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Fishing for Health: Upstream and Downstream

Cover design by Catherine Harder

This illustration portrays a stratified system where knowledge, care, and profit circulate through an interconnected web of actors, yet do not flow equally. Through disrupted reciprocity, the piece reveals how structural inequalities determine who benefits upstream and who is left downstream, unseen and discarded.

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.

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Contact: mjgh.med@mcgill.ca
Website: mjgh.library.mcgill.ca

Letter from the Editor

As the first blossoms of spring cautiously unfurl on Mont Royal, the *McGill Journal of Global Health* (MJGH) introduces Volume XV: *Interconnectedness and Reciprocity*, marking 15 years of peer-reviewed, student-run academic journalism in global health.

Formerly known as *The Prognosis*, the roots of *MJGH* were planted in 2011 and have been carefully nurtured by the McGill Global Health Programs. Since its first issue, the journal has published 101 articles from interdisciplinary scholars worldwide, including this volume. Its editorial and peer review system has upheld learning opportunities for early-career researchers to gain experience in publishing and journal management.

Global health is defined by a scholarship of relationality and contingencies, nestled within broader structures of power. It demands that we confront the thorny questions that interrogate our systems; how they reinforce or neglect equity and how they might be transformed to advance justice. The eclectic set of articles in this 15th edition does just that: invite readers to examine how social, political, and economic structures shape and are transformed by global health challenges.

The contributions span multiple levels of analysis. Some articles foreground material conditions, such as mental health within financial precarity in Bangladesh, local governance in health policy implementation in the Philippines, and vulnerabilities in global governance and coordination. Others examine the structural conditions, including colonial and patriarchal logics in health epistemology, gaps in paternal mental health recognition, and the intersection of antimicrobial resistance and infrastructure collapse in Palestine. Together, the articles illustrate that contemporary health challenges are increasingly interconnected.

Complementary to publication, the *MJGH* continued its legacy of global engagement. This year's programming brought together researchers to reflect on the challenges and opportunities in the academic publishing process. The follow-up workshop harnessed this momentum, inviting community partners to challenge common misconceptions about how research can support grassroots movements, and encouraged participants to provide their insights in a local case study of heat stress and gentrification in Montreal.

The *MJGH* is a product of an ecosystem of a generous, patient, and caring collective. We thank the McGill Global Health Programs' ongoing guidance, foresight, and support of early-career academics. We thank the peer reviewers who volunteered their invaluable expertise to support the integrity of this work. Most importantly, we recognise the authors, whose contributions reflect the urgency and complexity of this evolving field.

In an increasingly uncertain global health landscape, strengthening linkages is essential. A future requires collaborating with communities with justice at the forefront and nurturing reciprocal trust.

In solidarity,

Esme Longley, B.A. & Sc.

Editor-in-Chief, *McGill Journal of Global Health*

MScPH Candidate

On behalf of the MJGH Editorial Team 2025 - 2026

Editorial Board

Editor-In-Chief

Esme Longley, MSc Public Health Candidate

Esme is completing a MSc in Public Health at McGill University after completing a B.A. & Sc. in Sustainability, Science, and Society. Leveraging policy work in health and climate equity across the United Nations, the UK Civil Service, and the private sector, as well as experience in health equity research, Esme hopes to bring a fresh and interdisciplinary perspective to MJGH, with a strong emphasis on epistemic justice.

Copy Editors

Jayde Lee, PhD Family Medicine Candidate

Jayde's research interests lie in women's health, particularly the potential impacts of miscarriage. She joined MJGH to learn more about the process of publishing in peer-reviewed journals and to support fellow students in sharing and disseminating their work. Her global health interests include advancing health equity, especially for marginalized and underserved populations across different contexts.

Kanny Diane, MSc Public Health Candidate

The McGill Journal of Global Health really speaks to Kanny because she is passionate about health sciences, advocacy, and journalism as an instrument of change. Kanny is interested in the ways research, communication, and storytelling can support meaningful action in global health spaces. Her main global health interest is alternative organization.

Céline Gruz, BSc Immunology (Honours) Candidate

Céline has a strong interest in global health, particularly the impacts of climate change on health and infectious diseases, as well as gender inequities and barriers to healthcare access. Over the summer, she conducted research in environmental health, which strengthened her commitment to addressing environmental and social determinants of health through public policy. Céline is excited to help promote interdisciplinary global health research through the MJGH.

Madison Hughes, MSc Epidemiology Candidate

Madison joined MJGH to help make global health research more accessible and engaging, while continuing to strengthen her writing and editorial skills. She's especially interested in supporting work that bridges research, policy, and real-world practice, and in thinking about how knowledge moves beyond academic spaces. Her global health interests broadly include rural medicine and women's health.

Outreach Editors

Nafanta Fadiga, MSc Family Medicine Candidate

Nafanta joined the McGill Journal of Global Health to help strengthen pathways between research, policy, and community action through accessible, equity-oriented knowledge translation. Her work focuses on sickle cell disease, chronic pain, and maternal and reproductive health. Her interests are grounded in a commitment to epistemic and health equity, particularly amplifying lived experience and community-led perspectives.

Rayyan Mounib, BA International Development Studies (Honours)

Rayyan joined MJGH because she cares about making global health research feel accessible, honest, and grounded in lived experience. Her interests include gender-responsive water governance, humanitarian crises, and accountability in global health policy. She is also interested in how editorial work shapes the ways knowledge is shared and understood in global health.

Design Editor

Catherine Harder, MSc Public Health Candidate

Catherine joined the McGill Journal of Global health because she wants to use her time at McGill not only to learn, but to use her past experiences to contribute to meaningful initiatives such as MJGH. Her global health interests focus on addressing health inequities and improving access to care in underserved communities. She is particularly passionate about advancing women's health and refugee health through sustainable, scalable interventions.

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Economic Strain and Depressive Symptoms Among University Students in Bangladesh: A Quality-of-Life Study

Muhammad Hassan Bin Afzal[1]

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Affiliations
[1]Department of Statistics and Data Science, Jahangirnagar University, Dhaka, Bangladesh

Correspondence
hassanafzal1@juniv.edu

Abstract

Economic comfort plays a significant role in ensuring students' quality of life. Measuring the economic condition of students in lower middle-income countries is a vital step in analyzing the impact of economic strain on quality of life. This study investigates the impact of cumulative economic strain on the mental health of a random sample of 500 undergraduate students of a private university in Bangladesh. Three self-reported and validated depression scales (BDI-II, PHQ-9, and CES-D) were used to analyze depressive symptoms, and a new Economic Strain Index (ESI) measured self-reported financial pressure, debt, and satisfaction with living conditions. More severe depressive symptoms are linked to students who experience greater economic strain, and female students are more likely to be impacted by the economic strain. The results suggest that the economic strain is consistently linked to increased depressive symptoms in all subgroups. The current study does not claim any causal relationship because of its cross-sectional design, nor does it claim generalizability given its limited study setting within one private academic institution. Campus-based financial assistance and mental health services, which also specifically focus on culturally sensitive, localized gender norms, could reduce depressive symptoms and enhance students' quality of life.

Keywords: economic strain; depressive symptoms; LMIC context; cross-instrument validation; student mental health; quality of life

Introduction

Economic stability plays a significant role in shaping how young adults navigate their academic journey, and the quality of their lives [1–4]. Students who experience financial pressure, personal debt, or poor living conditions can experience depressive symptoms and lower well-being. This form of economic strain is infrequently measured with short-term indicators in university settings. Existing research mostly focuses on household or national stress indicators, leaving less attention to student-centered strain in lower-middle-income (LMIC) contexts [5]. Even though there is extensive literature exploring the role of economic strain and well-being among young-adult students, there is still limited work on exploring the economic strain as a formative cumulative index and precisely investigating how the economic strain impact various validated depressive scales in lower-middle-income country settings.

The current study focuses on a private academic institution in Bangladesh, where 500 undergraduate students self-reported their quality of life and responses to questions on socioeconomic conditions and mental health. The results from recent studies show that university students tend to report higher depressive symptoms with higher economic strain in addition to lack of family support, and resources [6,7]. Furthermore, studies also find that economic strain may operate differently across demographic groups and affect their quality of life, and that these effects are often moderated by gender and socioeconomic status [2,8–13]. Therefore, the current study investigates two core research questions. First, to what extent does a brief Economic Strain Index correspond to the severity of depressive symptoms measured across three validated scales among Bangladeshi undergraduate students? Second, to what extent do the associations between economic strain and depression differ by gender? The empirical analysis uses a three-stage analytical strategy to investigate the economic strain-depression link among Bangladeshi undergraduate students.

Related Literature

Financial strain, academic pressure, and a lack of social support are all frequently associated with increased symptoms of anxiety and depression in research on university students' well-being. Studies conducted in Europe have shown this pattern across a variety of academic infrastructures and access levels contexts. National surveys conducted in Germany reveal a decrease in social connections and worries about the sustainability of academic support, both of which are linked to students' motivation and mood [14–16]. In the United Kingdom, student perceptions of online teaching quality and workload were associated with stress and depressive symptoms, suggesting that academic disruptions can shape daily experiences of well-being [17].

The empirical studies from Norway add further detail by showing how changes in learning environments and interaction patterns influence stress and coping among students [18,19]. Cross-national comparisons expand this picture. Recent cross-national and longitudinal studies show high levels of depression and anxiety across nine countries, emphasizing both shared stressors and local structural factors shaping student well-being [5,20]. Additional studies in European contexts show that academic pressure, loneliness, and financial uncertainty frequently interact, with implications for emotional health and quality of life among university students [21–25]. Economic strain is linked to poorer student mental health across various settings worldwide. UK studies have linked difficulty paying bills, debt exposure, and high financial worry to poorer psychological scores and declines over time [26–29]. During the pandemic, US data show that food insecurity and multiple hardships relate to worse mental health, even after adjustment [30]. Evidence from Bangladesh aligns with these larger findings while highlighting contextual differences. A nationwide cross-sectional survey during university closures documented high rates of depression and anxiety among students, with financial strain and institutional type playing important roles [6]. Earlier work with first-year students also reported substantial symptoms and identified socioeconomic stressors that interact with academic demands [7,26,27,31]. These studies indicate that strain is not only financial but also embedded in students' living arrangements, family resources, and access to support systems.

The existing research and its findings highlight three key gaps that the current study aims to address. Firstly, economic strain is a significant factor affecting students' emotional well-being, academic engagement, and performance. Secondly, existing research often uses broad stress or income measures rather than specific, brief economic strain indicators that closely align with students' current lived experiences. Thirdly, gender differences are often noted, but how strain affects male and female students in LMIC settings remains less well explored. These underexplored themes justify the development of a novel, brief economic strain index (ESI) to assess economic strain as an indicator of quality of life and examine its relationship with depressive symptoms, using multiple measurement tools in a lower-middle-income context.

Theoretical framework and hypotheses

The study draws on three complementary theoretical frameworks. In this study, "traditions" refers to established lines of research which present balancing explanations of how economic strain influences mental health conditions. The stress process tradition posits that material strain and role pressures increase psychological distress by depleting coping resources [24,32]. The social determinants tradition locates these strains in everyday economic conditions that influence exposure and vulnerability [25,33]. The conservation of resources perspective posits that resource depletion exerts a greater effect than resource acquisition, leading to prolonged shortages and enduring symptoms [33,34]. All of these traditions support the idea that strain exposure results from a combination of stressors rather than one fundamental characteristic. Financial strain, debt, and discontent with living conditions are just a few of the stressors that the Economic Strain Index (ESI) compiles and uses as the exposure of interest. After controlling for age, gender, socioeconomic status, sleep patterns, and hours of social engagement, the first research question (RQ1) asks how much cumulative strain predicts the severity of depressive symptoms on three validated scales . The second research question (RQ2) asks whether gender influences this relationship within the same models. The current study makes the following three hypotheses after a thorough review of the literature and analysis of related studies:

(H1):

Higher economic strain is associated with more severe depressive symptoms across the three scales.

(H2):

Economic strain has a stronger association with depressive symptoms for female students than for male students.

(H3):

The positive association between economic strain and depressive symptoms remains consistent across inferential, structural, and predictive approaches.

Methods

Study setting and sample

The data come from an anonymized group of 500 undergraduate students at a private university in Dhaka, Bangladesh, drawn from the "Mental Health of Undergraduate Students in Bangladesh" dataset. The dataset was created in 2024 by researchers at Daffodil International University

to document student well-being, living conditions, and economic pressures alongside validated depression scales [35]. Because the sample comes from one private institution, the results speak most directly to similar university settings and should not be treated as nationally representative. The questionnaire covers demographic characteristics, student-life experiences, and validated depression scales, and the instrument file details the relevant sections and response formats [35].

Measures

Dependent variables (depression outcomes): The data collection strategy measures depressive symptoms with three validated scales: the Beck Depression Inventory-II (BDI-II), the Patient Health Questionnaire-9 (PHQ-9), and the Center for Epidemiologic Studies Depression Scale (CES-D). BDI-II captures symptom severity, PHQ-9 captures DSM-aligned symptoms over the past two weeks, and CES-D captures symptom frequency over the past week. The study uses three measures specifically the BDI-II, PHQ-9, and CES-D, to evaluate whether the association between economic strain and depressive symptoms holds across complementary instruments. Higher scores indicate more severe symptoms on each scale.

Primary independent variable: Economic Strain Index (ESI). We use a short set of concrete, student-relevant indicators to capture day-to-day financial pressure reported directly by students. The study introduces a new formative Economic Strain Index (ESI) as the primary independent variable to measure the overall economic worries among Bangladeshi undergraduate students. It combines three binary variables: financial pressure, personal debt, and dissatisfaction with the living environment, and scales the resulting score to 0-1 (ESI_norm). Structure tests on the full sample show KMO = 0.530 and Bartlett's test $p < 0.001$. This KMO statistic is methodologically appropriate because the index is designed as a formative composite of distinct stressors rather than a reflective latent construct. A one-factor solution loads all three items as expected, with financial pressure loading most strongly; the PCA loadings are positive for all items. KMO (Kaiser–Meyer–Olkin) checks whether the items share enough common pattern to combine into one index, and Bartlett's test checks whether the items are meaningfully correlated. Both tests support summarizing the three items as one economic strain measure. Figure 1 shows the distribution of ESI_norm against three main dependent variables in this study, with most cases at 0.33 and 0.67. Additional data preprocessing reveals that the Spearman correlations, with ESI following the expected direction, align with the three depression outcomes and covariates. Robustness checks confirm consistent results. A factor-scaled ESI ranks students similarly and yields comparable effects. Leave-one-item-out and weighted versions maintain the same sign and magnitude. Different binning methods for descriptive plots do not change the overall trend. ESI_norm is the normalized index (scaled from 0 to 1), with higher values indicating greater economic strain. These cut points reflect low, mid-range, and high strain within the sample and support clear descriptive comparisons.

Covariates. Age (years), gender (male = 0, female = 1), subjective socioeconomic status (ordered levels), typical sleep hours, and typical social hours are obtained from the student life section. The instrument file lists response options used to code these fields.

Missing data and preprocessing

The raw bilingual labels are mapped to programmatic names, fields are converted to numeric types, and ordinal categories are maintained. After specific recodes and checks, the analytic file includes N = 500. Variance inflation factor (VIF) values are close to 1.0, indicating no multicollinearity issues. Brief median imputations address small gaps in ordinal fields. The descriptive Figure 1 illustrates the sample composition (ESI four-point distribution) and aligns with the data presented in Table 1.

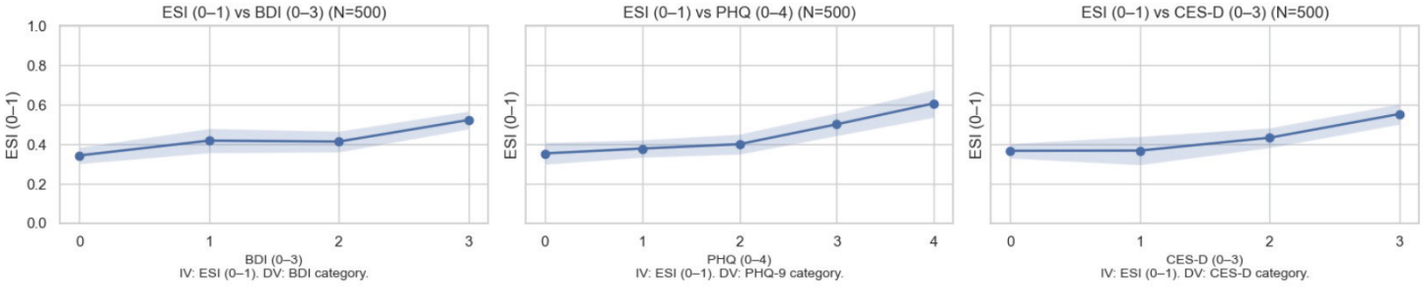

Figure 1. Three panels showing class balance and Mean ESI by DV category (95% CIs) for BDI-II, PHQ-9, CES-D.

The category profile exhibits headroom across outcomes. BDI is most frequently at minimal severity, PHQ-9 at mild, and CES-D at minimal. ESI spans the entire range, with the largest groups at 0.33 (41.8%) and 0.67 (30.4%), and a smaller high-strain group at 1.00 (7.2%). Female participants make up 28.6% of the cohort, while male participants comprise 71.4%. These distributions justify the use of ordered models and a latent approach, and they motivate the ESI trend panels. Figure 3 shows mean outcome levels with 95% confidence intervals across quantiles of continuous ESI; the panels illustrate graded risk and help guide the reader through the inferential tests.

Analytic plan

The study employs three linked analyses to address the two core research questions. First, we fit ordered logistic regression models to estimate the association between a one-unit increase in economic strain and moving into a higher depression severity category, holding covariates constant. Second, we fit a structural equation model (SEM) that combines the three depression scales into one latent depression factor. Third, we use a machine-learning classifier as a robustness check to determine whether economic strain remains a top predictor when the objective is prediction rather than inference.

Analytic strategy

In the second step, a structural equation model treats BDI-II, PHQ-9, and CES-D as ordinal indicators of a single latent Depression factor. This latent factor is then regressed on ESI_norm and the same set of covariates, with gender again allowed to modify the effect of strain. This framework places all three instruments on a standard scale, accounts for measurement error, and tests whether the economic strain pathway remains when depression is modeled as a unified construct rather than three separate outcomes. Model evaluation utilizes standard fit indices for categorical SEM (i.e., CFI, TLI, RMSEA with confidence interval, and SRMR), as well as standardized loadings and paths.

Machine learning robustness check

In the third step, a multiclass XGBoost classifier predicts depression severity categories based on ESI_norm and the covariates, using a stratified train–test split with class-balanced weights. This step does not aim to create a clinical screening tool; instead, it provides a predictive cross-check of feature importance in a non-linear context. Performance metrics (i.e., accuracy, macro-F1, and quadratic weighted kappa) evaluate how well the model reproduces the ordered categories, and permutation-based SHAP values rank features by their average contribution to predictions. If ESI_norm is a strong predictor in the ordered logit models, it remains a key factor in the latent Depression construct in SEM, and ranks among the top features according to

Table 1. Summary of measures and response distributions (N=500)

Variable (role)	Code	Response label	%
BDI_score (Primary DV)	0	Minimal depression	33.0
	1	Mild depression	16.2
	2	Moderate depression	22.4
	3	Severe depression	28.4
PHQ_score (Primary DV)	0	Minimal depression	21.2
	1	Mild depression	30.6
	2	Moderate depression	21.6
	3	Moderate-severe depression	13.8
	4	Severe depression	12.0
	—	Missing	0.8
CESD_score (Primary DV)	0	Minimal or no depressive symptoms	43.8
	1	Mild depression	13.0
	2	Moderate depression	21.0
	3	Severe depression	22.2
ESI_norm (Primary IV)	0	0.00 (formative composite of financial pressure, debt, and living-environment dissatisfaction)	20.6
	1	0.33	41.8
	2	0.67	30.4
	3	1.00	7.2
Gender_binary (Control)	0	Male	71.4
	1	Female	28.6
SES_encoded (Control)	1	Lower	3.4
	2	Lower-Middle	14.2
	3	Middle	65.6
	4	Upper-Middle	15.8
	5	Upper	1.0
Sleep_hours_num (Control)	1	Below 5 hours	18.4
	2	5 hours	18.6
	3	6 hours	32.2
	4	7 hours	17.8
	5	8 hours	10.2
	6	More than 8 hours	2.8
Social_hours_num (Control)	1	< 2 hours/day	16.0
	2	2–4 hours/day	44.4
	3	5–7 hours/day	26.2
	4	8–10 hours/day	7.8
	5	> 10 hours/day	5.6

SHAP. The triangulation supports the idea that cumulative economic strain is a central driver of depressive symptoms in this group. The following sections present and compare results from these three modelling approaches. We treat this as a robustness check: we train the model with repeated cross-validation and report out-of-sample accuracy, then use permutation SHAP values to rank which predictors contribute most to correct classification.

Results

Ordered Logistic Models

Table 2 presents six ordered logistic regression models: a main-effects model and an ESI × gender model for each depression scale (BDI-II, PHQ-9, CES-D). All models include ESI_norm as the primary predictor and adjust for age, gender, socioeconomic status, hours of sleep, and hours of social activity. The descriptive ESI trend panels show a steady increase in symptom levels with increasing strain, consistent with the regression estimates.

Across all three scales, the main-effects models support (H1). As economic strain increases from the lowest to the highest level (0 to 1 on ESI_norm), the odds of being in a worse BDI category rise by a factor of approximately 4.47. Similarly, odds are about 4.67 times higher for PHQ-9 and 4.36 times higher for CES-D, even after controlling for other factors. These figures indicate roughly a four-fold increase in the likelihood of experiencing more severe depressive symptoms across different measurement tools.

The interaction models do not support (H2), as the (ESI_norm × gender) interaction terms cluster near 1.00 (approximately 1.05–1.12), have wide confidence intervals, and are not statistically significant. Model fit remains consistent. However, gender shows a clear baseline difference: at the same ESI level, female students have roughly 50–95% higher odds of being in more severe categories compared to male students. The ordered models, therefore, suggest a gendered baseline gap but a similar economic-strain slope. Control variables behave as expected: higher socioeconomic status and more sleep correlate with lower odds of severe symptoms, while more social hours correlate with higher odds, especially in the top CES-D categories. Age shows minimal association. These factors do not significantly diminish the economic-strain effect.

Proportional-odds assessments indicate that BDI-II satisfies the assumption, with stable ESI coefficients across thresholds. For PHQ-9 and CES-D, the ESI effect is stronger at the most severe categories, suggesting slight violations of the proportional odds assumption. Sensitivity analyses with partial proportional-odds and adjacent-category models reveal the same main trend: ESI_norm consistently predicts positively, and the interaction remains non-significant. These results justify proceeding with a latent-variable test as the next step.

Structural Equation Modeling (SEM)

The SEM treats BDI-II, PHQ-9, and CES-D as ordinal indicators of a single latent Depression factor (Figure 2). All three scales load strongly on this factor, with standardized loadings ranging from 0.91 to 0.96. Model fit is excellent (CFI and TLI are approximately 1.00, RMSEA is around 0.00, and SRMR is low), supporting the assumption of a shared underlying construct. The regression of the latent factor on ESI_norm and the covariates reinforces the main-effects pattern. The standardized path from ESI_norm to Depression is about $\beta \approx 0.24$ (unstandardized approximately 0.97, $p < 0.001$). A one-standard-deviation increase in ESI_norm corresponds to roughly a 0.24-standard-deviation rise in latent depression, which is a larger effect than paths from sleep, SES, social hours, or age. Sleep and SES show protective paths; social hours and gender display positive paths; age is nearly zero. Allowing the ESI to Depression path to vary by gender does not improve model fit, and the moderating path remains small and non-significant. As with the ordered models, gender shifts the baseline level but does not affect the strength of the ESI slope. The SEM thus supports (H1) and again does not support (H2). Along with the strong loading structure, these results provide compelling evidence for (H3): the effect of economic strain persists when the three scales are combined into a single construct.

Predictive Ranking

The final step employs a multiclass XGBoost classifier and permutation-based SHAP values as a predictive cross-check (Figure 3). Each model predicts depression category from ESI_norm and covariates using a stratified train–test split with class-balanced weights. Predictive performance is modest: accuracy is 0.24 for BDI (baseline 0.33), 0.31 for PHQ-9 (baseline 0.31), and 0.34 for CES-D (baseline 0.44), with macro-F1 scores around 0.22–0.30. These results indicate that the models do not provide strong classification and are not suitable for screening. Consequently, this machine-learning approach was strictly deployed as an exploratory tool to extract SHAP values for non-linear feature ranking, not as a clinical diagnostic classifier. However, the SHAP rankings are consistent. For BDI-II, ESI_norm is the second most important feature (after sleep hours). For PHQ-9 and CES-D, ESI_norm is one of the top-ranked feature, surpassing age, sleep, and social hours. Therefore, even in a non-linear setting with modest accuracy, economic strain remains a key driver of predicted depression severity. Thus, predictive ranking supports both (H1) and (H3) for the current study.

Across the three approaches, the Economic Strain Index has profound effects on student mental health and well-being. In stage one, the ordered logit models show

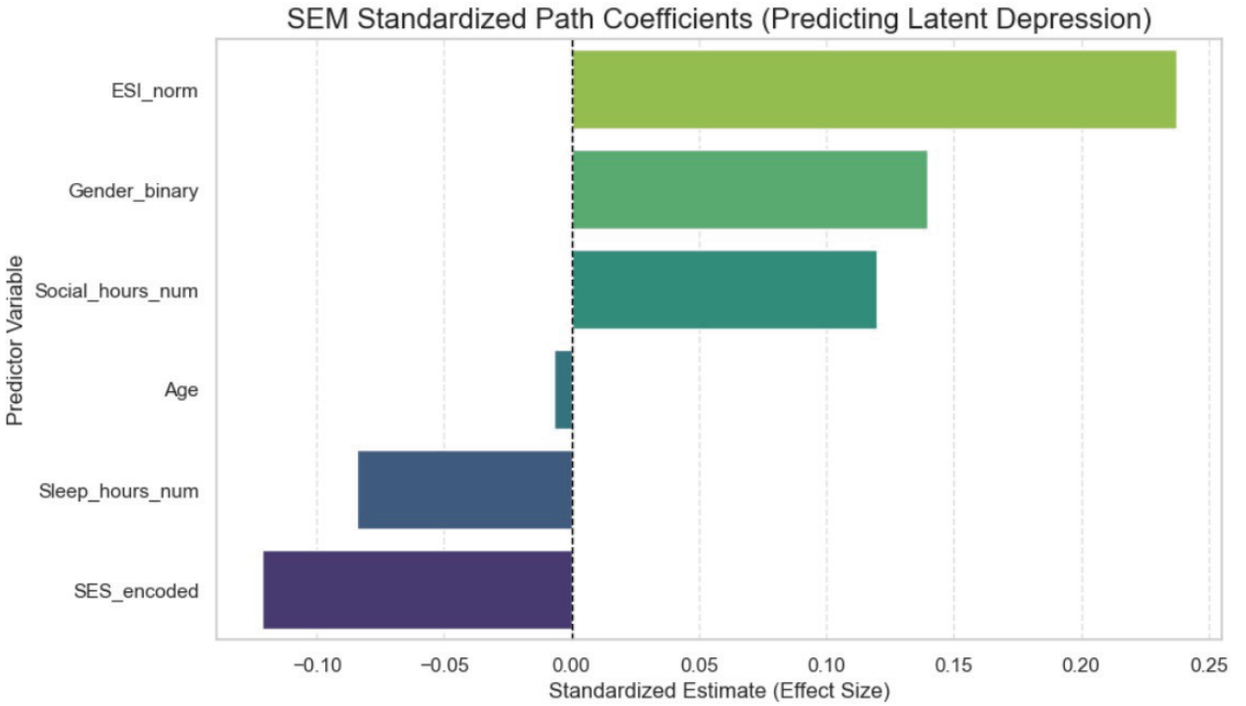

Figure 2. SEM path diagram with standardized loadings and paths.

that moving from the lowest to the highest level of economic strain results in a three to fourfold increase in the odds of being in worse depression categories. In stage two, the SEM highlights that a one-standard-deviation increase in ESI_norm is associated with about a 0.24-standard-deviation rise in a common depression factor. Finally, the XGBoost–SHAP results show that ESI_norm consistently ranks among the top features across all three outcomes. Therefore, the findings from all three approaches support (H1) and (H3) such that economic strain is strongly and consistently linked to depressive symptoms across multiple analytical approaches. Although there is no clear evidence supporting (H2), gender differences are evident in baseline levels. Overall, the triangulation highlights cumulative economic strain as a key quality-of-life factor for students in this setting.

Discussion

The core aim of this study is to investigate whether an Economic Strain Index can predict depression severity among university students in Bangladesh and whether gender influences this relationship. Across all three validated depression scales, ordered logistic models indicate that increasing from ESI_norm = 0 (lowest strain) to ESI_norm = 1 (highest strain) is associated with a 3.3–3.7-fold rise in the odds of being in a higher depression category, after adjusting for age, gender, socioeconomic status, sleep, and social hours. The second analytical strategy, SEM, also confirms this pattern: a one-standard-deviation increase in ESI_norm corresponds to roughly a 0.24-standard-deviation rise in a latent Depression factor that combines BDI-II, PHQ-9, and CES-D. XGBoost–SHAP rankings identify ESI among the top one or two predictors, despite modest overall accuracy. Overall, these findings support (H1) and (H3).

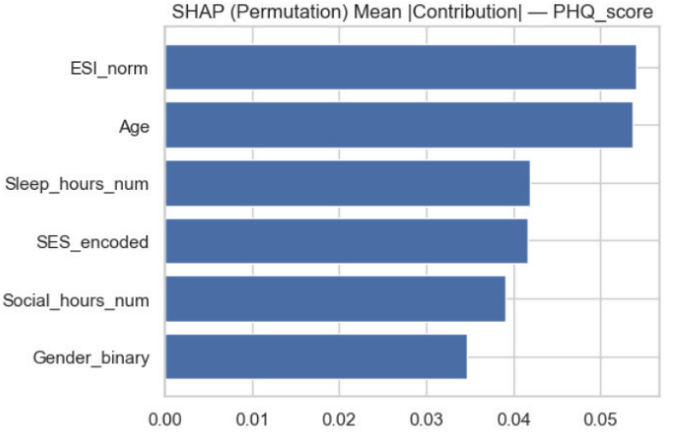

Figure 3. SHAP feature importance (mean |SHAP|).

Table 2. Convergent evidence on the effect of the Economic Strain Index (ESI_norm) across modeling strategies

Outcome / construct	Model type	ESI_norm effect (metric)	Approximate impact / size	Other key patterns and role in triangulation
BDI-II severity category	Ordered logit (H1 main-effects)	OR = 4.47, 95% CI [2.44, 8.20], $p < 0.001$	≈ 4.47x higher odds of worse BDI category (0 to 1 change in ESI)	Female gender OR = 1.95; higher SES and more sleep protective; more social hours harmful. Supports H1; baseline gender gap, common strain slope.
PHQ-9 severity category	Ordered logit (H1 main-effects)	OR = 4.67, 95% CI [2.55, 8.58], $p < 0.001$	≈ 4.67x higher odds of worse PHQ category	Female gender OR = 1.50; SES and sleep protective; social hours harmful. Strongest ESI odds ratio of the three scales. Proportional odds partly drift at upper cuts.
CES-D severity category	Ordered logit (H1 main-effects)	OR = 4.36, 95% CI [2.35, 8.07], $p < 0.001$	≈ 4.36x higher odds of worse CES-D category	Female gender OR = 1.60; SES and sleep protective; social hours harmful. Proportional odds show stronger ESI effects at highest CES-D levels.
Latent Depression factor	SEM (structural path from ESI)	Standardized path β_ESI to Depression = 0.237 (unstd Estimate = 0.97, $p < 0.001$)	+0.24 SD higher latent depression per 1 SD increase in ESI_norm	BDI, PHQ-9, CES-D load very highly on Depression (Std. loadings ≈ 0.91–0.96). Fit excellent (CFI/TLI ≈ 1.00; RMSEA ≈ 0). ESI has the largest structural path among predictors.
BDI-II severity category	XGBoost + SHAP	Mean SHAP for ESI = 0.065	2nd highest feature impact (after sleep hours)	Shows a prominent rightward shift for the Economic Strain Index, driving BDI-II severity predictions.
PHQ-9 severity category	XGBoost + SHAP	Mean SHAP for ESI = 0.054	2nd highest feature impact (after age)	Shifts to the second-highest position after age for PHQ-9 symptom classification.
CES-D severity category	XGBoost + SHAP	Mean SHAP for ESI = 0.068	2nd highest feature impact (after age)	Shifts to the second-highest position after age for CES_D symptom classification.

These results are consistent with the stress process, social determinants, and conservation of resources traditions, all of which suggest that cumulative financial pressure, debt, and poor living conditions increase psychological distress. Specifically, these findings align with the conservation of resources theory by demonstrating how the cumulative depletion of fundamental material security elevates baseline depressive symptoms. The formative ESI index, constructed from concrete stressors rather than assumptions, functions as intended: higher scores indicate greater depressive severity across various instruments and analytical methods. The findings expand on prior Bangladeshi research linking economic hardship, institutional context, and academic pressure to student mental health. The findings support prior research showing that financial stress and unstable learning environments harm educational well-being. The effects vary across identities such as gender, socioeconomic status, language, and social positions, where precarious visa statuses and unexpected health crises can further exacerbate students' exposure to strain and limit access to support [8,12,13,36–42].

The primary contribution of the current study, consequently, is building a novel and brief economic strain index (ESI) that captures the localized nuances and then tests whether economic strain has any significant association with depressive symptoms through validated scales. The findings suggest that the formative ESI is strongly associated with all the validated depressive symptom scales, and gender differences reveal a clear baseline pattern: women have 50–95% higher odds of being in worse depression categories than men at the same ESI level, and SEM indicates higher latent depression levels as well. However, the ESI slope does not differ by gender, which does not support (H2). Economic strain seems to operate through a shared mechanism, with women starting from a higher baseline level. Therefore, the evidence suggests that financial strain is a key indicator of student mental health in this context, and gender reflects baseline vulnerability rather than differential sensitivity to strain.

Policy Implications

The findings from the current study recommend that student mental health policy and academic financial policy should be part of a cohesive policymaking process rather than separate discussions. Some recommended options for improving undergraduate students' health and well-being include

targeted scholarships, well-designed fee relief, and short-term emergency grants that reduce immediate economic pressure, along with structured work–study programs that pay fair wages, protect study time, and reduce reliance on unstable off-campus jobs. Subsequently, additional important measures that support sleep and basic counseling, such as reasonable class schedules, careful exam clustering, quiet hours in hostels, and brief, focused counseling, may complement financial efforts by addressing smaller but consistent factors linked to depressive symptoms.

The study also acknowledges that, as a private academic institution in an LMIC setting, allocating more focused resources and dedicated support to improve students' financial well-being and ensure better mental health, lower depressive symptoms, and an overall improved quality of life is not easy. Therefore, additional planning and long-term planning are needed to have such a foundational space to foster resource allocation and discussion among young people. Furthermore, universities may consider gender-responsive supports that reduce barriers to help-seeking and safety. Examples include safe and accessible campus spaces, access to trained counselors who can meet students' needs, and clear reporting and referral pathways. These steps align with the study's findings without implying causal effects beyond the observed associations.

Limitations

There are several limitations to consider when interpreting these findings. First, the cross-sectional design and reliance on self-reported survey data preclude establishing causality. Notably, the relationship between financial difficulties and mental health may be bidirectional; while economic strain can exacerbate depression, students already experiencing higher depressive symptoms might also perceive and report their financial struggles more negatively due to reporting bias. Second, the sample is drawn from a single private university in Dhaka, which restricts the generalizability of the results to public universities or regional campuses. Third, the Economic Strain Index (ESI) used is a brief three-item measure that, while covering core aspects of financial pressure, debt, and housing dissatisfaction, may not capture the full spectrum of economic stressors. Statistically, partial deviations from proportional odds for the PHQ-9 and CES-D at the highest categories suggest more complex patterns among the most severe cases. Finally, the machine-learning models demonstrated limited accuracy and macro-F1 scores that did not surpass simple baselines; consequently, SHAP results were utilized strictly to rank feature importance at the population level rather than for individual clinical predictions.

Conclusion

The findings strongly suggest that across all three depression measures and several analytical techniques, a simple Economic Strain Index that incorporates financial strain, personal debt, and living environment dissatisfaction is consistently linked to more severe depressive symptoms. More specifically, the findings support a strong association rather than a causal claim, given the cross-sectional design. This pattern is particularly noticeable in a lower-middle-income setting, where family resources may be strained, and formal financial safety nets are not robust or stable, which also aligns with theoretical frameworks on stress, social determinants, and resource loss.

Furthermore, the study also finds that women at the same strain level have higher baseline depression levels, which emphasizes the significance of taking gender into account when developing financial and mental health policies and making sure that those who are initially at higher risk receive financial assistance. Future research should expand this approach across multiple universities, incorporate longitudinal data, and evaluate targeted interventions to lower ESI scores. Meanwhile, the clear message for universities and policymakers is to reduce economic strain through scholarships, fee waivers, structured work–study programs, and supportive learning environments, practical strategies to enhance student mental health.

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Ethics Approval. The original survey followed institutional and national guidelines for research with human participants and received ethics approval from the host institution. The current analysis uses anonymized, publicly available data and was exempt from further review.

Data Availability. The anonymized undergraduate mental-health dataset is available through Mendeley Data (DOI: 10.17632/f4z2bfv7vk.1). The instrument file and variable descriptions accompany the dataset. The full Python code, in a Jupyter notebook, is also available with the journal as additional materials for transparency, replicability, and research rigor.

Competing Interests. The author declares no competing interests.

References

1. Högberg B. Educational stressors and secular trends in school stress and mental health problems in adolescents. Social Science & Medicine. 2021 Feb 1;270:113616. doi:10.1016/j.socscimed.2020.113616

2. Karyotaki E, Cuijpers P, Albor Y, Alonso J, Auerbach RP, Bantjes J, et al. Sources of Stress and Their Associations With Mental Disorders Among College Students: Results of the World Health Organization World Mental Health Surveys International College Student Initiative. Front Psychol. 2020 Jul 30;11. doi:10.3389/fpsyg.2020.01759

3. Li Z, Yao R, Cho SH. Economic Insecurity, Perceived Stress, and Depressive Symptoms: A Longitudinal Study on Mental Health. Applied Research Quality Life. 2025 Aug 1;20(4):1611–28. doi:10.1007/s11482-025-10485-3

4. Afzal MHB. Economic hardship and voting intentions: the influence of inflation in the U.S. presidential choices. SN Bus Econ. 2024 Nov 20;4(12):159. doi:10.1007/s43546-024-00753-z

5. Ochnik D, Rogowska AM, Kuśnierz C, Jakubiak M, Schütz A, Held MJ, et al. Mental health prevalence and predictors among university students in nine countries during the COVID-19 pandemic: a cross-national study. Sci Rep. 2021 Sep 20;11(1):18644. doi:10.1038/s41598-021-97697-3

6. Hossain MJ, Ahmmed F, Khandokar L, Rahman SMA, Hridoy A, Ripa FA, et al. Status of psychological health of students following the extended university closure in Bangladesh: Results from a web-based cross-sectional study. PLOS Global Public Health. 2022 Mar 31;2(3):e0000315. doi:10.1371/journal.pgph.0000315

7. Rifat AH, Bithi IJ, Rifat AH, Bithi IJ. Mental Stress, Socioeconomic Status, and Academic Performance: A Critical Analysis among University Students of Bangladesh. In: Education Annual Volume 2023 [Internet]. IntechOpen; 2023 [cited 2025 Nov 13]. Available from: https://www.intechopen.com/chapters/85845 doi:10.5772/intechopen.109795

8. Afzal MHB. From Connectivity to Care: How Digital Inclusion Shapes Women's Healthcare Decision-Making in Bangladesh. In: Proceedings of the 12th International Conference on Next Generation Computing, Communication, Systems and Security [Internet]. Sylhet Bangladesh: ACM; 2025 [cited 2026 Mar 19]. p. 35–43. Available from: https://dl.acm.org/doi/10.1145/3777555.3777557 doi:10.1145/3777555.3777557

9. Zimmerman FJ, Katon W. Socioeconomic status, depression disparities, and financial strain: what lies behind the income-depression relationship? Health Economics. 2005;14(12):1197–215. doi:10.1002/hec.1011

10. Afzal AB. Longitudinal Trends in Depression and Associated Lifestyle Behaviors: Insights from the SWAN Study. The Columbia University Journal of Global Health [Internet]. 2025 [cited 2026 Mar 19];15(1). Available from: https://journals.library.columbia.edu/index.php/jgh/article/view/13230

11. Eisenberg D, Hunt J, Speer N. Mental health in American colleges and universities: variation across student subgroups and across campuses. J Nerv Ment Dis. 2013 Jan;201(1):60–7. doi:10.1097/NMD.0b013e31827ab077 PubMed PMID: 23274298.

12. Afzal MHB. The Role of Legislative Policy Entrepreneurs in Bridging the Digital Gaps for Immigrants in Host Communities Amidst Global Health Crises. In: Auer ME, Hortsch H, Michler O, Köhler T, editors. Mobility for Smart Cities and Regional Development - Challenges for Higher Education. Cham: Springer International Publishing; 2022. p. 846–57. (Lecture Notes in Networks and Systems). doi:10.1007/978-3-030-93907-6_91

13. Afzal MHB. The effects of the global health crisis on us immigration policies: shifting political agenda-setting and the mobility crisis of immigrants. SN Soc Sci. 2022 Sep 6;2(9):185. doi:10.1007/s43545-022-00486-6

14. Brailovskaia J, Teismann T, Precht LM, Schneider S, Margraf J. The "bubbles"-study: validation of ultra-short scales for the assessment of positive mental health, life satisfaction, and perceived social support. J Public Health (Berl). 2024 Apr 25. doi:10.1007/s10389-024-02266-3

15. Lehnchen J, Helmer SM, Heinrichs K, Burian J, Deptolla Z, Heumann E, et al. Assessment of study conditions, needs for action and students' mental health in Germany – results from the cross-sectional StudiBiFra study. J Public Health (Berl). 2025 Jan 4. doi:10.1007/s10389-024-02387-9

16. Voss A, Dettmer S, Tschorn M, Zoellick JC. Study demands and health status among medical students in two German universities. J Public Health (Berl). 2024 Aug 27. doi:10.1007/s10389-024-02336-6

17. Chen T, Lucock M. The mental health of university students during the COVID-19 pandemic: An online survey in the UK. PLOS ONE. 2022 Jan 12;17(1):e0262562. doi:10.1371/journal.pone.0262562

18. LeTendre GK, Helgetun JB, Woo H, Ikoma S. The Teacher and The State: A Comparative Analysis of Nordic and East Asian Nations. Emerald Group Publishing; 2025. 217 p.

19. Røsand I, Klomstén AT. Exploring Adolescent Stress and Coping Strategies in School: A Qualitative Study of Upper Secondary School Students in Norway. Nordisk tidsskrift for utdanning og praksis. 2024 Dec 31;18(3):146–72. doi:10.23865/up.v18.5975

20. Ochnik D, Rojczyk E, Choina Z, Nowak H, Skalska M, Sroka M, et al. Network analysis of depressive and anxiety symptoms with well-being in students during the COVID-19 pandemic: a repeated cross-sectional study. Sci Rep. 2024 Nov 20;14(1):28789. doi:10.1038/s41598-024-80095-w

21. Ahmed N, Barnett P, Greenburgh A, Pemovska T, Stefanidou T, Lyons N, et al. Mental health in Europe during the COVID-19 pandemic: a systematic review. The Lancet Psychiatry. 2023 Jul 1;10(7):537–56. doi:10.1016/S2215-0366(23)00113-X PubMed PMID: 37321240.

22. Chiesa V, Antony G, Wismar M, Rechel B. COVID-19 pandemic: health impact of staying at home, social distancing and 'lockdown' measures—a systematic review of systematic reviews. J Public Health (Oxf). 2021 Sep 1;43(3):e462–81. doi:10.1093/pubmed/fdab102

23. Di Fazio N, Morena D, Delogu G, Volonnino G, Manetti F, Padovano M, et al. Mental Health Consequences of COVID-19 Pandemic Period in the European Population: An Institutional Challenge. International Journal of Environmental Research and Public Health. 2022 Jan;19(15):9347. doi:10.3390/ijerph19159347

24. Glonti K, Gordeev VS, Goryakin Y, Reeves A, Stuckler D, McKee M, et al. A Systematic Review on Health Resilience to Economic Crises. PLOS ONE. 2015 Apr 23;10(4):e0123117. doi:10.1371/journal.

pone.0123117

25. Leigh-Hunt N, Bagguley D, Bash K, Turner V, Turnbull S, Valtorta N, et al. An overview of systematic reviews on the public health consequences of social isolation and loneliness. Public Health. 2017 Nov 1;152:157–71. doi:10.1016/j.puhe.2017.07.035
26. Richardson M, Abraham C, Bond R. Psychological correlates of university students' academic performance: a systematic review and meta-analysis. Psychol Bull. 2012 Mar;138(2):353–87. doi:10.1037/a0026838 PubMed PMID: 22352812.
27. Richardson T, Elliott P, Roberts R, Jansen M. A Longitudinal Study of Financial Difficulties and Mental Health in a National Sample of British Undergraduate Students. Community Ment Health J. 2017 Apr;53(3):344–52. doi:10.1007/s10597-016-0052-0 PubMed PMID: 27473685; PubMed Central PMCID: PMC5337246.
28. Cooke R, Barkham M, Audin K, Bradley M, Davy J. Student debt and its relation to student mental health. Journal of Further and Higher Education. 2004 Feb 1;28(1):53–66. doi:10.1080/0309877032000161814
29. Jessop DC, Reid M, Solomon L. Financial concern predicts deteriorations in mental and physical health among university students. Psychology & Health. 2020 Feb 1;35(2):196–209. doi:10.1080/08870446.2019.1626393 PubMed PMID: 31181966.
30. Myers CA. Food Insecurity and Psychological Distress: A Review of the Recent Literature. Curr Nutr Rep. 2020 Jun;9(2):107–18. doi:10.1007/s13668-020-00309-1 PubMed PMID: 32240534; PubMed Central PMCID: PMC7282962.
31. Ebert DD, Buntrock C, Mortier P, Auerbach R, Weisel KK, Kessler RC, et al. Prediction of major depressive disorder onset in college students. Depress Anxiety. 2019 Apr;36(4):294–304. doi:10.1002/da.22867 PubMed PMID: 30521136; PubMed Central PMCID: PMC6519292.
32. Aneshensel CS, Mitchell UA. The Stress Process: Its Origins, Evolution, and Future. In: Johnson RJ, Turner RJ, Link BG, editors. Sociology of Mental Health: Selected Topics from Forty Years 1970s-2010s [Internet]. Cham: Springer International Publishing; 2014 [cited 2026 Mar 19]. p. 53–74. Available from: https://doi.org/10.1007/978-3-319-07797-0_3 doi:10.1007/978-3-319-07797-0_3
33. Shankar J, Ip E, Khalema E, Couture J, Tan S, Zulla RT, et al. Education as a Social Determinant of Health: Issues Facing Indigenous and Visible Minority Students in Postsecondary Education in Western Canada. International Journal of Environmental Research and Public Health. 2013 Sep;10(9):3908–29. doi:10.3390/ijerph10093908
34. Hobfoll SE. The Influence of Culture, Community, and the Nested-Self in the Stress Process: Advancing Conservation of Resources Theory. Applied Psychology. 2001;50(3):337–421. doi:10.1111/1464-0597.00062
35. Hasan MZ, - Galib AA, Uddin MS. A Dataset on the Mental Health of Undergraduate Students in Bangladesh [Internet]. Vol. 1. 2024 Aug 9;1. doi:10.17632/f4z2bfv7vk.1
36. Annink A, Gorgievski M, Den Dulk L. Financial hardship and well-being: a cross-national comparison among the European self-employed. European Journal of Work and Organizational Psychology. 2016 Sep 2;25(5):645–57. doi:10.1080/1359432X.2016.1150263
37. Borgonovi F, Pál J. A Framework for the Analysis of Student Well-Being in the Pisa 2015 Study : Being 15 In 2015. MINISTERIO DE EDUCACION [Internet]. 2016 Oct [cited 2025 Nov 26]. Available from: https://repositorio.minedu.gob.pe/handle/20.500.12799/4863
38. Hammoudi Halat D, Soltani A, Dalli R, Alsarraj L, Malki A. Understanding and Fostering Mental Health and Well-Being among University Faculty: A Narrative Review. Journal of Clinical Medicine. 2023 Jan;12(13):4425. doi:10.3390/jcm12134425
39. Russell J, Austin K, Charlton KE, Igwe EO, Kent K, Lambert K, et al. Exploring Financial Challenges and University Support Systems for Student Financial Well-Being: A Scoping Review. International Journal of Environmental Research and Public Health. 2025 Mar;22(3):356. doi:10.3390/ijerph22030356
40. Van de Velde S, Buffel V, Bracke P, Van Hal G, Somogyi NM, Willems B, et al. The COVID-19 International Student Well-being Study. Scand J Public Health. 2021 Feb 1;49(1):114–22. doi:10.1177/1403494820981186
41. Afzal MHB. Recommended practices for doctoral students in navigating and engaging in online courses during COVID-19 pandemic: A personal narrative from a doctoral candidate. Biochem Mol Biol Educ. 2021 Sep;49(5):679–80. doi:10.1002/bmb.21550 PubMed PMID: 34089565; PubMed Central PMCID: PMC8239589.
42. Afzal MHB. The Correlations between Microfinance Participation and Intimate Partner Violence (IPV) in Rural Bangladesh: Economic Disempowerment and Deteriorating Social Health in Rural Women [preprint] [Internet]. Politics of Gender; 2019 Jun [cited 2022 Feb 4]. Report No. Available from: https://preprints.apsanet.org/engage/apsa/article-details/5cfea9c8b1eed50012fbcb46 doi:10.33774/apsa-2019-xwc4c

AI Statement

The author declares that AI was used in line with the MJGH AI policy. Gemini Thinking was used to fix grammar and improve readability. All text generated was reviewed by the author.

The Critical Drivers in the Institutionalization and Implementation of the PhilHealth Outpatient Primary Care Benefit Package: A Case Study of Batuan, Bohol, Philippines

Mark Johnuel Duavis[1,2], Vanessa Chavez[1,2], Deni Marie Gomonid[1,3], Kayessa Ylona Bunagan[1,4], Anderson Ventura[1,5]

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Affiliations
[1]Ateneo de Manila University School of Government

[2]Department of Health Central Visayas

[3]Department of Health Zamboanga Peninsula

[4]Department of Health Eastern Visayas

[5]Department of Health Negros Island

Correspondence
markjohnuel@gmail.com

Abstract

Background. PhilHealth's Konsulta Program has provided financing for outpatient primary care services in the decentralized Philippine health system since 2021. However, despite a record number of accreditations nationwide, many accredited facilities struggle with their institutionalization and operationalization, as evidenced by PhilHealth's extremely low capitation disbursements. This study examines and identifies the critical drivers of Konsulta implementation in the Batuan Primary Care Facility (PCF), a local government unit (LGU)-owned rural health facility in the fourth-class municipality of Batuan, within the province of Bohol, which generated an aggregate 10.35 million Philippine pesos (Php) alongside significant growth in patient and service coverage.

Methods. A sequential mixed-methods case study design was employed, combining quantitative analysis of secondary financial and service data (2022-2025 PhilHealth Statement of Accounts Payable; Batuan LGU financials) with qualitative thematic narrative analysis drawn from document reviews (AKSK project report, LGU ordinances, and meeting minutes) and semi-structured key informant interviews with PCF staff, LGU officials and national agency representatives. Descriptive statistics assessed performance while thematic analysis ranked drivers.

Results. Batuan generated Php 10.35 million from Konsulta which increased 2023 LGU health funds and compensated 2024 and 2025 budget cuts. Four initial institutionalization constraints emerged 1) governance, 2) health resources, 3) human workforce, and 4) information technology systems, which were addressed by the implementation AKSK project. Critical drivers ranked by salience included 1) strong governance, 2) health workers commitment, 3) external agency collaboration and 4) community participation.

Conclusion. Batuan's implementation demonstrates Konsulta's viability in improving primary care financing. Critical to its success are robust government support, strategic partnerships, driven workforce, and active community engagement. Despite implementation challenges, policy reforms, service enhancement and capability investments enabled Batuan to create a replicable model for other local government units.

Keywords: PhilHealth; health financing; primary care financing; primary care; Philippines; capitation; local health financing; universal health coverage; universal health care; out-of-pocket expense; financial risk protection

Background and Introduction

The implementation of the Universal Health Care (UHC) Act in the Philippines is geared to enhance access to quality healthcare services while reducing the financial burden across the population. However, despite its implementation, Filipinos continue to face high out-of-pocket (OOP) expenses with 44% of medical expenses shouldered directly by households [1]. One major driver contributing to this is the high OOP share associated with outpatient primary care visits, regardless of whether the service is availed in a public or private facility or accessed in an urban, rural or remote site [2,3,4].

In 2021, the Philippine Health Insurance Corporation (PhilHealth), the country's sole government social health insurance arm, launched the Konsultasyon Sulit Tama (Konsulta) Program. It is the agency's rebranded flagship outpatient benefit package which seeks to expand access to primary care services and align with the broader objectives of the UHC Act. The program gives all PhilHealth members free access to medical consultations, health risk screening, 13 select laboratory and diagnostic testing, and 21 select drugs and medicines [5]. PhilHealth, in return, pays the health provider a maximum of 1700 Philippine pesos (Php) per patient divided into two tranches, using a performance-based capitation mechanism [5].

Five years into its implementation, a variable level of commitment among primary care facilities in the country has been observed. Low uptake from facilities and operational issues have surfaced in its initial roll out years, compounded further by implementation delays due to the COVID-19 pandemic [6,7]. The trend, however, improved in 2025 with PhilHealth reporting 3,149 accredited Konsulta Package Providers nationwide, serving 88% of the total cities and municipalities [8].

Despite the increasing number of accredited primary care facilities for the Konsulta program, PhilHealth reports that only 0.001% of its total disbursements were paid to primary care facilities [8]. This signifies that the primary care benefit package may not have been implemented fully by most accredited facilities and patients may have continued to shoulder the expenses from their own pockets. This underscores that high facility accreditation rate does not always correlate with program institutionalization nor patient's financial risk protection.

While many facilities seem to struggle with the institutionalization and operationalization of the Konsulta Program, one rural municipality in Bohol, Philippines has optimized its implementation of the primary care benefit package. Despite starting late in June 2023, the Batuan Primary Care Facility (PCF) has already delivered significant progress in both health service delivery and financing. In less than three years, the program has not only provided comprehensive primary care encounters, medicines and diagnostic tests to more than 7,824 residents but has also generated Php 10.3 million in aggregate funds.

Building on the foregoing, this study aims to examine the institutionalization of the Konsulta Program at the Batuan PCF. Specifically it aims to 1) describe the initial institutionalization process, 2) identify facility-specific institutionalization challenges and enumerate strategies employed to overcome them, 3) assess the performance of the facility in the past four years (2022-2025), in terms of revenue collection, patient and service coverage, and overall local health system financing, and 4) determine critical drivers that contributed to its current performance. By generating evidence-based insights, practical lessons and replicable strategies, this paper intends to guide other Philippine primary care facilities in effectively operationalizing this financing scheme in the direction of universal health coverage.

Methods

Study Design

This descriptive case study employed a sequential quantitative and qualitative narrative analysis design to explore and examine the implementation of the Konsulta Program in the Batuan PCF from 2022-2025 and identify critical drivers that facilitated its operationalization.

Study Locale

The study was conducted in the Batuan PCF, the sole PhilHealth-accredited and Department of Health (DOH)-licensed primary care facility in the municipality of Batuan, a fourth-class, landlocked, agricultural municipality located in the central part of the province of Bohol, Philippines. Being a local government unit (LGU)-operated facility, it provides primary care services to 15 barangays (the Philippines smallest administrative unit), two of which are classified as Geographically Isolated and Disadvantaged Areas (GIDA). The facility served approximately 13,475 population in 2025 [9].

Study Population

Key informants included 1) Health and non-health support staff of the Batuan PCF, 2) local government officials including Local Chief Executive, and members of the Expanded Local Health Board (ELHB) and 3) representatives of the Department of Health and PhilHealth Tagbilaran Local Health Insurance Office. A purposive sampling approach was used to select participants who had direct experience with the program's implementation. The sample size was guided by data saturation, assessed through an iterative process of concurrent data collection and analysis. Saturation was deemed to have been reached when successive interviews

yielded no new codes or themes, and when additional data only reinforced existing categories without adding conceptual depth or variation relevant to the research questions.

Data collection method

Quantitative data on the performance of the municipality of Batuan in the PhilHealth Konsulta Program in the past four years (2022-2025), in terms of 1) revenue collection and 2) patient and service coverage were obtained from secondary data mining through PhilHealth Konsulta Statements of Account Payable 1 and 2 (2023-2025). Quantitative data on 3) overall local health system financing was retrieved from financial reports of the Municipal Accounting and Budget Office of the Local Government of Batuan, Bohol. Prior to data collection, consent was sought from the Office of the Municipal Mayor with furnished copies to the Municipal Health Office, Municipal Accounting Office and the Municipal Budget Office. Collected data were accessible only to the study researchers and were kept in a secure, password-protected web-based link (Google Drive).

Qualitative data were obtained through 1) document review and 2) semi-structured key informant interviews. Documents reviewed included 1) the Adunay Kwarta sa Konsulta (AKSK) Implementation Report 2024; [10] 2) pertinent municipal ordinances, executive orders, minutes of ELHB meetings, [11,12] and minutes of Batuan PCF meetings of the Local Government of Batuan, Bohol (2023–2025); [13,14] and 3) news articles from reputable news agencies. These documents, with the exemption of news articles, were collected and verified with the approval and consent of the Office of the Municipal Mayor to establish a chronological account of Konsulta institutionalization in the municipality.

A semi-structured key informant interview was done following the document analysis to 1) supplement and validate the preliminary findings, 2) further describe the institutionalization Konsulta process, and 3) determine the critical drivers that contributed to its current performance. All interviews were conducted between February 27, 2025 and March 3, 2025 with cognizance of their preferred interview mode (online or face-to-face). All interviews took place after obtaining informed consent, were recorded using a digital voice recorder and/or built-in virtual meeting recording application, and were transcribed verbatim with supplemental field notes. Collected data were accessible only to the researchers of this study and were kept in a password-protected, web-based repository (Google Drive).

Data analysis

Descriptive statistics were utilized for the analysis of quantitative data. Qualitative data from documents were reviewed and underwent chronological structuring and content analysis to extract pertinent institutionalization events, and milestones. Findings were synthesized into an implementation timeline, which served as the foundation for the key informant interviews. Information gaps were identified and documented to guide the development of key informant interview questions.

Qualitative data from key informant interviews were analyzed using thematic narrative analysis, supplementing the structured implementation timeline with additional stakeholder insights. The analysis commenced with the familiarization through multiple rereadings of the transcribed verbatim responses while noting recurring topics and themes. Emerging themes were then identified, coded and organized into categories. A synthesized and integrated framework containing chronological events from the document analysis and the thematic analysis results from the interviews were generated through an iterative process. Preliminary findings were shared with key informants for validation to ensure accuracy, credibility and contextual relevance.

Results and Discussion

This section presents the: 1) institutionalization timeline of Konsulta in the facility via the AKSK blueprint; 2) the identified facility-specific institutionalization challenges and how they were addressed; 3) the facility performance metrics in nominal values (revenue, patient and service coverage, and overall impact in local health financing), 4) Batuan's contextual profile, 5) the identified critical drivers ranked by salience, and the 6) findings' global and regional relevance.

1. Institutionalization of the Konsulta Program

The establishment of Konsulta in the Batuan PCF followed a structured, multisectoral, systems-based, output-oriented, and time-bound approach detailed in the AKSK Initiative [10]. The project followed a two-phase blueprint outlining key action areas and timelines [10]. Phase 1, coined as the Intensive Konsulta Initiation, focused on a strategic systems-based strengthening of the five health system pillars identified as critical in ensuring initial success. Phase 2, included measures to ensure long-term sustainability.

Key actors who voluntarily conceptualized and spearheaded the initiative were the facility head and the DOH deployed health workers who drafted the initial roll-out plan [10]. Tenured LGU-hired staff initially received the plan with resistance but were ultimately won over by persistent advocacy. The initiative was further sealed by the political backing of the Municipal Mayor who issued an executive order organizing the municipal UHC Konsulta Task Force [10,15]. Through a series of consultations starting April 2023, the initial plan was refined into the final AKSK blueprint highlighting governance oversight by the ELHB, technical assistance from PhilHealth and DOH, and community participation through barangay officials, community-based organizations, and people's initiatives [10].

2. Addressing Facility-specific Institutionalization Challenges

Following thematic analysis, four facility-specific institutionalization challenges emerged. These were grouped into 1) governance and administrative hurdles (lukewarm LGU support and lack of local legislative policy backing), 2) health resource and logistical challenges (limitations in medicines, laboratory tests and health supplies), 3) human resource limitations (staff shortage, work overload, lack of training and absence of performance incentive) and 4) health information system and information technology (IT) infrastructure constraints (nonfunctional electronic medical records, absence of computers and the lack of reliable internet connection). Governance hurdles were identified as the primary challenge that contributed to the emergence of other institutional challenges.

Further subanalysis revealed recurring subthemes: 1) long-tenured Batuan PCF staff had limited engagement with LGU leadership, and 2) there were no deliberate legislative advocacy activities targeting the local council. Many senior staff expressed negative perceptions of the Konsulta program, citing unsatisfactory experiences with earlier primary care benefit schemes. Konsulta represents the latest iteration in PhilHealth's two-decade effort to redesign its primary care package. (7) These historical experiences appeared to erode trust in the current reform and contributed to weak internal advocacy for executive-legislative support. As a result, the facility lacked strong political and legislative backing for Konsulta.

Addressing Governance Hurdles

Governance hurdles were addressed through a four-point action agenda: 1) LGU engagement, 2) creation of a Konsulta task force, 3) lobbying for the passage of Konsulta-related policies and, 4) inclusive community participation.

Noting the political influence and authority of local leaders, LGU engagement was the primary strategy and was done through continuous advocacy initiatives during and outside ELHB meetings [10,11,12]. "Konsulta was consistently included in the agenda of the Local Health Board. I believe this played a significant role in generating support from stakeholders, such as local leaders" (Member, ELHB, personal communication, March 2, 2025).

Persistent policy support lobbying was also pursued resulting in the passage of two landmark ordinances which embedded program sustainability safeguards [16,17]. The involvement of grassroots stakeholders was also key in generating broader community support and ensuring that the initiative's objectives align with the realities on the ground.

Strengthening Health Resources and Logistics

The lack of health resources was identified as a recurring theme amongst bottlenecks in Konsulta institutionalization. "(The) lack of resources was the most difficult to address in Batuan's case. As a rural agricultural town, Batuan has limited funds. It is hard to raise taxes and (further) tax the already burdened population. Had the municipality's fund been sufficient, these concerns can be addressed, personnel can be hired and laboratory equipment can be purchased" (Municipal Mayor, personal communication, March 3, 2025). Through a series of consultations and negotiations, resource limitations were addressed by fund reallocation to procure essential medications and diagnostics [10,11]. While some Konsulta-mandated services e.g. Electrocardiogram (ECG) and radiography were still not made available due to budget constraints, the facility established contractual agreements with partner diagnostic facilities to provide the services at no cost to patients [10]. The facility also teamed up with the Department of Science and Technology for the allocation of an RxBox machine, a device with a built-in ECG capability [18,19]. The facility also partnered with a non-government organization, International Care Ministries, in the provision of X-Ray services, at least once per quarter [12,14].

Despite the initial challenges, the facility gradually was able to procure its own ECG and urinalysis machines. "We truly had difficulty meeting some of the basic services during the early months of implementation. But gradually, we were able to provide 10 of the 13 mandatory tests" (Physician, Batuan PCF, personal communication, March 2, 2025). On the sustainability side, an ordinance allocating 70% of the Konsulta funds for the procurement of additional health resources was passed [17].

Human Resource (HR) Development and Incentives

Overcoming HR-related challenges was quintessential since the facility operated with only 22 health and non-health staff at the program onset. "Staff shortages, unfamiliarity of the Konsulta system, work overload and limited incentives for health workers (which) may not sufficiently motivate staff were the biggest challenges" (Nurse, Batuan PCF, personal communication, March 2, 2025).

A four-point HR strategy was then developed which included 1) provision of capability-building activities, 2) workforce recruitment, 3) institutionalization of a performance-based incentive system, and 4) regular staff review on program implementation [10]. Capability building activities were not only limited to formal training, as post-training on-the-job mentoring and coaching sessions were conducted to solidify knowledge application [10]. Simplified processing guides were also developed and displayed at each workstation to help the staff navigate the Konsulta system [10]. To improve workload and manage increasing data entry demands, hiring of additional data encoders and health workers was lobbied, [11] resulting in the deployment of two midwives and a dentist from DOH, and the hiring of three midwives, one nurse and two data encoders from the LGU [10,12].

The ratification of the ordinance which provides for performance-based incentives also became pivotal, as it assured the health facility staff a 30% share of the total revenue, distributed on a performance-based mechanism [17]. "The 30% staff share motivates every staff to accomplish their assigned tasks and ensures that this program will be sustainable in the coming years. The "Law of Effect" by Edward Thorndike, states that behaviors followed by rewards are more likely to be repeated" (Medical Technologist, Batuan PCF, personal communication, March 2, 2025). Aside from incentives, part of the measures to ensure continuous HR engagement and improvement is the conduct of monthly Konsulta performance reviews [10].

Improving Health Information Systems and Digital Infrastructure

To address health-information-related challenges, the facility pivoted on a three-point strategy. The first focused on the reactivation of the iClinicSys electronic medical record system and the retraining of all the staff [10]. Second was the lobbying for additional computers, [11,12] which led to the procurement of seven computers, resulting in a one-computer-to-one-midwife ratio. Third, the facility devised an interim paper-based data capture form allowing the staff to have a seamless processing of cases while waiting for full digitalization [10].

In mid-2024, the facility had to endure the disruption of its internet service. "It was one of the most difficult times to process Konsulta cases. Our internet system was down which meant we had to use cellular data for uploading claims. This definitely reduced our performance" (Midwife, personal communication, March 2, 2025). The issue was resolved with the installation of a satellite internet service (Starlink) following the allocation of Php 155,000 from Konsulta Funds [20].

3. Batuan Konsulta Performance

Revenue collection

The Konsulta revenue collection has shown a significant upward trend from 2022 to 2025 (Figure 1), reflecting growth in patient volume at the fixed per-patient capitation rate. The facility began receiving payments in 2023 and experienced a major increase in 2024. In eight months of 2025, the facility earned Php 5,505,280 bringing the cumulative facility nominal revenue to Php 10,540,881.47.

The increasing revenue underscores the program's financial viability particularly in addressing persistent health financing concerns for low-income municipalities like Batuan. While revenue is modest in the first year, attributable to institutionalization pains, the steep increase in 2024 coincided with rapid improvements in program implementation and the facility's successful navigation of institutionalization challenges amid national uptake challenges. These figures

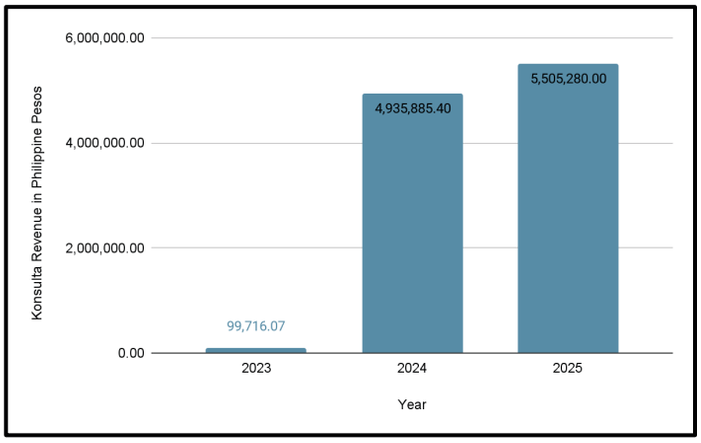

Figure 1. Annual revenue from PhilHealth Konsulta Program in the Batuan PCF calendar year 2022-2025

Source: *Konsulta Statement of Account Payable 1 and 2, PhilHealth*

(Note: 2025 data represent nominal values from January to November only. Revenue reflects patient volume x fixed capitation rate of Php 1700/ patient)

are nominal and may reflect demand shifts not captured in this analysis.

Patient Coverage

Between 2022 to 2025 (Figure 2), a significant upward trend in patient coverage (number of patients registered and profiled in the facility was seen). From an initial 2,494 profiled patients in 2023, the numbers surged to 6881 in 2024 and 8096 in January to November 2025. This consistent increase is consistent with facility efforts to streamline program implementation and system-related improvements, although other factors such as changes in care-seeking patterns, and social marketing campaigns may have also contributed. "There is improvement in the structure. The PCF implemented measures to make things better. The LGU (also) found ways to address the challenges. A better internet connection (was) secured through the procurement of Starlink so that internet be available in all corners of the town where consultation can be made. Data encoders were hired to augment the staff" (Municipal Mayor, personal communication, March 3, 2025).

Service Provision and Coverage

All four indicators on Konsulta-mandated services from 2022 to 2024 also showed a rising trend (Figure 3). While complete 2025 data were not available at the time of this

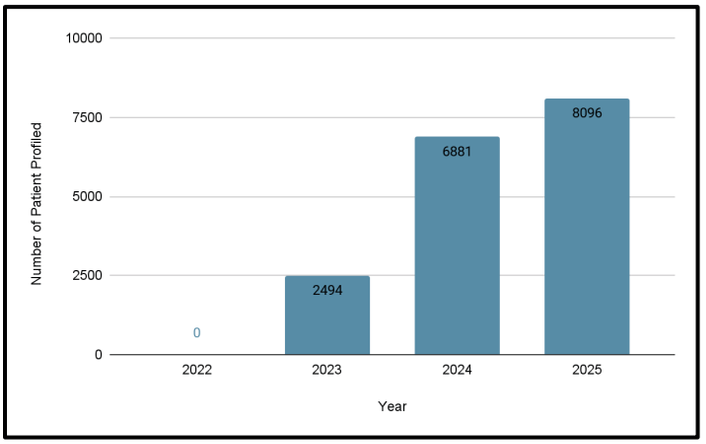

Figure 2. Number of Patients Profiled at the Batuan PCF, calendar year 2022-2025

Source: *Konsulta Statement of Account Payable 1 and 2, PhilHealth*

(Note: 2025 data represent values from January to November only)

studyare still not available until December, the substantial increase across all service categories highlighted the facility's amplified capacity to provide services. This may also be attributed to the conduct of the Konsulta Caravan in October 2024, which was awarded as the biggest single-venue caravan in Central Visayas. The recruitment and deployment of additional facility staff may also be a factor in the dramatic increase [10,12,20]. Overall, the trend implies that more patients are receiving free primary care services, reinforcing the mandate of Konsulta towards UHC.

Overall local health system financing

The addition of the Konsulta funds has improved the overall health financing of the municipality (Figure 4). Before Konsulta implementation, the Batuan PCF relied solely on LGU funds with a meager year-on-year increase between 2019 and 2022. The addition of Konsulta funds in 2023, though relatively modest, boosted the health finances to Php 17.21 million. The following year, regular funding for health was decreased but was compensated by Php 4.6 million Konsulta funds.

The valuable effect of Konsulta funds is critical as it not only expanded the available budgetary resources, but it also compensated for any budgetary shifts and gaps. The challenge, therefore, is to ensure that Konsulta implementation is stable and reliable to allow a steady revenue flow. It should also be emphasized that while the addition of Konsulta funds shifts the local health system's overdependence on internal funds, it should not be a basis for budget cuts of LGU funds to the local health budget.

4. Batuan's Contextual Profile

Batuan represents a typical 4th class municipality with a population of 13,475 and poverty incidence of 30.5% versus 18.1% national rate [9,33,34]. The municipality is landlocked, largely rural, has two GIDA areas and is predominantly an agriculture-based economy (rice, coconut and root-crop production) which means it lacks the urban advantages of higher PhilHealth beneficiary density, better health worker availability, accessible transportation systems and improved IT connectivity [34]. However, patient coverage (registration and profiling) is higher at 66% than the national (5.8%) and Central Visayas Region (4.5%) average [29]. Comparing performance of struggling regions (e.g. Cagayan Valley's 1.4% and Western Visayas' 2%) with similar geographic and sociodemographics settings, Batuan's accomplishments suggest that certain drivers overcame typical rural and economic constraints [29, 36].

5. Critical Drivers In Konsulta Implementation

Thematic analysis ranked four drivers by salience based on interview mentions: 1) strong leadership and governance (84%); 2) commitment of facility staff (64%); 3) collaboration of external agencies (52%); and 4) community participation (48%). These drivers appear separable from Batuan's local context, helping the facility navigate through constraints that are commonly observed in Konsulta facilities of the same setting.

Strong Leadership and Governance

Thematic analysis ranked robust leadership and governance as the most cited cornerstones (84%) that contributed to the Batuan PCF's performance. "Gaining full support from the Mayor, Vice Mayor, and Sangguniang Bayan and involving Barangay Captains & Community Leaders are key factors in the success of the Philhealth Konsulta Program" (Midwife, Batuan PCF, personal communication, March 2, 2025).

The Batuan PCF head, who collaborated with local leaders, was also identified as a significant figure. "The success of the program mainly fell to the efforts of the people behind this, which is mainly our facility head. From the beginning, I believe the Konsulta Program will be successful because of his guidance, leadership, and strong power" (Nurse, Batuan PCF, personal communication, March 2, 2025). This aligns with Thailand's capitation-driven reforms, where primary care network leaders acted as 'change champions' to overcome resistance, mirroring Batuan's facility head [21].

Analysis suggests that without the solid leadership

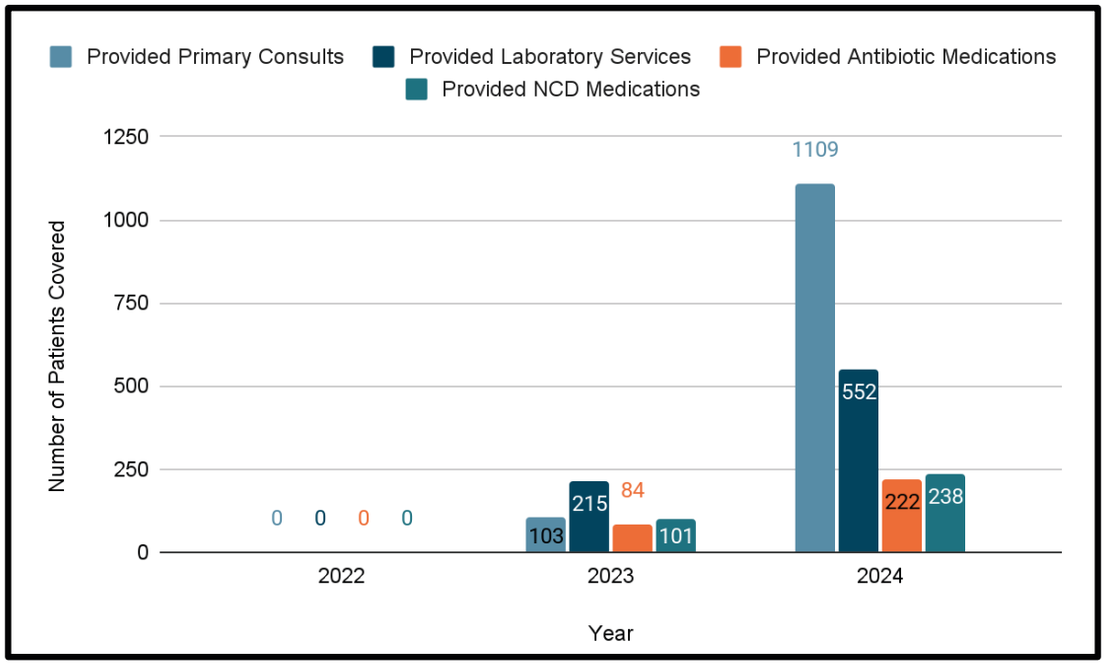

Figure 3. Number of Patients Provided Konsulta-mandated Services, Batuan PCF, C.Y. 2022-2024

Source: Konsulta Statement of Account Payable 1 and 2, PhilHealth

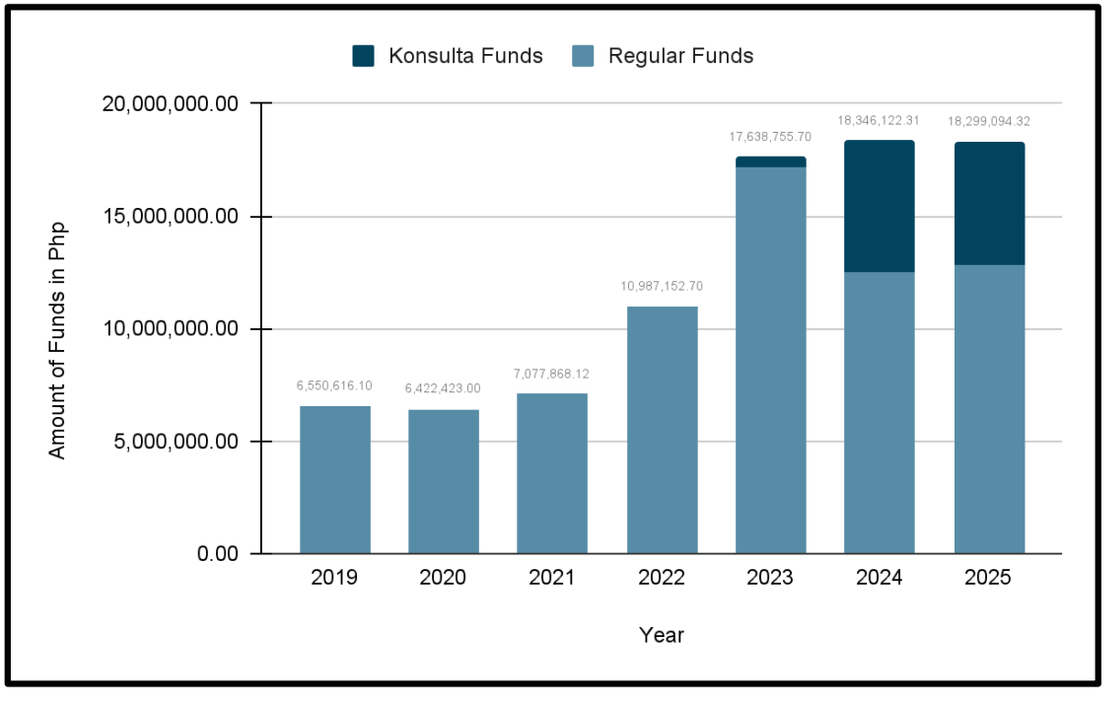

Figure 4. Annual Operational Budget for Health 2019-2025

Source: Municipal Budget Office

and governance of both the facility head and the LGU leaders, the program would not have performed as effectively. This is consistent with existing literature, which identifies that engaged leadership fosters accountability, secures necessary policy support, and ensures the sustainability of health programs [22]. The Batuan experience underscores the importance of municipal leaders' commitment in translating health policies into meaningful action, ultimately improving financing and service delivery.

Commitment of Facility Staff

The facility staff's commitment played a critical role in the Batuan PCF's performance despite initial HR issues on short staffing and work-overload. Through a series of staff consultations, they were able to see the program beyond the challenges. "We had to compromise and hold consecutive meetings in order for them to understand the whole picture" (Physician, Batuan PCF, personal communication, March 2, 2025). Eventually, health workers developed the value of 'helping each other' to address challenges. A game-changer was also the institutionalization of performance-based incentives which further heightened their commitment and motivation.

Collaboration with External Agencies

The technical support and assistance of DOH and PhilHealth has also been key especially during the initial program institutionalization [10]. "Our external partners were helpful from the beginning. DOH has provided all the necessary technical support from training, human resource, computers and policy guidance. PhilHealth has been consistent, assisting us to conduct multiple social caravans. They provided us with retooling workshops and were always ready to help us troubleshoot any Konsulta-related concerns" (Physician, Batuan PCF, personal communication, March 2, 2025).

Beyond the provision of technical resources and assistance, the facility's vibrant relationship between the other agencies was seen as a critical driver. "Batuan's engagement with external partners is truly commendable, and that they really have a smooth and harmonious relationship that contributes in ensuring the success of the Konsulta Program" (DOH Representative, personal communication, March 3, 2025).

PhilHealth, on their part, reiterated their commitment to the accredited facilities. "PhilHealth regularly conducts an annual Konsulta forum, and we have established group (messaging) chats with accredited facilities where they can funnel their concerns. We also make sure that the capitation is paid ahead of time" (Social Insurance Officer, PhilHealth, personal communication, March 3, 2025).

It is apparent that the strong collaboration between the Batuan PCF and its partners was central not only in the establishment of the Konsulta program but also in ensuring its sustainability. This synergistic effort has laid strong foundations which could be modelled by other starting facilities.

Community Participation

Active community participation was pivotal in Konsulta institutionalization as it helped shape the program direction while maintaining community relevance and connection. The engagement of barangay health workers as facilitators of initial patient encounters strengthened community-level awareness and ownership. "The involvement of barangay leaders and community volunteers is one best practice that can be replicated in other facilities" (Midwife, personal communication, March 2, 2025). Sustained community involvement during institutionalization ensured that the program reflected local needs, fostered trust and public support, and created a positive cycle of engagement that enhanced implementation efficiency and long-term sustainability.

6. Global And Regional Relevance

Batuan's experience offers potentially transferable lessons for other decentralized health systems, including Canada's provincial primary care reforms and primary care capitation schemes in LMICs. However, these must be interpreted in light of the substantial systemic barriers and implementation difficulties observed in many other Philippine and international facilities. Canada's Family Health Teams have faced similar challenges from staff resistance to new collaborative models, IT gaps and fragmented governance structures [23]. Thailand's universal coverage reforms similarly encountered workforce and governance constraints, as well as readiness of health centers for information technology [21,24]. Batuan's combination of engaged facility leadership, ordinance-backed performance incentives, and early IT investments addressed many of these bottlenecks.

Batuan's ELHB and multisectoral approach also resonates with other primary care reforms in LMICs. In Indonesia's Puskesmas KBK capitation, strong local leadership and multisectoral coordination were key [25]. South Africa's Ideal Clinics leverage District Clinical Specialist Teams and facility-level champions to drive gains [26,27]. Likewise, Batuan's 30% revenue-share incentives echo global successes: capitation plus performance payments in Chile, Indonesia and South Africa have advanced chronic care quality, despite ongoing issues with risk adjustment for high-need patients [28]. Taken together, these cross-context parallels suggest that the governance, incentive and IT strategies observed in Batuan may inform other decentralized primary care systems.

National Implementation Barriers

National and local reports indicate that many accredited facilities remain only partially operational, with low registration, underutilization of benefits, and underclaiming of capitation funds often due to reported gaps in local political engagement, nonpredictable provider revenue flows and incentives, and unresolved IT and connectivity bottlenecks [29,30,31]. Emerging Philippine and international literature identifies common systemic barriers to performance-based capitation in primary care, ranked by prominence across reports: 1) service capacity gaps such as limited medicines/ diagnostics tying tranche payments to delivery in Guimaras and Indonesia, [7,25,29] 2) digital infrastructure deficits such as electronic medical record (EMR) interoperability failures and poor connectivity, [25,30,36,37] 3) human resource shortages such as physician gaps, administrative overload, absent incentives, [22,36] 4) leadership/ governance deficits such as weak LGU ownership, coordination failures [22,25,32,36].

In contrast, Batuan deliberately established a Konsulta task-force, codified a 30% performance-based staff share through a local ordinance, and invested in both human resources for data encoding and reliable internet. From this contrast, several "what-not-to-do" lessons emerge for other LGUs: 1) relying on accreditation alone without a multisectoral governance body, 2) expecting staff to absorb Konsulta processes without well-designed incentives, and 3) launching Konsulta first without addressing basic IT systems and connectivity issues.

Strengths and Limitations of the Study

This study benefits from its in-depth, multi-perspective approach, combining quantitative financial data with qualitative insights from health workers, local officials, and national stakeholders. The triangulation of different data sources enabled a holistic understanding of both the operational and contextual factors driving program success. However, several limitations must be acknowledged. First, the analysis is observational and based on a single case study, so it cannot establish causal effects of implementation on revenue, coverage, or overall financing. The reported financial and coverage trends are nominal values, not adjusted for inflation, though fixed capitation rates mean revenue growth primarily reflects patient volume rather than price changes. Second, the study did not systematically measure or control for other external factors (health seeking behavior, local disease patterns, broader economic shocks) that could have influenced utilization and revenue. As a result, the observed improvements should be interpreted as associations aligned with the timing of AKSK institutionalization rather than definitive proof of causality. Third, the analysis covers only one municipality, which may limit external generalizability though it allows a rich contextual depiction of real-world implementation. Fourth, financial records used for quantitative analysis depended on secondary government data, which were limited to the January 2022 – November 2025 period and subject to documentation completeness. Moreover, interviews were conducted within a relatively short time frame, potentially constraining the capture of longer-term implementation outcomes. Lastly, Batuan's strong local governance and facility leadership represent facilitative predispositions which may be absent elsewhere, and may require external technical support to cultivate and replicate. Despite these limitations, the study provides actionable insights for practitioners and policymakers seeking to strengthen primary care financing in decentralized settings..

Conclusion

The Batuan PCF's implementation of the Konsulta program shows that when effectively institutionalized, capitation payments for primary care financing could potentially be both economically feasible and sustainable for the local health system. Its strong implementation is also key in ensuring that universal health coverage is tangible at the primary care level.

Batuan's institutionalization is heavily reliant on local government support, with funding, policy support and continuous stakeholder involvement posing as critical drivers. Despite limited resources, a dedicated, capacitated and incentivized health workforce can also propel program achievement. Strategic partnerships with external organizations like DOH and PhilHealth also strengthens initial institutionalization and sustain operationalization. Lastly, the Batuan PCF's experience highlights the value of grassroots mobilizations and community involvement, significantly improving patient coverage and service utilization. Although initial difficulties with governance, supply and logistics, human resource, and IT investments were encountered, targeted solutions allowed Batuan to develop a replicable model for other LGUs to apply.

While this case study focuses on Batuan, it offers insights that may inform other low- and middle-income countries implementing decentralized or performance-based primary care schemes. Many nations in Southeast Asia and Sub-Saharan Africa share similar governance and financing contexts where local governments manage primary service delivery. The experience of Batuan suggests that strong leadership, financial incentives, and community participation, may contribute to sustainable primary care financing in decentralized contexts, though successful adaptation would require tailoring to local conditions These lessons can potentially inform the design of similar programs in other global health systems pursuing universal health coverage for primary care under constrained fiscal environments.

Within the Philippines, Batuan's experience offers a potential model for primary care capitation. Philippine DOH and PhilHealth might consider nudging LGUs to strengthen ELHB, organize Konsulta Task Forces and consider revenue sharing with health staff via national circulars to ensure performance optimization. Canadian provinces scaling Family Health Organizations could potentially draw lessons from Batuan's mid-level facility leadership and targeted workforce recruitment (midwives, encoders) to accelerate team-based roll-out. Similarly, WHO and regional bodies might find value in documenting such approaches for PHC financing toolkits, while facilities initiating capitation could consider prioritizing facility-head capacity building, local policy support for sustainability, and rural connectivity solutions.

References

1. Philippine Statistics Authority. 2023 Philippine National Health Accounts. Quezon City: PSA; Aug 2024. Available from: https://psa.gov.ph/statistics/pnha
2. World Bank Group. Supply-side readiness of primary health care in the Philippines. Report No. 32021. Washington (DC): World Bank; 2019. doi:10.1596/32021.
3. Javier X, Crosby P, Ross R, Ranchez-Vila ME, Santos MS. Understanding out-of-pocket expenditure for outpatient and inpatient care: Philippine National Health Expenditure Survey, Round 1. Health Policy Plan. 2022;37(4):457–464. doi:10.1093/heapol/czab119
4. Dans LF, Marfori JRA, De Mesa RYH, Galingana CLT, Fabian NMC, Rey MP, et al. Health benefit utilization and out-of-pocket expenses in outpatient care and hospitalizations: baseline surveys of three primary care sites in the Philippines. Acta Med Philipp. 2024;58(16):133-40. doi:10.47895/amp.vi0.7453.
5. Philippine Health Insurance Corporation. PhilHealth Circular No. 2024-0013: Enhancement of the PhilHealth Konsulta Benefit Package. Pasig City: PhilHealth; 2024.
6. Department of Health (Philippines). Health Care Financing Strategy of the Philippines 2023–2028: Towards Universal Health Care. Manila: Department of Health; 2023.
7. Wee-Co PA, Sigua JA, Alvior HM, Samson MC, Lechuga J, Vîlcu I, Boxshall M. Strengthening PhilHealth's Role in Purchasing Primary Care Services. Philippine UHC Law Series: Brief 6. Manila: ThinkWell; 2021.
8. Philippine Health Insurance Corporation. Stats and Charts 2024 (v1.3). Pasig City: PhilHealth; May 23, 2025. Available from: https://www.philhealth.gov.ph/about_us/statsncharts/SNC_2024_20250523_v1.3.pdf
9. Philippine Statistics Authority. Updated projected mid-year population for the Philippines based on the 2015 POPCEN results: 2020–2025. Quezon City: PSA; Mar 28, 2021. Available from: https://psa.gov.ph/system/files/phcd/2022-12/Cities%2520and%2520Municipalities%2520Population%2520Projections_2015CBPP_Phils.pdf
10. Local Government of Batuan, Bohol. Adunay Kwarta sa Konsulta: A multisectoral, systems-based approach in improving local health financing through intensified primary care benefit package implementation. Batuan, Bohol: Municipality of Batuan; 2024.
11. Local Government of Batuan, Bohol. Minutes of the 2023 Q2 Expanded Local Health Board Meeting. Batuan, Bohol: Municipality of Batuan; Jun 22, 2023.
12. Local Government of Batuan, Bohol. Minutes of the 2023 Q3 Expanded Local Health Board Meeting. Batuan, Bohol: Municipality of Batuan; Sep 26, 2023.
13. Batuan Primary Care Facility & Birthing Center. Minutes of Regular Staff Meeting. Batuan, Bohol: Municipality of Batuan; Mar 31, 2023.
14. Batuan Primary Care Facility & Birthing Center. Minutes of July Regular Staff Meeting. Batuan, Bohol: Municipality of Batuan; Jul 30, 2023.
15. Local Government of Batuan, Bohol. Executive Order No. 12, Series of 2023: An Order Creating the Universal Health Care (UHC) Konsulta Task Force in the Municipality of Batuan. Batuan, Bohol: Municipality of Batuan; 2023.
16. Local Government of Batuan, Bohol. Municipal Ordinance No. 12-24-2023: An Ordinance Providing for the Utilization of PhilHealth eKonsulta Capitation Received from the Philippine Health Insurance Corporation and for Other Purposes ("Municipal PhilHealth eKonsulta Omnibus"). Batuan, Bohol: Municipality of Batuan; 2023.
17. Local Government of Batuan, Bohol. Municipal Ordinance No. 12-35-2024: An Ordinance Implementing and Institutionalizing the PhilHealth Konsulta Program in the Municipality of Batuan. Batuan, Bohol: Municipality of Batuan; 2024.
18. Nazario D. Unboxing the potential: RxBox arms RHUs with better health response. Manila Bulletin. 2023 Mar 8. Available from: https://mb.com.ph/2023/3/8/unboxing-the-potential-rx-box-arms-rh-us-with-better-health-response
19. Subingsubing K. The RxBox: Out-of-the-box aid for rural health care. Philippine Daily Inquirer. 2023 Mar 6. Available from: https://newsinfo.inquirer.net/1738745/the-rxbox-out-of-the-box-aid-for-rural-health-care
20. Local Government of Batuan, Bohol. Municipal Appropriation Ordinance No. 12-20-2024: An Ordinance Allocating the Capitation Fund-eKonsulta in the Amount of PHP 835,891.01 for Various Programs and Activities of the Municipal Health Office. Batuan, Bohol: Municipality of Batuan; 2024.
21. Towse A, Mills A, Tangcharoensathien V. Learning from Thailand's health reforms. BMJ. 2004;328(7431):103-5. doi:10.1136/bmj.328.7431.103.
22. de Claro V, Lava JB, Bondoc C, et al. The role of local health officers in advancing public health and primary care integration: lessons from the ongoing Universal Health Coverage reforms in the Philippines. BMJ Glob Health. 2024;9:e014118. doi:10.1136/bmjgh-2023-014118

23. Grant A, Kontak J, Jeffers E, Lawson B, MacKenzie A, Burge F, et al. Barriers and enablers to implementing interprofessional primary care teams: a narrative review of the literature using the consolidated framework for implementation research. BMC Prim Care. 2024;25(1):25. doi:10.1186/s12875-023-02240-0.

24. Kijsanayotin B, Speedie S. Are health centers in Thailand ready for health information technology? A national survey. AMIA Annu Symp Proc. 2006;2006:424-8.

25. Firdhaus OIF, Sriatmi A, Suryoputro A. Challenges and strategies for implementing performance-based capitation in Indonesian community health centers: a scoping review. Eduvest J Univ Stud. 2024;4(10):9173-87. doi:10.59188/eduvest.v4i10.43186.

26. Hunter JR, Makgalagadi Y, Tucker JM, Ravhengani NM, Asmall S. The ideal clinic in South Africa: progress and challenges in implementation. S Afr Health Rev. 2017;2017(1):111-23. doi:10.10520/EJC-c80fcc8dc.

27. Onoya D, Mokhele I, Cele R, Musakwa N, Kgowedi S, Shumba K, et al. Rapid review of the ideal clinic realisation and maintenance programme among primary healthcare providers in the Gauteng Province, South Africa. BMJ Open Qual. 2025;14(2):e003212. doi:10.1136/bmjoq-2024-003212.

28. Barber SL, Mathauer I, Rosenberg M, Larrain N, Liu Y, Long Q, et al. Purchasing primary care services for quality chronic care: capitation with performance payments in four countries. Int J Health Plann Manage. 2025;40(4):1007-12. doi:10.1002/hpm.3929.

29. Tiongco MT, Cielo B II, . Initial Results of the Konsulta Package Process Evaluation. Manila: De La Salle University - Social Development Research Center (SDRC), UNDP, NEDA; 2024 Dec 16. Available from: https://nep.depdev.gov.ph/storage/document/1761205193_Intial%20Results%20of%20the%20Konsulta%20Package%20Process%20Evaluation.pdf

30. Perandos-Astudillo CM, Roño RC. Improving access and efficiency in PhilHealth Konsulta: policy notes. SPMC J Health Care Serv. 2025;11(2):8. Available from: https://spmcjournal.com/V11N2Galley/ASTUDILLO-V11N2.pdf

31. Cabalza D. PhilHealth: Few Filipinos availing themselves of Konsulta. Inquirer.net. 2025 Mar 31. Available from: https://newsinfo.inquirer.net/2048393/philhealth-few-filipinos-availing-themselves-of-konsulta

32. Philippine Statistics Authority. PSA Releases the 2021 City and Municipal Level Poverty Estimates. PSA.gov.ph. 2023. Available from: https://www.psa.gov.ph/content/psa-releases-2021-city-and-municipal-level-poverty-estimates

33. Department of Economy, Planning, and Development Region 7. Statement on the 2023 full year official poverty statistics [Internet]. Cebu City (PH): Department of Economy, Planning, and Development Region 7; 15 Aug 2024 [cited 2026 Mar 18]. Available from: https://dro7.depdev.gov.ph/statement-on-the-2023-full-year-official-poverty-statistics/

34. Local Government of Batuan, Bohol. Disaster Risk Reduction and Management in Health Plan 2023–2025 for the Municipality of Batuan, Bohol. Batuan, Bohol: Municipality of Batuan; 2023.

35. PhilHealth, LGUs address low registration for Konsulta. Daily Tribune [Internet]. 2025 Mar 8. Available from: https://tribune.net.ph/2025/03/08/philhealth-lgus-address-low-registration-for-konsulta

36. Bernal-Sundiang N, De Mesa RYH, Marfori JRA, Fabian NMC, Calderon YT, Dans LF, et al. Governance in primary care systems: experiences and lessons from urban, rural, and remote settings in the Philippines. Acta Med Philipp. 2023;57(3).

37. Evio BD, Bonito SR. Formative evaluation of the implementation of eHealth in the Philippines: a qualitative study. Acta Med Philipp. 2024;58(12):35.

AI Statement

The authors declare that AI was used in line with the MJGH AI policy. Quillbot and ChatGPT were used to edit grammar and language.

Network Fragmentation and the 2025 Funding Shock: Early Warning Signs of Systemic Risk in Global Health Governance

Adela B. Santos Domínguez[1], Carlos Ballesteros Pérez[2]

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Affiliations
[1]Global Health Centre, Geneva Graduate Institute, Geneva, Switzerland

[2]Faculty of Political and Social Sciences, UNAM, Mexico City, Mexico

Correspondence
adela.santos@graduateinstitute.ch

Abstract

Background. Global health governance (GHG) has shifted from polycentric coordination to topological fragmentation. COVID-19 expanded World Health Organization (WHO) financing participation but eroded cohesion, producing dispersed connectivity. The 2025 contraction, driven by major donor withdrawal, intersected with existing fragilities.

Objective. To assess whether changes in WHO's financing architecture (2016–2025) exhibit early-warning patterns of declining resilience and critical transition dynamics.

Methods. Social network analysis (SNA) of WHO Programme Budget data across five biennia, examining network cohesion, fragmentation, and component structure through Scheffer's critical transitions framework.

Results. Pre-pandemic networks showed declining density and rising modularity. During COVID-19, participation surged but cohesion eroded, with density halving, clustering declining sharply, and weakly connected components multiplying. Post-pandemic stabilization retained a segmented and concentrated structure, while temporal autocorrelation increased across biennia, indicating reduced flexibility.

Conclusion. The WHO financing network exhibits patterns compatible with lower-resilience configurations approaching critical thresholds. For WHO leadership, topology-based metrics may offer diagnostics of systemic vulnerability. For donor states, findings suggest that concentrated bilateral funding can affect multilateral resilience through network cohesion. Findings should be interpreted cautiously given the number of observations, partial coverage of the 2024–2025 biennium (Q1), and the observational design, which does not permit causal inference or prediction.

Keywords. World Health Organization (WHO); Global Health Governance (GHG); Development Assistance for Health (DAH); critical transitions theory, social network analysis; global health system resilience

Introduction

Over the past two decades, global health governance (GHG) has transformed profoundly. A predominantly state-centred system has evolved into a landscape of governments, multilateral organisations, philanthropic foundations, and public–private partnerships. While this pluralisation has expanded actors and resources, it has also generated overlapping mandates, fragmented financing, and coordination challenges [1–3]. Within this landscape, the World Health Organization (WHO) continues to hold a formal coordinating mandate and a central institutional position [4]. However, its capacity to exercise integrative leadership has become progressively constrained by a growing reliance on voluntary and earmarked contributions, which tend to disperse priorities across programs and partners and weaken system-wide coherence [1,5]. This governance architecture is characterized by high interdependence

among heterogeneous actors, the absence of a single locus of control, and reliance on distributed financing mechanisms [5–8]. These features justify conceptualizing GHG as a complex system in which outcomes emerge from interactions among multiple components rather than hierarchical command [9,10].

Understanding these dynamics requires analyzing relational structure. Social network analysis (SNA) provides this perspective by examining how ties among actors shape power, influence, and dependency [11–15]. Rather than focusing only on funding volumes, it highlights the relational architecture through which resources flow and dependencies emerge [15]. Widely used in epidemiology, public administration, and international relations [11,13–17], SNA helps map WHO financing ties, identify central and brokerage actors, and assess fragmentation, concentration, and interdependence [11–15]. In doing so, it can reveal structural vulnerabilities that budget analyses may overlook, especially under systemic stress. Evidence from outbreaks such as SARS and Ebola shows that emergencies often produce temporary coordination surges without sustained integration [18–20]. The 2025 contraction, following the withdrawal of the United States from the WHO, reinforces concerns that fragmented financing streams weaken the resilience of global health governance [21].

Assessing whether such vulnerabilities are deepening over time, however, requires an analytical framework that links structural change to systemic resilience. To this end, this study draws on critical transitions theory, which originates in dynamic systems theory and examines how complex systems shift between alternative stable states as resilience erodes, often following gradual internal changes rather than abrupt external shocks alone [22,23]. Two indicators are particularly salient: rising variance, meaning greater fluctuations in system properties suggesting instability; and increasing temporal autocorrelation, meaning the persistence of patterns across time, which implies slower recovery from disturbance. Once a transition occurs, recovery to the previous state typically requires disproportionately greater effort, a phenomenon termed hysteresis [22].

In institutional and governance contexts, these concepts can be operationalised empirically through SNA. Persistent fragmentation, reflected in high modularity and a growing number of weakly connected components, signals the emergence of increasingly self-contained financing clusters with weaker integration across the system. In practice, this may indicate more siloed funding patterns and reduced coordination across programs or actors. Low clustering coefficients suggest that existing ties are less likely to reinforce coordination locally, while changes in density and network diameter capture broader shifts in overall connectivity across the system [13,24,25]. Tracking these metrics over time therefore helps assess whether a governance network retains the capacity to recover cohesion or is instead moving towards a more fragmented and less resilient configuration.

Against this backdrop, this study applies SNA to WHO financing data from 2016 to 2025 to examine structural change over time. It analyses the evolution of the financing network across five biennia, assesses whether observed patterns are consistent with early-warning signals of declining resilience and possible transition dynamics, and interprets these findings considering the 2025 geopolitical and financial context.

Methods and materials

Data sources

We analysed publicly available WHO Programme Budget data drawn from the International Aid Transparency Initiative (IATI) tabular datasets. For each biennium (2016–2017; 2018–2019; 2020–2021; 2022–2023; 2024–2025), the most recent Q4 release was used, except for 2024–2025, for which only Q1 data were available at the time of collection (February–March 2025) [26–30].

To mitigate potential seasonal bias, Q1 2024–2025 data were compared against Q1 data from prior biennia (where available), confirming no systematic quarterly variation. Sensitivity analyses excluding 2024–2025 were conducted and yielded consistent trends (see Supplementary Material).

To avoid distortion of network topology, funding flows directed to WHO Headquarters were excluded, as their centralising effect would dominate measures. The retained IATI records thus capture disbursements from state and non-state donors to WHO program areas other than Headquarters, thereby reflecting the relational structure of financing across implementation domains.

Graph specification and data preparation

Each biennium was modelled as a directed, weighted graph G=(V,E), where nodes V represent donors and WHO program areas, and edges E denote financial flows from donor to program. When multiple contributions existed between the same donor-program pair within a biennium, these were aggregated into a single edge whose weight corresponds to the total disbursed amount in US dollars.

To ensure comparability across biennia for metrics sensitive to scale, monetary edge weights were normalised within each biennium using min-max scaling to the unit interval [0,1], producing unit-free values. Graphs were treated as simple directed weighted networks, with no self-loops and multi-edges collapsed through aggregation.

Processed edge and node tables corresponding to

each biennium, together with derived network metrics, were archived to ensure reproducibility and can be found in the supplementary material.

Metrics and community detection

Community detection was performed with the Louvain algorithm [31] implemented in Gephi 0.10.1 with resolution = 0.8, random seed = 42, and 10 iterations guaranteeing modularity convergence <0.001 [32]. This configuration was held constant across all biennia to ensure reproducibility and comparability, following Traag et al. recommendations for longitudinal analysis [33]. Modularity values are reported as Newman–Girvan scores [34] and interpreted in conjunction with clustering and component structure, rather than as a standalone indicator of fragmentation.

Weakly connected components were defined as subgraphs where all nodes are reachable when edge directionality is ignored, calculated using Gephi's Connectivity algorithm. This metric was preferred over strongly connected components because financial flows in governance networks do not require reciprocity to sustain cohesion; the relevant property is whether actors remain linked within a broader cooperative structure [11].

For comparability, path-based metrics (diameter, average path length) were calculated on binary projections using Dijkstra's algorithm, while local metrics retained normalised weights to preserve tie intensity [35]. Network diameter was therefore used to capture overall connectivity independently of financial magnitude, whereas weighted degree and clustering coefficients reflect the intensity and local density of ties [13,25]. These choices follow established SNA practices and support longitudinal comparability [12].

Analytical framework

Temporal patterns in these metrics were examined through the lens of Scheffer's critical transitions theory [22]. Two early-warning indicators are particularly relevant: increasing temporal autocorrelation, understood as the persistence of structural patterns across successive biennia and indicative of slower recovery from disturbance; and rising variance, reflected in larger fluctuations in key metrics such as modularity and density, signalling instability in the system's configuration [22,23].

Temporal autocorrelation was approximated as the first-order autocorrelation coefficient (lag-1 ACF) for each metric across biennia, computed via Pearson correlation of successive values. Rising variance was operationalised as the coefficient of variation (standard deviation divided by mean) to normalise dispersion relative to metric magnitude. In network terms, persistent high modularity and the proliferation of weakly connected components indicate a more segmented financing structure; low clustering coefficients reflect weak local cohesion; and changes in density and diameter capture shifts in global connectivity and efficiency [13,24,25]. Together, these metrics were treated as empirical proxies for resilience, enabling assessment of whether the WHO financing network retains the capacity for reintegration or drifts toward a fragmented equilibrium. These indicators should be interpreted as heuristic proxies rather than deterministic predictors of systemic transition.

Software and reproducibility

Data processing and transformation were conducted in Python (version 3.11.13) using the pandas library. Network construction, metric computation, and visualisation were performed in Gephi (version 0.10.1). Cleaned datasets, network tables, and Gephi statistical outputs supporting the analyses are available in the supplementary materials and in the public GitHub repository adelasantosd/who-financing-network_fragmentation_2016-2025_dataset, which ensures transparency and reproducibility.

Results

Structural changes in network composition

Between 2016–2017 and 2018–2019, the WHO financing and implementation network remained broadly stable in size (636 versus 624 nodes), with a modest decline in edges (3,477 to 3,277). Despite this apparent stability, the network became less integrated internally: average degree and density declined, while modularity increased sharply (0.294 to 0.466), indicating that financing ties were becoming more segmented into semi-autonomous communities. At the same time, the number of weakly connected components rose from 2 to 123, and clustering remained low. In practical terms, financing relationships were increasingly concentrated within separate clusters, with fewer ties linking the network as a whole [11,13].

The pandemic biennium (2020–2021) marked a phase of rapid expansion. The network grew substantially in nodes (999) and edges (4,444), reflecting the mobilisation of new actors and resources during COVID-19. However, cohesion weakened further: density halved (0.009 to 0.004), average degree fell, weakly connected components multiplied to 546, and clustering dropped to its lowest observed value (0.012), indicating minimal local reinforcement of ties. Modularity declined from 0.466 to 0.339, suggesting crisis-driven reconfiguration as emergency funds created cross-cutting ties that temporarily bridged existing silos. Because clustering remained near zero, however, these ties were not

locally reinforced, helping explain why the network returned to a more segmented structure after the acute phase of the pandemic.

This non-monotonic trajectory is consistent with dynamics discussed in critical transitions theory as indicative of declining resilience in systems approaching critical thresholds [23]. Network diameter increased from 3 to 5, suggesting reduced global efficiency, as resources and coordination had to move through longer paths across the system [11]. The system did not recover its pre-pandemic level of cohesion; instead, it settled into a configuration in which financial flows were more concentrated while cross-program coordination remained limited, increasing vulnerability to donor withdrawal.

Overall, the network evolved from pre-pandemic fragmentation, through a phase of crisis-driven expansion, into a post-pandemic configuration marked by persistent fragmentation and limited reintegration. Results for 2024–2025 should be interpreted cautiously, as they include a full year of 2024 but only the first quarter of 2025. Although based on Q1 data, the 2024–2025 metrics fall within the trajectory established across the previous four biennia. Sensitivity analyses excluding this period yield identical qualitative trends (Table 1).

Early-warning signals

The empirical trajectory described above aligns with Scheffer's diagnostic framework for critical transitions [22]. Rather than interpreting metrics in isolation, we examine their combined temporal dynamics as indicators of changing resilience. Temporal autocorrelation (the tendency for network structures to persist across successive biennia) increased monotonically from 0.21 to 0.64 (Table 1). With only five biennial observations, these coefficients should be interpreted cautiously; nevertheless, their directional consistency remains analytically informative.

In complex systems theory, such persistence has been associated with "memory effects," whereby disturbances leave lasting imprints and recovery from shocks becomes progressively slower [22]. In this case, the high modularity observed in 2018–2019 (0.466) remained elevated through 2024–2025 (0.352) despite the COVID-19

Table 1. Structural metrics of WHO financing and implementation networks by biennium

Biennium	Nodes	Edges	Avg. degree	Avg. weighted degree	Diameter	Density	Weakly connected	Modularity	Lag-1 ACF (Modularity)	CV (Modularity)	Clustering Coeff.
2016–2017	636	3,477	5.467	7,830,940.929	3	0.009	2	0.294	0.21	0.15	0.043
2018–2019	624	3,277	5.252	6,276,974.777	3	0.008	123	0.466	0.41	0.28	0.050
2020–2021	999	4,444	4.448	5,357,131.799	5	0.004	546	0.339	0.58	0.32	0.012
2022–2023	596	4,582	7.688	10,020,182.090	4	0.013	121	0.350	0.62	0.35	0.014
2024–2025*	564	3,686	6.535	8,521,931.344	4	0.012	126	0.352	0.64	0.36	0.018

*Data for 2024–2025 include full-year 2024 but only Q1 2025. Bold values indicate changes >2 SD from null-model permutation tests (n=1,000) at $p<0.05$.

Source: Author's calculations using WHO Programme Budget Data, Q4 releases (2016–2023) and Q1 release [26–30].

disruption, suggesting that fragmentation was not merely transient.

Concurrently, rising variance (with the coefficient of variation increasing from 0.15 to 0.36) is consistent with growing instability in the network's configuration. Although the limited number of time points constrains formal time-series inference, the oscillation between expansion (2020–2021: 999 nodes) and contraction (2022–2025: ~580 nodes), together with the non-monotonic recovery of modularity, suggest a system fluctuating between alternative configurations rather than reintegrating into a more cohesive structure [22].

Taken together, these signals appear in three structural patterns: persistent fragmentation (modularity stabilizing at ~0.35, weak components >120), weak local cohesion (clustering <0.02), and reduced global efficiency (density halving during crisis, with diameter increasing). In substantive terms, this points to a financing architecture organized into semi-autonomous clusters, with few reinforcing ties within them and longer paths linking the system as a whole [13,14,24,25].

Alternative explanation and exclusion

One possible interpretation of elevated modularity is efficient functional specialization, whereby donors concentrate resources according to comparative advantage. Under such conditions, however, specialization would typically be accompanied by stronger internal coordination within modules, reflected in higher clustering among actors operating in related domains. In our data, by contrast, clustering declined to 0.012 during the pandemic and did not recover beyond 0.018 thereafter. This weakens the specialization hypothesis and instead suggests a financing structure marked by disconnection rather than designed differentiation [2,3].

A second interpretation is that the observed segmentation reflects strategic earmarking efficiency rather than fragmentation. However, this would also be expected to coincide with stronger internal coordination and more stable cross-program linkages, which are not observed in the longitudinal series. The persistence of weak local cohesion therefore supports reading the pattern as structural segmentation rather than optimized specialization.

Mechanistic interpretation by phase

The temporal trajectory can be interpreted in three phases. During the pre-pandemic period (2016–2019), the drift toward fragmentation reflected a polycentric governance setting in which multiple actors operated in parallel without effective integrative coordination [3,4].

The pandemic (2020–2021) did not produce sustained integration but rather crisis-driven reconfiguration [36]: emergency funding generated cross-cutting ties that temporarily bridged existing divisions, yet these links lacked institutional reinforcement and dissipated once crisis financing receded. As those flows contracted, the network returned to a more segmented structure with fewer nodes, consistent with hysteresis dynamics [22].

In the post-pandemic years (2022–2025), the system appears to stabilize in a fragmented configuration characterized by concentrated resources (peak weighted degree), weak local cohesion, and persistent modularity [22]. This should not be read as recovery. Instead, it points to a fragile financing structure in which disruptions affecting key funding relationships are more likely to spread, while cross-program coordination capacity erodes over time.

Discussion

Theoretical implications: From polycentricity to fragmentation

While GHG has often been described as polycentric [2,18], our findings suggest that the WHO financing architecture is better characterized by topological fragmentation: clusters are weakly bridged and the system is less integrated overall. This distinction is analytically significant: polycentricity presumes functional differentiation accompanied by bridging mechanisms [2], whereas the observed metrics indicate structural decoupling rather than coordinated diversity. The contribution of this study lies not in introducing network analysis to global health, but in longitudinally linking network topology to critical transitions theory, thereby translating resilience diagnostics into governance-relevant metrics.

This trajectory challenges the crisis-integration hypothesis prevalent in regime complexity literature [36], which posits that exogenous shocks generate denser interdependencies as actors seek mutual gains. Instead, we observe crisis-driven reconfiguration: COVID-19 mobilised resources without consolidating cross-program ties, reinforcing concentration around a narrower set of actors and relationships [37]. The post-pandemic persistence of this configuration is consistent with hysteresis dynamics, whereby path dependencies may inhibit reintegration even after the immediate crisis subsides, leaving the system consolidated around a lower-resilience configuration [22].

Funding shocks as drivers of systemic instability

The contraction in development assistance for health observed in 2025 [21] illustrates how exogenous shocks can interact with underlying network structure to produce

cascading vulnerabilities. In practical terms, funding shocks are more easily absorbed when coordination does not depend on a narrow set of donor-program ties. In the WHO financing architecture, the removal of key bridging relationships can generate system-wide losses of connectivity, severing communities from the broader network and increasing fragmentation [38].

The concentration of financial flows creates structural over-reliance on specific donor-program dyads. When these ties break, the absence of alternative pathways reduces the system's ability to absorb the shock through reconfiguration [11,39]. This aligns with Scheffer's account of how systems with reduced resilience may exhibit asymmetric responses: gradual degradation followed by abrupt disruption once perturbations exceed a critical threshold [22].

The politicization of health aid highlighted in recent analyses [21] compounds this fragility by introducing volatility into tie-formation processes. When development assistance becomes contingent on electoral cycles rather than institutionalized commitments [40], the network loses temporal predictability, that is, the stable recurrence of relationships that enables long-term coordination. Our data are consistent with this pattern: the increase in temporal autocorrelation reflects not stable cooperation, but growing structural rigidity, understood here as a reduced capacity to adapt tie-formation patterns to changing resource environments.

Existing scholarship similarly warns that overreliance on earmarked voluntary contributions constrains WHO's capacity to sustain integrative linkages [1,5]. Under such conditions, actors may prioritise bilateral or sub-network arrangements, reinforcing segmentation and weakening cohesion, the very features our analysis associates with declining resilience.

Although some states and organisations have attempted to cushion the shock, for instance, China's US$500 million pledge to WHO and modest increases from Australia, Japan, and South Korea [21], these contributions are unlikely to restore pre-2025 structural cohesion. In Scheffer's terms, the observed dynamics are consistent with movement toward a regime boundary, where the system displays features compatible with a lower-resilience configuration in which WHO's coordinating role becomes increasingly constrained by chronic underfunding and competitive donor politics [22].

Policy implications

Rather than generic calls for "more coordination," our analysis suggests specific leverage points where institutional design can alter network topology to enhance resilience.

First, attention should focus on strengthening linkages across otherwise weakly connected parts of the network. Our findings show that the clustering coefficient never rose above 0.018 after 2016, indicating chronically weak local cohesion. In practice, this suggests that financing ties have not been dense enough to support reinforcing connections across programs or actors. In Scheffer's terms, such weak local connectivity may signal a reduced capacity to recover once fragmentation becomes entrenched [22]. For WHO and its financing partners, this means that preserving multilateral resilience depends not only on the volume of resources mobilised, but also on whether funding arrangements support connections across program areas rather than reinforcing silos [11,13].

Second, the findings suggest that contribution design matters as much as contribution volume. The concentration observed in our network analysis reinforces longstanding concerns that reliance on a narrow set of dominant donors makes the system more vulnerable to political shifts [1,5]. When resources flow disproportionately through a limited number of donor-program ties, disruptions at those nodes can reverberate across the network. For donor countries such as Canada, and for middle powers seeking to sustain multilateral health efforts, this implies that flexible, pooled, and more predictable multi-year contributions, alongside support for a stronger assessed-contribution base, may do more to preserve system-wide cohesion than tightly earmarked or highly fragmented funding streams. Contributions routed through arrangements that strengthen shared multilateral capacity may therefore have greater systemic value than those confined to narrow bilateral or programmatic channels. More broadly, the findings suggest that diversification and predictability are not only financing principles but also structural conditions for resilience [1,39].

Third, reinforcing WHO's convening and coordinating role remains critical. The findings suggest that once financing relationships become more fragmented, restoring prior levels of cohesion becomes more difficult, even after the immediate shock subsides [22]. In this context, WHO's role extends beyond agenda-setting to maintaining and rebuilding connections across otherwise weakly linked parts of the system. The literature notes that crises such as Ebola or COVID-19 may open windows for institutional reform, yet these opportunities are often missed when emergency coordination is not translated into sustained structural change [18,41,42]. From this perspective, supporting WHO's capacity to convene donors, align funding streams, and maintain cross-program linkages may be essential if multilateralism is to remain adaptive rather than drift into a more segmented and brittle form [5].

Strengths of the study

Several methodological features shape the interpretation of the findings in conjunction with the limitations discussed below. The longitudinal design, spanning five consecutive biennia (2016–2025), allows structural trajectories to be examined over time rather than inferred from cross-sectional observations. This temporal depth makes it possible to detect persistence, non-linear shifts, and autocorrelation dynamics that would likely remain obscured in single-period analyses. The analytical framework combines social network analysis with critical transitions theory, linking measurable topological indicators to concepts such as resilience, fragmentation, and hysteresis. This integration enables structural patterns within WHO's financing architecture to be interpreted through a complexity-informed lens while remaining grounded in observable network metrics.

Use of publicly available WHO Programme Budget data enhances transparency and reproducibility. The use of standardised network measures and archived datasets facilitates replication and supports future comparative work across multilateral institutions. By foregrounding network topology as a dimension of systemic vulnerability, the analysis complements volume-based assessments of multilateral financing. Rather than focusing exclusively on aggregate funding levels, it examines how relational configurations may condition adaptive capacity within global health governance.

Limitations

This study's findings should be interpreted with caution considering several constraints. Methodologically, biennial aggregation ensures comparability across periods but may mask short-term fluctuations and intra-period dynamics that may be relevant for understanding shifts in donor behaviour. Community detection results are sensitive to parameter choices (such as the resolution value used for modularity) and alternative specifications could yield different partitions [32,43]. Moreover, while weighted degree was incorporated, modularity and clustering were calculated in unweighted form, which may underestimate the influence of large financial contributions. Additional measures, such as reciprocity, brokerage, or assortativity, were not included but could shed further light on actor roles and positional dynamics [11,25].

Data-related limitations are also relevant. The exclusion of WHO Headquarters flows, despite being necessary to avoid distortion of network topology, removes a major hub and likely underestimates centralisation (approximately 30% of total funding). For 2024–2025, only Q1 data were available, whereas Q4 releases were used for previous biennia, limiting strict longitudinal comparability. Furthermore, aggregating flows by biennium may obscure intra-period volatility, potentially underestimating true variance. Because IATI data depend on donor reporting timeliness, lags in 2024–2025 could artificially reduce observed network density.

Conceptually, the analysis is observational and cannot establish causality. Structural patterns interpreted here as early-warning signals may also reflect exogenous political, economic, or epidemiological drivers. The application of the critical transitions framework to governance networks involves interpretive choices [22,23]. Finally, while fragmentation is treated here as a marker of fragility, high modularity can also capture autonomy or functional specialisation valued by certain actors. These caveats highlight the need for complementary approaches and suggest that future work should integrate finer temporal resolution, weighted community detection, and comparative analyses across different global health networks. Exogenous geopolitical and macroeconomic factors not modelled here may contribute to the observed structural shifts.

Future research agenda

Building on these findings, future research could advance the integration of complexity science into GHG by operationalising Scheffer's framework more systematically. Extending this approach would involve not only tracking financing networks at higher temporal resolution but also comparing them with other governance arenas, to assess whether similar tipping dynamics are observable across scales. Combining SNA with complexity models and cross-system comparisons could clarify when fragmentation reflects adaptive diversity versus proximity to critical thresholds. Such extensions would open a broader research agenda at the interface of complexity science and GHG.

Conclusion

This study provides empirical evidence that the WHO financing network exhibits patterns consistent with early-warning dynamics discussed in the critical transitions literature, including rising temporal autocorrelation, increasing variance, and persistent fragmentation. The system exhibits structural features consistent with a lower-resilience configuration in which recovery to pre-pandemic integration would require substantial intervention.

For WHO leadership, this implies that volume-based resource mobilization will be insufficient without institutional reforms that also address the structure of financing relationships. For donor states, the findings suggest that bilateral efficiency may trade off against multilateral resilience, a tension that must be navigated when designing contribution strategies.

The unprecedented contraction in global health financing in 2025 occurred in a system already showing endogenous fragilities, suggesting that external shocks may accelerate movement toward a fragmented equilibrium. Absent institutional changes to increase clustering, reduce modularity, and strengthen bridging mechanisms, the network may become more vulnerable to system-wide fragmentation under future shocks. This suggests that network structure merits consideration as a potential site of institutional intervention.

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Ethical approval. Not applicable.

Data availability. The processed datasets, network tables, and supporting analytical outputs used in this study are available at: https://github.com/adelasantosd/who-financing-network_fragmentation_2016-2025_dataset.

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References

1. Frenk J, Moon S. Governance Challenges in Global Health. N Engl J Med. 2013 Mar;368(10):936–42. doi:10.1056/NEJMRA1109339
2. Kickbusch I, Szabo MMC. A new governance space for health. Glob Health Action. 2014 Apr;7(1):1–7. doi:10.3402/gha.v7.23507 PubMed PMID: 24560259.
3. Youde JR. Global health governance [Internet]. Polity Press; 2012. 188 p. Available from: https://www.wiley.com/en-us/Global+Health+Governance-p-9780745653099
4. Hoffman SJ, Cole CB. Defining the global health system and systematically mapping its network of actors. Glob Health. 2018 Apr;14(1):1–19. doi:10.1186/S12992-018-0340-2/FIGURES/6 PubMed PMID: 29665828.
5. Sridhar D, Woods N. Are there simple conclusions on how to channel health funding? Lancet Lond Engl. 2010;375(9723):1326–8. doi:10.1016/S0140-6736(10)60486-2 PubMed PMID: 20381855.
6. Held D, Kickbusch I, McNally K, Piselli D, Told M. Gridlock, Innovation and Resilience in Global Health Governance. Glob Policy. 2019 May;10(2):161–77. doi:10.1111/1758-5899.12654
7. Fidler DP. The Challenges of Global Health Governance [Internet]. Council on Foreign Relations; 2010. Available from: https://www.jstor.org/stable/pdf/resrep24171.pdf
8. Frenk J, Gómez-Dantés O, Moon S. From sovereignty to solidarity: A renewed concept of global health for an era of complex interdependence. The Lancet. 2014 Jan;383(9911):94–7. PubMed PMID: 24388312.
9. Borghi J, Ismail S, Hollway J, Kim RE, Sturmberg J, Brown G, et al. Viewing the global health system as a complex adaptive system – implications for research and practice. F1000Research. 2022;11(1147):1–11. doi:10.12688/F1000RESEARCH.126201.1 PubMed PMID: 37600221.
10. Blanchet K, editor. Health system resilience: understanding complex adaptive systems. Cambridge, Massachusetts: The MIT Press; 2025.
11. Newman M. Networks: An Introduction. Oxford University Press; 2010. doi:10.1093/acprof:oso/9780199206650.001.0001
12. Derr A. Social Network Analysis 101: Ultimate Guide. Visible Network Labs [Internet]. [cited 2025 Jun 13]. Available from: https://visiblenetworklabs.com/guides/social-network-analysis-101/
13. Barabási AL. Cambridge University Press [Internet]. 2016 [cited 2025 Sep 12]. Network Science. Available from: http://networksciencebook.com/
14. Hafner-Burton EM, Kahler M, Montgomery AH. Network Analysis for International Relations. Int Organ. 2009 Jul;63(3):559–92. doi:10.1017/S0020818309090195
15. Borgatti SP, Mehra A, Brass DJ, Labianca G. Network Analysis in the Social Sciences. Science. 2009 Feb;323(5916):892–5. doi:10.1126/SCIENCE.1165821 PubMed PMID: 19213908.
16. Betsill MM, Bulkeley H. Transnational networks and global environmental governance: The cities for climate protection program. Int Stud Q. 2004 Jun;48(2):471–93. doi:10.1111/J.0020-8833.2004.00310.X
17. Jackson MO. Social and Economic Networks [Internet]. Princeton University Press; 2008. Available from: https://press.princeton.edu/books/paperback/9780691148205/social-and-economic-networks
18. Moon S, Sridhar D, Pate MA, Jha AK, Clinton C, Delaunay S, et al. Will Ebola change the game? Ten essential reforms before the next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola. The Lancet. 2015 Nov 28;386(10009):2204–21. doi:10.1016/S0140-6736(15)00946-0
19. Fidler DP. SARS, Governance and the Globalization of Disease. Palgrave Macmillan; 2004.
20. Wenham C, Eccleston-Turner M, Voss M. The futility of the pandemic treaty: caught between globalism and statism. Int Aff. 2022 May;98(3):837–52. doi:10.1093/IA/IIAC023

21. Krugman A. The State of Global Health Funding: August 2025. Think Global Health [Internet]. 2025 Jul 31 [cited 2025 Aug 9]. Available from: https://www.thinkglobalhealth.org/article/state-global-health-funding-august-2025

22. Scheffer M. Critical Transitions in Nature and Society. Critical Transitions in Nature and Society. Princeton University Press; 2020. 1–386 p. doi:10.2307/j.ctv173f1g1

23. Dakos V, Carpenter SR, Brock WA, Ellison AM, Guttal V, Ives AR, et al. Methods for detecting early warnings of critical transitions in time series illustrated using simulated ecological data. PloS One. 2012;7(7): e41010. Doi: 10.1371/journal.pone.0041010 PubMed PMID: 22815897; PubMed Central PMCID: PMC3398887.

24. Newman MEJ. Modularity and community structure in networks. Proc Natl Acad Sci U S A. 2006 Feb;103(23):8577–82. doi:10.1073/pnas.0601602103

25. Opsahl T, Agneessens F, Skvoretz J. Node centrality in weighted networks: Generalizing degree and shortest paths. Soc Netw. 2010 Jul;32(3):245–51. Doi: 10.1016/J.SOCNET.2010.03.006

26. World Health Organization (WHO). IATI Tabular Dataset – WHO Programme Budget Data 2016–2017 (Q4) [Internet]. World Health Organization; [cited 2025 Aug 9]. Available from: https://open.who.int/2016-17/iati/data

27. World Health Organization (WHO). IATI Tabular Dataset – WHO Programme Budget Data 2018–2019 (Q4) [Internet]. World Health Organization; [cited 2025 Aug 9]. Available from: https://open.who.int/2018-19/home

28. World Health Organization (WHO). IATI Tabular Dataset – WHO Programme Budget Data 2020–2021 (Q4) [Internet]. World Health Organization; [cited 2025 Aug 9]. Available from: https://open.who.int/2020-21/home

29. World Health Organization (WHO). IATI Tabular Dataset – WHO Programme Budget Data 2022–2023 (Q4) [Internet]. World Health Organization; [cited 2025 Aug 9]. Available from: https://open.who.int/2022-23/home

30. World Health Organization (WHO). IATI Tabular Dataset – WHO Programme Budget Data 2024–2025 (Q1) [Internet]. World Health Organization; [cited 2025 Aug 9]. Available from: https://open.who.int/2024-25/iati/data

31. Blondel VD, Guillaume JL, Lambiotte R, Lefebvre E. Fast unfolding of communities in large networks. J Stat Mech Theory Exp. 2008 Oct 1;2008(10): P10008. doi:10.1088/1742-5468/2008/10/P10008

32. Fortunato S. Community detection in graphs. Phys Rep. 2009 Jun;486(3–5):75–174. Doi: 10.1016/j.physrep.2009.11.002

33. Traag VA, Waltman L, Van Eck NJ. From Louvain to Leiden: guaranteeing well-connected communities. Sci Rep. 2019 Mar 26;9(1):5233. doi:10.1038/s41598-019-41695-z

34. Newman MEJ, Girvan M. Finding and evaluating community structure in networks. Phys Rev E. 2004;69(2):026113. doi:10.1103/PhysRevE.69.026113

35. Dijkstra EW. A note on two problems in connexion with graphs. Numer Math. 1959 Dec;1(1):269–71. doi:10.1007/BF01386390

36. Young OR. Governing Complex Systems: Social Capital for the Anthropocene. 1st edn. The MIT Press; 2017. (Earth System Governance). doi:10.7551/mitpress/9780262035934.001.0001

37. Colizza V, Flammini A, Serrano MA, Vespignani A. Detecting rich-club ordering in complex networks. Nat Phys. 2006 Feb 1;2(2):110–5. doi:10.1038/nphys209

38. Callaway DS, Newman MEJ, Strogatz SH, Watts DJ. Network Robustness and Fragility: Percolation on Random Graphs. Phys Rev Lett. 2000 Dec 18;85(25):5468–71. doi:10.1103/PhysRevLett.85.5468

39. Folke C. Resilience: The emergence of a perspective for social–ecological systems analyses. Glob Environ Change. 2006 Aug;16(3):253–67. Doi: 10.1016/j.gloenvcha.2006.04.002

40. Ooms G, Hammonds R. Global constitutionalism, responsibility to protect, and extra-territorial obligations to realize the right to health: time to overcome the double standard (once again). Int J Equity Health. 2014 Dec;13(1):68. doi:10.1186/s12939-014-0068-4

41. Harman S, Erfani P, Goronga T, Hickel J, Morse M, Richardson ET. Global vaccine equity demands reparative justice — not charity. BMJ Glob Health. 2021 Jun;6(6): e006504. doi:10.1136/bmjgh-2021-006504

42. Homer-Dixon T, Walker B, Biggs R, Crépin AS, Folke C, Lambin EF, et al. Synchronous failure: the emerging causal architecture of global crisis. Ecol Soc. 2015;20(3): art6. doi:10.5751/ES-07681-200306

43. Lancichinetti A, Fortunato S. Limits of modularity maximization in community detection. Phys Rev E. 2011;84(6):066122–30. doi:10.1103/PhysRevE.84.066122

AI Statement

The authors declare that AI was used in line with the MJGH AI policy. Grammarly was used to edit grammar and language.

Paternal Mental Health in the Perinatal and Postnatal Period: A Scoping Review

Indrani Paul[1,2]

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Affiliations
[1]Department of Medicine, Division of Clinical and Translational Research, McGill University

[2]Centre for Outcomes Research and Evaluation, McGill University Health Centre – Research Institute

Correspondence
indrani.paul@mail.mcgill.ca

Abstract

Background. Fatherhood lifestyle changes may contribute to stress and depression. Previous studies have highlighted risk factors for poor paternal mental health, including lack of social support, unemployment, and substance use. This review aimed to synthesize current evidence on paternal mental health during the perinatal and postnatal periods.

Methods. A five-stage scoping review framework based on Arksey and O'Malley was used to map current evidence on paternal mental health during the perinatal and postnatal periods, focusing on the prevalence of paternal stress and depression, risk factors, psychosocial impacts, and assessment tools. Articles published between 2015 and 2024 were retrieved from PubMed, Scopus, and Google Scholar. Data were extracted using a standardized charting form and analysed using narrative synthesis.

Results. A total of 1,142 articles were retrieved, and 11 were included in the final analysis. Studies represented Nigeria, Ethiopia, Finland, the United Kingdom, Australia, and China. Reported prevalence of paternal postpartum depression ranged from 2.5 to 54 percent. Common risk factors included unemployment, low income, lack of social support, and substance use. Psychosocial impacts included father-infant bonding difficulties, marital conflict, social isolation, and reduced quality of life.

Conclusion. Early intervention and culturally sensitive mental health support may help address these challenges.

Keywords: paternal mental health; postpartum depression; perinatal period; postnatal period; fatherhood; psychosocial risk factors; scoping review; father-infant bonding

Introduction

The perinatal period refers to the prenatal and early postnatal stages, representing a critical transition not only for mothers but also for fathers, whose mental well-being has often been overlooked in research and clinical practice [1]. Fatherhood, even when planned and desired, introduces significant lifestyle changes that can increase stress, anxiety, and the risk of depression in men [1]. A landmark meta-analysis of 43 studies involving over 28,000 fathers reported a pooled prevalence of paternal prenatal and postpartum depression of approximately 10.4% [2]. Fatherhood brings significant emotional and psychological demands, yet men remain far less likely than women to seek help for mental health difficulties during the postpartum period. This culture of silence contributes to paternal PPD going unrecognised and untreated, increasing its prevalence and severity among new fathers [3].

Maternal mental health has received more attention because it's directly linked to pregnancy and childbirth, and women are often seen as the main caregivers. In contrast, paternal mental health has been less studied, despite its impact on family well-being. A longitudinal cohort study suggests that around 7% of fathers exhibited high stress (above the 90th percentile) during the perinatal period, rising to 10% by two years postpartum [1]. These rates are concerning given their link to adverse childhood outcomes, including increased emotional and behavioral difficulties [4].

For instance, a prospective longitudinal cohort study reported a postpartum depression (PPD) rate of 8.9%,

compared to 17.8% for maternal depression. Unemployment was identified as a key contributor to paternal PPD. The study emphasized the need for targeted postnatal mental health services for fathers, especially those who are unemployed [5]. Similarly, a pooled analysis from Ethiopia reported a 20.86% prevalence of paternal PPD, with risk factors including low income, substance use, and lack of social support [6]. This study recommended routine screening and support programs to mitigate these issues.

Despite growing awareness, paternal mental health is still not widely prioritized in global mental health agendas [7]. Organizations such as the World Health Organization (WHO) and the Global Alliance for Maternal Mental Health have only recently begun to acknowledge the need for inclusive mental health strategies that extend beyond maternal care [7,8]. Addressing paternal mental health is critical not only for the well-being of fathers but also for the stability of the family unit and the healthy development of children [9].

However, it remains unclear what kind of information is available in the literature regarding the psychosocial outcomes of fathers, the challenges they encounter in maintaining their mental well-being during the perinatal and postnatal periods, and associated risk-factors for mental health conditions. Given the increasing recognition of paternal mental health as a critical yet underexplored issue, this study reviews the current evidence on paternal mental health during the perinatal and postnatal periods, with a focus on the prevalence of paternal stress and depression, associated risk factors, psychosocial impacts and current approaches for the assessment of these conditions (5). The review will help guide future longitudinal and intervention-based studies and inform supportive strategies for addressing paternal mental health needs [1, 4].

Methods

This study followed the five-stage scoping review framework developed by Arksey and O'Malley (2006), which provides a structured approach to mapping key concepts, types of evidence, and gaps in research [10]. The framework was chosen to explore the breadth and depth of existing literature on paternal mental health during the perinatal and postnatal periods, an area that remains underexamined in both research and practice [11]. A scoping review was considered the most appropriate method, as it allows for the inclusion of heterogeneous evidence and provides a comprehensive overview of current knowledge, while also identifying conceptual and methodological gaps in the literature [12]. According to Arksey and O'Malley's (2006), this scoping review followed five stages namely: identifying the research question; identifying relevant studies; study selection; charting the data and results presentation [10].

Stage 1: Identify the research question

Through the initial exploration of literature on characteristics of paternal mental health, the key objective of this scoping review is to map the available evidence on paternal mental health issues in the context of perinatal and postnatal phases. This review was guided by the following questions: 'What is the current prevalence of paternal stress and depression during the perinatal and postnatal periods?', 'What are the risk factors for paternal stress and depression', 'What are the psychosocial impacts of paternal stress and depression' and 'What are the current approaches for the assessment of these conditions?'

Stage 2: Identify the relevant studies

Search Strategy

A comprehensive search was performed to identify studies about paternal mental health during perinatal and postnatal periods [12]. This review followed Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines for scoping reviews [13]. The following Boolean search string was used: ("paternal depression" OR "father mental health" OR "paternal anxiety") AND ("perinatal period" OR "postnatal period" OR "fatherhood transition"). The search strategy primarily focused on peer-reviewed articles published in English between January 2015 and December 2024 and retrieved from three main databases: PubMed, Scopus, and Google Scholar. These databases were selected for their broad and multidisciplinary coverage of biomedical and psychological literature relevant to paternal mental health. The year 2015 was selected to ensure inclusion of the most current research and to reflect recent developments in clinical and policy discussions on paternal mental health. Grey literature and non-peer-reviewed sources were excluded to maintain the quality of included evidence. However, the absence of certain keywords in the search strategy, such as "paternal stress," "risk factors," "stress," "depression," "psychosocial," "screening," and "assessment," may have led to the exclusion of some relevant studies.

Stage 3: Literature selection

Inclusion and Exclusion Criteria

Studies focused on paternal mental health during the

perinatal or postnatal period, published in peer-reviewed journals and written in English were included. Literature concentrating exclusively on children and maternal mental health, non-English publications, and grey literature such as reports, theses, or non-peer-reviewed sources were excluded from the search.

Stage 4: Charting the data

Data Extraction and Synthesis

To ensure consistency and accuracy, a structured data extraction process was implemented in synthesizing findings from the eleven included studies. An excel template for data extraction was used to record details on authors & publication year, sample size, study design, study tools, and key findings related to paternal mental health. These findings included the prevalence of paternal stress and depression, risk factors, and approaches for mental health assessment.

Data Analysis

Data analysis involved textual narrative synthesis, where quantitative data, such as prevalence proportions, were tabulated to support cross-study comparison, and qualitative findings were categorized into themes such as risk factors, assessment tools, psychological impacts, and intervention strategies.

Results

Stage 5: Findings

Characteristics of Included Studies

The initial database search yielded 1,142 articles. After initial and full-text screening, 162 studies were duplicates, 750 studies were irrelevant to the topic, 149 studies did not report data relevant to this review, while 70 papers were excluded as they were grey literature, lacked primary or empirical data, or had inadequate methodological details. After these were excluded, 11 articles were selected for inclusion (Figure 1) [1, 4-6, 9, 11, 14-18]. The selected studies encompassed diverse study designs including longitudinal cohort studies, systematic reviews and meta-analyses, mixed-method studies and cross-sectional studies. Sample sizes ranged widely, from as few as 38 participants in matched-design studies to as many as 29,286 participants in meta-analyses. The geographic coverage of these studies included Nigeria, Ethiopia, Finland, the United Kingdom, Australia, and China.

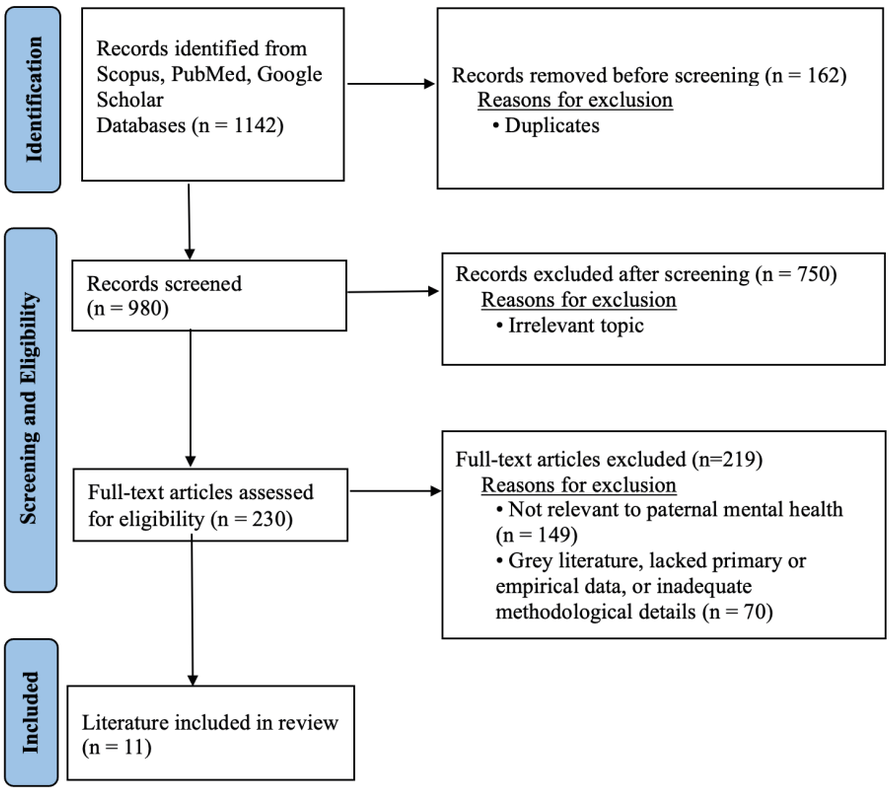

Figure 1. PRISMA flow diagram for scoping review

Narrative Synthesis

Prevalence of Paternal Stress and Depression

Prevalence proportions for stress and depression identified across the reviewed studies varied significantly, ranging from approximately 2.5% to 54%. The prevalence of paternal postpartum depression was notably high in Ethiopia at 20.86%, while studies from Nigeria reported a lower rate of approximately 8.9%, underscoring considerable geographic variation.

Risk Factors for Stress and Depression

Several psychosocial and economic risk factors for paternal PPD were identified by, a number of studies including unemployment, lower family income, substance use habits, and low social support [5, 6]. Of these, unemployment emerged as a particularly strong predictor of paternal postpartum depression in multiple studies [5, 9]. Economic hardship, such as lower family income, also featured prominently as a determinant influencing the mental health of fathers during these critical periods [14, 15].

Psychosocial Impacts of Paternal Mental Health

Included studies revealed a consistent association between paternal PPD and overall family well-being [13, 14]. Nine studies demonstrated a negative impact of paternal PPD on family dynamics, particularly in areas such as family stability and interpersonal relationships [2, 5, 6, 9, 12, 13, 14, 16, 17]. Additionally, two studies observed the role of paternal stress on children's emotional and behavioral development reporting a link between the psychosocial distress of fathers and behavioral problems in children [1, 17].

Assessment Tools or Approaches for Paternal Mental Health Conditions

Different assessment tools and approaches were employed in the assessment of, paternal mental health. Common measures included the Edinburgh Postnatal Depression Scale (EPDS), Beck Depression Inventory (BDI-II), and structured clinical interviews such as the Structured Clinical Interview for DSM-IV (SCID) [4, 9, 13]. Different studies used various assessment tools to measure paternal mental health. Common measures included the Edinburgh Postnatal Depression Scale (EPDS), Beck Depression Inventory (BDI-II), and structured clinical interviews such as the Structured Clinical Interview for DSM-IV (SCID) (4)(9)(13). These tools varied in sensitivity and cultural relevance, highlighting the need for standardized and context-appropriate assessments. These findings underscore the variability and complexity in the measurement and prevalence estimation of paternal mental health conditions.

To further clarify and visually synthesize the thematic findings identified through this scoping review, a conceptual diagram (Figure 2) was created. This diagram illustrates the interconnectedness of paternal well-being indicators, psychosocial and economic risk factors, and existing assessment tools or support strategies, offering a concise overview of critical elements influencing paternal mental health during the perinatal and postnatal periods.

Discussion

The findings of this review suggest that paternal depression and stress have a substantial impact on the family unit with emphasis on the perinatal and postnatal periods. A significant rate prevalence of PPD was identified, with paternal stress and depression consistently associated with adverse outcomes for both children and overall family dynamics. Despite these concerns, paternal mental health remains largely invisible in clinical practice, unlike maternal care, which is typically embedded in prenatal and postnatal care programs. Healthcare providers often lack adequate training and awareness to recognize paternal mental health concerns, leading to underdiagnosis and limited support services for fathers. Integrating mental health screening for fathers into routine perinatal checkups could help facilitate early identification and intervention. There is also a need for the development and validation of standardized, father-specific screening instruments suitable for use across diverse healthcare settings and populations. Mental health professionals and family physicians should receive targeted training to recognize symptoms of paternal depression, particularly when men present with somatic or "masked" symptoms. Additionally, digital health tools and mobile-based mental health interventions may offer scalable, cost-effective, and accessible solutions to support fathers in both urban and rural environments.

Consistent associations between paternal psychological distress and adverse child emotional and behavioral outcomes reinforce the intergenerational consequences of unaddressed paternal mental health issues. Socioeconomic determinants such as unemployment, lower family income, and limited social support emerged repeatedly as core contributors to PPD, underscoring the need for comprehensive family and community-based interventions. Additionally, the wide variation in assessment tools and reported prevalence rates reflects a lack of standardization in evaluating paternal mental health, particularly in under-resourced regions. To ensure a comprehensive understanding of this issue, review

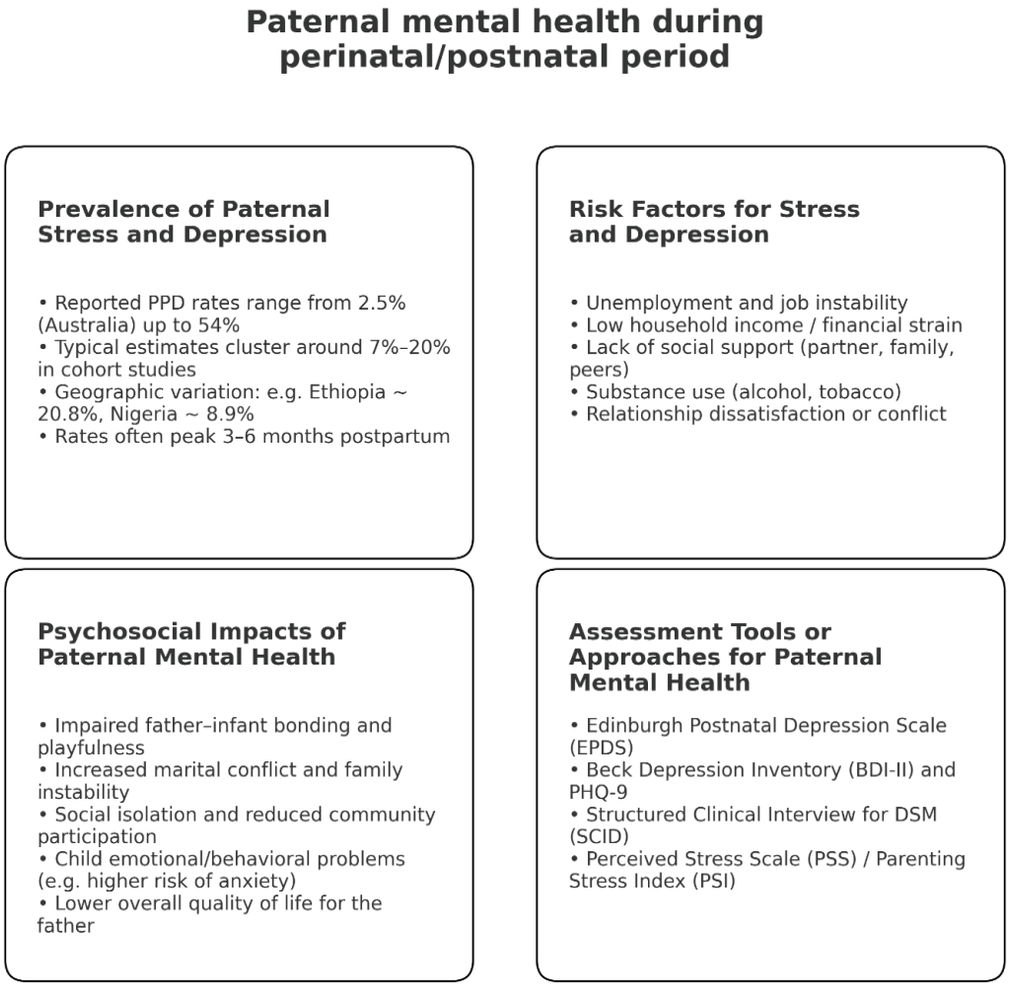

Figure 2. Conceptual Map of Paternal Mental Health During the Perinatal/Postnatal Period

articles were included alongside primary studies, as they offer consolidated insights and highlight broader trends in a research area that remains underdeveloped.

This review is strengthened by its synthesis of diverse study designs across multiple countries, offering a broad perspective on the state of paternal mental health research. A systematic search was conducted to ensure the quality and relevance of selected articles. However, several limitations must be acknowledged. The decision to include only English-language studies was made due to practical constraints, such as resource and time constraints which limited the feasibility of including non-English literature. While this approach is common in many scoping reviews, it may have excluded important evidence published in other languages, potentially introducing language bias. Additionally, it should be noted as a limitation that scoping reviews were included among the selected articles, potentially leading to duplication of studies already identified through the search strategy. Although these reviews were included due to their relevance and synthesized insights into paternal mental health, their findings such as the reported 10% prevalence rate of paternal postnatal depression derived from meta-analyses may overlap with other studies identified directly. Therefore, interpretations of findings should account for this potential overlap. Furthermore, the absence of certain keywords in the search strategy such as “paternal stress,” “risk factors,” “stress,” “depression,” “psychosocial,” “screening,” and “assessment” may have led to the exclusion of some relevant studies.

Moreover, the relatively small number of included studies does not necessarily reflect selection bias but rather points to the overall limited availability of focused research on paternal mental health during the perinatal and postnatal periods-especially in under-researched regions.

The studies also varied widely in methodology, sample size, and assessment tools, which complicated direct comparison and synthesis. Additionally, the predominance of studies from high-income countries restricts the generalizability of findings to low-resource contexts with different sociocultural dynamics and mental health infrastructures. These limitations highlight the need for more inclusive, multilingual, and culturally contextualized research to inform equitable and effective mental health policy and practice.

Conclusion

This scoping review highlighted the significant but often overlooked issue of paternal mental health during perinatal and postnatal stages. The findings reveal that fathers encounter forms of stress and depression, which can adversely impact family dynamics and child development. Key risk factors such as unemployment, low social support, and financial strain contribute to increased mental health challenges among fathers. This review underscores the need for inclusive mental health services that address paternal well-being alongside maternal care. Given the growing global awareness of paternal mental health as a critical component of family well-being, future research should prioritize the development of culturally appropriate screening tools and targeted interventions-particularly in low-resource settings to support fathers during the transition to parenthood and promote healthier family systems worldwide.

Table 1. Summary of Included Studies

Authors and year	Study design	Sample size	Screening tools	Study objective	Key findings
Fiona L. Challacombe et al. (2023)	Longitudinal cohort design	901 fathers and 939 mothers	Questionnaires as part of the Finnish CHILD-SLEEP birth cohort design	To investigate the impact of paternal perinatal distress on children's emotional and behavioral problems at 2 years, while controlling for maternal mental health factors.	Prevalence Approximately 7% of fathers reported high stress during the perinatal period, increasing to 10% at 2 years postpartum. Risk factors Paternal stress at 3 months postpartum was the strongest predictor of child emotional and behavioral problems at 2 years.
Álvarez-García et al. (2024)	Systemic Review	Several hundred to over two thousand participants, varying by study scope.	Edinburgh Postnatal Depression Scale (EPDS), Center for Epidemiological Studies Depression Scale (CES-D), Beck Depression Inventory (BDI-II), General Health Questionnaire (GHQ), Kessler Psychological Distress Scale (K6, K10).	To explore the prevalence and measurement of postpartum depression in fathers, identify instruments for assessing paternal postpartum depression, and highlight relevant risk factors and sources of resilience.	Prevalence Postpartum depression affects 8.75% to 18.5% of fathers. Risk factors Male gender role stress and lack of support. Psychosocial impacts Paternal postpartum depression is influenced by factors such as male gender role stress, unemployment, and perceived social stigma.
Chen et al. (2023)	Combination of quantitative and qualitative research designs	Ranged from 331 to over 2,000 participants, varying by study design and population	Edinburgh Postnatal Depression Scale (EPDS), Center for Epidemiological Studies Depression Scale (CES-D), Beck Depression Inventory (BDI-II), General Health Questionnaire (GHQ), Kessler Psychological Distress Scale (K6, K10), Depression, Anxiety, and Stress Scale (DASS), Swedish Parental Stress Questionnaire (SPSQ).	To clarify the concept of paternal perinatal depression, including its definition, attributes, antecedents, and consequences	Prevalence The prevalence of paternal perinatal depression ranges from approximately 8.75% to 9.76% during the prenatal and postpartum periods. Risk factors Personal and social issues, such as relationship problems and psychosocial stressors, which are associated with increased likelihood of depression in fathers. Psychosocial impacts Low levels of social support are associated with increased incidence of paternal perinatal depression, and depression can negatively affect family dynamics, including marital relationships and maternal emotions.

Kara Smythe et al. (2022)	Systematic review and meta-analysis	29,286 couples across 23 studies	Edinburgh Postnatal Depression Scale (EPDS).	To examine the prevalence of perinatal mood disorders in parental dyads and identify factors associated with these disorders.	Prevalence The prevalence of perinatal depression and anxiety in parental dyads ranges from approximately 1.72% to 3% Risk factors Socioeconomic hardship, relationship dissatisfaction, and maternal depression increasing the likelihood of mood disorders in both parents. Psychological impacts – The psychosocial impacts of perinatal mood disorders include increased risk of relationship dissatisfaction, reduced bonding with the infant, and adverse effects on child development. Factors such as socioeconomic hardship, lack of social support, and relationship stress can heighten these risks, affecting both parents and the family dynamic.
L.F. Philpott et al. (2017)	Systematic Review	31 to 1064 participants across different studies.	Perceived Stress Scale (PSS), Parenting Stress Index (PSI).	To systematically review evidence on stress in fathers during the perinatal period, focusing on measurement methods, stress levels, contributing factors, interventions, and the impact on fathers' health and social relationships.	Prevalence Prevalence of stress in fathers during the antenatal period ranges between 6 and 8.7%. Risk factors Paternal stress includes financial pressure, work problems, lower social support, social isolation, and negative feelings about pregnancy and childbirth. Psychosocial impacts The psychological impacts of paternal stress during the perinatal period include increased risk of mental health issues such as anxiety, depression, psychological distress, and fatigue, which can negatively affect fathers' social relationships and overall well-being.
Langley, E., Totsika, V., & Hastings, R. P. (2020)	Cross-sectional analysis	10,443 fathers	Self-report measures, including SDQ scores.	To investigate the psychological well-being of fathers with children who have intellectual disabilities compared to those without.	Prevalence Prevalence of psychological difficulties among fathers of children with ID is generally low, with many fathers reporting good well-being. Risk factors Key risk factors for poorer paternal well-being include child behavioral problems and living in income poverty. Psychosocial impacts Increased psychological distress, depression, anxiety, and stress, often linked to caregiving challenges and work-family conflict in case of fathers. These issues can affect their overall well-being and daily functioning.

V. Sethna et al., (2018)	Matched design study	38 fathers (19 depressed, 19 non-depressed)	Structured Clinical Interview for DSM-IV-TR (SCID), Edinburgh Postnatal Depression Scale (EPDS), Global Rating Scales for Mother-Infant Interaction (GRS).	To examine the association between diagnosed paternal postnatal depression and specific dimensions of playfulness in father-infant interactions, including physicality, playful excitation, tactile stimulation, and active engagement.	Prevalence The prevalence of paternal depression in the postnatal period is approximately 5-10% within the first year of a child's life. Risk factors A key risk factor for adverse child outcomes is paternal depression, which negatively affects father-infant interactions and parenting behaviors. Psychosocial impacts Paternal depression is linked to negative psychosocial impacts, including increased behavioral and emotional problems in children and reduced positive father-infant interactions such as playfulness and engagement.
Kitil et al. (2024)	Systematic review and meta-analysis.	2,055 fathers across five studies.	Edinburgh Postnatal Depression Scale (EPDS) or Patient Health Questionnaire (PHQ-9).	To investigate the prevalence and contributing factors of paternal postpartum depression (PPD) in Ethiopia.	Prevalence The pooled prevalence of paternal postpartum depression in Ethiopia is approximately 20.86%. Risk factors Low family income, substance use, poor social support, unplanned pregnancy, and infant sleep problems.
Olatunde Ayinde & Victor O. Lasebikan (2019)	Prospective longitudinal cohort study with a two-stage follow-up design	346 dyads of new fathers and their partners recruited, with 331 completing the study at baseline	Structured Clinical Interview, Statistical Manual 4th edition (SCID).	The study aimed to investigate the prevalence and characteristics of paternal postpartum depression (PPD) among fathers in Nigeria	Prevalence Overall prevalence of paternal postpartum depression (PPD) was 8.8%, while maternal depression at 6 weeks postpartum was significantly higher at 17.8% in the Nigerian cohort. Risk factors Unemployment was identified as the only sociodemographic factor significantly associated with paternal depression at birth. Psychological impacts Parental depression can increase stress, guilt, and feelings of inadequacy, which negatively affect both parents and parent-infant interactions.
Watkins et al., 2024	Scoping Review	37 studies, with data from 646 fathers (interviews) and 1,005 fathers (surveys/ question-naires).	Joanna Briggs Institute (JBI) critical appraisal tools for data extraction and NVivo software for thematic analysis.	To explore prospective first-time fathers' views concerning fatherhood in relation to their right to parental leave.	Prevalence Approximately 10% of fathers are affected by postnatal depression, often navigating these challenges alone due to limited support systems. Risk factors Low social support, financial strain, poor partner relationship, and maternal mental health issues.

References

1. Philpott LF, Leahy-Warren P, FitzGerald S, Savage E. Stress in fathers in the perinatal period: A systematic review. Midwifery. 2017 Dec;55:113–27. https://doi.org/10.1016/j.midw.2017.09.016
2. Paulson JF, Bazemore SD. Prenatal and postpartum depression in fathers and its association with maternal depression: a meta-analysis. JAMA. 2010;303(19):1961–1969. https://doi.org/10.1001/jama.2010.605
3. Scarff JR. Postpartum depression in men. Innov Clin Neurosci. 2019;16(5-6):11–14.
4. Smythe KL, Petersen I, Schartau P. Prevalence of Perinatal Depression and Anxiety in Both Parents: A Systematic Review and Meta-analysis. JAMA Netw Open. 2022 Jun 24;5(6):e2218969. https://doi.org/10.1001/jamanetworkopen.2022.18969
5. Ayinde O, Lasebikan VO. Factors associated with paternal perinatal depression in fathers of newborns in Nigeria. J Psychosom Obstet Gynecol. 2019 Jan 2;40(1):57–65. https://doi.org/10.1080/0167482X.2017.1398726
6. Kitil GW, Hussen MA, Chibsa SE, Chereka AA. Exploring paternal postpartum depression and contributing factors in Ethiopia: a systematic review and meta-analysis. BMC Psychiatry. 2024 Oct 30;24(1):754. https://doi.org/10.1186/s12888-024-06206-z
7. World Health Organization(n.d.). Maternal mental health. https://www.who.int/teams/mental-health-and-substance-use/promotion-prevention/maternal-mental-health.
8. Global Alliance for Maternal Mental Health. (2021). A global opportunity to address maternal mental health: An agenda for action [White paper]. https://www.gammh.org/_files/ugd/ed1171_e26c023336244bf9bea428d5edf661cd.pdf
9. Sethna V, Murray L, Edmondson O, Iles J, Ramchandani PG. Depression and playfulness in fathers and young infants: A matched design comparison study. J Affect Disord. 2018 Mar;229:364–70. https://doi.org/10.1016/j.jad.2017.12.107
10. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol. 2005 Feb 1;8(1):19–32. https://doi.org/10.1080/1364557032000119616
11. Mihailescu M, Neiterman E. A scoping review of the literature on the current mental health status of physicians and physicians-in-training in North America. BMC Public Health. 2019 Oct 24;19(1):1363. https://doi.org/10.1186/s12889-019-7661-9
12. Williams B, Reddy P, Marshall S, Beovich B, McKarney L. Simulation and mental health outcomes: a scoping review. Adv Simul. 2017 Jan 28;2(1):2. https://doi.org/10.1186/s41077-016-0035-9
13. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018 Oct 2;169(7):467–73. https://doi.org/10.7326/M18-0850
14. Chen J, Zhao J, Chen X, Zou Z, Ni Z. Paternal perinatal depression: A concept analysis. Nurs Open. 2023 Aug;10(8):4995–5007. https://doi.org/10.1002/nop2.1797
15. Álvarez-García, P., García-Fernández, R., Martín-Vázquez, C., Calvo-Ayuso, N., & Quiroga-Sánchez, E. (2024). Postpartum Depression in Fathers: A Systematic Review. Journal of clinical medicine, 13(10), 2949. https://doi.org/10.3390/jcm13102949
16. Langley E, Totsika V, Hastings RP. Psychological well-being of fathers with and without a child with intellectual disability: a population-based study. J Intellect Disabil Res. 2020 Jun;64(6):399–413. https://doi.org/10.1111/jir.12692
17. Attia Hussein Mahmoud H, Lakkimsetti M, Barroso Alverde MJ, Shukla PS, Nazeer AT, Shah S, Chougule Y, Nimawat A, Pradhan S. Impact of paternal postpartum depression on maternal and infant health: a narrative review of the literature. Cureus. 2024;16(8):e66478. https://doi.org/10.7759/cureus.66478
18. Challacombe FL, Pietikäinen JT, Kiviruusu O, Saarenpää-Heikkilä O, Paunio T, Paavonen EJ. Paternal perinatal stress is associated with children's emotional problems at 2 years. J Child Psychol Psychiatry. 2023 Feb;64(2):277–88. https://doi.org/10.1111/jcpp.13695

AI Statement

The author declares that AI was not used in this article.

Antimicrobial Resistance in War Zones: The Gaza Crisis

Chiara Collinet[1]*, Maya Farres[2]*

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Affiliations
[1]Department of Biology, McGill University, Montreal, Canada

[2]Department of Integrated Studies in Education, McGill University, Montreal, Canada

*All authors contributed equally.

Correspondence
maya.farres@mail.mcgill.ca

Abstract

Introduction. Antimicrobial resistance (AMR) poses a growing threat to global health, particularly in conditions that facilitate disease transmission. Conditions in the Gaza Strip caused by armed conflict, including poor sanitation, overcrowding, and significant damage to healthcare infrastructure, hinder effective infection control measures, and may facilitate the rapid spread of resistant pathogens.

Methods. This paper reviewed existing literature and reports on the ongoing conflict in Gaza and its relationship to the spread of AMR.

Results. The review identified significant implications of AMR in conflict settings for both the health and economic sectors while considering the ethical and political challenges of international intervention.

Conclusion. Potential measures to limit the spread of AMR in war zones include vaccination campaigns, strengthened humanitarian aid, and antimicrobial stewardship initiatives. Improved international cooperation may help to address the spread of AMR in conflict settings and its broader global health implications.

Keywords: antimicrobial resistance; war zones; Gaza; armed conflict; humanitarian aid

Introduction

Antimicrobial resistance (AMR) represents one of the most urgent challenges in global health [1]. AMR refers to adaptations developed by microorganisms in response to antimicrobial exposure, allowing them to survive subsequent use of antimicrobials. This limits the efficacy of these drugs and can increase the length and severity of previously treatable infections [1,2]. The recent surge in AMR has had serious domestic and global repercussions in multiple sectors, with AMR killing more people annually than armed conflict [2,3]. Over the next few decades, it is predicted that AMR will trigger a rise in global healthcare expenditures and a dramatic fall in economic output [4]. This will be especially detrimental to low-income countries and potentially lead to a substantial increase in extreme poverty around the globe [4]. In response, the World Health Organization (WHO) has proposed a critical global action plan (GAP) to limit its spread [5]. Despite these efforts, conditions favourable to disease transmission, particularly in war zones, have spread AMR pathogens at an alarming rate [6,7]. The conflict in Gaza epitomizes this issue, impeding the implementation of the GAP and posing both immediate and long-term threats to the health of the population [6-8].

The Gaza Crisis

The escalation of hostilities between Israel and Palestine on October 7, 2023 has promoted the emergence and spread of AMR pathogens by damaging healthcare facilities, eliminating sanitation infrastructure, and hindering infection prevention and control (IPC) measures [6-9]. Gaza's population is left vulnerable to disease from high stress and food insecurity, which depress the immune system and increase susceptibility to infection [6,8]. Moreover, the bombings in the Gaza Strip have led to the destruction of healthcare and sanitation infrastructure, causing the death of over 1,000 healthcare workers and leaving only a fraction of their original 36 hospitals in a state of partial functionality [10]. Due to the high casualty rate, hospitals

are overcrowded, and patients often receive treatment on hospital floors, leading to the spread of multidrug-resistant nosocomial infections [7,10]. Many other factors contribute to the development and spread of AMR in Gaza, including the lack of medical supplies, such as antibiotics, and the absence of functional microbiological laboratories, limiting accurate diagnosis and antimicrobial stewardship, and creating ideal conditions for the emergence and spread of AMR [7]. This threatens to worsen the already catastrophic toll of the war, with repercussions that will extend long into the future as resistant pathogens can persist in the environment, leading to new outbreaks [11]. Antimicrobial-resistant pathogens, also known as "superbugs," may also be spread to both refugees and humanitarian workers, allowing for transmission beyond the site of conflict. The proliferation of AMR in Gaza is a regional problem with global implications, posing a major threat to the future of public health.

Proposed Solutions

Prompt and effective action is critical to limiting the global repercussions of AMR in Gaza. Despite the development of WHO's GAP, there is a lack of a framework to guide the surveillance and management of AMR in warzones [5]. Global and national studies have demonstrated the effectiveness of vaccines in decreasing infection rates, treatment failure, and cumulative costs due to AMR [12]. Vaccines can be implemented on a national level through pre-existing immunization programs, creating an effective solution using existing infrastructure [13]. However, it is important to note that the adoption of this approach will be particularly challenging in conflict settings such as the Gaza Strip where health systems have been severely disrupted. Given the high risk of outbreaks in these regions, mass vaccination campaigns could also be implemented to prevent infections and hinder the spread of AMR. The WHO and UNICEF have already conducted a successful campaign against polio in Gaza, after the virus re-emerged in the summer of 2024 [14]. Additionally, education of healthcare workers regarding IPC and antimicrobial stewardship protocols is a vital component of managing AMR that suffers when resources are stretched thin [5,15]. Developing a framework to maintain education and IPC protocols in healthcare amidst war could be highly effective in preventing hospital-acquired AMR. This would likely depend on international funding providing support for healthcare workers and facilities in Gaza. Hindering the spread of pathogens outside of hospitals requires the implementation of stronger sanitation and waste-management infrastructure, which translates to universal access to clean water, sanitation, and hygiene. These strategies not only address AMR in war but may also be used as preventative measures in areas at high risk for conflict to alleviate the burden of AMR if war arises.

The actions outlined above are vital but can only be implemented with transnational cooperation and funding. An internationally recognized framework for addressing AMR in warzones is critical for regions such as Gaza. Improving AMR and epidemiological surveillance around the globe would give us a better understanding of existing resistant strains and their spread within war zones, acting as a basis for the creation of informed policies by transnational humanitarian organizations.

Ethical and Political Challenges

Despite the necessity of combating AMR, these efforts come with significant ethical and political challenges. In the heat of the Gaza crisis, resources were extremely limited, leading to the prioritization of life-threatening injuries over interventions to reduce AMR [7]. Furthermore, lower- and lower-middle-income countries such as Palestine largely rely on humanitarian aid to fund health campaigns [16]. The United States' withdrawal from the WHO initiated on January 20, 2025, threatened to deplete the funding the organization needs to provide this crucial aid [17,18]. In addition to financial constraints, humanitarian supplies and workers were prevented from entering the region by the Israeli blockade on the Gaza Strip [19]. Even when these barriers were temporarily overcome, humanitarian operations faced serious ethical challenges, as many aid workers lost their lives during the war [20]. These difficulties in providing vital humanitarian aid further emphasized the need for international cooperation in addressing the Gaza crisis. Despite the current ceasefire, the potential implications of the war for the AMR situation may have long-term national and global health repercussions.

Conclusion

When proposing global and regional responses to AMR, transnational authorities must consider the public health implications of conditions in war zones. Limited resources in regions experiencing conflict leave many countries reliant on humanitarian aid to fulfil basic needs, underscoring the importance of international funding and a clear framework for action. Increased emphasis on vaccine campaigns, antimicrobial stewardship, surveillance, and sanitation measures is necessary to address the immediate and long-term implications of the Gaza crisis on AMR in the region. Without prompt international action, there could be devastating repercussions both within and beyond Gaza's borders.

References

1. Prestinaci F, Pezzotti P, & Pantosti A. (2015). Antimicrobial resistance: a global multifaceted phenomenon. Pathogens and Global Health, 109(7), 309–318. https://doi.org/10.1179/2047773215Y.0000000030
2. World Health Organization. (2023, November 21). Antimicrobial resistance. Retrieved February 2025, from https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance
3. Herre, B, Rodés-Guirao, L, & Roser, M. (2024). War and peace. Our World in Data. Retrieved February 2025, from https://ourworldindata.org/war-and-peace?insight=armed-conflict-is-a-rare-cause-of-death-in-most-years-and-countries#key-insights
4. World Bank Group. (2017, March). Drug-resistant infections: A threat to our economic future. World Bank. Retrieved February 2025, from https://documents1.worldbank.org/curated/en/323311493396993758/pdf/final-report.pdf
5. World Health Organization. (2015). Global action plan on antimicrobial resistance. World Health Organization. Retrieved February 2025, from https://www.who.int/publications/i/item/9789241509763
6. Hussein, S, Ahmed, SK, Qurbani, K, Fareeq, A, & Essa, RA. (2024). Infectious diseases threat amidst the war in Gaza. Journal of Medicine, Surgery, and Public Health, 2, 100067. https://doi.org/10.1016/j.glmedi.2024.100067
7. Moussally, K, Abu Sittah, G, Gordillo Gómez, F, Fayad, A, & Farra, A. (2023, November 25). Antimicrobial resistance in the ongoing Gaza war: A silent threat. The Lancet, 402(10416), 1972 1973. https://doi.org/10.1016/S0140-6736(23)02508-4
8. Giri, BMS, Malla, A, & Adnani, QE. (2024). War-related injuries and multidrug-resistant infections: The crippling effect of Israel-Gaza armed conflict. International Journal of Surgery: Global Health, 7(5), e00479. https://doi.org/10.1097/GH9.0000000000000479
9. Granata, G, Cicalini, S, & Petrosillo, N. (2024). The Battle beyond the Battlefield: War's Influence on Antibiotic Resistance. Infectious Disease Reports, 16(5), 977-980. https://doi.org/10.3390/idr16050077
10. UN News. (2025, January 3). "Hospitals have become battlegrounds": Gaza's health system on brink of collapse. Retrieved February 2025, from https://news.un.org/en/story/2025/01/1158741
11. Scott, P, Deye, G, Srinivasan, A, Murray, C, Moran, K, Hulten, E, Fishbain, J, Craft, D, Riddell, S, Lindler, L, Mancuso, J, Milstrey, E, Bautista, CT, Patel, J, Ewell, A, Hamilton, T, Gaddy, C, Tenney, M, Christopher, G, Petersen, K, … Petruccelli, B. (2007). An outbreak of multidrug-resistant Acinetobacter baumannii-calcoaceticus complex infection in the US military health care system associated with military operations in Iraq. Clin Infect Dis.: an official publication of the Infectious Diseases Society of America, 44(12), 1577–1584. https://doi.org/10.1086/518170
12. Kalanxhi, E, Roberts, N, Miller, L, Bahati, F, & Laxminarayan, R. (2023, October). The value of vaccines to mitigate antimicrobial resistance: Evidence from low and middleincome countries [Report]. One Health Trust. Retrieved February 2025, from https://onehealthtrust.org/wp-content/uploads/2023/10/OHT-Report_Dec-8_final_Linked-1.pdf
13. World Health Organization (2024). Estimating the impact of vaccines in reducing antimicrobial resistance and antibiotic use: technical report. World Health Organization. https://iris.who.int/handle/10665/379116
14. World Health Organization. (2024, November 6). Second round of polio campaign in Gaza completed amid ongoing conflict and attacks: UNICEF and WHO. Retrieved February 2025, from https://www.who.int/news/item/06-11-2024-second-round-of-polio-campaign-in-gaza-completed-amid-ongoing-conflict-and-attacks--unicef-and-who
15. World Health Organization. Regional Office for Europe. (2021, April 12). Antimicrobial stewardship interventions: A practical guide. Copenhagen: World Health Organization. Retrieved February 2025, from https://www.who.int/europe/publications/i/item/9789289056267
16. World Bank. (2024, May 24). Fragility, conflict & violence: Overview. Retrieved February 2025, from https://www.worldbank.org/en/topic/fragilityconflictviolence/overview
17. The White House. (2025, January 20). Withdrawing the United States from the World Health Organization [Executive order]. Retrieved February 2025, from https://www.whitehouse.gov/presidential-actions/2025/01/withdrawing-the-united-states-from-the-worldhealth-organization/
18. World Health Organization. (2024, December 3). The United States of America and the World Health Organization: Partners in global health [Internet]. Retrieved February 2025, from https://www.who.int/about/funding/contributors/usa
19. United Nations Office for the Coordination of Humanitarian Affairs. (2025, April 7). World must act with urgency to save Palestinians in Gaza, top UN officials say. Retrieved February 2025, from https://www.unocha.org/news/world-must-act-urgency-save-palestinians-gaza-top-un-officials-say
20. United Nations Office for the Coordination of Humanitarian Affairs. (2025, April 4). Humanitarian Situation Update #277: Gaza Strip. Occupied Palestinian Territory. Retrieved April 2025, from https://www.unocha.org/publications/report/occupied-palestinian-territory/humanitarian-situation-update-277-gaza-strip#

AI Statement

The authors declare that AI was not used in this article.

Medicine as a Tool of Gendered Colonial Violence

Alexandra J. Douglas[1]

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Affiliations
[1]Department of International Development Studies, McGill University, Montreal, Canada

Correspondence
alexandra.douglas2@mail.mcgill.ca

Abstract

Introduction. Medicine in North America is widely perceived as a healing institution devoted to human welfare, yet this framing obscures its historical and ongoing role in perpetuating gendered colonial violence.

Methods. This commentary analyses the intersections of race, gender, and colonialism in Canadian and American health care systems, examining how colonial medical frameworks position racialized populations as the "Other".

Results. Colonial medical frameworks systematically devalue racialized populations through intersecting mechanisms. Whiteness and heteropatriarchy establish the white male body as the normative standard, excluding women and racialized groups from research and clinical decision- making. For populations facing intersecting systems of oppression, these harms compound: Indigenous women's access to regular healthcare providers declined from 75 percent (2015) to 48 percent (2020), while Black women face higher cardiovascular disease and cancer mortality alongside persistent undertreatment. The patriarchal and white-centred foundations of healthcare are structurally embedded and perpetuate gendered colonial violence.

Conclusion. Recognising medicine's entanglement with systemic harm is essential to dismantling the colonial structures that continue to shape health systems. Confronting these legacies requires addressing the intersections of race, gender, and colonialism through sustained efforts to decolonize medicine and rebuild health systems rooted in equity and justice.

Keywords: medical colonialism; health inequities; intersectionality; racialized healthcare; gendered violence; women's health

Introduction

Medicine, health research, and healthcare systems, especially in North America, are perceived by the settler-colonial majority as systems of healing and institutions devoted to human welfare [1]. This framing, while acknowledging medicine's role in healing, obscures its complicity in perpetuating systemic human rights abuses [2]. From the colonial era of British and French settlement and land dispossession, through Canada's development as a settler-colonial state, medicine has consistently functioned as a tool of gendered colonial violence [3].

Whiteness and Heteropatriarchy in Medical Systems

The concepts of 'whiteness' and heteropatriarchy are central to understanding systems of power and their reproduction in medicine. Central to colonialism is the creation of 'Us' versus 'Them', where white Europeans are depicted as rational, civilized and progressive, while non-white populations are seen as the 'Other' [4]. Empires relied on race theory to justify colonial conquest and naturalise white imperial rule [5]. While race is now understood as a social construct, colonial medicine reinforced colonialism by formalizing racial categories and portraying them as grounded in physical and social reality [5]. Medicine was wielded as a tool to pathologize racial and cultural differences, with Indigenous knowledge systems and healing practices often dismissed as inadequate or primitive in contrast to Western medicine [6]. Within this context, Bargallie defines whiteness as "a system of power relations that privileges non-Indigenous peoples over Indigenous peoples" in which the system constantly upholds white identities and interests as the natural, normal, and superior standards of existence [7]. This dynamic is entrenched in medicine, where the white

male body has historically been considered the standard for medical research and portrayed as typical, desirable, universally applicable, and superior [8].

Alongside whiteness, heteropatriarchy further structures medicine, resting on the assumption that heterosexuality and patriarchy are normal and natural [9]. Further, medicine operates as a site of heteropaternalism, where the father is both centre and leader, and should serve as the model for the social arrangement of the state [9]. Moreover, men have historically been the focus of health care and have predominated as doctors, researchers, and decision-makers, relegating women and racialized groups to the sidelines [10]. The exclusion of women from clinical research further highlights how medicine has perpetuated gendered violence by treating women's health as secondary and endangering lives through systemic neglect [11]. For decades until 1991, heart disease was labelled a "man's disease," with studies conducted almost exclusively on white, middle-aged men, leaving women underrepresented in research [12]. By failing to account for biological and physiological differences, the effect of gender bias in medical research and education results in delayed, inaccurate diagnoses, and higher mortality rates [13].

Othering and Racialized Health Inequities

The Tuskegee experiment exemplifies othering in medicine, where the construction of Black men as fundamentally different from White men (as 'Others') enabled researchers to violate basic ethical principles they would never have breached with white patients [14]. Moreover, research has shown that implicit racial bias in clinical settings results in Black patients receiving significantly less pain management than their white counterparts, as physicians often underestimate Black patients' pain, leading to lower analgesic doses [15,23]. By positioning Black bodies as suitable subjects for observation rather than deserving of treatment, the medical establishment revealed how othering strips individuals of their humanity and renders them objects of scientific curiosity rather than patients deserving care.

In the case of racialized minorities, this is clear when looking at the Black populations who face disproportionate disease burdens [16]. For instance, Black women are at a higher risk of developing cardiovascular diseases than Black men and receive substandard treatment compared to White women for similar conditions [17]. Further in cancer care, Black women are more likely to develop aggressive cancers at an earlier age and suffer higher mortality rates [18].

Intersecting Systems of Oppression

Indigenous women face multiple systems of oppression as they navigate settler colonialism and gender hierarchies. Currently, over one quarter of Indigenous people have unmet health care needs, while one in five Indigenous people report experiencing unfair treatment, racism, or discrimination from a healthcare professional [19]. Further, the healthcare gap for Indigenous women is increasing. For instance, in 2015, 75% of Indigenous mothers had a regular healthcare provider compared to 85% of non-Indigenous mothers [20], while in 2020, this gap grew substantially larger for Indigenous mothers, with only 48% of Indigenous mothers having a regular healthcare provider compared to 97% of non-Indigenous mothers [19]. The pattern of health inequities for non-white populations reveals a medical system that fundamentally devalues the lives of the 'Others' and perpetuates harm under the guise of care; representing systematic institutional failings rather than coincidental outcomes.

Colonialism is not a "historical point in time away from which our society has progressed" [9] but an enduring force that continues to uphold white patriarchal structures, particularly in healthcare. Colonial medical frameworks create a dichotomy between the colonizer and the 'Other'. The Coin Model of Privilege [21] illustrates how individuals can simultaneously experience both oppression and privilege. For instance, white women face gender-based discrimination but benefit from racial privilege that positions them above racialized populations. These hierarchies are further compounded by socioeconomic status, creating barriers to adequate healthcare for marginalized populations. Access to preventive care, specialist services, and timely interventions correlates strongly with economic resources, meaning that for racialized individuals, especially women, financial disadvantage frequently amplifies racial and gender discrimination [13,15,22]. Understanding these intersecting inequities through the Coin Model offers pathways for meaningful healthcare reform that addresses racial hierarchies, gender discrimination, and socioeconomic barriers simultaneously.

Toward Decolonizing Healthcare

Recognising medicine's entanglement with systemic harm is essential to dismantling the colonial structures that continue to shape health systems in Canada and beyond. The colonial healthcare system operates as a mechanism of domination, wielding Western medicine to invalidate Indigenous knowledge and to pathologize racial and cultural differences [23,24]. To dismantle this oppressive system, we must recognise the intersections of race, gender, and colonialism and how these manifest in disproportionate health outcomes for the 'Other'. While Canada has taken some steps to address these inequities, including efforts to integrate Indigenous knowledge and practices into healthcare, [25] confronting these legacies demands long-term, sustained commitment and concrete action to decolonise medicine and rebuild health systems rooted in equity and justice.

References

1. Shaheen-Hussain S. Fighting for a Hand to Hold: Confronting Medical Colonialism Against Indigenous Children in Canada. 2020. McGill-Queen's University Press.
2. Plaisime MV, Jipguep-Akhtar MC, Belcher HME. 'White People are the default': A qualitative analysis of medical trainees' perceptions of cultural competency, medical culture, and racial bias. SSM Qual Res Health. 2023 Dec 1;4:100312. doi:10.1016/j.ssmqr.2023.100312
3. Vissandjee B, Weinfeld M, Dupéré S, Abdool S. Sex, gender, ethnicity, and access to health care services: Research and policy challenges for immigrant women in Canada. Int Migr Integr. 2001;2(1):55–75. doi:10.1007/s12134-001-1019-7
4. Weis L. Identity Formation and the Processes of "Othering": Unraveling Sexual Threads. The Journal of Educational Foundations. 1995 Winter;9(1):17–33.
5. Amster EJ. The past, present and future of race and colonialism in medicine. CMAJ. 2022 May 24;194(20):E708–10. doi:10.1503/cmaj.212103 PubMed PMID: 35609910; PubMed Central PMCID: PMC9188792.
6. McCleery I. What is "colonial" about medieval colonial medicine? Iberian health in global context. J Mediev Iber Stud. 2015 Sep 1;7(2):151. doi:10.1080/17546559.2015.1077390 PubMed PMID: 26550030.
7. Bargallie DM. Maintaining the racial contract: Everyday racism and the impact of racial microaggressions on "Indigenous employees" in the Australian Public Service [phd] [Internet]. Queensland University of Technology; 2018 [cited 2025 Sep 8]. Available from: https://eprints.qut.edu.au/123010/ doi:10.5204/thesis.eprints.123010
8. Mayes C. White Medicine, White Ethics: On the Historical Formation of Racism in Australian Healthcare. Journal of Australian Studies. 2020 Jul 2;44(3):287–302. doi:10.1080/14443058.2020.1796754
9. Arvin M, Tuck E, Morrill A. Decolonizing Feminism: Challenging Connections between Settler Colonialism and Heteropatriarchy. Feminist Formations. 2013;25(1):8–34. doi:10.1353/ff.2013.0006
10. Schmotzer GL. Barriers and facilitators to participation of minorities in clinical trials. Ethn Dis. 2012;22(2):226–30. PubMed PMID: 22764647.
11. Bierer BE, Meloney LG, Ahmed HR, White SA. Advancing the inclusion of underrepresented women in clinical research. Cell Rep Med. 2022 Apr 19;3(4):100553. doi:10.1016/j.xcrm.2022.100553
12. Tobb K, Kocher M, Bullock-Palmer RP. Underrepresentation of women in cardiovascular trials- it is time to shatter this glass ceiling. Am Heart J Plus. 2022 Mar 5;13:100109. doi:10.1016/j.ahjo.2022.100109 PubMed PMID: 38560055; PubMed Central PMCID: PMC10978176.
13. Bess CJ. Gender Bias in Health: A Life or Death Issue for Woman with Coronary H. Hastings Journal of Gender & Law [Internet]. 1995 [cited 2025 Sep 8];6. Available from: https://repository.uclawsf.edu/hwlj/vol6/iss1/3
14. Shavers VL, Lynch CF, Burmeister LF. Knowledge of the Tuskegee study and its impact on the willingness to participate in medical research studies. Journal of the National Medical Association. 2000 Dec;92(12):563. PubMed PMID: 11202759.
15. da Silva PHA, Aiquoc KM, da Silva Nunes AD, Medeiros WR, de Souza TA, Jerez-Roig J, et al. Prevalence of Access to Prenatal Care in the First Trimester of Pregnancy Among Black Women Compared to Other Races/Ethnicities: A Systematic Review and Meta-Analysis. Public Health Rev. 2022;43:1604400. doi:10.3389/phrs.2022.1604400
16. Williams KKA, Baidoobonso S, Lofters A, Haggerty J, Leblanc I, Adams AM. Anti-Black racism in Canadian health care: a qualitative study of diverse perceptions of racism and racial discrimination among Black adults in Montreal, Quebec. BMC Public Health. 2024 Nov 13;24(1):3152. doi:10.1186/s12889-024-20636-0
17. Chiu M, Maclagan LC, Tu JV, Shah BR. Temporal trends in cardiovascular disease risk factors among white, South Asian, Chinese and black groups in Ontario, Canada, 2001 to 2012: a population-based study. BMJ Open. 2015 Aug 1;5(8):e007232. doi:10.1136/bmjopen-2014-007232
18. Bowden O. CTVNews [Internet]. 2023 [cited 2025 Sep 8]. Why doctors say breast cancer screenings need to happen at a younger age, especially for Black people. Available from: https://www.ctvnews.ca/health/article/why-doctors-say-breast-cancer-screenings-need-to-happen-at-a-younger-age-especially-for-black-people/
19. Canada PHA of. Healthcare for Indigenous women (infographic) [education and awareness] [Internet]. 2024 [cited 2025 Sep 8]. Available from: https://www.canada.ca/en/public-health/services/publications/aboriginal-health/healthcare-indigenous-women.html
20. Government of Canada SC. The Daily — Health care access and experiences among Indigenous people, 2024 [Internet]. 2024 [cited 2025 Sep 8]. Available from: https://www150.statcan.gc.ca/n1/daily-quotidien/241104/dq241104a-eng.htm
21. Nixon SA. The coin model of privilege and critical allyship: implications for health. BMC Public Health. 2019 Dec 5;19(1):1637. doi:10.1186/s12889-019-7884-9
22. Johnson J, Bottorff J, Browne A, Grewal S, Hilton B, Clarke H. Othering and being othered in the context of health care services. Health communication. 2004;16(2). doi:10.1207/S15327027HC1602_7 PubMed PMID: 15090288.
23. Hoffman KM, Trawalter S, Axt JR, Oliver MN. Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites. Proc Natl Acad Sci U S A 2016 Apr 4;113(16):4296. doi:10.1073/pnas.1516047113 PubMed PMID: 27044069.
24. Turpel-Lafond ME. In Plain Sight: Addressing Indigenous-specific Racism and Discrimination in B.C. Health Care [Internet]. 2020 Nov [cited 2025 Sep 8]. Available from: https://engage.gov.bc.ca/app/uploads/sites/613/2020/11/In-Plain-Sight-Summary-Report.pdf

25. Corso M, DeSouza A, Brunton G, Yu H, Cancelliere C, Mior S, et al. Integrating Indigenous healing practices within collaborative care models in primary healthcare in Canada: a rapid scoping review. BMJ Open. 2022 Jun 1;12(6):e059323. doi:10.1136/bmjopen-2021-059323 PubMed PMID: 35710234.

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The author declares that AI was not used in this article.