-12

and patient education. Nephrotoxic medications (e.g. NSAIDs, antivirals, PPIs) require careful monitoring. Special considerations include pregnancy, acute illness and cancer. Barriers include limited medication access in low-income countries and delayed adoption of evidence-based therapies. Digital health tools, interdisciplinary collaboration and shared decision-making improve outcomes.

Conclusions: Drug stewardship in CKD is essential for minimizing harm and optimizing. Addressing global inequities in medication access and implementing evidence-based interventions can enhance patient safety and quality of care.

Key words : Chronic kidney disease; Deprescribing; Drug stewardship; eGFR; Medication management; Medication reconciliation; Nephrotoxicity; Patient education.

SEARCH STRATEGY

Databases Searched were PubMed, Scopus, Google Scholar.Search Terms are ("Chronic kidney disease" OR CKD) AND ("Drug stewardship" OR "Medication management" OR "Deprescribing" OR "Medication reconciliation" OR "Nephrotoxicity"). Filters were Human studies, English language 2010–2025. Guideline Sources were KDIGO 2024 CKD guidelines, WHO essential medicines list. Additional Sources were reference lists of key reviews and meta-analyses.

INTRODUCTION

Abnormal kidney function results in alteration in pharmacokinetics and pharmacodynamics, and for people with Chronic Kidney Disease (CKD) as the GFR worsens, so does the prevalence of polypharmacy and comorbidities increases.[1] People with CKD are at increased risk of medication errors and inappropriate prescribing (Noted to be up to 37% in ambulatory outpatient studies and up to 43% in long-term care studies.[2,3] Because of the central role of the kidneys in the elimination of many medications and their metabolites, many medications require dose adjustment or discontinuation in people with low Glomerular Filtration Rate (GFR).[4] CKD increases the nephrotoxicity of some medications and nephrotoxicity is critical to avoid in people with low GFR. People with CKD have increased susceptibility to problems with medications, which may further contribute to suboptimal pharmacological management.[5,6] People with Chronic Kidney Disease (CKD) are prescribed, on average, 12 medications per day in addition to nonprescription therapies, creating a complex polypharmacy.[7] Medication management is an important component of the care of people with CKD.

Risk factors for medication-related problems in CKD include comorbid conditions, complex treatment regimens and polypharmacy, frequent medication changes, use of medications which have a narrow therapeutic window, drug interactions, complex care teams with multiple clinicians involved and challenges with treatment burden, cost and nonadherence.[7] Medications need to be prescribed responsibly, monitored for efficacy and safety and when they do not or no longer serve their intended purpose, discontinued. As in all medical decision-making, healthcare providers should consider the indication, benefit-risk profile and potential nephrotoxicity while balancing accessibility, availability, local health policies, cultural practices, affordability and patient preferences.

Medication management and drug stewardship in Chronic Kidney Disease (CKD) involve optimizing medication safety and effectiveness by adjusting doses based on kidney function (eGFR) selecting appropriate drugs, performing medication reconciliation and considering deprescribing when unnecessary. Key challenges include managing polypharmacy, adjusting drug doses for altered pharmacokinetics and avoiding nephrotoxic agents. Strategies like patient education, digital health tools and interdisciplinary collaboration are essential for successful stewardship, with the ultimate goal of preserving kidney health and improving patient

DISCUSSION

Key Principles of Drug Stewardship in CKD includes

i) Medication Selection: Choosing medications that are effective, safe, and less likely to harm the kidneys, avoiding known nephrotoxins

ii) Dose Adjustment: Modifying drug dosages based on the patient's estimated Glomerular Filtration Rate (eGFR) to account for impaired kidney clearance

iii) Monitoring: Continuously monitoring patients for both the effectiveness of medications and potential adverse drug reactions.

iv) Medication Reconciliation: Regularly reviewing all medications to prevent harmful interactions or inappropriate use

v) Deprescribing: Strategically stopping medications that are no longer needed or beneficial to reduce pill burden and potential harm.

Central to drug stewardship for people with CKD is to minimize use of medications in patients who have contraindications. Contraindications may be absolute, when risk of using the medication clearly outweighs any potential benefit or relative, when caution should be used when the medication is prescribed. Medications with relative contraindications may be prescribed provided no safer alternative exists. Careful monitoring and individualized treatment plans are crucial due to potential side effects and the need to avoid nephrotoxic medications. When new medications are started, healthcare providers should consider comorbidities, functional status and psychosocial factors (e.g. Socioeconomic status, self-efficacy) for each person with CKD.

Nephrotoxic Medications

Between 18%–20% of people with CKD G3-G5 receive at least one potentially-inappropriate nephrotoxic medication annually, primarily Non-Steroidal Anti-Inflammatory Drugs (NSAIDS) antivirals, fenofibrates, bisphosphonates and Proton Pump Inhibitors (PPI).[8,9,10] Drug-associated nephrotoxicity is an important contributor to new or worsening CKD.[11] Multiple mechanisms of nephrotoxicity have been reported including hemodynamic changes, vascular endothelial injury, glomerular disease, direct tubular toxicity including acute tubular injury or necrosis, acute interstitial nephritis, osmotic nephrosis, and crystal deposition.[12] Patient characteristics that increase the risk for nephrotoxicity include pre-existing CKD, concomitant use of other nephrotoxins (e.g. Vancomycin with piperacillin-tazobactamor vancomycin with aminoglycosides), high-doses or prolonged duration of nephrotoxins, older age, comorbidities (Including diabetes, heart and liver failure and solid organ transplantation) and acute illnesses, especially when associated with intravascular volume depletion and hypotension (e.g. Sepsis, shock).[13,14] Sometimes the use of a potentially nephrotoxic medication is unavoidable (e.g. Calcineurin inhibitor use in a patient with nephrotic syndrome). In this case, close monitoring for nephrotoxicity and risk mitigation using therapeutic drug monitoring is reasonable.

Over-The-Counter (OTC) Medications, Herbal Remedies and Dietary Supplements

The use of these therapies is observed in 25–70% of people with CKD.[15,16,17] Herbal remedies often used in an unmonitored setting, many of these remedies are composed of natural compounds with complex active ingredients that have not been evaluated in people with or without CKD. NSAIDS, the most commonly used OTC medication, are associated with altered intraglomerular hemodynamics, interstitial nephritis, analgesic nephropathy, hypertension and heart failure.[18,19] However, pain is prevalent in people with CKD and its patient-centered management is complicated: for some patients judicious NSAID use with monitoring of eGFR may be preferred to other pain medications, such as opioids, that have stronger associations with adverse events.[20,21]

Dietary supplements are likewise readily available and widely used as alternative or complementary therapy, without an evidence base. Patients should routinely be asked about use of non-prescription products. Unprescribed products that may threaten kidney health or interact with essential therapies for CKD should be discussed and the healthcare worker should clearly advocate for their discontinuation, within a framework that recognizes and respects the patient's perspective, which may be culturally or socially informed and which balances patient autonomy, beneficence, and non-maleficence. KDIGO guideline suggested to review and limit the use of over the counter medicines and dietary or herbal remedies that may be harmful for people with CKD.[22]

Drug Dosing for People with CKD

GFR is considered the best surrogate for renal clearance and therefore is central to determining eligibility and dose for drugs that are cleared by the kidneys. Major regulatory agencies now recognise that "Any contemporary, widely accepted and clinically applicable eGFR equation is considered reasonable to assess kidney function in pharmacokinetic studies".[23,24,25] Although many medications were historically approved based on the CG equation, laboratory reporting of eGFR typically uses equations such as the MDRD or CKD-EPI equations.[26-28] Because of the recognised limitations of creatinine, alternative filtration markers have been sought as adjunct or alternatives to estimate GFR for drug dosing and monitoring. Calculation of eGFR using alternative biomarkers such as cystatin C (eGFRcr-cys or eGFRcys)

might be appropriate if eGFRcr is not an accurate reflection of GFR. Estimated GFR from cystatin C in combination with creatinine (eGFRcr-cys) is recommended as a supportive test for eGFRcr when eGFRcr is thought to be inaccurate and clinical decisions are impacted by the level of GFR.[22]

The initial test for evaluating drug dosing in most circumstances will be creatinine-based eGFR (eGFRcr). The eGFRcr is widely available, routinely evaluated as part of the basic metabolic panel, is low cost, and has sufficient precision for most medication dose-adjustment.In general, if concern about the appropriateness of eGFRcr has led to measurement of cystatin C, it is suggested to remeasure creatinine at the same time and using a combination equation (eGFRcr-cys). Use of both biomarkers in the eGFR equation to some extent manages or mitigates the non-renal determinants of either alone. The native units for eGFRcr, eGFRcys and eGFRcr-cys for many contemporary equations are normalised to a nominal standard Body Surface Area (BSA) of 1.73m^2 and expressed as mL/min per 1.73m^2. The greatest impact of this nuance will be in patients with a body surface area that is markedly different than 1.73m^2.[29] KDIGO guideline suggested monitoring of eGFR, electrolytes and therapeutic medication levels, when indicated, in people with CKD receiving medications with narrow therapeutic windows, potential adverse effects or nephrotoxicity, both in outpatient practice and in hospital settings. For most people and clinical settings, validated eGFR equations using SCr are appropriate for drug dosing.[22]

Sex differences in drug safety and efficacy in people with CKD are understudied and very little is known about the optimal assessment of GFR in people who are transgender.[30] Sex differences in body weight and composition as well as physiology indeed impacts on drug metabolism and response and sex hormones appear to play an important role in modulating sex-based differences in pharmacokinetics across the life cycle.[31,32] It has been postulated excess risk of adverse drug reactions in women to be explained by overdosing, given that most drugs are prescribed to women and men at the same dose (i.e one pill per day) and pharmacokinetics are often higher in women.[33]

Special Circumstances for Drug Dose Adjustments in People with CKD

Acute illness

Acute illness leads to rapid changes in physiology that alter drug pharmacokinetics and pharmacodynamics. AKI decreases kidney elimination of drugs and their renally-eliminated metabolites. Acid-base abnormalities and accumulation of uremic toxins alter drug protein binding.[4] Acute-care drug use may compete for tubular secretion of serum creatinine at tubular transporters (e.g. High-dose sulfamethoxazole/trimethoprim [SMZ-TMP] for Pneumocystis jirovecii pneumonia) making it difficult to distinguish between pseudo- and true nephrotoxicity.[34,35] Further complicating pharmacokinetic evaluation in people with CKD who are acutely ill, serum concentrations of kidney filtration markers fluctuate because of changes in true GFR, in non-GFR determinants of the marker or in the volume of distribution of the marker. Dosing decisions during critical illness must balance all the factors which may alter the accuracy of estimating equations, consider the risks and benefits of the medication for the patient and iteratively re-evaluate progress toward therapeutic goals. Drug level monitoring should be used, where available.[36,37]

Pregnancy

Pregnancy may pose a risk of CKD progression for people with established CKD. In addition, some recommended medications to slow or prevent CKD progression are teratogenic (Such as ACEi/ARBs or mammalian target of rapamycin inhibitors) and discontinuation during pregnancy should be considered.[38]

Some CKD-specific medications should be continued during pregnancies such as hydroxychloroquine, tacrolimus, cyclosporin, eculizumab, prednisone, azathioprine, colchicine and intravenous immunoglobulin. When prescribing medications to people with CKD who are of child-bearing potential, always review teratogenicity potential and provide regular reproductive and contraceptive counseling in accordance with the values and preferences of the person with CKD. When pregnancy is not desired, we note that while the effect of different forms of contraception on GFR is unknown, oral contraceptives are associated with increased BP and hypertension.[39,40]

During lactation, thoughtful consideration of the risks and benefits of the drug and of lactation (To the patient and their child) and the patient's preferences about lactation is essential, along with the recognition that some medications suitable for use during pregnancy may not be appropriate for lactation and vice versa.[41] Multidisciplinary care with obstetrics, midwifery, lactation consultants and other subspecialty care will be essential at different points in the journey through pre-conception, pregnancy and lactation.[42]

Cancer

Non-GFR determinants of both creatinine and cystatin C may be more profound in people with cancer: Cachexia and malnutrition are common in people with cancer and lead to decreased creatinine production and overestimation of GFR, Cystatin C production may be increased in high-cell turnover diseases, in the presence of certain types of cancer cells and in people receiving high-dose corticosteroids as part of the chemotherapy. These increases in cystatin C concentrations may lead to an under-estimation of eGFR. Despite its relative inaccuracy compared with other validated eGFR equations, the CG equation continues to be one of the most-commonly used eGFR methods for these patients.[43,44] An evaluation of eGFR equation performance in patients with solid tumors observed the eGFRcr (CKD EPI) and the eGFRcr-cys (CKD-EPI) predicted mGFR with greater accuracy than CG.[45]

Medication Review and Medication Reconciliation

Medication review is essential for minimizing the occurrence of medication-related problems.[7] Medications that are no longer needed can be considered for discontinuation (e.g. PPI) and others will require dose reduction or discontinuation when GFR falls (e.g. Metformin). Perform thorough medication review periodically and at transitions of care to assess adherence, continued indication and potential drug interactions because people with CKD often have complex medication regimens and are seen by multiple specialists.

Medication reconciliation, the identification of the most complete and accurate list of medications, is the first step of the medication review process. Obtain an accurate medication list, including over-the-counter medications, from the patient and/or available sources (e.g. Caregiver, electronic medical record, smartphone applications). Evaluate whether all medications remain medically necessary or whether any other medication is required. Assess whether current medication (s) is the optimal medication (s) for each indication, individualised for each patient. Review the medication list for drug interactions, including drug-drug, drug-disease, drug-laboratory and drug-food interactions. Identify and resolve any discrepancies between the medications list and the one in the medical record.

Best practices for medication reconciliation and review includes documentation and communication. It seems likely that medication reconciliation and review routinely, at clinic visits, and at care transitions such as hospital discharge facilitates the achievement of benefits of evidence-based therapy.[46,47]

Safe Deprescribing

Deprescribing, "The planned and supervised process of discontinuing or reducing medications that may be causing harm or are no longer providing benefit" is integral to drug stewardship, having the potential to minimise medication-related problems and medication burden.[48] Obtain an accurate medication list, do medication reconciliation and include over-the-counter medications, herbal remedies and supplements. Identify medications that could be deprescribed:

- Medications that may no longer be indicated
- Medications that are potentially inappropriate
- Medications with questionable efficacy.

Conduct shared decision-making discussion about whether to deprescribe a medication: engage the patient and/or caregiver for their input on deprescribing the medication.

Deprescribing often is reactive (i.e. Occurring after an adverse event or symptom); however, proactive deprescribing is a hallmark of effective drug stewardship. Clinicians in primary care often do not know when or how to do deprescribing in people with CKD, therefore, optimal deprescribing should involve clinician education, decision support tools and/or pharmacist engagement.

Deprescribing During Acute Illness

People with CKD who experience acute illness are at heightened susceptibility for medication therapy problems due to the underlying disease state, volume status changes, hemodynamic alterations, altered end organ function, polypharmacy, drug-drug interactions and at times, uncertainty about their home medication regimen.[49] Many chronic medications are withheld in the context of acute illness because of altered risk-benefit, absence of indication (e.g. Antihypertensives in shock).

The rationale for temporary discontinuation of certain medications before elective surgery or procedures (e.g. Contrast imaging) is to prevent perioperative AKI and other complications such as hypotension, metabolic acidosis or hyperkalemia during the perioperative period. People with CKD admitted with AKI and hyperkalemia may need RASi, aldosterone antagonists, diuretics and potassium supplementation held, whereas those admitted with volume overload may need augmentation of these medications. Finally, fasting or starvation, acute surgery, intrabdominal pathology such as gastroenteritis or pancreatitis, acute intoxication and infection or sepsis potentiate the risk for ketoacidosis with SGLT2i.[50] During acute illness, a patient's clinical status and GFR may vary day-to-day requiring daily drug stewardship to minimize errors, especially through care transitions and rapid changes in health status.

If medications are discontinued during an acute illness, communicate a clear plan of when to restart the discontinued medications to the affected person and healthcare providers, and ensure documentation in the medical record.

Unplanned deprescribing during the treatment and resolution of adverse drug reactionsliketemporary discontinuation of medications to manage adverse events is indicated in most cases. However, fear for adverse event recurrence often results in failure to resume treatments.

During pre-conception, pregnancy and lactation

For people with established CKD, pregnancy is associated with risk of CKD progression.[51] Guidelines advise that some evidence-based medications that slow or prevent CKD progression, should not be prescribed during pregnancy because they are teratogenic (e.g. RASi, mycophenolate mofetil or have not been studied in this population.[52-54] Some CKD-specific medications can be safely continued during pregnancy, including hydroxychloroquine, tacrolimus, cyclosporin, eculizumab, prednisone, azathioprine, colchicine, and intravenous immunoglobulin. Biologics such as rituximab, belimumab and abatacept do not cross the placenta until the 15th week of gestation and discussion of the benefits and risks of these medications in the context of conception and pregnancy is essential for shared decision-making.[55]

Essential Strategies to Promote Drug Stewardship in CKD

Essential strategies to promote drug Stewardship in CKD includes

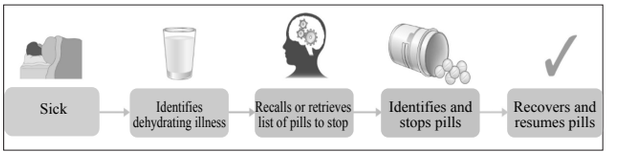
i) Patient Education and Engagement
ii) Interdisciplinary team Collaboration
iii) use of Digital Health Tools
iv) shared decision making.

Patient Education and Patient Empowerment

People with CKD should share responsibility for drug stewardship. Educating patients about their medications is crucial for successful stewardship. Educate and inform people with CKD regarding the expected benefits and possible risks of medications so that they can identify and report adverse events that can be managed. They can communicate the CKD diagnosis with non-nephrology healthcare providers for awareness and an assessment of drug selection and dose appropriateness. CKD patients can carry an up-to-date list of medications, know their GFR and recall prior adverse drug reactions. They should be educated about sick day rules and use of over the counter drugs and herbal remedies supplements

Sick-Day Rules

Providing guidance on managing medications during acute illnesses or when kidney function may be temporarily affected. Sick day rules refer to patient instructions to temporarily discontinue specific medication in the setting of a dehydrating illness to minimize the risk of AKI or medication accumulation in the setting of AKI. The acronym SADMAN (S) (Sulphonylureas, ACEi, diuretics and direct renin inhibitors, metformin, Angiotensin Receptor Blockers [ARB] NSAIDs) to which SGLT2i were subsequently added) was developed to help practitioners recall the classes of drugs to be temporarily discontinued. The complexity of sick day rules is challenging for any patient, challenges that are magnified by cognitive impairment, low literacy or visual impairment in the patient or caregiver.[56] The most reported problem is failure to restart medication.[57] The plan to restart medications should be detailed in the medical records and clearly communicated to patients.



Essential steps for appropriate sick day rule implementation

Over-The-Counter (OTC) Drugs, Herbal Remedies and Supplements: There are growing concerns regarding the use of falsified and substandard medications in LIC and LMIC which pose potential harm, particularly to those people at risk of, and with, CKD. Patients and their families should be aware that medication

falsification is often associated with illicit internet supply. These must be carefully reviewed and managed, as many can be nephrotoxic or interact with prescribed medications. Educate and inform people with CKD regarding the expected benefits and possible risks of medications so that they can identify and report adverse events that can be managed.

Interdisciplinary Team Collaboration: Strategies to improve drug stewardship by multidisciplinary interactions between nephrologists and clinical pharmacists provide safe and cost-effective care in people with CKD.[58,59,60]

Digital Health Tools: Utilizing digital tools can aid in medication reconciliation, dose calculations and patient monitoring.

Shared Decision-Making: Involving the patient in decisions about their medication plan promotes adherence and better outcomes.

Barrier to Drug Stewardship

Limited medication access and Slow adoption of evidence-based interventions (i.e. New therapies for CKD management) are two important barriers to successful drug stewardship in CKD patients.

Limited medication access is one of the important barrier to drug stewardship. The International Society of Nephrology (ISN) reported recently that only 35% of people in LIC countries have, for example, access to RASi, statins and insulin.[61] Despite the demonstrated cardiorenal benefits of SGLT2i and glucagon-like peptide-1 receptor agonists, these medications are still not available in many jurisdictions, nor considered in the national essential medication lists.[62-66] Within countries, healthcare workers and patients should campaign for universal drug coverage that is free at the point of use. The WHO and individual countries should expand their lists of essential kidney-related medications. A global program that utilizes generic formulations should also be considered as a tool to reduce the costs of drug delivery. Advocate for universal and indefinite coverage for essential and life-sustaining medications such as immunosuppression for kidney transplant recipients. Development of transparent pricing policies with pharmaceutical companies is also essential.

Slow adoption of evidence-based interventions (i.e. New therapies for CKD management) is also a barrier to drug stewardship, perpetuating health inequities and disparities in access to quality care. For example, poor uptake and adoption of clinical practice guidelines owing to the lack of appropriate education among patients, health professionals (Such as family physicians) and other stakeholders regarding new research findings and their effectiveness, the clinical inertia, feasibility and scalability of applying the interventions in 'real-life' settings.

CONCLUSION

People with CKD are particularly vulnerable to medication-related problems. Drug stewardship is essential to both minimizing medication-related problems and optimizing health for people with CKD. There is a critical need to address key barriers to drug stewardship, limitations in medication access and slow implementation of evidence-based care. Medication access inequities remain a priority for the promotion of health. Drug stewardship seeks to maximise the benefits and minimise risks in the context of the resource constraints affecting the patient and practitioner and seeks a more equitable future.

DISCLOSURE

The author declared no conflicts of interest.

REFERENCES

1. Vondracek SF, Teitelbaum I, Kiser TH. Principles of kidney pharmacotherapy for the nephrologist: Core Curriculum 2021. *Am J Kidney Dis.* 2021;78:442.

2. Dorks M, Allers K, Schmiemann G et al. Inappropriate medication in nonhospitalized patients with renal insufficiency: A systematic review. *J Am Geriatr Soc.* 2017;65:853.

3. Long CL, Raebel MA, Price DW et al. Compliance with dosing guidelines in patients with chronic kidney disease. *Ann Pharmacother.* 2004;38:853.

4. Roberts DM, Sevastos J, Carland JE, Stocker SL & Lea-Henry TN. Clinical pharmacokinetics in kidney disease: Application to rational design of dosing regimens. *Clinical Journal of the American Society of Nephrology.* 2018; 13: 1254.

5. Janse RJ et al. Use of guideline-recommended medical therapy in patients with heart failure and chronic kidney disease: From physician's prescriptions to patien s dispensations, medication adherence and persistence. *Eur J Heart Fail.* 2022;24(11): 2185.

6. Bramlage P et al. Guidelines adherence in the prevention and management of chronic kidney disease in patients with diabetes mellitus on the background of recent European recommendations : A registry-based analysis. *BMC Nephrol.* 2021; 22: 184.

7. Cardone KE, Bacchus S, Assimon MM, Pai AB & Manley HJ. Medication-related problems in CKD. *Adv Chronic Kidney Dis.* 2010; 17: 404.

8. Bosi A et al. Use of nephrotoxic medications in adults with chronic kidney disease in Swedish and US routine care. *Clin Kidney J.* 2022;15:442.

9. Davison SN et al. Analgesic Use in Patients With Advanced Chronic Kidney Disease: A Systematic Review and Meta-Analysis. *Can J Kidney Health Dis.* 2020; 7: 2054358120910329.

10. Armstrong MJ, Zhang K, Ye F, Klarenbach SW & Pannu NI. Population-Based Analysis of Nonsteroidal Anti-inflammatory Drug Prescription in Subjects With Chronic Kidney Disease. *Can J Kidney Health Dis.* 2023; 10: 20543581221149621.

11. Coca SG, Singanamala S & Parikh CR. Chronic kidney disease after acute kidney injury: A systematic review and meta-analysis. *Kidney Int.* 2012; 81: 442.

12. Perazella MA. Pharmacology behind Common Drug Nephrotoxicities. *Clin J Am Soc Nephrol.* 2018; 13:1897–1908.

13. Perazella MA & Rosner MH. Drug-Induced Acute Kidney Injury. *Clinical Journal of the American Society of Nephrology.* 2022; 17:1220.

14. Wagner L-A, Tata AL & Fink JC. Patient Safety Issues in CKD: Core Curriculum 2015. *American Journal of Kidney Diseases.* 2015; 66:159.

15. Laliberte MC et al. Use of over-the-counter medications and natural products in patients with moderate and severe chronic renal insufficiency. *Am J Kidney Dis.* 2007; 49:245.

16. Akyol AD, Yildirim Y, Toker E & Yavuz B. The use of complementary and alternative medicine among chronic renal failure patients. *J Clin Nurs.* 2011; 20: 1035.

17. Gabardi S, Munz K. & Ulbricht C. A review of dietary supplement-induced renal dysfunction. *Clin J Am Soc Nephrol.* 2007; 2: 757.

18. Sriperumbuduri S. & Hiremath S. The case for cautious consumption: NSAIDs in chronic kidney disease. *Curr Opin Nephrol Hypertens.* 2019; 28:163.

19. Arfè A et al. Non-steroidal anti-inflammatory drugs and risk of heart failure in four European countries: nested case-control study. *BMJ.* 2016; 354: i4857.

20. Novick TK et al. Associations of Opioid Prescriptions with Death and Hospitalization across the Spectrum of Estimated GFR. *Clin J Am Soc Nephrol.* 2019; 14: 1581.

21. Zhan M et al. Association of Opioids and Nonsteroidal Anti-inflammatory Drugs With Outcomes in CKD: Findings From the CRIC (Chronic Renal Insufficiency Cohort) Study. *Am J Kidney Dis.* 2020; 76: 184.

22. KDIGO Workgroup. KDIGO 2024. Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int.* 2024.

23. Agency EM (Ed Committee for Medicinal Products for Human Use (CHMP). 2016.

24. Group R I G W & (CDER) C f D E a R. (Food and Drug Administration. U S. Department of Health and Human Services. 2020.

25. Food and Drug Administration. Draft guidance. Pharmacokinetics in patients with impaired renal function. Study design, data analysis and impact on dosing. 2020.

26. Levey AS et al. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. *Ann Intern Med.* 2006; 145: 247.

27. Levey AS et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009; 150:604.

28. Inker LA et al. New Creatinine- and Cystatin C–Based Equations to Estimate GFR without Race. *New England Journal of Medicine.* 2021; 385:1737.

29. Titan S et al. Performance of Indexed and Nonindexed Estimated GFR. *Am J Kidney Dis.* 2020;76:446.

30. Collister D, Saad N, Christie E & Ahmed S. Providing Care for Transgender Persons With Kidney Disease: A Narrative Review. *Can J Kidney Health Dis.* 2021; 8: 2054358120985379.

31. Mauvais-Jarvis F et al. Sex- and Gender-Based Pharmacological Response to Drugs. *Pharmacol Rev.* 2021; 73: 730–762.

32. Soldin OP & Mattison DR. Sex differences in pharmacokinetics and pharmacodynamics. *Clin Pharmacokinet.* 2009; 48:143.

33. Zucker I & Prendergast BJ Sex differences in pharmacokinetics predict adverse drug reactions in women. *Biol Sex Differ.* 2020; 11: 32

34. Urakami T et al. Is trimethoprim/sulfamethoxazole-associated increase in serum creatinine a pseudo-elevation or true nephrotoxicity? *Journal of Infection and Chemotherapy.* 2021; 27: 1193.

35. Miano TA et al. Association of vancomycin plus piperacillin–tazobactam with early changes in creatinine versus cystatin C in critically ill adults: A prospective cohort study. *Intensive Care Medicine.* 2022; 48: 1144.

36. Rawson TM et al. Optimizing antimicrobial use: Challenges, advances and opportunities. *Nat Rev Microbiol.* 2021; 19: 747.

37. Lazarus B. et al. Association of Metformin Use With Risk of Lactic Acidosis Across the Range of Kidney Function: A Community-Based Cohort Study. *JAMA Intern Med.* 2018; 178: 903.

38. Tangren J, Bathini L, Jeyakumar N et al. Pre-pregnancy eGFR and the risk of adverse maternal and fetal outcomes: A population-based study. *J Am Soc Nephrol.* 2023;34:656.

39. Chang DH, Dumanski SM, Ahmed SB. Female reproductive and gynecologic considerations in chronic kidney disease: Adolescence and young adulthood. *Kidney Int Rep.* 2022;7:152.

40. Kalenga CZ, Dumanski SM, Metcalfe A et al. The effect of non-oral hormonal contraceptives on hypertension and blood pressure: Asystematic review and meta-analysis. *Physiol Rep.* 2022;10:e15267.

41. Gotestam Skorpen C. et al. The EULAR points to consider for use of antirheumatic drugs before pregnancy and during pregnancy and lactation. *Ann Rheum Dis.* 2016; 75: 795.

42. Wiles K et al. Clinical practice guideline on pregnancy and renal disease. *BMC Nephrol.* 2019; 20: 401.

43. Claudel SE, Gandhi M, Patel AB & Verma A. Estimating kidney function in patients with cancer: A narrative review. *Acta Physiol (Oxf).* 2023; e13977.

44. Casal MA, Nolin TD & Beumer JH Estimation of Kidney Function in Oncology: Implications for Anticancer Drug Selection and Dosing. *Clin J Am Soc Nephrol.* 2019; 14: 587.

45. Costa ESVT et al. A prospective cross-sectional study estimated glomerular filtration rate from creatinine and cystatin C in adults with solid tumors. *Kidney Int.* 2022; 101: 607.

46. St Peter WL, Wazny LD & Patel UD New models of CKD care including pharmacists: Improving medication reconciliation and medication management. Current opinion in nephrology and hypertension. 2013;22: 656.

47. BCPRA Kidney Care Committee, 2017.

48. Thompson W. & Farrell B. Deprescribing: What is it and what does the evidence tell us? *The Canadian journal of hospital pharmacy.* 2013; 66: 201.

49. Hassan Y, Al-Ramahi R, Aziz N. & Ghazali R. Adverse drug events in hospitalized patients with chronic kidney disease. *International journal of clinical pharmacology and therapeutics.* 2010; 48: 571.

50. Long B, Lentz S, Koyfman A & Gottlieb M. Euglycemic diabetic ketoacidosis: Etiologies, evaluation and management. *The American Journal of Emergency Medicine.* 2021; 44: 157.

51. Jones DC & Hayslett JP Outcome of Pregnancy in Women with Moderate or Severe Renal Insufficiency. *New England Journal of Medicine.* 1996; 335: 226.

52. Cooper WO et al. Major congenital malformations after first-trimester exposure to ACE inhibitors. *N Engl J Med.* 2006; 354: 2443.

53. Framarino-dei-Malatesta M et al. Impact of mTOR-I on fertility and pregnancy: State of the art and review of the literature. *Expert Rev Clin Immunol.* 2013;9:781.

54. Tangren J et al. Pre-Pregnancy eGFR and the Risk of Adverse Maternal and Fetal Outcomes: A Population-Based Study. *J Am Soc Nephrol.* 2023;34:656.

55. Dao KH & Bermas BL Systemic Lupus Erythematosus Management in Pregnancy. *Int J Womens Health.* 2022;14:199.

56. Martindale AM et al. Understanding the implementation of 'sick day guidance' to prevent acute kidney injury across a primary care setting in England: a qualitative evaluation. *BMJ Open.* 2017; 7: e017241.

57. Morris RL et al. Preventing Acute Kidney Injury: A qualitative study exploring 'sick day rules' implementation in primary care. *BMC Fam Pract'.* 2016; 17: 91.

58. Song YK et al. Effectiveness of Clinical Pharmacist Service on Drug-Related Problems and Patient Outcomes for Hospitalized Patients with Chronic Kidney Disease: A Randomized Controlled Trial. *J Clin Med.* 2021; 10: 1788.

59. Al Raiisi F et al. Clinical pharmacy practice in the care of Chronic Kidney Disease patients: A systematic review. *Int J Clin Pharm.* 2019; 41:630.

60. Joy MS et al. Clinical pharmacists as multidisciplinary health care providers in the management of CKD: A joint opinion by the Nephrology and Ambulatory Care Practice and Research Networks of the American College of Clinical Pharmacy. *Am J Kidney Dis.* 2005; 45:1105.

61. Francis A et al. Barriers to accessing essential medicines for kidney disease in low- and lower middle-income countries. *Kidney Int.* 2022; 102:969.

62. Giorgino F, Vora J, Fenici P & Solini A. Renoprotection with SGLT2 inhibitors in type 2 diabetes over a spectrum of cardiovascular and renal risk. *Cardiovasc Diabetol.* 2020;19:196.

63. Neuen BL et al. SGLT2 inhibitors for the prevention of kidney failure in patients with type 2 diabetes: A systematic review and meta-analysis. *Lancet Diabetes Endocrinol.* 2019;7:845.

64. Vitale M, Haxhi J, Cirrito T & Pugliese G. Renal protection with glucagon-like peptide-1 receptor agonists. *Curr Opin Pharmacol.* 2020;54:91.

65. Empagliflozin in Patients with Chronic Kidney Disease. *New England Journal of Medicine.* 2022; 388:117.

66. Taglione MS & Persaud N. Assessing variation among the national essential medicines lists of 21 high-income countries: A cross-sectional study. *BMJ Open.* 2021; 11: e045262.

Original Article

Marine City Medical College Journal

Inappropriate Use of Antibiotic: A Cross Sectional Observational Study in Paediatric Outpatient Department of A Tertiary Care Hospital, Bangladesh

Mohammad Shahab Uddin[1*] Basana Rani Muhuri[1] Md. Abdus Salam[2]
Rukhsana Akbar Alice[3] Jannatul Ferdaous Meem[4]

ABSTRACT

Background: Antibiotic misuse is a growing concern, particularly in pediatric populations, contributing to Antimicrobial Resistance (AMR). This study investigates the prevalence and factors associated with antibiotic misuse in children under 5 years old at a tertiary care pediatric Outpatient Department (OPD) in Marine City Medical College & Hopital, Chattogram.

Materials and methods: A cross-sectional study was conducted from January to June 2024 at Marine City Medical College and Hospital. Data were collected from 575 children through caregiver interviews and medical record reviews. Descriptive statistics and chi-square tests were used for data analysis.

Results: The majority of children (78%) were prescribed antibiotics for conditions where they were not indicated, such as viral infections. Antibiotics were primarily sourced from drug shops and unqualified practitioners. Only 67% of caregivers completed the full course of antibiotics, and 66% lacked awareness of the risks of misuse.

Conclusion: Antibiotic misuse is widespread, driven by OTC procurement, improper prescriptions and low caregiver awareness. Interventions to regulate antibiotic sales, educate caregivers, and improve healthcare provider practices are essential.

1. Professor of Pediatrics
Marine City Medical College, Chattogram, Bangladesh.
2. Associate Professor (cc) of Pediatrics
Marine City Medical College, Chattogram, Bangladesh.
3. Resident Physician of Pediatrics
Marine City Medical College & Hospital, Chattogram, Bangladesh.
4. Registrar of Pediatrics
Marine City Medical College & Hospital, Chattogram, Bangladesh.

*Correspondence **Professor (Dr.) Mohammad Shahab Uddin**
Email: drshahabpaedi@gmail.com
Cell : +88 01819 13 53 48

Date of Submitted : 05.08.2024
Date of Accepted : 31.08.2024

Key words: Antibiotic misuse; Antimicrobial resistance; Antibiotic prescriptions; caregiver awareness; Pediatric OPD.

INTRODUCTION

The misuse of antibiotics is a global health concern, particularly in low- and middle-income countries such as Bangladesh. Antibiotics are often prescribed for self-limiting viral infections, fueling the rise of Antimicrobial Resistance (AMR) now recognized as one of the greatest threats to public health.[1] In Bangladesh, misuse among children under five is especially alarming, as this group is highly vulnerable to antibiotic-resistant infections.[2] Studies indicate that 50–70% of pediatric antibiotic prescriptions are unnecessary, often given for colds, flu and other viral conditions.[3,4] In outpatient settings, quick diagnoses without confirmatory tests contribute to inappropriate prescribing.[5] The issue is compounded by over-the-counter availability of antibiotics, enabling self-medication by caregivers, especially in rural areas with limited access to qualified providers.[6,7]

Children in this age group face heightened risks, as early antibiotic exposure can disrupt gut microbiota and increase resistance, complicating future treatments.[8,9] Despite WHO and AAP recommendations to restrict antibiotic use to necessary cases, overprescription remains widespread.[10,11] Factors driving misuse include weak healthcare infrastructure, lack of diagnostic facilities and unregulated sales.[12,13] Many caregivers consult unqualified practitioners or purchase antibiotics directly from drug stores, while physicians often yield to caregiver expectations.[14-16] In Dhaka, over 50% of caregivers believed antibiotics were essential for common pediatric illnesses regardless of cause.[17] Awareness is limited: A rural study found only 30% of caregivers understood correct antibiotic use.[18]

Given this context, investigating antibiotic misuse among children under five in Bangladesh is crucial. This study aims to assess its prevalence in a tertiary care pediatric Outpatient Department (OPD) of Marine City Medical College & Hospital, identify contributing factors, and propose strategies to mitigate the problem.

MATERIALS AND METHODS

This study is a cross-sectional observational study conducted at the pediatric Outpatient Department (OPD) of Marine City Medical College and Hospital in Bangladesh, from January to June 2024. Ethical approval was obtained from the institutional review board of Marine City Medical College and Hospital and informed consent was obtained from the caregivers of all participating children.

The study targeted children under the age of five years who attended the pediatric OPD of Marine City Medical College and Hospital during the study period. Children who had been prescribed antibiotics were included in the study if the antibiotics were prescribed for conditions where antibiotics were not indicated (Such as viral infections or self-limiting conditions).

Inclusion criteria

Eligible participants were those who had been prescribed antibiotics irrespective of the clinical condition, even in cases where antibiotics were not medically required. In addition, only caregivers who were willing to participate and provide informed consent were included.

Exclusion criteria

Children with confirmed bacterial infections requiring antibiotic therapy, such as sepsis or pneumonia, were excluded from the study. Children with chronic illnesses or immune system deficiencies that necessitated regular antibiotic treatment were also not eligible. In addition, children whose caregivers did not provide consent for participation were excluded.

The sample size for the study was calculated using a standard formula for cross-sectional studies. Considering a population size of approximately 1,000 children attending the Pediatric OPD during the study period, a confidence level of 95% and a margin of error of 5%, the required sample size was calculated to be 384 children. A total of 575 children were included in the study to ensure sufficient data coverage and to account for any incomplete data.

Data were collected using structured questionnaires, which were administered to caregivers during their visit to the OPD at Marine City Medical College and Hospital. The questionnaire was designed to capture the following data:

- *Demographic Information:* Child's age, sex, caregiver occupation and educational status.
- *Clinical Data:* Diagnosis made by the healthcare provider and the conditions leading to the prescription of antibiotics. This data was extracted from the child's medical record.
- *Antibiotic Prescriptions:* Type of antibiotics prescribed, the frequency of use and duration of prescribed treatment.
- *Caregiver Awareness:* Caregiver knowledge regarding the proper use of antibiotics, including their understanding of the risks of overuse and the necessity of completing the prescribed course. This information was gathered through a caregiver interview and a set of questions based on common knowledge about antibiotic use.

The study also focused on the source of antibiotic prescription, whether the prescription was made by a healthcare professional or if the antibiotic was purchased over-the-counter or recommended by unqualified practitioners.

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Frequencies and percentages were calculated for categorical variables, such as the type of antibiotics prescribed and the source of prescription. Continuous variables, such as age, were analyzed using means and standard deviations.

To assess associations between various factors (Such as caregiver education level, the source of prescription and antibiotic misuse) chi-square tests were used for categorical data. Independent t-tests were employed to compare the mean age of children in groups with appropriate and inappropriate antibiotic use. A p-value of less than 0.05 was considered statistically significant.

The study adhered to ethical guidelines for medical research. Informed consent was obtained from the caregivers before participation, explaining the study's purpose, procedures, and potential risks. Caregivers were assured that all personal information would be kept confidential and that their participation was voluntary.

RESULTS

Table I Demographic Characteristics of Study Participants (n=575)

Characteristic	Study Group (n=575)
Age (Mean ± SD)	2.7 ± 1.2 years
Gender	
- Male	311 (54%)
- Female	204 (46%)
Caregiver Occupation	
- Housewife	380 (66%)
- Job Holder	135 (24%)
Caregiver Education	
- < High School	177 (31%)
- ≥ High School	398 (69%)

Table I presents the demographic details of the study participants, including age, gender, caregiver occupation, and educational status.

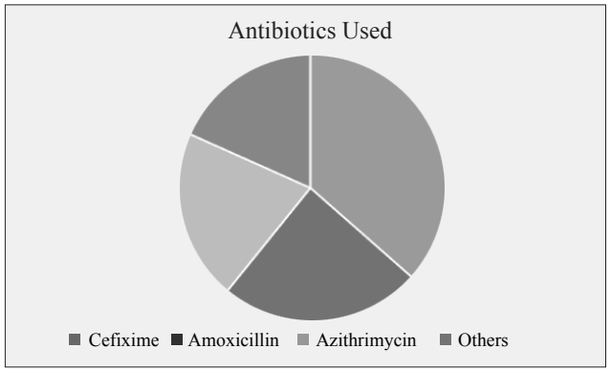


Figure 1 Distribution of Antibiotic Prescriptions by Type

Figure 1 shows the distribution of antibiotics prescribed to children in the study, highlighting the most common antibiotics used (n=575).

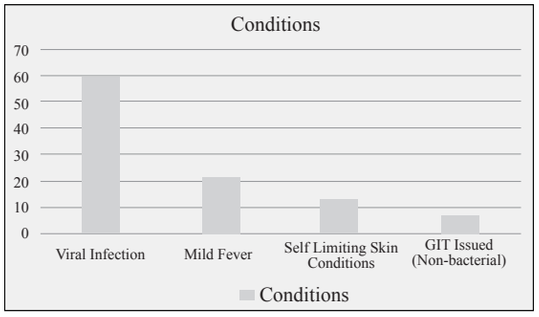


Figure 2 Antibiotic Prescription for Inappropriate Conditions

Figure 2 details the conditions for which antibiotics were inappropriately prescribed, such as viral infections or mild fever.

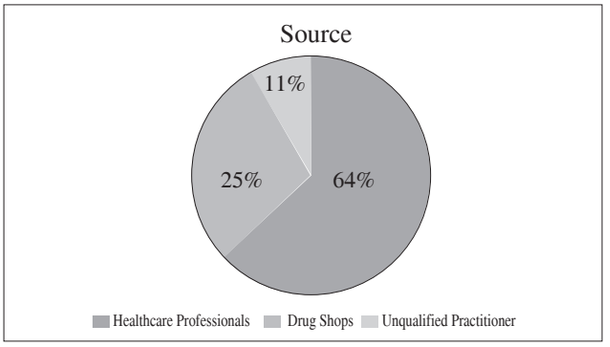


Figure 3 Sources of Antibiotic Prescriptions

Figure 3 outlines the various sources from which antibiotic prescriptions originated, including healthcare professionals, drug shops, and unqualified practitioners.

Table II Compliance with Full Antibiotic Course (n=575)

Compliance	Frequency (n=575)	Percentage (%)
Full Course Completed	385	67%
Full Course Not Completed	190	33%

Table II shows the rate of compliance with completing the full prescribed antibiotic course.

Table III Caregiver Awareness of Antibiotic Misuse

Caregiver Awareness	Frequency (n=575)	Percentage (%)
Aware of Risks of Misuse	198	34.4%
Unaware of Risks	377	65.6%

Table III highlights the level of awareness among caregivers about the misuse of antibiotics.

Table IV Association Between Caregiver Education and Antibiotic Misuse (n=575)

Caregiver Education Level	Antibiotic Misuse (n=575)	Non-Misuse (n=575)	p-value
< High School	155 (87%)	22 (13%)	<0.001
≥ High School	150 (38%)	248 (62%)	<0.001

Table IV examines the relationship between caregiver education level and the incidence of antibiotic misuse. The Chi-square test was performed to assess statistical significance.

Table V Antibiotic Prescription Based on Child's Condition (n=575)

Condition	Antibiotic Prescribed (n=575)	No Antibiotic Prescribed (n=575)	p-value
Fever	180 (31.3%)	395 (68.7%)	<0.01
Respiratory Issues	135 (23.5%)	440 (76.5%)	<0.05
Skin Conditions	85 (14.8%)	490 (85.2%)	<0.05
Gastrointestinal Issues	70 (12.2%)	505 (87.8%)	<0.05

Table V shows the prevalence of antibiotic prescriptions based on specific conditions. The Independent t-test was used to determine significant differences between antibiotic prescriptions and non-prescriptions for each condition.

DISCUSSION

The findings revealed a high prevalence of inappropriate antibiotic prescriptions, with 78% of children receiving antibiotics for conditions where they were not indicated, such as viral infections (59.1%) mild fever (20.9%) and self-limiting skin conditions (13.0%). These results align with global reports of unnecessary antibiotic use in pediatric populations, which contribute significantly to Antimicrobial Resistance (AMR).[1,2] Similar research in Bangladesh has documented high rates of antibiotic over-prescription in outpatient settings, particularly for viral illnesses.[3,4] Such practices are concerning, as antibiotic overuse in children can lead to resistant infections and microbiota disruptions that are difficult to treat.[5]

A notable factor in misuse was the influence of unqualified healthcare providers. Nearly 85% of prescriptions were obtained from healthcare professionals, drug shops or unqualified practitioners. This trend is consistent with other studies in Bangladesh, where limited access to qualified providers and over-the-counter availability of antibiotics drive inappropriate use.[6,7] Caregivers' tendencies to seek antibiotics without consultation, often believing they are necessary for any infection, further worsens the problem.[8] These findings emphasize the urgent need for regulatory measures to restrict unprescribed antibiotic sales in the informal sector.

The study also identified a considerable gap in caregiver awareness. Approximately 66% of caregivers were unaware of the risks of antibiotic misuse, mirroring findings from other low-income settings.[9,10] Limited understanding of resistance and the importance of completing full courses perpetuates misuse. For example, a rural Bangladeshi study found that only 30% of caregivers had even basic knowledge of appropriate antibiotic use.[11] In our study, only 67% of children completed prescribed courses, a significant concern as incomplete treatment increases the likelihood of resistance and recurrent infections.[12,13] These findings underscore the necessity of targeted health campaigns and provider-led counseling to improve adherence and awareness.

Caregiver education emerged as another important determinant. Children of caregivers with lower education levels were more likely to receive unnecessary antibiotics, consistent with existing literature.[14] Studies show that more educated caregivers are better at seeking appropriate care and adhering to medical advice, including antibiotic stewardship.[15] Addressing this educational gap may therefore be a key intervention strategy.

The conditions for which antibiotics were prescribed also reflect common misconceptions. Fever and respiratory infections often viral accounted for a large proportion of prescriptions. Notably, 31.3% of children with fever received antibiotics, despite most cases being viral in origin. This finding is consistent with global studies showing frequent use of antibiotics against viral infections.[16,17]

Overall, the findings suggest that both caregiver factors and provider practices drive misuse. Strengthening diagnostic practices and limiting prescriptions to necessary cases should be priorities for healthcare providers.[18] The implementation of antibiotic stewardship programs in hospitals and OPDs may provide a structured approach to reducing inappropriate use.[19] At the policy level, stricter regulation of antibiotic sales, especially in drug shops and informal markets, is essential.[20]

Antibiotic misuse in Bangladeshi pediatric outpatient settings is widespread, driven by over-prescription, lack of caregiver awareness and unregulated sales. Addressing this challenge requires coordinated action through caregiver education, provider training, stewardship programs, and stricter policy enforcement to reduce misuse and mitigate the growing threat of AMR.

LIMITATIONS

This study was conducted at a single tertiary care hospital, Marine City Medical College and Hospital, and as such, the findings may not be fully representative of the broader population in Bangladesh. Additionally, the study relied on caregiver self-reports to assess antibiotic misuse, which could be subject to recall bias or social desirability bias. Furthermore, since this was a cross-sectional study, it could not establish causal relationships between the identified factors and antibiotic misuse.

CONCLUSION

This study highlights the critical issue of antibiotic misuse in children under five years old in Bangladesh. The over-prescription of antibiotics for viral infections and self-limiting conditions, combined with low caregiver awareness and the widespread availability of antibiotics in drug shops, exacerbates the problem.

RECOMMENDATION

Efforts to reduce antibiotic misuse must include improving caregiver education, enhancing healthcare provider practices, and regulating antibiotic sales. Public health campaigns and antibiotic stewardship programs are essential in combating antibiotic resistance and ensuring the appropriate use of antibiotics in pediatric populations.

ACKNOWLEDGEMENT

The authors express their gratitude to the all associates of the Pediatric Outpatient Department of Marine City Medical College & Hospital.

AUTHORS CONTRIBUTIONS

Contribution to Concept, Design and Data - ASU, BRM
Accountability - ASU, BRM, MAS, RAA, JFM
Drafting and Critical revision - ASU, BRM
Final approval - ASU, BRM, MAS, RAA, JFM.

DISCLOSURE

All the authors declared no conflicts of interest.

REFERENCES

1. World Health Organization (WHO). Antimicrobial resistance: Key facts. 2021. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.

2. Saha S, Rahman MM, Ahmed S et al. Antimicrobial resistance in Bangladesh: A situation analysis. *Lancet Infect Dis.* 2020;20(3):e72-e81.

3. Cox A, Fink G, Mohamad M. Antibiotic misuse in children: A review of literature. *Pediatr Infect Dis J.* 2018;37(10):e286-e293.

4. Ahmed B, Islam S, Rahman S. Misuse of antibiotics in pediatric outpatient departments in Bangladesh: A study. *Bangl J Med Sci.* 2019;18(1):35-42.

5. Zhang J, Zhang X, Zhang H. The impact of antibiotics on gut microbiota in children. *Gut Microbes.* 2016;7(4):268-276.

6. Hossain A, Begum S, Mannan MA. Over-the-counter antibiotics in rural Bangladesh: Prevalence and implications. *J Pharm Policy Pract.* 2019;12:7.

7. Patel S, Alam S, Sheikh A. The role of informal healthcare providers in Bangladesh. *Health Policy Plan.* 2017;32(3):275-282.

8. Rowe AK, O'Brien KL, Williams P et al. How do children respond to antibiotic treatment? An evaluation of pediatric antibiotic prescriptions. *Pediatrics*. 2018;141(3):e20170689.

9. Rahman M, Rahman MA, Hossain MD. Assessing the impact of antibiotic misuse in rural Bangladesh. *J Bangladesh Coll Physicians Surg.* 2018;36(2):93-100.

10. Khan MA, Jahan N, Akter T. Parent's knowledge and practice regarding the use of antibiotics in children in rural Bangladesh. *BMC Public Health.* 2021;21(1):1024.

11. Hannan A, Masud MS, Mollah MA et al. Factors contributing to antibiotic misuse in Bangladesh: A study of pediatric clinics. *Bangladesh Med Res Counc Bull.* 2017;43(2):73-79.

12. Christakis DA et al. Early television exposure and subsequent attentional problems in children. *Pediatrics.* 2004;113(4):708-713.

13. Christakis DA. The effects of infant media usage: What do we know and what should we learn? *Acta Paediatr.* 2009;98(3):15-17.

14. White AR, Papadopoulos L, Allen A et al. Barriers to rational antibiotic prescribing in pediatric practices: A Bangladesh case study. *J Antimicrob Chemother.* 2020;75(1):148-153.

15. Talukder M, Hossain M. Caregiver perceptions and practices regarding antibiotics in pediatric care. *Pediatr Care.* 2019;23(4):229-235.

16. Ross-Degnan D, Soumerai SB. Improving drug use: What can we learn from developing countries? *Soc Sci Med.* 2002;55(11):1835-1844.

17. Samad N, Shawon MA, Roshid R. Physicians' prescribing behavior and patient expectation: A case study from Bangladesh. *Health Policy Plan*. 2020;35(5):639-646.

18. Zimmerman FJ, et al. Television and DVD/video viewing in children younger than 2 years of age. *Arch Pediatr Adolesc Med.* 2007;161(5):473-479.

19. Lillard AS, Peterson J. The immediate impact of different types of television on young children's executive function. *Pediatrics.* 2011;128(4):644-649.

20. Hannan A, Masud MS, Mollah MA et al. Over-the-counter antibiotics and their impact in Bangladesh. *Health Policy Plan.* 2020;35(7):802-809.

Original Article

Marine City Medical College Journal

Mobile Device Dependency and Its Association with Eye Disorders and Mood Changes in Children: A Cross-Sectional Analysis

Kaniz Farjana Mumu[1*] Md Aminul Haque[2] Farjana Islam[3] Akramul Azam[4] Heba Haque[5]

ABSTRACT

Background: The increasing use of mobile devices among children has raised concerns about their impact on physical and mental health, particularly regarding eye disorders, mood changes and academic performance. Limited research has focused on younger populations in developing countries, making this an area of growing importance. This study aimed to investigate the association between mobile device dependency, screen time and their effects on eye health, mood disturbances and academic performance in children aged 6-9 years.

Materials and methods: A cross-sectional study was conducted from January to August 2024 in Dhaka, targeting parents of 260 children from four kindergarten schools. Data were collected using structured questionnaires assessing mobile device usage patterns, eye-related complaints (Eye strain, dryness, vision problems) mood changes (Irritability, anxiety mood swings) and academic performance. Mobile device dependency was measured using validated scales, while eye disorders and mood changes were reported by parents and where possible, confirmed by medical check-ups. Statistical analyses were performed to determine the association between screen time, dependency, eye disorders, mood changes and school performance.

Results: Mobile device dependency was observed in 59.6% of children, with 36.5% spending 2-3 hours on devices daily. Eye disorders were prevalent in 57.7% of the children, with eye strain being the most common complaint (30.8%). Mood changes were reported in 75% of the children, with irritability (32.7%) and mood swings (28.8%) being the most frequent issues. Mobile device dependency was significantly associated with both eye problems ($p=0.022$) and mood changes ($p=0.005$). Additionally, dependent children had poorer academic performance compared to their non-dependent peers ($p=0.012$).

Conclusion: Mobile device dependency in children is significantly linked to eye disorders, mood disturbances, and lower academic performance. Strategies to regulate screen time and promote healthier device usage are crucial to mitigating these adverse effects.

Key words: Academic performance; Eye disorders; Mobile device dependency; Mood changes; Screen time.

1. Medical Officer of Neurology
Evercare Hospital, Dhaka, Bangladesh.
2. Consultant of Neurology
Evercare Hospital, Dhaka, Bangladesh.
3. Assistant Professor of Neurology
Dhaka Medical College, Dhaka, Bangladesh.
4. Assistant Professor of Neurology
Chittagong Medical College, Chattogram, Bangladesh.
5. Consultant of Ophthalmology
Evercare Hospital, Chattogram, Bangladesh.

*Correspondence **Dr. Kaniz Farjana Mumu**
Email: dr.mumu.dmc@gmail.com
Cell : +88 01777 51 13 80

Date of Submitted : 05.09.2024
Date of Accepted : 28.09.2024

INTRODUCTION

Cell phone use has become an integral part of modern life, serving as one of the primary sources of information, communication and entertainment. As of today, more than 6.5 billion people worldwide use cell phones, a number that continues to grow rapidly. Young adults, in particular, spend significant amounts of time on their cell phones, engaging with social media, playing games, communicating, or using them for academic purposes.[1,2] While cell phones provide numerous benefits, especially in terms of access to information and social connectivity, the excessive use of these devices has raised concerns about the potential impact on physical and mental health.[3,4]

Studies have demonstrated that cell phones can support physical and mental well-being, especially when used in moderation for educational or health-related purposes. However, excessive use of cell phones is now widely recognized as a potentially addictive behavior, with detrimental effects on the overall well-being of users. A longitudinal study conducted over three years

among adolescents identified cell phone use as a significant predictor of depression in young adults.[5-7] Additionally, adults who spend excessive time on their phones are often associated with higher levels of depression, anxiety and loneliness.[8,9]

Cell phone addiction has also been linked to increased stress levels. Problematic use of these devices is associated with psychological distress, emotional dysregulation, and obsessive-compulsive behaviors. Some studies have even connected excessive phone usage to symptoms related to Attention-Deficit Hyperactivity Disorder (ADHD).[10-12] The heightened reliance on mobile phones, particularly among vulnerable young adults, can result in mood disturbances, anxiety and depression.[13,14]

Another significant concern is the physical health of individuals who excessively use cell phones. Prolonged screen time and improper posture during phone use have been linked to musculoskeletal problems such as back pain, neck pain and eye strain.[15,16] According to a systematic review, the prevalence of musculoskeletal issues related to mobile device usage ranges from 8% to 89% in adults.[17,18] These conditions arise from poor posture, frequent neck movements, and hand overuse during extended mobile phone sessions.[19,20]

Moreover, excessive cell phone use can affect lifestyle habits, including diet and physical activity, leading to unhealthy weight gain and an increased risk of obesity.[21-23] A growing body of evidence also points to a connection between cell phone dependence and childhood obesity, which highlights the far-reaching consequences of excessive device usage.[24,25]

The study investigates the impact of mobile device dependency on eye disorders, mood changes and academic performance in children aged 6-9 years.

MATERIALS AND METHODS

The study employed a cross-sectional design, conducted in Dhaka from January to August 2024. Data was collected from four kindergarten schools, targeting parents of 260 children aged 6-9 years. The selection of participants was based on their willingness to participate, ensuring a representative sample of children from diverse socioeconomic backgrounds.

Data collection was performed using structured questionnaires distributed to the parents. The questionnaire assessed mobile device usage patterns, including screen time and dependency, as well as eye-related issues such as complaints of eye strain, dryness, and vision problems. Additionally, it included questions related to mood changes observed by parents, such as irritability, anxiety and mood swings.

To measure mobile device dependency, validated scales were incorporated into the questionnaire, ensuring reliable and standardized data. Eye disorders were assessed using parent-reported symptoms and, where possible, confirmation from medical check-ups. Mood changes were assessed using behavior rating scales tailored for children.

Informed consent was obtained from the parents before data collection, with assurances of confidentiality and voluntary participation. Parents were briefed on the purpose of the study and ethical guidelines were strictly followed to protect the rights and privacy of the participants. The study adhered to the ethical principles of the Helsinki Declaration, ensuring the well-being of the children involved.

RESULTS

In the study, the age distribution shows that 30.8% (n=80) of participants are 7 years old, followed by 25.0% (n=65) aged 8, 24.2% (n=63) aged 9 and 20.0% (n=52) aged 6. The gender distribution reveals that 51.9% (n=135) of participants are male, while 48.1% (n=125) are female. As per the socioeconomic status, majority came from middle-income families (53.8%) [Table I]. Mobile device dependency was observed in 59.6% of children, with 36.5% spending 2-3 hours on devices daily. There was a significant association between screen time and mobile device dependency ($p=0.004$) indicating that children with higher screen time were more likely to be dependent [Table II]. 57.7% of children reported eye problems, with eye strain (30.8%) being the most common complaint, followed by dry eyes (23.1%) and headaches (21.2%) [Table III]. All eye-related complaints showed statistically significant associations with mobile device dependency, with p-values <0.05. Mood changes were prevalent in 75% of the children. The most commonly reported issues were irritability (32.7%) and mood swings (28.8%) [Table IV]. A strong correlation between higher screen time and eye disorders, with children who spent more than 3 hours on devices having a 40% prevalence of eye-related issues. The association between screen time and eye disorders was statistically significant ($p=<0.05$). Children with more than 3 hours of daily screen time

exhibited mood changes in 57.7% of cases, compared to just 11.5% of those with less than 1 hour (p= <0.05) [Table V]. While all groups showed relatively high dependency rates, the association between socioeconomic status and dependency was statistically significant (p=0.041) [Table VI]. Further more children who are device-dependent had a significantly higher rate of low performance (58.1%) compared to non-dependent children (42.9%) wich was statistically significant. 80.0% of Children with eye disorders exhibited mood changes compared to those without eye problems (68.2%).

Table I Socioeconomic Statusof the Children (n=260)

Socioeconomic Status	Frequency (n)	Percentage (%)
Low	70	26.9
Middle	140	53.8
High	50	19.3

Table II Mobile Device Dependency and Screen Time (n=260)

Variable	Frequency (n)	Percentage (%)	p-value
Daily Screen Time (Hours)			
< 1 hour	40	15.4	0.015
1-2 hours	85	32.7	
2-3 hours	95	36.5	
> 3 hours	40	15.4	
Mobile Device Dependency			
Yes	155	59.6	0.004
No	105	40.4	

Table III Prevalence of Eye Disorders Among Children (n=260)

Eye Disorder	Frequency (n)	Percentage (%)	p-value
Eye Strain	80	30.8	0.032
Dry Eyes	60	23.1	0.021
Blurred Vision	45	17.3	0.040
Headaches (related)	55	21.2	0.017
Total Eye Disorder	150	57.7	
No Eye Complaints	110	42.3	

Table IV Mood Changes Associated with Mobile Device Use (n=260)

Mood Change	Frequency (n)	Percentage (%)	p-value
Irritability	85	32.7	0.005
Anxiety	60	23.1	0.014
Mood Swings	75	28.8	0.022
Difficulty in Concentration	65	25.0	0.029
Total with Mood Changes	195	75.0	
No Mood Changes	65	25.0	

Table V Correlation of Screen Time with Eye Disorders and Mood Changes (n=260)

Screen Time (hours)	Eye Disorder		Mood Changes		
	Eye Disorder Present (n)	Percentage (%)	Mood Changes Present (n)	Percentage (%)	p value
< 1 hour	10	6.7	15	11.5	< 0.05
1-2 hours	30	20.0	45	34.6	
2-3 hours	50	33.3	60	46.2	
> 3 hours	60	40.0	75	57.7	
Total Eye Disorder	150	57.7	195	75.0	

Table VI Association Between Socioeconomic Status and Mobile Device Dependency (n=260)

Socioeconomic Status	Device Dependent (n)	Percentage (%)	p-value
Low	40	57.1	0.041
Middle	85	60.7	
High	30	60.0	

DISCUSSION

In our study, 59.6% (n=155) of the children were classified as mobile device dependent. The majority of the children (36.5%) spent 2-3 hours per day on mobile devices, while 15.4% spent more than 3 hours daily. These findings are consistent with similar studies indicating a significant increase in mobile device use among young children. A study conducted by Domingues-Montanari also highlighted an alarming rise in mobile device dependency among children, noting that children aged 5-9 years increasingly rely on screens for entertainment, education and communication.[26] Our results suggest a significant association between screen time and mobile device dependency (p=0.004) reinforcing the argument that excessive screen use predisposes children to dependence.

The study found that 57.7% (n=150) of the children experienced eye disorders, with eye strain being the most common complaint (30.8%), followed by dry eyes (23.1%) and blurred vision (17.3%). Prolonged screen time had a clear impact on eye health, as children who spent more than 3 hours on mobile devices had a 40% prevalence of eye problems, while those with less than 1 hour of screen time had a prevalence of just 6.7%. These results align with previous research, such as the study by Lanca and Saw, which found that excessive screen exposure was linked to a rise in eye strain and myopia in young children.[27] Additionally, our results show a statistically significant correlation between screen time and the prevalence of eye problems (p=0.022), reinforcing the negative effects of mobile devices on eye health in children.

Mood disturbances were prevalent in 75% (n=195) of the children in this study. The most commonly reported issues were irritability (32.7%) anxiety (23.1%) and mood swings (28.8%). Importantly, children with more than 3 hours of daily screen time exhibited mood changes in 57.7% of cases, compared to only 11.5% for those with less than 1 hour of screen time. These findings are consistent with a study by Twenge and Campbell, which found that excessive screen time was significantly associated with increased risks of mood disturbances, including anxiety and depression in children.[28] Our results further show a strong correlation between mobile device dependency and mood changes (p=0.005), indicating that high screen time may not only affect children's physical health but also their emotional well-being.

Our study found that mobile device dependency was linked to poor academic performance, with 58.1% (n=90) of dependent children performing poorly in school, compared to 42.9% (n=45) of non-dependent children. This finding mirrors research by Lepp et al. which demonstrated that students who spent more time on their phones had significantly lower academic performance compared to those with limited usage.[3] The association between mobile device dependency and academic difficulties was statistically significant (p=0.012), suggesting that excessive mobile device use may negatively affect cognitive functions, such as concentration and memory, which are crucial for academic success.

Children from middle-income families had the highest mobile device dependency rate (60.7%) followed by those from high-income families (60%) and low-income families (57.1%). While these findings suggest that socioeconomic status influences mobile device usage, it is clear that dependency is widespread across all income levels. This finding corroborates a study by Ophir et al. which found that children from all socioeconomic backgrounds are increasingly exposed to digital screens, though the intensity and type of usage may vary based on socioeconomic factors.[29] In our study, the association between socioeconomic status and mobile device dependency was statistically significant (p=0.041).

Children with eye disorders were significantly more likely to experience mood changes (80%) compared to those without eye issues (68.2%). This strong correlation (p=0.001) suggests that the physical discomfort caused by eye strain and other related problems may exacerbate emotional disturbances, such as irritability and anxiety. Previous studies, including one by Choong et al. have also pointed out that prolonged screen exposure can contribute to both visual and psychological stress in children.[30]

LIMITATIONS

The study has certain limitation which includes short duration of time and cross sectional study.

CONCLUSION

This study highlights the substantial impact of mobile device dependency on both physical and emotional health in young children. More than half of the participants exhibited eye problems and three-quarters reported mood disturbances, with significant correlations observed between high screen time and these adverse effects. Mobile device dependency was also linked to poor academic performance, emphasizing the need for better regulation of screen use in this age group. Given these findings, parents, educators and policymakers must promote balanced screen time and encourage activities that minimize the risks of eye strain, emotional distress and academic difficulties. This study underscores the importance of understanding the pervasive impact of screen time on children's well-being and provides evidence-based insights for developing interventions to ensure healthier digital habits.

RECOMMENDATION

Further research is needed to explore long-term strategies to mitigate the negative consequences of mobile device dependency, especially in younger populations who are increasingly exposed to digital media.

ACKNOWLEDGEMENT

All the authors express their thanks to the all respondents and their guardians.

AUTHORS CONTRIBUTIONS

Contribution to Concept, Design and Data - KFM, MAH
Accountability - KFM, MAH, FI, AA, HH
Drafting and Critical revision - KFM, MAH
Final approval - KFM, MAH, FI, AA, HH.

DISCLOSURE

All the authors declared no conflicts of interest.

REFERENCES

1. O'Dea S. Number of Smartphone Subscriptions Worldwide from 2016 to 2027. [(Accessed on 11 May 2022)]. https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/.

2. Shoukat S. Cell Phone Addiction and Psychological and Physiological Health in Adolescents. *EXCLI J.* 2019;18:47–50. doi: 10.17179/excli2018-2006.

3. Lepp A, Barkley J E, Sanders G J, Rebold M, Gates P. The Relationship between Cell Phone Use, Physical and Sedentary Activity, and Cardiorespiratory Fitness in a Sample of U.S. College Students. Int. *J. Behav. Nutr.* Phys. Act. 2013;10:79.
doi: 10.1186/1479-5868-10-79.

4. Thomée S. Mobile Phone Use and Mental Health. A Review of the Research That Takes a Psychological Perspective on Exposure. Int. *J. Environ. Res. Public Health.* 2018;15:2692. doi: 10.3390/ijerph15122692.

5. Stawarz K, Preist C, Coyle D. Use of Smartphone Apps, Social Media, and Web-Based Resources to Support Mental Health and Well-Being: Online Survey. JMIR Ment. *Health.* 2019;6:e12546.
doi: 10.2196/12546.

6. De-Sola Gutiérrez J, Rodríguez de Fonseca F, Rubio G. Cell-Phone Addiction: A Review. *Front. Psychiatry.* 2016;7:175.
doi: 10.3389/fpsyt.2016.00175.

7. Coyne S M, Stockdale L, Summers K. Problematic Cell Phone Use, Depression, Anxiety and Self-Regulation: Evidence from a Three Year Longitudinal Study from Adolescence to Emerging Adulthood. *Comput. Hum. Behav.* 2019;96:78–84.
doi: 10.1016/j.chb.2019.02.014.

8. Ivanova A, Gorbaniuk O, B achnio A, Przepiórka A, Mraka N, Polishchuk V, Gorbaniuk J. Mobile Phone Addiction, Phubbing, and Depression among Men and Women: A Moderated Mediation Analysis. *Psychiatric Quart.* 2020;91:655–668.
doi: 10.1007/s11126-020-09723-8.

9. Jeong B, Lee J Y, Kim B M, Park E, Kwon J G, Kim D J, Lee Y, Choi JS, Lee D. Associations of Personality and Clinical Characteristics with Excessive Internet and Smartphone Use in Adolescents: A Structural Equation Modeling Approach. *Addict. Behav.* 2020;110:106485.
doi: 10.1016/j.addbeh.2020.106485.

10. Karsay K, Schmuck D, Matthes J, Stevic A. Longitudinal Effects of Excessive Smartphone Use on Stress and Loneliness: The Moderating Role of Self-Disclosure. *Cyberpsychol. Behav. Soc. Netw.* 2019;22:706–713.
doi: 10.1089/cyber.2019.0255.

11. Squires L R, Hollett K B, Hesson J, Harris N. Psychological Distress, Emotion Dysregulation and Coping Behaviour: A Theoretical Perspective of Problematic Smartphone *Use. Int. J. Ment. Health Addict.* 2021;19:1284–1299.
doi: 10.1007/s11469-020-00224-0.

12. Kempf C A, Ehrhard K A, Stoner S C. Evaluation of Obsessive-Compulsive Symptoms in Relation to Smartphone Use. *Ment. Health Clin.* 2020;10:44–48.
doi: 10.9740/mhc.2020.03.044.

13. Kim H-J, Min J-Y, Min K-B, Lee T-J, Yoo S. Relationship among Family Environment, Self-Control, Friendship Quality, and Adolescents' Smartphone Addiction in South Korea: Findings from Nationwide Data. *PLoS ONE.* 2018;13:e0190896.
doi: 10.1371/journal.pone.0190896.

14. Rosen L D, Whaling K, Carrier L M, Cheever N A, Rokkum J. The Media and Technology Usage and Attitudes Scale: An Empirical Investigation. Comput. *Hum. Behav.* 2013;29:2501–2511.
doi: 10.1016/j.chb.2013.06.006.

15. Reinecke L, Aufenanger S, Beutel M E, Dreier M, Quiring O, Stark B, Wölfling K, Müller K W. Digital Stress over the Life Span: The Effects of Communication Load and Internet Multitasking on Perceived Stress and Psychological Health Impairments in a German Probability Sample. *Null.* 2017;20:90–115.
doi: 10.1080/15213269.2015.1121832.

16. Elhai J D, Rozgonjuk D, Yildirim C, Alghraibeh A M, Alafnan A A. Worry and Anger Are Associated with Latent Classes of Problematic Smartphone Use Severity among College Students. *J. Affect. Disord.* 2019;246:209–216.
doi: 10.1016/j.jad.2018.12.047.

17. Zhen R, Liu R-D, Hong W, Zhou X. How Do Interpersonal Relationships Relieve Adolescents' Problematic Mobile Phone Use? The Roles of Loneliness and Motivation to Use Mobile Phones. *Int. J. Environ. Res. Public Health.* 2019;16:2286.
doi: 10.3390/ijerph16132286.

18. Alavi S S, Ghanizadeh M, Farahani M, Jannatifard F, Alamuti S E, Mohammadi M R. Addictive Use of Smartphones and Mental Disorders in University Students. Iran. *J. Psychiatry.* 2020;15:96.
doi: 10.18502/ijps.v15i2.2681.

19. Elhai J D, Gallinari E F, Rozgonjuk D, Yang H. Depression, Anxiety and Fear of Missing out as Correlates of Social, Non-Social and Problematic Smartphone Use. *Addict. Behav.* 2020;105:106335.
doi: 10.1016/j.addbeh.2020.106335.

20. Dempsey S, Lyons S, McCoy S. Early Mobile Phone Ownership: Influencing the Wellbeing of Girls and Boys in Ireland? *Null.* 2020;14:492–509.
doi: 10.1080/17482798.2020.1725902.

21. Takao M, Takahashi S, Kitamura M. Addictive Personality and Problematic Mobile Phone Use. Cyber. *Psychol. Behav.* 2009;12:501–507.
doi: 10.1089/cpb.2009.0022.

22. Schoeni A, Roser K, Röösli M. Symptoms and Cognitive Functions in Adolescents in Relation to Mobile Phone Use during Night. *PLoS ONE.* 2015;10:e0133528.
doi: 10.1371/journal.pone.0133528.

23. Chahal H, Fung C, Kuhle S, Veugelers P J. Availability and Night-Time Use of Electronic Entertainment and Communication Devices Are Associated with Short Sleep Duration and Obesity among Canadian Children. *Pediatr. Obes.* 2013;8:42–51.
doi: 10.1111/j.2047-6310.2012.00085.x.

24. Domoff S E, Sutherland E Q, Yokum S, Gearhardt A N. Adolescents' Addictive Phone Use: Associations with Eating Behaviors and Adiposity. Int. *J. Environ. Res. Public Health.* 2020;17:2861.
doi: 10.3390/ijerph17082861.

25. Morita N, Nakajima T, Okita K, Ishihara T, Sagawa M, Yamatsu K. Relationships among Fitness, Obesity, Screen Time and Academic Achievement in Japanese Adolescents. *Physiol. Behav.* 2016;163:161–166.
doi: 10.1016/j.physbeh.2016.04.055.

26. Domingues-Montanari S. Clinical and psychological effects of excessive screen time on children. *J Paediatr Child Health.* 2017;53(4):333-338.

27. Lanca C, Saw SM. The association between digital screen time and myopia : A systematic review. *Ophthalmic Physiol Opt.* 2020;40(2):216-229.

28. Twenge JM, Campbell WK. Associations between screen time and lower psychological well being among children and adolescents : Evidence from a population based study. *Prev Med Rep.* 2018;12:271-283.

29. Ophir Y, Asterhan CSC, Schwarz B B. The digital footrints of adolescent depression, social rejection and victimization of bullying on Facebook. *Computers in Human Behavior.* 2019; 91:62-71.

30. Ferdaus F & Begum, S. Health and Economic Impacts of Climate Change in Rural Bangladesh and Options to go through. *Khulna University Studie*s. 2023;25–29.
https://doi.org/10.53808/kus.si.2023.ices.a24-ls.

Original Article

Marine City Medical College Journal

Causes and Characteristics of Depression in Stroke Patients: A Cross-Sectional Study

Sohail Moslem[1*] Taslima Sultana[2] Md Aminul Islam[3] Emtiaz Ahammed[4]

ABSTRACT

Background: Stroke is a leading cause of death and disability worldwide, with Post-Stroke Depression (PSD) being a prevalent psychological complication. PSD negatively impacts stroke recovery, leading to increased disability and mortality. Identifying factors associated with PSD can guide early intervention strategies and improve outcomes. This study aimed to assess the prevalence and factors associated with PSD in stroke patients, focusing on demographic, clinical and treatment-related variables.

Materials and methods: A cross-sectional study was conducted at Evercare Hospital, Dhaka, from January to June 2024, involving 190 stroke patients. Patients were assessed for depressive symptoms using the Hamilton Depression Rating Scale (HDRS) and Beck Depression Inventory (BDI). Key variables analyzed included age, gender, education, stroke type, stroke severity, functional outcomes, comorbidities, rehabilitation and medication compliance. Chi-square tests were used to explore associations, with significance set at $p<0.05$.

Results: PSD was present in 58.9% of stroke patients. Depression was significantly associated with younger age (<50 years, $p=0.012$), lower education (Below SSC, $p=0.042$) severe stroke (NIHSS >16, $p<0.001$) and recent stroke onset (<3 months, $p<0.001$). Higher dependency, measured by FIM and Barthel Index scores and diabetes ($p=0.034$) were also linked to depression. Patients receiving regular physical therapy and adhering to medications had lower rates of depression ($p=0.017$, $p=0.035$).

Conclusion: PSD is prevalent among stroke survivors and is associated with younger age, lower education, severe stroke, functional dependency and diabetes. Regular rehabilitation and treatment compliance reduces the risk of depression. Early screening and comprehensive rehabilitation programs are essential to improving mental health outcomes in stroke patients.

Key words: Functional outcomes; Post-stroke depression; Rehabilitation; Stroke severity.

1. Resident Medical Officer of Neurology
Evercare Hospital, Dhaka, Bangladesh.
2. Associate Professor of Pharmacology and Therapeutics
Khulna City Medical College, Khulna, Bangladesh.
3. Medical Officer
Cumilla New Meghna General Hospital, Cumilla, Bangladesh.
4. Medical Officer
Cumilla Medicare General Hospital, Cumilla, Bangladesh.

*Correspondence : **Dr. Sohail Moslem**
Email: sohailmoslem1132@gmail.com.
Cell : +88 01648 29 80 44

Date of Submitted : 16.09.2024
Date of Accepted : 12.10.2024

INTRODUCTION

Stroke is the second leading cause of death worldwide after myocardial infarction and is a major cause of adult disability, affecting millions globally.[1,2,3] In 2010, it was estimated that 16.9 million people experienced their first stroke, with 33 million stroke survivors and 5.9 million stroke-related deaths.[4] Of all stroke cases, approximately 88% are ischemic, 9% are intracerebral hemorrhagic and 3% are subarachnoid hemorrhagic.[5] Both stroke mortality and morbidity are increasing globally. According to the World Health Organization, in 2002, the total number of deaths due to cerebrovascular accidents in Pakistan was 78,512. Similarly, in Brazil, between 1994 and 1997, the annual hospitalizations due to stroke ranged between 198,705 and 295,596, with an estimated 25% of these cases being recurrent strokes.[6] Among stroke survivors, motor impairment is present in approximately 80% of cases.

Depression is a common psychological complication in stroke survivors. It is characterized by periods of sad mood and anhedonia, which is the inability to experience pleasure from previously enjoyable activities such as eating, exercising or social interactions, persisting for at least two consecutive weeks as per DSM-IV criteria.[8] Post-Stroke Depression (PSD)

significantly impacts recovery, leading to increased disability and mortality among stroke survivors.[9] Morris et al. reported in 1993 that stroke patients with depression were 3.4 times more likely to die within 10 years than their non-depressed counterparts.[10] Depression negatively influences stroke recovery through various mechanisms. For instance, depressed patients may be less motivated to participate in rehabilitation due to persistent fatigue or hopelessness, while cognitive impairments may further delay recovery by reducing adherence to treatment schedules, leading to increased mortality rates.

Post-stroke depression is prevalent in both men and women, with a systematic review of 51 studies by Hackett et al. in 2005 estimating that the overall frequency of PSD is approximately 33%.[11] Stroke survivors experience debilitating morbidity and superimposed PSD further diminishes their quality of life and impairs recovery.

The present study was conducted to estimate the magnitude of post-stroke depression in a clinical setting to facilitate the development of departmental protocols for early screening and referral for PSD treatment. Early detection and intervention for PSD can improve the quality of life, expedite recovery and increase functionality for stroke survivors.[12,13]

MATERIALS AND METHODS

The cross-sectional study was conducted at the Department of Neurology, Evercare Hospital, Dhaka, to explore the causes and characteristics of depression among stroke patients. A total of 190 patients diagnosed with stroke were included in the research, spanning a study period from January to June 2024. The patients were selected based on specific inclusion and exclusion criteria, focusing on individuals who had experienced a stroke and were exhibiting depressive symptoms.

Data collection involved face-to-face interviews with the participants, using both structured questionnaires and validated tools to assess depressive symptoms. The Hamilton Depression Rating Scale (HDRS) and Beck Depression Inventory (BDI) were employed to evaluate the severity of depression. In addition, detailed sociodemographic and clinical data were gathered, including age, gender, stroke type, stroke severity, and time since the stroke. These data points helped in understanding the relationship between stroke and depression in this patient population.

Informed consent was obtained from all participants before their inclusion in the study. Patients were assured of confidentiality and the voluntary nature of their participation. The research adhered to ethical standards, with approval obtained from the institutional review board of Evercare Hospital. All patients were informed about their right to withdraw from the study at any time without any consequence to their medical treatment. The data collected were analyzed using statistical techniques to identify key causes and characteristics of depression in stroke patients. Factors such as stroke severity, type of stroke, duration since the stroke, as well as sociodemographic variables like age, gender and educational level were examined about depression. The results were used to provide insights into the mental health challenges faced by stroke patients, contributing to better-targeted interventions for this vulnerable group.

RESULTS

Table I Demographic Characteristics of Stroke Patients and Their Association with Depression (n = 190)

Variable	Category	Total (n = 190)	Depression Present (n = 112)	Depression Absent (n = 78)	p-Value
Age Group	< 50 years	55 (28.9%)	40 (35.7%)	15 (19.2%)	0.012*
	50-65 years	90 (47.4%)	50 (44.6%)	40 (51.3%)	
	> 65 years	45 (23.7%)	22 (19.6%)	23 (29.5%)	
Gender	Male	110 (57.9%)	60 (53.6%)	50 (64.1%)	0.098
	Female	80 (42.1%)	52 (46.4%)	28 (35.9%)	
Educational Level	Below SSC	70 (36.8%)	45 (40.2%)	25 (32.1%)	0.042*
	SSC-HSC	80 (42.1%)	50 (44.6%)	30 (38.5%)	
	Graduate and above	40 (21.1%)	17 (15.2%)	23 (29.4%)	

*p-value derived from Chi-square test, *Significant at $p < 0.05$.

Table I shows that age and educational level are significantly associated with the presence of depression among stroke patients. Patients below 50 years and those with lower education levels (Below SSC) had higher rates of depression. Gender, although analyzed, was not found to be significantly associated with depression in this cohort.

Table II Clinical Characteristics of Stroke and Their Association with Depression (n = 190)

Variable	Category	Total (n = 190)	Depression Present (n = 112)	Depression Absent (n = 78)	p-Value
Type of Stroke	Ischemic	130 (68.4%)	80 (71.4%)	50 (64.1%)	0.184
	Hemorrhagic	60 (31.6%)	32 (28.6%)	28 (35.9%)	
Stroke Severity	Mild (NIHSS 0-5)	80 (42.1%)	30 (26.8%)	50 (64.1%)	<0.001**
	Moderate (NIHSS 6-15)	70 (36.8%)	55 (49.1%)	15 (19.2%)	
	Severe (NIHSS>16)	40 (21.1%)	27 (24.1%)	13 (16.7%)	
Time Since Stroke	< 3 months	100 (52.6%)	72 (64.3%)	28 (35.9%)	<0.001**
	3-6 months	90 (47.4%)	40 (35.7%)	50 (64.1%)	

Table II shows that stroke severity and time since stroke are significantly associated with the presence of depression ($p < 0.001$). Patients with more severe strokes and those who had their stroke less than three months prior exhibited higher rates of depression. The type of stroke, ischemic or hemorrhagic, did not show a significant association with depression.

Table III Association of Depression with Functional Outcomes and Dependency Levels (n = 190)

Variable	Category	Total (n = 190)	Depression Present (n = 112)	Depression Absent (n = 78)	p-Value
Functional Independence Measure (FIM) Score	< 60 (Severe dependency)	70 (36.8%)	50 (44.6%)	20 (25.6%)	0.008*
	60-100 (Moderate dependency)	80 (42.1%)	45 (40.2%)	35 (44.9%)	
	> 100 (Mild dependency)	40 (21.1%)	17 (15.2%)	23 (29.5%)	
Barthel Index	< 20 (Severe)	60 (31.6%)	45 (40.2%)	15 (19.2%)	0.004*
	20-60 (Moderate)	80 (42.1%)	50 (44.6%)	30 (38.5%)	
	> 60 (Mild)	50 (26.3%)	17 (15.2%)	33 (42.3%)	

Table III demonstrates that lower FIM scores and lower Barthel Index scores, indicating higher levels of dependency and poorer functional outcomes, were significantly associated with depression among stroke patients.

Table IV Comorbid Conditions and Their Association with Depression (n = 190)

Comorbidity	Category	Total (n = 190)	Depression Present (n = 112)	Depression Absent (n = 78)	p-Value
Hypertension	Yes	120 (63.2%)	75 (67.0%)	45 (57.7%)	0.083
	No	70 (36.8%)	37 (33.0%)	33 (42.3%)	
Diabetes	Yes	100 (52.6%)	65 (58.0%)	35 (44.9%)	0.034*
	No	90 (47.4%)	47 (42.0%)	43 (55.1%)	
Dyslipidemia	Yes	80 (42.1%)	52 (46.4%)	28 (35.9%)	0.065
	No	110 (57.9%)	60 (53.6%)	50 (64.1%)	

Table IV reveals that diabetes is significantly associated with depression among stroke patients ($p = 0.034$). While hypertension and dyslipidemia were also assessed, no statistically significant association was found with depression in this population.

Table V Treatment and Rehabilitation Factors Associated with Depression (n = 190)

Variable	Category	Total (n = 190)	Depression Present (n = 112)	Depression Absent (n = 78)	p-Value
Rehabilitation Type	Physical Therapy	140 (73.7%)	90 (80.4%)	50 (64.1%)	0.017*
	None	50 (26.3%)	22 (19.6%)	28 (35.9%)	
Medication Compliance	Regular	130 (68.4%)	70 (62.5%)	60 (76.9%)	0.035*
	Irregular	60 (31.6%)	42 (37.5%)	18 (23.1%)	

Table V shows that stroke patients who received regular physical therapy and adhered to their medication regimen were less likely to suffer from depression. Both rehabilitation type and medication compliance were significantly associated with depression status ($p < 0.05$).

DISCUSSION

This study aimed to identify the causes and characteristics of depression in stroke patients. Based on the analysis, 58.9% (112 out of 190) of stroke patients exhibited symptoms of depression, indicating that depression is a prevalent comorbidity in stroke survivors. This finding is consistent with previous studies, which reported depression rates ranging from 30% to 60% among stroke patients depending on the population studied and assessment methods.[14]

Our results indicate that age and education are significantly associated with depression among stroke patients. Specifically, depression was more common among patients younger than 50 years (35.7%) compared to those aged over 65 years (19.6%) ($p = 0.012$). This aligns with the findings of Choi et al. who also reported that younger stroke survivors were at higher risk for depression. The higher incidence of depression in younger patients may be attributed to the profound impact stroke has on their quality of life, as they are more likely to be in their working years and may experience greater psychological distress due to sudden loss of independence.[15]

The educational level also emerged as a significant predictor of depression, with 40.2% of patients having education below SSC experiencing depression, compared to only 15.2% of those with a graduate or postgraduate degree ($p = 0.042$). Lower educational attainment may be associated with poorer coping mechanisms and reduced access to healthcare resources, both of which can contribute to higher rates of depression, as noted in studies conducted in developing countries.[16]

Stroke severity, as measured by the National Institutes of Health Stroke Scale (NIHSS), was a strong predictor of depression. Among patients with severe strokes (NIHSS > 16) 24.1% were depressed, while only 26.8% of those with mild strokes (NIHSS 0-5) exhibited depression ($p < 0.001$). These findings corroborate those of Hackett et al. who demonstrated that stroke severity is one of the most significant clinical predictors of post-stroke depression. Severe strokes often result in greater physical disability and functional dependency, which can lead to increased emotional distress.[17]

Additionally, the time since the stroke was a significant factor. Depression was more prevalent among patients who had experienced a stroke within the past three months (64.3%) compared to those who had a stroke three to six months prior (35.7%) ($p < 0.001$). This early onset of depression may be due to the acute psychological trauma and adjustment challenges immediately following a stroke, as supported by other studies showing that depression is most prevalent in the early months post-stroke.[14]

Functional outcomes, measured using the Functional Independence Measure (FIM) and the Barthel Index, were also closely associated with depression. Patients with severe dependency (FIM < 60) showed a 44.6% depression rate, while those with mild dependency (FIM > 100) had a lower depression rate of 15.2% ($p = 0.008$). Similarly, a Barthel Index score below 20, indicating severe disability, was associated with a 40.2% rate of depression ($p = 0.004$). These findings are consistent with the work of Shewangizaw et al, who noted that poor functional recovery is a major risk factor for depression in stroke survivors.[19] Patients who experience significant physical limitations and dependency on caregivers are likely to feel a loss of autonomy, which can contribute to feelings of hopelessness and depression.[18]

Diabetes was the only comorbid condition significantly associated with depression in this study. Among patients with diabetes, 58.0% experienced depression, compared to 42.0% without diabetes ($p = 0.034$). This is in line with findings by Yang et al. who reported that stroke patients with diabetes have higher rates of depression due to the compounded effects of managing a chronic disease along with stroke recovery.[20] Hypertension and dyslipidemia, although common in the study population, were not significantly associated with depression, suggesting that the presence of these conditions may not be as impactful on the psychological health of stroke patients as diabetes.

Rehabilitation and treatment adherence were key factors in reducing the likelihood of depression. Patients who received regular physical therapy had an 80.4% depression rate, compared to 64.1% among those who did not receive therapy ($p = 0.017$). This suggests that physical therapy can alleviate depression by improving functional recovery and fostering a sense of progress and control over the recovery process. Similar results were observed by Lavu et al. who found that active rehabilitation programs are associated with lower depression rates in stroke survivors.[21]

Moreover, regular compliance with medication was associated with lower rates of depression, with 62.5% of compliant patients being depressed compared to 37.5% of those with irregular compliance ($p = 0.035$). This highlights the importance of ensuring that patients adhere to their prescribed treatment regimens, as poor compliance may worsen stroke outcomes and in turn, increase the risk of depression.

LIMITATION

Cross sectional and single centre study.

CONCLUSION

This study highlights several demographics, clinical, and treatment-related factors associated with depression in stroke patients. Younger age, lower education levels, severe stroke, early post-stroke period, functional dependency, diabetes, and lack of rehabilitation or medication compliance are all significantly linked to depression. These findings underscore the importance of early intervention and comprehensive rehabilitation programs to address the mental health challenges faced by stroke survivors.

RECOMMENDATIONS

Future studies should aim to explore long-term outcomes and the impact of psychological support services on post-stroke depression.

ACKNOWLEDGEMENT

All the authors express their gratitude to the all associates of Neurology Department, Evercare Hospital, Dhaka.

AUTHORS CONTRIBUTIONS

Contribution to Concept, Design and Data - SM, TS
Accountability - SM, TS, MAI, EA
Drafting and Critical revision - SM, TS
Final approval - SM, TS, MAI, EA.

DISCLOSURE

All the authors declared no conflicts of interest.

REFERENCES

1. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *The Lancet.* 2006;367(9524):1747-1757.

2. Kolominsky-Rabas PL, Heuschmann PU, Marschall D, Emmert M, Baltzer N, Neundörfer B, Schöffski O, Krobot KJ. Lifetime cost of ischemic stroke in Germany: Results and national projections from a population-based stroke registry. *Stroke.* 2006;37(5):1179- 1183.

3. Minnerup J, Seeger FH, Kuhnert K, Diederich K, Schilling M, Dimmeler S, Schäbitz WR. Intracarotid administration of human bone m ar ro w m ononuc lear cel l s in rat photothrombotic ischemia. *Experimental & translational stroke medicine.* 2010;2(1):3.

4. Feigin VL, Forouzanfar MH, Krishnamurthi R, Mensah GA, Connor M, Bennett DA, Moran AE, Sacco RL, Anderson L, Truelsen T, O'Donnell M. Global and regional burden of stroke during 1990–2010: Findings from the Global Burden of Disease Study 2010. *The Lancet.* 2014;383(9913):245-255.

5. Asfandiyarova N, Kolcheva N, Ryazantsev I, Ryazantsev V. Risk factors for stroke in type 2 diabetes mellitus. *Diabetes and Vascular Disease Research.* 2006;3(1):57-60.

6. Yamashita LF, Fukujima MM, Granitoff N, Prado GF. Paciente com acidente vascular cerebral isquêmicojá é atendido com maisrapidez no Hospital São Paulo. *Arquivos de NeuroPsiquiatria.* 2004.

7. Moura RD, Fukujima MM, Aguiar AS, Fontes SV, Dauar RF, Prado GF. Predictive factors for spasticity among ischemic stroke patients. *Arqui vos de neuro-ps iquiatria.* 2009;67(4):1029-1036.

8. Poynter B, Hon MS, Diaz-Granados N, KapralM, Grace SL, Stewart DE. Sex differences in the prevalence of post-stroke depression: A systematic review. *Psychosomatics.* 2009;50(6):563-569.

9. Robinson RG, Jorge RE. Post-stroke depression: A review. *American Journal of Psychiatry.* 2015;173(3):221-231.

10. Morris PL, Robinson RG, Andrzejewski P, Samuels J, Price TR. Association of depression with 10-year poststroke mortality. *American Journal of Psychiatry.* 1993; 150:124.

11. Hackett ML, Yapa C, Parag V, Anderson CS. Frequency of depression after stroke. *Stroke.* 2005;36(6):1330-1340.

12. Stroke WH. Recommendations on stroke prevention, diagnosis and therapy. Report of the WHO Task Force on Stroke and other Cerebrovascular Disorders. *Stroke.* 1989;20(10):1407-1431.

13. Williams LS, Brizendine EJ, Plue L, Bakas T, Tu W, Hendrie H, Kroenke K. Performance of the PHQ-9 as a screening tool for depression after stroke. *Stroke.* 2005;36(3):635-638.

14. Liu L, Xu M, Marshall IJ, Wolfe CD, Wang Y, O'Connell MD. Prevalence and natural history of depression after stroke: A systematic review and meta-analysis of observational studies. *PLoS Med.* 2023;20(3):e1004200.
doi: 10.1371/journal.pmed.1004200. PMID: 36976794; PMCID: PMC10047522.

15. Choi HL, Yang K, Han K, Kim B, Chang WH, Kwon S, Jung W, Yoo JE, Jeon HJ, Shin DW. Increased Risk of Developing Depression in Disability after Stroke: A Korean Nationwide Study. *Int J Environ Res Public Health.* 2023;20(1):842.
doi: 10.3390/ijerph20010842. PMID: 36613164; PMCID: PMC9819798.

16. Mofatteh M. Risk factors associated with stress, anxiety and depression among university undergraduate students. *AIMS Public Health.* 2020;8(1):36-65.
doi: 10.3934/publichealth.2021004. PMID: 33575406; PMCID: PMC7870388.

17. Hackett ML, Anderson CS. Predictors of depression after stroke: A systematic review of observational studies. *Stroke.* 2005 ;36(10):2296-2301.
doi: 10.1161/01.STR.0000183622.75135.a4. Epub 2005 Sep 22. PMID: 16179565.

18. Schulz R, Sherwood PR. Physical and mental health effects of family caregiving. *Am J Nurs.* 2008;108(9 Suppl):23-7; quiz 27.
doi: 10.1097/01.NAJ.0000336406.45248.4c. PMID: 18797217; PMCID: PMC2791523.

19. Shewangizaw S, Fekadu W, Gebregzihabhier Y, Mihretu A, Sackley C, Alem A. Impact of depression on stroke outcomes among stroke survivors: Systematic review and meta-analysis. *PLoS One.* 2023;18(12): e0294668.
doi: 10.1371/journal.pone.0294668. PMID: 38039323; PMCID: PMC10691726.

20. Yang S, Boudier-Revéret M, Kwon S, Lee MY, Chang MC. Effect of Diabetes on Post-stroke Recovery: A Systematic Narrative Review. *Front Neurol.* 2021;12:747878.
doi: 10.3389/fneur.2021.747878. PMID: 34970205; PMCID: PMC8712454.

21. Lavu VK, Mohamed RA, Huang R, Potla S, Bhalla S, Al Qabandi Y, Nandula SA, Boddepalli CS, Gutlapalli SD, Mohammed L. Evaluation and Treatment of Depression in Stroke Patients: A Systematic Review. *Cureus.* 2022;14(8):e28137.
doi: 10.7759/cureus.28137. PMID: 36134047; PMCID: PMC9482426.

Case Report

Marine City Medical College Journal

Acute Kidney Injury Due to Postpartum HELLP Syndrome Complicated by Sepsis: A Case Report and Literature Review

Iffat Noshin[1*] Sudipa Dutta[2] Rana Kumar Saha[3] Pradip Kumar Dutta[4]

ABSTRACT

Background: Acute Kidney Injury (AKI) during pregnancy and postpartum is a leading cause of maternal and fetal morbidity in low- and middle-income countries. HELLP (Hemolysis, Elevated Liver enzymes, Low Platelets) syndrome is a rare but severe etiology that can progress rapidly to irreversible renal damage.

Case Presentation: A 21-year-old woman presented with anuria following cesarean delivery. She subsequently developed fever, vomiting, diarrhea and generalized edema. Imaging revealed bilateral pleural effusion and echogenic kidneys. Renal biopsy confirmed cortical necrosis. She required multiple hemodialysis sessions and progressed to End-Stage Renal Disease (ESRD).

Discussion: HELLP syndrome accounts for 10–15% of severe preeclampsia cases and may occur postpartum (30% of cases) without hypertension. Sepsis further increases renal ischemic injury. Cortical necrosis remains a devastating complication with limited recovery potential. Early recognition, hemodialysis initiation and renal biopsy are essential for prognostication and long-term planning.

Conclusion: This case highlights the importance of early detection of postpartum HELLP, comprehensive evaluation of anuric patients and timely renal biopsy. The vigilance for HELLP-related AKI even without hypertension, combined with prompt management, may improve outcomes.

1. Medical Officer of Nephrology
Marine City Medical College & Hospital, Chattogram, Bangladesh.
2. Medical Officer
Upazila Health Complex, Chandanaish, Chattogram, Bangladesh.
3. Assistant Professor of Nephrology
Marine City Medical College, Chattogram, Bangladesh.
4. Professor of Nephrology
Marine City Medical College, Chattogram, Bangladesh.

*Correspondence **Dr. Iffat Noshin**
Email: noshiniffat@gmail.com
Cell : +88 01755 94 53 79

Date of Submitted : 10.08.2024
Date of Accepted : 22.09.2024

Key words: Acute kidney injury; Cortical necrosis; HELLP syndrome; Hemodialysis; Postpartum complications; Renal transplantation.

INTRODUCTION

Pregnancy-related AKI, though rare in developed countries, continues to be a major health burden in resource-limited settings. Modern obstetric care has reduced its incidence in high-income nations to <1 per 10,000 pregnancies.[1] In developing nations, however, rates remain as high as 4–7% of obstetric admissions.[2] HELLP syndrome, first described by Weinstein in 1982, represents a severe form of preeclampsia but can manifest postpartum and in normotensive patients.[3]

CASE PRESENTATION

A 21-year-old gravida 2, para 1 woman underwent an emergency Lower Segment Cesarean Section (LSCS) at 35+ weeks of gestation due to premature rupture of membranes on 15/9/23. She had been normotensive throughout her pregnancy, with no history of proteinuria, urinary tract infection or preeclampsia-related symptoms. Postoperatively, she developed anuria within 24 h, accompanied by nausea, greenish bilious vomiting, watery diarrhea and progressive leg swelling.

On admission to the ICU at Marine City Medical College & Hospital (MCMCH) (17/09/2023) her vitals were: blood pressure 140/80 mmHg, pulse 110 bpm, respiratory rate 30/min, temperature 100°F and SpO_2 98% on 3 L/min oxygen. She appeared icteric and mildly drowsy (GCS 15/15). Initial physical examination revealed bilateral pedal edema, ascites and facial puffiness. Lungs were clear on auscultation.

Table I Initial Laboratory Parameters on Admission

Parameter	Result	Reference range
Hemoglobin	9.8	11.5-16.5
Total leukocyte count	13200	4000-10000
Platelets	85,000	150,000-450,000
Bilirubin	3.2	0.2-1.1
AST (U/L)	280	10-40
ALT (U/L	220	7-56
LDH (U/L)	960	140-280
Serum Creatinine	5.8	0.5-1.1
Blood urea	120	15-45
Potassium(mmol/L	5.6	3.5-5
Urine output(ml/Day	<10	>800

Despite supportive care and fluid management, she remained anuric. Broad-spectrum antibiotics were started empirically. Salmonella IgM serology returned positive and intravenous ceftriaxone was initiated. Over the next 12 days, she experienced intermittent high-grade fevers peaking at 103–104°F, worsening edema, and dyspnea.

Table II Clinical Progression and Key Events

Day Post-LSCS	Event/Observation
Day 1	Anuria after cesarean section
Day 2-3	Vomiting , diarrhea, bilateral edema
Day 5	Initiated hemodialysis
Day 12	Persistent fever, Urine output-10 ml/ay
Day 21	Gradual increase in urine output (450 ml/day)
6 weeks	Urine output improved (1800ml/day)
	creatinine remained high.

Ultrasound abdomen revealed bilateral mild pleural effusion, slightly echogenic kidneys (RK: 11.5 cm, LK: 11.8 cm) and echogenic material within the uterine cavity suggestive of a blood clot or retained placental tissue. Chest X-ray (Film unavailable) reportedly showed bilateral lung consolidation.

Despite increasing urine output, her renal function failed to recover. Renal biopsy-delayed due to fever-showed diffuse renal cortical necrosis, confirming irreversible damage. She was transitioned to thrice-weekly hemodialysis, planned for arteriovenous fistula creation and evaluated for future kidney transplantation.

DISCUSSION

HELLP syndrome complicates 0.5–0.9% of all pregnancies and 10–20% of severe preeclampsia cases.[4] Approximately 30% of cases present postpartum, sometimes up to seven days after delivery, and 10–20% may occur without preeclampsia or hypertension.[5]

Renal involvement in HELLP is frequent, with AKI developing in up to 40% of patients. Z[6] Renal cortical necrosis is rare in developed countries (<2% of AKI) but can account for 15–20% of pregnancy-related AKI in developing settings.[2,7]

Sepsis significantly worsens maternal renal outcomes by exacerbating hypoperfusion and ischemia.[8] Early initiation of hemodialysis, even in oliguric or anuric states, is associated with improved maternal survival even if renal recovery is unlikely.[9] Adjunctive monitoring strategies, including novel biomarkers like Neutrophil Gelatinase-Associated Lipocalin (NGAL) and cystatin-C, may improve early detection of pregnancy-related AKI, but are not widely available in low-resource settings.[10]

Long-term outcomes depend on the extent of cortical necrosis. Partial cortical necrosis may allow partial renal recovery, while diffuse cortical necrosis often leads to ESRD requiring transplantation.[11]

This case underscores gaps in early monitoring-no baseline renal function or urine charting was available. The absence of preeclampsia signs delayed HELLP recognition. Prompt biopsy aids prognosis and transplant planning.

CONCLUSION

This case demonstrates that postpartum HELLP syndrome, even without antecedent hypertension, can result in irreversible renal cortical necrosis. Prompt diagnosis, comprehensive evaluation and timely renal replacement therapy are critical to improving maternal prognosis in resource-limited settings.

ACKNOWLEDGEMENT

The author acknowledge the support of diseased family. They also give heartful thanks to the associates of Nephrology, Marine City Medical College & Hospital, Chattogram.

AUTHORS CONTRIBUTIONS

Contribution to Concept, Design and Data - PKD
Accountability - IN, SD, RKS, PKD
Drafting and Critical revision - PKD, SD
Final approval - IN, SD, RKS, PKD

DISCLOSURE

All the authors declared no conflicts of interest.

REFERENCES

1. Lopes van Balen VA, van Gansewinkel TA, de Haas S, van der Graaf AM, de Jongh MA, van der Ven AJ et al. Pregnancy-related acute kidney injury: A nationwide retrospective cohort study in the Netherlands. *Kidney Int Rep.* 2017;2(2):225-235.

2. Prakash J, Niwas SS, Parekh A, Pandey LK, Sharatchandra L, Arora P, Mahapatra AK. Acute kidney injury in late pregnancy in developing countries. *Nephrology (Carlton).* 2010;15(6):695-700.

3. Weinstein L. Syndrome of hemolysis, elevated liver enzymes, and low platelet count: A severe consequence of hypertension in pregnancy. *Am J Obstet Gynecol.* 1982;142(2):159-167.

4. Sibai BM, Ramadan MK, Usta I, Salama M, Mercer BM, Friedman SA. Maternal morbidity and mortality in 442 pregnancies with HELLP syndrome. Am J Obstet *Gynecol.* 1993;169:1000-1006.

5. Martin JN Jr, Rinehart BK, May WL, Magann EF, Terrone DA, Blake PG. The spectrum of severe preeclampsia: Comparative analysis by HELLP syndrome classification. *Am J Obstet Gynec*ol. 1999;180:1373-1381.

6. Rinehart BK, Terrone DA, Magann EF, Martin RW, May WL, Martin JN Jr. Preeclampsia-associated renal failure: A continuum of severe preeclampsia, HELLP syndrome and acute fatty liver of pregnancy. *J Matern Fetal Med.* 1999;8(4):206-210.

7. Nampoory MR, Johny KV, Seshadri MS, Gupta RK, Al-Hilali N, Sugathan TN et al. Cortical necrosis in pregnancy-related acute renal failure in Kuwait. *Nephrol Dial Transplant.* 1992;7(10):1035-1039.

8. Nayak KC, Jain AK, Sharma R, Gupta A, Mathur A. Renal cortical necrosis in obstetric complications. *J Assoc Physicians India.* 1993;41:795-797.

9. Macedo E, Mehta RL. Continuous dialysis therapies: Core curriculum 2008. *Clin J Am Soc Nephrol.* 2008;3:869-880.

10. Haase M, Bellomo R, Devarajan P, Schlattmann P, Haase-Fielitz A. Accuracy of neutrophil gelatinase-associated lipocalin (NGAL) in diagnosis and prognosis in acute kidney injury: A meta-analysis. *Am J Kidney Dis.* 2009;54(6):1012-1024.

11. El-Reshaid W, Kapoor MM, Varro J, Kodera K. Renal cortical necrosis: review of 35 cases and literature survey. *Nephrol Dial Transplant.* 1993;8(12):1243-1248.

Name of Reviewers (October 2023)

Editorial Review

- **Professor Dr. Pradip Kumar Dutta**
  Head, Department of Nephrology
  Marine City Medical College, Chattogram.

- **Dr. Farhad Hussain**
  Associate Professor of Biochemistry
  Marine City Medical College, Chattogram.

Peer Review

- **Professor Dr. Prabir Kumar Das**
  Head, Department of Cardiology (Retired)
  Chittagong Medical College, Chattogram.

- **Professor Dr. Sayeed Mahmud**
  Deaprtment of Community Medicine & Public Health
  Institute of Applied Health Sciences (IAHS) Chattogram.

- **Professor Dr. Serajun Noor**
  Head, Department of Obstetrics & Gynaecology
  Chattagram Maa-O-Shishu Hospital Medical College, Chattogram.

- **Professor M Jalal Uddin**
  Head, Department of Community Medicien & Public Health
  Chattagram Maa-O-Shishu Hospital Medical College, Chattogram.

- **Professor (cc) Dr. Zabeen Choudhury**
  Department of Paediatrics
  Chittagong Medical College, Chattogram.

(List is not according to seneority)

MARINE CITY MEDICAL COLLEGE

Marine City Medical College Journal (MCMCJ)

Information to Authors

Marine City Medical College (MCMC) started its historical and memorable journey in the year 2013. MCMC is one of the famous and reputed Medical College among the Private Medical Colleges in Bangladesh. It is situated in port city, Chattogram. The aim of the MCMC is to attain a standard level in Health & Medical education at home and abroad.

Marine City Medical College is affiliated under Chittagong Medical University & approved by the Ministry of Health & Family Welfare, Government of People's Republic of Bangladesh. A very good number of academicians, researchers and skill professionals are performing in this institute.

Marine City Medical College inaugurated to publish a double blinded, peer reviewed scientific journal from April 2022.

The "Marine City Medical College Journal (MCMCJ)" is a half yearly published eg. April & October accorded with a view to translation of current research into clinical practice. It is the official publication of the Marine City Medical College - having ISSN : 3080-1257.

MCMCJ publishes article of authors from any part of the globe, but has a special interest in publishing research articles of authors from Bangladesh and of relevance to developing countries. It publishes Editorial, Original (Research) article, Special article, Review article, Short communication, Case report and Letters on new findings of Medical Science.

MCMCJ follows the recommendations made by International Committee of Medical Journal Editors (ICJME) (http://icmje.org/).

Submission of Manuscript

Manuscript (Papers) are submitted to the Managing Editor or authorised persons or by Email at any time. Papers accepted for publication are subjected to peer review and editorial revision. Manuscript should be typed in English (Font size and style: 10, Times New Roman) on one side of white bond paper of A4 size with margins of at least 2.5 cm, using double space throughout. With full title (Title should be concise and informative) accompanied by a cover letter signed by Principal and Co-authors including name, academic degrees, designation, the departmental and institutional affiliation. Complete address, Cell number including Email address of Corresponding author should be mentioned. Not more than 6 (Six) authors will be accepted for all manuscripts.

Manuscript to be submitted by email.
Email : basanabd60@yahoo.com
Rejected manuscript will not be returned.

Abstract

A structured abstract should not be of more than 250 words. It should be a factual description of the study (Includes aim or Objectives) Methods (Includes patient population, procedures and data analysis) Results and Conclusion. The abstract should contain the data to support the key findings or conclusions of the study and this should be self explanatory without references to the text. the first time an abbreviated term is used it should be spelled out in full form and follow with the abbreviation in parentheses for example:- CHD (Coronary Heart Disease). Please do not cite any references in the abstract.

3 (Three) to 10 (Ten) key words may be provided below the abstract.

Types of Manuscripts

Editorial : It is a invited article. Based on current affairs of Medical Science with any disciplines. Maxium length of the editorial may be with in 1000-1200 words and number of references maxium in 10 (Ten).

Original Article : It is a research, observational and experimental article should be devided into the following sections with headings :

- Introduction (Length should not be more than 500 words)
- Materials and methods (Length range 250-300 words)
- Results (Description of the tables and figures should not more than 250 words)
- Discussion (Length range 500-700 words)
- Limitation
- Conclusion
- Recommendation
- Acknowledgements
- Disclosure

Single digit numbers used in the text should be in words except datas and reference numbers. Maximum length of text may be with in 2000-2500 words (Excluding references). The total number of reference should not be less than 15 (Fifteen) for the original article.

Special Article

It is a medical based text of any disciplines. Maximum length of the Special article should not be more than 2000 words (Excluding references). The total number of reference should not be less than 10 (Ten).

Review Article

It is a prestigious article, which is divided into the following sections with headings :

- Introduction
- Search Strategy
- Discussion
- Conclusion
- Disclosure

Review article should not generally exceed 4000 words, including illustrations and the number of references should not be more than 30 (Thirty). According to guidelines of BMDC, Review article should be written by senior author, who have written minimum of 02 Original research articles and 04 Case reports on the same topic.

Case Report

Text of Case report with the following section :

- Introduction
- Case Report
- Images
- Discussion
- Figures / Legends
- Conclusion
- Disclosure

Maximum length of the text may be with in 1000-1500 words (Excluding references). The total number of reference should not be less than 10 (Ten).

Letter

Letter should be brief and to the point with in 500-600 words only.

It is noted that standard abbreviations should be used whenever. The full form for which the abbreviations stands followed by the abbreviation in parenthesis should precede the use of the abbreviation in the text except for standard ones like 45^{O}c, 35mg/L etc in all types of text.

References

Regarding references please follow the Vancouver style (Uniform requirements for manuscripts submitted to biomedical journals prepared by the International Committee of Medical Journal Editors (ICMJE guideline http://www.icmje.org).

Reference citations in the text should be numbered in arabic numerals at the end of the sentence eg [1,2] consecutively in order in which they are mentioned in the text.

Book references should have the name of the authors, chapter title, editors, *Book name,* the edition, place of publication, the publisher, the year and the relevant pages.

Journal references should have the name of the authors, title of the article, editors, *name of the journal,* volume and issue number, place of publication, the publisher, the year and relevant pages.

The first six authors of a work should be named.

Examples

Book reference : Bucholz RW and Heckman JD. *Rock wood and Green's Fractures in Adult.* In : Kinzler KW, editors. 8th ed. Philadelphia : Lippincott Williams & Wilkins. 2020;3:2639-2688.

Journal reference : Riddel V, Watkinson J, Gazet M. Thyroidectomy : Preventation of bilateral recurrent nerve palsy. *British Journal of Surgery.* 2021;57(2):8-12.

Citation from a website : Ardehali MM, Irani S, Firouzifar M. A unique intraluminal growth of juvenile nasopharyngeal angiofibroma : A Case report. *BioMedicine.* 2020;10(3):41-44.

DOI : 10.37796/211-8039.1019.

Table

- All tables should be numbered using Roman numerals (I, II).
- Table should always be cited in text in consecutively using Roman numericals (eg Table I, II).
- Mention the caption at the top of table. Table should be planned as brief as possible. No punctuation mark in the caption of table.
- Significance values and other statistical data should be included beneath the table.

Figures / Graphs

- All Figures / Graphs are to be numbered using Arabic numerals (1, 2).
- Figures / Graphs always to be cited in text consecutively using Arabic numerical (eg 1, 2).
- Provide a caption at the bottom for each figures / graphs. No punctuation mark in the caption of table.
- Reduce figures / graphs to fit either in one column or within the two column width of the journal page.

Please provide only 2/3 tables with Roman numerical I, II with caption at the top of the table and only 2/3 figures / graphs with Arabic numerical 1, 2, with caption at the bottom of the figures / graphs.

Images / Photographys / Legends

Unmounted glossy print, B-2 size with good contrast (600 pixels). 3 Images / Photographys / Legends are allowed for whole text.

Authors Contribution

The persons involved with all the following

i) Initial research design / Conception / Acquisition of data / Data interpretation / Analysis.

ii) Manuscript drafting / Critical revision of content.

iii) Final approval.

Above cited categories must be met. Each author should have participated sufficiently in the work to take public responsibility for appropriate portiions of the content

Any authors name seemed to be guest and ghost authors, eg. Not relative with discipline of the matter will jeopardise the acceptance of the manuscript.

Competing Interests (Disclosure)

Marine City Medical College Journal requires authors to declare any competing financial or other interest in relation to their work. Where an author gives no competing interests, the listing will read the author (s) declare that they have no competing interests.

Declaration

The article should accompany a declaration signed by author and co-authors which includes a statement that neither the article nor any part of its essential subtance table or figures is published in any journal nor submitted elsewhere for consideration of publication before appearing in this journal. The declaration form must be collected from our website.

Plagiarism Detection

Before peer review, all the submitted manuscripts are screened by the Plagiarism detector, hence all the authors are requested to avoid the overlapping or similar text from published articles as a result originality to be maintained.

According to the International Committee of Medical Journal Editors (ICMJE) less than 20% of Plagiarism are accepted for submitted manuscript (Excluding references).

MARINE CITY
MEDICAL COLLEGE

MARINE CITY
MEDICAL COLLEGE

Marine City Medical College Journal (MCMCJ)

Declaration

I/We the undersigned, solemnly affirm that I/We have read and approved the article under the title

---

---

submitted for publication in the **MCMCJ**

I/We further affirm that :

1. The article mentioned above has not been published before nor submitted for publication in any form, in an other journal by me / an of us
2. The authorship of this article will not be contested by anybody else whose names is/are not listed here
3. I/We individually / jointly share the responsibility for the integrity of the content of the manuscript
4. Each of us have generated / contributed to part of the intellectual content of the paper
5. Conflict of interest (If any) has been disclosed
6. We also agree to the authoriship of this article in the following sequence:

Authors name (in sequence)	Signature
1. ----------	----------
2. ----------	----------
3. ----------	----------
4. ----------	----------
5. ----------	----------
6. ----------	----------

Correspondence : Dr.

Cell :
Email :

Important notes:

1. All the authors are requested to sign this form independently in the sequence mentioned
2. Each author should be able to defend publicly in the scientific community, that intellectual content of the paper for which he/she can take responsibility
3. If the authorship is contested at any state of publication the article will not be processed till the issue is resolved