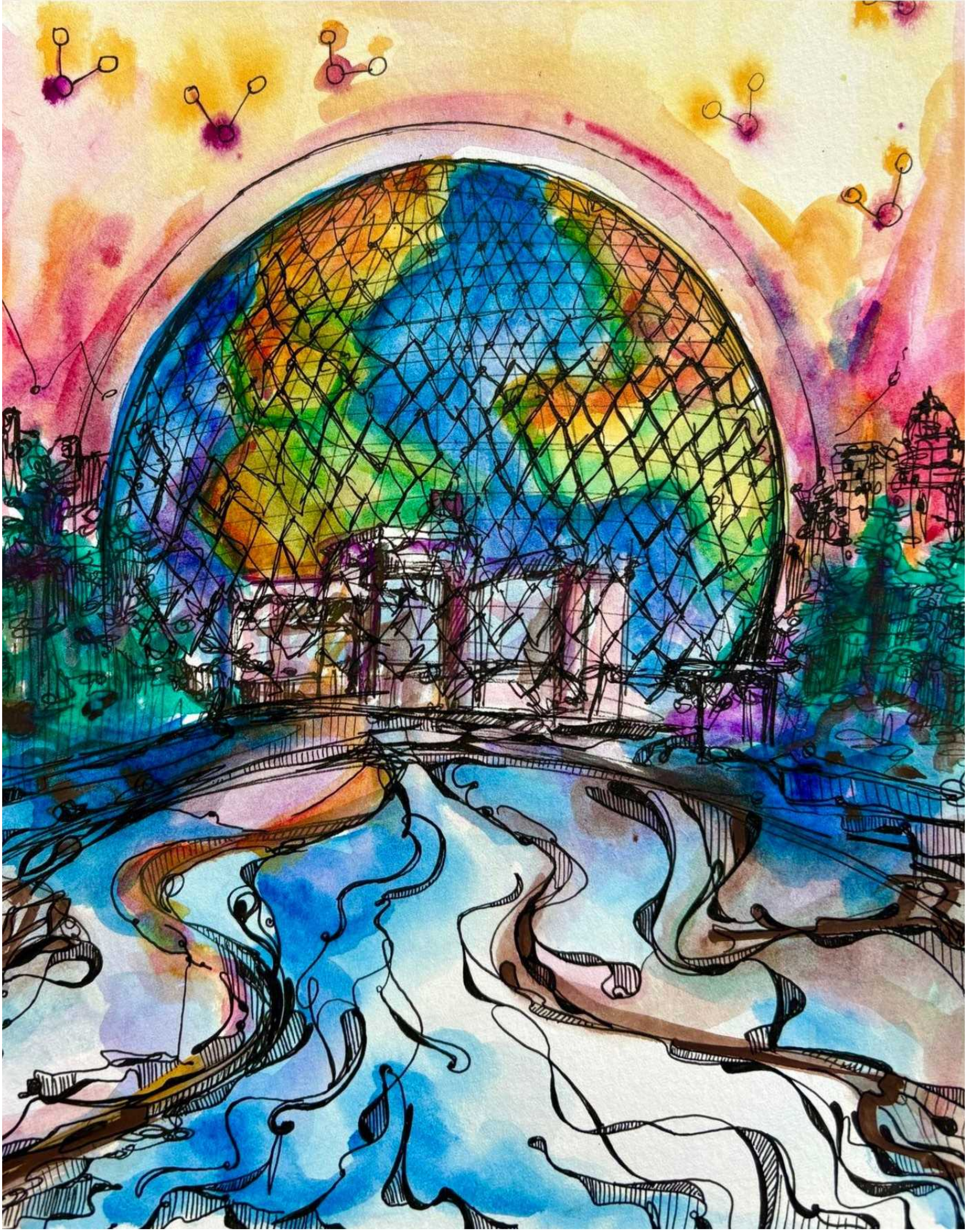
McGILL JOURNAL OF GLOBAL HEALTH

Volume XIV | Issue 1 | 2025



Strength in Solidarity: Global Health Amidst Polycrisis

Cover design and artwork by Evelyn Rogan

Reflection on the Cover

Political mismanagement, environmental degradation, and systemic health inequities are converging into an interconnected polycrisis that poses an urgent threat to global public health. While these overlapping crises may appear overwhelming, they also present a powerful opportunity to foster solidarity and co-create equitable, sustainable solutions. We have risen to similar challenges before—most notably when the international community united in Montreal, Canada, to ban chlorofluorocarbons and protect the Earth's ozone layer. Today, we must once again transform our shared vulnerabilities into collective resilience.

McGill University is situated on the traditional territory of the Kanien'kehà:ka, a place which has long served as a site of meeting and exchange amongst nations. We recognize and respect the Kanien'kehà:ka as the traditional custodians of the lands and waters on which this journal was produced.

McGill Journal of Global Health

Spring 2025 | Volume XIV | Issue 1

Aknowledgements

The editorial board would like to acknowledge the following individuals for their invaluable support in the development of this journal:

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The McGill Journal of Global Health is an initative supported by McGill Global Health Programs.

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FOREWORD

Dear Reader,

We, the Editorial Team, are pleased to present *Volume XIV* of the *McGill Journal of Global Health (MJGH),* a publication rich in knowledge, evidence, and insight for global health practitioners and researchers. Formerly known as The Prognosis, *MJGH* is a peer-reviewed, student-run academic journal established in 2011 with the support of McGill Global Health Programs. It provides a vital platform for students to publish original research and reviews, share critical perspectives, and engage with the global health community. Since its inception, *MJGH* has published 14 issues featuring 87 articles on pressing global health topics, reaching readers in 172 countries and regions. More than 60 students have contributed to the journal through roles on the editorial board, gaining valuable experience in academic publishing and journal management. *MJGH* continues to amplify the voices of emerging global health scholars and empowers the next generation of global health leaders.

Amid the growing turbulence in global politics, marked by cuts to global health aid, attacks on scientists and trusted public health institutions, and rising anti-vaccination campaigns, public health systems face unprecedented challenges. In this context, *Volume XIV* of *MJGH* offers a much-needed beacon of hope. It encourages us to envision a shared future grounded in solidarity, equity, and resilience. This volume provides critical perspectives on the fractures in global health caused by geopolitical uncertainty and their adverse effects on healthcare access, population health, and scientific progress. It also charts paths for resistance against marginalization and calls for collective action. Among its highlights, *Volume XIV* underscores the urgent need to integrate recent public health graduates into the workforce, recognizing the vast potential they demonstrated during the COVID-19 pandemic. It explores barriers and potential solutions for achieving equitable access to universal healthcare for Indigenous communities, particularly in Nunavut. *Volume XIV* also addresses structural stressors, such as socioeconomic disparities, that increase the risk of neurodegenerative diseases in Canada's aging population. From Nigeria, the volume reaffirms the importance of vaccination coverage by spotlighting the burden of measles and emphasizing the critical role of primary healthcare centers in improving health outcomes. A case study from Pakistan showcases how an enhanced health information system can transform healthcare delivery and public health infrastructure in low- and middle-income countries. Additionally, the volume advocates for intersectional approaches to sexual health education, including awareness of sexually transmitted infections, to improve health outcomes and promote equity. In essence, *Volume XIV* presents a powerful collection of articles that diagnose pressing challenges in global health while offering actionable strategies for building more equitable, informed, and resilient health systems worldwide.

We are deeply grateful to McGill Global Health Programs for their continued support in sustaining *MJGH.* We also extend our sincere thanks to *Prof. Madhukar Pai*, *Stéphanie Laroche-Pierre, Jesse Radz, Kevin O'Neill, and Johnathan Lin*, whose guidance, dedication and contributions have been instrumental to this year's success. Our appreciation also goes to the peer reviewers who generously volunteered their time and expertise to strengthen the quality of submissions, and to our authors for their outstanding research, perseverance, and commitment.

Thank you for taking the time to read and support this publication. We hope you find it both meaningful and thought-provoking.

Sincerely,
Juwel Rana, Editor-in-Chief
On behalf of the MJGH Editorial Team 2024–2025

EDITORIAL BOARD

Editor-in-Chief

Juwel Rana

Juwel Rana is a PhD candidate in Epidemiology, specializing in Environmental Epidemiology. His doctoral research focuses on developing and applying mixture methods to estimate the causal effects of time-varying environmental pollutants on human health. His broader interests include global environmental health, health disparities, non-communicable diseases, machine learning, causal inference, and epidemiologic methods. Juwel established the *Bangladesh Longitudinal Child-Adolescent Development, Education, and Environment Study (BLADES)*, which encompasses approximately 2,500 households in Dhaka and Dinajpur districts. He is passionate about critical and equitable engagement and promoting equity across the social and environmental determinants of health. Juwel has authored over 60 peer-reviewed articles and has received several prestigious awards, including the FRQS, McGill Alumni Fellowship, Erasmus Mundus Excellence, and the Paul Dudley White International Scholar Award, recognizing his dedication and excellence in the field.

Executive Editor

Omotayo Olaoye

Omotayo Olaoye is a PhD Candidate in Epidemiology at McGill University, specializing in pharmacoepidemiology. Her research focuses on medicines utilization and safety in patients with chronic obstructive pulmonary disease. She holds a Bachelor's degree in Pharmacy from Obafemi Awolowo University, Nigeria, and a Master's degree in Public Health from the University of Glasgow, UK. Omotayo has over seven years of experience spanning pharmacy practice in clinical and community settings, as well as epidemiological and global health research. Prior to her doctoral studies, she contributed to the design and implementation of national and global antimicrobial resistance initiatives across the Commonwealth through her work with the Commonwealth Partnerships for Antimicrobial Stewardship and the Scottish Government. A recipient of prestigious awards including the Vanier Canada Graduate Scholarship, FRQS, and the UK Government's Chevening and Commonwealth Scholarships, she has authored several peer-reviewed publications and presented her research extensively.

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Karen Wassef

Karen is a PhD student in the Department of Family Medicine. She is interested in quality improvement research in the context of non-communicable disease and serious illness. Her research focuses on understanding the social and healthcare experiences of people from racialized and marginalized communities in Canada. Her current work aims to foster person- and relationship-centred care to improve the quality and equity of primary care services.

Toufica Sultana

Toufica Sultana, a PhD student in Family Medicine at McGill University, co-founded the South Asian Institute for Social Transformation (SAIST) and has worked as a lecturer at Eastern University, Dhaka. She has also taught Sociology and Sustainable Development courses at institutions such as North South University and City University. Her research journey began at Research and Evaluation Division, BRAC. Prior to joining McGill, she worked as Research Assistant at Toronto Metropolitan University. Her current work focuses on maternal health, vaccine hesitancy, child development and mental health service utilization in LMICs, and Canada.

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Tarini Jayaprakash

Tarini Jayaprakash is an MSc Public Health student passionate about advancing child health and addressing health inequities. Her work focuses on combating child malnutrition and promoting sustainable solutions for vulnerable communities. She is also actively involved in research projects aimed at developing guidelines for conducting research with South Asian populations, ensuring cultural sensitivity and inclusivity. Through her academic and community-based initiatives, Tarini strives to create meaningful change in health outcomes for underserved populations, contributing to a future where equitable access to health and well-being is a universal reality.

Nina Anastasia Zevgolis

Nina is an Honours Environment student passionate about medical entomology and infectious disease. Specializing in the ecological determinants of health, her summer research will focus on quantifying heat-related deaths on the island of Montreal. With experience as a journalist and in various editorial leadership roles, Nina is dedicated to science communication.

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Vincent is an Honours Neuroscience student with a passion for global health. His interests are in circumpolar health, Indigenous health, and healthcare access. Vincent has experience in community-based health research, particularly with Inuit communities in the Northwest Territories. He is eager to broaden his understanding of health equity and global health research through his involvement with MJGH this year.

Maira Claudio

Maira is in her second year of the Master of Science in Public Health program. Her primary area of interest is in global and public health ethics and understanding the health consequences that public health policies may impose on marginalized populations. Her interest in global health stems from her passion for advancing health equity through an interdisciplinary lens. Maira has been actively involved in research projects on digital health, childhood ethics, and the application of intersectionality as a critical social theory to explore precarious employment as a social determinant of health.

Design Editor

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Evelyn Rogan (she/her) is a BSc Environmental Science student passionate about multidisciplinary and community-driven research within the intersection of environment and health. She would like to continue to expand her knowledge in climate-resilient agricultural production, environmental contamination and health, and socio-environmental justice in Canada and abroad. She is focused on knowledge co-production in scientific research and using visual illustrations to increase the accessibility of scientific communications.

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Invited Perspective

As Fractures in Global Health Deepen, Combating ‘Othering’ Is a Must

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Received: April 1, 2025 | **Published Online:** April 28, 2025

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In 2020, during the middle of the COVID-19 pandemic, writer and activist Arundati Roy said “the pandemic is a portal” reflecting on how the humankind can emerge from the pandemic to a different and a better world of our making [1]. However, as we all know, the opposite happened. Vaccine inequity, clear prioritization of lives of those in high-income countries (HICs) and lack of accountability from state actors and global institutions defined the pandemic response [2-3]. We are now faced with an even more dire status quo, where political forces aim to dismantle global public health by gutting the existing multilateral efforts and by sowing discord and division among communities [4–6]. USA, the largest funder in global health, has cut off funding from its main international development arm, the USAID [7] and other global organizations such as Gavi, the vaccine alliance [8]. USA has showcased its isolationist policy agenda by withdrawing from the Paris Agreement and from the World Health Organization (WHO) [9]. As many have noted this will result in countless deaths and affect vulnerable communities often in economically poor settings [5,10]. The Trump administration is also actively labeling equity advocates as enemies, hunting them down with force–especially affecting minority populations and international students [6,11]. While Trump maybe the recent flagbearer for destructive isolationism of HICs, the USA is not the only country taking this path of cutting aid [12-13] and fueling anti-immigrant/minority sentiments [14].

A central tenet of these policies impacting global health and their advocacy, is division created by ‘othering’. Othering aims to break the connectedness between communities, marking individuals and groups different (often inferior) than the dominant social group [15-16]. Othering can be built on existing social divisions of class, race, skin color, religion, sexual and gender identity, citizenship, and more [15-16]. It is reasonable to say that we are caught up in an information and policy epidemic that pits us against each other – using our differences. Thus, increasingly the value of the lives and/or opinions of another community is often met with lack of empathy, dismissal or worse, vitriol. This is perhaps the strongest possible enemy to the human and planetary wellbeing. Borrowing Roy’s words, we seemed to be going through these challenging times, “dragging the carcasses of our prejudice and hatred, our avarice, our data banks and dead ideas, our dead rivers and smoky skies behind us” (1).

The purpose of this editorial, therefore, is to put a red flag on these social, political and policy pathways of othering as a tool for power - and invite you to be a changemaker.

By raising this red flag, we hope to combat complacency and call for active engagement in anti-othering efforts. We can start within our own social circles at McGill, expanding to Québec, to Canada and then globally. The key is to start somewhere and recognize we have created enemies of minorities within our own communities, in low- and middle-income countries (LMICs), and have rationalized deaths due to disease or destruction as an inevitability of the status quo. We invite you to challenge the helplessness you may feel and channel the deep discomfort into efforts of combating othering. We offer three main considerations for pathways forward. First, is centering kindness in our engagements in anti-othering. Second, is a commitment to listening and unlearning. Finally, we ask to you strongly consider becoming an active advocate – to combat anti-othering across the board.

Centering kindness to combat othering

Recognizing that these are times of acute mental and emotional exhaustion due to social and economic pressures, compounded by man-made and natural disasters, is an essential first step. Existing pressures on our lives and the global crises constantly present in our news feed can lead to lessening of empathy and kindness [17]. However, to build anti-othering efforts, a foundational step is to bank on kindness and to navigate with empathy [18]. Differing opinions, differing cultural values, different educational status or any other differences should not be the basis for rapid disagreement and our acts of holding others accountable can still be built upon kindness. So, we ask for introspection and effort in building your capacity for kindness. This applies to engaging those with differing values and also those with similar values but different views on what solutions can be. It is necessary to recognize collaborators and allies are not a monolith and have diversity of opinion.

Commitment to listening and unlearning

The necessity for listening and unlearning has been recognized before, especially in relation to equity efforts [19]. It involves proactively learning from others with humility and curiosity. However, commitment to listening and un-learning is not an altruistic act. It is an essential skill that is relevant for growth in career and effective engagement in your day to day lives as well [20]. Therefore, our ask is to reframe listening and unlearning as a self-development exercise, rather than or in addition to, an effort to combat othering in society. Once you develop listening and unlearning as a key skill for your self-growth, you can open yourself up to the differing views and allow space for re-learning or leaving harmful framings of people or situations behind. This development will also strengthen your capacity to be kinder, a consideration we highlighted above. Most importantly, the capacity to listen and unlearn will allow us to recognize the fault lines in our systems that reinforce harmful ways of othering.

Stand-up against othering – activate, advocate and agitate

This is not a drill. The times we live in require your active participation in combating othering. Building on the above two essential skills of centering kindness and building capacity for unlearning, it is necessary for all of us to build a counterculture against othering. We need to go out of our way to explain the necessity for equity, to combat harmful perpetuation of stereotypes, and to listen to the voices that are marginalized. To the extent possible, we also need to combat our inclination to play it safe or take an approach maintaining silence for personal convenience. We implore you to leverage your privileges (of citizenship, skin color, education, positions of leadership etc.) to stand for those who may not be able to be as vocal or are under scrutiny. Those affected could include your own peers in your classroom, workplace or neighborhood – simply based on their citizenship status, racial or ethnic identity, religion or views expressed. Despite the overwhelming shifts in social or political norms, we must not fall victim to helplessness within ourselves. It will be important to remind ourselves that courage is infectious and that your act of courage will light up another's capacity to be courageous.

In closing, we want to recognize the enormous mental and emotional energy that is required in efforts of countering othering–especially when going against the status quo. However, based on our experiences, we also know that there is joy in building these efforts together, in forming these communities that rise above the divisive rhetoric and prioritize wellbeing of each other. We believe that the portal Arundati Roy mentioned is still open and that we can push our world towards a more united future and a future where we do not allow othering to be weaponized. The wellbeing of our species and our planet depends on it.

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Research Article

The Dynamic Public Health Workforce: Who Is a Young Professional?

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Received: March 22, 2025 | **Published Online:** April 28, 2025
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Abstract

The interdisciplinary and inter-professional nature of the public health field has made it difficult to clearly define career pathways, which impacts those trying to enter the field, especially young public health professionals (YPHPs). Indeed, the regular use of the terminology "young professional" warrants discussion regarding its definition, significance, and the roles it encompasses. This study utilized an exploratory qualitative approach to explore the insights and underlying contexts that shape the perspectives surrounding YPHPs through a general survey followed by focus group discussions and key informant interviews. Findings suggest that the term "YPHPs" appears to associate the individual's role in the workforce, focusing on their years of practical experience. The terms and criteria of what fits its profile vary between organizations, countries, and contexts. Young professionals are attributed with enthusiasm for public health and are required to have numerous professional and human-centric competencies. There is a need for cooperation between schools of public health, employers, and young professionals to understand and meet the future public health workforce's needs. As public health is dynamic; defining and streamlining opportunities for young professionals in public health is necessary to strengthen the future of public health systems.

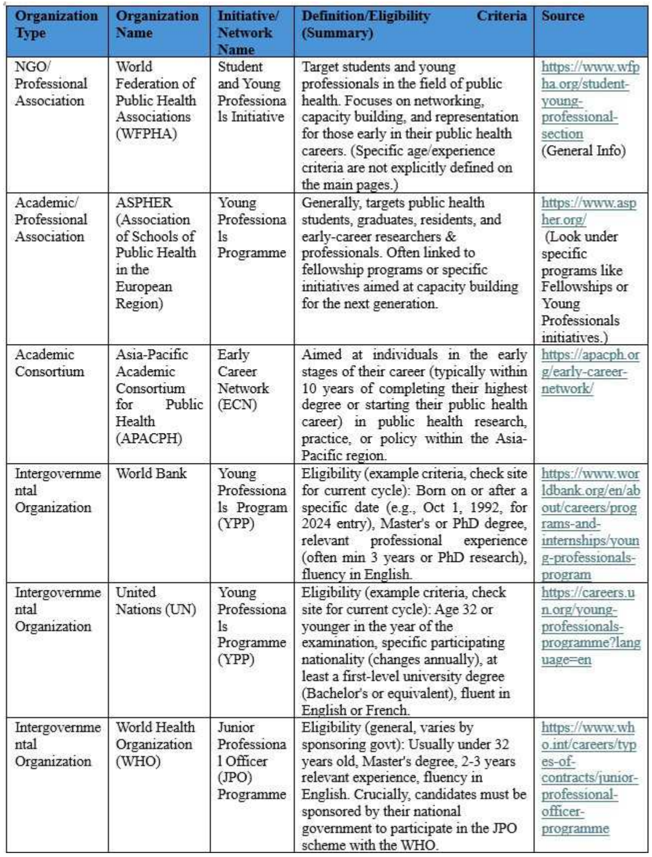
Keywords: Public health; Workforce; Young professional; Education; Employment

Introduction

Public health (PH) has transformed with the changing needs of our societies and an evolving understanding of health and wellbeing. It has advanced with a growing societal awareness of the field and the re-definition of the role of the public health workforce (PHW) in creating a safer, healthier, and more sustainable society [1]. Core PH skills and aptitudes have shifted from more traditional or "hard" competencies, such as epidemiology and biostatistics, to include "soft" competencies, such as strategic planning, systems thinking, and communication [2-3]. However, the interdisciplinary and inter-professional nature of the field has made it difficult to clearly define positions within PH, which impacts those trying to enter the field-particularly young public health professionals (YPHPs).

Professional identities are built by the PH core competencies guidelines [4-5], which provide useful frameworks for PH curriculum and career development [6]. However, they do not successfully serve as a blueprint for employment and job security, as evidenced by the widespread challenges faced by PH graduates in terms of securing stable employment in traditional PH roles [2,7]. Today, PH education can be assessed at bachelor's, master's, and PhD levels, resulting in a high supply of PH graduates. This is apparent in the USA, where the number of PH graduate degree conferrals increased by more than 300% between 1992 and 2016 [8]. Other countries such as India [9] and Australia [10] have experienced similar trends. Evidently, persistent PHW shortages are being experienced despite the growth in PH programs and graduate numbers in some regions of the world [7, 10]. The lack of clearly defined career paths for non-medical graduates in PH also plays a role in this occurrence [7]. Education and career development must capture up-to-date employer perspectives/expectations for YPHPs to enable them to lead fulfilling and meaningful careers [11-12]. There has also been an emergence of young professional networks, such as the Student and Young Professionals Initiative- World Federation of Public Health Associations [13], ASPHER Young Professionals Programme [14], the Asia-Pacific Academic Consortium for Public Health-Early Career Network [15], and more. Equally, in the employment sector, international organizations have recruitment initiatives specifically for young professionals, such as the World Bank's Young Professionals Program [16], the United Nations Young Professionals Programme [17], and the World Health Organization (WHO)'s Junior Professional Officer Programme [18]. The eligibility criteria for these programs are variable, and different terminologies, including "early career" or "young professional," are used, which often differentially exclude applications based on age, nationality, education, and years of experience. An effort must be made to align definitions for who is a "young professional" to guide these initiatives so that YPHPs can be trained, evaluated, and elicit plans for a career development trajectory.

Table 1. Various Definitions by Key Intergovernmental, Non-Governmental Organizations, and Academic Institutes



Organization Type	Organization Name	Initiative/ Network Name	Definition/Eligibility Criteria (Summary)	Source
NGO/ Professional Association	World Federation of Public Health Associations (WFPHA)	Student and Young Professionals Initiative	Target students and young professionals in the field of public health. Focuses on networking, capacity building, and representation for those early in their public health careers. (Specific age/experience criteria are not explicitly defined on the main pages.)	https://www.wfpha.org/student-young-professional-section (General Info)
Academic/ Professional Association	ASPHER (Association of Schools of Public Health in the European Region)	Young Professionals Programme	Generally, targets public health students, graduates, residents, and early-career researchers & professionals. Often linked to fellowship programs or specific initiatives aimed at capacity building for the next generation.	https://www.aspher.org/ (Look under specific programs like Fellowships or Young Professionals initiatives.)
Academic Consortium	Asia-Pacific Academic Consortium for Public Health (APACPH)	Early Career Network (ECN)	Aimed at individuals in the early stages of their career (typically within 10 years of completing their highest degree or starting their public health career) in public health research, practice, or policy within the Asia-Pacific region.	https://apacph.org/early-career-network/
Intergovernmental Organization	World Bank	Young Professionals Program (YPP)	Eligibility (example criteria, check site for current cycle): Born on or after a specific date (e.g., Oct 1, 1992, for 2024 entry), Master's or PhD degree, relevant professional experience (often min 3 years or PhD research), fluency in English.	https://www.worldbank.org/en/about/careers/programs-and-internships/young-professionals-program
Intergovernmental Organization	United Nations (UN)	Young Professionals Programme (YPP)	Eligibility (example criteria, check site for current cycle): Age 32 or younger in the year of the examination, specific participating nationality (changes annually), at least a first-level university degree (Bachelor's or equivalent), fluent in English or French.	https://careers.un.org/young-professionals-programme?language=en
Intergovernmental Organization	World Health Organization (WHO)	Junior Professional Officer (JPO) Programme	Eligibility (general, varies by sponsoring govt): Usually under 32 years old, Master's degree, 2-3 years relevant experience, fluency in English. Crucially, candidates must be sponsored by their national government to participate in the JPO scheme with the WHO.	https://www.who.int/careers/types-of-contracts/junior-professional-officer-programme

Lastly, the COVID-19 pandemic has highlighted that public health cannot be protected without an adequately skilled and qualified PHW [19-20]. However, the exclusion of and confusion around incorporating young professionals into pandemic efforts threaten the future of PHW by limiting opportunities for current YPHPs and negatively impacting the quality of education of current PH students [21-22]. We should provide current students and young professionals with opportunities to work, develop, and take on leadership and decision-making roles, as they are the future of PH [22-23]. YPHPs are asking to be involved in active, meaningful ways as they envision how the future of societies could be rebuilt better and healthier [22]. They have fostered opportunities and taken the initiative to grow their skills through collaborative workshops, social media engagements, online discussions, and more, which is beneficial for the field of PH, which is currently suffering from years of erosion [24-25]. It is important to invest in their energy and prioritize their role in meaningful engagement to foster innovation and inclusiveness for future workforce planning. Their role, however, can only be fully understood if who they are is understood. To this end, this study aims to understand the profile of YPHPs from their perspective and the viewpoints of the PHW, including employers. Our aim, therefore, is to offer a better understanding of who a YPHP is in efforts to make alignments for a definition that guides the field of PH towards ensuring that the needs of its workforce are addressed and that they are fit for purposes.

Methods and Materials

2.1. Research Design and Setting

The study was conducted between January and October 2021. The exploratory qualitative study followed the Standards for Reporting Qualitative Research (SRQR) and Consolidated Criteria for Reporting Qualitative Research (COREQ) to organize, analyze, and interpret data into a structured qualitative research framework, shown in Supplementary Materials (Table S1) [26, 27]. The study included two focus group discussions (FGD) of YPHPs and key informant interviews (KII) of multiple stakeholders from the Asian, European, and North American regions.

2.2. Participants and Recruitment

The study population included individuals working in PH, broadly defined to encompass any profession focused on improving population health and wellbeing. To recruit YPHPs for the FGD, we developed an online open-text survey advertised through our professional and personal PH networks and social media accounts. Interested YPHPs completed the online survey, and the completion of the survey implied consent of survey respondents. All participants were over 18 years of age, and basic demographic information, including gender, country of birth, year of birth, and occupation, was collected. Personal information was coded to maintain confidentiality. A purposive sampling strategy was employed to invite 20 participants from the pool of survey respondents who indicated interest in joining the FGD. Gender and country of birth were considered for regional and gender representation. Thirty eligible participants were invited through email to account for potential no-shows, no responses, and schedule conflicts. The invitation letter included the study information sheet with a declaration about their voluntary participation. If the participants agreed with the research, they were required to email the consent form back. Twenty participants agreed to join the scheduled FGDs by emailing back the consent form, and 14 attended the FGDs. The number of FGDs (two) and participants per group was considered optimal to gather the information needed for this exploratory analysis [28, 29]. For the KII, we contacted ten (10) individuals based on their role in the PHW from a mix of academic, research, practice, and employer backgrounds through snowball sampling from our professional and personal PH networks. We further scheduled one-on-one meetings with seven key informants who agreed with written/oral consent to participate in a KII to discuss their perspective on who a YPHP is.

2.3. Data Collection: FGD and KII

The FGD and KIIs were conducted using online meeting platforms to ensure feasibility and comfortability and overcome barriers related to the physical distance of engaging YPHPs and KIIs across the globe. Interview checklists were used to conduct the semi-structured FGD and KIIs and can be found in the Supplementary Materials (Table S2). They were developed based on the relevant literature, responses of YPHPs from the open-text online survey, and researchers' subject knowledge as YPHPs. TTC, JR, and GT led the FGD for a duration of 60 minutes. TTC, JR, and GT administered the KIIs, which were scheduled for 60 minutes, and most interviews were between 40-60 minutes long. The FGD and KII were completed/ended when the discussion added no new insights on the subject matter. The FGD and KIIs were audio-recorded, and handwritten notes were taken during the interview to assist the researchers with participant recall and identify the most important aspects of the discussion during analysis. Interviewees did not receive any benefit/token/gift in recognition of their contribution to the study.

2.4. Data Analysis

All the audio-recorded interviews were transcribed verbatim into separate Word documents and then checked by the research team for accuracy against the original recording. For thematic coding, each FGD participant and KII interviewee was anonymously assigned a unique identifier to each transcript denoting the type: FGD-participant (FGD-P) or key informant (KII); and the interview number for that individual (e.g., KII-1). The thematic analysis (both inductive and deductive) was performed in accordance with Braun and Clarke's (2006) six phases to address our research question. This analytic technique is flexible and useful for processing and producing organized findings from large volumes of verbatim content [29]. Data analysis team members reviewed the coding and finalized the analysis for validation and to ensure accuracy. The study findings were reported following SRQR and COREQ guidelines for transparency in qualitative research reporting.

2.5. Rigor and Trustworthiness

To safeguard confidentiality, the transcripts were only shared with the interviewers and data analysis team members. We triangulated data collection and analysis techniques by incorporating transcripts, meeting notes, and validation feedback from data analysis team members. Additionally, we conducted team meetings for final verification and gathered remarks from team members.

Results

3.1. Characteristics of YPHPs

The survey received 101 responses (approximately 20-60 years old based on year of birth, Female-66, Male-33, N/A-2). Eighty respondents indicated they were interested in participating in the FGD (Africas-4, Americas- 16, Asia-47, Europe-9, Oceania-2, N/A-2). Table 2 includes the keywords frequently used by respondents. Respondents across all age ranges and occupations used young, early, or emerging terminology to describe their current status. Their self-labeled identity was reflected based on their years of practical experience and/or understanding of PH theories/frameworks (proximity to completing education). Very few described chronological age as a key component for a YPHP. Keywords used by respondents to describe their characteristics and skills are listed below. Respondents stated that competencies/skills were different depending on the PH discipline.

Table 2. Identified Keywords of Open-Text Survey

Characteristics[1]	Keywords used by Respondents
Professional Identity (Terminology)	*Young, Early Career, Emerging, Early Stage (Professional, Scientist, Researcher)*
Profile	*Recently graduated, Working experience (1-5 years), Starting/reorienting career, Accumulating work experience, Learning stage, Diversity, Digital Culture*
General Skills	*Passion, Teamwork, Communication, Intrinsic Motivation, Proactive, Courage, Learning, Empathy, Innovation, Flexibility, Novelty, Interested, Resilient*
Employable Skills	*Negotiation, Communication, Project Management, Soft Skills, Complex Systems Thinking, Networker, Research & Data, Presentation, Writing, Basic Public Health Knowledge, Teamwork, Emotional Intelligence, Professionalism, Diplomacy, Leadership, Monitoring and Evaluation, Multi-disciplinary, Critical Thinking, Advocacy, Attention to Detail, Patience, Accountability, Transparency, Confidentiality, Ability to engage with different audiences, Intercultural skills, Tech-Savvy*

[1] NB: The collated responses are based on the opinions of survey participants.

Table 3. Participant Profiles

Focus Group Discussion	Self-Identification[1]	Gender	Current Occupation[1]	Region[1]
FGD-P1	Early-Career	Female	Dentist	Asia
FGD-P2	Early-Career	Male	Consultant	Asia
FGD-P3	Young Professional	Female	Masters' Student	Asia
FGD-P4	Young Professional & Early Career	Male	Assistant Professor	Europe
FGD-P5	Early-Career Scientist	Female	PhD Student	Europe
FGD-P6	Young Professional	Female	Health Educator	Americas
FGD-P7	Young Professional	Male	Project Coordinator	Africa
FGD-P8	Early Career	Female	Masters' Student	Africa
FGD-P9	Young Professional & Early Career	Male	Researcher	Asia
FGD-P10	Young Professional	Male	Freelancer	Africa
FGD-P11	Young Professional	Female	Community Worker	Americas
FGD-P12	Young Professional & Early Career	Female	Researcher	Europe
FGD-P13	Young Professional	Female	Government PH Worker	Asia
FGD-P13	Early Career	Female	Government PH Worker	Asia
Key Informant Interview	**Role in the Public Health Workforce**		**Gender**	**Region**
KII-1	Expert		Male	Asia
KII-2	Employer/Recruiter		Male	Asia
KII-3	Expert		Female	Europe
KII-4	Expert		Male	Europe
KII-5	Employer/Recruiter		Female	Americas
KII-6	Employer/Recruiter		Female	Americas
KII-7	Expert		Female	Americas

[1] Based on survey response.

3.2. Characteristics of FGD-Ps and KII

A brief background of the 14 FGD-Ps and seven KIIs are listed in Table 3. Codes are used to conceal the participants' identities.

3.3. Who is a Young Professional?

Differing opinions about YPHPs were revealed in the findings that reflect the unique historical and social contexts in which PH education and practice have evolved. We have grouped these differing opinions by five key themes: (1) YPHP terminology and profile (2) General/employable dynamic skills and competencies (3) the role of education (4) the role of YPHPs in the workforce, society, and health system and (4) COVID-19, an opportunity.

3.3.1. YPHP Terminology and Profile

The term "young professional" is primarily used to describe the individual's role within the workforce. FGD-Ps and KIIs identified the most common terms they have heard were "young professional", "early career", "early researcher", "recent graduate", and "temp." KIIs felt there was no substantial attachment, and one term needed to stand out more than the others. There was a slight concern about the word "young" due to the connotation towards chronological age, echoed by FGD-Ps. KIIs who had worked in North America highlighted that the word "young" is avoided as policies were in place to prevent ageism. However, it was also recognized that large-scale global organizations also use the term "young," highlighting the understanding that the language changes in each organization, country, and context. FGD-Ps also shared experiences when applying for research grants or positions in which the word "young" or "early-researcher" had established criteria and potentially higher standards than the criteria for a practical role. KIIs mentioned that different countries viewed researchers based on publications or years of research experience.

When asked about the defining features of a YPHP, there was a lack of clarity on whether the individual was a student, a recent graduate, or graduated from FGD-Ps. The most common profile was attributed to individuals with a basic depth of PH knowledge with limited field experience (often less than two years) but could range up to 7 years of experience. KIIs identified YPHPs as individuals who have a higher education. Still, it was acknowledged that the degree streams for a bachelor's degree program were increasingly effective at preparing individuals for the field. YPHPs were described by both groups as someone who were still gaining work experience in the field of PH and may continue to shift to different positions and organizations. They are well-versed in digital literacy and trained in public health in the digital health era from the 2000s. FGD-Ps shared that the identity of a young professional was linked to the profession itself, describing PH as a unique, multidisciplinary sphere where individuals can enter and leave easily. This sentiment was reinforced by the KIIs, who shared stories of individuals who were from different disciplines, such as architecture or music, who had an interest in PH and pursued it in their masters' but returned back to their original focus afterward. A PHP was thought to be "anyone who is working towards the wellbeing and health of the population." These conditions shift the career trajectory as individuals who join the PHW can be any age, with any experience. According to KIIs and FGD-Ps, this composite discipline is what makes the PH profession attractive.

3.3.2. General and Employable Dynamic Skills and Competencies

Both groups (KIIs and FGDs) revealed that the characteristics (Table 2) of a young professional are extensive and aligned with the survey results. KIIs felt it was difficult to generalize employable characteristics because the field of PH has many sub-roles that have their own stereotypes of important traits. However, KIIs reinforced that they felt YPHPs were filled with enthusiasm, drive, and passion. Regarding employment, KIIs shared that YPHPs should be able to design, implement, and evaluate interventions and have a basic knowledge of PH, including epidemiology, fieldwork, statistics, economics, and more. In today's job market, KIIs highlight that YPHPs need to be competent in analyzing, interpreting, and using data, including technical knowledge such as software and programming skills and understanding risks associated with data and technology misuse. YPHPs are instrumental in project coordination, grant writing, and developing proposals. However, to be employable, education and technical skills only play one part of the role. KIIs emphasized that YPHPs need to carry a sense of responsibility and professionalism, which leads to result-oriented outcomes. They need to focus on "human-centric" competencies such as empathy and emotional intelligence. YPHPs need to be flexible, resilient, and adaptable to the situation. It is a very multidisciplinary and multicultural field. Thus, it is important to be sensitive and have empathy, humility, and compassion, which are necessary to work with diverse cultures and vulnerable groups of populations. These skills cannot be learned from theory but are developed over time via practice-based experiences. Being able to maintain relationships with people, understanding how to build networks, and communicating with multiple audiences are critical skills. Communicating with multiple audiences (both orally and through writing) is arguably the most difficult and important skill to have. PHPs need to have emotional intelligence and diplomatic skills as they will often work with different levels of government, civil societies, and leaders. The most important skill recognized by KIIs is the art of communication. The skill to connect with people, develop partnerships, and know how to use them effectively is important in the field of PH. Communication also builds leadership skills, and leadership skills often include creating a presence for public speaking, social media engagement, and ethical strategies. KIIs highlighted that the strong communicators are leaders in the field of PH. In addition to communication, leaders in PH are also able to effectively practice and drive change management in organizations, communities, and society, as per KIIs.

3.3.3. The Role of Education

KIIs described the YPHP as the client of the education system, providing the demand for PH programs. Schools of PH have the role and responsibility to educate and prepare PH graduates for the changing PHW. KIIs described a basic knowledge of PH as important to have, and the foundations of a degree provide basic tools and theoretical knowledge. KIIs highlighted that PH graduates are well-educated on a) the social foundations of wellbeing, health, and their relationship to disease prevention and health promotion and b) how policy development, health systems, health promotion, health literacy, health in all policies, and data to the lack of a clear career trajectory path from the classroom. The FGD-Ps shared a feeling of disconnection between their education and potential careers, which contributed to their confusion regarding the entry point into a PH career.

3.3.4. The Role of YPHPs in the Workplace, Society and Health System

YPHPs are the backbone of PH work. KIIs highlight that hey do everything from field research to social media to engagement in the workplace. They are used in many areas because they have the skills to be flexible. However, this is also recognized as a fault. FGD-Ps share their concerns that they still do not understand what a PHP does and if they are prepared for the field. Experiences connected with trial runs for job searches to recognize which PH role was a fit for their skills and experiences. KIIs share that YPHPs are the new workforce for retirees leaving the field and are well-versed in the new demands of PH, including digital technology. However, the career pathway and transition for a YPHP remain unclear in the workplace compared to sectors such as engineering. This is attributed to the uncertainty of their employment options, which is interlinked with the job market that is saturated by a clinical PH system. KIIs acknowledged a clinical background was placed as a priority for hiring practices, and not enough accommodation for non-clinical PHPs were taken in consideration. One KI shared that it is a paradox to hire clinicians in PH roles when there is a low supply of clinicians in the country. KIIs also highlighted that they found their graduates leaving traditional PH roles, as their skills were being demanded in positions outside of health. YPHPs want to do more, but the PH job opportunities are not ready for them. The jobs they are looking for do not exist, placing a high emphasis on building a network within the health system. In academia, there are barriers to cost-containment in certain regions which is a "destructive palette", while in government agencies, the number of positions is both low in availability with a low salary. The diverse skills and competencies that a YPHP is attractive in areas like pharmacy and technology where PH is evident. Governments have a responsibility to recognize the gap and shifts in order to plan their workforce accordingly to not lose strong PH candidates. KIIs called for action by the main leaders of PH to alleviate the concerns of YPHPs by professionalizing and regulating the PH profession.

3.3.5. COVID-19: An Opportunity

KIIs highlighted that COVID-19 has been an opportunity for the PHW as there was a shift in understanding what PH is. COVID-19 impacts made the pandemic everyone's business due to its disruptive nature. Prior to COVID-19, several KIIs organizations were beginning to incorporate YPHPs into their strategies, and the pandemic propelled forward official actions and provided the case for PH funding. KIIs saw a desire by young professionals to help, and FGD-Ps emphasized that the pandemic was an opportunity for them to diversify their fields of interest. YPHPs were offering their assistance and demonstrated their skills in the work-from-home digital era as they were comfortable hosting webinars, live discussions, etc. KIIs shared that organizations that took advantage of the momentum benefited from strong outputs and gained a new impression of the PH leaders of the future. COVID-19 also opened doors in terms of employment because workplaces were forced to shift to remote work. The opportunity for digital inclusion in the workplace practice provided new ways for individuals in different geographic regions to apply for jobs, creating a more diverse and inclusive workforce.

Discussion

The study reaffirmed the understanding that the PH career path is a difficult trajectory to map, which is both advantageous and disadvantageous for the YPHP community. More research is required to provide direction for the early career PH individuals of the PHW. PH is not hiding in the back corners but pushing to center stage [10-11]. The demands on the PHW are continuously evolving due to an emerging polycrisis characterized by rising infectious disease threats, climate-related health challenges, and increasing burdens of NCDs [31-32]. YPHPs are thus an important factor when considering future PHW planning [22-23]. However, it is clear from the findings that the idea of who is a YPHP is aligned with the broad scope of practice of PH. Participants emphasize their enthusiasm and dedication to PH, indicating that the need for more PH research is urgent to not only minimize the transition needs of new graduates but also to retain PHPs in PH. There is a need for action to step up to improve the PHW gaps through research and action. It remains difficult to incorporate a clearly agreed definition due to the differing demands of the profession. The changing structure of PH systems influences the successful preparation, transition, and integration of YPHPs [12, 20].

The term young professional is used differently in each organization, country, and context. However, there are concerns regarding inclusive and ageist language with the word "young" versus "early career," with no clear consensus on how to define the label clearly. Historical references were made to the PHP, where in the past, PH education started at the bachelors' level, PH graduates became younger [7-9]. It is also common to see students completing a bachelor's and then going straight into a master's or PhD before working in the field full-time. KIIs emphasized that this is a positive shift because today's graduates are more prepared for PH fieldwork because they have more opportunities to be educated in the right skills and competencies. YPHPs also live with globalization and digital influences, providing a more flexible mindset.

However, YPHPs are still struggling with their role in the PHW. The list of PH skills and competencies is comprehensive, requiring an understanding of essentially everything [2]. KIIs and FGD-Ps mentioned that a basic knowledge of PH is required, but the list of what that entails is long and varied. The lesson is that PH education needs to focus less on theoretical concepts and more on practical experience at the grassroots level. KIIs mentioned that the education curriculum is not moving at the same speed as the changing health system, and the shelf-life of skills used to be 10 years but now is most likely 2 years. The description of YPHPs' general and employable skills and competencies develop over practical experience, similar to many other professions. For example, medical professions require years of practical experience before becoming an independent physician. The PHP could model a similar requirement, given the shared experiences by FGD-Ps that PH is a person-to-person, human-centric profession. Schools of PH need to focus more on transitional, trajectory career plans that can define measures of experience rather than a discourse about PH that is too easily overwhelmed by possibilities. We need to expose the PH curriculum to match the availability of employment opportunities, which is a constant disconnect [5,9].

YPHPs also need to be provided with meaningful and genuine opportunities. They are equipped with fresh ideas [10]. KIIs shared that if organizations treated young professionals with an understanding that they wanted to do more, YPHPs could be used as a motor of action. To do this, it is important to communicate with YPHPs. FGD-Ps did not mention the shift of PHPs to areas outside the traditional PH roles, which should be divulged in further research because of the connotation that it is a negative perception. The professionalization and regulation of PH may have allowed YPHPs to gain a flexible, self-driven attitude towards PH employment, focused simply on the alluring spirit of PH, improving health and wellbeing. The responsibility of retaining YPHPs in PH careers remains with the diverse mentorship from mid-level/expert staff who contribute to PH history, offer different perspectives, and provide formal/informal support to empower young professionals in their sphere of work [3, 8]. PH organizations need to construct a sound organizational structure for smooth transitions in their workforce while providing YPHPs the same respect for a work-life balance and correlated pay for their skills. PHW needs to recognize the growing numbers of YPHPs and their identity, role, and opportunity in PH [2, 22].

4.1. Limitations and Further Research

This study was limited by using the word "young", "public health" and 'professional', as it may have deterred individuals from completing the survey or answering questions from personal perceptions that they may not qualify due to "age", "discipline of public health" such as global health or 'job title'. Furthermore, the survey results contained a higher response rate from Asia and only included English responses. To ensure a comprehensive representation of YPHP and PHW perspectives, the selection of participants accounted for gender, nationality, and occupation. This study also did not account for PH globalization and mobility trends, which may limit understanding the participants' perspectives. KIIs also used snowball sampling. Thus, the generalization of research findings to the international PH population is limited. KIIs acknowledged that their responses may be more aligned with the needs of the country they primarily work in despite having global experiences. Future research should align with reviewing the transitions of YPHPs in the PHW and incorporate a deeper review into strategies for forecasting and planning with YPHP. This could be used in job descriptions, similar to other job sectors where entry, mid, and expert levels have time standards.

Conclusion

To our understanding, a YPHP should refer to an individual who embodies the spirit of PH and is beginning their professional career in this field. This study has highlighted how the complexity of a career in public health can be largely tied to a lack of recognition for YPHPs and unclear career pathways and progression. Furthermore, PH is in a unique field with a strong capacity to drive change and elicit societal impact. The role of YPHPs in the PHW needs to be recognized, as it is still difficult to define who a YPHP is due to the different perspectives and expectations of the practice and profession. Given the dynamism of the PHW, YPHPs represent the future of PH. Furthermore, a degree of cooperation among sectors in envisioning unique and innovative transitional strategies to create opportunities for employment in PH needs to acknowledge the capacity of new graduates that comes with experience and lifelong learning. It is clear that YPHPs are growing in number and are eager to be part of this discussion. We urge the field to continue to research about who a YPHP is and elicit further conversation regarding a potential transition framework and opportunities for young public health professionals.

Funding: This research received no external funding.
Ethical Approval: The North South University (NSU) Institutional Review Board, Bangladesh, approved the study protocol: 2021/OR-NSU/IRB/0403.
Data Avaliability: All the personal data of the participants are anonymized in any publication of study findings, and de-identified data will be kept in NSU drive for up to three years to meet the ethical standard of NSU Research Ethics Committee.
Acknowledgments: The authors extend their gratitude to all respondents, participants and key informants who participated in the study. The views expressed in the article are those of the authors and do not necessarily reflect those of the organizations involved.

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Perspective

Addressing Medical Licensure Barriers to Improve Healthcare Access in Nunavut

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Received: March 8, 2025 | **Published Online:** April 28, 2025

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Introduction

Nunavut is the largest and least inhabited territory in Canada [1]. While people often marvel at Nunavut's natural beauty, we tend to overlook the stark healthcare realities faced by its inhabitants. One major challenge in Nunavut is achieving equitable access to health care. Medical transportation is widely normalized, and Nunavut residents are often forced to travel thousands of kilometers for treatment. The financial and human burdens of medical transportation are unjustifiable. This paper explores alternative solutions to healthcare sovereignty in northern Canada. Virtual care and recurrent locum physicians are methods that can bring care closer to Nunavut communities. However, a major barrier to their implementation is the current medical licensure system in Canada. Physicians must obtain separate licences to practise in each province or territory [2]. This redundant, time-consuming, and costly system restricts physicians from practising in rural areas outside of their licensing authority. Introducing a pan-Canadian medical licensure will improve access to care in Nunavut.

An Unsustainable Status Quo

Nunavut has a population of 37,000, most of whom are Inuit. The territory's remoteness poses unique challenges, including a chronic shortage of healthcare professionals. Three of the 25 communities in Nunavut have full-time physicians; the rest are serviced by community health nurses [3]. Because of the limited medical infrastructure, Nunavut experiences substantial health inequities compared to the rest of Canada. For example, Nunavut's life expectancy at birth is eleven years lower than the Canadian average [4]. Despite stark health disparities, Nunavut has the highest per capita healthcare spending in the world at over 25% of the territory's GDP [5]. In 2020-2021, the Nunavut government projected an annual expenditure of $107.6 million on medical travel [6]. This amounts to over $2,900 per person per year [7].

Alternative Models Worth Pursuing

Medical transport does not contribute to sustainable health sovereignty in Nunavut. Rather, it is a temporary measure to remedy the shortage of healthcare workers in northern communities. Medical evacuation is undoubtedly necessary, but it should not be viewed as the end goal. Investments in medical travel takes away from funding that could otherwise support alternative models of health delivery. This paper suggests two alternative models: virtual care and recurrent locum physicians.

Virtual Care

Many visits to southern hospitals are for specialist consultations. Telemedicine is a promising model to provide specialist care in remote communities. Virtual care is efficient and prevents unnecessary medical travel. For example, the Champlain BASE™ eConsult service offers an asynchronous communication platform between primary care providers (PCP) and specialists [8]. In a 2014-2016 study in Nunavut, 35% of the eConsult cases allowed the PCP to avoid an in-person referral [8]. The total estimated savings from this study were $180,552.73, or $1,100.93 per case. Limitations to telemedicine include poor internet connectivity and, more importantly, Canada's medical licensure system which restricts most physicians from providing virtual care across provincial/territorial jurisdictions.

Recurrent Locum Physicians

Short-term locums have become the primary source of doctors in Nunavut, which undermines continuity of care. There are currently no Nunavut-based studies describing the impacts of high physician turnover rates, but other rural communities in Canada and Australia have shown lower patient satisfaction, poorer health outcomes, and issues of cultural safety [3]. Physicians are drawn to Nunavut because of the broader scope of practice, but the high cost of living, limiting job opportunities for spouses, and distance from family dissuade them from staying long-term [3]. This article proposes an alternative model composed of a network of recurrent locum physicians. By encouraging physicians to take recurring assignments to the same remote community, they can become acquainted with the patients and facilities. For instance, recurrent locum physicians could work in Nunavut one week per month or one season per year. Importantly, these physicians can form trusting relationships with the community and can follow up with patients regarding their treatments. Unfortunately, like virtual care, a major barrier to attracting physicians to work part-time in Nunavut is the convoluted medical licensure system.

Medical Licensure Standing in the Way

Canada's medical licensure system is a barrier preventing the expansion of virtual care and recurrent locum physicians in Nunavut. Provinces and territories administer their own healthcare coverage using funding from the federal government via the Canada Health Transfer. This fragmented governance structure creates a poorly coordinated collection of administrations. Physicians who are licensed in one jurisdiction must go through an entirely separate application to practise in another jurisdiction [2]. The medical licensure process involves a lengthy list of documentation. Some jurisdictions even require physicians to present their degrees in-person [9]. Despite the standards being nearly identical, each province/territory has its own review process to grant licences. This time-consuming and costly process dissuades many physicians from working outside of their primary jurisdiction. The eConsult study circumvented these barriers by having the specialist offer a purely advisory role [8]. However, licensure policies restrict interjurisdictional provision of care. In most cases, specialists who wish to treat patients in Nunavut must have a Nunavut medical licence.

A survey from the Canadian Medical Association [10] showed that 91% of physicians support national licensure. Furthermore, 30% of physicians reported that, if a national licensure existed, they would work in rural-remote regions on an ongoing basis. Critics of the national licensure system claim that it may worsen the shortage of physicians in rural areas because of a widespread migration of rural physicians to urban centres [11]. However, an Australian study reviewing the mobility pattern of physicians showed no major drift away from rural areas after implementing a national licensure [12].

Strategies to Implement a National Medical Licensure

There are numerous ways to implement a national licensure system in Canada. Provinces and territories could establish mutual agreements to recognize each other's medical licences. Alternatively, a centralized online platform could facilitate seamless transfer of necessary documents to all licensing bodies [2]. Canada could also emulate Australia's approach where every state has its own regulatory body, but physicians are allowed to practise anywhere in the country [13]. Constitutional lawyers have affirmed that a licensure framework similar to that of Australia would not violate the Canadian constitution [9]. Increasing physician mobility is a meaningful step towards improving healthcare access in Nunavut.

Conclusion

Implementation of a national medical licensure is one piece of a larger puzzle. Long-term solutions require a holistic and interdisciplinary approach—one that simultaneously addresses social determinants and educational barriers. Housing, food security, early childhood development, mental health, language, and culture are major determinants of health for Inuit that must be reflected in the healthcare system [14]. Furthermore, there needs to be improved community-based medical infrastructure and educational programs to support the next generation of Inuit health professionals. Inuit communities can be best served by physicians and nurses who know the culture and language [15]. Medical transportation can no longer be our primary solution to Nunavut's healthcare challenges. Moreover, the history of harmful medical interventions in northern Canada has reinforced mistrust in the health system among Inuit [16]. Moving forward, it is important to prioritize Indigenous involvement in the development of healthcare policies. Alternative models such as telemedicine and recurrent locum physicians offer promising avenues for improving healthcare access. However, Canada's medical licensure system poses a significant barrier to their implementation. Establishing a pan-Canadian medical licensure will increase physician mobility and enhance access to care.

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Review Article

Exploring Access to Universal Healthcare among Indigenous Peoples in Canada

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Received: February 5, 2025 | **Published Online:** April 28, 2025

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Abstract

Canada's healthcare system is founded on universality, yet Indigenous Peoples face significant barriers to equitable care. This paper explores the challenges Indigenous communities encounter, including jurisdictional disputes, systemic racism, and inadequate healthcare infrastructure. It argues that achieving inclusivity requires moving beyond one-size-fits-all policies toward culturally responsive, community-driven solutions that uphold Indigenous rights and self-determination. Strategies discussed include cultural safety programs, better healthcare provider education, and increased Indigenous participation in decision-making. It calls for a collaborative approach involving all levels of government, especially Indigenous governments, to improve policy development, resource allocation, and service delivery. Legal reform and clearer accountability frameworks are essential to shifting power dynamics and ensuring equitable access to healthcare.

Keywords: Indigenous health; Health equity; Universal healthcare; Policy development; Cultural safety

Introduction

Canada's healthcare system, founded on the principle of universality, is often seen as a global model, emphasizing that healthcare access should be based on need, not financial means [1]. The Senate affirms that every resident is entitled to publicly funded health services under provincial or territorial plans [2]. Universal programs aim to provide equal services regardless of location or socioeconomic status [3]. However, this ideal fails to address the health disparities faced by Indigenous Peoples, who continue to encounter significant barriers. These disparities highlight a critical oversight in national healthcare: the failure to incorporate the unique needs and rights of Indigenous communities. By not addressing these inequities, Canada risks reinforcing colonial structures and systemic racism in public institutions, exacerbating intergenerational trauma and eroding trust in government systems.

Research links healthcare challenges among Indigenous communities to the broader concept of universal health coverage in Canada [3]. Statistics show that 32% of First Nations people off-reserve, 30% of Métis, and 29% of Inuit report unmet healthcare needs, with discrimination reported by 24% of First Nations, 23% of Inuit, and 18% of Métis [4]. Indigenous Peoples experience higher rates of child mortality, infectious diseases, diabetes, and lower life expectancy compared to non-Indigenous populations [3], undermining the core objective of the Canada Health Act [5]. This paper examines the barriers preventing Indigenous Peoples' access to healthcare and presents strategies to overcome them. Achieving true inclusivity requires moving beyond a one-size-fits-all approach and adopting culturally responsive, community-driven solutions that respect Indigenous rights and self-determination.

Barriers Encountered by Indigenous Peoples

Indigenous communities in Canada face significant barriers within the healthcare system, undermining its ideal of universality [3]. Key obstacles include the affordability of essential services, limited funding, and lack of awareness about available coverage. These challenges stem from jurisdictional disputes in Canada's healthcare framework, where cost-sharing agreements between the federal government and provinces hinder coverage for services like dental, vision, home care, and other health supports.

Recent provincial decisions reveal the fragility of the cost-sharing model. Alberta, under Premier Danielle Smith, plans to withdraw from the federal dental care program by 2026, arguing it duplicates existing coverage for many Albertans [6]. Provinces remain wary of federal commitments, citing past instances where Ottawa reduced or cut funding, forcing them to absorb the shortfall. Although these tensions affect all Canadians, they place a heavier burden on Indigenous communities already facing socio-economic disadvantages. Despite federal initiatives like the Non-Insured Health Benefits (NIHB) program for Inuit and Status Indians, Indigenous Peoples often pay out-of-pocket for essential services not covered by these programs. As a result, they experience higher rates of dental issues, vision impairments, and chronic conditions requiring home care [3]. Gaps in knowledge about NIHB coverage and high transportation costs, especially from remote communities further hinder access to care [7]. Beyond jurisdictional issues, race plays a crucial role in healthcare access for racialized and marginalized communities [8]. In Canada, racism is a documented barrier to Indigenous peoples' access to non-Indigenous-led health services [9]. A qualitative study in Prince George identified racism and discrimination as major obstacles to healthcare for Indigenous people [9].

Additionally, 71% of Indigenous adults in Toronto reported experiencing racism from healthcare professionals, which hindered or delayed their care. Both healthcare providers and Indigenous community members highlighted discrimination based on Indigenous status, identity, or appearance [9], revealing the pervasive nature of racism in the healthcare system.

Discrimination in Canadian healthcare often stems from negative biases among healthcare professionals, rooted in widespread stereotypes about Indigenous Peoples. These biases lead to harmful assumptions, such as labeling Indigenous individuals as addicts or alcoholics, causing healthcare providers to question the legitimacy of their illnesses or suspect them of seeking medication fraudulently. This discrimination worsens healthcare disparities, with physicians withholding specialist referrals [10].

Discrimination and racism in healthcare significantly affect the quality of care Indigenous Peoples receive. One of the most common barriers reported by Indigenous participants is the perceived poor quality of care, often linked to racism, such as delayed diagnoses, denial of medication (especially pain relief), long wait times, or lack of treatment. These experiences foster the belief that care will be inadequate or discriminatory, causing many to avoid seeking healthcare. Thus, perceived poor quality, shaped by racism, mediates the impact of systemic racism on reduced healthcare access for Indigenous populations [11].

Research on urban Indigenous populations shows that racism delays healthcare seeking, often until conditions worsen and require emergency department visits. One study found that Indigenous individuals have higher hospital admission rates for conditions typically treatable in primary care settings [11]. While racism impacts Indigenous health, it is just one of many barriers to quality care. Infrastructure also plays a crucial role in the accessibility and adequacy of healthcare for Indigenous populations.

Universal healthcare for Indigenous Peoples also faces challenges due to inadequate infrastructure. While 70% of Inuit in Nunangat have seen a medical professional, only 23% have a regular doctor, and 14% report unmet healthcare needs. Common reasons include unavailable services (25%) or services not offered at the right time (15%) [7]. These statistics highlight the significant impact of inefficient infrastructure, as effective healthcare delivery relies on a sufficient and well-equipped workforce [7]. Geography further compounds these challenges as a place of residence greatly impacts access to timely health services. Indigenous peoples in rural and remote areas face challenges in finding and retaining healthcare professionals, leading to shortages and reliance on non-resident workers [7]. Lengthy waitlists and a lack of accessible doctors or nurses create additional barriers for First Nations individuals on reserves [7]. Even in urban areas, where services are more accessible, significant barriers remain [9]. The scarcity of healthcare professionals increases transportation challenges, as many Indigenous individuals must travel to urban hospitals for emergencies, specialist appointments, diagnoses, and treatments. This extensive travel incurs high costs, discouraging some from seeking care, which delays diagnosis and treatment [7]. Financial hardship exacerbates these issues, with poverty acting as a major barrier to accessing healthcare, even within Canada's universal system [12].

Breaking Down Barriers to Indigenous Healthcare with Targeted Solutions

Combating Racism and Discrimination

Racism is a significant barrier to equitable healthcare for Indigenous communities. A survey found that while only 16% of Indigenous respondents reported never experiencing healthcare discrimination, 84% of white healthcare workers acknowledged its widespread prevalence [13]. Papillon argues that addressing healthcare racism in Canada requires a model that embraces diversity within universality. In contrast, Browne et al. [14] suggest adopting the "Cultural Safety" framework, developed by Māori nurse leaders. This approach goes beyond cultural sensitivity by challenging power dynamics, discriminatory practices, and entrenched racism, while also recognizing the lasting effects of historical injustices on health and healthcare.

Patient- and family-centered care should be expanded to include contextually tailored care that addresses the unique characteristics of local communities and populations. This involves adjusting practices, policies, and clinical guidelines to meet the needs of local demographics and the changing social realities they face [14]. Successful implementation of these strategies requires supportive organizational policies and a deep understanding of the diverse contexts shaping the health of Indigenous Peoples and the socio-political environment in which healthcare is provided [14].

To combat healthcare racism, comprehensive training for professionals in all public health disciplines is essential. Indigenous Peoples often face unsafe care, disrespect, and discrimination from healthcare providers, making it critical for training to focus on delivering culturally safe care while addressing racism, discrimination, and negative stereotypes. Such training is key to narrowing the health gap between Indigenous and non-Indigenous Peoples [7]. At the organizational level, mandatory anti-racist training for all personnel, including administrators, managers, and service providers, is necessary to address the risk of inequitable treatment. Additionally, cultural safety training is crucial for improving communication between Indigenous individuals and healthcare providers, helping to counteract racism and support universal healthcare [14].

Effective communication reduces stress for Indigenous patients who may not speak English or French as their primary language, helping them express health concerns and understand their diagnosis, treatment, and medications. Key strategies include using Indigenous translators, patient navigators, and health workers, providing culturally relevant health education and respecting Indigenous family structures [7]. Building relationships, reflecting on personal behaviors and beliefs, and involving patients in care decisions are essential for improving communication and applying cultural safety in healthcare. These strategies are crucial for enhancing access to healthcare for Indigenous Peoples and combating years of racist treatment. Additionally, reforms should prioritize Indigenous-led approaches to health, with Indigenous control over service design and administration being central to ensuring cultural safety in healthcare [3].

A key strategy in combating healthcare racism is for providers to confront and actively address racism and discrimination toward Indigenous Peoples. This requires healthcare providers to understand the historical context influencing Indigenous healthcare experiences [14]. Healthcare staff must develop strategies to counter judgments about "personal responsibility" that may arise in verbal and non-verbal interactions. For example, clinic staff must learn to respond to those who blame Indigenous Peoples for their suffering, particularly regarding health and substance use issues [14]. Establishing a "speak-up culture" is vital to combat racism, as reluctance to denounce prejudiced behavior contributes to systemic racism [13]. Critical allyship is essential, involving active efforts to challenge discriminatory practices, support marginalized voices, and advocate for systemic change.

Organizations addressing racism and discrimination must challenge neoliberal discourses that promote meritocracy and individual responsibility, as these ideologies obscure systemic inequities. Such discourses overlook the structural barriers faced by marginalized communities. Allegations of discrimination should be taken seriously, as dismissing patients' concerns about disrespect as oversensitivity or an unfair advantage invalidates their experiences and perpetuates harm [14].

Resolving Jurisdictional Obstacles

The need to address "jurisdictional quagmires" is widely acknowledged [3]. The ongoing ambiguity among federal, provincial, and territorial governments leads to delays in healthcare access and exacerbates inequities for Indigenous populations [3]. Proposed solutions include promoting co-equal treatment of all stakeholders to foster collaboration, clarifying legislative responsibilities, and increasing the involvement of provinces, states, and territories in Indigenous healthcare. Papillon argues that, given Canada's political structure, "jurisdictional realignment is highly unlikely," and that the focus should shift toward "collaboration and coordination." Addressing jurisdictional challenges requires the establishment of a legislative framework that clearly defines federal responsibilities, accompanied by robust accountability mechanisms to ensure transparency and prevent the erosion of commitments. This approach fosters collaboration among federal, provincial/territorial, and Indigenous partners, treating all stakeholders as "co-equals" to move beyond the segmented model and ensure the legitimacy of healthcare programs for Indigenous beneficiaries [3].

Research also highlights the power imbalance between governmental agencies regarding healthcare. This strategy emphasizes collaborative efforts, led by the federal government, to strengthen relationships with provinces and Indigenous communities. Federal authorities have often treated provinces, states, and territories as peripheral to healthcare transfers, despite their potential roles in data collection, health service planning, and resource optimization. Although constitutional constraints limit the ability to coerce provinces, federal planners can still foster collaboration through joint studies, planning initiatives, and implementation efforts involving provinces, states, and tribes [15].

This assertion highlights the divergence between national and sub-national actors in Canadian policy toward Indigenous Peoples, challenging the view that national policy merely reflects sub-national politics. It argues that those holding this view are mistaken. Federal authorities must, therefore constitutionally and with greater conscientiousness consider the interests of provinces, states, and territories in relation to Indigenous Peoples [15]. The conclusion follows that Canadian federal policy on the transfer of health planning and implementation to Indigenous Peoples has not adequately accounted for the interests and influence of provinces, states, and territories. A model in which these actors actively contribute to shaping federal policy could improve the fulfillment of health needs within Indigenous communities and make better use of limited resources [15].

Conclusion

In conclusion, this paper underscores the urgent need for inclusive and equitable healthcare policies tailored to Indigenous communities in Canada. While Canada's healthcare system is founded on universality, the persistent health disparities faced by Indigenous Peoples, driven by underfunding, staffing shortages, and systemic barriers, reveal a significant gap in achieving this ideal. These disparities are deeply entrenched in systemic racism and institutional neglect. Including Indigenous voices in health planning and program development is essential for creating culturally responsive and effective healthcare services. Without their active participation, Indigenous needs and perspectives are overlooked, resulting in policies that are ineffective and harmful, thereby perpetuating cycles of inequality. Prioritizing Indigenous-led initiatives and establishing frameworks for collaboration between federal, provincial, territorial, and Indigenous authorities is crucial to ensuring a healthcare system that truly serves all Canadians while respecting the dignity and rights of Indigenous Peoples.

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Human and Planet Health: Collective Well-being © Evelyn Rogan

Research Article

Time Series Analysis of Measles Incidence in Nigeria Using Surveillance Data from 2011 to 2022

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Received: January 22, 2025 | **Published Online:** April 28, 2025
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Abstract

Background: Measles is a highly contagious viral disease that primarily affects children, especially in underdeveloped nations. In Nigeria, inadequate vaccine coverage has sustained measles endemicity. This study analyzed the trend and seasonality of measles in Nigeria and forecasted its trajectory from January 2023 to December 2026. **Methods and Materials:** Time series analysis was applied to laboratory-confirmed measles cases from the World Health Organization case-based surveillance data reported in Nigeria from January 2011 to December 2022. The analysis was conducted using Seasonal and Trend decomposition using Loess and the Seasonal Autoregressive Integrated Moving Average (SARIMA) model, with model selection determined by the Akaike Information Criterion and validated using residual diagnostics. Measles incidence forecasts for 2023 to 2026 were generated, with predictive accuracy assessed using the root mean square error and mean absolute error (MAE). **Results:** A total of 203,587 measles cases were reported during this period, with an average incidence of 7.5 cases per one million individuals. Seasonal peaks were consistently observed from January to March, with no discernible long-term trend. The SARIMA $(3, 0, 1)(1, 1, 1)_{12}$ model demonstrated the best fit for forecasting, achieving an MAE of 3.2 cases per one million population when comparing predicted and observed incidence in 2023. Forecasts suggest the seasonal patterns and magnitudes will persist through 2026, assuming all factors remain constant. **Conclusion:** This study highlights seasonal peaks in measles incidence from January to March in Nigeria, highlighting the urgent need for improved vaccination coverage and targeted public health interventions during peak seasons to mitigate the disease burden.

Keywords: Measles incidence; Seasonality; Time series analysis; Prediction; Nigeria

Introduction

Measles, historically a leading cause of child mortality, is a highly contagious vaccine-preventable disease caused by Morbillivirus [1]. Transmission primarily occurs through aerosol droplets or oral secretions from infected to susceptible individuals, particularly children under 17 years of age [2]. Symptoms typically appear 10 to 15 days after exposure and include fever, cough, rash, and generalized body aches [3].

Measles exhibits a seasonal pattern, peaking during colder and drier seasons, particularly in tropical climates of endemic countries [2]. The World Health Organization (WHO) recommends administering the first dose of a measles-containing vaccine (MCV1) to infants at nine months in endemic regions and between 12 to 15 months in non-endemic countries [4]. To ensure adequate immunity, a second dose (MCV2) is included in routine immunization schedules to protect individuals who may not develop sufficient immunity after the MCV1. This two-dose strategy significantly enhances population immunity and is essential in regions with high measles transmission rates [2].

The global incidence of measles decreased by approximately 88% from 2000 to 2016 [5]; however, progress in controlling the disease has been significantly hindered by inadequate vaccination coverage in many developing countries. This shortfall has resulted in the resurgence and re-establishment of endemic measles transmission [6-7]. To achieve measles elimination, the WHO aims to reach at least 95% immunization coverage with the MCV1 at both national and district levels, while also reducing the incidence to fewer than 5 cases per million individuals. These targets are essential for sustained progress in measles eradication efforts [8].

According to the U.S. Centers for Disease Control and Prevention, over sixty million measles vaccine doses were delayed or not administered globally due to the COVID-19 pandemic [9]. In a developing country like Nigeria, the situation is particularly severe, with the country ranking fourth among those facing major global measles outbreaks. Contributing factors include a substantial number of unvaccinated children, low routine immunization coverage, and heightened susceptibility among the population [9-10]. In 2015, approximately three million of the global total of 20.8 million infants lacking the MCV1 were in Nigeria [2]. Given the ongoing measles burden in Nigeria and the risk of future outbreaks, understanding incidence patterns over time is essential for improving disease surveillance and response. Thus, this study investigates the trend and seasonality of measles in Nigeria through case-based surveillance data spanning January 2011 to December 2022, with a subsequent four-year forecast starting from January 2023. The research aims to provide a valuable reference for strategies in mitigating and eliminating measles in Nigeria.

Methods and Materials

The study utilized data obtained from the official website of WHO, which included laboratory-confirmed measles cases reported monthly in Nigeria from January 2011 to December 2022 [11]. Population estimates for Nigeria during this period were retrieved [12]. The incidence risk of measles was calculated for each month by dividing the monthly cases by the estimated annual population and multiplying the result by one million. This method allowed for a standardized incidence risk per million population [13]. Statistical analyses were conducted using Stata and R for descriptive statistics and time series analysis, respectively [14-15]. The time series analysis utilized Seasonal and Trend decomposition using Loess (STL) based on Cleveland's approach (a method that effectively separates trend, seasonality, and residual components in nonstationary time series data, making it well-suited for analyzing measles incidence patterns), and the Durbin-Watson test for autocorrelation assessment using a two-sided alternative hypothesis [16, 17]. These methods allowed for a comprehensive understanding of the trends and seasonal patterns in the data.

Following Box and Jenkins' iterative modeling steps, the study assessed the need for differencing during STL and applied the Seasonal Autoregressive Integrated Moving Average (SARIMA) model to the data to filter out seasonal effects and achieve stationarity [18]. The SARIMA model's parameters (p, d, q) (P, D, Q) s were estimated, with the autocorrelation function (ACF) and partial autocorrelation function (PACF) used to guide order determination. In this context, p represents the non-seasonal autoregression order, d is the non-seasonal differencing, q represents the non-seasonal moving average order, P denotes for seasonal autoregression order, D is the seasonal differencing, Q represents the seasonal moving average order, and 's' indicates the length of the seasonal period. The best predictive model was identified based on the lowest Akaike Information Criterion (AIC), and its accuracy was further assessed using the root mean square error (RMSE) [19]. This approach aligns with standard practices in time series analysis [18], providing robust forecasting capabilities while accounting for seasonal variations in the data.

The fit of the model was validated for normality, homoscedasticity, and independence using quantile-quantile (Q-Q) plots, residual' distribution analysis, and the Ljung-Box test [20]. The chosen model was used to predict measles incidence in Nigeria for the year 2023, with the predictions visualized using a line chart. The mean absolute error (MAE) was computed to assess the average absolute difference between observed and predicted measles incidence for 2023. Furthermore, the model was extended to forecast monthly measles incidence from January 2024 to December 2026, providing a long-term projection of the disease to provide actionable insights for policymakers while balancing predictive reliability.

Results

3.1 Descriptive Analysis of Measles Incidence

The total number of measles cases reported from January 2011 to December 2022 was 203,587, and the average incidence was 7.5 cases per million population in Nigeria. The measles incidence ranged from 0.3 to 101.9 per one million population. Measles incidence peaked during January to March, with interquartile ranges of 13.5, 17.7, and 17.5 cases per one million population in January, February, and March, respectively, surpassing those of the other months (Figure 1). The highest spike was recorded in the year 2013, followed by 2019, and 2022 (Figure 2).

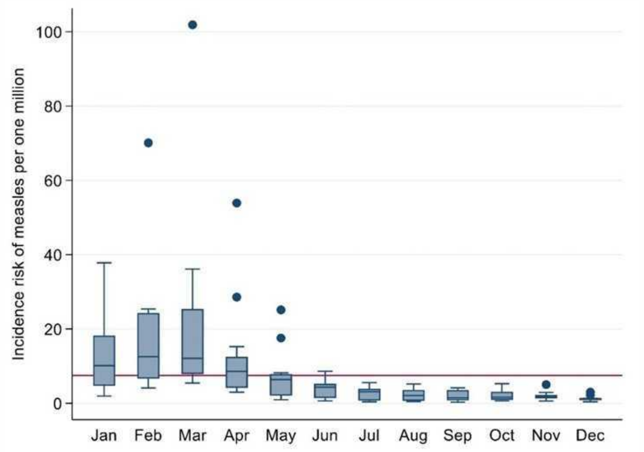

Figure 1. Box plot showing the distribution of the overall monthly incidence of measles per one million of the population in Nigeria (2011 to 2022), (red reference line depicts the overall average incidence)

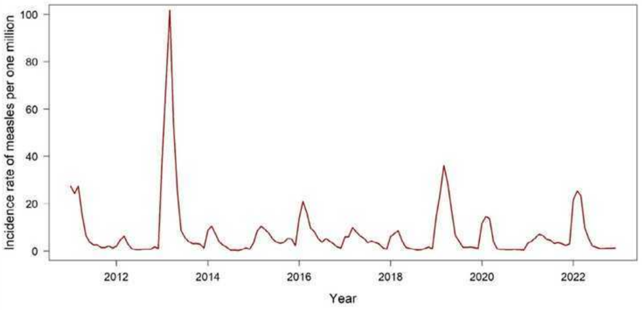

Figure 2. Line plot of the observed incidence of measles per one million population in Nigeria (2011 - 2022)

3.2 Seasonal ARIMA Model for 2012 to 2022

The STL decomposition analysis is broken down into four key components. The top panel displays the original time series, showing fluctuations in measles incidence with noticeable peaks and troughs. The second panel illustrates the seasonal component, highlighting a recurring annual pattern with consistent peaks and troughs, suggesting a distinct and stable seasonality in the incidence of measles. The third panel represents the long-term trend component, which does not exhibit a clear upward or downward trajectory, indicating no clear trend in the incidence of measles over the study period. Finally, the fourth panel captures the residual component, representing unexplained variation in the data after accounting for both seasonality and trend (Figure 3). The Durbin-Watson test indicated autocorrelation in the monthly time series data. After evaluating four SARIMA models using criteria such as AIC, ACF, PACF, and residual QQ-plot (Table 1), the SARIMA (3, 0, 1)(1, 1, 1)$_{12}$ model was chosen as the best-fitting model for predicting measles incidence in Nigeria.

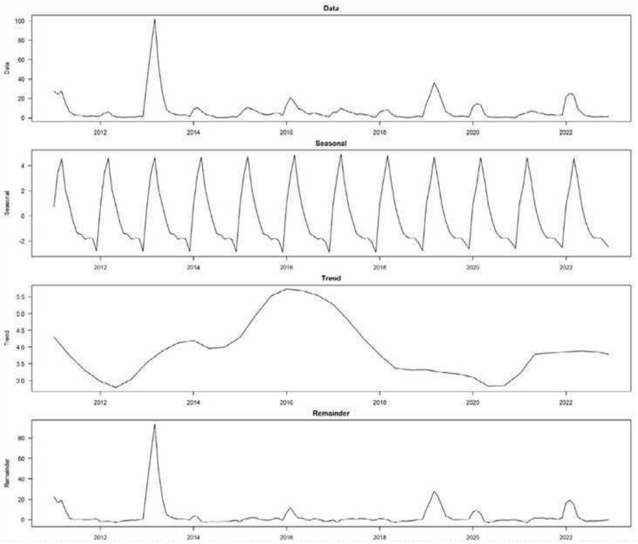

Figure 3. Seasonal and trend decomposition using Loess for incidence risks of measles per million population in Nigeria from 2011 to 2022

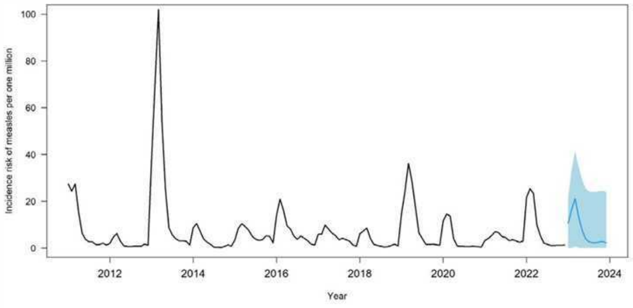

Figure 4: Time series of measles incidence per one million population in Nigeria with a 12-month forecast for 2023 and 95% prediction intervals

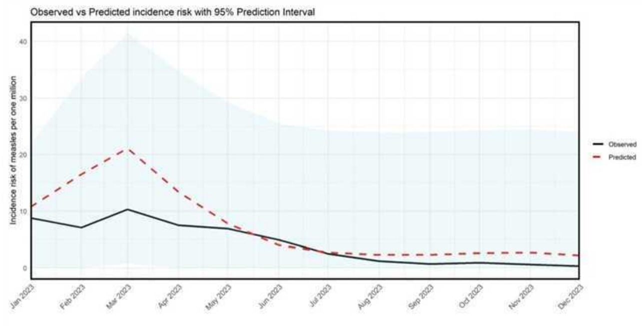

Figure 5. Line plot comparing the observed and predicted measles incidence with 95% prediction intervals per one million population in Nigeria for the year 2023

Table 1. The root mean square error and Akaike Information Criterion for the four fitted SARIMA models to explain the incidence of measles in Nigeria from 2011 to 2012

Fit	Models	Akaike Information Criterion	Root Mean Square Error
1	SARIMA(0,0,0)(0,1,0)$_{12}$	1137.8	17.1
2	SARIMA(0,0,0)(1,1,0)$_{12}$	1079.7	13.4
3	SARIMA(0,0,0)(1,1,1)$_{12}$	1034.9	10.4
4	SARIMA(3,0,1)(1,1,1)$_{12}$	867.6	5.3

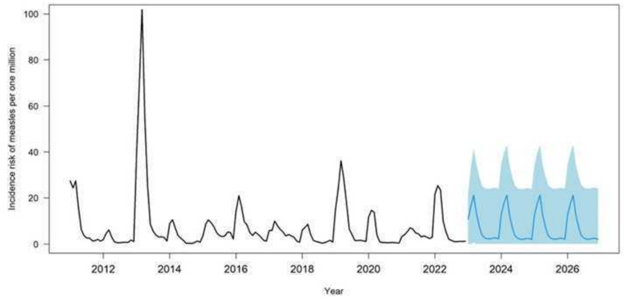

Figure 6. Time series showing the measles incidence per one million of the population in Nigeria, along with a 48-month forecast (2023–2026) and 95% prediction intervals

3.3 Forecasting the Measles Incidence to 2026

The SARIMA (3, 0, 1)(1, 1, 1)$_{12}$ model forecasted monthly measles incidence from January to December 2023 (Figure 4). A comparison between the predicted and observed data resulted in an MAE of 3.2 cases per one million population (Figure 5), and the observed incidence falls within the predicted estimates' 95% prediction interval for 2023. The model also projected similar measles incidence levels for an additional three years from January 2024 to December 2026 (Figure 6).

Discussion

Measles remains a major cause of child mortality in Nigeria and other developing nations, due to weak health infrastructure and vaccination coverage [4]. This study, employing time series analysis on eleven years of data from laboratory-confirmed measles cases, provides insights into the trends, seasonal patterns of measles incidence, and future projections of this trajectory.

In Nigeria, gaps in routine immunization campaigns have been a major factor contributing to recurrent measles outbreaks [21]. Despite a slight increase in vaccine coverage from 42% in 2012 to 47% in 2013, the country experienced its most extensive measles outbreak in 2013, particularly affecting unvaccinated children under five [21]. The outbreaks observed in 2019 and 2022 could likely be tied to a decline in vaccinations and were possibly exacerbated by the COVID-19 pandemic, as seen in other countries like the UK, the US, and Pakistan [22-24]. Adequate action is emphasized for Nigeria, citing low coverage, inadequate healthcare services, and limited community awareness as contributing factors [22, 25]. Measles remains endemic in Nigeria, as reflected in the country's consistently high case-reporting rates [21].

Since 2006, Nigeria has maintained a nationwide case-based surveillance system that includes identifying and reporting suspected cases, conducting serological confirmation, and sharing the data with the WHO on a weekly basis. In 2016 alone, Nigeria reported over 11,800 confirmed measles cases, accounting for nearly 40% of all confirmed cases reported in the African Region [21]. The study revealed endemic transmission, with measles incidence ranging from 0.3 to 101.9 per one million population, surpassing the WHO's control threshold of less than 5 cases per one million [4]. A clear seasonal peak was observed in measles incidence from January to March, with a gradual decline until December, consistent with findings from Ibrahim et al. [26]. This persistent transmission highlights the challenges in controlling measles in Nigeria and underscores the urgent need for sustained vaccination and public health measures to meet global health standards. Based on the observed seasonality, we recommend pre-emptive vaccination campaigns ahead of peak transmission periods to maximize immunity before cases surge. Additionally, targeted public health outreach efforts, such as awareness campaigns, school-based immunization programs, and enhanced surveillance, should be intensified during high-risk periods to mitigate outbreaks. These measures, informed by our results, could help optimize resource allocation and strengthen measles control efforts.

Statistical models play a crucial role in analyzing historical surveillance data, identifying patterns that may signal emerging health threats, and enabling timely responses from public health agencies to potential outbreaks [27]. ARIMA modeling, a popular technique for time series analysis and short-term forecasting, has found extensive application in epidemiology. It has been widely utilized to monitor and accurately predict infectious diseases, such as influenza in China and the USA, Leptospirosis in Thailand, and Cryptosporidiosis in Canada [28-30]. The application of the SARIMA model for predicting the incidence of measles is innovative. To the best of our understanding, no study has previously utilized this model in the surveillance of measles in Nigeria. This model incorporates the seasonality of measles and ensures stationarity before making predictions, offering enhanced reliability compared to the commonly used ARIMA model. In 2023, the predicted and observed measles incidence closely aligned with a moderate average absolute error. Extending the analysis, the model forecasts similar seasonal patterns and magnitudes persisting into 2026, contingent on constant factors. Ultimately, this study introduces a valuable tool for measles surveillance and prediction in Nigeria.

The predictions for measles incidence exhibit considerably wide 95% prediction intervals, with the intervals for each month including 0.00 cases per million population. Such wide CIs may result from unmeasured confounders in the data, such as variability in transmission dynamics, and or potential changes in vaccination coverage. While our model captures historical seasonality and trends, these findings underscore the importance of ongoing surveillance and adaptive public health strategies. Nigeria has implemented measures to control measles, including the integration of MCV1 and MCV2, but success hinges on addressing underlying challenges [21]. Proactive efforts are essential to prevent persistence of seasonal patterns in measles incidence. Contributing factors such as low vaccination coverage and delayed outbreak responses may sustain measles endemicity.

While our findings provide valuable insights to the monitoring and surveillance of measles incidence in Nigeria, several limitations should be acknowledged. First, the model predictions do not account for external factors such as vaccination campaigns, government interventions, or cross-border outbreaks, all of which can significantly influence measles transmission dynamics. As a result, the projections may be overly simplistic and should be interpreted with caution. Second, the study relies on case-based surveillance data, which may be subject to underreporting or misclassification, particularly in regions with limited healthcare access, such as Nigeria. Such data limitations could introduce bias in incidence estimates and impact the reliability of the forecasts. Additionally, this analysis focuses on the time series of measles in Nigeria, without considering its spatial component due to the absence of state-level data in the analyzed surveillance data. Furthermore, we approximated the estimated annual population of humans as the population at risk, which requires caution in the interpretation of the findings. This approximation may not fully reflect the true population at risk of the disease. Despite these constraints, our study highlights critical seasonal trends that can inform targeted public health interventions. Future research should integrate additional covariates to improve model robustness and predictive accuracy. Overall, this analysis provides a reference for decision-makers to formulate timely strategies for mitigating and eliminating measles in Nigeria. Emphasizing a targeted vaccination initiative in high-risk populations, particularly children, before the annual peak in March will ensure immunity and is crucial for effective outbreak prevention

Conclusion

This study identified a consistent seasonal peak in measles incidence from January to March in Nigeria, with no clear long-term trend observed. Forecasts suggest that these seasonal patterns and magnitudes will persist through 2026, underscoring the need for enhanced vaccination coverage and targeted interventions during peak seasons. However, the wide 95% prediction intervals around predicted estimates highlight uncertainty, emphasizing the need for ongoing surveillance. Therefore, policymakers are urged to implement the necessary measures to mitigate the anticipated increase in measles cases and work towards effective control and eventual eradication.

Funding: No funding was received for this project.

Author contributions: RO: conceptualization, data analysis, validation, writing-original draft. BA: review of methodology, writing-review & editing. EJ and PA: writing-review & editing. OB: conceptualization, supervision, review, and editing.

Competing interests: None declared

Acknowledgment: Many thanks to the World Health Organization for providing public access to the dataset that supports this work, which is invaluable for measles surveillance in Nigeria.

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Perspective

Socioeconomic Disparities, Chronic Stress, and Neurodegeneration: A Canadian Policy Perspective on Risk Reduction

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Received: December 17, 2024 | **Published Online:** April 28, 2025

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Introduction

Neurodegenerative diseases, such as Alzheimer's and Parkinson's disease, impair the brain’s functionality [1]. Global aging, driven by improved nutrition, sanitation, education, and healthcare, has increased neurodegenerative disease prevalence [2-3]. While aging remains the most significant risk factor for neurodegenerative diseases [4], research has shown that chronic stress, which is more prevalent amongst individuals of low socioeconomic status (SES), is a critical factor contributing to the onset and progression of neurodegeneration [5-6]. Individuals with lower SES experience heightened stress due to a range of factors, including financial instability and poor housing [6 - 8]. Chronic stress drives neuroinflammation [5, 9], oxidative stress [5, 10], and behavioral changes [6-7], all of which accelerate neurodegeneration. Therefore, addressing the structural causes of chronic stress, particularly those linked to SES disparities, is crucial in mitigating the rising incidence of neurodegenerative diseases. This perspective synthesizes literature to propose a framework linking socioeconomic status, chronic stress, and neurodegeneration and discusses how policy interventions with a focus on the Canadian context can address structural stressors to reduce neurodegenerative disease risk.

Mechanisms Linking Stress and Neurodegeneration

Many pathways link stress and neurodegeneration (Figure 1). Stress activates the body’s hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, leading to the release of cortisol, epinephrine, and other stress hormones [11-13]. Chronic exposure to these hormones impairs neuroplasticity, increases glutamate toxicity, and decreases neurogenesis, all of which contribute to neuronal death and the development of neurodegenerative diseases [5, 12, 14]. Stress-induced neuroinflammation also plays a crucial role in this process. Pro-inflammatory cytokines, which are upregulated during stress, activate pathways that promote neuronal damage and protein aggregation, which are key features of neurodegenerative diseases [5, 9, 15-17]. Additionally, stress induces oxidative stress, disrupting mitochondrial function and activating cell death pathways. Behavioral changes, including poor nutrition, sedentary lifestyle, smoking, and poor sleep quality, which are more common in low-SES populations, exacerbate these effects, creating a vicious cycle that accelerates neurodegeneration [7, 18].

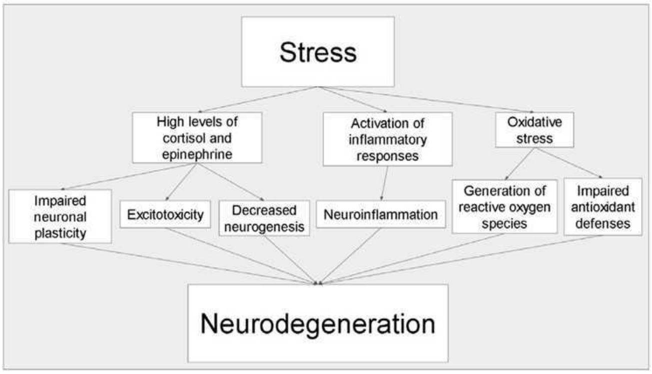

Figure 1. Non-exhaustive pathways of how stress can lead to neurodegeneration

Socioeconomic Status and Chronic Stress

The relationship between SES and stress is well-documented. Baum et al. [6] propose a pathway that describes how SES can impact stress exposure. Specifically, low-SES individuals experience more stress because of a lack of resources and adverse environmental condition, such as more hazards and pollution. Additional pathways through which low SES increases stress and exposure are discussed below (Figure 2).

Individuals from lower socioeconomic backgrounds are more likely to experience chronic stress due to factors such as financial insecurity, low educational attainment, poor housing conditions, and limited access to healthcare [6-8, 19, 20]. Furthermore, low-SES individuals face environmental stressors like pollution and unsafe housing [6,21-22]. Occupational stress is also more prevalent among low-SES populations, with many working in high-stress, low-wage jobs that offer limited job security and benefits [23-25]. Moreover, low social status exacerbates stress through various mechanisms, including discrimination, stigma, and social exclusion, which reduce access to supportive social networks and hinder effective coping strategies [26]. The cumulative effect of these stressors is a heightened vulnerability to chronic stress, which increases the risk of neurodegeneration. In addition to the direct impact of stress, low-SES individuals may face barriers to accessing resources that could mitigate the effects of stress, such as mental health services, nutritious food, and physical activity opportunities [23-24].

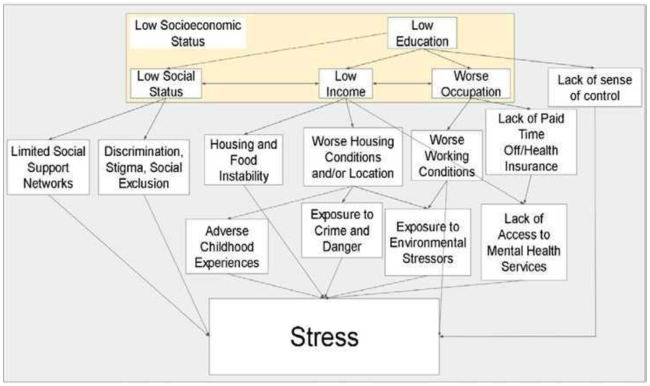

Figure 2. Non-exhaustive pathways of how low socioeconomic status increases stress and impairs an individual's ability to regulate their stress

This exacerbates their stress burden and can increase their risk for neurodegenerative diseases. The cumulative effect of these stressors is a heightened vulnerability to chronic stress, which increases the risk of neurodegeneration. In addition to the direct impact of stress, low-SES individuals may face barriers to accessing resources that could mitigate the effects of stress, such as mental health services, nutritious food, and physical activity opportunities [23-24]. This exacerbates their stress burden and can increase their risk for neurodegenerative diseases.

Policy Solutions to Address Stress and Neurodegeneration

Addressing the intersection of SES, chronic stress, and neurodegeneration requires targeted policy interventions with demonstrated effectiveness. Focusing on the Canadian context, this section highlights two key domains where such interventions have shown promise in mitigating chronic stress among low-SES populations: minimum wage policies and housing affordability initiatives.

Empirical evidence from Canada suggests that raising the minimum wage is associated with improved mental health and reduced financial strain. A study using data from Statistics Canada's National Population Health Survey (1994–2001) found that increases in provincial minimum wages correlated with lower levels of psychological distress and depressive symptoms, particularly among low-wage workers [27]. Similarly, a comparative analysis of 24 OECD countries, including Canada, found that higher minimum wages contributed to improved population health by reducing poverty rates, increasing access to healthcare, and lowering smoking prevalence, likely via reduced financial stress [28]. Together, these findings suggest that increasing minimum wages may be an effective structural intervention for alleviating chronic stress in low-SES individuals and, by extension, reducing stress-related neurodegeneration. Access to affordable housing is another critical determinant of stress among low-SES populations. A study in Ontario found that access to subsidized housing led to significant reductions in depressive symptoms and general distress over a 6 to 18 month period [29]. More recently, LeLoup et al. [30] analyzed 2018 Canadian Housing Survey data and found that long-term, social housing had the most substantial positive effect on renters' economic well-being. Social housing, defined as housing provided or subsidized by governments or non-profits at below-market rates for those in financial need, offers both affordability and long-term tenure security, which are essential for reducing stress linked to housing precarity.

Importantly, these findings do not align well with the Canada Housing Benefit (CHB), introduced as part of the federal National Housing Strategy in 2017. The CHB aims to help low-income Canadians pay rent by providing direct, portable financial assistance [31]. While it aims to increase housing accessibility, it is sensitive to market volatility, such as rising rents and housing shortages, making it a less stable or effective long-term solution for stress reduction. Subsequently, LeLoup et al. [30] found that direct monetary transfers like the CHB had little measurable impact on renters' overall economic well-being. Therefore, the focus of housing accessibility policies should be on expanding social and non-market housing, which has the greatest potential to improve economic well-being and reduce stress associated with housing insecurity, particularly for those in greatest need.

Conclusion

This paper has explored the relationship between SES, chronic stress, and neurodegeneration, highlighting the role of stress in exacerbating the risk of neurodegenerative diseases. Low-SES individuals are more likely to experience chronic stress, which, through mechanisms such as neuroinflammation and oxidative stress, contributes significantly to the development of neurodegenerative diseases. In Canada, policymakers must address the structural drivers of SES-related stress by specific measures, such as increasing the minimum wage and improving housing accessibility, to reduce the burden of neurodegenerative diseases Coordinated efforts across all levels of government, alongside community partnerships, are essential. Targeted policy interventions that address the root causes of chronic stress can help reduce a modifiable risk factor for neurodegeneration, promoting healthier and more equitable aging.

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Development, Implementation, and Evaluation of a Health Information System for a Rural Clinic in Pakistan: A Pilot Model for Low-Resource Settings

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Received: December 7, 2024 | **Published Online:** April 28, 2025
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Abstract

Background: Health information systems (HIS) play a pivotal role in modern healthcare by improving patient outcomes, enhancing data management, and supporting public health initiatives. Despite these benefits, HIS adoption remains limited in rural areas of low- and middle-income countries (LMICs), where healthcare challenges are more pronounced. This study describes the development, implementation, and evaluation of a clinician led HIS model in a rural clinic in Sadwal Kalaan, Punjab, Pakistan. **Methods and Materials:** A structured four-step approach was used in developing, implementing and evaluating the HIS: 1) assessing the need for a HIS through interviews and focus group discussions with the clinic manager, physicians, and auxiliary healthcare staff; 2) designing a system tailored to the clinic's context; 3) implementing a patient intake form designed using a survey questionnaire; and 4) evaluating adoption guided by iterative feedback from key stakeholders and impact on healthcare delivery. **Results:** The HIS was successfully integrated into the clinic's workflow, facilitating patient follow-up by enabling retrieval of previous medical visits. Data was collected from 3,900 patient encounters on demographics, medical presentation, management, and overall patient satisfaction. Nearly all (99.8%) of respondents provided sufficient information regarding their condition and treatment. The system enhanced clinic operations by facilitating data-driven decision-making, optimizing resource allocation, and informing medication stock management. Despite initial resistance from staff regarding additional documentation workload, structured training and workflow adaptations ensured successful adoption. **Conclusion:** Overall, the findings demonstrate that implementing a clinician-led HIS in rural Pakistan is feasible and beneficial, offering scalability for similar settings in other LMICs.

Keywords: Health information systems; Community healthcare; Healthcare delivery; Healthcare innovation; Pakistan

Introduction

Health information systems (HIS) play a critical role in modern healthcare by leveraging technology to facilitate efficient, accurate data collection that enables data-driven improvements inpatient care, workflow efficiency, operations management, and public health surveillance in a sustainable and streamlined manner, enhancing health outcomes [1-4]. These systems provide a comprehensive framework for managing various aspects of healthcare, including administrative, financial, and clinical decision support processes.

In low- and middle-income countries (LMICs) like Pakistan, the adoption of HIS is particularly essential due to the potential to achieve significant improvements in healthcare delivery. Despite the growing recognition of their benefits, the implementation of HIS in LMICs faces several barriers. These include high upfront costs, technological challenges, inadequate training, and issues related to data security and confidentiality [5-6]. However, there are also facilitators, such as clinician-led co-development and evaluation of HIS, which can enhance the integration of digital platforms into existing health systems and overcome these obstacles [5-6]. By engaging clinicians in the development and evaluation process, HIS can ensure that the system meets the needs of healthcare providers and enables sustainable and effective data collection and management.

The importance of HIS in improving health outcomes cannot be overstated. They enable the effective collection and management of patient data, which is crucial for both individual patient care and broader public health initiatives [1, 7]. In hospitals, HIS have demonstrated the ability to reduce medical errors, improve the accuracy and readability of data, and facilitate faster data retrieval. These improvements contribute to better patient outcomes and more efficient healthcare delivery [7]. In Pakistan, the healthcare system faces significant challenges, including limited government spending on health, outdated infrastructure, and a lack of coordination among various health information systems [8]. These barriers hinder the adoption of HIS in Pakistan, yet there is a clear and well-established need for a robust health information management system to support data-driven decision-making and improve healthcare outcomes [8-9].

Developing and implementing a model HIS for clinics in rural Pakistan is essential to address the information deficit and enhance healthcare delivery in these remote and resource-limited settings [10-11]. This paper describes a four-step approach to designing, implementing, and evaluating an HIS in rural Pakistan and provides insights into technological and organizational factors affecting its adoption to improve healthcare delivery and patient outcomes in Pakistan.

Methods and Results

2.1 Study Setting

We sought to establish a HIS in a rural community-based medical clinic in Sadwal Kalaan, Punjab, Pakistan. The clinic, named Assa Clinic, was launched in 2019 as a non-profit medical institution aimed at offering free basic health services (e.g., consultation, prescriptions, labs, request for imaging and specialist evaluation) to low-income families in rural Gujrat, and reduce the burden on the Punjab Health Commission and consequently, the nation. The clinic serves 120 patients/day (both pediatric and adult), manages various acute and chronic conditions, has access to a lab with limited operational capacity, one ECG machine, four patient beds, and primarily outpatient medications. At the time of this study, there were two primary care physicians and one auxiliary healthcare worker who took the role of patient flow management, registration and triaging, primary assessment, medication administration, and discharge planning, as well as another auxiliary healthcare staff to function as a laboratory technician and reduce the overall burden on the clinic where necessary.

2.2 Ethics Approval

Ethical approval was obtained from the Assa Clinic to use data from the patients' intake form. Formal research ethics board approval was not required for this quality improvement and implementation project, as no identifiable patient information was collected or analyzed, and the intervention was embedded in standard clinic operations. All data were obtained from patients who voluntarily agreed to complete the intake form as part of routine clinical care and consented to its use for quality improvement and evaluation purposes. Data were de-identified prior to analysis to protect patient confidentiality, and access was restricted to study coordinators.

2.3 Study Approach

This study followed a four-step structured approach to develop, implement, and evaluate the HIS, as outlined below:

2.3.1 Understanding the Need for a HIS at Assa Clinic - Step I

A two-week period between July 1–July 14, 2023 was dedicated to assessing the need for a HIS.This involved conducting structured interviews and focus group discussions with clinic management, physicians, and auxiliary healthcare staff to determine key priorities and system requirements. The first step for need assessment was to establish buy-in between the clinic administration. To do so, a series of interviews with clinic management, physicians, and healthcare staff were conducted separately and in groups to inquire about the vision and determine the need for a HIS most suitable for the clinic. A qualitative thematic coding approach, employing an inductive methodology, was utilized to analyze data collected throughout the study. No qualitative software was employed, thematic patterns were manually identified based on direct feedback from clinic staff and workflow assessments. The following themes emerged during interactions with the aforementioned stakeholders regarding the role and impact of the HIS at the Assa clinic:

2.3.1.1 Data Collection and Management: Implementing a HIS at the Assa clinic would streamline data collection and management processes. Patient records are traditionally maintained manually, which can lead to errors and inefficiencies, with no system to enable data retrieval during follow-up assessments. A user-friendly and cost-effective electronic health records (EHR) system can help ensure that patient demographics, medical history, and management information are accurately recorded and easily accessible. This digital transformation would enhance the continuity of care and reduce redundant tests and treatments [12-13].

2.3.1.2 Accuracy and Readability of Data: Digital records improve the accuracy and readability of patient information, eliminating the challenges associated with handwritten notes. This clarity is particularly crucial in a high-volume and resource-limited outpatient setting, where quick and accurate information retrieval is necessary for effective patient management [12,14]. Although no documentation on the patient encounter was available prior to this study, the staff at the clinic voiced attempts to do so via paper charting but their efforts were not sustainable due to the existing infrastructure (limited storage, technological capacity, and staff) concerns regarding perceived usefulness and increase in workload with little return on investment.

2.3.1.3 Faster Data Retrieval: A HIS facilitates faster data retrieval, enabling providers to quickly access a patient's medical history, lab results, and previous treatments. This efficiency is essential in a busy clinic like Assa clinic, where reducing wait times can improve patient satisfaction and increase clinic throughput [13, 15]. A major area of improvement identified by the host site was to enable patient follow-ups which will require retrieval of data around past medical visits at the clinic. Prior to the study, the clinic was serving primarily as an urgent care facility, but its vision was to transition to preventative care with periodic health visits and follow-ups.

2.3.1.4 Improvement in Health Outcomes: With comprehensive and accurate patient data, healthcare providers can make better-informed decisions, leading to improved health outcomes. The clinic serves a low-income community with limited access to healthcare. Many patients rely on the Assa clinic as their primary source of medical care. By implementing a HIS, the clinic can offer more reliable and comprehensive care, ultimately improving the health and well-being of the community. Monitoring trends in patient demographics, common conditions, and treatment outcomes can help the clinic identify areas for improvement in its operations to allocate resources more effectively [12, 16].

2.3.1.5 Addressing Information Deficit: In Pakistan, where the healthcare burden is high and resources are limited, a HIS can address significant information deficits. Centralizing and digitizing patient data ensures that essential health information is accessible to providers, researchers, and policymakers, improving healthcare delivery and supporting public health initiatives [13-14, 16]. Buy-in was re-enforced with establishment of leadership by the clinic physicians to help implement the HIS and adapt as needed.

2.3.2 HIS Design and Development - Step II

Over the subsequent two weeks (July 15–July 31, 2023), a clinician-led HIS was designed based on iterative stakeholder feedback through structured interviews. A prototype system was developed as a patient-intake form, enabling data collection on patient demographics, medical history, clinical encounters, and overall patient experiences. Training materials for users were also prepared to facilitate implementation. The key elements of the HIS agreed upon by all groups included data collection on 1) patient demographics; 2) the medical encounter; 3) management of patient presentation and underlying medical condition; and 4) overall patient experience. Table 1 presents the details of the patient intake form. Various electronic data collection software and interfaces were presented to the team at the Assa clinic. Based primarily on familiarity, access, and ease of use for the healthcare staff at the Assa clinic, the Forms feature of Google was used as the data entry interface and Microsoft Excel as the data management tool. The liaison (RA) was offered to explore other options, to which they rated this set-up as the most favorable. A 2-hour training session regarding data collection and management was organized between the study investigators (RA) and the physician lead at the Assa clinic. To ensure survey completion, the survey responses were confidential although not anonymous. All experimental data was kept in a password-protected Excel file in the primary investigator's key-restricted office and only shared between study coordinators. All data was anonymized before being sent to a statistician excluding from data collection for analysis.

2.3.3 Implementation and Data Collection - Step III

The patient-intake form was implemented at the Assa clinic over six months (August 1, 2023 – January 31, 2024). Iterative feedback from clinic staff and healthcare providers was incorporated to refine the system. An organized process for implementing the HIS (patient-intake form) without disrupting patient flow was established. Patient registration to collect information on demographics and begin the medical encounter was done at an area deemed most suitable for access to patients and workflow of the healthcare liaison (RA). The medical encounter and management of patient presentation was handwritten by the physician and subsequently transcribed by the healthcare liaison (RA) to the electronic HIS interface. Data collection on the patient's experience was completed at time of discharge from clinic by the liaison (RA). Data collection was done using the Forms feature of Google and Microsoft excel. Regarding facilitators and barriers to implementation of the HIS, a qualitative thematic coding approach employing an inductive methodology was utilized. Thematic patterns were manually identified based on direct feedback from clinic staff, observations of patient-provider interactions, and workflow assessments. Emerging themes are discussed in the "Evaluation" section under "technological", "organizational", and "acceptability".

Table 1. Patient Intake Form: The HIS

Information Category	Data Collected
Part 1: Patient demographics	Name, age, gender, address, phone number
	Education status, housing status, transportation available
Part 2: Medical encounter	Reason for visit, past medical history
	New patient or follow-up
	Pregnant (yes or no) +/- access to pre-natal care
Part 3: Management of medical problem	Diagnosis and management plan
Part 4: Patient experience	Received information about health burden/condition
	Overall satisfaction with visit

2.3.4 Evaluation (February 1 – February 14, 2024) - Step IV

Data from 3,900 patient encounters were analyzed, enabling sustainable data collection to guide patient follow-up and management of the clinic's operations and resources.

2.3.4.1 Adoption: The HIS platform was successfully adopted at the Assa clinic since piloting its implementation in July 2023. From August 1, 2023-January 31, 2023, data was collected on 3900 patients, all of whom agreed to complete the patient intake for the purpose of this study and quality improvement and operations management of the clinic, including 3 attending physicians licensed with the College of Family Medicine Pakistan. Key participant demographics included gender (64.9% female, 35.1% male), education level (67.1% attended an educational institution; 52.4% did not complete secondary school), and residence in one of 17 unique communities within the clinic's catchment area. Data on patient follow-up was collected on 16% (624) of the population that had already completed a patient intake form, collecting the same information as their initial visit: gender, age, social determinants of health, past medical history, access to pre-natal care (if pregnant), previously established diagnosis and management plan. The HIS allowed for retrieval of prior clinical encounters, which was not previously feasible in the clinic's paper-based system. This improvement in continuity of care was a key indicator of enhanced follow-up. Information on patient experience collected at time of discharge demonstrated that 99.8% of respondents affirmed receiving sufficient information regarding their condition and treatment, while 99.9% confirmed that their expectations for the visit were met.

The HIS also enabled management of the clinic's operations and resources as per feedback from clinic staff. Data collection on the burden of disease allowed clinic staff to redistribute healthcare resources toward these priority areas. The HIS facilitated data-driven decision-making, leading to informed medication stock management and adjustments in physician scheduling to accommodate high-demand services.

2.3.4.2 Technological: The proposed HIS was designed to meet the specific needs of a rural clinic with limited technological infrastructure. Recognizing the varying levels of digital literacy among clinic staff, the system was designed to be intuitive, with minimal reliance on complex software interfaces. The auxiliary healthcare worker responsible for data entry received hands-on demonstrations and ongoing virtual training to ensure competency. The HIS incorporated clinical documentation and basic decision-support tools, enabling efficient data collection and retrieval without significantly disrupting workflow. Compared to more comprehensive HIS models, such as those proposed by Malik et al. [8], this system was simplified to prioritize usability and sustainability in a resource-limited setting. Key considerations included ensuring offline data entry capacity, minimizing hardware requirements, and maintaining compatibility with the clinic's existing infrastructure. While advanced features such as automated clinical decision support, electronic discharge summaries, and computerized provider order entry were recognized as beneficial, they were excluded due to implementation constraints and stakeholder preferences.

2.3.4.3 Organizational: A clinician-led approach to system design ensured that the HIS remained adaptable, reliable, and responsive to evolving clinical needs. The HIS was developed with a focus on sustainability and seamless integration into the clinic's operational framework. Key organizational constraints, such as minimal storage space, unreliable internet access, and limited human resources, were addressed by designing a low-cost, scalable solution using Google Forms for data entry and Microsoft Excel for storage and analysis. Feedback from clinic administrators indicated that the HIS implementation aligned with budgetary constraints and demonstrated a favorable return on investment through improved patient data management and operational efficiency. This improvement in continuity of care was a key indicator of enhanced follow-up. Information on patient experience This improvement in continuity of care was a key indicator of enhanced follow-up. Information on patient experience clinical value, helping to sustain engagement and ensure long-term compliance. These organizational adaptations highlight the feasibility of HIS adoption in similarly resource-limited settings.

2.3.4.4 Acceptability: The HIS received strong acceptance from key stakeholders, including clinic administration, physicians, and healthcare staff, due to its perceived usefulness and ease of integration into routine workflows. Early engagement with stakeholders and iterative feedback sessions facilitated buy-in and minimized resistance to change. Training sessions were designed to be accessible and practical, allowing users with varying levels of technological proficiency to navigate the system effectively. A notable aspect of acceptability was the adaptability of intake processes to minimize disruption to clinical encounters. While some patients, particularly those with limited digital literacy, initially expressed concerns about providing additional information, these were addressed through clear communication by clinic staff. Intake data collection was strategically conducted during waiting periods to minimize workflow interruptions. Overall self-report patient experience was deemed excellent, a marker of strong acceptability of the HIS by patients. Despite initial concerns about increased workload, post-implementation evaluations confirmed that data entry tasks remained manageable. The HIS significantly enhanced patient follow-up, improved data-driven decision-making, and optimized resource allocation, reinforcing its overall value to the clinic.

Discussion and Conclusion

The implementation of a clinician-led HIS in a rural Pakistani clinic demonstrates the feasibility and benefits of digital health solutions in resource-limited settings. By enabling structured patient data collection, improving follow-up care, and enhancing clinic operations without overburdening staff, the HIS proved to be an effective and sustainable intervention. Key factors contributing to its success included a user-friendly interface, strategic workflow adaptation, and ongoing training, which minimized resistance and optimized usability. Stakeholder engagement and phased implementation further facilitated adoption, allowing the system to integrate seamlessly into existing clinical workflows. Challenges such as manual data entry burdens, sustainability beyond initial study periods, and generalizability to diverse clinical settings remain significant.

This study has several limitations. First, the sample selection bias may have influenced the findings, as participants were limited to those who sought care at a single rural clinic, limiting generalizability. Training staff to incorporate this HIS into the host site requires language proficiency from the principal investigators, which may also hinder generalizability to other regions or LMICs. Second, interviewer bias may have been introduced during qualitative data analysis, as thematic coding was conducted manually without the use of qualitative analysis software, leading to potential subjectivity in theme identification. Third, challenges in maintaining objectivity arose due to the clinician-led nature of the HIS implementation, which may have resulted in confirmation bias among participants and socially desirable responses in feedback. To mitigate these biases, iterative stakeholder discussions were conducted, and patient satisfaction surveys were self-administered to ensure anonymity. Another major limitation of this study was a methodological design that did not allow for a robust evaluation of the HIS' impact.

Future efforts will integrate advanced data analytics and user-friendly electronic interfaces to enhance the interpretation of patient-reported information and facilitate patient participation in data collection, ultimately supporting patient-led health service improvement. To broaden the impact of the HIS model, we aim to export it to additional rural clinics in Pakistan and other healthcare settings. Strategic collaborations with governmental and non-governmental health organizations will be pursued to facilitate a national rollout strategy, enabling wider adoption in low-resource healthcare settings. Future research will focus on scaling up HIS implementation by incorporating automated analytics and exploring efficient patient-led data entry methods. Long-term success will be ensured through multisite evaluations to expand HIS adoption, alongside continued collaborations with governmental and non-governmental organizations.

This study provides a model for HIS adoption in similar low-resource settings, underscoring the transformative potential of digital health in strengthening healthcare delivery and improving patient outcomes in LMICs.

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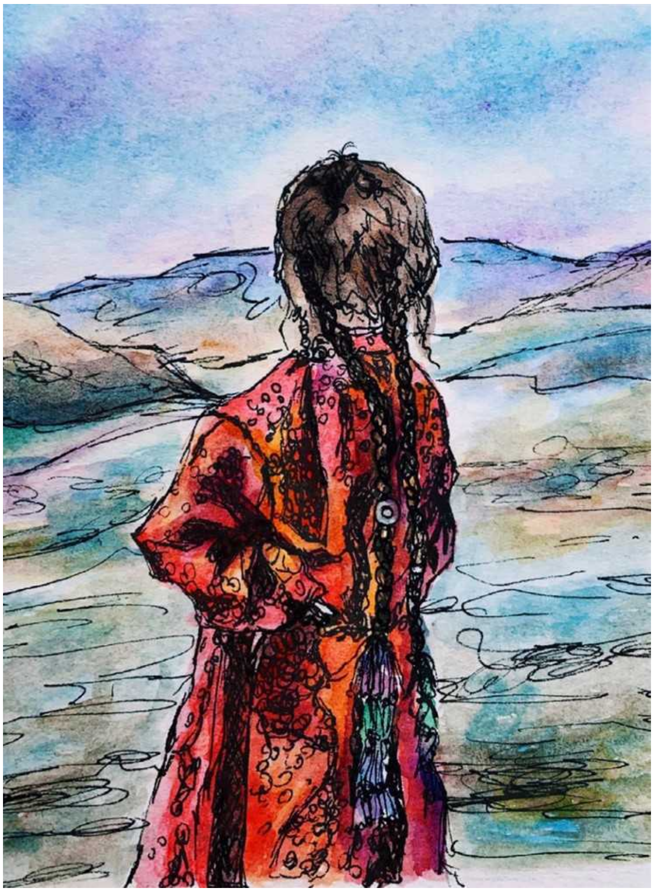

As Far As the Clinic Can See © Evelyn Rogan

Research Article

Factors Associated with Sexual Behaviour among Women Aged 15-49 in South African Low-Income Communities

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Received: January 24, 2025 | **Published Online:** April 28, 2025
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Abstract

Introduction: South Africa faces disproportionately high rates of sexually transmitted diseases (STDs), especially in low-income communities. Understanding how demographic, socioeconomic, and knowledge-based factors influence sexual behaviour is critical for targeted public health interventions. Therefore, this study examined the relationships between socioeconomic status (SES), education, ethnicity, marital status, STD awareness, and sexual behaviour among women aged 15 – 49 in low-income South African communities. **Methods and Materials:** We conducted a cross-sectional study utilizing data from the South Africa Demographic and Health Survey 2016 (SADHS 2016). Key variables included sexual behaviour (safe versus risky), SES, education, place of residence, ethnicity, marital status, and awareness of STDs. Bivariate and multivariable analyses were used to assess associations between sexual behaviour and the aforementioned variables. **Results:** Among 8,513 respondents, 22.3% (95% CI: 21.1–23.5) engaged in risky sexual behaviour. Higher SES was associated with increased odds of risky behaviour, as were White, Coloured, and Indian/Asian ethnicities compared to Black Africans. Conversely, higher education levels, being married or cohabiting, and STD awareness (having heard of AIDS) significantly reduced risky sexual behaviour. Urban residence had no significant effect. These findings highlight the influence of socioeconomic and educational factors on sexual health outcomes. **Conclusion:** Sexual behaviour may be influenced by a number of factors, and behavioural patterns vary across groups. Public health strategies and intersectional approaches to sexual health should be considered to enhance education and STD awareness to reduce risky behaviours and improve sexual health outcomes in different population groups.

Keywords: Sexual behaviour; STI; Socioeconomic status; Education; Ethnicity

Introduction

Sub-Saharan Africa (SSA) experiences a substantial share of the worldwide sexually transmitted infection (STI) cases, accounting for approximately 40% of the global total [1-2]. Approximately 19 million new STI cases are reported annually in the region, around 50% of infections occur in individuals aged 15 – 24 [3]. As of 2020, approximately 7.7 million people in South Africa were living with HIV. While STIs and HIV affect both sexes, young women in Sub-Saharan Africa face significantly higher biological, social, and economic risks [4]. Moreover, gender differences in HIV risk behaviours in South Africa have been linked to socioeconomic status, intimate partner violence, and psychosocial factors [5]. It is hereby essential to understand the factors influencing young women's sexual behaviour to create effective human immunodeficiency virus (HIV) prevention measures.

The literature indicates that age is a significant demographic factor that is associated with unsafe sexual practices, with younger females (15–24 years) more likely to engage in unprotected sex with multiple partners [6], this heightened vulnerability is due to a lack of awareness, societal influences, and limited access to sexual and reproductive health services [7]. Socioeconomic factors, including poverty, low education levels, and unemployment, are strongly linked to a rise in the risk of HIV infection [8]. Of the two million adolescents living with HIV/AIDS globally, 82% reside in sub-Saharan Africa, and each day, 460 adolescent girls become infected with HIV in eastern and southern Africa. South Africa, with the world's highest HIV prevalence (13.5%, affecting 7.7 million people), also faces high rates of early adolescent pregnancies, which further increases the risk of HIV transmission [9-10].

Around 14 million young people die each year from sexual and reproductive health problems, despite the known benefits of safe sex practices [8, 11]. Adolescents' sexual risk behaviours may be shaped by their social and economic conditions, including intimate partner violence, caregiver support, and access to basic needs [12]. The relationship between income or wealth and HIV risk remains complex and requires further investigation. Some studies suggest that socioeconomic stressors might push individuals of lower socioeconomic status (SES) towards riskier sexual behaviours, such as engaging in transactional sex. However, more evidence is needed to understand better how socioeconomic indicators impact People Living with HIV (PLWHIV) in South Africa, especially when accounting for behavioural and demographic factors [13-14].

The DREAMS initiative by President's Emergency Plan for AIDS Relief (PEPFAR), launched in 2015, uses 12 evidence-based interventions to tackle social and economic factors and improve HIV prevention in young women in sub-Saharan Africa [15]. Despite these efforts, high rates of STDs persist in South Africa's low-income communities, reflecting systemic challenges such as poverty, limited healthcare access, and inadequate sexual health education. This research aims to investigate how demographic factors, socioeconomic status (SES), and sexually transmitted diseases (STD) knowledge influence sexual behaviour among females aged 15 to 49 in these communities. Understanding these factors is key to developing interventions that address root causes and support informed sexual health decisions. By focusing on the demographic disparities and socioeconomic inequities, this research has the potential to inform policy and practice, strengthen health systems, and reduce health disparities in South Africa and beyond.

Methods and Materials

2.1 Dependent Variable

This study used sexual behaviour as an outcome variable generated using Multiple Correspondence Analysis (MCA). Risky sexual behaviours comprised actions that increased the likelihood of adverse health outcomes such as STIs and unplanned pregnancies. Specifically, this included unprotected sex (vaginal, oral, or anal), having multiple sexual partners, early sexual debut, engaging in sex with high-risk partners (e.g., those who inject drugs, those with other multiple sexual partners), and alcohol/substance use during sexual encounters. To achieve this, a set of categorical variables related to sexual behaviour were identified as input variables for MCA. These variables captured different aspects of sexual behaviour, including condom use, number of sexual partners, history of transactional sex, and history of sexually transmitted infections (STIs). By applying MCA, the multi-dimensional data were reduced into a single composite score that represents an individual's sexual behaviour pattern. Principal coordinates were assigned to each response category. Through this process, individual observation was positioned along a continuum from safe to risky sexual behaviour based on their MCA scores. To create a binary variable, the MCA scores were split into two equal quantiles (median split approach). The binary outcome variable was coded as 0 = safe sexual behaviour and 1= risky sexual behaviour. Additional file 1 showed the list of variables used to generate sexual behaviour variable.

2.2 Independent Variables

The explanatory variables included were socioeconomic status (high SES and low SES), highest education level (no education, primary, secondary and higher education), locality type (urban and rural), ethnicity (Black/African, White, Coloured and Indian/Asian), marital status (never in union, married/living with partner and widow/divorced/separated, ever heard of STI (no and yes), and Ever heard of AIDS (no and yes). In the South African context, the term Coloured refers to a distinct, officially recognized population group of mixed ancestry, with its own cultural, linguistic, and historical identity. This classification stems from apartheid-era racial categorization and differs significantly from its usage in other contexts, such as the United States. Socioeconomic status is a composite variable representing different levels of socioeconomic standing. It was constructed using MCA, following the same approach as the dependent variable. Additional file 2 showed the list of variables used to generate the socio-economic status.

2.3 Statistical Analysis

The statistical analyses were carried out using STATA 18 (Standard Edition). Survey weights were used in all statistical analyses. Descriptive statistics were employed to summarise sample characteristics. Two distinct models were used. Model I: Univariate analyses were performed to explore the relationship between sexual behaviour and each independent variable. Variables determined statistically significant were included in multivariable logistic regression models to identify characteristics risky sexual behaviour. Model II was fitted using a backward stepwise logistic regression, with variables retained based on a p-value exclusion threshold of 0.2. The strength, direction, and level of statistical significance were established using adjusted odds ratios (aOR), 95% confidence intervals (CI), and p-values < 0.05. A coefficient plot was also utilised to show the estimates from the two models. The stepwise regression approach was chosen to simplify the model by eliminating non-significant variables. Although stepwise regression may raise concerns about overfitting, the sample size was adequate in this study.

2.4 Ethical Clearance

No formal ethical approval was sought for this study, as the study utilised open-source data available from Statistics South Africa (Stats SA) via the following link: https://dhsprogram.com/methodology/survey/survey-display-390.cfm. The dataset includes a range of characteristics, from sociodemographic, maternal and child health, as well as knowledge of HIV/AIDS and HIV transmission collected from a nationally representative sample. The data is publicly available for research purposes and has been anonymized to protect the privacy and confidentiality of the respondents.

The use of this data complies with the terms and conditions set by Statistics South Africa (Stats SA), which allows for its use in academic and policy research. The researchers acknowledge Stats SA for providing access to this valuable data [17].

Results

The sample consisted of n = 8,513 participants. Over half of the sample were from high SES (54.0%), 77.1% had completed secondary school, over two thirds (67.3%) lived in urban areas and 86.8% were Black/African. Moreover, most of the participants were never married (58.6%), and over 90% had ever heard of an STI (96.5%) and AIDS (95.6%). Of 8,513 participants, 22.3% (95% CI: 21.1–23.5) engaged in risky sexual behaviour. A higher prevalence of risky sexual behaviour was observed among participants from high SES, those with primary education, rural residents, the Coloured ethnic group, those who never married, and those who never had an STI or AIDS.

Table 1. Sample Characteristics

Variables	Sample	Risky		P value
	n	%	95% CI	
Total	**8513**	**22.3**	**21.1–23.5**	
Socioeconomic status				
High SES	4304	23.4	21.9-25.0	0.036*
Low SES	3931	21.1	19.4-22.8	
Highest educational level				
No education	190	21.5	15.0-29.7	0.001*
Primary	862	24.7	20.8-29.1	
Secondary	6581	22.9	21.6-24.3	
Higher	880	16.4	13.8-19.5	
Type of place of residence				
Urban	4804	21.6	20.2-23.1	0.080
Rural	3709	23.7	21.9-25.7	
Ethnicity				
Black/African	7358	21.3	20.1-22.6	0.005*
White	214	22.8	16.5-30.7	
Coloured	848	29.8	26.6-33.3	
Indian/Asian	88	35.2	19.4-55.1	
Marital Status				
Never in union	5134	32.6	30.9-34.4	<0.001*
Married/Living with partner	2840	3.8	3.0-4.8	
Widow/Divorced/Separated	539	32.2	27.5-37.2	
Ever heard of STI				
No	267	33.3	27.8-39.4	<0.001*
Yes	8246	21.9	20.7-23.1	
Ever heard of AIDS				
No	332	32.9	27.7-38.6	<0.001*
Yes	8181	21.8	20.6-23.0	

* Indicate significance at 95%

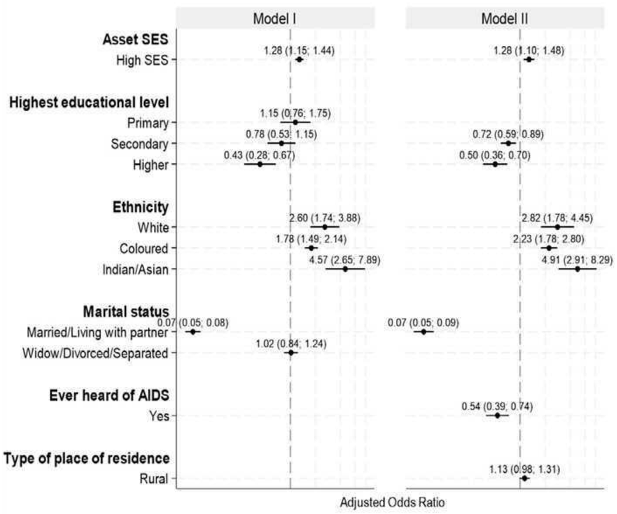
3.1 Bivariate Analysis

The bivariate analysis results evaluating sexual behaviour against each independent variables were added as additional files. Further, additional file 3 showed a bivariate association between sexual behaviour and each independent variable. The following section focuses solely on coefficient plots for significant variables included in the Multivariable model.

3.2 Multivariable Analysis

In the first model (Model I), the odds of risky sexual behaviour were significantly higher among those from high SES compared to low [Adjusted odds ratio (aOR) = 1.28 (95% CI: 1.15–1.44), p = <0.001], and also significantly higher among Whites [aOR=2.60 (95% CI: 1.74–3.88), p = <0.001], Coloured people [aOR=1.78 (95% CI: 1.49–2.14), p = <0.001] and Indian/Asians [aOR=4.57 (95% CI: 2.65–7.89), p = <0.001] than Black Africans. However, the odds of risky sexual behaviour were significantly lower among those with higher education compared to those without formal education [aOR = 0.43 (95% CI: 0.28–0.67), p = 0 <0.001]. The odds of risky sexual behaviour were also significantly lower those who were married or living with a partner compared to those who were never in union [aOR = 0.07 (95% CI: 0.05–0.08), p = <0.001]. In the second model (Model II), the odds of risky sexual behaviour were significantly higher among those from high SES compared to low [aOR = 1.28 (95% CI: 1.10–1.48), p = 0.001], and also significantly higher among Whites [aOR = 2.82 (95% CI: 1.78–4.45), p = <0.001], Coloured people [aOR = 2.33 (95% CI: 1.78–2.80), p = <0.001] and Indian/Asians [aOR=4.57 (95% CI: 4.91–8.29), p = <0.001] than Black Africans. However, the odds of risky sexual behaviour were significantly lower among those with secondary education [aOR = 0.72 (95% CI: 0.59–0.89), p = 0.003] and higher education [aOR = 0.50 (95% CI: 0.36–0.70), p = <0.001] compared to no those without formal education. The odds of risky sexual behaviour were also significantly lower those who had heard of AIDS before compared to those who had never [aOR = 0.54 (95% CI: 0.39–0.74), p = <0.001].

Figure 1. Coefficient Plot of Factors Associated with Risky Sexual Behaviour



Discussion

This study investigated the associations of demographic factors, socioeconomic status, and STD/HIV knowledge with sexual behaviour among females aged 15 to 49 in low-income communities in South Africa. Understanding the factors influencing young women's sexual behaviour is crucial for designing effective prevention strategies. Our study revealed that although females who engage in safe sexual behaviours form a larger proportion, a significant number still engage in risky sexual behaviours. Overall, this study found that individuals with high socio-economic status, White people, Coloured people, and Indians were significantly associated with engaging in risky sexual behaviours. Conversely, individuals with secondary or higher education, those who are married or cohabiting, and those aware of AIDS were less likely to engage in risky behaviors.

This study found a significant association between high SES and risky sexual behaviours. This aligns with a previous study which identified a positive association between high SES and engagement in risky sexual behaviours [18, 19], suggesting that these individuals may be likely to participate in risky behaviours due to access to resources, and different social norms or expectations compared to individuals with lower SES who may be less exposed socially. On the other hand, low SES individuals face barriers to safe practices due to financial constraints and limited access to prevention resources. A study in Durban, South Africa, confirmed that poverty and unemployment hinder access to HIV prevention [20]. Overall, both high and low SES present distinct sexual health challenges, necessitating tailored interventions. A meta-analysis in sub-Saharan Africa found that 75% of sexually active male youths engaged in high-risk sex with girls usually within the same age brackets as themselves [21]. Uchidi et al. linked multiple sexual partnerships to factors like young age, urban residence, higher education, media exposure, and working away from home. These findings highlight the need for targeted interventions. [22]. The finding that higher socioeconomic status (SES) was associated with increased risky sexual behaviours, while higher educational attainment appeared protective, highlights a complex dynamic. It is possible that girls from higher SES households may experience greater exposure to socially permissive environments where risky behaviour is more normalized and increased access to unsupervised leisure or peer group influence, which could facilitate engagement in risk behaviours. In contrast, higher education may be associated with improved knowledge, empowerment, and access to sexual and reproductive health resources, fostering more informed and protective decision-making.

Our study further found that individuals with secondary or higher education levels are less likely to engage in risky sexual behaviour compared to those with lower or no higher education. These findings are consistent with existing literature [23]. Studies have examined the impact of secondary and higher education on risky sexual behaviours, including early sexual debut, having multiple partners, and inconsistent condom use. Studies show that adolescents with secondary education tend to delay sexual debut, have fewer partners, and use condoms more consistently than those with only primary or limited education [24-30]. Schools may be thought to provide structured environments with sexual education programs, which further reinforce safe practices. Rather than the number of sexual partners alone, it is possible that the nature of those relationships, including condom use, equality in decision-making, and mutual consent, plays a more critical role in determining sexual health risk for young girls. For instance, an individual with multiple partners who consistently uses protection may face less risk than someone in a monogamous relationship with a partner engaging in unprotected sex with others. The results also showed that married or cohabiting individuals generally appeared to be less likely to engage in risky sexual behaviours compared to those who had never been in a union. A recent study also supported this, indicating that factors such as longer-term relationships and stable partnerships contribute to lower engagement in risky sexual activities. However, inconsistent condom use remains a concern among married and cohabiting individuals [31-33].

Our study found that those who had heard of AIDS were significantly less likely to engage in risky behaviours compared to those who had not. This finding aligns with multiple studies conducted in South Africa, which confirm that HIV knowledge is associated with increased condom use and safer sexual practices [31, 34 – 36]. These emphasize the critical role of awareness and knowledge in influencing sexual behaviour. Lastly, our analysis also showed that living in rural areas was a significant factor. Individuals living in rural areas were slightly more likely to engage in risky behaviors due to limited access to sexual health services, sex education, STI awareness, and prevention resources. Cultural and social norms in rural areas may also discourage contraceptive use while promoting early marriage. Economic disparities contribute to transactional sex and multiple partnerships for financial support [37 – 39]. Another study conducted by Eaton and colleagues in South Africa highlighted the significant influence of both proximal (interpersonal relationships and physical/organizational environments) and distal (cultural and structural) contexts on sexual behaviour. Economic deprivation was identified as a pervasive factor contributing to risky sexual practices. Social norms that perpetuate women's subordination within sexual relationships were found to exacerbate unsafe sexual behaviours [40].

Research highlights that socioeconomic and community factors strongly influence sexual behaviour in low-income settings. Poverty, inadequate healthcare services, and weak social cohesion increase engagement in risky behaviours. A systematic review found that negative peer influences and gender power imbalances exacerbate unsafe sexual practices [40 – 42]. Neighbourhood-level studies further emphasize the role of peer attitudes and economic hardship in shaping young women’s sexual behaviours. Comparisons with other African countries reveal similar patterns, reinforcing the need for comprehensive sexual education, family-based health programs, and economic empowerment initiatives to promote safer sexual practices [43].

These findings highlight the urgent need for targeted interventions, including comprehensive sexual education, community-and family-based health programs, and economic empowerment initiatives, to promote safer sexual practices among women in low-income communities within South Africa and sub-Saharan Africa in general.

Our study has some limitations. We used an outcome variable derived from a composite of self-reported indicators of sexual behaviour, such as history of STIs and condom use during the most recent sexual encounter. Relying on self-reported data introduces the potential for recall bias, where participants may inaccurately remember or report their behaviours due to social desirability bias or memory lapses. This limitation could affect the accuracy and reliability of the findings, as participants may underreport risky behaviours or overstate adherence to safe practices. Additionally, the cross-sectional design of the study limits causal inference regarding the relationships observed between demographic factors, socioeconomic status, STD/HIV knowledge, and sexual behaviours. The inability to establish temporal sequences prevents definitive conclusions about causality, highlighting the need for longitudinal studies to better understand the dynamics influencing sexual behaviour in low-income South African communities over time. While the study included a large sample size of over 8,000 participants, the variability in the data may have contributed to wider confidence intervals for some estimates, with certain intervals exceeding a range of 3 in the final models. This suggests that there may be substantial uncertainty around these specific estimates, which could be due to heterogeneity in the population or the variability in certain factors. However, the large sample size ensures that the results are generally robust, and the wider confidence intervals should be interpreted as reflecting inherent data variability rather than limitations in sample size. Lastly, while the role of partner violence in shaping sexual behaviour is well-documented, particularly in contexts where power imbalances limit women's sexual autonomy, our dataset did not include sufficient responses to questions that are directly related to intimate partner violence. This is a limitation, and future research should incorporate GBV-related measures to better understand how structural and interpersonal violence intersect with sexual risk, especially among adolescent girls and young women. Furthermore, as SES was measured using a self-reported composite index, it may not accurately reflect income or economic stability, which could limit the precision of interpretations drawn from SES-related patterns in sexual behaviour.

4.1 Implications and Policy Recommendations

Implications: The persistence of risky sexual behaviours among females in low-income communities underscores the need for targeted education and intervention programs. Tailoring educational efforts to the socio-economic and cultural realities of these communities is essential for influencing behaviour change and reducing risk. The association between high socio-economic status (SES) and risky sexual behaviours highlights the diverse influences on sexual health. Public health strategies should acknowledge SES-driven disparities, ensuring that individuals with high SES receive appropriate education rather than assuming they already possess adequate knowledge. For those with lower SES, interventions must tackle barriers such as poverty and limited healthcare access to facilitate safer sexual practices. Interventions should not focus solely on Black/African individuals but consider the distinct needs of other racial groups. Cultural sensitivity is key, ensuring interventions align with diverse beliefs and norms. Addressing healthcare access disparities across racial groups is crucial for improving health outcomes and mitigating risk.

The protective effect of secondary or higher education against risky behaviours reinforces the importance of improving educational access in low-income communities. Public health policies should prioritize comprehensive sexual education in schools, equipping individuals with the knowledge and skills to make informed sexual health decisions. The lower likelihood of risky sexual behaviours among married or cohabiting individuals suggests that promoting stable relationships could be a viable public health strategy. Programs fostering relationship stability and mutual responsibility may reduce high-risk practices. Conversely, interventions for single individuals should emphasize safe sex education and access to healthcare services. Ensuring condom accessibility and promoting proper usage awareness in social settings can enhance safe sex practices. Policies advocating for condom availability in public and private spaces, alongside community engagement initiatives, can create supportive environments for safer behaviors. The study's finding that AIDS awareness reduces risky behaviors underscores the importance of public health campaigns and community outreach. Efforts should focus on accurate, widespread information dissemination, particularly in high-risk and low-income communities. Community health workers can play a vital role in delivering culturally appropriate education and facilitating healthcare access. Regular monitoring and evaluation will ensure interventions remain effective and responsive.

Recommendations: Effective interventions must address the interplay of demographics, SES, and STD/HIV knowledge among females aged 15 to 49 in low-income South African communities. Strategies should include school-based comprehensive sex education, community-driven initiatives led by peer educators and local leaders, and healthcare-centred programs ensuring accessible counselling and resources in clinics and hospitals. Programs should be stratified by SES, addressing healthcare access, education, and financial constraints that shape sexual behaviours. Given South Africa's history of racial health disparities, interventions should be ethically designed to prevent stigma while engaging communities in equitable implementation. Addressing gender norms is crucial, requiring empowerment programs that strengthen women's negotiation skills for safer sex, promote gender equality, and engage men in challenging harmful stereotypes. Economic dependence and limited legal protections must also be addressed through supportive policies that enhance female autonomy and safety.

Conclusion

This study provides insights into the complex relationships between demographic factors, socioeconomic status, and STD/HIV knowledge and their impact on the sexual behaviour of females aged 15 to 49 in low-income South African communities. The findings highlight the importance of targeted educational interventions aimed at increasing awareness of HIV/AIDS and other STDs, promoting safe sexual practices, and addressing cultural and socioeconomic barriers that influence sexual behaviours differently across racial groups. Despite limitations such as reliance on self-reported data and the cross-sectional study design, the results highlight critical areas for public health intervention. Moving forward, longitudinal research and comprehensive, culturally sensitive programs are essential to sustainably reduce risky sexual behaviours and improve sexual health outcomes in these vulnerable populations. By addressing these challenges systematically, stakeholders can develop more effective strategies that empower individuals to make informed decisions about their sexual health and well-being.

Conflict of Interests: Authors declare no conflict of interests
Data availability: https://dhsprogram.com

Conceptualisation: DNE, SCC; **Literature review:** TOO, DNE; **Methods:** DNE, SCC, FLH., MMM, TOO; **Data Analysis:** SCC, SSD, FLH; **Discussions:** SSD, DNE, SCC, TOO, MMM; **Write-up and Review:** DNE, SCC, SSD, FLH, TOO, MMM

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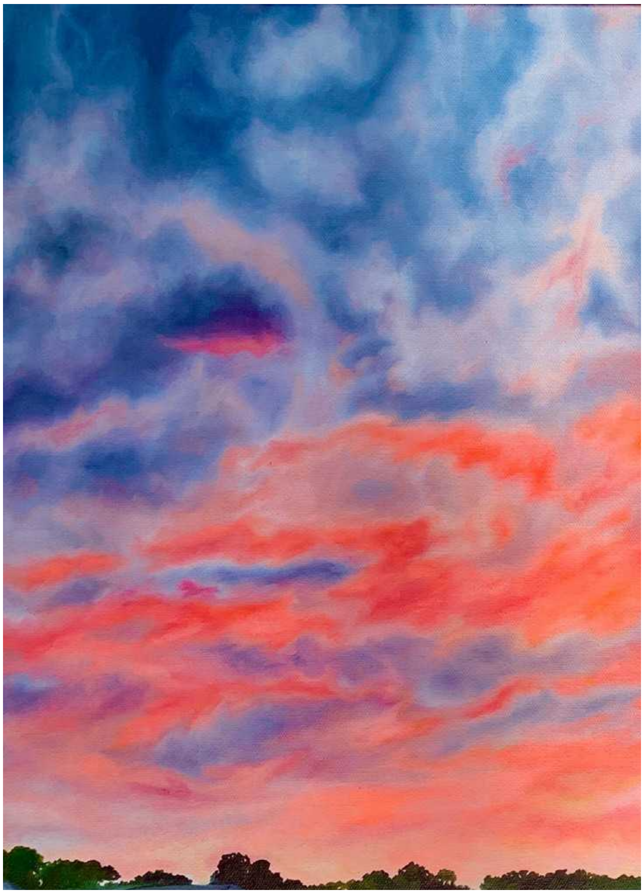

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Research Article

Patients' Profiles and Their Satisfaction with the Quality of Health Services Offered in Primary Healthcare Centers in Anambra State, Nigeria

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Received: 19 February 2025 | **Published Online:** April 28, 2025

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Abstract

Background: The primary healthcare center (PHC) is the initial point of contact for individuals seeking healthcare within their community. Its purpose is to deliver comprehensive health services that cater to patients' unique needs and expectations. However, patient satisfaction from primary health centers has received negligible attention. This study aimed to evaluate patient satisfaction levels with healthcare services provided by primary health centers in Anambra State, Nigeria. **Methods and Materials:** We conducted a cross-sectional study in twelve primary health centers with a descriptive design employing Chi-square, Cramér's V, and linear regression to assess the relationship between patient profile and their satisfaction. Servqual dimensions were used to investigate whether a statistically significant correlation exists between patient profile and patient satisfaction level. **Result:** A total of 385 individuals responded to the survey. The responsiveness dimension of the Servqual dimension had the lowest mean score among the five dimensions assessed. No significant correlations were found between patient satisfaction levels and patient profiles: sex, age, marital status, highest educational attainment, and average monthly income. **Conclusion:** When assessed with the Servqual dimension, patients' satisfaction with the quality of health services offered in the PHCs in Anambra state indicated a suboptimal level of satisfaction. Enhancements in infrastructure and healthcare worker training are essential to elevating the quality of health services provided.

Keywords: Patient satisfaction; Servqual dimensions; Patient profiles; Primary health center; Health services

Introduction

The Primary Healthcare Center (PHC) serves as the first point of contact for individuals' healthcare needs within a community. This concept emphasizes a shared responsibility for addressing healthcare needs and their determinants, involving not only the government but also the community as a whole. There is a significant need to comprehend the importance of patient satisfaction in providing high-quality health services [1]. The degree of patient satisfaction is a reliable measure of service quality, reflecting the patient's verdict towards their experiences while using the health services. According to Peprah and Atarah [1], healthcare service quality is a metric that helps identify areas for improvement. Patient satisfaction levels provide actionable insights into the strengths and weaknesses of healthcare services, informing quality improvement initiatives.

When patients are not satisfied with the level of care provided in PHCs, they tend to discontinue these services and potentially seek other healthcare providers such as traditional health givers, secondary, tertiary, and private health facilities. This may result in low turnout in the PHCs, which can lead to delays or interruptions in treatment plans. In some cases, individuals may stop seeking healthcare services, which may lead to poor health outcomes. The patients' reliance on alternative health services suggests dissatisfaction with their experiences in PHCs. The quality of health services rendered in healthcare centers has been confirmed to affect patients' continued use of health services [2].

Nigeria's healthcare system undoubtedly faces significant challenges, including inadequate funding and severe staff shortages. The country allocates 3.5% to 6.24% of its total budget to health financing, indicating insufficient expenditure on health [3]. Additionally, according to Global Health Workforce [4], Nigeria is one of 36 African countries facing a critical shortage of health workers. For example, the nurse-to-patient ratio is alarmingly low, standing at 1:1160 – far below the WHO-recommended standard of 1:5 [5]. Geographical and distributional inequalities also plague the system, with rural areas facing severe service limitations [6]. These issues collectively undermine the quality and accessibility of healthcare services in Nigeria.

The primary healthcare system is severely underdeveloped, with only a few facilities providing adequate services [7-8]. As a result, patients' expectations and needs are often ignored, unlike in developed countries, where patient satisfaction is a top priority [9]. Nigerian patients are not consulted or involved in designing and implementing healthcare services; instead, they are merely recipients of care, without a voice. This is particularly concerning, as those who can afford better care often seek it elsewhere, leaving the under-resourced public healthcare system to struggle. Thus, this study examines the profiles of patients and their satisfaction levels in utilizing services provided by PHCs in Anambra State, Nigeria, from April to July 2024, and assesses potential correlations between patients' demographic profiles and the level of satisfaction.

Methods and Materials

This study employed a descriptive-correlational research design, specifically a cross-sectional survey, which involved collecting data from a large group of individuals at a single point in time [10]. The descriptive design was used to analyze the frequency and percentage of the patient profiles, including age, sex, marital status, average monthly income, and highest educational attainment [10]. Additionally, this study design assessed and described patient satisfaction levels regarding the quality of healthcare services provided in 12 PHCs in Anambra State. The correlational aspect of the study examined the relationships between patient profiles and patient satisfaction levels. The study variables were categorized into independent variables (patient profiles) and dependent variables (patient satisfaction level). The variables were observed and measured without manipulation, preserving a natural setting. This study is based on two theoretical frameworks: the SERVQUAL Model, also known as the Gap Model, and the Disconfirmation Expectancy Theory, also referred to as the Expectation Theory [11]. The SERVQUAL Model, developed by Parasuraman et al. [12] in 1985, assesses customer satisfaction across five dimensions: reliability, responsiveness, assurance, tangibles, and empathy. The Disconfirmation Expectancy Theory, introduced by Richard Oliver in 1977, explains consumer satisfaction and post-purchase behavior [13]. It posits that customer satisfaction is determined by the gap between their expectations and the actual performance of a product or service.

Tangibles refer to the physical aspects, such as facilities, equipment, and staff appearance [11]. Reliability involves delivering services consistently and accurately, significantly impacting service quality and patient satisfaction [11]. Responsiveness is the eagerness to attend to customers and provide timely services [12]. Assurance consists of the technical knowledge and professionalism of the health worker, as well as their capacity to instill confidence and trustworthiness [11]. Finally, the dimension of empathy entails paying individualized attention to customers [11]. The SERVQUAL Patient Satisfaction Questionnaire was adapted for healthcare to measure patients' satisfaction with the services they received and had two parts. The first part collected personal information about the patients, such as age, sex, marital status, education, and income. The second part asked patients about their satisfaction with the healthcare services, using a 5-point scale: 5 – Very satisfied, 4 – Satisfied, 3 – Neither satisfied nor dissatisfied, 2 – Dissatisfied, 1– Very dissatisfied.

2.1 Research Area

Anambra State, Nigeria, in the southeastern part of the country, served as the study location. Primary Health Center covers an estimated population of 10,000 to 20,000 individuals in the state. It is meant to be in every ward of a local government area [14]. The state has approximately 150 or more public primary health centers, with Anambra South having the highest number of primary health centers.

2.2 Respondents

Before collecting data, ethical approval was obtained from the University of the Visayas Research Board. All respondents volunteered to participate in the study and signed an informed consent form. The study respondents were patients (18 years and above) of selected primary health centers in Anambra State who attended the health center from April to July 2024. The sample size is 385, where the Cochran's formula was used for sample size calculation, at a 95% confidence interval and a 5% margin of error. Of 385 distributed questionnaires, 380 were completed, yielding a 98.7% response rate. The data collected from the respondents for this research work was solely used for research purposes.

2.3 Sampling Design.

Quota sampling was used to select 385 respondents from 12 primary health centers. This technique ensured a representative sample that reflected the diverse characteristics of the population.

2.4 Statistical Data Analysis

This study used various statistical methods to analyze patient data. Frequency distribution and percentages were used to describe patient profiles and mean scores. Standard deviation was used to measure patient satisfaction levels. The chi-square test, Cramér's V, and linear regression analysis were used to examine relationships between variables and identify significant correlations. The assumptions of the chi-square, Cramér's V, and linear regression tests were checked before they were carried out.

Results

Table 1 presents the demographic distribution of respondents using PHCs. It shows that more females (61.1%) use PHCs than males. Respondents aged 35-64 (55.5%) are more likely to use PHCs, older patients (16.8%) have low turnout, possibly due to access barriers or previous dissatisfaction. Married individuals (49.7%) constitute the majority of other civil status groups, while widows/widowers (1.1%) were the smallest group.

The table below illustrates patient satisfaction levels across various SERVQUAL dimensions: the respondents' mean scores were reported. The mean scores and the factor mean were calculated on a five-point scale and coded as follows: Mean Score 0.01 - 1.00 = "Strongly Dissatisfied," Mean Score 1.01 - 2.00 = "Dissatisfied," Mean Score 2.01 - 3.00 = "neither satisfied nor dissatisfied," Mean Score 3.01-4.00 = "Satisfied," and Mean Score 4.01 -5.00 = "Strongly Satisfied."

Chi-square and Cramér's V tests were used to answer the research question and test the hypothesis. The null hypothesis posits that "no significant association exists between patients' characteristics and satisfaction levels." This hypothesis is rejected if the chi-square test yields significance values below the 0.05 threshold, indicating a statistically significant relationship at a 95% confidence level.

Table 1. Demographic Distribution of Respondents

Characteristics	Frequency	Percentage
Sex		
Male	148	38.9
Female	232	61.1
Age		
18 – 34	105	27.6
35 – 64	211	55.5
65+	64	16.8
Marital Status		
Married	189	49.7
Single	175	46.1
Divorced	3	0.8
Widow/Widower	4	1.1
Separated	9	2.3
Average Monthly Income		
$12.6	5	1.3
$13 -$32	111	29.2
$32 -$6	193	50.8
$64 - $158	71	18.7
Level of Education		
Primary Education	96	25.3
Secondary Education	148	38.9
Higher Education	122	32.1
Post-Graduate Education	14	3.7

Table 2. Service Quality in the Five Dimensions of Servqual

Statements Tangibility	Mean Score	Standard Deviation	Descriptive Interpretation
The primary health center has modern service facilities	2.35	0.84	Neither satisfied/dissatisfied
The primary health center has a clean and tidy environment	3.06	0.98	Satisfied
The health workers are well-dressed	3.39	0.82	Satisfied
The appearance of the environment showed that it is a health center.	3.29	0.91	Satisfied
Factor mean	**3.02**	**0.89**	**Satisfied**
Reliability			
The primary health center can provide the promised services	2.72	0.99	Neither dissatisfied/satisfied
The health workers have a strong sense of responsibility and provide timely services	2.60	0.96	Neither dissatisfied/satisfied
The health workers have excellent skills	2.62	0.97	Neither dissatisfied/satisfied
The health personnel can record the condition accurately	2.60	0.97	Neither dissatisfied/satisfied
The primary health center should inform the patient of the exact time of medical treatment	2.71	0.98	Neither dissatisfied/satisfied
Factor mean	**2.65**	**0.90**	**Neither dissatisfied/satisfied**
Responsiveness			
Healthcare personnel can provide services on time	2.61	0.96	Neither dissatisfied/Satisfied
Health workers can handle patients' complaints quickly	2.52	0.93	Neither dissatisfied/Satisfied
Results of laboratory tests can be obtained quickly	2.59	0.96	Neither dissatisfied/Satisfied
Health workers are always available	2.73	0.99	Neither dissatisfied/Satisfied
Factor Mean	**2.61**	**0.96**	**Neither dissatisfied/Satisfied**
Assurance			
Healthcare personnel are trustworthy	2.90	1.00	Neither dissatisfied/Satisfied
Patients feel safe when they see a nurse/healthcare provider	3.26	0.91	Satisfied
Primary health centers attach great importance to protecting patients' privacy	3.05	0.98	Satisfied
Health workers keep patients informed of treatment plans and medication	2.69	0.98	Neither dissatisfied/Satisfied
Factor Mean	**2.98**	**0.97**	**Neither dissatisfied/Satisfied**
Empathy			
Primary healthcare workers treat patients equally	2.61	0.97	Neither dissatisfied/Satisfied
Primary health centers always adhere to the interests of the patients	2.55	0.94	Neither dissatisfied/Satisfied
Healthcare workers do not accept bribes	3.21	0.94	Satisfied
Healthcare providers can accurately understand the needs of the patients	2.86	1.02	Neither dissatisfied/Satisfied
Patients are able to get along with primary health personnel during visits to the primary health centers	3.25	0.93	Satisfied
Factor Mean	**2.89**	**0.96**	**Neither dissatisfied/Satisfied**

Table 3. Relationship between Respondents' Profiles and Their Level of Satisfaction

Variable	Dimension	Chi-square	*p*-value	Cramér's V
Age	Tangibility	3.184	0.247	0.074
Sex	Tangibility	2.083	0.371	0.060
Educational attainment	Tangibility	2.091	0.403	0.064
Average monthly income	Tangibility	1.831	0.611	0.092
Marital Status	Tangibility	2.461	0.421	0.060
Age	Responsiveness	4.045	0.117	0.081
Sex	Responsiveness	2.391	0.383	0.071
Educational attainment	Responsiveness	2.111	0.223	0.061
Average monthly income	Responsiveness	2.031	0.603	0.091
Marital Status	Responsiveness	2.781	0.401	0.064
Age	Reliability	4.104	0.147	0.060
Sex	Reliability	3.024	0.465	0.713
Educational attainment	Reliability	2.182	0.423	0.071
Average monthly income	Reliability	1.172	0.722	0.082
Marital Status	Reliability	3.511	0.331	0.734
Age	Assurance	3.281	0.371	0.074
Sex	Assurance	2.803	0.651	0.069
Educational attainment	Assurance	2.191	0.513	0.063
Average monthly income	Assurance	2.331	0.530	0.083
Marital Status	Assurance	2.570	0.422	0.074
Age	Empathy	4.284	0.457	0.079
Sex	Empathy	2.874	0.409	0.061
Educational attainment	Empathy	2.891	0.421	0.066
Average monthly income	Empathy	2.331	0.821	0.095
Marital Status	Empathy	2.515	0.612	0.074

Analyzing the respondents' opinions using chi-square and Cramér's V's value revealed that the patient profile does not have a significant influence on the perceived quality of healthcare services provided by primary health centers in Anambra State. The dependent variable was chosen because the question is an indicator of patient satisfaction; this question also focuses on understanding patient satisfaction. It also reflects the patients' experience with the health workers' communication and guidance, which is a critical aspect of patient-provider interaction and can significantly impact patient satisfaction. The question also aligns with the five dimensions of the Servqual and is also measurable and quantifiable for linear regression analysis [12].

Table 4. Regression Results

Factors	Beta	95% CI	P-value
Higher level education	0.005	-0.038, 0.042	0.922
Marital status	-0.016	-0.030, 0.022	0.768
Average monthly income	0.080	-0.003, 0.020	0.136
Sex	0.058	-0.042, 0.155	0.263
Age	-0.102	-0.007, 0.0001	0.054

Note: Dependent Variable = I usually receive a satisfactory consultation, explanation, and guidance from nurses in the healthcare centers, R2 = 0.020, F-stat = 1.493. P-Value of F-Stat. = 0.191.

From Table 4, the unstandardized beta (B) for level of education is 0.002, meaning that as education increases, satisfaction slightly increases, but the effect is negligible. The standardized beta (0.005) reinforces that education has almost no predictive power in explaining satisfaction. Similarly, marital status has negative beta coefficients (B=-0.004, β= -0.016), implying that being in a different marital category slightly decreases satisfaction, but the effect is very small and statistically insignificant (p=0.768). Average monthly income has a positive but weak relationship with satisfaction (β=0.009, β=0.080), suggesting that higher income may lead to slightly better satisfaction, though the effect is not significant (p=0.136). Gender has a small positive impact (β=0.056, β=0.058), meaning males or females may have slightly different experiences with nurse consultations, but the effect is weak and not statistically meaningful (p= 0.263). Age has a negative effect on satisfaction (β = −0.003, β=−0.102), suggesting that as people get older, they tend to be slightly less satisfied with nurse consultations. This effect is more substantial than the other variables, and the p-value (p=0.054) is close to significance, indicating that age may be a relevant factor in predicting satisfaction. Overall, all confidence intervals cross the null; hence, none of the independent variables show a strong or statistically significant effect on patients' satisfaction.

Discussion

This study assessed patient satisfaction levels with healthcare services provided by primary health centers in Anambra State, Nigeria. Our study indicates that patients' satisfaction with the quality of health services provided at the 12 included PHCs in Anambra State, as assessed using the SERVQUAL dimensions, was suboptimal. The study's respondents were predominantly female, married, and within 35-64 years age bracket. Most had secondary education or less (64.2%), which may influence their healthcare choices [15]. Those with higher education were less represented, which could be due to better access to quality healthcare. The average monthly income was 51,000-100,000 naira ($32-$63).

The study revealed a notable disparity in patients' satisfaction levels with various aspects of primary healthcare services. While patients expressed satisfaction with the physical facilities (tangibility) of primary health centers, their feelings towards other service dimensions (reliability, responsiveness, assurance, and empathy) were neutral. Satisfaction with specific aspects of tangibility, such as the cleanliness and tidiness of the environment, the appearance of the health center, and the attire of health workers, is encouraging. Nevertheless, there is room for improvement. For instance, providing pipe-borne water, a reliable power supply, adequate infectious waste management, and functional toilet facilities could further enhance the overall satisfaction with the tangibility dimension. Similarly, studies [16-17] reported high satisfaction rates with the cleanliness of hospital environments. This finding aligns with the Servqual model, which emphasizes the importance of tangible aspects in shaping patient satisfaction [17]. Satisfaction with tangibility is consistent with previous studies, such as Peprah and Atarah's [1], which found that patients were highly satisfied with the tangible aspects of healthcare services. These research findings underscore the importance of a clean and tidy environment and have consistently shown that a clean environment positively correlates with patient satisfaction [17].

The study findings on the reliability dimensions of primary healthcare services in Nigeria reveal concerning trends. Respondents' neutral sentiments towards reliability suggest inconsistent experiences, with some services meeting expectations while others fall short. Studies [16, 18] reported low scores in the reliability dimension compared to other evaluated dimensions when patient satisfaction and service quality were assessed in a tertiary hospital in Southeast Nigeria, suggesting that inconsistent experiences with healthcare services are a common issue in various health facilities. The inconsistency in reliability scores may be due to factors such as variability in staff performance, inadequate resources and equipment, lack of training for health workers, and poor compensation and benefits for staff, leading to issues like long waiting times, communication gaps, and poor referral links, which have been cited as major contributors to low reliability scores in previous studies [16, 19-20]. The inability of PHCs to deliver expected services has far-reaching implications. It could result in adverse health consequences, higher morbidity rates, and increased mortality, which calls for improving the quality of health services.

The responsiveness dimension is a critical aspect of healthcare services, and the study's findings highlight the need for improvement. Nigeria's severe shortage of healthcare workers, with a nurse-to-patient ratio significantly lower than the WHO-recommended standard (5), contributes significantly to the neutral sentiments and potential dissatisfaction expressed by respondents. Additional challenges, such as a lack of staff accommodation, functional laboratories, and equipment, contribute to poor health outcomes, delayed treatments, and misdiagnosis. With other studies pointing at similar cases [1, 21] of low responsiveness scores with patient satisfaction, the most sustainable thing to do to improve the situation is to address the shortage of healthcare workers, improve staff accommodation, and provide functional laboratories and equipment by the government and healthcare administrators to enhance the responsiveness dimension. Additionally, efforts should be made to improve communication gaps, waiting times, and referral links by training the staff of PHCs on the importance of good communication.

This study revealed a neutral sentiment among respondents regarding the "assurance" dimension of primary healthcare services, indicating unmet expectations and potential erosion of trust. The findings suggest that patients may harbor concerns about healthcare provider competence, privacy, confidentiality, and inadequate information sharing about treatment plans and medications. The results underscore the need for targeted improvements in primary healthcare services to foster patient trust, ensure privacy and confidentiality, and enhance overall satisfaction, as professional conduct exhibited by healthcare providers impressed patients [19] positively. The low assurance dimension scores, when compared to the results of studies [19, 21], suggest inconsistent experiences with healthcare services as a common issue that needs urgent attention. To address this, periodic training for health workers, better staffing, and a conducive work environment could enhance competence, motivation, and patient care, ultimately leading to better job satisfaction, as previously suggested [19].

The empathy dimension of primary healthcare services received low satisfaction ratings, primarily due to inadequate facilities, unfavorable working conditions, and insufficient training for healthcare workers. These issues hinder patient-centered care, erode trust, strain patient-provider relationships, and compromise care quality. The low satisfaction rating of the empathy dimension by respondents aligns with the studies by Shariff et al. [22] and Zun et al. [20], which reported that service quality fell short of expectations, particularly in the empathy dimension, as measured by the SERVQUAL model. This underscores the need for targeted improvements in Nigeria's healthcare system. It is crucial to prioritize patient needs and train healthcare workers to demonstrate concern and provide client-centered care, as studies by Kashif et al. [23] and Papanikolaou and Zygaris [24] highlighted empathy as a vital dimension in healthcare service quality. To enhance empathy in healthcare, emphasis should be placed on training healthcare workers, collecting patient feedback, supporting staff well-being, and fostering a culture of patient-centered care. This approach can lead to better patient outcomes and satisfaction.

Furthermore, patient demographics (age, marital status, income, sex, and education) did not significantly impact satisfaction levels. Similar to previous findings, this study found no statistically significant correlation between patients' age, sex, educational levels, average monthly income, marital status, and level of satisfaction [26–31]. Importantly, the regression model explained only a small proportion of the variance in patient satisfaction ($R^2=0.02$), suggesting that sociodemographic factors alone may not be strong predictors of patient satisfaction.

Previous studies have also highlighted inadequate equipment and facilities as major challenges in Nigeria's healthcare system, negatively impacting patient satisfaction. This was evident in assessing patient satisfaction with emergency care services at a University Teaching Hospital in South-west Nigeria [32]. Studies have consistently shown that patient satisfaction is influenced by communication, accessibility, and hospital environment [21, 33]. To improve patient satisfaction, healthcare providers must prioritize environmental cleanliness, patient privacy, communication, and interpersonal skills [21]. Addressing these issues is crucial to enhancing patient satisfaction and healthcare outcomes in Nigeria.

Our study has some limitations. The findings are limited by quota sampling, which may introduce bias due to its non-random nature. Furthermore, the choice of sampling method was necessitated by the difficulty in accessing data for all patients attending PHCs in Anambra State, which further underscores the lack of generalizability of these results. Finally, while p-values were used to assess statistical significance in patient satisfaction, they should be interpreted with caution, as they may reflect the certainty or practical relevance of observed differences.

Conclusion

In conclusion, patient satisfaction was assessed using the SERVQUAL dimensions (reliability, assurance, tangibility, empathy, and responsiveness). Patient demographics, including age, marital status, sex, education, and income, did not significantly influence overall patient satisfaction. However, there may be a correlation between patient satisfaction and the quality of health services offered in primary health centers. Based on the respondents' comparison of their actual experiences with their pre-existing expectations before visiting the facilities, there is a pressing need to deliver precise, reliable, high-quality services. This can be achieved by training staff, improving infrastructure and systems through government funding and donations, and addressing staffing shortages by employing more health workers and providing accommodation for 24-hour availability. The government, through the Anambra State Primary Healthcare Development Agency and Local Government Authority, is responsible for implementing these solutions.

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Volume XIV | Issue 1 | 2025

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