Online ISSN 3080-9479
Print ISSN 2226-454X

JNHFB
Vol 14. Issue 3
Sep 2025

Journal of National Heart Foundation of Bangladesh

Content

Editorial 73
Professor Fazila-Tun-Nesa Malik

Articles

Review Articles

Shared Purpose, Different Worlds: Strengthening Community Organization–Academia Partnerships for Cross-Sectorial Research Impact 74
Mohammad Mojammel Hussain Raihan, Viana Farzanah, Nashit Chowdhury, Irfan Hyder, Tanvir Chowdhury Turin

Securing Web-Based Surveys: A Three-Stage Strategy for Detecting and Preventing Fraudulent Human and Automated Responses 81
Irfan Hyder, Nashit Chowdhury, Mohammad Mojammel Hussain Raihan, Tanvir Chowdhury Turin

Original Articles

Gender Difference in Coronavirus Disease 2019 (COVID-19) 87
Fazila-Tun-Nesa Malik, Md. Kalimuddin, Mir Ishraquzzaman, Nazir Ahmed, Mohammad Badiuzzama, Mir Nesaruddin Ahmed, Ashok Dutta, Dhiman Banik, Mohammad Abdullah Al Mamun, Sohel Reza Choudhury

Association between on Admission Serum NT-pro BNP and ST-segment Resolution in Patients with Acute ST Elevated Myocardial Infarction undergoing Primary Percutaneous Coronary Intervention 92
Md Nazmul Haque, Fazila-Tun-Nesa Malik, Md Habibur Rahman, Md Kalimuddin, Md Shafi-Ul-Alam, Abdul Momen, Md Shamim Chowdhury

Association between PR Segment Displacement with Adverse In-hospital Outcome after Thrombolysis in Patients with Acute ST Elevation Myocardial Infarction 99
Md. Jasim Uddin, Syed Nasir Uddin, Shaila Nabi, Mohammad Abul Khair, Isha Abdullah Ali, ABM Shafiuzzaman, Iffat Ara Sharmin, Sabuj Biswas, Gokul Chandra Datta

Case Report

Unexpected cause of NSTEMI in a 50-year-old male: Spontaneous Coronary-Artery Dissection (SCAD) 105
Md Shamim Chowdhury, Fazila-Tun-Nesa Malik, Md Kalimuddin, Nazir Ahmed, Mohammad Badiuzzaman

ISSN 2226-454X

JNHFB
Vol 14. Issue 3
Sep 2025

Journal of National Heart Foundation of Bangladesh

Journal of National Heart Foundation of Bangladesh (JNHFB)

Published by

National Heart Foundation of Bangladesh
Plot 7/2, Section – 2, Mirpur,
Dhaka 1216, Bangladesh

Tel : 880 2 58054708-12
Fax : 880 2 48039237
E-mail : journal@nhf.org.bd
Web : www.nhf.org.bd
Facebook : www.facebook.com/bangladesh.heartfoundation

Date of Publication

01 Sep 2025

Printed by

Nazifa Communication
278/3, Katabon, Dhaka-1205
Phone : 01777380966

Annual Subscription

BDT 500 for local and US$ 50 for overseas subscribers

About the Journal: Journal of National Heart Foundation of Bangladesh (JNHFB) is the official journal of National Heart Foundation of Bangladesh. This peer review journal publishes articles on clinical, basic science and epidemiological studies on a variety of cardiology, cardiac surgery and other heart health topics including prevention, rehabilitation and health promotion. The target audiences of the journal include cardiologists, cardiac surgeons, specialist physicians, public health specialists and general physicians. The journal is published in English, thrice a year in the months of January, May and September.

Journal of National Heart Foundation of Bangladesh welcomes contribution from all branches of cardiovascular diseases in the form of original articles, review articles, case reports, images in cardiac medicine and surgery and introduction of techniques in "How To Do It' section. The articles submitted are subject to peer review and editorial revision. The author(s) should disclose any conflict of interest if any during submission and also state that the submitted article have not been published in whole or in part except abstracts or accepted for publication in any other journal. Authors must conform to the uniform requirements for manuscripts submitted to biomedical journals (N Engl J Med 1991; 324:424-8).

All submissions require a covering letter addressed to Professor Fazila-Tun-Nesa Malik, Editor-in-Chief, Editorial Board, Journal of National Heart Foundation of Bangladesh. For any inquiries, you may contact us at journal@nhf.org.bd, but all formal submissions must be made through the online portal. Tables, figures, and text should be included in the same submission file. The signed copyright statement by all authors must be scanned and submitted as a supplementary file during the online submission process.

Preparation of manuscript
Type the manuscript on white bond paper, 216 x 279 mm (8/2 x 11 in.) or ISO A4 (212 x 297 mm), with margins of at least 25 mm (1 in.). Type only on one side of the paper. Use double spacing throughout, including title page, abstract, text, acknowledgments, references, tables, and legends for illustrations. Begin each of the following sections on separate pages: title page, abstract and key words, text, acknowledgments, references, individual tables, and legends. Number pages consecutively, beginning with the title page. Type the page number in the upper or lower right-hand corner of each page.

Title page
The title page should carry (a) the title of the article, which should be concise but informative; (b) first name, middle initial, and last name of each author, with highest academic degree(s) and institutional affiliation; (c) name of department(s) and institution(s) to which the work should be attributed; (d) disclaimers, if any; (e) name and address of author responsible for correspondence about the manuscript; (f) name and address of author to whom requests for reprints should be addressed or statement that reprints will not be available from the author; (g) source(s) of support in the form of grants, equipment, drugs, or all of these; and (h) a short running head or foot line of no more than 40 characters (count letters and spaces) placed at the foot of the title page and identified.

Authorship
All persons designated as authors should qualify for authorship. The order of authorship should be a joint decision of the coauthors. Each author should have participated sufficiently in the work to take public responsibility for the content. Authorship credit should be based only on substantial contributions to (a) conception and design, or analysis and interpretation of data; and to (b) drafting the article or revising it critically for important intellectual content; and on (c) final approval of the version to be published. Conditions (a), (b), and (c) must all be met. Participation solely in the acquisition of funding or the collection of data does not justify authorship. General supervision of the research group is also not sufficient for authorship. Any part of an article critical to its main conclusions must be the responsibility of at least one author. A paper with corporate (collective) authorship must specify the key persons responsible for the article; others contributing to the work should be recognized separately (see Acknowledgments). Editors may require authors to justify the assignment of authorship.

Abstract and Key Words
The second page should carry a 250 words structured abstract. The abstract should state the purposes of the study or investigation, basic procedures (selection of study subjects or laboratory animals; observational and analytical methods), main findings (give specific data and their statistical significance, if possible), and the principal conclusions. Below the abstract provide, and identify as such, 3 to 10 key words or short phrases that will assist indexers in cross-indexing the article and may be published with the abstract.

Text
The text of observational and experimental articles should be divided into sections with the headings Introduction, Methods, Results, and Discussion. Long articles may need subheadings within some sections to clarify their content, especially the Results and Discussion sections.

Introduction
State the purpose of the article. Summarize the rationale for the study or observation. Give only strictly pertinent references, and do not review the subject extensively. Do not include data or conclusions from the work being reported.

Methods
Describe your selection of the observational or experimental subjects (patients or laboratory animals, including controls) clearly. Identify the methods, apparatus (manufacturer's name and address in parentheses), and procedures in sufficient detail to allow other workers to reproduce the results. Give references to established methods, including statistical methods; provide references and brief descriptions for methods that have been published but are not well known; describe new or substantially modified methods, give reasons for using them, and evaluate their limitations. Identify precisely all drugs and chemicals used, including generic name(s), dose(s), and route(s) of administration.

Ethics
When reporting experiments on human subjects indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) or with the Helsinki Declaration of 1975, as revised in 1983: Do not use patients' names, initials, or hospital numbers, especially in any illustrative material. When reporting experiments on animals indicate whether the institution's or the National Research Council's guide for, or any national law on, the care and use of laboratory animals was followed.

Statistics
Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid sole reliance on statistical hypothesis testing, such as the use of P values, which fails to convey important quantitative information. Specify any general-use computer programs used.

Put general descriptions of methods in the Methods section. When data are summarized in the Results section specify the statistical

methods used to analyze them. Restrict tables and figures to those needed to explain the argument of the paper and to assess its support. Use graphs as an alternative to tables with many entries; do not duplicate data in graphs and tables. Avoid nontechnical uses of technical terms in statistics, such as "random" (which implies a randomizing device), "normal," "significant," "correlations," and "sample." Define statistical terms, abbreviations, and most symbols.

Results

Present your results in logical sequence in the text, tables, and illustrations. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations.

Discussion

Emphasize the new and important aspects of the study and the conclusions that follow from them. Do not repeat in detail data or other material given in the Introduction or the Results section. Include in the Discussion section the implications of the findings and their limitations, including implications for future research. Relate the observations to other relevant studies. Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not completely supported by your data. Avoid claiming priority and alluding to work that has not been completed. State new hypotheses when warranted, but clearly label them as such. Recommendations, when appropriate, may be included.

Acknowledgments

At an appendix to the text one or more statements should specify (a) contributions that need acknowledging but do not justify authorship, such as general support by a departmental chairman; (b) acknowledgments of technical help; (c) acknowledgments of financial and material support, specifying the nature of the support; (d) financial relationships that may pose a conflict of interest. Authors are responsible for obtaining written permission from persons acknowledged by name, because readers may infer their endorsement of the data and conclusions. Technical help should be acknowledged in a paragraph separate from those acknowledging other contributions.

References

References should be written in Vancouver style. Number references consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals in parentheses. References cited only in tables or in legends to figures should be numbered in accordance with a sequence established by the first identification in the text of the particular table or illustration. Try to avoid using abstracts as references; "unpublished observations" and "personal communications" may not be used as references, although references to written, not oral, communications may be inserted (in parentheses) in the text. Include among the references papers accepted but not yet published; designate the journal and add "In press." Information from manuscripts submitted but not yet accepted should be cited in the text as "unpublished observations" (in parentheses). The references must be verified by the author(s) against the original documents.

Tables

Type each table double-spaced on a separate sheet. Do not submit tables as photographs. Number tables consecutively in the order of their first citation in the text and supply a brief title for each. Give each column a short or abbreviated heading. Place explanatory matter in footnotes, not in the heading. Explain in footnotes all nonstandard abbreviations that are used in each table. For footnotes use the following symbols, in this sequence: *, t, +, §, II, , * tt. Identify statistical measures of variations such as standard deviation and standard error of the mean. Do not use internal horizontal and vertical rules. Be sure that each table is cited in the text. If you use data from another published or unpublished source obtain permission and acknowledge fully. The use of too many tables in relation to the length of the text may produce difficulties in the layout of pages.

Illustrations

Submit three complete sets of figures. Figures should be professionally drawn and photographed; freehand or typewritten lettering is unacceptable. Instead of original drawings, roentgenograms, and other material send sharp, glossy black-and white photographic prints, usually 127 X 173 mm (5 x 7 in.), but no larger than 203 x 254 mm (8 x 10 in.). Letters, numbers, and symbols should be clear and even throughout and of sufficient size that when reduced for publication each item will still be legible. Titles and detailed explanations belong in the legends for illustrations, not on the illustrations themselves. Each figure should have a label pasted on its back indicating the number of the figure, author's name, and top of the figure. Do not write on the back of figures or scratch or mar them by using paper clips. Do not bend figures or mount them on cardboard. If photographs of persons are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph.

Figures should be numbered consecutively according to the order in which they have been first cited in the text. If a figure has been published acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Permission is required irrespective of authorship or publisher, except for documents in the public domain. For illustrations in color the journal requires color negatives, positive transparencies, or color prints.

Legends for Illustrations

Type legends for illustrations double-spaced, starting on a separate page, with Arabic numerals corresponding to the illustrations. When symbols, arrows, numbers, or letters are used to identify parts of the illustrations, identify and explain each one clearly in the legend.

Units of measurement

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples. Temperatures should be given in degrees Celsius. Blood pressures should be given in millimeters of mercury. All hematologic and clinical-chemistry measurements should be reported in the metric system in terms of the International System of Units (SI).

Abbreviation and symbols

Use only standard abbreviations. Avoid abbreviations in the title and abstract. The full term for which an abbreviation stands should precede its first use in the text unless it is a standard unit of measurement.

The Editor reserves the customary right to style and if necessary shortens the material accepted for publication and to determine the priority and time of publication. Editor assumes that work based on honest observations.

Editorial

Professor Fazila-Tun-Nesa Malik
MBBS; FCPS; MRCP; FRCP; FACC; FSCAI
Secretary General, National Heart Foundation of Bangladesh

This third issue of volume fourteen of the Journal of the National Heart Foundation of Bangladesh stands as a testament to our enduring commitment to fostering excellence in cardiovascular science and public health research. It reflects the collective efforts of our contributors, reviewers, and editorial team in promoting innovative clinical practices, ethical biomedical research, and evidence-based policymaking. Through the dissemination of locally relevant and globally significant findings, this issue continues our mission to strengthen the scientific foundation for improved cardiovascular health in Bangladesh and across the region.

The issue includes two review articles, three original research papers, and one case report, each contributing to our understanding of contemporary challenges and innovations in cardiology.

Raihan et al. in their review article discussed the significance of community academia partnerships in advancing equity and ethical collaboration within research. Their paper brings attention to how mutual trust, transparency, and shared decision-making can strengthen community engagement and enhance the overall impact of academic inquiry.

Hyder et al. contribute a method-oriented paper focusing on the design and implementation of web-based surveys. They highlight the growing importance of digital data collection and outline practical approaches to ensure data quality, reliability, and integrity in an increasingly automated research environment.

Malik et al. in their original article explore gender-based variations in COVID-19 outcomes, underscoring the need to recognize sex-specific differences in disease manifestation and treatment response. Their findings support a more inclusive approach to clinical research and health policy.

Haque et al. in their study highlights the prognostic utility of NT-proBNP in acute coronary syndromes, reinforcing its role as an important biomarker for risk assessment and clinical decision-making.

Uddin et al. examine the predictive value of PR-segment displacement in myocardial infarction, suggesting that early electrocardiographic changes can provide useful insights into patient prognosis and guide timely intervention.

The case report of Chowdhury et al. describe spontaneous coronary artery dissection an uncommon yet increasingly recognized cause of myocardial infarction emphasizing diagnostic accuracy and the benefits of conservative management.

Collectively, these articles embody the journal's mission to disseminate knowledge, encourage clinical excellence, and foster innovation in cardiovascular care. Each contribution reflects our shared vision—to strengthen research capacity and improve heart health across Bangladesh and beyond.

Review Article

Shared Purpose, Different Worlds: Strengthening Community Organization–Academia Partnerships for Cross-Sectorial Research Impact

Mohammad Mojammel Hussain Raihan[1,2], Nashit Chowdhury[1,2], Viana Farzaneh[1], Irfan Hyder[1,2], Tanvir Chowdhury Turin[1,2,3]

[1]Department of Family Medicine, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; [2]Department of Community Health Science, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; [3]Department of Epidemiology & Research, National Heart Foundation Hospital & Research Institute, Dhaka, Bangladesh

Abstract

This paper explores how community organization and academia partnership (COAP) may foster equity, reciprocity, and shared power in research with community organizations. It argues that authentic and ethical partnerships require understanding the diverse and complex ecosystem of community actors (public, private, nonprofit, and grassroots) and their unique capacities, accountabilities, and connections to the communities they serve. Partnerships can be conceptualized across four-level continuum of arrangement — (a) minimal participation, (b) advisory or consultative involvement, (c) active collaboration, and (d) co-governing. Minimal involvement occurs when the community organization is informed and provides basic support, such as facilitating access to participants. Advisory involvement arises when the organization serves as a consultant or advisor, offering feedback without formal decision-making authority. Active collaboration reflects a deeper partnership in which the organization co-creates the research, participating in study design, data collection, and analysis. Finally, co-governing represents full shared leadership, with the organization and academic partners jointly making decisions, setting priorities, and guiding the implementation of the project. Partnership arrangements can be from limited communication to shared leadership and decision-making. These growing levels represent increasing trust, mutual accountability, and co-ownership of both process and outcomes. Drawing on lessons from practice and theory, the paper proposes that COAPs thrive when they balance academic rigor with community priorities through structures that embed fairness, transparency, and respect. Practical considerations for sustaining ethical and equitable COAPs include transparent communication, fair governance structures, equitable resource sharing, mutual capability bridging, and inclusive dissemination strategies. Together, these elements transform COAPs into dynamic partnerships that align academic rigor with community priorities, strengthen trust, and promote sustainable, community-driven collective impact.

Keywords: Community organization–academic Partnerships; Equity; Community engagement; Collaboration continuum; Co-governance.

(JNHFB 2025; 14 : 74-80) DOI : 10.61819/jnhfb.v14i2.5

Introduction

Community engagement has become an important focus in academic research and is increasingly recognized as an approach for producing trustworthy, contextually relevant, and actionable evidence that supports clinicians, patients, and families in making informed healthcare decisions [1]. Community-Engaged research (CEnR) as a transformative approach bridges the long-standing gap between academic inquiry and the lived experiences of communities [2]. Unlike traditional top-down or researcher-driven models that often impose externally defined priorities and overlook local realities,[3] CEnR emphasizes collaboration, equity, and mutual learning between researchers and community members and/organizatio [4]. Over the past two decades, CEnR has been increasingly recognized as a robust framework for addressing social, structural, and environmental inequities by actively involving community members, organizational representatives, and researchers throughout the research process. Through this collaborative approach, CEnR enhances understanding of complex community issues and translates knowledge into meaningful, community- informed actions that directly benefit those involved [5].

Rooted in the principles of shared decision-making, reciprocity, and mutual respect, CEnR shifts the research paradigm from conducting research on communities to conducting research with and for them [6]. This participatory model fosters co-learning, shared ownership, and equitable contribution among all partners, thereby ensuring that diverse forms of expertise and lived experience inform the research process [7]. By engaging communities at each stage, from identifying research priorities to interpreting results and/or mobilizing knowledge, CEnR builds trust, strengthens community

Corresponding Author
Tanvir C Turin MBBS, PhD
Department of Family Medicine,
Room G012, Health Sciences Center, 3330 Hospital Drive Northwest, Calgary, Alberta T2N 4N1, Canada. Email : turin.chowdhury@ucalgary.ca

capability, and enhances the cultural and contextual relevance of research outcomes [2]. Therefore, this inclusive approach redefines research as a collaborative and action-oriented process that advances health equity and sustainable social transformation.

This paper outlines how community organization and academia partnerships (COAP) may serve as effective vehicles for fostering inclusive, ethical, and impactful research. It first highlights the importance of understanding community organizations, recognizing that right-holder communities are often embedded within networks of multiple actors, including academic institutions, grassroots organizations, policymakers, and service providers, each influencing the research process in distinct ways. It then examines the varying levels of involvement and engagement that community organizations can have within research partnerships, illustrating how these levels shape power dynamics, collaboration, and the co-production of knowledge. Finally, the paper discusses practical considerations for sustaining equitable partnerships, emphasizing strategies that promote transparency, accountability, and long-term community benefit.

Community Organization and Academia Partnership

COAPs compels researchers to operationalize the core principles of CEnR into structured, collaborative frameworks that bridge the gap between academic inquiry and real-world application. As Drahota et al. note that traditional research conducted in community settings often progressed in a one-directional manner, with academics designing studies, collecting data, and disseminating findings with minimal community input.[3] This approach frequently led to research that was often disconnected from community needs and lacked long-term sustainability. COAPs are envisioned to counter this imbalance by establishing formalized, equitable partnerships grounded in trust, shared decision-making, and mutual benefit. Within this framework, community actors play active roles in identifying priorities, shaping interventions, co-owning outcomes, and ensuring that research aligns with lived experience, thereby contributing directly to community well-being. COAPs represent an evolution from research on communities to research with and for them, enhancing both the ethical integrity and practical relevance of academic work[3].

The effectiveness of COAPs lies in their ability to leverage the complementary strengths of both academic and community sectors. Academic institutions contribute methodological rigor, analytical expertise, and access to institutional infrastructure, while community organizations bring contextual insight, local credibility, and a deep understanding of sociocultural realities that influence research implementation.[3] This synergistic collaboration enhances relevance, applicability, and translation of research outcomes into community contexts, particularly within public health and social service domains. [8] Engaging community partners also allows researchers to adapt interventions to local needs and capacities, thereby improving feasibility, ownership, and long-term sustainability. These partnerships foster collective accountability and shared ownership, both of which are critical for achieving enduring impact and advancing health equity within the communities they serve [3].

Beyond collaboration, COAPs embody a paradigm shift in how research partnerships are to be conceptualized and maintained. Rather than transactional relationships, where community partners are limited to recruitment or outreach roles, high-functioning COAPs embrace shared leadership, collective accountability, and continuous reflexivity.[9] Khodyakov et al. (2013) emphasize that community participation in COAPs exists on a continuum, from minimal consultation to full co-leadership in governance and decision-making [10]. Successful COAPs intentionally cultivate equitable structures through transparent communication, mutual respect, and iterative evaluation of partnership processes. When implemented ethically, COAPs strengthen community trust, generate policy-relevant outcomes, and ensure that knowledge production remains socially responsive and sustainable [11]. By embedding community priorities throughout every phase of the research process, COAPs redefine the academic–societal relationship, transforming research into a collaborative vehicle for equity, empowerment, and systemic change.

Understanding Community Organizations

While CEnR provides the philosophical foundation for equitable and participatory collaboration, its successful implementation depends on understanding the complex ecosystem of actors within a community. Communities function within interdependent networks of institutions—public, private, nonprofit, and grassroots—that collectively influence social well-being and shape community priorities[4]. To establish a meaningful research partnership with organizations, researchers must first identify and understand these organizations—their mandates, capacities, and relationships with the communities they serve [6]. Recognizing this organizational landscape transforms engagement from an abstract ethical commitment into a deliberate, context-driven practice rooted in mutual respect and community agency. When researchers take the time to understand the organizational structures and social dynamics of a community, they move beyond tokenistic collaboration and create conditions where community actors play active roles in defining community priorities, shaping research design, and co-owning outcomes [12].

Understanding the diversity among community organizations is fundamental to forming equitable and sustainable partnerships. Turin et al. suggests classifying organizations serving immigrant and ethnocultural communities into three main sectors: public, private, and

nonprofit. Each type were defined by distinct mandates, resources, and degrees of community embeddedness [4]. Public and private sector organizations may provide essential services or resources but often maintain limited, temporary connections with grassroots communities. In contrast, nonprofit organizations, particularly grassroots sociocultural organizations and community service organizations, are more deeply embedded within community networks and trusted by community members. Grassroots sociocultural organizations often emerge organically from shared cultural, social, or faith-based identities and embody lived experiences that reflect community realities [4,13]. Community service organizations, on the other hand, operate at the interface of program and practice, translating community needs into institutional advocacy and linking marginalized populations with broader systems of health and social care. Similar classifications have been described in the broader literature on community partnerships, where the spectrum of organizations ranges from small, informal collectives to structured agencies with dedicated research portfolios [14,15]. Recognizing this organizational diversity enables researchers to tailor engagement strategies, identify capability gaps, and design partnerships that balance community insight with academic rigor.

Figure 1 presents a conceptual typology mapping the diverse sectors within a community and illustrating the interconnections among public, private, nonprofit, and grassroots organizations engaged with immigrant and ethnocultural populations. The diagram shows government/public, private/for-profit, and nonprofit sectors alongside grassroots and informal groups, highlighting their complementary roles. Each color block represents a sector, while nested boxes identify organizational types such as local and national government bodies, corporate and professional entities, social enterprises, community service organizations, and civic or advocacy groups. Similar yellow shading marks organizations most frequently involved in community–academic partnerships in immigrant and ethnocultural contexts. Overall, the typology captures the complex, interdependent ecosystem of actors whose coordinated efforts enable equitable, context-driven, and sustainable community-engaged research.

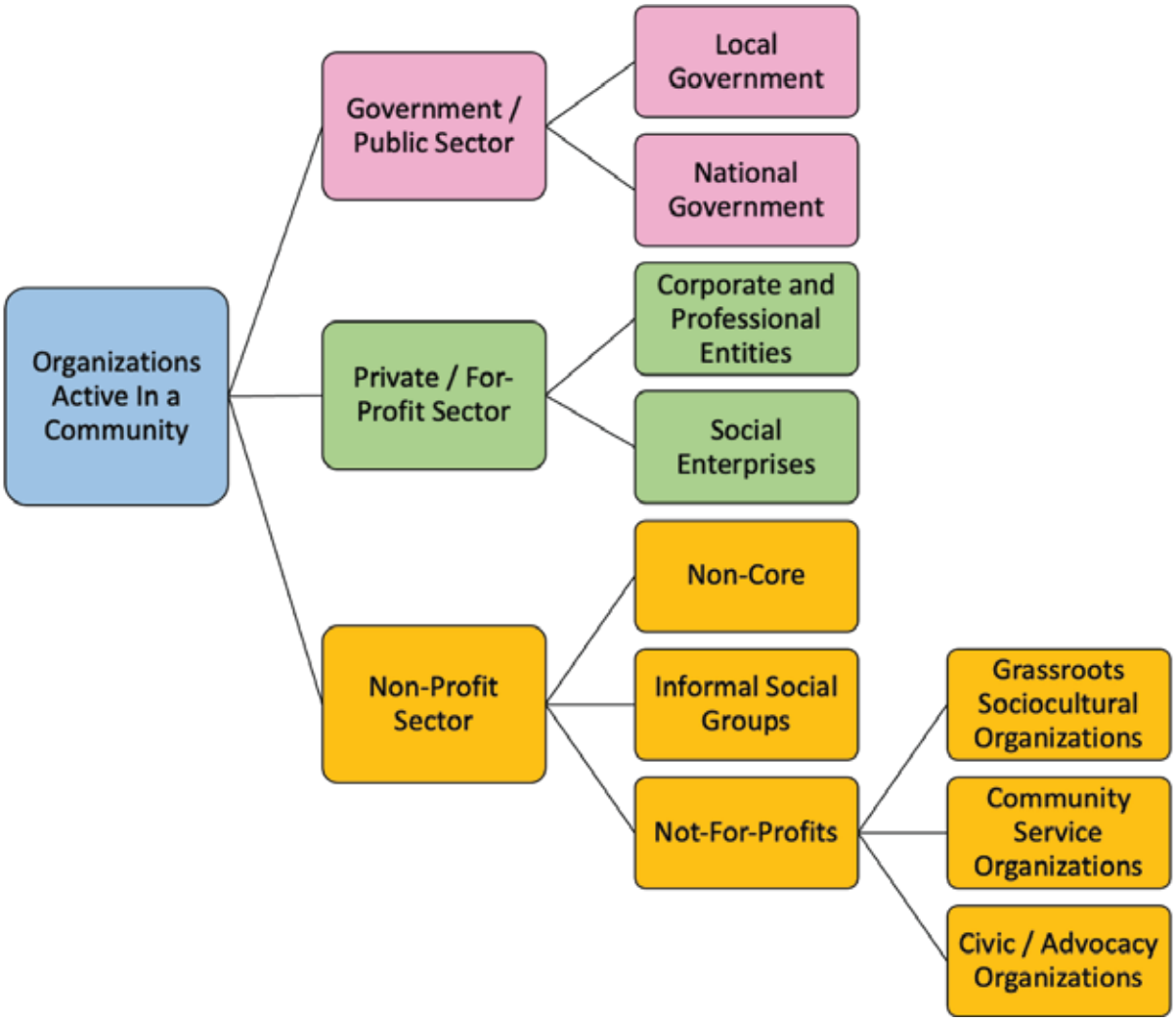


Figure 1. Typology of community-organizations engaged for research partnership.

Effective engagement also requires understanding how community organizations function as interconnected layers within a broader social system. Grassroots sociocultural organizations offer cultural legitimacy and trust but may lack administrative resources; larger organizations provide infrastructure and technical capability but can be more distant from everyday community realities. For researchers, this understanding encourages humility, reflexivity, and curiosity, which are qualities essential for developing authentic, non-extractive relationships [16]. Therefore, taking the time to learn how each organization defines its mission, makes decisions, and measures success prevents tokenistic involvement and promotes genuine collaboration. Finally, community organizations bring irreplaceable contextual intelligence to research partnerships. Their embeddedness in community life, their history of service, and their ability to build trust make them indispensable partners in producing ethical, relevant, and actionable research. Studies have shown that partnerships built on mutual respect and shared ownership lead to greater research utilization, enhanced health equity outcomes, and stronger community capability [17]. Engaging community organizations as equal collaborators ensures that research outcomes remain both scientifically rigorous and socially meaningful, anchored in lived experience, responsive to community priorities, and directed toward collective goals of equity and empowerment.

Continuum of Community Organization Engagement and Involvement in COAP

A critical dimension of COAP lies in recognizing that community organizations engage in research along a continuum defined by varying levels of trust, shared experience, organizational capability, and institutional structure. Building on community-based participatory research (CBPR) literature, [3,6,10,15] four progressive levels of engagement/involvement can be conceptualized — (a) minimal participation, (b) advisory or consultative involvement, (c) active collaboration, and (d) co-governing. Together, these levels illustrate an evolving process of relationship-building in which COAPs advance from limited engagement toward equitable and sustained co-leadership in research design, implementation, and dissemination. This continuum also reflects a broader shift from transactional relationships, primarily focused on exchange, consultation, and access, to transformative partnerships grounded in shared power, mutual learning, and collective systems change. Recognizing this continuum enables COAPs to evaluate the maturity, reciprocity, and equity of their partnerships, which are core tenets of CBPR emphasizing shared power, co-learning, and mutual benefit [15]. This progressive spectrum of engagement is illustrated in Figure 2, which conceptualizes how community organizations can partner from the level of minimal participation to full co-governance within COAPs.

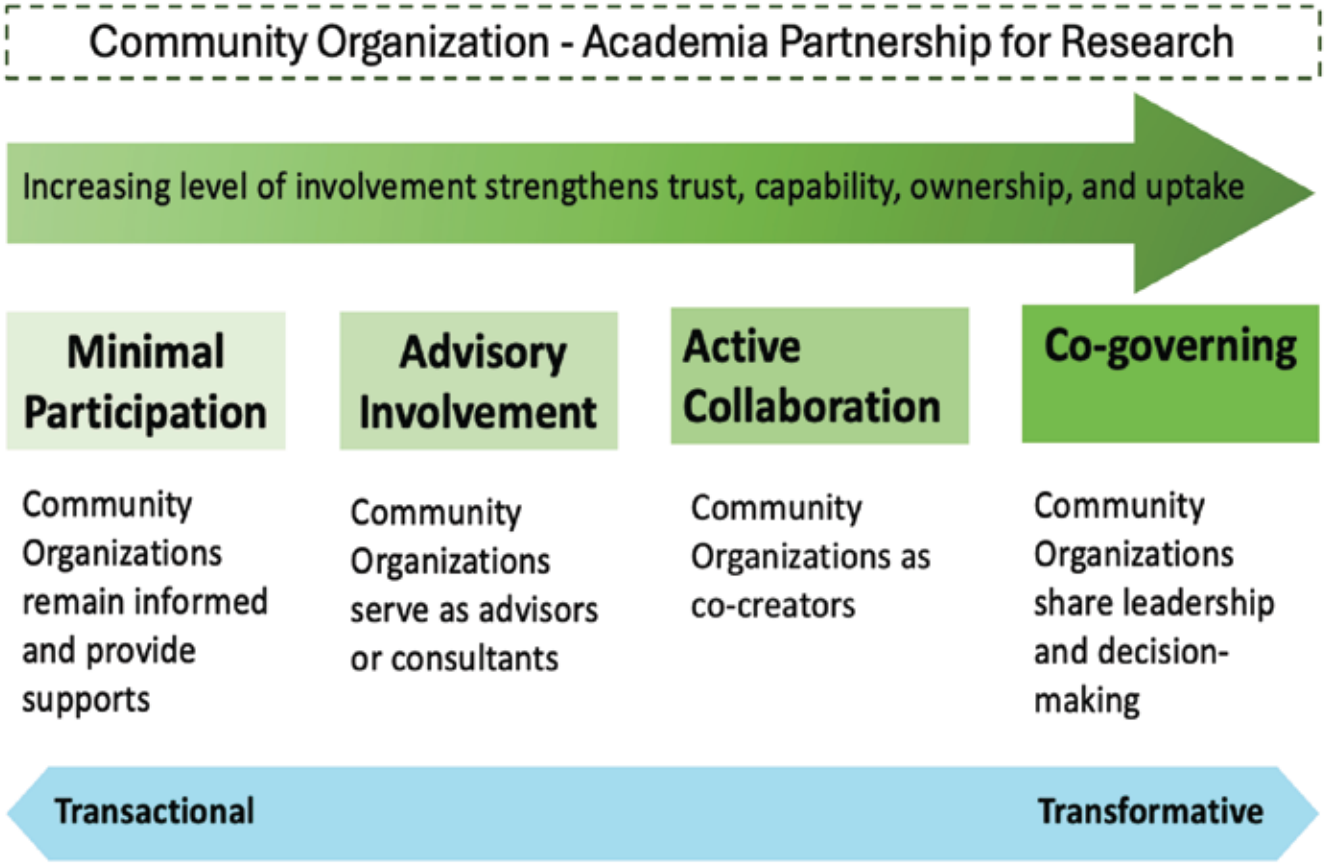


Figure 2. Continuum of community organization engagement and involvement in COAP

The minimal participation level represents the most basic form of involvement in COAPs, where community organizations are kept informed about research activities, goals, and outcomes but have no direct influence on study design or decision-making. This stage corresponds to the outreach phase commonly described in community-based research frameworks—a preliminary mode of engagement focused primarily on information sharing and establishing initial contact with communities [3,15]. At this level, engagement within COAPs is primarily one-directional: academic researchers design and lead the study, while community organizations are informed about its process or results. Their participation may include assisting with recruitment, distributing information, or facilitating community access, but their role in shaping research decisions remains limited. The primary goal here is to establish transparency and open communication rather than shared governance. Although this level can help familiarize researchers with community contexts and foster initial trust, it also carries the risk of reinforcing an exploitative or extractive dynamic if not followed by deeper, more participatory forms of engagement [18]. To prevent this dynamic, researchers must communicate project goals, scope, and anticipated benefits transparently and respectfully, laying a foundation for trust and deeper, participatory engagement.

The advisory involvement level represents a more developed stage of engagement, where community organizations are actively asked to share insights, perspectives, and feedback on research design, implementation, and dissemination. While academics may still retain ultimate authority over final decisions, the consultative process provides meaningful opportunities for dialogue, negotiation, and mutual understanding. At this stage, establishing clarity around mutual expectations, timelines, and institutional constraints becomes essential. As Turin et al. (2022) emphasize, early conversations about working styles, organizational capacities, and accountabilities help align expectations and mitigate tensions between the methodological rigor of academic research and the fast-paced, outcome-driven operations of community organizations[4]. Such discussions lay the groundwork for trust and transparency, setting the stage for genuine collaboration. However, partnerships that remain confined to this level risk becoming transactional, where community organizations act mainly as advisors rather than co-creators in shaping research direction [10]. Advancing toward collaborative engagement requires more equitable participation in decision-making processes, ensuring that community perspectives actively shape the direction and priorities of the research [4,15].

The active collaboration level of engagement represents a more balanced and reciprocal partnership of co-creation, characterized by shared responsibilities, mutual learning, and a growing sense of trust. Community organizations are actively involved in shaping research questions, co-developing study designs, and participating in data collection, interpretation, and dissemination [3]. While academic partners may retain methodological leadership, community organizations exert significant influence over the relevance, cultural sensitivity, and ethical integrity of the research [15]. Effective COAPs at this stage intentionally prioritize research agendas identified by community organizations, particularly those aligned with their service mandates and local priorities [4]. Such openness ensures that research is both contextually relevant and immediately applicable to community realities. Equally essential is strengthening community organizations' research capability through structured training, workshops, and mentorship programs [3,4]. As Turin et al. (2022) note, these initiatives not only enhance understanding of research design and analysis but also foster long-term sustainability and shared ownership of outcomes [4]. This collaborative model embodies the CBPR ethos of "doing research with, not on, communities," enabling both partners to contribute their distinct strengths—scientific expertise from academics and contextual insight from practitioners.

At the co-governing level, COAPs achieve the most advanced form of engagement, where community organizations and academic researchers share authority, accountability, and ownership at every stage of the research process. At this stage, decision-making, resource allocation, data management, and dissemination are jointly governed, with priorities driven by community-identified needs and goals [3,15]. This level represents the full realization of equity within COAPs, where both academic and community partners share authority and benefit equally from the knowledge generated, ensuring that research outcomes are directly responsive to community interests and priorities. Equitable resource sharing and transparent governance mechanisms, such as memoranda of understanding (MOUs) or project charters, further strengthen accountability and sustainability [4]. These agreements clarify mutual goals, delineate partner roles, and prevent miscommunication, particularly in long-term or multi-partner projects. Acknowledging community partners' time and expertise through fair compensation or honoraria also reinforces the principle of shared benefit and institutionalizes equity within COAP structures. As noted in the literature, authentic engagement emerges when community partners participate fully and openly, contributing genuine perspectives and co-shaping the research process [19]. This form of collaboration reflects a partnership grounded in mutual recognition, trust, and solidarity [20]. When achieved, co-equal partnerships produce knowledge that is both scientifically rigorous and socially transformative, grounded in collective ownership, mutual accountability, and sustained trust.

Therefore, successful COAPs evolve along this continuum through deliberate efforts to balance methodological rigor with community priorities, openness to community-defined research agendas, equitable sharing of resources, and capability bridging. These elements are not peripheral but foundational to equitable engagement, enabling COAP to

progress beyond consultation toward authentic, co-equal partnerships that yield sustainable and meaningful community impact [4].

Practical Considerations for Sustaining Ethical, Equitable, and Empowered COAP

Effective COAPs require careful attention to the ethical and operational mechanisms that sustain equity, respect, and authentic collaboration. Beyond shared vision and trust, such partnerships thrive when communication, governance, and resource management are deliberately structured to balance power and uphold fairness. Reciprocal and transparent communication channels ensure that all partners remain informed, feedback flows in both directions, and misunderstandings are prevented, reinforcing mutual accountability [3]. As emphasized in recent scholarship on ethical community engagement, governance structures must reflect a fair division of labor, ensuring that community organizations are not confined to implementer or recruitment roles but are meaningfully engaged in agenda-setting, study design, data interpretation, and dissemination [11]. Shared governance frameworks that explicitly distribute decision-making power help avoid hierarchical imbalances and uphold respect for the knowledge systems of both partners.

Successful partnerships extend beyond procedural collaboration to cultivate solidaristic relationships grounded in mutual recognition, empathy, and shared moral purpose [19]. These relationships help balance academic research goals with community organizations' advocacy and service goals, thereby preventing tensions that can reinforce stereotypes or erode trust between community organizations and the populations they serve. Sustaining ethical COAP requires both partners to openly acknowledge their intersecting missions and negotiate them collaboratively through continuous dialogue and reflexive practice.

Moreover, equitable partnerships depend on fairness in resource distribution, mutual capability bridging, and inclusive dissemination. Equitable allocation of funding, authorship, and recognition fosters long-term collaboration while validating the intellectual and experiential contributions of community organizations [15]. Dedicated training, mentorship, and technical support enhance community autonomy and capability, enabling organizations to participate as equal partners across all stages of the research process. Finally, knowledge dissemination should extend beyond academic audiences to ensure findings are accessible, contextually relevant, and beneficial to the communities involved—through co-authored publications, community forums, or advocacy-oriented reports. Together, these practical considerations, summarized in Table 1, underscore the ethical, structural, and procedural dimensions essential for sustaining equitable collaboration and addressing the recurrent challenges faced by community organizations in research partnerships [4].

Table 1: Practical strategies to strengthen equity and collaboration in COAP.

Aspect	Key Consideration	Intended Outcome
Communication	Establish clear, ongoing, and reciprocal dialogue between researchers and community organizations.	Builds trust, prevents misunderstanding, and maintains transparency.
Governance	Develop shared decision-making mechanisms, define roles, and establish accountability structures to ensure fair division of labour.	Promotes equity, mutual responsibility, and power balance.
Resource Sharing	Ensure equitable allocation of funding, authorship, and recognition between academic and community partners.	Encourages fairness, long-term collaboration, and respect for community expertise.
Capability Bridging	Invest in training, mentorship, and technical support for both community and academic partners.	Strengthens community autonomy, participation, and partnership sustainability.
Dissemination	Co-develop inclusive communication strategies, including co-authored publications and accessible community reports.	Enhances visibility, advocacy potential, and real-world impact.

Conclusion

COAP embodies a transformative model of collaboration that bridges academic inquiry with community priorities, ensuring that research remains both meaningful and impactful. Grounded in shared decision-making, reciprocity, and mutual respect, COAP shifts the research paradigm from studying communities to collaborating with them. Such partnerships foster trust, transparency, and sustained engagement, enabling the co-creation of knowledge that is contextually relevant and responsive to real-world challenges. When communication is open, governance inclusive, and resources equitably distributed, COAP functions as an engine of innovation—strengthening research quality while enhancing community resilience. Beyond generating knowledge, an effective COAP drives long-term capability bridging and social transformation. It empowers communities to shape research agendas, inform policy, and translate evidence into tangible action. Through equitable participation and inclusive dissemination, COAP extends the reach and relevance of academic work, ensuring that findings return to and benefit the communities from which they originate. Therefore, COAP redefines the social role of research as a collaborative and justice-oriented endeavor—advancing scientific understanding while fostering collective well-being and sustainable transformation.

Conflict of interest: None.

Funding: The authors have no relevant financial or non-financial interests to disclose.

Declarations: We (the authors) take full responsibility for the content of this paper. We acknowledge the use of AI (editgpt) for assistance with English language editing. We used prompts to improve the structure of sentences that we deemed could be further improved. AI was prompted to improve clarity by improving grammar and choice of vocabularies used in the text. All suggestions were critically reviewed and revised to ensure the integrity of our own expressions. The authors have no conflicts of interest,

relevant funding, employment, financial or non-financial interests to declare.

Reference

1. Ahmed SM, Nelson D, Kissack A, Franco Z, Whittle J, Kotchen T, et al. Towards Building a Bridge between Community Engagement in Research (CEnR) and Comparative Effectiveness Research (CER). Clin Transl Sci 2015; 8: 160–165.
2. Turin TC, Chowdhury N, Newaz T, Raihan MMH, Rahman N, Rumana N. Nurturing Acceptance for Research in the Community: Conceptualising Engagement Towards Research Through Normalisation Process Theory. Heal Expect 2025; 28: e70356.
3. Drahota A, Meza RD, Brikho B, Naaf M, Estabillo JA, Gomez ED, et al. Community-Academic Partnerships: A Systematic Review of the State of the Literature and Recommendations for Future Research. Milbank Q 2016; 94: 163–214.
4. Turin TC, Chowdhury N, Rumana N, Lasker MAA, Qasqas M. Partnering with organisations beyond academia through strategic collaboration for research and mobilisation in immigrant/ethnic-minority communities. BMJ Glob Heal 2022; 7: e008201.
5. Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: Assessing partnership approaches to improve public health. Annu Rev Public Health 1998; 19: 173–202.
6. Turin TC, Chowdhury N, Haque S, Rumana N, Rahman N, Lasker MAA. Meaningful and deep community engagement efforts for pragmatic research and beyond: engaging with an immigrant/racialised community on equitable access to care. BMJ Glob Heal; 6. Epub ahead of print 23 August 2021. DOI: 10.1136/BMJGH-2021-006370.
7. Kwan C, Walsh CA. Ethical Issues in Conducting Community-Based Participatory Research: A Narrative Review of the Literature. Qual Rep 2018; 23: 369–386.
8. Ross LF, Loup A, Nelson RM, Botkin JR, Kost R, Smith GR, et al. The Challenges of Collaboration for Academic and Community Partners in a Research Partnership: Points to Consider. J Empir Res Hum Res Ethics 2010; 5: 19.
9. Kantek J. 'Reflexivity in Action': Navigating Researcher Positionality(ies) and Responsibility(ies) Through a Community Advisory Board. J Particip Res Methods 2025; 6: 2025.
10. Khodyakov D, Stockdale S, Jones A, Mango J, Jones F, Lizaola E. On measuring community participation in research. Health Educ Behav 2013; 40: 346–354.
11. Pratt B. Community organisation-researcher partnerships: what concerns arise for community organisations and how can they be mitigated? J Med Ethics 2020; 46: 693–699.
12. Cargo M, Mercer SL. The value and challenges of participatory research: strengthening its practice. Annu Rev Public Health 2008; 29: 325–350.
13. Khalid A, Haque S, Alvi S, Ferdous M, Genereux O, Chowdhury N, et al. Promoting health literacy about cancer screening among muslim immigrants in Canada: Perspectives of imams on the role they can play in community. J Prim Care Community Health. 2022;13:21501319211063051. doi: 10.1177/21501319211063051.
14. Martinez-Damia S, Marzana D, Paloma V, Marta E. The Mediating Role of Migrant Community-Based Organizations: Challenges and Coping Strategies. Voluntas 2023; 35: 1.
15. Wallerstein N, Duran B. Community-based participatory research contributions to intervention research: The intersection of science and practice to improve health equity. Am J Public Health; 100. Epub ahead of print 1 April 2010. DOI: 10.2105/AJPH.2009.184036.
16. Giusto A, Triplett NS, Foster JC, Gee DG. Future Directions for Community-Engaged Research in Clinical Psychological Science with Youth. J Clin Child Adolesc Psychol 2024; 53: 503–522.
17. O'Mara-Eves A, Brunton G, Oliver S, Kavanagh J, Jamal F, Thomas J. The effectiveness of community engagement in public health interventions for disadvantaged groups: a meta-analysis. BMC Public Health; 15. Epub ahead of print 2015. DOI: 10.1186/S12889-015-1352-Y.
18. Turin TC, Raihan MMH, Aroua M, Chowdhury NA. Research ethics: Overcoming the exploitative dynamic through ethical research. Bangabandhu Sheikh Mujib Med Univ J 2025; 18: e79016–e79016.
19. Pratt B, Cheah PY, Marsh V. Solidarity and Community Engagement in Global Health Research. Am J Bioeth 2020; 20: 43–56.
20. Pratt B, de Vries J. Community engagement in global health research that advances health equity. Bioethics 2018; 32: 454–463.

Review Article

Securing Web-Based Surveys: A Three-Stage Strategy for Detecting and Preventing Fraudulent Human and Automated Responses

Irfan Hyder[1,3]; Nashit Chowdhury[1,2]; Mohammad Mojammel Hussain Raihan[1,2]; Tanvir Chowdhury Turin[1,2,4]

[1]Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, 3330 Hospital Drive NW, Calgary, AB, T2N 4N1. Canada; [2]Department of Family Medicine, Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, 3330 Hospital Drive NW, Calgary, AB, T2N 4N1. Canada; [3]Transdisciplinary Research Program, Faculty of Graduate Studies, University of Calgary, 2500 University Drive NW, Calgary Alberta T2N 1N4, Canada; [4]Department of Epidemiology & Research, National Heart Foundation Hospital & Research Institute, Dhaka, Bangladesh.

Abstract

Web-based surveys are efficient and cost-effective methods to collect data from diverse, large, and geographically dispersed populations. They overcome the physical and logistical barriers of in-person or paper-based data collection, enabling broad, rapid, and inclusive participation across geographic and demographic boundaries. However, the increasing automation of online environments exposes these surveys to threats from bots, duplicate entries, and fraudulent responses that can compromise data integrity and study validity. This method-focused paper presents a comprehensive strategy for minimizing these risks through three interrelated stages: Design and Testing, Data Collection, and Data Cleaning and Validation. The structure integrates technical solutions and strategic research design principles to prevent, detect, and remediate survey fraud while safeguarding participant privacy and accessibility. Key preventive measures include eligibility screening, geofencing, device fingerprinting, CAPTCHA implementation, and honeypot traps during instrument design and testing. Real-time monitoring employs personalized survey links, traffic pattern analysis, and consistency checks to identify anomalous behavior during the data collection stage. In the last stage after data collection, rigorous data cleaning involves automated rule-based filters, manual adjudication of suspicious responses, and reliance on composite fraud scoring models to ensure the inclusion of high-quality, bot-free data for analysis. By synthesizing current best practices and emerging challenges, this work provides a practical guide for researchers designing and conducting secure web-based surveys in increasingly complex and adversarial digital environments.

(JNHFB 2025; 14 : 81-86) DOI : 10.61819/jnhfb.v14i2.6

Survey research

Surveys are powerful tools for measuring population characteristics, behaviours, and attitudes, providing valuable insights that inform research, policy, and decision-making across diverse fields[1]. Traditional survey methods such as face-to-face, mail, and telephone surveys continue to be widely used, yet each presents inherent challenges related to cost, logistics, screening difficulties, and response rates that affect their effectiveness and feasibility. These challenges vary by methods, ranging from staffing and geographic limitations in in-person surveys to caller ID screening and rising operational costs in telephone surveys [2]. This evolving landscape necessitates consideration of web-based surveys, which offer various advantages, but also face a distinct set of data quality and security risks.

Corresponding Author
Dr. Tanvir C. Turin
Department of Family Medicine, Cumming School of Medicine, University of Calgary
G012F, Health Sciences Centre, 3330 Hospital Drive NW
Calgary, Alberta, Canada, T2N 4N1
Email: turin.chowdhury@ucalgary.ca

In the current digital era, the reach and convenience of the Internet have transformed survey methodology. Web-based surveys have become a dominant format across a wide range of age demographics [3]. The rise is mainly due to their cost-effectiveness, ability to reach a large audience, and the removal of physical barriers and scheduling constraints, allowing participants to respond at their convenience. In many social research studies involving sensitive questions, respondents are more likely to give accurate responses to an online survey compared to a face-to-face or computer assisted telephone survey [4]. This format helps eliminate survey administrator bias and removes the need for separate data entry, since respondents enter their answers directly into the electronic system. [5] Despite these advantages, online survey administration introduces unique risks to data quality. These risks come primarily from survey fraud, including automated and scripted responses that threaten data validity[6].

Although bot activity is typically considered to be the biggest threat in web-based survey, [7] academic reports

rarely detail the survey administration protocol and data cleaning techniques to detect and remove bot and fraudulent responses [7]. This paper addresses this gap by focusing on bot infiltration and presenting a platform-agnostic approach for prevention, real-time detection, and post-field remediation within the broader web-survey workflow. It is increasingly documented in recent literature that addressing these threats is essential, because unchecked fraud can distort samples, bias estimates, and ultimately compromise inference [8].

Web-Based Survey Methods

A survey, in its most fundamental form, involves collecting information from a sample of individuals through their responses to questions [9]. Web-based surveys are often self-administered questionnaires, mostly delivered and completed via the internet. It allows researchers to efficiently collect data from diverse and geographically dispersed populations.

In the late 1990s and early 2000s, leading survey methodologists warned that internet coverage was too limited for the general-population to conduct web surveys [10]. Since then, individuals' access to internet has expanded substantially. In most urban settings today, household internet availability is near-universal, making web-first or web-only designs feasible for many studies, with remaining gaps concentrated among older adults, lower-income households, and rural/remote areas. According to the World Bank's 2024 data, [11] over 80% of the population in most high-income nations has regular internet access, making web-based survey designs viable. In methodological terms, web-surveys preserve the classical structure of survey research (design, sampling, recruitment, data collection, and analysis) while introducing digital dependencies that require additional safeguards.

Currently most web-based surveys use prominent platforms such as Qualtrics, SurveyMonkey, Google Forms, REDCap, and others. They offer user-friendly interfaces, customizable question formats, and integrated data analysis tools, addressing a wide range of research needs from basic feedback collection to complex experimental designs. These platforms also enable automated data capture, adaptive branching, and multimedia integration, enhancing convenience and data integrity.

Current Threat Landscape in Web-based Surveys

The modern web-survey environment faces a growing spectrum of threats driven by increasing automation, data exploitation, and participant incentives. Within web-based survey research, these threats can be conceptualized through the Total Survey Error framework, which addresses representation and measurement errors specific to this context. 12 Within web-based surveys, 'errors of representation' arise from ineligible or automated respondents such as bots or duplicates, while 'errors of measurement' primarily stem from inattentive or low-effort human responses.

Many web-based surveys are anonymous; therefore, eligibility is easier to spoof, identities can be recycled, and responses can be generated by scripts or language models that look superficially "reasonable." Fraudulent entries are a frequent phenomenon here, which can severely compromise the validity of study estimates. This warrants employment of rigorous safeguards aimed at virtually eliminating such responses. At the same time, these safeguards must be calibrated so they do not erode privacy, reduce accessibility, or undermine participant trust.

Bots and Fraud in Web-Based Surveys: Motives and Mechanisms

Recent studies show that, the web-based surveys can meet or even significantly exceed response rate than the mail questionnaire [13]. However, the trade-off here is exposure that often invites automated bots. These malicious software applications can complete surveys automatically and at scale, [14] often motivated by financial gain or manipulation of study outcomes, that can quietly distort estimates or overwhelm recruitment budgets [8].

Bots are created to mimic human interactions in online environments, including surveys. Their motives vary but commonly include financial gain, such as exploiting incentives or rewards for completing surveys, and fraudulent manipulation to distort data or disrupt research validity. Some bots are deployed by profit-driven individuals to inflate participation numbers or harvest data, while others serve political or commercial interests, aiming to influence rankings, public opinion, or policy perception. In severe cases, bot activity is used strategically to undermine data reliability, manipulate consumer insights, or sabotage competitors.

Strategies for Risk Mitigation

This section outlines a practical approaches or safeguarding data quality in web-based surveys. In order to measure and control the quality of the survey, we first need to understand the survey process [1]. In existing literature, survey implementation or execution processes is categorized in diverse ways. Some scholars define the stages as pre-fielding, fielding, and post-fielding stages, [15] while others describe them as design, instrument development, and execution [16]. For the purpose of this study, these processes are synthesized into three stages: (1) Design and Testing, (2) Data Collection, and (3) Data Cleaning and Validation. This three-stage conceptualization helps researchers to strategically plan which preventive measures to implement, determine the optimal timing for each, and understand how to effectively apply these controls to combat automated or bot responses throughout the entire survey process.

In the Design and Testing stage, foundational controls focus on eligibility criteria, recruitment strategies, and instrument development to prevent opportunities for fraudulent responses. This stage includes piloting and refining the questionnaire to ensure it deters automation and promotes valid participation while maintaining respondent privacy and accessibility.

During the Data Collection stage, real-time monitoring mechanisms are implemented. These include throttling traffic spikes and using platform-specific links to pinpoint problematic channels. Personalized authentication to enforce participation limitation, while geo–time-zone checks block out-of-scope entries. The continuous oversight facilitates early identification of irregularities, allowing prompt intervention such as restricting access or modifying recruitment channels to uphold data integrity.

The Data Cleaning and Validation stage encompasses post-field rule-based filtering to remove duplicates, illogical or implausible responses, and other low-quality data. Manual reviewer adjudication is needed for contextual insights with flagged entries. Documenting each decision and balancing exclusion thresholds to protect participant inclusion and confidentiality is also a big part of this stage.

Stage 1: Design and Testing

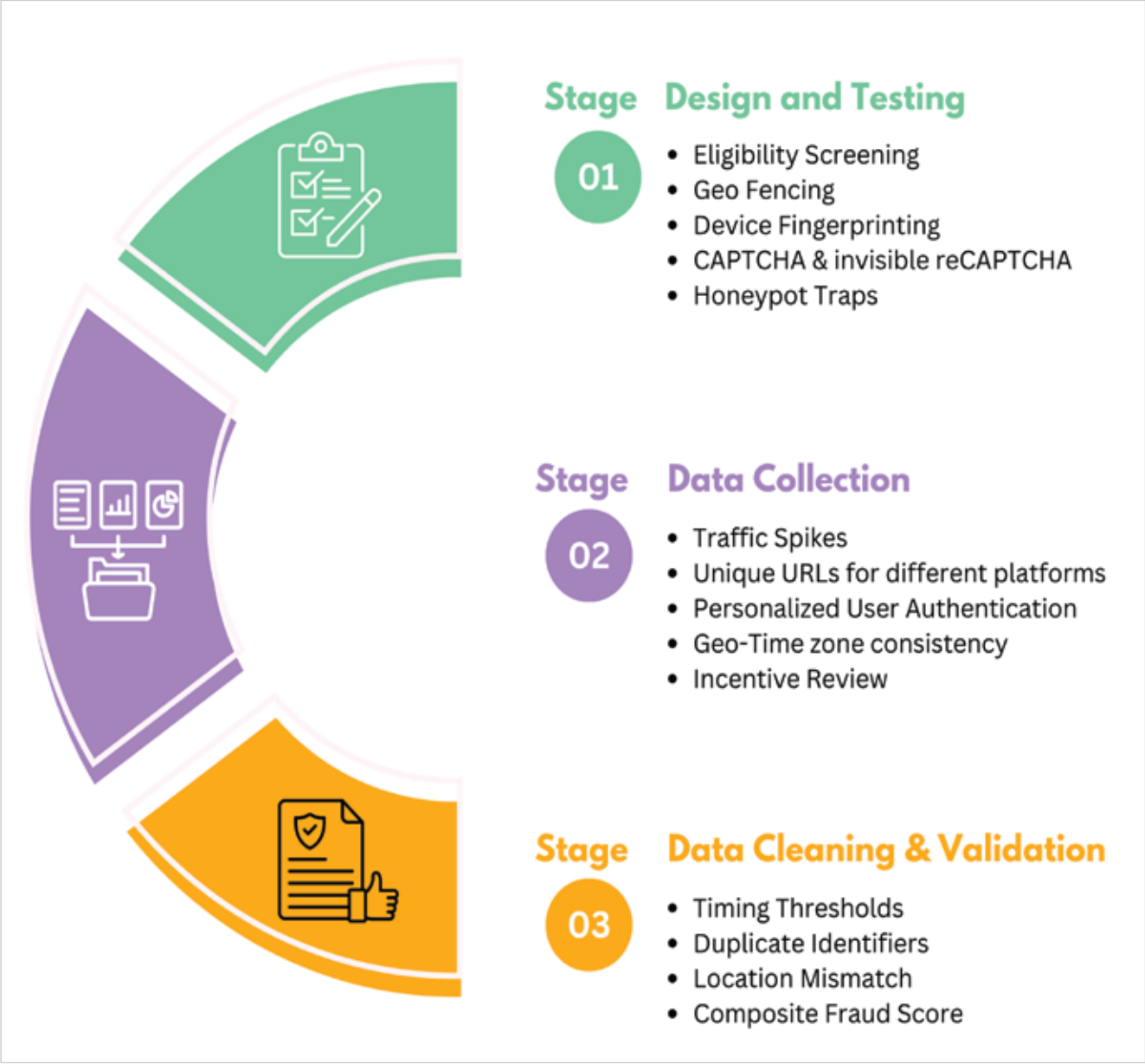


Figure 1: Risk mitigation strategies across the three stages of web-based survey execution

Eligibility Screening: Effective prevention starts before the survey launch. The survey life cycle begins with designing the survey instrument, where eligibility rules are established, and sampling strategies are defined. At this stage, researchers must anticipate the possibility of unwanted traffic from bots and fraudulent actors and define eligibility criteria that are both verifiable and resistant to manipulation. This strategy is moderately effective in bot detection and prevention [14].

In web-based surveys, researchers also should reveal as little as possible about study purpose before eligibility is established. This can be done by hiding titles and defer introductions until after screeners, so that large language model (LLM) driven bots can't mine context to choose the "right" answers.

Geo-Fencing: Geofencing establishes a virtual boundary around specific geographic areas, [17] allowing researchers to ensure that survey responses originate only from eligible locations while automatically blocking out-of-region IPs. This targeted approach enhances data accuracy and prevents unauthorized participation. Nonetheless, sophisticated bots can circumvent geofencing by leveraging technologies such as Virtual Private Networks (VPNs), which allow them to appear as if they are located within the specified boundary despite being elsewhere.

IP or Device based Fingerprinting: Fingerprinting allows anonymous detection of repeated attempts from the same device. This function places a cookie on the respondent's browser after they submit a response that blocks them from submitting a subsequent response [18]. However, Virtual Private Servers (VPS) pose a significant challenge VPS technology can bypass IP and device-based fingerprinting methods because it allows bots to operate behind independently unique IP addresses and manipulate device signatures to evade detection [19]. Additionally, sophisticated bots can modify device fingerprints, and submit multiple survey responses. [20] Researchers need to be aware that restricting survey access by IP address also comes with a cost, as it may also exclude legitimate participants who share the same IP, such as family members or students living in shared housing [21].

CAPTCHA and reCAPTCHA: CAPTCHA has long been used to keep bots from misusing web services [22]. It is an automatic security test to determine whether a user is a real human or a computer program, [22] which is said to be easy for humans but difficult for computers [23]. Embedding an invisible reCAPTCHA at the start of the survey adds a human-interaction step that remains a relatively high barrier for automated bots [22]. These systems evaluate cursor movement, scrolling, page dwell time, and input hesitation, which tend to differ between humans and bots. If the system detects suspicious, non-human-like behavior, it may require the respondent to complete an additional test, such as selecting images matching a prompt. This process helps prevent the entry of invalid or fraudulent actors into the survey. While CAPTCHAs serve as an important initial defense against automated bots, they are not foolproof, as many CAPTCHA implementations lack sufficient security to block more sophisticated attacks [14].

Honeypot Traps: Another technique can be used during instrument design is to include hidden questions also known as honeypot fields. This is a form of a trap embedded in a survey, programmed to engage and deceive bot respondents [14]. This can be accomplished by adding the @HIDDEN action tag to an item in REDCap or by adding custom JavaScript code to an item in Qualtrics [24]. These are hidden questions visible only to automated bots help distinguish machine entries from human participants. However, advanced bots may still detect hidden questions and intentionally avoid responding to them to pose as human [14]. Nevertheless, researchers should implement honeypot questions in web-based surveys as they do not require extra effort, but can trap some bots in the process without burdening participants.

Stage 2 - Data Collection

Traffic Spikes: Even with meticulous survey design, real-time monitoring during data collection remains essential. Fraudulent submissions often occur in bursts characterized by atypical completion times, spikes in traffic, or uniform response patterns. Continuous tracking of submission velocity, IP activity, and completion metadata enables early identification of such anomalies.

Unique URLs for different Platforms: It is advantageous to view recruitment channels as an integral part of access control. The initial layer of protection involves identifying who can access the survey and how they gain entry. A key strategy to reduce bot respondents involves issuing personalized, single-use survey links to each participant, ensuring that each link can only be accessed once and cannot be shared or reused [24]. For closed populations, such as university students, panel members, or clinic patients, implementing this strategy is sometimes feasible. However, when the survey is designed for broader audience, links disseminated on public social media platforms typically attract more opportunistic traffic. In this scenario, one possible measure is rotating link variants associated with each channel and monitor if any streams produce unusual activity. When anomalous activity is detected, it is advised to shut down the compromised survey link and replace it with a new link and fresh tokens [14]. This limits rapid, repeated bot submissions and reduces the burden of data cleaning later in the process.

Geo-time zone consistency: Researchers can perform a geo-time zone consistency check in by capturing the participant's local time via JavaScript and comparing it to their reported or expected time zone. For example, Qualtrics allows embedding JavaScript code that retrieves the client's browser time (which reflects their local time zone) and stores it in an embedded data field for later analysis or conditional logic. Other measures during the monitoring phase of a survey include but are not limited to monitoring IP and associated location to find mismatches, Geo-checks and time-zone consistency, and they should be applied judiciously.

Incentive Review: Compensation for survey participation should not be automated. Taking time to screen the received data for potential fraudulent responses before sending incentives can discourage bots [14].

Stage 3 - Data Cleaning & Validation

Even with advanced security, sampling, and in-survey quality checks are in place, some problematic responses may still slip past initial defenses. For this reason, a thorough data cleaning and validation stage is necessary to ensure bot-free responses. This stage involves systematically verifying that all control measures implemented during the survey design phase were effective. By rigorously assessing these controls at the validation stage, researchers can ensure that the survey data is consistent with the intended participant criteria and free from automated or fraudulent responses. For example, if bot detection feature is enabled in Qualtrics, it activates the field Q_RecaptchaScore, where a score of greater than or equal to 0.5 means the respondent is likely a human and a score of less than 0.5 means the respondent is likely a bot [25]. There are some other measures that can be considered during this stage:

Timing Thresholds: Another way to identify bots at this stage is to check for unusually short completion times. Automated filters can flag and remove responses completed too fast to be genuine. Therefore, applying timing thresholds during cleaning can be effective. It helps to exclude both careless and fraudulent submissions without relying on subjective judgment.

Duplicate Identifiers: Rule-based filters can also be applied to make an automated checks to remove duplicate entries, responses that violate survey logic, or submissions that fail critical quality controls (for example, impossible answer combinations). This helps prevent fraudulent responses without human subjectivity.

Location Mismatch: Manual review processes target inconsistencies such as mismatches between declared and IP-based geolocations. These patterns strongly indicate bot activity or respondent attempts to manipulate the survey. Careful adjudication of this metadata strengthens detection beyond automated flags alone.

Composite Fraud Score: Instead of relying on single indicators, researchers can also benefit from composite scoring models (for example, Relevant ID, Q_Recaptcha Score and Q_Ballot Box Stuffing in Qualtrics), which integrate multiple flags to identify probable fraud with high accuracy and minimize false exclusions. For instance, logic based on these fields can be set up (such as screening out possible bots or fraudulent responses), by adding these embedded data fields to the survey flow. Thorough and transparent documentation of all cleaning decisions, including rationale and impact, is vital to maintain ethical standards and scientific rigor throughout data validation.

Additional Measures for Survey Fraud Prevention:

There are additional controls available in all the stages mentioned above that can help flag suspicious activity and prevent bots when the survey is launched. Studies have suggested that lowering incentives would lower fraudulent behavior.[18] However, lowering incentives usually also lowers the participation rates. Researchers can also include a clause offering to interview participants after they complete the survey. However, to maintain anonymity and avoid bias, the contact information collected for scheduling interviews must be stored separately from survey responses. If responses are linked to identifying information, participants may alter their answers, leading to interview bias. Different platforms use common features such as bot-detection scores (RelevantID fraud score for Qualtrics) [25], duplicate-response checks, and "ballot box stuffing" which can guard against automation, identify repeated entries, and block duplicates before they enter the dataset [26].

Some Examples of Scenarios, Signals, and Immediate Actions in Web Surveys:

Table 1 presents some sample scenarios at two evidence levels: soft signals and hard triggers. Soft signals are suspicion cues that require confirmation before exclusion; hard triggers are pre-specified fail conditions that justify immediate containment or removal. For each case, the table lists what is noticed first, the signals (diagnostic confirmations), and the actions that needs to be taken if such cases occur.

Table 1: Detection Signals and Countermeasures for Fraudulent Responses in Web-Based Surveys.

Scenario	*Signals*	*Immediate Actions*
Sudden surge in submissions *(soft signal)*	Submissions arrive in large bursts within short period of time; Response quality drop s during an "attack window" ; platform fraud scores spike.	Pause or throttle survey link; mark the suspicious time window; ensure bot controls like reCAPTCHA and fingerprint checks; rotate new channel-specific link.
Claims inconsistent with eligibility/location *(soft signal)*	Claimed eligibility (e.g., region or time zone) doesn't match IP geolocation; entries originate outside the target area.	Enable geofencing or server - side screen -outs where justified.
Incentive requests cluster or repeat *(soft signal)*	Same email/phone/name across multiple entries or waves for repeat incentive request.	Cross-check incentive requests using name/email/phone; queue suspicious cases; withhold rewards pending adjudication.
Hidden item (honeypot) is populated *(Hard trigger)*	Responses appear for hidden items that are invisible to human users.	Exclude per pre -registered rule; flag neighboring time window; consider elevating entry friction (e.g., CAPTCHA) for that channel.
Extreme speeding *(Hard trigger)*	Survey completed in implausibly short time relative to its length or complexity.	Apply soft minimum -time rule; flag for adjudication; exclude if failing multiple criteria
Duplicate submissions from the same agent *(Hard trigger)*	Same device/browser fingerprint used repeatedly; platform flags high duplication scores.	Enforce rate limits per device/ IP address by using survey platform's duplicate detection tools; remove confirmed duplicates during data cleaning.

Conclusion

In an era where bots are rapidly evolving, the threat of fraudulent data in web-based research has never been greater [26]. Despite strong initial safeguards, the emergence of advanced AI agents that are powered by large language model (LLM), has dramatically complicated the challenge.

Recent experiments reveal that these AI bots can outsmart many traditional quality checks: they detect and skip hidden trap questions, slow their pace to evade timing alerts, and craft tailored responses that convincingly mimic human behavior across both closed and open-ended survey items [27]. While each individual control can potentially be defeated, a multi-layered, collective plan remains the most robust defense. Collectively, these measures increase both the technical and resource cost required for fraud or bot attacks and reduce the number and impact of fraudulent responses during the survey's fielding period [27].

Finally, designing and conducting a web-based online survey requires addressing a comprehensive range of security and privacy challenges. At the same time, researchers also need to consider the benefits of each method against its costs and practical challenges.24 For instance, removing payment for participants might reduce fraud but also discourage people from joining the surveys [18]. Therefore, ensuring data integrity in web-based surveys requires a multi-layered approach that combines technological safeguards with thoughtful instrument design, continuous monitoring, and rigorous data validation.

Conflict of interest: None.
Funding: The authors have no relevant financial or non-financial interests to disclose.

Declarations: We (the authors) take full responsibility for the content of this paper. We acknowledge the use of AI (editgpt) for assistance with English language editing. We used prompts to improve the structure of sentences that we deemed could be further improved. AI was prompted to improve clarity by improving grammar and choice of vocabularies used in the text. All suggestions were critically reviewed and revised to ensure the integrity of our own expressions. The authors have no conflicts of interest, relevant funding, employment, financial or non-financial interests to declare.

Reference

1. Biemer PP, Lyberg L. Introduction to Survey Quality. Wiley; 2003. doi:10.1002/0471458740
2. Traditional vs. Online Survey Research. AIMultiple. Accessed October 25, 2025. https://research.aimultiple.com/online-survey-research/
3. Fitzgerald D, Hockey R, Jones M, Mishra G, Waller M, Dobson A. Use of Online or Paper Surveys by Australian Women: Longitudinal Study of Users, Devices, and Cohort Retention. J Med Internet Res. 2019;21(3):e10672. doi:10.2196/10672
4. Arundel A. Survey fundamentals. In: 2023:7-24. doi:10.4337/9781800376175.000065. Van Selm M, Jankowski NW. Conducting Online Surveys. Qual Quant. 2006;40(3):435-456. doi:10.1007/s11135-005-8081-8
6. Bonett S, Lin W, Topper PS, Wolfe J, Golinkoff J, Deshpande A et al. Assessing and Improving Data Integrity in Web-Based Surveys: Comparison of Fraud Detection Systems in a COVID-19 Study. JMIR Form Res. 2024;8(1):e47091. doi:10.2196/47091
7. Johnson MS, Adams VM, Byrne J. Addressing fraudulent responses in online surveys: Insights from a web-based participatory mapping study. People Nat. 2024;6(1):147-164. doi:10.1002/pan3.10557
8. Dupuis M, Meier E, Cuneo F. Detecting computer-generated random responding in questionnaire-based data: A comparison of seven indices. Behav Res Methods. 2019;51(5):2228-2237. doi:10.3758/s13428-018-1103-y
9. Check JW, Schutt RK. Research Methods in Education. SAGE; 2012.
10. Schaefer DR, Dillman DA. Development of a Standard E-Mail Methodology: Results of an Experiment. Public Opin Q. 1998;62(3):378. doi:10.1086/297851
11. World Bank Open Data. World Bank Open Data. Accessed October 22, 2025. https://data.worldbank.org
12. Groves RM, Lyberg L. Total Survey Error: Past, Present, and Future. Public Opin Q. 2010;74(5):849-879. doi:10.1093/poq/nfq065
13. Kiernan NE, Kiernan M, Oyler MA, Gilles C. Is a Web Survey as Effective as a Mail Survey? A Field Experiment Among Computer Users. Am J Eval. 2005;26(2):245-252. doi:10.1177/1098214005275826
14. Storozuk A, Ashley M, Delage V, Maloney EA. Got Bots? Practical Recommendations to Protect Online Survey Data from Bot Attacks. Quant Methods Psychol. 2020;16(5):472-481. doi:10.20982/tqmp.16.5.p472
15. Callegaro M, Manfreda KL, Vehovar V. Callegaro, Manfreda, Vehovar. Web Survey Methodology.; 2015.
16. Glasow P. Fundamentals of Survey Research Methodology.
17. Shevchenko Y, Reips UD. Geofencing in location-based behavioral research: Methodology, challenges, and implementation. Behav Res Methods. 2024;56(7):6411-6439. doi:10.3758/s13428-023-02213-2
18. Teitcher JEF, Bockting WO, Bauermeister JA, Hoefer CJ, Miner MH, Klitzman RL. Detecting, preventing, and responding to "fraudsters" in internet research: ethics and tradeoffs. J Law Med Ethics J Am Soc Law Med Ethics. 2015;43(1):116-133. doi:10.1111/jlme.12200
19. Pozzer R, Hammer MJ, Underhill-Blazey M, Wright AA, Tulsky JA, Hong F, et al. Threats of Bots and Other Bad Actors to Data Quality Following Research Participant Recruitment Through Social Media: Cross-Sectional Questionnaire. J Med Internet Res. 2020;22(10):e23021. doi:10.2196/23021
20. Venugopalan H, Munir S, Ahmed S, Wang T, King ST, Shafiq Z. FP-Inconsistent: Measurement and Analysis of Fingerprint Inconsistencies in Evasive Bot Traffic. arXiv. Preprint posted online September 21, 2025. doi:10.48550/arXiv.2406.07647
21. Regmi PR, Waithaka E, Paudyal A, Simkhada P, van Teijlingen E. Guide to the design and application of online questionnaire surveys. Nepal J Epidemiol. 2016;6(4):640-644. doi:10.3126/nje.v6i4.17258
22. Dinh NT, Hoang VT. Recent advances of Captcha security analysis: a short literature review. Procedia Comput Sci. 2023;218:2550-2562. doi:10.1016/j.procs.2023.01.229
23. Nerurkar AK, Thampi GT, Motwani D, Chaudhari K, Panhale P. Intelligent robotic process automation that shall make captcha security ineffective. In: 2023:020027. doi:10.1063/5.0175270
24. Pozzer R, Hammer MJ, Underhill-Blazey M, Wright AA, Tulsky JA, Hong F, et al. Threats of Bots and Other Bad Actors to Data Quality Following Research Participant Recruitment Through Social Media: Cross-Sectional Questionnaire. J Med Internet Res. 2020;22(10):e23021. doi:10.2196/23021
25. Fraud Detection. Accessed November 1, 2025. https://www.qualtrics.com/support/survey-platform/survey-module/survey-checker/fraud-detection/
26. Parker JN, Rager TL, Burns J, Mmeje O. Data Verification and Respondent Validity for a Web-Based Sexual Health Survey: Tutorial. JMIR Form Res. 2024;8:e56788-e56788. doi:10.2196/56788
27. How To Outsmart Survey Bot Respondents. SurveyMonkey. Accessed October 25, 2025. https://www.surveymonkey.com/curiosity/outsmart-bot-survey-respondent/

Original Article

Gender Difference in Coronavirus Disease 2019 (COVID-19)

Fazila-Tun-Nesa Malik[1], Md. Kalimuddin[1], Mir Ishraquzzaman[1], Nazir Ahmed[1], Mohammad Badiuzzama[1], Mir Nesaruddin Ahmed[1], Ashok Dutta[1], Dhiman Banik[1], Mohammad Abdullah Al Mamun[2], Sohel Reza Choudhury[2]

[1]Department of Cardiology, National Heart Foundation Hospital & Research Institute, Mirpur, Dhaka; [2]Department of Epidemiology & Research, National Heart Foundation Hospital & Research Institute, Mirpur, Dhaka.

Abstract

Introduction: In Bangladesh, males were more affected by Coronavirus Disease 2019 (COVID-19) than females. However, there is a paucity of data regarding gender-based differences in the outcomes of COVID-19 patients. Therefore, the objective of this study was to compare the demographic and clinical characteristics, as well as the in-hospital outcomes, of COVID-19–positive male and female patients.

Methods: This prospective observational study included all consecutive confirmed symptomatic and asymptomatic COVID-19 positive patients from March 8th, 2020, to July 7th, 2023, at the National Heart Foundation Hospital & Research Institute of Bangladesh. Baseline and clinical characteristics & in-hospital outcome of both genders were assessed for comparison.

Results: This study included a total of 2506 confirmed COVID-19 positive patients. Of them 1684 (67.2%) patients were male and 822 (32.8%) were female. Male were older (52.45 ±14.86 years vs 45.90 ± 17.33 years; p=0.001) than female and had more co-morbidities (p= 0.001) than female. Among healthcare personnel, 27.0% were female and 13.6% were male (p=0.001). Male had more risk factors and comorbidities than female: cardiovascular disease (81.1% vs 64.4%; p=0.001); hypertension (62.8% vs 50.0%; p=0.001); dyslipidemia (27.5% vs 20.9%; p=0.001) and obesity (35.0% vs 25.4%; p=0.001). Female were more symptomatic (73.7% vs 69.7%; p=0.03) than male. Cough, sore throat, abdominal symptoms, numbness and dizziness were significantly higher in female than male. Male had more severe form of COVID-19 disease {(moderate: 2.4% vs 1.9%; p=0.49), (severe: 6.8% vs 5.2%; p=0.13)}. Male were more hospitalized (44.4% vs 34.9%; p=0.009) than female and most of the female treated either in home isolation or in institutional isolation (65.1% vs 59.6%; p=0.008). Male had non-significantly higher mortality rate than female (4.2% vs 3.5%; p=0.4).

Conclusion: COVID-19 male was usually older, had more comorbidities, a higher probability of hospitalization, increased risk of moderate-severe COVID-19 and associated with non-significantly higher mortality rate as compared with female.

Key Ward: COVID-19, Gender, Demographics, Clinical features, In-hospital outcome

(JNHFB 2025; 14 : 87-91) DOI : 10.61819/jnhfb.v14i2.8

Introduction

During the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak caused by the SARS-CoV-1 virus, studies found that women had a lower mortality risk compared to men [1]. Similarly, research on Middle East respiratory syndrome (MERS)-CoV showed that men were more frequently infected and had higher death rates than women [2]. Recent data on COVID-19 also indicate that males experience more severe disease outcomes and higher death rates than females [3–5]. In many Asian countries, men have been affected by COVID-19 more than women, with male-to-female infection ratios ranging from approximately 1.1 to 1.93:1 [6–9]. However, in European populations, the opposite trend has been observed, where females tend to be infected more, with a male-to-female ratio of about 0.47:1 [10,11]. While many developed nations report similar infection and death numbers across genders, several countries show a disproportionate burden among men [12]. For instance, men make up 88% of cases in Bahrain, 85% in Qatar, 75% in Saudi Arabia and South Sudan, 74% in Pakistan, and 71% in Bangladesh. Death rates in Chad, Bangladesh, Malawi, Qatar, and Pakistan also skew heavily male, with 74–80% of fatalities occurring in men. Conversely, countries such as Ukraine, Moldova, Poland, Latvia, Jamaica, Georgia, and Armenia report that females account for 55–60% of COVID-19 infections [12]. These gender differences in viral infection outcomes likely result from multiple factors, including variations in hormone

Corresponding Author
Md Kalimuddin
Associate Professor
Department of Cardiology
National Heart Foundation Hospital & Research Institute, Mirpur, Dhaka.

levels, immune system responses, genes located on the X chromosome, genetic susceptibility, and societal influences related to gender roles [13–15]. Our study aimed to analyze the differences in demographic profiles, clinical features, and hospital outcomes between male and female patients diagnosed with COVID-19.

Materials and methods

This prospective observational study was carried out in the non-COVID tertiary cardiac care hospital (National Heart Foundation Hospital & Research Institute, Dhaka, Bangladesh) from March 08, 2020, to July 07, 2023. All admitted patients, who subsequently got diagnosed as COVID positive and health care personnel of this hospital, who become COVID positive were included in this study. Both symptomatic and asymptomatic patients were included in this study. The study was approved by the Ethics Review Committee of National Heart Foundation Hospital & Research Institute (N.H.F.H. & R.I./4-14/7/AD-1105) and written informed consent was obtained from all patients or patients' attendance.

Baseline variables, comorbidities, clinical presentation, treatment, and severity of COVID-19 were analysed. Baseline information included age, risk factors and co-morbidities (hypertension, diabetes mellitus, dyslipidemia, obesity, cardiovascular disease, chronic obstructive pulmonary disease /bronchial asthma (COPD/BA), chronic kidney disease). The degree of severity of COVID-19 was classified as mild, moderate, severe, and critical ill [16,17]. Participants were considered partially vaccinated (PV) if received one dose of vaccine, fully vaccinated (FV) if received two doses of vaccine and boosted if received three doses of vaccine.

Descriptive statistics were used to characterize the study population. Continuous variables are described using the mean and standard deviation (SD), and compared using unpaired student's 't' test. Discrete variables were expressed as frequency rates and percentage. Categorical variables between groups were compared using the chi-square test or Fisher's exact test. A p value <0.05 was considered statistically significant. All analyses were performed using SPSS statistical software version 16.0 (SPSS Inc., Chicago, IL, USA).

Results

During this period a total of 2506 patients were included. Of whom 1684 (67.2%) patients were male and 822 (32.8%) were female. Male were older (52.45 ±14.86years vs 45.90 ± 17.33 years; p=0.001) than female and had more co-morbidities (p= 0.001) than female. Among healthcare personnel, 27.0% were female and 13.6% were male (p=0.001). Male had more risk factors and comorbidities than female: cardiovascular disease (81.1% vs 64.4%; p=0.001); hypertension (62.8% vs 50.0%; p=0.001); dyslipidemia (27.5% vs 20.9%;p=0.001) and obesity (35.0% vs 25.4%; p=0.001). Among male 29.2% were unvaccinated, 5.6% received PV, 24.2% FV, 13.1% booster dose. On the other hand, 30.0% female were unvaccinated, 11.2% received PV, 19.8% FV, 7.8% booster dose. Gender-specific baseline characteristics of COVID-19 patients are presented in Table 1. Most of the male had multiple comorbidities (Figure 1).

Table 1: Gender-specific baseline characteristics of COVID-19 patients (n-2506)

Variables	Male (n=1684)	Female (n=822)	p value
	Mean±SD/ f(%)	Mean±SD/f (%)	
Age (Mean±SD) year	52.45 ±14.86	45.90 ± 17.33	0.001#
Patient category			
HCP	229(13.6%)	222(27.0%)	0.001*
Non-HCP	1455(86.4%)	600(73.0%)	0.001*
Risk factors & comorbidities			
HTN	1057(62.8%)	411(50.0%)	0.001*
DM	690(41.0%)	313(38.1%)	0.16*
Dyslipidemia	463(27.5%)	172(20.9%)	0.001*
Cardiovascular disease	1366(81.1%)	529(64.4%)	0.001*
COPD/BA	93(5.5%)	46(5.6%)	0.94*
Obesity	590(35.0%)	209(25.4%)	0.001*
CKD	635(37.7%)	291(35.4%)	0.26*
Number of comorbidities			0.001*
<4	862(51.2%)	558(67.9%)	
≥4	822(48.8%)	264(32.1%)	
Diagnosis			0.001*
COVID-19 only	287(17.0%)	262(31.9%)	
COVID-19 with heart Disease	1397(83.0%)	560(68.1%)	

COVID-19: coronavirus disease 2019; DM: diabetes mellitus; HCP: healthcare personnel; non-HCP: non-healthcare personnel; SD: standard deviation; HTN: hypertension; COPD: chronic obstructive pulmonary disease; BA: Bronchial asthma; CKD: chronic kidney disease. *Chi square test was done to find out the significance; #Student's 't' test was done to find out the significance.

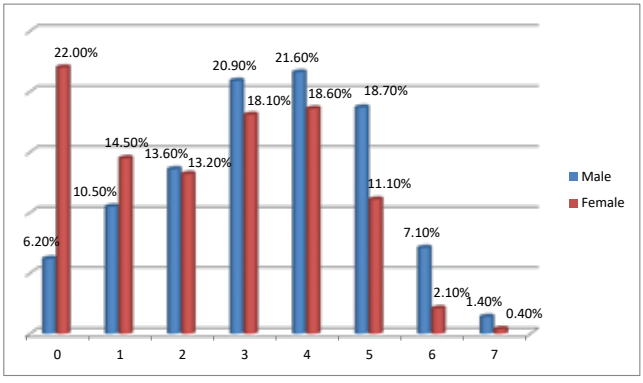


Figure 1: Bar diagram showing number of comorbidities among male and female with coronavirus disease 2019 (n=2506)

Female were more symptomatic (73.7% vs 69.7%; p=0.03) than male. Prolonged duration of symptoms was observed among female patients (3.6 ± 4.4 days vs 3.2 ± 3.6 days). Cough (38.3% vs 32.2%; p=0.003), sore throat (13.3% vs 5.9%; p=0.001), diarrhea (5.6% vs 2.8%; 0.001), anosmia (13.3% vs 5.3%; p=0.001), fatigue (33.5% vs 25.5%; p=0.001), headache (18.4% vs 11.0%; p=0.001), body-ache

(26.0% vs 17.3%; p=0.001), anorexia (16.1% vs 8.2%; p=0.001), nausea (7.2% vs 2.6%; p=0.001), vomiting (8.0% vs 2.2%; p=0.001), abdominal pain (3.5% vs 1.3%; p=0.001), numbness (3.5% vs 1.4%; p=0.001) and dizziness (13.5% vs 8.9%; p=0.001) were significantly higher in female than male. Gender-specific clinical presentations of COVID-19 patients are outlined further in Table 2.

Table 2: Gender-specific clinical presentation of coronavirus disease 2019 patients (n=2506)

Variables	Male (n=1684) f(%)	Female(n=822) f(%)	p value*
Clinical presentation			
Symptomatic	1174(69.7%)	606(73.7%)	0.03
Asymptomatic	510(30.3%)	216(26.3%)	
Duration of symptoms (Mean±SD) days	3.2±3.6	3.6±4.4	0.009
Fever	849(50.4%)	436(53.0%)	0.21
Cough	543(32.2%)	315(38.3%)	0.003
Sore throat	100(5.9%)	109(13.3%)	0.001
Shortness of breath	619(36.8%)	290(35.3%)	0.47
Diarrhea	47(2.8%)	46(5.6%)	0.001
Anosmia	89(5.3%)	109(13.3%)	0.001
Fatigue	430(25.5%)	275(33.5%)	0.001
Headache	185(11.0%)	151(18.4%)	0.001
Body-ache	292(17.3%)	214(26.0%)	0.001
Anorexia	138(8.2%)	132(16.1%)	0.001
Nausea	44(2.6%)	59(7.2%)	0.001
Vomiting	37(2.2%)	66(8.0%)	0.001
Abdominal pain	22(1.3%)	29(3.5%)	0.001
Numbness	23(1.4%)	29(3.5%)	0.001
Dizziness	150(8.9%)	111(13.5%)	0.001
Generalized itching	37(2.2%)	25(3.0%)	0.2

COVID-19: *Chi square test was done to find out the significance.

Patients were treated either in hospital or in isolation. Oxygen therapy (low flow, high flow) was given when required. Prone positioning was advised for all patients. Treatment outline is given in Table 3. Ivermectin received 35.2% male and 35.2% female. Three male (0.2%) and one female (0.1%) received hydroxy-chloroquine. Only 33 (2.0%) male& 12 (1.5%) female received favipiravir. Only few males and female required remdesivir (4.3% vs 4.7%; p=0.64).

Table 3: Gender-specific distribution of treatment of COVID-19 patients (n=2506)

Variables	Male (n=1684) f (%)	Female (n=822) f (%)	p value*
Antibiotics			
IV	499 (29.6%)	224 (27.3%)	0.001
Oral + IV	78 (4.6%)	29 (3.5%)	
Oral	480 (28.5%)	306 (37.2%)	
Not received	627 (37.2%)	263 (32.0%)	
Antibiotics			
Single	809 (48.0%)	449 (54.6%)	0.008
Double	248 (14.8%)	110 (13.4%)	
Not received	627(37.2%)	263 (32.0%)	
Steroids	90(5.3%)	47(5.7%)	0.7
Favipiravir	33(2.0%)	12 (1.5%)	0.37
Remdesivir	73(4.3%)	39(4.7%)	0.64
Ivermectin	593 (35.2%)	311(37.8%)	0.2
Hydroxy-chloroquine	3(0.2%)	1(0.1%)	0.73
Enoxaparine	1337 (79.4%)	503 (61.2%)	0.001
Rivaroxaban	1346 (79.9%)	507 (61.7%)	0.001

COVID-19: coronavirus disease 2019; IV: intravenous. *Chi square test was done to find out the significance.

Regarding antibiotic therapy, 809 (48.0%) male & 449 (54.6%) female were treated with a single antibiotic, and 248 (14.7%) male& 110 (13.4%) female were given double antibiotic therapy (p=0.008). The antibiotics used generally covered common pathogens. The antibiotics used were doxycycline, azythromycin, cephalosporins, fluoroquinolones, carbapenems and β-lactamase inhibitors. Intravenous (IV) antibiotic therapy (29.6% vs 27.3%) and double antibiotics (14.8% vs 13.4%) were given more in male patients. Most of the patients received either ivermectin plus azithromycin or ivermectin plus doxycycline combination. The duration of antibiotic treatment was 5–10 days. Steroid therapy with methylprednisolone and dexamethasone for 3–7 days was received only few males and female (5.7% vs 5.3%; p=0.7). Low molecular weight heparin was used more in male than female (79.4% vs 61.2%; p=0.001) followed by rivaroxaban (10 mg once daily for 1 month). We administered vitamin C, vitamin D3 and zinc to most of the patients.

Male were more hospitalized (44.4% vs 34.9%; p=0.009) than female and most of the female treated either in home isolation or in institutional isolation (65.1% vs 59.6%; p=0.008). In male patients- mild disease was 59.9% (1009), moderate disease was 2.4% (40); severe disease was 6.8% (114) and critical ill was 0.7% (11). In female patients-mild disease was 65.6% (539), moderate disease was 1.9% (16); severe disease was 5.2% (43) and critical ill was 1.0% (8) (Table 4). Male had non-significantly higher mortality rate than female (4.2% vs 3.5%; p=0.4).

Table 4: Gender-specific in-hospital outcome of COVID-19 patients (n=2506)

Variables	Male (n=1684) f (%)	Female (n=822) f (%)	p value*
Hospitalization	680 (44.4%)	287 (34.9%)	0.009
Home isolation	1004 (59.6%)	535 (65.1%)	0.008
Disease severity			
Asymptomatic	510(30.3%)	216(26.3%)	0.038
Mild	1009(59.9%)	539(65.6%)	0.006
Moderate	40(2.4%)	16(1.9%)	0.49
Severe	114(6.8%)	43(5.2%)	0.13
Critical ill	11(0.7%)	8(1.0%)	0.38
Mortality	71 (4.2%)	29 (3.5%)	0.4

COVID-19: coronavirus disease 2019. *Chi square test was done to find out the significance.

Discussion

Key findings from our study include: (1) Females were underrepresented among COVID-19 patients compared to males (2) Male patients were generally older and had a higher prevalence of comorbid conditions (3) Female patients exhibited a greater number of clinical symptoms than their male counterparts (4) Males experienced more severe disease and had higher hospitalization rates and (5) Although mortality was slightly higher among males, the difference was not statistically significant.

In our cohort, men accounted for 67.2% of cases. Early reports from China suggested a predominance of male COVID-19 patients, yet more recent data from other regions indicate that females may sometimes have higher infection rates. For example, the Korean Society of Infectious Diseases reported that among 4,212 confirmed cases, 37.7% were male and 62.3% female [18]. This contrasts with data from China, where males constituted approximately 51% of COVID-19 cases [18]. An Italian study with 783 patients found a male-to-female ratio of about 2.1:1, indicating greater male involvement [19]. Similarly, Sha et al. observed 72.4% male cases [20], and Raimondi et al. reported 55.7% males [21]. In contrast, Su et al. found a slight female predominance, with a male-to-female ratio of roughly 0.87:1 (53% males vs. 47% females) [22].

Our study revealed that males were significantly older, with a mean age of 52.45 ±14.86 years compared to 45.90 ±17.33 years in females and also had more comorbidities. However, other studies did not find significant gender differences in age or comorbidity burden [20-23]. For instance, one study reported a median age of 58 years with no difference between genders (56 years for males vs. 59 years for females) [20]. An Italian study noted an average age of 67.6 years and no significant difference between sexes (67.0 vs. 67.8 years) [21]. Su et al. [22] found the mean age to be 38.6 years without gender variation (39.3 vs. 37.9 years) and Taiwanese public surveillance data showed similar median ages for males and females (59 vs. 63 years) with comparable comorbidity rates [23].

In our study, female was more symptomatic and had prolonged duration of symptoms. Symptoms such as cough, sore throat, diarrhea, loss of smell, fatigue, headache, muscle aches, anorexia, nausea, vomiting, abdominal pain, numbness, and dizziness were more frequent among females. Conversely, Su et al. [22] found no significant gender difference in symptom presentation, including cough, fever, sore throat, malaise, and anosmia, a finding echoed by Jin et al. [23]. Sha et al. [20] reported a higher incidence of fever in males (90.4% vs. 82.0%), while Raimondi et al. observed more gastrointestinal symptoms in females (24.6% vs. 15.7%) [21]. One possible explanation for increased gastrointestinal symptoms in females is a higher expression of ACE2 receptors in the transverse colon [21].

Regarding disease severity, more males required hospitalization (44.4% vs. 34.9%; p=0.009), while a greater proportion of females had mild illness (65.6% vs. 59.9%; p=0.006). Males had a higher likelihood of developing moderate to severe COVID-19. This gender difference in disease severity may be influenced by factors such as viral entry mechanisms, immune and inflammatory responses, and endothelial or vascular function [21]. Although Sha et al. [20] did not find a statistically significant difference in severity, severe cases were more common in men (24.3% vs. 19.1%). Jin et al. [23] similarly reported males tending toward more severe disease presentations (p=0.035).

Mortality in our cohort was slightly higher among males (4.2% vs. 3.5%), but this difference lacked statistical significance (p=0.4). Other studies, however, have demonstrated a significant gender disparity in death rates [20-23]. For example, Sha et al. [20] reported a lower fatality rate in females compared to males (4.4% vs. 10.0%; p=0.031). Multivariate analysis linked increased mortality to age, male sex, and comorbidities [20]. An Italian study observed higher 28-day mortality in men (38.1% vs. 26.1%; p=0.018), though gender was not an independent predictor once disease severity was accounted for [21]. Taiwan's surveillance data revealed that male COVID-19 patients had a 6.4 times higher mortality rate than females (3.2% vs. 0.5%, p<0.05) and accounted for 2.4 times more deaths (70.3% vs. 29.7%, p=0.016) [23]. Despite similar infection rates, men face worse outcomes and higher mortality independent of age [23]. Underlying biological and genetic factors, including differences in immune response and hormonal influences, are believed to contribute to this gender disparity [24]. A meta-analysis of over three million cases globally further confirmed that, although infection rates are similar between sexes, men are nearly three times more likely to require intensive care and have increased odds of death compared to women [25].

Limitation

Our study has a few important limitations. First, it was carried out in a cardiac hospital that was not exclusively dedicated to COVID-19 care. Second, the study included asymptomatic patients, which might have influenced the findings. Third, a large proportion of the male participants had underlying coronary artery disease, potentially affecting outcomes. Finally, we did not assess biological factors such as hormonal status and immune function, nor did we evaluate gender-related influences like lifestyle habits and socioeconomic conditions.

Conclusion

Male COVID-19 patients were generally older, had a greater burden of comorbid conditions, faced a higher likelihood of hospitalization, and were at increased risk of developing moderate to severe disease. Although mortality rates were higher among males, the difference compared to females was not statistically significant.

Acknowledgement

We would like to thank Mrs Rehana Akter and Mr. Rasel Hasan, National Heart Foundation Hospital & Research Institute, for their sincere hard work in collecting and tabulating the data.

References

1. Karlberg J, Chong DS, Lai WY. Do men have a higher case fatality rate of severe acute respiratory syndrome than women do? Am J Epidemiol. 2004;159:229-231.
2. Alghamdi I, Hussain I, Alghamdi M, Almalki S, Alghamdi M, Elsheemy M. The pattern of Middle East respiratory syndrome

coronavirus in Saudi Arabia: a descriptive epidemiological analysis of data from the Saudi Ministry of Health. Int J Gen Med. 7:417-423.

3. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395:507-513.
4. Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. JAMA. 2020;323:1574.
5. Haitao T, Vermunt JV, Abeykoon J, Ghamrawi R, GunaratneM, Jayachandran M, et al. COVID-19 and sex differences: mechanisms and biomarkers. Mayo Clin Proc. 2020; 95:2189-2203.
6. Meng Y, Wu P, Lu W, Liu K, Ma K, Huang L, et al. Sex-specific clinical characteristics and prognosis of coronavirus disease-19 infection in Wuhan, China: a retrospective study of 168 severe patients. PLoS Pathog 2020;16(4):e1008520.
7. Su YJ, Lai YC. Comparison of clinical characteristics of coronavirus disease (COVID-19) and severe acute respiratory syndrome (SARS) as experienced in. Travel Med Infect Dis. 2020:101625.
8. Nikpouraghdam M, Jalali Farahani A, Alishiri G, Heydari S, Ebrahimnia M, Samadinia H, et al. Epidemiological characteristics of coronavirus disease 2019 (COVID-19) patients in IRAN: a single center study. J Clin Virol. 2020;127:104378.
9. Kim ES, Chin BS, Kang CK, Kim NJ, Kang YM, Choi JP, et al. Korea national committee for clinical management of COVID-19. Clinical course and outcomes of patients with severe acute respiratory syndrome coronavirus 2 infection: a preliminary report of the first 28 patients from the Korean cohort study on COVID-19. J Kor Med Sci. 2020;35(13):e142.
10. Lechien JR, Chiesa-Estomba CM, Place S, Van Laethem Y, Cabaraux P, Mat Q, et al. COVID-19 Task Force of YO-IFOS. Clinical and epidemiological characteristics of 1420 European patients with mild-to moderate coronavirus disease 2019. J Intern Med. 2020;288(3):335-344.
11. Jia J, Hu X, Yang F, Song X, Dong L, Zhang J, et al. Epidemiological characteristics on the clustering nature of COVID-19 in Qingdao City, 2020: a descriptive analysis. Disaster Med Publ Health Prep. 2020;31:1-5.
12. Aleksanyan Y, Weinman JP. Women, men and COVID-19. Social Science & Medicine. 2022;294:114698.
13. Klein SL, Flanagan KL. Sex differences in immune responses. Nat Rev Immunol. 2016;16:626-638.
14. Klein SL. The effects of hormones on sex differences in infection: from genes to behavior. Neurosci Biobehav R. 2000;24:627-638.
15. Robinson DP, Huber SA, Moussawi M, Roberts B, Teuscher C, Watkins R, et al. Sex chromosome complement contributes to sex differences in coxsackievirus B3 but not influenza A virus pathogenesis. Biol Sex Differ. 2011;2:8.
16. Zu ZY, Jiang MD, Xu PP, Chen W, Ni QQ, Lu GM, et al. Coronavirus disease 2019 (COVID-19): a perspective from China. Radiology, 2020, 296:E15-25.
17. Yue H, Bai X, Wang J, Yu Q, Liu W, Pu J, et al. Clinical characteristics of coronavirus disease 2019 in Gansu province, China. Ann Palliat Med, 2020; 9:1404-1412.
18. Zaher K, Basingab F, Alrahimi J, Basahel K, Aldahlawi A. Gender Differences in Response to COVID-19 Infection and Vaccination.Biomedicines. 2023; 11:1677.
19. Borghesi A, Zigliani A, Masciullo R, Golemi S, Maculotti P, Farina D, et al. Radiographic severity index in COVID-19 pneumonia: relationship to age and sex in 783 Italian patients. Radiol Med. 2020;125(5):461-464.
20. Sha J, Qie G, Yao Q, Sun W, Wang C, Zhang Z, et al. Sex Differences on Clinical Characteristics, Severity, and Mortality in Adult Patients With COVID-19: A Multicentre Retrospective Study. Front. Med. 2021;8:607059.
21. Raimondi F, Novelli L, Ghirardi A, Russo FM, Pellegrini D, Biza R, et al. Covid-19 and gender: lower rate but same mortality of severe disease in women-an observational study. BMC Pulm Med. 2021;21:96.
22. Su Y-J, Kuo K-C, Wang T-W, Chang C-W. Gender-based differences in COVID-19. New Microbe and New Infect. 2021; 42: 100905.
23. Jin J-M, Bai P, He W, Wu F, Liu X-F, Han D-M, et al. Gender Differences in Patients With COVID-19: Focus on Severity and Mortality. Front. Public Health. 2020;8:152.
24. Plebani M, Lippi G. Sex and gender differences in COVID-19: a narrative review. Ital J Gender-Specific Med. 2022;8(2):105-111.
25. Peckham H, de Gruijter NM, Raine C, Radziszewska A, Ciurtin C, Wedderburn LR et al. Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ITU admission. Nat Commun. 2020;11:6317.

Original Article

Association between on Admission Serum NT-pro BNP and ST-segment Resolution in Patients with Acute ST Elevated Myocardial Infarction undergoing Primary Percutaneous Coronary Intervention

Md Nazmul Haque[1], Fazila-Tun-Nesa Malik[2], Md Habibur Rahman[2], Md Kalimuddin[2], Md Shafi-Ul-Alam[3], Abdul Momen[3], Md Shamim Chowdhury[2]

[1]Barahmanbaria Sadar Hospital, Barahmanbaria; [2]Department of Cardiology, National Heart Foundation Hospital & Research Institute (NHFH&RI), Dhaka; [3]Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka

Abstract

Introduction: Post-percutaneous coronary interv2ntion (PCI) assessment of ST-segment resolution (STR) serves as a vital indicator of perfusion at heart micro vessels in patients with ST-segment elevation myocardial infarction (STEMI). NT-pro BNP emerges as a significant biomarker, aiding in risk stratification and prognostication in acute coronary syndrome. The aim of the study objective was to find out association between on admission N-terminal pro-B-type natriuretic peptide (NT-pro BNP) and ST-segment resolution and predicting about reperfusion before primary PCI.

Methods: This cross-sectional analytical study was carried out at national Heart Foundation Hospital & Research Institute (NHFH&RI) for one year from May 2023 to April 2024 involving 104 patients with STEMI who met the inclusion and exclusion criteria. A digital 12-lead ECG was recorded at admission and 60 minutes after primary PCI and blood samples were collected for NT-pro BNP. ST segment resolution ≥50% was considered as successful reperfusion and categorized as Group I, whereas STR<50% was considered failed reperfusion and categorized as Group II.

Results: Result revealed that maximum patient was in 51-60years age group (38.4%) and male predominant (86.5%). Diabetes mellitus (68.96%), hypertension (86.20%) and dyslipidemia (86.20%) were more in Group II. The mean (±SEM) NT-pro BNP level In Group I and group II was 385±53.47pg/ml and 6727±1286.39pg/ml respectively. Notably, NT-pro-BNP ≥688pg/ml showed highest Youden Index with sensitivity of 86.2%, specificity of 85.3%, positive predictive value (PPV) of 69.44%, negative predictive value (NPV) of 94.12% and accuracy of 85.58% to predict failed ST resolution.

Conclusions: NT-pro BNP level on admission is an important biomarker to predict ST resolution after Primary PCI.

Key words: STEMI, Primary PCI, NT-pro BNP.

(JNHFB 2025; 14 : 92-98) DOI : 10.61819/jnhfb.v14i2.8

Introduction

Primary percutaneous coronary intervention (PCI) is the preferred reperfusion strategy in patients with STEMI. The success of PCI can be determined electrocardiographically by measuring ST-segment resolution (STR) after procedure and angiographically by evaluating Thrombolysis in Myocardial Infarction (TIMI) flow [1]. However, good epicardial blood flow does not necessarily imply adequate perfusion at the myocyte level. That is why monitoring STR after successful primary PCI is probably the most convenient method to assess if appropriate perfusion is achieved in the heart micro vessels, because STR reflects the physiology of myocytes, which are the final target of coronary blood flow [2]. Recent studies have shown that STR is an important prognostic indicator for late revascularization, recurrence rate of myocardial infarction, but does not predict long-term mortality in patients with STEMI undergoing primary PCI [3].

In acute coronary syndrome, both BNP and NT-pro BNP were elevated but NT-pro BNP might be a better diagnostic biomarker than BNP [4]. Higher levels of NT-pro BNP level were associated with greater LV end-diastolic volume, a greater LV end-systolic volume, lower LVEF, a larger infarct

Corresponding Author
Md Nazmul Haque
Barahmanbaria Sadar Hospital
Barahmanbaria

size, and a larger number of transmural segments [5]. In patients with acute myocardial infarction, this biomarker level on admission were independently associated with extent, severity, and complexity of coronary atherosclerosis as assessed by SYNTAX score [6]. Baseline NT-pro BNP may identify low risk patients who underwent primary PCI and eligible for discharge within 48-72 hours [7]. Not only that, NT-pro BNP had value in patients with STEMI who underwent primary PCI in predicting 1month major adverse cardiovascular events (MACEs) [8]. The level of NT-pro BNP was significantly higher in those with no-reflow phenomenon (Ayhan et al., 2013) and significantly lower in those with ST segment resolution compared with the counterpart who underwent primary PCI [9]. NT-pro BNP is a valuable tool for predicting prognosis in these patients. The aim of the study was to find out association between on admission NT-pro BNP and ST-segment resolution after one hour of primary PCI.

Materials and Methods

This cross-sectional analytical study was carried out at the Department of Cardiology of National Heart Foundation Hospital and Research Institute (NHFH & RI) from May 2023 to April 2024(one year). For this study, the sample size was calculated by using Cochran's formula considering 95% level of significance and 5% precision level (marginal error). The calculated sample size was 104. All STEMI patients who underwent primary PCI were included in this study. patients with STEMI who refused to primary PCI; patients with STEMI delayed arrival (>12 hours); patients with STEMI with cardiogenic shock and acute left ventricular failure and patients with STEMI with known hepatic and renal impairment were excluded from the study.

Particulars of the patient, targeted history were taken, and detailed clinical examinations were performed and recorded in a pre-designed structured questionnaire. Demographic data such as age, sex, and BMI by measuring weight and height were recorded. Risk factor profiles including smoking, hypertension, diabetes, dyslipidemia, and family history of premature coronary artery disease were noted.

According to the Western Pacific Region Office of WHO recommendation among South Asians, obesity was defined as BMI > 25.0 kg/m2 [10]. Primary PCI was defined as emergent PCI with balloon, stent, or others approved device, performed on infarct related artery (IRA) without previous fibrinolytic treatment [11]. A digital 12-lead ECG was recorded at a speed of 25 mm/s and a voltage of 10 mm/mV was obtained for all patients on admission (Preprocedural ECG) and 60 min after primary PCI (post procedural ECG). A single lead with maximum ST segment elevation was measured. ST segment resolution was measured after 60 min of primary PCI. ST segment resolution <50% after one hour (01) of primary PCI was considered as failed reperfusion, whereas STR≥50% was regarded as successful reperfusion. NT-pro BNP was measured on admission. Coronary angiography and PCI were performed according to standard practice. Informed written consent was taken from each patient before enrollment. The study protocol was approved by ethics review committee of NHFH&RI.

The data obtained from the study were analyzed, and the significance of differences was estimated using statistical methods. Continuous variables with normal distribution were expressed as mean value ± standard deviation and compared using unpaired Student's t-test. Continuous variables with non-normal distribution were compared using the Mann-Whitney U test. Categorical variables were compared using the Chi-square test. Correlation analysis was performed to adjust for potential confounders in predicting the relation between NT-pro BNP level and STR. Receiver operating characteristics (ROC) curve was used to derive the optimum cutoff value of the NT-pro BNP level for prediction of poor ST resolution. A probability (p) value of ≤0.05 was considered significant, while p > 0.05 was considered insignificant. Statistical analysis was carried out using SPSS 22.

Results

Total 104 participants were selected after considering inclusion and exclusion criteria. The mean age of the patients (n=104) was 54.30 ±11.77 years. The maximum patient age group was between 51-60 years (38.4%). Among the study population, 86.5% (90) were male and 13.5% (14) were female. About 57.69% patients had diabetes mellitus (DM), 65.4% patients had hypertension (HTN), 76.69% patients had dyslipidemia, 62.5% patients had history of smoking, 33.6% patients were obese, and 32.7% patients had family history of coronary artery disease. The base line and clinical characteristics of the patients were presented in table 1. Regarding location of STEMI, 48.07% of cases diagnosed as inferior myocardial infarction (MI), 46.2% as anterior (anteroseptal, anterior, ext. anterior) MI and others (lateral, postrerior) MI 5.7%.

Table 1: Baseline and clinical characteristics of the patients (n-104)

Variables	Mean±SD/n (%)
Age (Mean±SD) year	54.30 ±11.77
Age category	
• <40 years	10(09.6%)
• 40-50 years	33(31.7%)
• 51-60 years	40(38.4%)
• >60 years	21(20.1%)
Gender	
• Male	90(86.5%)
• Female	14(13.5%)
Risk factors	
HTN	68(65.4%)
DM	60(57.7%)
Dyslipidemia	80(76.6%)
Obesity	35(33.6%)
Family history of CAD	34(32.7%)
Smoking	
• Smoker	45(43.2%)
• Ex-smoker	20(19.2%)
Location of myocardial infarction	
Inferior MI	50(48.07%)
Anterior MI	48(46.2%)
Others	06(5.7%)

SD: standard deviation; DM: diabetes mellitus; HTN: hypertension; CAD: coronary artery disease; MI: myocardial infarction.

Table 2 showing laboratory variables of among the study population. The mean (±SD) value of hemoglobin was 13.12 ±1.50%. Mean (±SD) serum creatinine was 1.20 ±0.16 mg/dl. Regarding fasting lipid profile, mean (±SD) of total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), triglyceride (TG) were 219.47 ±48.32 mg/dl, 39.01 ± 5.02 mg/dl, 106.58 ±21.14 mg/dl, 155.30 ± 51.58 mg/dl respectively. Mean (±SEM) value of NT-proBNP was 2153.86 ±453.61pg/ml. The mean (±SD) left ventricular ejection fraction (LVEF) was 48.39 ± 5.68 %.

Table2: Distribution of biochemical variables and LVEF among the patients (n=104)

Variables	Mean±SD
Hb%	13.12±1.50
WBC(/mm^3)	12632.692±3258.40
Serum creatinine (mg/dl)	1.20±0.16
Total cholesterol (mg/dl)	219.47±48.32
TG (mg/dl)	155.30±51.58
LDL (mg/dl)	106.58±21.14
HDL (mg/dl)	39.01±5.02
RBS (mmol/L)	11.57±4.21
HbA1C (%)	7.90±6.70
Troponin I (ng/ml)	37.71±18.47
NT pro BNP (pg/ml)(Mean±SEM)	2153.86±453.61
SGPT (U/L)	45.91±12.04
LVEF(%)	48.39±5.68

SD: standard deviation; LVEF: left ventricular ejection fraction; WBC: white blood cell; TG: triglyceride; LDL: low density lipoprotein; HDL: high density lipoprotein; RBS: random blood sugar; NT pro BNP: N-terminal pro-B-type natriuretic peptide; SEM: standard error of the mean; SGPT: serum glutamate pyruvate transaminase.

Table 3: Angiographic findings of the study population (n=104)

Variables	Frequency	Percentage (%)
Angiographic findings		
Presence of multivessel stenosis	32	30.8
Vessels involved		
LAD	65	62.5
RCA	54	51.9
LCX	22	21.2
LM	01	01.0
TIMI flow (post PCI)		
TIMI 2	09	08.7
TIMI 3	95	91.3
	Mean±SD	
Symptom onset to hospitalization (hrs)	6.66±2.80	
Door to wire crossing (min)	75.50±10.50	

LAD: left anterior descending; RCA: right coronary artery; LCX: left circumflex; LM: left main; TIMI: thrombolysis in myocardial infarction; PCI: percutaneous coronary intervention; SD: standard deviation; hrs: hours; min: minute.

The angiographic findings (Table 3) of the study reveal that 30.8% (32 patients) had multivessel stenosis. Among the vessels involved, the left anterior descending artery (LAD) was most frequently affected (62.5%). Regarding Thrombolysis in Myocardial Infarction (TIMI) flow grades, 91.3% of patients achieved TIMI 3 flow, indicating complete perfusion, while 8.7% had TIMI 2 flow, indicating partial perfusion. The average time from symptom onset to hospitalization was mean (±SD) 6.66±2.80hrs, and the average door to wire crossing time was mean (±SD)75.50±10.50min, highlighting the efficiency and promptness of the intervention process.

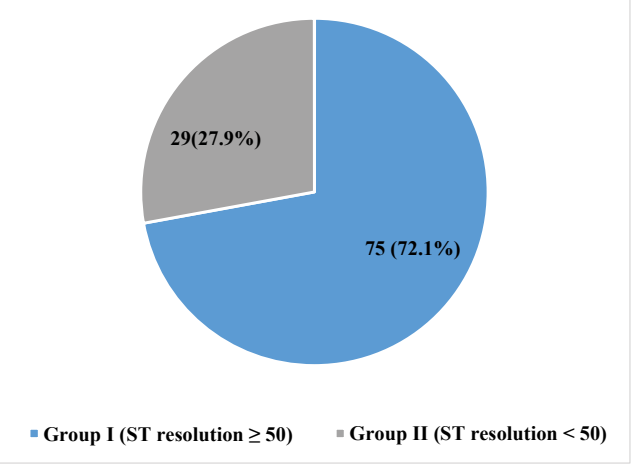


Figure 1: ST-resolution of the study population (n=104)

Among the study population, 72.1% (75) had successful ST-resolution and 27.9% (29) had failed ST-resolution (Figure 1).

In group II diabetes mellitus 68.96%, hypertension 86.2%, and dyslipidemia 86.20% were present and statistically significant evidenced by p-values of 0.032, 0.006, and 0.002, respectively. However, smoking status, family history of coronary artery disease (CAD), and obesity do not show significant differences between the two groups.

Table 4: Distribution of risk factors between two groups (n=104)

Risk Factors	Group I (n=75)	Group II (n=29)	p-value
	Frequency (%)	Frequency (%)	
Diabetes Mellitus	40 (53.33)	20 (68.96)	^{c}0.032^s
Hypertension	43 (57.3)	25 (86.2)	^{c}0.006^s
Dyslipidemia	55 (73.33)	25 (86.20)	^{c}0.002^s
Smoking status			
• Smoker	47 (62.7)	18 (62.1)	^{c}0.879^{ns}
Family H/O CAD	28 (37.3)	6 (20.7)	^{c}0.105^{ns}
BMI (kg/m^2)			
• Obese (>25)	25(33.3)	10 (34.4)	^{c}0.105^{ns}

H/O: history of; CAD: coronary artery disease; BMI: body mass index; c = chi-square test ns = non-significant; s = significant

Across different parameters including hemoglobin percentage, serum creatinine, lipid profile (Total cholesterol, HDL, LDL, TG), SGPT, hemoglobin A1C, and troponin I level, no significant differences are observed between the two ST-resolution groups (Table 5). Only LVEF was statistically different (p <0.001) in two groups.

Table 5: Biochemical and LVEF findings between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Mean±SD	Mean±SD	
Hb%	13.17±1.55	13.00±1.40	$^{t}0.609^{ns}$
Serum creatinine (mg/dl)	1.21±0.15	1.19±0.19	$^{t}0.632^{ns}$
Total cholesterol (mg/dl)	221.72±47.94	213.65±49.67	$^{t}0.448^{ns}$
TG (mg/dl)	155.28±48.53	155.37±59.69	$^{t}0.993^{ns}$
LDL (mg/dl)	106.02±19.09	108.03±26.03	$^{t}0.666^{ns}$
HDL (mg/dl)	39.32±5.39	38.24±3.88	$^{t}0.329^{ns}$
SGPT (U/L)	46.50±12.61	44.37±10.46	$^{t}0.422^{ns}$
HbA1C (%)	7.12±1.81	7.83±1.97	$^{u}0.088^{ns}$
Troponin I (ng/ml)	37.10±19.41	39.28±15.98	$^{u}0.406^{ns}$
LVEF	50.84±3.80	42.06±4.82	$<^{t}0.001^{s}$

SD: standard deviation; TG: triglyceride; LDL: low density lipoprotein; HDL: high density lipoprotein; SGPT: serum glutamate pyruvate transaminase; LVEF: left ventricular ejection fraction. t = unpaired t-test; u = Mann-Whitney U-test; ns = non-significant; s = significant

NT pro BNP levels between Group I (n=75) and Group II (n=29) demonstrates a significant difference (Table 6). In Group I, the mean ±SEM NT pro BNP level is notably lower at 385.41±53.47 whereas in Group II, the mean NT pro BNP level is substantially higher at 6727±1286.39, with a p-value of less than 0.001.

Table 6: NT pro BNP level between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Mean±SEM	Mean±SEM	
NT pro BNP (pg/ml)	385.41±53.47	6727.43±1286.39	$<^{u}0.001^{s}$

NT pro BNP: N-terminal pro-B-type natriuretic peptide; SEM: standard error of the mean; u = Mann-Whitney U-test; s = significant

The Spearman's rank correlation analysis between NT-pro BNP and ST-resolution (Figure 2) showing a moderate negative correlation coefficient of -0.514, indicating that as NT pro BNP levels increase, ST-resolution tends to decrease. The value is (p<0.001) meaning this correlation is statistically significant.

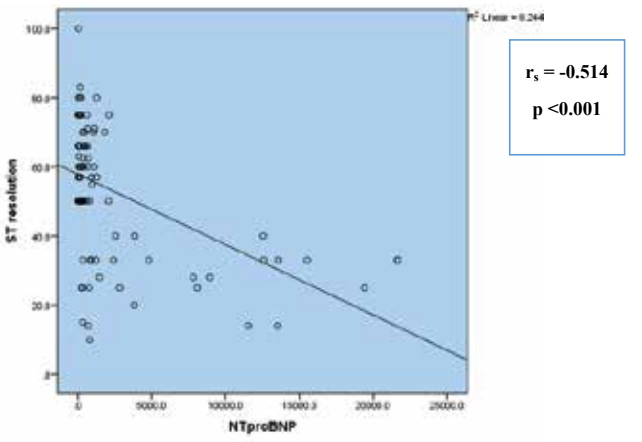


Figure 2: Correlation of NT pro BNP with ST-resolution (n=104); NT pro BNP: N-terminal pro-B-type natriuretic peptide

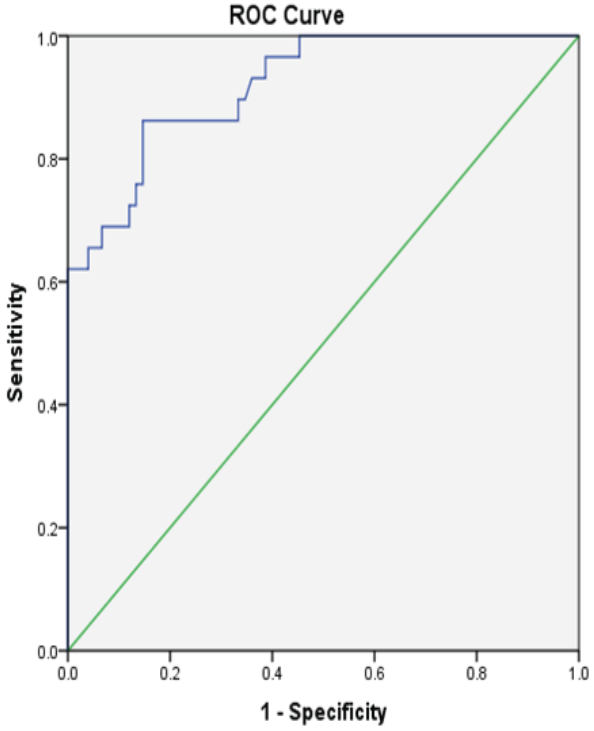
The comparison of variables between Group I and Group II reveals significant differences (Table 7). In Group I, 24% of patients had multivessel stenosis, whereas in Group II, this percentage was notably higher at 48.3% (p = 0.016). Additionally, the mean time from symptom onset to hospitalization was in Group II mean ±SD (10.96±0.82) with a p-value of less than 0.001. The door to wire crossing time was in Group II mean ±SD 90.50±10.55 with a p-value of less than 0.001.

Table 7: Angiographic findings between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Frequency (%)	Frequency (%)	
Presence of multivessel stenosis	18 (24)	14 (48.3)	$^{c}0.016^{s}$
	Mean ±SD	Mean ±SD	
Symptom onset to hospitalization (hrs)	5±0.82	10.96±0.82	$<^{t}0.001^{s}$
Door to wire crossing (min)	60.20±10.50	90.50±10.55	$<^{t}0.001^{s}$

SD: standard deviation; hrs: hours; min: minute; c = chi-square test; t = unpaired t-test ns = non-significant; s = significant

Receiver operating characteristics (ROC) analysis (Figure 3) of NT-pro BNP level on admission to predict ST segment resolution yielded an area under curve (AUC) value of 0.920 (95% CI 0.864-0.975) demonstrating statistically significant result (p <0.05).



Area	Std. Error	p value	95% Confidence Interval	
			Lower	Upper
.920	.028	<0.001	.864	.975

Figure 3: ROC analysis for cut-off value of NT-pro BNP; ROC: Receiver operating characteristics; NT pro BNP: N-terminal pro- B-type natriuretic peptide

A cut-off value of ≥688 showed the highest Youden index (0.715) with 86.2% sensitivity and 85.3% specificity (Table 8).

Table 8: Determination of cut off value with Youden index

Cutoff value	Sensitivity	Specificity	Youden index (j=sen+spe-1)
≥672	0.862	0.827	0.689
≥680	0.862	0.840	0.702
≥688	0.862	0.853	0.715
≥745.50	0.828	0.853	0.681
≥810	0.793	0.853	0.646

Sensitivity 86.21% and specificity 85.33% found from the derived cutoff value can predict poor ST resolution with about 85.58% accuracy (Table 9).

Table 9: Sensitivity, specificity, PPV, NPV and accuracy gained by the derived cutoff of NT pro BNP with 95% confidence interval for predicting ST-segment resolution

Statistic	Value	(95% Confidence Interval)
Sensitivity	86.21%	68.34% to 96.11%
Specificity	85.33%	75.27% to 92.44%
PPV	69.44%	56.37% to 79.99%
NPV	94.12%	86.50% to 97.56%
Accuracy	85.58%	77.33% to 91.70%

PPV=Positive Predictive Value; NPV=Negative Predictive Value; NT pro BNP: N-terminal pro-B-type natriuretic peptide.

Notably, NT-proBNP along with diabetes mellitus, hypertension, dyslipidemia, presence of multivessel stenosis, and LVEF demonstrate statistically significant associations with ST-segment resolution, with p-values less than 0.05 (Table 10).

Table 10: Univariate analysis of the factors predictive for ST-segment resolution

Factors	OR	95% CI		p value
		Lower	Upper	
Diabetes Mellitus	2.596	1.074	6.273	0.034
Hypertension	4.651	1.472	14.695	0.009
Dyslipidemia	3.951	1.579	9.885	0.003
NT-pro -BNP	1.998	0.997	2.999	<0.001
Presence of multivessel stenosis (>50%)	2.956	1.201	7.275	0.018
LVEF (%)	1.496	1.296	1.727	<0.001

OR: odds ratio; CI: confidence interval; NT pro BNP: N-terminal pro-B-type natriuretic peptide; LVEF: left ventricular ejection fraction.

Discussion

In this present study, the mean age was 54.30 ± 11.77years. The maximum patient age group was between 51-60 years (38.4%). Almost similar findings were observed by previous studies: mean age 53.1±12.6 years and maximum patient age group between 51-60 years (37.5%) [12] & mean age 52.7±10.4 years [13]. South Asians have multiple risk factors that pose potentially atherogenic condition. It may be due to altered metabolic condition, frequent infection, inflammation, constant stress and narrowness of the arteries. CAD most probably occurs in relatively early age groups in our country. Among the study population, male was 86.5% & female was 13.5% which was consistent with another study- 87.7% male and 12.3% female [14].

Patients arriving at the hospital after a prolonged duration of chest pain (10±0.82hours) and door to wire crossing time (90.50±10.55 min) were more likely to have failed STR compared to those who got early medical attention (5±0.82 hours) and door to wire crossing time (60.20±10.50 min).This finding was similar to study conducted by Park et al. [2] where symptom to door time (133±94min) and door to balloon time (81±51min) was higher in the group of incomplete STR. Individuals with diabetes mellitus (68.96%), hypertension(86.2%) & dyslipidemia (86%) demonstrated a higher in Group II ($p<0.05$). Study conducted by Park et al. [2] also revealed hypertension, diabetes mellitus, and hyperlipidemia had a higher association with incomplete STR. Shavadia et al. [15] showed diabetes mellitus was more associated with failed STR. In this study, among the Group-I, 62.7% of patients were current smoker while 62.1% patients of Group-II were current smoker and after comparing the data of two groups, p value was not significant (p value =0.879). Blomet al. [16] showed smoking is more associated with failed reperfusion which didn't match with this study.

In this study, among the study population 72.1% underwent ≥50% ST segment resolution & 27.9% underwent <50% ST segment resolution. Study conducted by Lorgis et al. [17] found 73% participants having ≥50% ST segment resolution & 27% underwent <50% ST segment resolution& the obtained result was parallel to this study. Peng et al. [9] stated that a total of 202 patients (92.7 %) showed STR at 180 min after primary PCI. Conversely, 16 patients (7.3 %) failed to show STR (non-STR) which didn't match with this study.

Across different parameters including Hemoglobin percentage, Serum creatinine, Serum Glutamic Pyruvic Transaminase, Hemoglobin A1C, and Troponin I level, no significant differences are observed between the two ST-resolution groups.

Notably, a higher (50±.84%) LVEF was significantly associated with Group-I and lower (42.06±4.82) in Group-II. In support of our findings, Park et al. [2] also showed significant association of LVEF with failed STR (43±19) which is similar to this study. In this study, presence of multivessel stenosis is more (48.3%) in Group-II but Woo et al. [18] showed there is almost same in both complete and incomplete STR group.

On admission NT-pro BNP level in Group-I mean ±SEM (385.41±53.47pg/ml) and Group-II (6727.43±1286.39pg/ml) levels demonstrate a significant difference ($p < 0.001$), implying a potential association with ST segment resolution percentages in cardiovascular health assessment. Our finding was similar with Peng et al. [9] as they also found higher NT-pro BNP concentrations in non-STR group (4476.2 ± 1784.9 pg/ml vs. 2,505.6 ± 1,638.4 pg/ml; $p < 0.005$). ROC analysis of NT-pro BNP level on admission to predict ST segment resolution yielded an AUC value of 0.920 (95% CI 0.864-0.975) demonstrating statistically significant result ($p <0.05$). A cut-off value of ≥ 688 pg/ml showed the highest Youden index (0.715) with sensitivity of 86.21%, specificity of 85.33%, positive predictive value (PPV) of 69.44%, negative predictive value (NPV) of 94.12%, and an overall accuracy of 85.58%. A study by Peng et al. [9] found 81.2% sensitivity and 65.8% specificity with cut off value of NT-pro BNP ≥2563.6pg/ml.

Verouden et al. [19] also found elevated NT-pro BNP levels (>608 ng/L) emerged as the strongest predictor of incomplete ST-segment recovery (adjusted odds ratio 2.6, 95% confidence interval 1.6 to 4.1; $p <0.001$) compared to other biomarkers and clinical predictors which is similar to this study.

Fabris et al. [20] found patients with STR< 70% had higher NT-pro BNP values compared to patients with complete STR (> 70%) [Mean ±SD 375.2 ±1021.7 vs 1007.4 ±2842.3, Median (IQR) 111.7 (58.4-280.0) vs 168.0 (62.3-601.3), P < .001]. At multivariate logistic regression analysis, independent predictors associated with higher risk of poor myocardial reperfusion (STR< 70%) were: NT-pro BNP (OR 1.17, 95%CI 1.04-1.31, P = .009).

A study aimed to examine the association between five serum biomarkers, collected before emergency coronary angiography, and immediate ST-segment recovery in patients undergoing primary PCI for ST-segment elevation myocardial infarction (STEMI). The biomarkers measured were N-terminal pro-brain natriuretic peptide (NT-pro-BNP), cardiac troponin T, creatinine kinase-MB fraction, high-sensitivity C-reactive protein, and serum creatinine, with blood samples drawn through the arterial sheath at the start of PCI. Incomplete ST-segment recovery was defined as <50%. Among the 662 STEMI patients included, 338 (51%) had incomplete ST-segment recovery. Elevated NT-pro-BNP levels (>608 ng/L) emerged as the strongest predictor of incomplete ST-segment recovery (adjusted odds ratio 2.6, 95% confidence interval 1.6 to 4.1; $p <0.001$) compared to other biomarkers and clinical predictors [19].

Limitations of the Study

There were some limiting factors which might have an effect on the results: i) The study was conducted in a single center; 2) Purposive sampling was done instead of random sampling and iii) Reliance on single measurements of NT-pro BNP and ST-segment resolution at admission may overlook dynamic changes over time.

Conclusion

The present study showed that on admission serum NT-pro BNP level has significant association with ST-segment

resolution among patients of STEMI following primary PCI. Thus, measurement of NT-pro BNP level on admission may be considered as an essential parameter of predicting successful revascularization before primary PCI. Large scale, multicenter study should be considered to establish temporal relationships between serum NT-pro-BNP levels and ST-segment resolution over time and outcome of primary PCI.

References

1. Brener SJ, Dizon JM, Mehran R, Guerchicoff A, Lansky AJ, Farkouh M, et al. Complementary prognostic utility of myocardial blush grade and ST-segment resolution after primary percutaneous coronary intervention: Analysis from the HORIZONS-AMI trial. American Heart Journal. 2013;166(4):676-683.
2. Park SR, Kang YR, Seo MK, Kang MK, Cho JH, An YJ, et al. Clinical Predictors of Incomplete ST-Segment Resolution in the Patients With Acute ST Segment Elevation Myocardial Infarction. Korean Circulation Journal. 2009;39(8):310-316.
3. Ndrepepa G, Alger P, Kufner S, Mehilli J, Schömig A, Kastrati A. ST-segment resolution after primary percutaneous coronary intervention in patients with acute ST-segment elevation myocardial infarction. Cardiology Journal. 2012;19(1):61-69.
4. Cao Z, Jia Y, Zhu B. BNP and NT-proBNP as Diagnostic Biomarkers for Cardiac Dysfunction in Both Clinical and Forensic Medicine. Int J Mol Sci. 2019;20(8):1820.
5. Haeck JDE, Verouden NJW, Kuijt WJ, Koch KT, Van Straalen JP, Fischer J, et al. Comparison of Usefulness of N-Terminal Pro-Brain Natriuretic Peptide as an Independent Predictor of Cardiac Function Among Admission Cardiac Serum Biomarkers in Patients With Anterior Wall Versus Nonanterior Wall ST-Segment Elevation Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention. The American Journal of Cardiology. 2010;105(8):1065-1069.
6. Sarak T, KaradeniZ M. The relationship between serum NT-proBNP levels and severity of coronary artery disease assessed by SYNTAX score in patients with acute myocardial infarction. Turkish Journal of Medical Sciences. 2019;49(5):1366-1373.
7. Schellings DAAM, Adiyaman A, Giannitsis E, Hamm C, Suryapranata H., Ten Berg JM, et al. Early Discharge After Primary Percutaneous Coronary Intervention: The Added Value of N-Terminal Pro–Brain Natriuretic Peptide to the Zwolle Risk Score. J Am Heart Assoc. 2014;3(6):e001089.
8. Qin Z, Du Y, Zhou Q, Lu X, Luo L, Zhang Z, et al. NT-proBNP and Major Adverse Cardiovascular Events in Patients with ST-Segment Elevation Myocardial Infarction Who Received Primary Percutaneous Coronary Intervention: A Prospective Cohort Study. Cardiol Res Pract. 2021;2021:9943668.
9. Peng B, Xia H, Ni A, Wu G, Jiang X. Serum NT-proBNP on admission can predict ST-segment resolution in patients with acute myocardial infarction after primary percutaneous coronary intervention. Herz. 2015;40(6):898-905.
10. Hanlon P, Byers M, Walker BR, Macdonald HM. (2010) 'Environmental and nutritional factors in disease'. In: College, N.R., Walker, B.R., Ralston S.H. Davidson's Principles and Practice of Medicine. 22nd. Edinburgh: Elsevier, 118.
11. Byrne RA, Rossello X, Coughlan JJ, Barbato E, Berry C, Chieffo A, et al. 2023 ESC Guidelines for the management of acute coronary syndromes. European Heart Journal. 2023;44(38):3720-3826.
12. Salim M, Malik F, Ahmed N, Badiuzzaman M, Khan R, Malik A, et al. In-hospital outcome of primary percutaneous coronary intervention for the management of acute ST-segment elevation myocardial infarction in a Bangladeshi population. CVD Prevention and Control. 2010;5(1): 23-26.
13. Goyal BM, Sharma SM, Walia M. B-Type natriuretic peptide levels predict extent and severity of coronary artery disease in non-ST elevation acute coronary syndrome and normal left ventricular function. Indian Heart Journal. 2014;66(2):183-187.
14. Sinha PK, Suruchi K, Sharma PK, Jana D. Failure of thrombolysis with streptokinase in acute myocardial infarction using ECG criteria : an observational study. International Journal of Scientific Research. 2020;9(10): 1-3.
15. Shavadia JS, Granger CB, Alemayehu W, Westerhout CM, Povsic TJ, Van Diepen S, et al. Novel Biomarkers, ST-Elevation Resolution, and Clinical Outcomes Following Primary Percutaneous Coronary Intervention. Journal of the American Heart Association. 2020; 9(3):e016033.
16. Blom J, Van T Hof AWJ, Henriques JPS, Geertman JH, Slingerland, Hoorntje JCA. NT-pro BNP: a marker for successful myocardial reperfusion in AMI patients treated with primary percutaneous coronary intervention. European Journal of Heart Failure. 2004;6(6):749-752.
17. Lorgis L, Zeller M, Dentan G, Sicard P, Jolak M, L'Huillier I, et al. High levels of N-terminal pro B-type natriuretic peptide are associated with ST resolution failure after reperfusion for acute myocardial infarction. QJM. 2007;100(4):211-216.
18. Woo JS, Cho JM, Kim SJ, Kim MK, Kim CJ. Combined Assessments of Biochemical Markers and ST-Segment Resolution Provide Additional Prognostic Information for Patients With ST-Segment Elevation Myocardial Infarction. Korean Circulation Journal 2011;41(7):372-378.
19. Verouden NJW, Haeck JDE, Kuijt WJ, Van Geloven N, Koch KT, Henriques JP, et al. Comparison of the Usefulness of N-Terminal Pro-Brain Natriuretic Peptide to Other Serum Biomarkers as an Early Predictor of ST-Segment Recovery After Primary Percutaneous Coronary Intervention. The American Journal of Cardiology. 2010;105(8):1047-1052.
20. Fabris E, Ten Berg JM, Hermanides RS, Ottervanger JP, Dambrink JHE, Gosselink AM, et al. NT-proBNP level before primary PCI and risk of poor myocardial reperfusion: Insight from the On-TIME II trial. American Heart Journal. 2021;233:78-85.

Original Article

Association between PR Segment Displacement with Adverse In-hospital Outcome after Thrombolysis in Patients with Acute ST Elevation Myocardial Infarction

Md. Jasim Uddin[1], Syed Nasir Uddin[1], Shaila Nabi[1], Mohammad Abul Khair[1], Isha Abdullah Ali[2], ABM Shafiuzzaman[1], Iffat Ara Sharmin[3], Sabuj Biswas[1], Gokul Chandra Datta[1]

[1]Department of Cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh; [2]Department of Cardiology, Ibrahim Cardiac Hospital & Research Institute, Dhaka, Bangladesh; [3]Department of Clinical Pathology, Dhaka Medical College & Hospital, Dhaka, Bangladesh

Abstract

Introduction: Atrial ischemia produces similar changes in the PR-segment as ventricular ischemia in the ST-segment. The occurrence of PR segment displacement on the admission ECG can predict the risk of developing adverse in-hospital outcomes, especially for ST-segment elevation myocardial infarction (STEMI) patients and is strongly correlated with the severity of STEMI. However, further studies are needed to see this relationship between PR segment displacement and in-hospital outcomes in patients with STEMI.

Method: This prospective observational study was conducted at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh, from February 2019 to September 2020 on 200 patients with two equally divided groups based on PR segment displacement: Group I with PR displacement ≥ 0.5mm and Group II with PR displacement <0.5 mm. Only the initial ECGs at the time of arrival to the emergency department were used to calculate PR segment displacement. A PR segment elevation or depression of ≥0.5mm was considered significant. Arrhythmia, heart failure, cardiogenic shock, duration of hospital stay, and death were observed during the index hospitalization.

Results: Out of 200 patients, 112 had PR segment displacement. Among patients of PR segment displacement, PR segment depression (59.82%) was higher than elevation (40.18%). All of the atrial arrhythmias were observed more frequently in group I in comparison to group II, and among them, atrial fibrillation was significantly higher in group I (28% vs 10%; p=0001). Cardiogenic shock was also observed more in group I with significant PR depression than without significant PR depression (18% vs 8%; p=0.03). The mean hospital stay was significantly higher in group I than group II (Mean±SD = 6.05±1.84 vs 3.87±1.46 days; p<0.001). Incidence of ventricular arrhythmias, heart failure, atrial thrombus, and death didn't differ significantly between the groups (p>0.05). The odds ratios of hypertension, heart rate, and PR segment displacement were significant in univariate analysis. In multivariate analysis after adjusting for these variables, only PR segment displacement was found to be the independent predictor for developing adverse in-hospital outcomes, with an OR of 6.54.

Conclusion: Significant PR segment displacement is associated with adverse in-hospital outcomes, especially in the form of atrial fibrillation and cardiogenic shock in patients with ST elevation myocardial infarction after thrombolytic therapy.

Keywords: PR segment displacement, Hospital outcome, Thrombolysis, ST-segment elevation.

(JNHFB 2025; 14 : 99-104) DOI : 10.61819/jnhfb.v14i2.10

Introduction

In the acute myocardial infarction (AMI), ST-segment elevation cannot predict the severity of the disease, atrial involvement, or overall effect [1]. It is well known that AMI may involve the atria, but clinicians have not paid special attention to this fact. Atrial infarction is mostly diagnosed concomitantly with ventricular infarction. Its incidence in AMI varies significantly between studies, ranging from 0.7% to 42% [2,3]. In AMI, the electrocardiographic (ECG) sign of PR segment depression could signify extensive atrial ischemia or infarction, which is usually overlooked. The first case of atrial infarction was described in 1925, [4] and this was 17 years before Langendorf made the first ECG demonstration of atrial infarction [5]. Cushing et al. [6]

Corresponding Author
Dr. Md. Jasim Uddin
Junior Consultant, Department of Cardiology
National Institute of Cardiovascular Diseases, Dhaka, Bangladesh.
E-mail: jasimu070@gmail.com

reported the largest series of autopsy-proven atrial infarctions, including 31 of 182 cases of fatal MIs (17% incidence). The first antemortem diagnosis of atrial infarction was made by Hellerstein [7].

The ECG is the only means of diagnosing atrial infarctions before death [2]. The most commonly accepted ECG diagnosis of ATMI (atrial myocardial infarction) was defined by Liu et al. [8]. Agreeing to this definition, ATMI major and minor criteria were structured along with the basis on PR segment elevation or depression, abnormal P wave morphology, and the presence of a supraventricular arrhythmia. Diagnosis of atrial infarction can be reached only from ECG by a small, transient elevation and reciprocal depression of the PR segment, usually connected with alterations in the configuration of the P wave [9]. PR segment elevation of just 0.5mm or PR segment depression of 0.8 mm is strongly suggestive of atrial infarction [10]. Atrial ischemia produces similar changes in the PR-segment as ventricular ischemia in the ST-segment. Continuous monitoring of dynamic PR segment changes in patients with AMI is feasible and can detect concurrent atrial ischemia. When the patient is in sinus rhythm, ATMI often causes abnormal P waves and a PR segment [6]. Likewise, ignoring PR segment changes related to atrial infarction criteria and arrhythmias may result in delayed diagnosis of the atrial infarction [11]. PR segment displacement is suggestive of atrial infarction occurring concomitantly with STEMI. Previous studies reported that PR segment displacement in any lead, found in 31% of patients with STEMI, predicted both short-term and long-term poor outcomes [12].

Patients with ATMI have frequent cardiac and noncardiac complications. Profound PR segment depression ≥1-2 mm in inferior leads was associated with a complicated hospital course and poor short-term effect in acute inferior MI [13]. The occurrence of PR segment displacements on the admission ECG can predict the hazard of developing supraventricular arrhythmias, particularly atrial fibrillation, during hospitalization for MI [14]. Supraventricular arrhythmias often complicate atrial infarction, and these arrhythmias, including atrial fibrillation, are the most common and may have hemodynamic consequences [15]. Supraventricular tachyarrhythmias have been established to occur more often in patients with concomitant atrial involvement compared to those with ventricular infarction alone (61–74% vs. 8%) [12]. The frequency of arrhythmias in atrial infarction may be as high as 70%, in contrast to about 20% in ventricular infarction [6]. Thromboembolic complications, such as pulmonary and systemic embolism, are also more common events with associated ATMI. In addition to the associated supraventricular arrhythmias, atrial infarction may present with lethal implications, such as thromboembolism and atrial rupture [16]. Early prediction of their occurrence is significant because they may influence the selection of therapy during the early stages of the infarctions [17]. Therefore, this study aims to assess PR segment displacement in acute ST-elevation MI patients and predict in-hospital outcomes.

Methods

This prospective observational study was conducted at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh, from February 2019 to September 2020.The study protocol was accepted by the Ethical Review Committee of NICVD. A total of 200 patients admitted to the Department of Cardiology, NICVD, Dhaka, with the diagnosis of STEMI who were treated with thrombolytic therapy (Streptokinase) during index hospitalization and had no exclusion criteria considered for the study. Informed written consent was taken from each patient before enrollment. Meticulous history was taken, detailed clinical examination was performed, and recorded in a predesigned structured questionnaire. Demographic data, such as age, sex, was recorded. Risk factor profile, including smoking, hypertension, diabetes, dyslipidemia, and family history of coronary artery disease (CAD), was noted. Investigations like cardiac troponin I, serum creatinine, and random blood sugar (RBS) were carried out. Initial ECGs at the time of arrival to the hospital or the emergency department were used in the study. Variables collected from the ECG recordings include heart rhythm, PR segment displacements (elevation and depression), and types of STEMI. These ECGs were interpreted by the magnification of a still picture of the ECG. PR segment elevation or depression of ≥0.5mm was considered significant. Patients were divided into two groups based on PR segment displacement. Those with a significantly displaced PR segment (≥0.5 elevations or depression) were categorized as group I, and those without a significantly displaced PR segment were categorized as group II. Arrhythmias, heart failure, cardiogenic shock, duration of hospital stay, and death were observed during the index hospitalization. All the data were recorded in the data collection sheet. The data obtained from the study were analyzed, and the significance of differences was estimated by using statistical methods. Continuous variables were expressed as mean value ± standard deviation and compared using the unpaired Student's t-test. Categorical variables were compared using the chi-square test. Univariate logistic regression analysis was performed to specify the odds ratio (OR) for overall adverse in-hospital outcomes. Multivariate logistic regression analysis was done to investigate independent predictors of in-hospital outcomes. Statistical significance was assumed if $p \leq 0.05$ throughout the study. Statistical analysis was carried out by using SPSS 25.0.

Results

Table 1 showed that the mean age of the study population was 56.7±8.2 years in Group I and 58.1±8.4 years in Group II, with no significant difference ($p = 0.08$). Most of the study subjects were males. (Figure1). The male and female ratio was 2:1. There is no statistically significant difference ($p=0.32$) in

the sex distribution of the study patients. Group I patients had the highest percentage of hypertension (55%), followed by smoking (45%), diabetes mellitus (39%), dyslipidemia (15%), and family history of coronary artery disease (13%). On the contrary, in Group II, diabetes mellitus was predominant (44%), followed by hypertension (41%), smoking (40%), dyslipidemia (17%), and family history of coronary artery disease (11%). All the risk factors mentioned in Table 2 showed no statistically significant difference between the two groups ($p > 0.05$), except for hypertension ($p = 0.04$).

Table 1: Distribution of the study patients according to age

Age in years	Group I (n = 100)		Group II (n = 100)		Total (n=200)		p value
	Number	%	Number	%	Number	%	
Age group							
35 – 44	4	4.0	4	4.0	8	4.0	
45 – 54	44	44.0	32	32.0	76	38.0	
55 – 64	31	31.0	35	35.0	66	33.0	
65 – 74	18	18.0	29	29.0	47	23.5	
75 – 84	3	3.0	0	0.0	3	1.5	
Age (Mean ±SD)	56.7±8.2		58.1±8.4		57.4±8.3		0.28^{ns}

SD: standard deviation; Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns: not significant. P-value reached from an unpaired t-test.

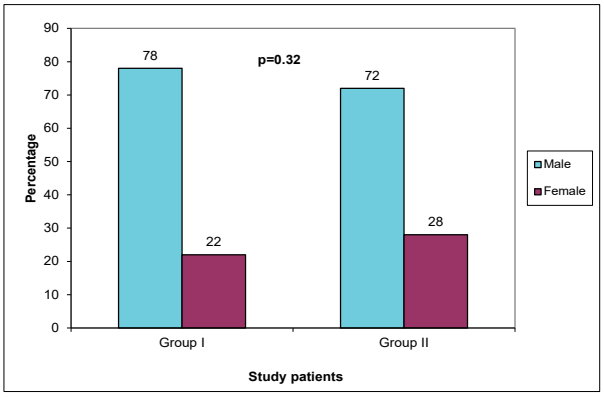


Figure 1: Gender distribution among the study patients by a bar diagram
Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns= not significant. P-value reached from the Chi-square test.

Table 2: Distribution of the study patients according to cardiovascular risk factors

Risk Factors	Group I (n = 100)		Group II (n = 100)		Total (n=200)		p value
	Number	%	Number	%	Number	%	
Smoking	45	45.0	40	40.0	85	42.5	0.47^{ns}
Hypertension	55	55.0	41	41.0	96	48	0.04^{s}
Diabetes mellitus	39	39.0	44	44.0	83	41.5	0.48^{ns}
Dyslipidemia	15	15.0	17	17.0	32	16	0.69^{ns}
Family history of premature CAD	13	13.0	11	11.0	24	12.0	0.66^{ns}

CAD: coronary artery disease; Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns: not significant; s: significant.Data was analyzed using the Chi-Square test.

The heart rate was 91.2±19.4 beats per minute in Group I and 80.2±14.7 beats per minute in Group II (Table 3), with a statistically significant difference ($p=0.01$). Anterior wall MI was found in about 39% of Group I and 43% of Group II (Table 4). On the contrary, non-anterior wall MI was found in 61% and 57% in Group I and Group II, respectively. No significant difference was found among the patients in terms of the site of MI ($p=0.56$). Regional Wall Motion Abnormality (RWMA) was observed in 39% and 35% of Group I and Group II (Table 5), respectively, with no statistically significant difference ($p=0.65$). The mean left ventricular ejection fraction (LVEF) was 54.6 ± 5.4% in Group I &52.2 ± 3.3% in Group II ($p=0.17$).

Table 3: Distribution of the study patients by heart rate status

Parameters	Group I (n = 100)	Group II (n = 100)	p value
	Mean ± SD	Mean ± SD	
Heart rate/minute	91.2±19.4 (60-150) *	80.2±14.7 (60-110) *	0.001^{s}

SD: standard deviation; Group I: patients with PR segment displacement: Group II: patients without PR segment displacement; s: significant. The figure in parentheses indicates the range. P-value reached from an unpaired t-test

Table 4: Distribution of the study patients by the site of MI

Site of MI	Group I (n = 100)		Group II (n = 100)		Total (n=200)		p value
	Number	%	Number	%	Number	%	
Anterior	39	39.0	43	43.0	82	41.0	0.56^{ns}
Non-anterior	61	61.0	57	57.0	118	59.0	

MI: myocardial infarction; Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns: not significant; s: significant. Data was analyzed using the Chi-Square test.

Table 5: Comparison of two groups by echocardiography

VARIABLES	Group I (n = 100)		Group II (n = 100)		p value
	Number	%	Number	%	
RWMA					
Present	39	39.0	35	35.0	$^{a}0.65^{ns}$
Absent	68	68.0	65	65.0	
LVEF in %					
36 – 44 (Moderate)	5	5.0	4	4.0	
45 – 54 (Mild)	40	40.0	44	44.0	
≥ 55 (Normal)	55	55.0	52	52.0	
Mean ± SD	54.6 ± 5.4		52.2 ± 3.3		$^{b}0.17^{ns}$

RWMA: regional wall motion abnormality; LVEF: left ventricular ejection fraction; SD: standard deviation; Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns: not significant. a=P value reached from using the Chi-Square test. b=P value reached from unpaired t-test

Among patients who had PR segment displacement, about 60% had PR segment depression, while 40% had PR segment elevation (Table 6).PR segment depression was more commonly observed in limb leads, while PR segment elevation was more commonly observed in the precordial leads. Table 7 depicts a comparison of patients by in-hospital outcome. Heart failure developed in 21% of Group I and 18% of Group II subjects with a statistically insignificant difference (p=0.59). In atrial arrhythmias, AF occurred in 28% and 10% of patients in Group I and Group II, respectively, with a statistically significant difference (p=0.001). Ventricular arrhythmias were found to be similar in both groups of patients, with no significant difference (p>0.05). Cardiogenic shock developed in 18% of patients in Group I and 8% in Group II patients with a statistically significant difference (p=0.03). It was observed that the mean hospital stay period was higher in Group I than in Group II, which was 6.05±1.84 vs. 3.87±1.46 days. The mean difference was statistically significant (p<0.001). Finally, 15% of patients died in Group I and 8% of patients in Group II, with statistically no significant difference (p=0.12). Out of the 3 variables, PR segment displacement was found to be the independent predictor for developing adverse in-hospital outcomes with an Odds ratio (OR) being 6.54 (Table 8).

Table 6: Distribution of PR segment elevation and depression among patients with PR segment displacement

Characteristics	PR segment displacement	
	Number	%
PR segment elevation Leads (n=45)	45	40.18
Limb leads	22	48.9
Precordial leads	23	51.1
PR segment depression Leads (n=67)	67	59.82
Limb leads	37	55.2
Precordial leads	30	44.8

Group I: Patients with PR segment displacement.

Table 7: Comparison of patients by the in-hospital outcome

In-hospital outcome	Group I (n =100)		Group II (n=100)		Total (n=200)		p value
	Number	%	Number	%			
Atrial Arrhythmias							
AF	28	28.0	10	10.0	38	19.0	**0.001**[s]
AT	5	5.0	1	1.0	6	3.0	0.09[ns]
Atrial extrasystole	4	4.0	1	1.0	5	2.5	0.17[ns]
PSVT	3	3.0	0	0.0	3	1.5	0.08[ns]
Ventricular arrhythmia							
VT	5	5.0	7	7.0	12	6.0	0.55[ns]
VF	2	2.0	2	2.0	4	2.0	1.00[ns]
Heart failure	21	21.0	18	18.0	39	19.5	0.59[ns]
Cardiogenic shock	18	18.0	8	8.0	26	13.0	0.03[s]
Atrial thrombus	3	3.0	0	0.0	3	1.5	0.08[ns]
Hospital stays [Mean ± SD Range (Min-Max)]	6.05±1.84 (2 – 9)		3.87±1.46 (2 – 8)				[b]<0.001[s]
Death	15	15.0	8	8.0	23	11.5	0.12[ns]

AF: atrial fibrillation; AT: atrial tachycardia; PSVT: paroxysmal supraventricular tachycardia; VT: ventricular tachycardia; VF: ventricular fibrillation; SD: standard deviation; Group I: patients with PR segment displacement; Group II: patients without PR segment displacement; ns: not significant; s: significant. Data were analyzed using the Chi-Square test and Fisher's exact test. b= p-value reached from unpaired t-test.

Table 8: Factors related to the adverse in-hospital outcome as a dependent variable

Variables of interest	Multivariate analysis		
	OR	95% CI of OR	p value
Hypertension	1.18	0.543 – 2.580	0.67[ns]
Heart rate	1.06	0.201 – 9.801	0.09[ns]
PR segment displacement	6.54	1.910 – 19.44	0.001[s]

OR: odds ratio; CI: confidence interval; s: significant; ns: not significant.

Discussions

Baseline characteristics of the study subjects were similar between the two groups in this study, except for hypertension, which was more prevalent in patients in group I.

In the present study, the age range spanned from 35 to 84 years, with the majority of patients falling within the 45-54 year age group. The average age was 56.7±8.2 years for group I and 58.1±8.4 years for group II, which aligns with the findings of Lu et al. [12]. Conversely, a different study by Jim et al. [13] reported a mean age of 67.9 ± 10.4 years in the PR-segment depression group and 64.9 ± 13.1 years in the control group. Male patients were predominant in this study population (75%). Lu et al. [12] also found male predominance. A similar observation was also noted in several other studies [13,18].

In this study sample, hypertension emerged as the most prevalent risk factor (48%), followed by smoking (42.5%), diabetes (41.5%), dyslipidemia (16%), and a family history of coronary artery disease (12%). Similarly, the study conducted by Lu et al. [12] reported hypertension as the leading risk factor (74.5%), with smoking (57.1%) ranking second. However, their findings indicated a higher prevalence of a family history of premature CAD (45%) compared to diabetes (33%). On the other hand, Jim et al. [13] also highlighted hypertension as the predominant risk factor (55%). However, it was accompanied by hyperlipidemia and diabetes, with a family history of premature CAD not being recorded in their study. In the current study, statistical analysis revealed no significant differences in the prevalence of cardiac risk factors between the two groups (p > 0.05), except for hypertension. Hypertension was significantly more common in Group I compared to Group II (55 vs. 41), and this difference was found to be statistically significant (p < 0.04).

Among group I patients, the mean heart rate was 91.2±19.4 beats per minute (bpm), and among group II subjects, the mean heart rate was 80.2±14.7 bpm in the current study, and statistically significant differences were found in relation to heart rate between the study groups (p=0.01). This finding differs from the study of Jim et al. [13], where the mean heart rate on presentation was higher (111 ± 27 beats/min).

In this present study, anterior MI was less common in both groups than non-anterior MI. Anterior MI was found in 39% of group I and 43% of group II. On the contrary, non-anterior MI was found in 61% and 57% of group I and group II, respectively. These differences in the prevalence of types of MI between the groups were not statistically significant (p>0.05). Although this finding differs from the study by Lu et al [12], where they found anterior MI was the predominant presentation (54.45%). Several Bangladeshi studies on STEMI also found a lower number of anterior MI than non-anterior MI [19-21].

All the patients of this study were evaluated by echocardiography to see the LVEF and RWMA. The mean LVEF was 54.6 ± 5.4% in Group I and 52.2 ± 3.3% in Group II. Statistically, no significant difference in LVEF was found among the study groups (p=0.17). Similar findings were observed by studies of both Lu et al. [12] and Jim et al. [13].

In this current study, among Group I patients, PR segment depression (59.82%) was higher than elevation (40.18%), and PR segment depression was more commonly observed in limb leads than precordial leads, while PR segment elevation was more commonly observed in precordial leads than limb leads. A similar finding was also observed by Lu et al. [15] in their study. They also concluded that the presence of PR depression in limb and precordial leads was associated with higher 1-year mortality in anterior wall STEMI patients but not in non-anterior wall STEMI patients [12].

In the present study, the adverse outcome was more frequently observed in group I patients in comparison to group II. Among the atrial arrhythmias, atrial fibrillation (19%) was more frequently observed, followed by atrial tachycardia (3%), atrial extra systole (2.5%), and paroxysmal supraventricular tachycardia (1.5%). All these atrial arrhythmias were observed more frequently in group I in comparison to group II, and among them, atrial fibrillation was observed significantly higher in the group with the PR displacement (28% vs 10%; p=0001). Nielsen et al [14] also observed that atrial fibrillation is the predominant arrhythmia in their study. Lu et al. [12] also observed supraventricular arrhythmia as the predominant arrhythmia in their study, though they didn't mention which type is more common. But Jim et al. [13] found atrial tachycardia as the predominant arrhythmia and more than atrial fibrillation in their study.

In this study, among the ventricular arrhythmias, hemodynamically significant ventricular tachycardia and ventricular fibrillation were analyzed. Ventricular tachycardia was more common in group II than in group I (7 vs 5), and these differences were not significant (p=0.55) between the two groups. Ventricular fibrillation was observed similarly in numbers in groups I and II (2 vs 2, p=1.00).

In this current study, heart failure was observed in 19.5% of patients. There was no significant difference with respect to the occurrence of heart failure between the groups (p=0.59). The study of Nielsen et al. [14] also observed more heart failure in groups who fulfilled major criteria of atrial infarction, including significant PR depression, than the other group (80.9% vs 47%). They also observed heart failure more in patients with supraventricular arrhythmia (65.7%).

Cardiogenic shock was also observed more in GroupI than in Group II in this study. This difference between the two groups in relation to cardiogenic shock is statistically significant (p=0.03). This finding is like both Lu et al. [12] and Jim et al. [13] studies. The loss of atrial 'kick' may lead to decreased ventricular filling pressures, causing decreased cardiac output and significant hemodynamic consequences, such as cardiogenic shock. These patients will be preload dependent and may benefit from aggressive fluid loading [12].

In this present study, Thrombosis has been observed more in group I patients than in group II patients, though this difference is not statistically significant (3% vs 0%; p =0.08). Both Lu et al. [12] and Nielsen et al. [14] observed a higher rate of thrombosis and thromboembolism in the atrial infarction group of their study.

In this current study, it was observed that the duration of hospital stay was higher in group I than in group II (6.05±1.84 & 3.87±1.46 days in group I and group II, respectively). The mean difference was statistically significant (p<0.001). This finding is similar to the study of Lu et al. [12], where they observed that the median length of hospital stay was 5 days in the total population of that study.

Death is higher in group I patients than in group II patients in this present study (15% vs 8%), but the differences between the two groups in relation to death were not significant (p=0.12). These findings are like the study of Nielsen et al. [14], where they also observed no significant difference in mortality between the two groups (3 vs 12, p >0.05), but these findings differ from the studies conducted by Lu et al. [12] and Jim et al. [13]. In the study by Jim et al. [13], the presence of PR-segment depression was associated with an increase in in-hospital mortality (44.4 vs. 11.7%, p = 0.015), and in the study by Lu et al. [12], the 30-day mortality (14% vs. 9% p < 0.05) and 1-year mortality (33% vs. 12% p < 0.001) were statistically significant.

In this current study, binary logistic regression analysis was done to identify variables that were independently associated with at least one adverse outcome. The odds ratios of hypertension, heart rate, and PR segment displacement were significant in univariate analysis. In multivariate analysis after adjusting for these variables, only PR segment displacement was found to be the independent predictor for developing adverse in-hospital outcomes, with

an OR being 6.54. Lu et al. [12] also observed a similar result in their study. After adjusting for age, ejection fraction, peak troponin I level, and left main disease, PR displacement in any lead was associated with increased 1-year mortality (adjusted OR 6.22 (2.23–18.64)) in that study.

There were several limitations of the study. As purposive sampling was done so there could be a chance of selection bias. The study population was heterogeneous, including age, gender, the time interval from symptom onset to hospital admission, and ECG types of STEMI, blood sample collection for random blood sugar, and fasting lipid profile. Tachycardia may interfere with the measurement of the PR segment, and this effect could not be totally excluded. As the PR segment tended to resolve spontaneously, it is possible that this ECG sign may not be seen in patients who presented late. The sample size was small, so it may not reflect the true scenario. For the identification of significant arrhythmia, patients were observed in coronary care unit (CCU) for 24 hours only; later, it was diagnosed only by ECG based on the patient's complaints of palpitation, so some arrhythmias may be missed. Ventricular extrasystole and idioventricular rhythm were also observed but not analyzed because they are frequently observed due to successful thrombolysis and are benign in course.

Conclusion

Significant PR segment displacement is associated with adverse in-hospital outcomes, especially in the form of atrial fibrillation and cardiogenic shock in patients with ST elevation myocardial infarction after thrombolytic therapy. Correct identification of this subset of patients through early identification of PR displacement could alert the physician to the potential for future complications.

References

1. Coppola G, Carità P, Corrado E, Borrelli A, Rotolo A, Guglielmo M, et al. ST-segment elevations: always a marker of acute myocardial infarction. Indian Heart Journal. 2013;65(4):412-423.
2. Lazar EJ, Goldberger J, Peled H, Sherman M, Frishman WH. Atrial infarction: Diagnosis and management. American Heart Journal. 1988;116(4):1058-1063.
3. Vargas-Barrón J, López-Meneses M, Roldán FJ, Romero-Cárdenas A, Keirns C, Espinola-Zavaleta N, et al. The impact of right atrial ischemia on inferior myocardial infarction with extension to the right ventricle: transesophageal echocardiographic examination. Clinical Cardiology. 2002;25(4):181-186.
4. Clerc. Infarctus auriculaire: tachyarrhythmia terminale [article in French]. Bull Mem Soc Med Hop Paris.1925;41:1603.
5. Langandorf R. Elektrokardiogramm beiVorhof-Infarkt. Acta Medica Scandinavica. 1939;100(1-2):136-149.
6. Cushing EH, Feil HS, Stanton EJ, Wartman WB. Infarction of the cardiac auricles (atria): Clinical, pathological and experimental studies. British Heart Journal.1942;4(1-2):17-34.
7. Hellerstein HK. Atrial infarction with diagnostic electrocardiographic findings. American Heart Journal.1948;36(3):422-430.
8. Liu CK, Greenspan G, Piccirillo RT. Atrial infarction of the heart. Circulation. 1961;23:331-338.
9. Abildskov JA. The atrial complex of the electrocardiogram. American Heart Journal. 1959;57(6):930-941.
10. Young EW, Koenig A. Auricular infarction. American Heart Journal.1994;3(28):287-294.
11. Shakir DK, Arafa SOE. Right atrial infarction, atrial arrhythmia, and inferior myocardial infarction from a missed triad: a case report and review of the literature. The Canadian Journal of Cardiology. 2007;23(12):995-997.
12. Lu MLR, Nwakile C, Bhalla V, Venecia T de, Shah M, Figueredo VM. Prognostic significance of abnormal P wave morphology and PR-segment displacement after ST-elevation myocardial infarction. International Journal of Cardiology. 2015;197:216-221.
13. Jim MH, Siu CW, Chan AO, Chan RHW, Lee SWL, Lau CP. Prognostic implications of PR-segment depression in inferior leads in acute inferior myocardial infarction. Clinical Cardiology. 2006;29(8):363-368.
14. Nielsen FE, Andersen HH, Gram-Hansen P, Sørensen HT, Klausen IC. The relationship between ECG signs of atrial infarction and the development of supraventricular arrhythmias in patients with acute myocardial infarction. American Heart Journal. 1992;123(1):69-72.
15. Morris JJ, Entman M, North WC, Kong Y, Mcintos H. The Changes in Cardiac Output with reversion of atrial fibrillation to sinus rhythm. Circulation.1965;31:670-678.
16. Lu MLR, Venecia T de, Patnaik S, Figueredo VM. Atrial myocardial infarction: A tale of the forgotten chamber. International Journal of Cardiology. 2016;202:904-909.
17. Yıldız SS, Keskin K, Avsar M, Cetinkal G, Sigirci S, Aksan G, et al. Electrocardiographic diagnosis of atrial infarction in patients with acute inferior ST-segment elevation myocardial infarction. Clinical Cardiology. 2018;41(7):972-977.
18. Korhonen P, Väisänen J, Nousiainen J, Huhtala H, Yli-Mäyry S, Raatikainen P. Detection of concurrent atrial ischemia with continuous monitoring of dynamic PR-segment changes in patients with acute myocardial infarction. Journal of Electrocardiology. 2013;46(4):324-330.
19. Ahmed F, Rahman A, Rahman MA, Chowdhury TA, Chowdhury MSH, Uddin SN, et al. Predictors of Short-Term Outcomes of Primary Percutaneous Coronary Intervention. Bangladesh Heart Journal. 2018;33(2):112-120.
20. Cader FA, Haq MM, Nasrin S, Kabir CS. Presentation, Management Practices and In-hospital Outcomes of Patients with Acute Coronary Syndrome in a Tertiary Cardiac Centre in Bangladesh. Bangladesh Heart Journal. 2018;32(2):106-113.
21. Howlader AK, Rahman A, Momen A, Kundu SK, Siddiqui MKR, Roy SS, et al. Association of TIMI Risk Score with Angiographic Severity of Coronary Artery Diseases and In-Hospital Outcome in Patients with STEMI Undergoing Primary PCI. Cardiovascular Journal. 2018;10(2):135-139.

Case Report

Unexpected cause of NSTEMI in a 50-year-old male: Spontaneous Coronary-Artery Dissection (SCAD)

Md Shamim Chowdhury, Fazila-Tun-Nesa Malik, Md Kalimuddin, Nazir Ahmed, Mohammad Badiuzzaman

Department of Cardiology, National Heart Foundation Hospital & Research Institute, Dhaka

Abstract

Spontaneous coronary-artery dissection (SCAD) has emerged as an important cause of myocardial infarction in young people. Although SCAD is uncommon, awareness of both the disease and its angiographic appearance has improved. Accurate and rapid diagnosis is paramount because the management of acute myocardial infarction caused by SCAD differs vastly from that of atherosclerotic myocardial infarction. The use of endocoronary imaging such as IVUS and optical coherence tomography is necessary in case of diagnostic doubt (especially in SCAD type 2 and 3). The optimal management of SCAD remains unclear. A conservative approach should be the preferred strategy. Here we report a case of a 50-year-old male patient who presented with chest pain for 7 days with the diagnosis of non-ST-segment elevation myocardial infarction (NSTEMI). Coronary angiography showed a type 1 SCAD of the obtuse marginal & right coronary artery. The patient was discharged under medical treatment.

Key words: Spontaneous Coronary Artery dissection, Non-ST Elevation Myocardial Infarction.

(JNHFB 2025; 14 : 105-108) DOI : 10.61819/jnhfb.v14i2.7

Introduction

Spontaneous coronary artery dissection (SCAD) is defined as an epicardial coronary artery dissection that is not associated with atherosclerosis or trauma and not iatrogenic. The predominant mechanism of myocardial injury occurring because of SCAD is coronary artery obstruction caused by formation of an intramural hematoma (IMH) or intimal disruption rather than atherosclerotic plaque rupture or intraluminal thrombus. SCAD has emerged as an important cause of acute coronary syndrome, myocardial infarction, and sudden death, particularly among young women and individuals with few conventional atherosclerotic risk factors [1]. Recent studies show SCAD to be the cause of up to 1–4%of acute coronary syndrome (ACS) [2]. We report the case of a 50-year-old male patient with no major cardiovascular risk factor who presented as a case of NSTEMI & eventually diagnosed as SCAD. The patient was treated medically with favorable results.

Case report

A 50 year old normotensive, nondiabetic, nonsmoker male patient presented the complains of chest pain for last 7 days & shortness of breath for last 3 days. He was treated as NSTEMI with 6 doses of LMWH at outside hospital. On examination his vital signs were stable, Lungs: bi -basal crepitation. GRACE SCORE: 132. His ECG (Figure 1) revealed ST depressions in infero-lateral leads (Leads II, III, AvF, V3-V6). The results of the transthoracic echocardiography showed hypokinesia of inferior, posterior, apical lateral & apical anterior wall with an ejection fraction of 40-45%. His troponin I was raised (1.43 ng/ml, normal range: up to 0.6 ng/ml). Other biochemical parameters & x-ray chest were normal.

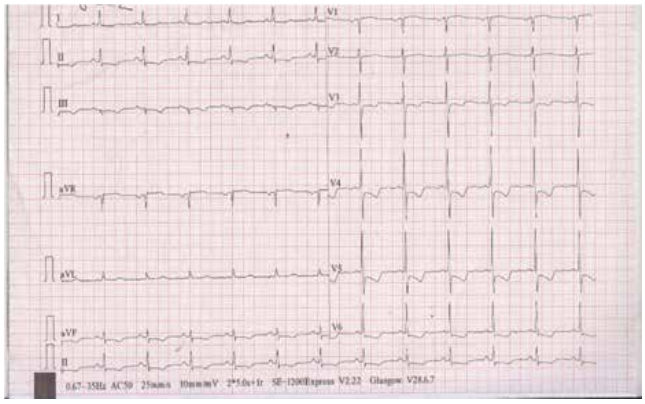


Figure 1: 12 lead surface ECG shows infero-lateral ischemia.

Coronary angiogram (Figure 2) was done on next day which revealed: left anterior descending artery (LAD): type IV vessel, normal with thrombolysis in myocardial infarction

Corresponding Author
Md Shamim Chowdhury
Registrar, Department of Cardiology
National Heart Foundation Hospital & Research Institute, Dhaka

(TIMI) 3 flow; left circumflex artery (LCX): normal with TIMI 3 flow, obtuse marginal (OM)1: dissecting plaque in osteo-proximal segment; right coronary artery (RCA): TIMI 3 flow with dissecting plaque (red arrow) at mid segment. He was diagnosed as SCAD & treated with guideline directed medical therapy (antiplatelet drugs, statins, beta blockers, angiotensin receptor-neprilysin inhibitor & sodium-glucose cotransporter-2 inhibitors). Patient was discharged in stable condition & he was in favourable condition on 6 months follow up.

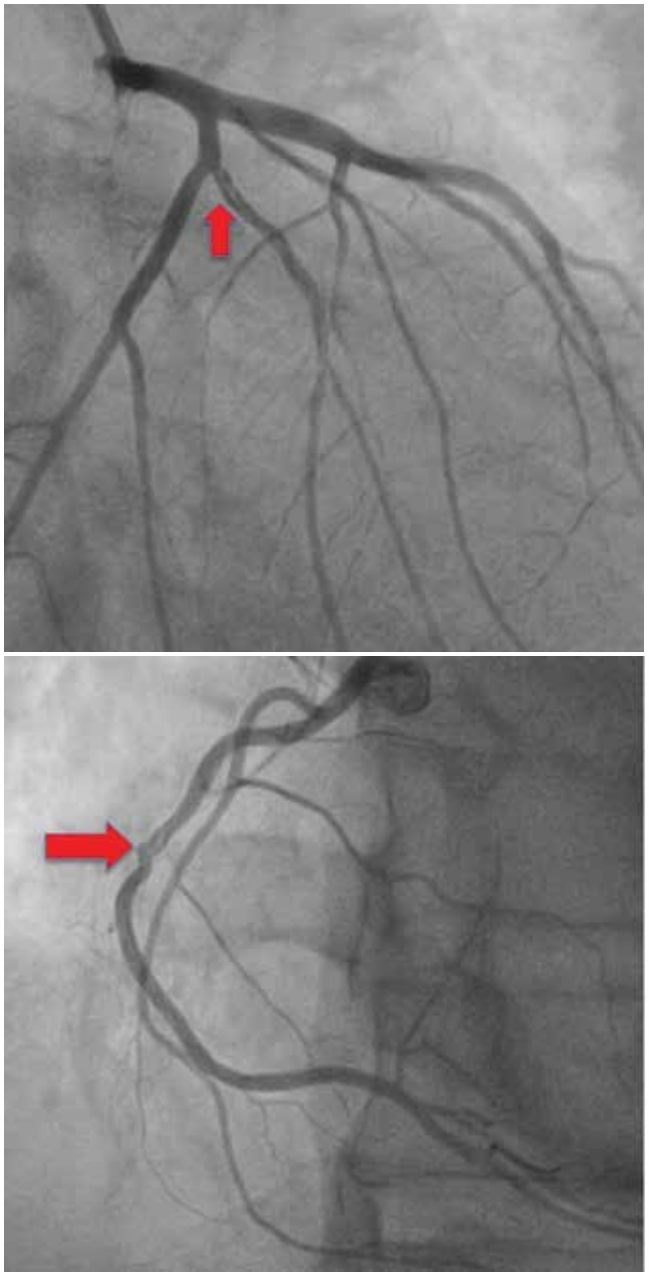


Figure 2: left panel still image of left coronary system shows non flow limiting dissecting plaque in osteo-proximal segment of first obtuse marginal branch of left circumflex artery (red arrow); right panel still image of right coronary system shows that dissecting plaque (red arrow) at mid segment.

Discussion

SCAD is defined as a separation of the layers of an epicardial coronary-artery wall by intramural hemorrhage, with or without an intimal tear. This condition is not associated with atherosclerosis, iatrogenic injury, or trauma [3]. SCAD accounts for up to 4% of all ACS, but the incidence is reported to be much higher (22-35% of ACS) in women <60 years of age, in pregnancy-related MI, and in patients with a history of fibromuscular dysplasia, anxiety, depression, or previous neuropsychiatric disorders [4,5]. The development of SCAD can be explained by two interrelated mechanisms [6,7]: Inside-out" phenomenon: blood extravasation from the intima to the media following a rupture of the intima (creating an intimal flap) accessible to an angiographic diagnosis. The 'outside-in' phenomenon: The vasa vasorum located at the level of the media ruptures, resulting in the occurrence of an isolated intramural hematoma without access to the arterial lumen (Figure 3). In both situations, the false channel, usually in the outer one third of the media, tends to extend and compress the true channel, leading to myocardial ischemia [1].

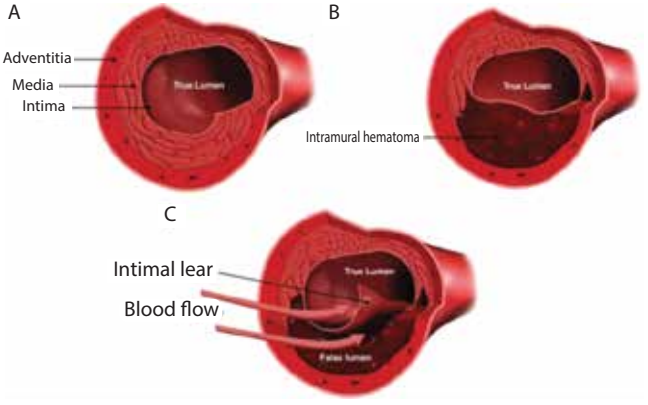


Figure 3: Cross-sectional views of the coronary artery [1]. (A) Normal coronary artery. (B) Coronary artery with intramural hematoma. (C) Coronary artery with intimal tear.

Spontaneous coronary artery dissection is characterized by the spontaneous formation of an intramural hematoma, which can lead to compression of the true lumen and myocardial infarction. An intimal tear may be present. The cause of SCAD is unknown but probably includes factors related to patient vulnerabilities and inciting triggers such as emotional stress, physical stress (e.g., from an extreme Valsalva maneuver, retching, vomiting, coughing, or isometric exercise), the use of stimulant medications or illicit drugs, and hormonal triggers (e.g., pregnancy) [8].

Meta-analyses of case series suggest that it presents as ST-elevation myocardial infarction in 48%, as non–ST-elevation myocardial infarction in 36%, and as unstable angina in 6.5%. Stable angina, congestive heart failure, and ventricular arrhythmia account for the remainder of presentations; 8–14% of cases present as life-threatening arrhythmia [9,10]. Coronary angiography remains the 'first-line' examination in case of suspected

ACS and is the gold standard for the diagnosis of SCAD. The classification of Saw et al. [1,3,8] describes angiographic signs which are widely adopted (Figure 4). In the Saw angiographic SCAD classification [8]:

- SCAD Type 1 (contrast dye staining of the arterial wall with multiple radiolucent lumen)
- SCAD Type 2 A (long diffuse and smooth narrowing) with non-obstructive coronary arteries (stenosis <50%)
- SCAD Type 2 B long diffuse and smooth narrowing) with severe coronary obstruction (>50
- SCAD Type 3 (focal or tubular stenosis that mimics atherosclerosis)
- SCAD Type 4: as a complete occlusion of the vessel

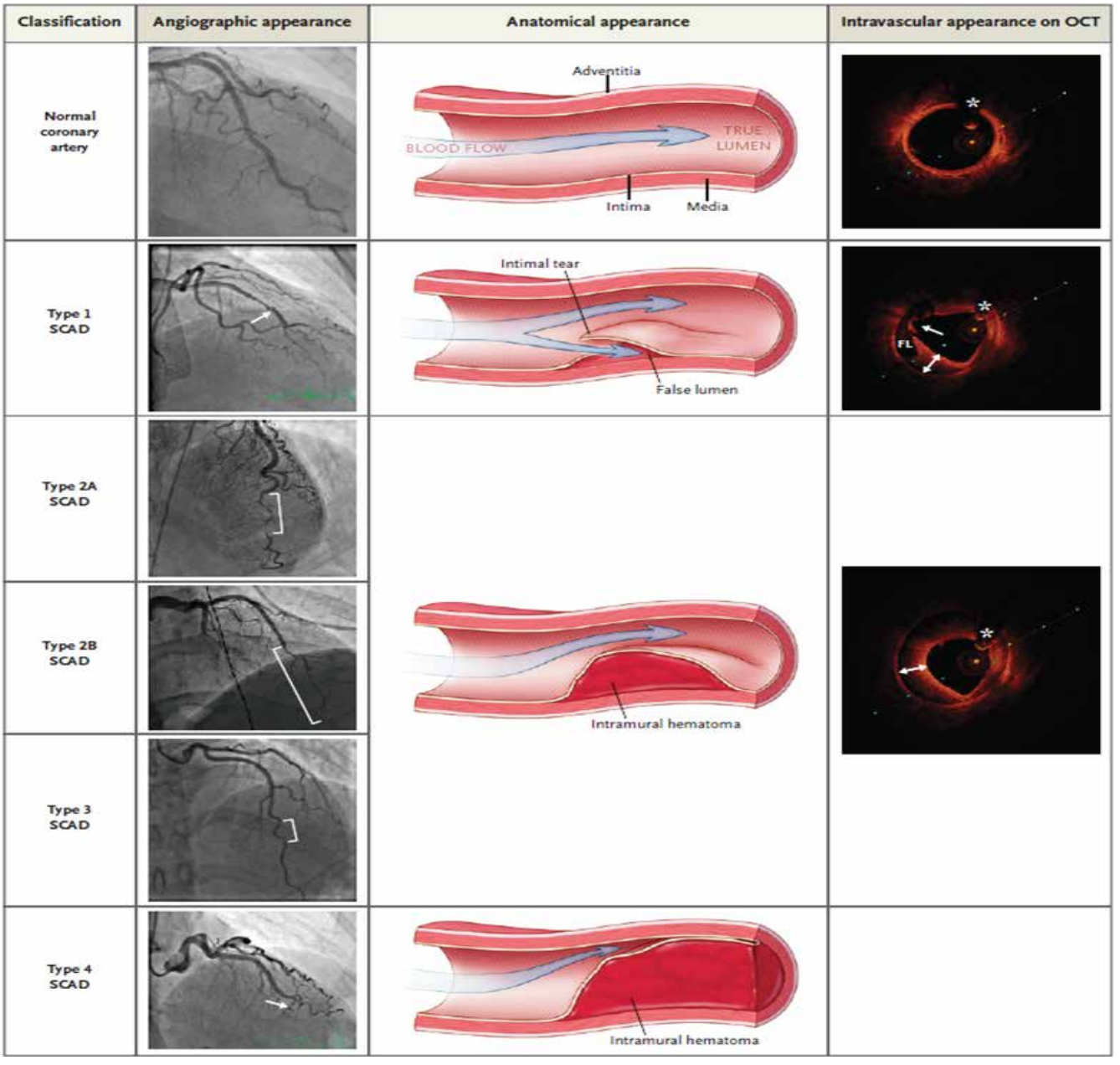


Figure 4: Angiographic, anatomical, and intravascular appearance of SCAD [3,8]. Asterisks indicate a guidewire shadow artifact.

The use of endocoronary imaging such as optical coherence tomography and intravascular ultrasound is necessary in case of diagnostic doubt (especially in SCAD type 2 and 3) [11]. In addition to the management of acute myocardial infarction in patients with SCAD, the treatment objectives are to manage chronic chest pain, prevent recurrence of SCAD, assess for and manage extra coronary vascular abnormalities, and improve quality of life. The optimal

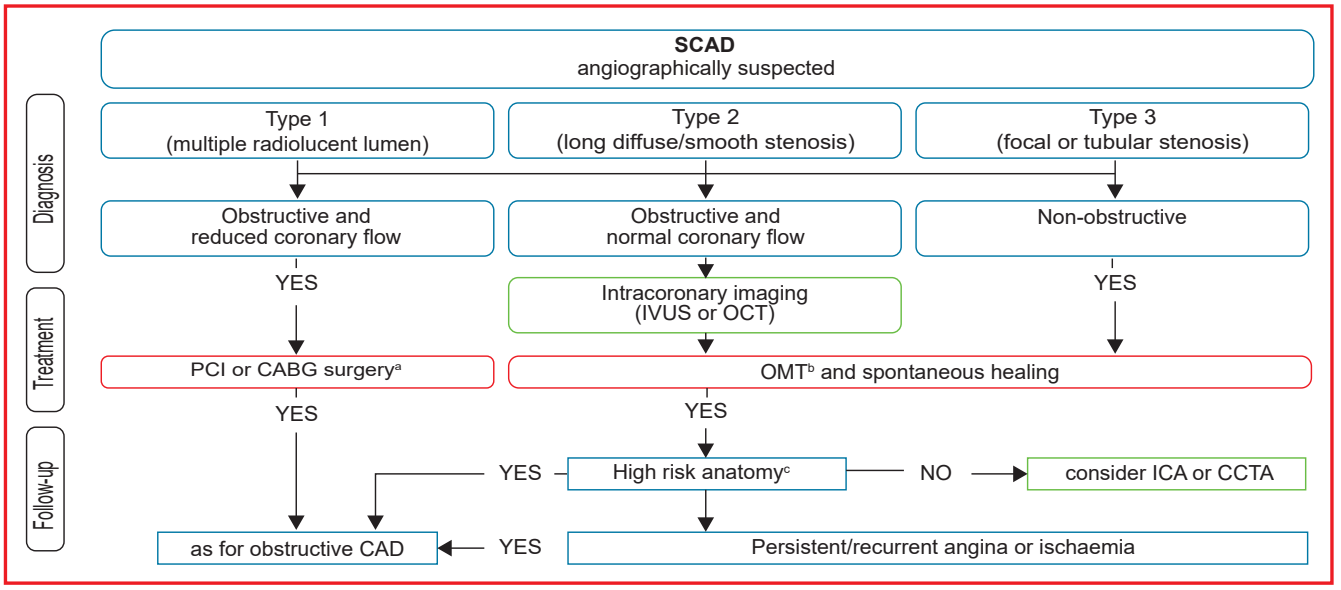


Figure 5: Diagnosis and treatment of patients with non–ST-segment elevation acute coronary syndrome related to SCAD [12]. Selection of revascularization strategy for high-risk anatomy according to local expertise, b Beta-blocker recommended while benefit of DAPT is questionable. c Left main or proximal left anterior descendent or circumflex or right coronary artery, multivessel SCAD. CABG, coronary artery bypass grafting; CAD, coronary artery disease; CCTA, cardiac computed tomographic angiography; ICA, invasive coronary angiography; IVUS, intravascular ultrasound; OCT, optical coherence tomography; OMT, optimal medical therapy; PCI, percutaneous coronary intervention; SCAD, spontaneous coronary artery dissection.

management of SCAD is still unclear, since no RCTs have compared medical therapy to revascularization strategies. According to available data, with the exception of very high risk profile patients, a conservative approach should be the preferred strategy for SCAD management [12]. SCAD management has been taken from the recommendations of the 2020 European Society of Cardiology [12] (Figure 5).

Conclusion

Spontaneous coronary dissection, a particular form of ACS, is classified as myocardial infarction with non-obstructive coronary arteries (MINOCA) according to the latest recommendations and remains a challenge in terms of diagnosis and management. The diagnosis is initially angiographic and may require endocoronary imaging for greater accuracy. Conservative treatment (i.e. medical) remains the best option since in the majority of cases the evolution is favorable. Though SCAD is predominant with female, here we present a case of 50 years old male with NSTEMI who was eventually diagnosed as SCAD Type I (angiographically) & treated medically.

References

1. Hayes SN, Kim ESH, Saw J, Adlam D, Arslanian-Engoren C, Economy KE, et al. American Heart Association Council on Peripheral Vascular Disease; Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Genomic and Precision Medicine; and Stroke Council. Spontaneous Coronary Artery Dissection: Current State of the Science: A Scientific Statement from the American Heart Association. Circulation. 2018 ;137(19): 523-557.
2. Tweet MS, Hayes SN, Pitta SR, Simari RD, Lerman A, Lennon RJ, et al. Clinical features, management, and prognosis of spontaneous coronary artery dissection. Circulation. 2012;126(5):579-588.
3. Kim ESH. Spontaneous coronary-artery dissection. N Engl J Med 2020; 383:2358-2370.
4. Mortensen KH, Thuesen L, Kristensen IB, Christiansen EH. Spontaneous coronary artery dissection: A Western Denmark Heart Registry study. Catheter Cardiovasc Interv. 2009; 74:710-717.
5. Nishiguchi T, Tanaka A, Ozaki Y, Taruya A, Fukuda S, Taguchi H, et al.Prevalence of spontaneous coronary artery dissection in patients with acute coronary syndrome. Eur Heart J Acute Cardiovasc Care. 2016; 5:263-270.
6. Adlam D, Alfonso F, Maas A, Vrints C; Writing Committee. European Society of Cardiology, acute cardiovascular care association, SCAD study group: a position paper on spontaneous coronary artery dissection. Eur Heart J. 2018;39(36):3353-3368.
7. Mokhberi V, Bagheri B, Navidi S, Amini SM. Spontaneous Coronary Artery Dissection: A Case Report. J Tehran Heart Cent. 2015 ;10(3):159-162.
8. Saw J. Coronary angiogram classification of spontaneous coronary artery dissection. Catheter Cardiovasc Interv. 2014; 84:1115-1122.
9. Giacoppo D, Capodanno D, Dangas G, Tamburino C. Spontaneous coronary artery dissection. Int J Cardiol. 2014 ;175(1):8-20.
10. Wonnacott D, Berringer R. Dissection spontanée de l'artère coronaire:Rapport de cas et revue de la littérature. Can Fam Physician 2016;62: e721–723.
11. Poon K, Bell B, Raffel OC, Walters DL, Jang IK. Spontaneous coronary artery dissection: utility of intravascular ultrasound and optical coherence tomography during percutaneous coronary intervention. Circ Cardiovasc Interv. 2011 ;4(2): e5-7.
12. Collet JP, Thiele H, Barbato E, Barthélémy O, Bauersachs J, Bhatt DL, et al.ESC Scientific Document Group. 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. Eur Heart J. 2021 ;42(14):1289-1367.