

Investigating the Association Between Household Gender Dynamics, Intimate Partner Violence, Mothers' Mental Health, Child Abuse, and Child Stunting in Rwanda

Jean Nepo Utumatwishima

Department of Public Health and Community Medicine
Institute of Medicine
Sahlgrenska Academy, University of Gothenburg



UNIVERSITY OF GOTHENBURG

Gothenburg 2025

Investigating the Association Between Household Gender Dynamics, Intimate Partner Violence,
Mothers' Mental Health, Child Abuse, and Child Stunting in Rwanda

© Jean Nepo Utumatwishima 2025
jean.nepo.utumatwishima@gu.se

ISBN 978-91-8115-437-5 (PRINT)
ISBN 978-91-8115-438-2 (PDF)

Printed in Borås, Sweden 2025
Printed by Stema Specialtryck AB



To the Government of Rwanda, for granting me the invaluable opportunity to pursue my education from secondary school, through medical school, and ultimately to the PhD level.

To the Government of Sweden, through the University of Rwanda–Sweden Program, for the generous support provided in strengthening PhD training for scholars of the University of Rwanda.

*To my beloved wife and children—**Nassin, Inas, Inam, Iwan, and Ihan**—for their unwavering love, patience, and support that sustained me throughout this academic journey.*

Investigating the Association Between Household Gender Dynamics, Intimate Partner Violence, Mothers' Mental Health, Child Abuse, and Child Stunting in Rwanda

Jean Nepo Utumatwishima

Department of Public Health and Community Medicine, Institute of

Medicine

Sahlgrenska Academy at University of Gothenburg

Gothenburg, Sweden

ABSTRACT

Background: Many low- and middle-income countries still encounter the persistent challenge of child stunting, despite the widespread implementation of public health interventions aimed at reducing it. Most studies and interventions have primarily focused on child-related factors, often overlooking the broader household conditions. A deeper understanding of the household environment, including the health and behaviors of mothers and the family dynamics surrounding child-rearing, is crucial for addressing the stunting problem more effectively.

Aim: This thesis aims to investigate the association between household dynamics, such as gender roles, social support, women's decision-making, intimate partner violence (IPV), mothers' behaviors related to child disciplining, and mothers' mental health disorders, with stunting of children aged between one month and three years.

Methods: The studies in this thesis are based on a cross-sectional, population-based study design. Data was collected through interviews with mothers using an investigator-administered questionnaire, which included standardized WHO questions for assessing IPV, the Mini International Neuropsychiatric Interview questionnaire for evaluating mental health, and UNICEF Multiple Indicator Cluster Surveys (MICS)-guided questions for assessing child abuse. The Multidimensional Poverty Index (MPI), created by Oxford University, was used to evaluate the household's socioeconomic status. In total, 601 mothers along with their children, who were between one month and three years old, participated in the study. Using a geographic grid method in collaboration with Lund University, villages in Rwanda's Northern Province were identified, and households were selected through a simple random sampling process. Child age, along with weight and height measurements, served to compute height-for-age z-scores for assessing stunting, per WHO anthropometric guidelines. Descriptive measures and logistic regression models, both bi-variable and multivariable, were employed in the data analysis, showing adjusted odds ratio (aOR) and 95% confidence intervals.

Results: Among the 601 mother–child pairs, 27.1% of the children were stunted. Within the stunted group, 60.1% were boys and 39.9% were girls. Stunting increased with age, peaking at 39.9% in children aged 25–36 months. The mothers were predominantly from low-income backgrounds (88.4%), over 30 years old (56.4%), had low educational attainment (78.2%), and worked in unskilled jobs (97.3%). The average MPI was 0.265 across the sample. There was no statistical difference in the MPI scores between households with stunted children and those without stunted children. Nearly half (47.4%) of mothers endured IPV both prior to and during pregnancy. Mothers’ experience of physical IPV prior to pregnancy [aOR=1.29 (1.01 to 2.03)], along with sexual IPV encountered during pregnancy [aOR=1.25 (1.04 to 2.01)], were associated with child stunting. Depression was also a key risk factor, as children of mothers with current major depressive disorder had stunted growth [aOR = 1.67 (1.06–2.61)]. Both insufficient support while ill and lack of personal guidance of mothers were associated with child stunting, with [aOR=1.93 (1.13 to 3.28)] and [aOR=2.44 (1.41 to 4.26)], respectively. Harsh disciplining methods used by mothers, especially when both physical and non-physical approaches were employed, were linked to a higher odds ratio of child stunting [OR = 1.92 (1.08–3.41)].

Conclusions: Despite ongoing public health interventions in Rwanda, child stunting remains a significant problem. The findings highlight that child undernutrition is not only influenced by direct nutritional factors but is also deeply rooted in household dynamics, mothers’ well-being, and gendered social structures. Mental health disorders, exposure to IPV, lack of social support, and violent child-disciplining practices were all strongly associated with child stunting. Integrating mental health screening for pregnant women, educating expectant mothers on the importance of social support, and raising awareness about the dangers of violent child disciplining methods and encouraging non-violent alternatives are essential additions to the ANC content. These results underscore the need for a holistic, interdisciplinary, multisectoral approach that incorporates mental health services, IPV prevention, gender-sensitive interventions, enhanced ANC, and parental support programs into existing nutrition and child health initiatives. Tackling these broader determinants is essential for sustainable improvements in child growth and long-term public health gains.

Keywords: child growth, child stunting, intimate partner violence, mental health disorders, child violence, household living conditions, social support, Rwanda

ISBN 978-91-8115-437-5 (PRINT)
ISBN 978-91-8115-438-2 (PDF)

SAMMANFATTNING PÅ SVENSKA

Bakgrund: Många låg- och medelinkomstländer har fortfarande stora problem med barns hämmade längdtillväxt på grund av undernäring, trots omfattande folkhälsointerventioner vars syfte har varit att minska detta problem. Tidigare insatser har främst fokuserat på barnrelaterade faktorer, och därmed förbisett ett bredare fokus på barns dagliga levnadsvillkor. En djupare förståelse av barns levnadsvillkor, inklusive mödrars hälsa och beteenden, samt familjens syn på fostran av barn, är avgörande för att effektivt kunna minska problematiken med undernäring hos barn.

Syfte: Avhandlings syfte är att undersöka sambandet mellan familjedynamik, såsom könsroller, kvinnors beslutsfattande och socialt stöd, partnervåld (IPV), vidare mödrars psykiska hälsa och beteenden relaterade till barnmisshandel, och kronisk undernäring hos barn under tre år.

Metoder: Studien är en populationsbaserad tvärsnittsstudie. Data samlades in genom en forskaradministrerad enkät, som inkluderade standardiserade WHO-frågor för att bedöma moderns utsatthet för partnervåld (IPV). Vidare användes Mini International Neuropsychiatric Interview-enkäten för att undersöka psykisk ohälsa hos mödrarna, och UNICEFs Multiple Indicator Cluster Surveys (MICS) frågor för att bedöma barnmisshandel. Hushållens socioekonomiska status mättes med hjälp av Multidimensional Poverty Index (MPI), ett verktyg utvecklat av Oxford University. Totalt deltog 601 kvinnor och deras barn, som alla var i åldrarna en månad till tre år. Byar i Rwandas norra provins valdes ut med hjälp av ett geografiskt informationssystem (Geographical Information System, GIS), ett ramverk för att samla in, hantera och analysera data utvecklat av Lunds universitet. Deltagande hushåll inom varje by valdes ut slumpmässigt. För att bedöma barns hämmade längdtillväxt användes data som vikt, längd och ålder för att beräkna längd-för-ålder z-poäng, med hänvisning till WHO:s antropometriska standard. För att analysera data användes deskriptiv statistik och bi- samt multivariabel logistisk regression.

Resultat: Av studiens 601 mödrar och deras 601 barn var prevalensen av hämmad längdtillväxt 27,1%, högre hos pojkar (60,1%) än hos flickor (39,9%). Hämmad längdtillväxt ökade med åldern, med en topp på 39,9% hos barn i åldern 25–36 månader. Mödrarna var övervägande låginkomsttagare (88,4%), över 30 år gamla (56,4%), hade låg utbildningsnivå (78,2%) och arbetade i okvalificerade yrken (97,3%). Multidimensional Poverty Index (MPI) var 0,265, utan statistiskt signifikant skillnad mellan hushåll med tillväxthämmade och icke-tillväxthämmade barn (MPI 0,263, 95% CI: 0,216–0,310 vs. 0,265, 95% CI: 0,237–0,293). Nästan hälften av mödrarna (47,4%) levde med partnervåld (IPV) såväl före som under graviditeten, där utsatthet för fysiskt partnervåld före graviditeten (AOR = 1,29, 95% CI: 1,01–2,03) och sexuellt partnervåld under graviditeten (AOR = 1,25, 95% CI: 1,04–2,01) var associerat med barns hämmade längdtillväxt. Depression hos mödrarna var också en viktig riskfaktor, då barn till mödrar med pågående depression visade höga odds för nedsatt längdtillväxt (AOR = 1,67, 95% CI: 1,06–2,61). Brist på stöd under sjukdom (AOR = 1,93, 95% CI: 1,13–3,28), samt avsaknad av personlig vägledning (AOR = 2,44, 95% CI: 1,41–4,26) var kopplade till högre odds för barns hämmade längdtillväxt (OR = 1,92, 95% CI: 1,08–3,41).

Konklusioner: Trots pågående folkhälsointerventioner kvarstår barns hämmade längdtillväxt som ett betydande problem i Rwanda. Resultaten visar att undernäring hos barn inte enbart påverkas av direkta näringsfrågor utan även är djupt rotade i familjedynamiken, samt har samband med mödrars välbefinnande och könsrelaterade sociala strukturer. Mödrars psykiska hälsoproblem, såsom exponering för partnervåld, brist på socialt stöd och användande av våld i fostranssyfte var alla starkt associerade med tillväxthämmade barn. Att integrera screening för psykisk ohälsa hos gravida kvinnor, utbilda blivande mödrar om vikten av socialt stöd, öka medvetenheten om farorna med våldsamma fostringsmetoder av barn och uppmuntra icke-våldsamma alternativ är viktiga tillägg till den förebyggande mödravårdens innehåll.

Resultaten understryker behovet av en holistisk, multisektoriell strategi som inkluderar psykiska hälsoinsatser, förebyggande av partnervåld, ökad jämställdhet, förbättrad mödravård och föräldrastödsprogram i pågående interventionsprogram för förbättrad barnhälsa. Att hantera dessa bredare samhällsfaktorer är avgörande för hållbara förbättringar av barns näringsstatus och längdtillväxt och skulle medföra långsiktiga folkhälsovinster.

Nyckelord: barns hämmade längdtillväxt, partnervåld, psykiska hälsotillstånd våld mot barn, hemförhållanden, socialt stöd, Rwanda

LIST OF PAPERS

This thesis is based on the following studies, which are denoted in the text by the Roman numerals:

- I. **Utumatwishima, J. N.,** Mogren, I., Umubyeyi, A., Mansourian, A., & Krantz, G. (2024). How do household living conditions and gender-related decision-making influence child stunting in Rwanda? A population-based study. *PLOS ONE*, *19*(3), e0290919. <https://doi.org/10.1371/journal.pone.0290919>. Open Access.
- II. **Utumatwishima, J. N.,** Mogren, I., Elfving, K., Umubyeyi, A., Mansourian, A., & Krantz, G. (2024). Women's exposure to intimate partner violence and its association with child stunting: findings from a population-based study in rural Rwanda. *Global Health Action*, *17*(1). <https://doi.org/10.1080/16549716.2024.2414527>. Open Access.
- III. **Utumatwishima, J. N.,** Mogren, I., Elfving, K., Umubyeyi, A., & Krantz, G. (2025). Poor mental health in mothers is associated with child stunting: findings from a population-based cross-sectional study in Rwanda. Manuscript under Review.
- IV. **Utumatwishima, J. N.,** Mogren, I., Elfving, K., Umubyeyi, A., & Krantz, G. (2025). Child disciplining practices and their association with child stunting in Rwanda: insights from a population-based study. Manuscript under Review.

CONTENTS

SAMMANFATTNING PÅ SVENSKA	vi
LIST OF PAPERS.....	viii
ACRONYMS AND ABBREVIATIONS	xi
DEFINITIONS IN SHORT	xii
1 INTRODUCTION.....	1
1.1 Role of mothers in combating child malnutrition.....	3
1.2 The effect of poverty and household living conditions on child nutrition.....	4
1.2.1 Estimating poverty levels using the multidimensional poverty index.....	5
1.3 The impact of intimate partner violence on mother and child health	6
1.3.2 Effects of IPV on mothers' overall health.....	7
1.3.3 Effects of IPV on child growth and development	7
1.4 Mental health disorders in mothers and their impact on child health.....	7
1.4.1 The role of fathers in early childhood development, a reflection.....	8
1.5 Child disciplining by mothers and impact on child health	8
1.6 Theoretical framework.....	9
1.7 Conceptual framework linking child growth challenges to household poverty, gender dynamics, mothers' IPV exposure, mothers' mental health, and disciplinary practices.....	9
1.8 Thesis Rationale.....	10
1.9 Scientific methods	11
2 AIMS.....	12
2.1 General aim.....	12
2.2 Specific aims.....	12
3 MATERIALS AND METHODS.....	13
3.1 Study setting	13
3.2 Summary of materials and methods used in all studies included in this thesis	14
3.2.1 Study design, study population, sample size, and participants recruitment	15
3.2.2 Data collection procedures	16
3.2.3 Variables	17
3.2.4 Instruments	18
3.3 Data analyses	22
3.4 Ethical Considerations	23
4 RESULTS.....	24
4.1 Influence of living conditions and gender related decision-making stunting (Paper I)...	26
4.2 Association between women's exposure to IPV and child stunting.....	29
(Paper II).....	29
4.3 Association between mothers' poor mental health and child stunting (Paper III).....	33
4.4 Child disciplining practices and their association with child stunting	36
(Paper IV)	36

5 DISCUSSION39

5.1 Household gender roles: The overlooked yet crucial factor in childhood development . 39

5.2 Multidimensional poverty index: A holistic view of poverty beyond income..... 40

5.3 Women's exposure to IPV increases the likelihood of stunting in their children 41

5.4 Poor mental health in mothers is associated with child stunting..... 43

5.5 Child disciplining practices are associated with child stunting 44

5.6 Methodological considerations 47

6 CONCLUSIONS AND IMPLICATIONS.....50

6.1 Conclusions..... 50

6.2 Implications 51

7 FUTURE PERSPECTIVES.....54

ACKNOWLEDGEMENT55

REFERENCES.....58

ACRONYMS AND ABBREVIATIONS

AF	Alkire-Foster
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
AP	Attributable Proportion
CHWs	Community Health Workers
CI	Confidence Interval
CMHS	College of Medicine and Health Sciences
DHS	Demographic and Health Survey
ECD	Early Childhood Development
ERR	Excess Relative Risk
GAD	Generalized Anxiety Disorder
HAZ	Height-for-Age Z score
HBM	Health Belief Model
ICD-10	International Classification of Diseases, 10th Revision (1993)
IPV	Intimate Partner Violence
LICs	Low-Income Countries
LMICs	Low and Middle-Income Countries
MDD	Major Depressive Disorder
MICS	Multiple Indicator Cluster Surveys
MINI	Mini International Neuropsychiatric Interview
MPI	Multidimensional Poverty Index
NST1	National Strategy for Transformation
OR	Odds Ratio
PTSD	Post-Traumatic Stress Disorder
RDHS	Rwanda Demographic and Health Survey
RERI	Relative Excess Risk due to Interaction
SBCC	Social and Behavior Change Communication
SDG	Sustainable Development Goal
SEM	Socio-Ecological Model
SI	Synergy Index
SPRP	Stunting Prevention and Reduction Project
UNECE	United Nations Economic Commission for Europe
WHO	World Health Organization

DEFINITIONS IN SHORT

<p>Child undernutrition</p>	<p>It refers to a lack of essential nutrients needed for growth, leading to issues like stunting, wasting, or being underweight. This condition impairs development, weakens immunity, and increases illness risk.</p>
<p>Child stunting</p>	<p>It is a condition characterized by insufficient height relative to a child's age, signaling long-term undernutrition. It arises when children experience prolonged periods without adequate nutrition, particularly during crucial stages of growth and development.</p>
<p>Gender dimensions</p>	<p>In this thesis, gender dimensions pertain to the impact of gender on social, economic, and cultural dynamics, as well as on roles and power dynamics within families. They emphasize how gender-specific challenges and experiences shape child growth and development.</p>
<p>Intimate partner violence</p>	<p>Intimate partner violence includes actions in a close relationship that cause physical, emotional, or sexual harm, such as physical assault, emotional abuse, sexual coercion, and control.</p>
<p>Mothers' mental health</p>	<p>In this thesis, mothers' mental health refers to the psychological well-being of mothers with children under the age of three, including conditions like depression, anxiety, and suicidal behavior that impact caregiving.</p>
<p>Child abuse</p>	<p>Child abuse behavior refers to any intentional action or pattern of actions that inflicts harm, mistreatment, or neglect on a child</p>

1 INTRODUCTION

Chronic undernutrition is a deficiency in key nutrients required for growth and development, leading to stunting, wasting, or underweight [1]. This condition impairs physical and intellectual development, weakens immunity, and increases illness risk [2]. Child stunting is a condition characterized by insufficient height relative to a child's age, signaling long-term undernutrition [3]. It arises when children experience prolonged periods without adequate nutrition, particularly during crucial stages of growth and development [1]. Despite considerable efforts over the years to combat child stunting worldwide, it remains a major public health issue [3]. Child stunting is most prevalent in low-income countries (LICs), especially in Sub-Saharan Africa and South Asia [3]. Despite a global consensus on the definition and measurement of stunting, it often goes unnoticed in communities where short stature is typical due to the lack of routine growth monitoring and its indistinct visual signs [3]. In Rwanda, child stunting rates declined from 38% in 2015 to 33% in 2020, as reported by the Demographic and Health Surveys (DHS) conducted in 2014–2015 and 2019–2020 [4, 5]. The 5% decrease in child stunting prevalence over five years in Rwanda remains insufficient. Furthermore, the DHSs between 2015 and 2020 indicate a slight increase in the prevalence of child stunting in Rwanda's Northern Province [5]. The modest decrease in child stunting rates over five years, despite multiple public health interventions, coupled with the rise in stunted children in Rwanda's Northern Province, reflects a stagnation in the country's human capital development. This situation emphasizes the urgent need for an in-depth investigation into the root causes of child stunting in Rwanda, particularly in the Northern Province. In 2018, 34% had a minimally acceptable diet, and 37% experienced sufficient environmental health [6]. Recognizing the importance of coordinated efforts, Rwanda embraced a multi-sectoral strategy by implementing comprehensive development programs aimed at enhancing human capital and combating child stunting, aligning with a broader World Bank initiative to promote children's long-term health [7]. In 2021, several interventions were implemented, such as enhancing the reach of high-impact strategies while encouraging participation through the social protection project, tackling widespread food insecurity among vulnerable families, expanding home-based Early Childhood Development (ECD) sites for high-risk households, launching behavior change communication initiatives to raise awareness about stunting, and reforming the Community Health Workers program [6, 7]. Following the

implementation of the earlier interventions, the Rwandan government renewed these efforts in 2023, aiming to reduce child stunting to 19% by 2024 [6]. Redesigned interventions included improving child nutrition monitoring with tools like the child scorecard and length mat, used by Community Health Workers (CHWs), and boosting attendance at antenatal care (ANC) visits, particularly in the first trimester [6, 7]. Nutrition counseling quality was also improved, and the supply chain for nutrition commodities was evaluated [7]. Nutrition services were strengthened, with poultry and nutrient-rich crops like iron-fortified beans and orange sweet potatoes provided to support vulnerable households [6, 7]. Water quality management in rural areas was enhanced through increased access to clean water and school-based purifiers, while the *“Hehe n'Igwingira”* campaign promoted awareness on stunting, nutrition, and hygiene [6]. The interventions launched in 2021 and revised in 2023, with aim to decrease child stunting from 33% to 19% by 2024, reveal a critical oversight: the lack of emphasis on mothers, who are the primary caregivers, particularly for children under the age of five [6, 7]. Despite their vital role in child nutrition and development, mothers have been largely neglected in these initiatives, undermining the interventions' overall effectiveness. This thesis seeks to illustrate that when mothers have access to favorable living conditions, maintain good mental health, and practice positive parenting behaviors, they are essential in the battle against child stunting.

Framing this research within the context of global public health

In clinical settings, healthcare providers managing cases of chronic undernutrition (stunting) in children often do not consider broader contextual determinants. It is uncommon for clinicians to assess mothers' mental health prior to and throughout pregnancy, exposure to IPV, or disciplining practices within the household. Even more rarely are questions asked about the household's geographic location, overall living conditions, food security status, or the quality and safety of milk consumed by the family, whether produced domestically or purchased.

Contemporary global public health frameworks advocate for an interdisciplinary and multisectoral response to stunting, recognizing it as a multifaceted issue. Aligned with this perspective, eight PhD researchers from different scientific disciplines collaborated under the Rwanda Undernutrition Program to comprehensively investigate the drivers of stunting in the Northern Province of Rwanda. Geospatial scientists employed grid-based sampling methods to ensure

representativeness; agricultural and veterinary teams assessed household food security and milk safety; obstetricians and pediatricians developed a Pilot Rwandan Medical Birth Register; and this thesis focused on gender perspectives in examining household living conditions and mothers' well-being as potential determinants of child stunting.

1.1 Role of mothers in combating child malnutrition

Mothers are typically the key decision-makers when it comes to household purchases and determining what the family consumes. In many African cultures, they serve as the primary caregivers, which places them at the forefront of ensuring proper nutrition for their children [8].

During a child's first 1,000 days, mothers play a crucial role in making essential decisions about breastfeeding, early nutrition, and the introduction of complementary foods [9].

The choices mothers make about breastfeeding and when to introduce complementary foods greatly influence nutritional outcomes for children, especially in their early years. Mothers' knowledge of balanced nutrition and the role of essential nutrients directly impacts the quality of the meals they provide [10]. Within a household, a mother's dietary habits are strongly connected to the eating behaviors of her children [8]. In many households, mothers are alone responsible for meal planning, cooking, and managing resources, significantly influencing the family's overall diet [8].

Cultural beliefs and traditions heavily influence family feeding practices, and mothers often strive to integrate these customs with modern nutritional understanding [11]. Additionally, mothers play a crucial role in monitoring their child's growth and health, ensuring that any signs of malnutrition are promptly addressed [12]. In general, the caregiving decisions mothers make are essential for supporting healthy development and preventing malnutrition in their children. However, mothers face numerous challenges in ensuring their children get adequate nutrition, with factors such as poverty, limited resources, and food insecurity often exacerbating these difficulties [13].

Financial limitations often hinder the ability to provide nutritious meals, as healthy food options tend to be more costly and less readily available [14]. A lack of sufficient nutritional knowledge is another significant challenge for many mothers, as some may be unaware of the importance of a balanced diet or lack the skills to prepare nutrient-dense meals [15]. Furthermore, cultural beliefs and traditional feeding practices may conflict with contemporary nutritional recommendations,

leading to confusion [16]. For mothers who work or are single parents, time limitations further complicate meal preparation, making it more challenging to prioritize nutrition while balancing multiple responsibilities [17]. Additionally, the inconsistent information from various sources, including healthcare professionals, social media, and food marketing, increases confusion, thus making it difficult for mothers to make well-informed choices regarding their diets [18].

Insufficient access to healthcare and nutrition counseling can hinder mothers from receiving the support needed to address their children's nutritional needs [19]. Additionally, managing children's selective eating behaviors adds further difficulty in ensuring a balanced diet [20]. In regions where malnutrition is prevalent, frequent illnesses can aggravate nutritional deficiencies, reinforcing a difficult cycle [21].

1.2 The effect of poverty and household living conditions on child nutrition

Across the globe, numerous parents and families struggle to provide the diverse and nutritious foods necessary for young children's growth, development, and learning [22]. Factors such as rising inequalities, conflicts, climate crises, escalating food prices, the abundance of unhealthy food choices, aggressive marketing strategies, and poor feeding practices are pushing millions of children into food insecurity [23]. Families living in poverty often struggle to access nutritious food, leading to diets that lack essential nutrients [24]. Financial constraints typically force them to rely on cheaper, calorie-rich foods that are deficient in vitamins and minerals, contributing to malnutrition [24]. Challenging household conditions often lead to food scarcity, where families face inconsistent access to adequate nutrition for maintaining health and daily activity [25]. This insecurity can disrupt regular eating habits and result in insufficient nutrition, negatively impacting a child's growth and development [26]. Substandard living environments, such as inadequate housing and limited access to safe water, adversely affect children's health [27]. Inadequate sanitation raises the likelihood of diseases that can worsen nutritional health, as conditions like diarrhea result in nutrient depletion and reduced appetite [28]. Parents lacking knowledge about proper dietary practices find it difficult to prepare balanced meals, which are vital for their children's growth [17]. The stress resulting from poverty can negatively affect parents' mental health, which in turn may influence their caregiving behaviors [29]. Overwhelmed by their situation, parents may neglect their children's nutritional needs [30].

Prolonged poor nutrition during critical growth periods impairs children's development, learning, and overall health [31].

1.2.1 Estimating poverty levels using the multidimensional poverty index

Poverty is the most pressing global issue, and addressing it is essential for achieving sustainable development [32]. Poverty has traditionally been understood and quantified through monetary metrics, focusing on household consumption and expenditure [33]. However, it is now broadly acknowledged that poverty encompasses multiple dimensions. Incorporating a multidimensional perspective into poverty measurement provides a more comprehensive understanding of the interconnected challenges faced by those in poverty [34]. This recognition is reflected in the United Nations' first Sustainable Development Goal, which aims to halve multidimensional poverty by 2030 [35]. The MPI provides a holistic approach to evaluating poverty, extending beyond mere income assessment [36]. It considers a range of factors that contribute to deprivation across multiple dimensions, capturing the intricate realities of poverty [34, 37].

Multidimensional poverty index and child stunting prevalence in Rwanda

In Rwanda, the Northern Province, long regarded as one of the wealthiest regions due to its constant green climate and abundant agricultural output, faced unexpected scrutiny when Demographic Household Surveys revealed a rise in child stunting between 2015 and 2020. This trend raised significant questions about the underlying causes of child stunting, especially given that household food insecurity did not appear to be the primary issue.

Table 1. Prevalence of child stunting by Provinces in Rwanda

Province	DHS 2015	DHS 2020	Difference
Northern	40%	41%	+1%
Southern	40.5%	33%	-7.5%
Western	44.9%	40%	-4.9%
Eastern	34.8%	29%	-5.8%
Kigali City	22%	21%	-1%

Comparison of provincial stunting prevalence using DHS 2015 and DHS 2020 [4, 5].

Table 2. Multidimensional poverty index in Rwanda

Province	MPI	H ¹	A ²	Vulnerable people	Severe Poverty	Population Share
East	0.232	49.6%	46.7%	23.5%	19.4%	27.1%
Kigali City	0.100	22.4%	44.6%	14.8%	7.1%	12.9%
North	0.264	55.6%	47.4%	22.8%	22.9%	15.1%
South	0.251	53.1%	47.2%	24.8%	21.8%	22.1%
West	0.264	54.2%	48.6%	24.1%	22.9%	22.9%

Global MPI in Rwandan provinces [37]

¹H: Headcount ratio (deprived in at least one-third of the weighted indicators)

²A: Intensity of poverty (The average proportion of deprivations experienced by the poor)

1.3 The impact of intimate partner violence on mother and child health

IPV refers to abusive or violent behavior within a relationship, whether involving current or former spouses or dating partners [38]. IPV can take multiple forms, such as physical harm through force, non-consensual sexual acts, stalking that instills fear through persistent unwanted contact, and psychological abuse aimed at emotional harm or control [39, 40]. IPV is a significant global issue, with approximately 30% of women worldwide having reported sexual or physical violence by their partner at some point in their lives [41]. In the United States, about 41% of women and 26% of men have faced physical or sexual abuse, or stalking, committed by a partner at any point in a person's life [41, 42]. In Sub-Saharan Africa, the IPV rate is a particularly big problem. Around 31% of women experience physical IPV, 30% face emotional IPV, and 13% encounter sexual IPV. Overall, at least one form of IPV affects 43% of women in the region [41, 42]. IPV prevalence among pregnant women in sub-Saharan African nations is notably high (42%) [42].

1.3.2 Effects of IPV on mothers' overall health

IPV poses serious risks to the physical and psychological well-being of pregnant women and mothers [43]. Physically, it can result in injuries, chronic pain, digestive issues, and a range of other bodily symptoms [43]. IPV is closely linked to mental health issues like depression, anxiety, and substance use disorders [43]. Such health effects may persist, undermining mothers' well-being and caregiving capacity [44].

1.3.3 Effects of IPV on child growth and development

Even if IPV affects partners, it indirectly affects children. When children are exposed to parents engaged in IPV, especially in their early developmental age, it induces significant stress responses, potentially affecting their neurodevelopment [45]. Consequences that are observed are behavioral problems and academic difficulties at school. The trauma of being exposed indirectly to IPV results in delayed physical growth, referred to as stunting [45]. IPV affects not only mothers through emotional and physical harm, but also indirectly harms young children, impairing their emotional and physical development[46, 47].

1.4 Mental health disorders in mothers and their impact on child health

Mental health disorders are significant public health challenges that affect a considerable proportion of pregnant women and mothers globally [48]. Public health literature highlights that approximately one in five women report mental health conditions during pregnancy or in the post-partum period [49]. Childbearing women frequently report exposure to mental health disorders, with depression, anxiety disorders, and post-traumatic stress disorder (PTSD) being among the most common [50]. The occurrence of these disorders can depend on various factors, including socioeconomic status, ethnicity, and the availability of healthcare services [51].

The overall health and optimal early development of children are closely linked to the physical, psychological, and social well-being of their mothers [52]. When mothers constantly experience undiagnosed, untreated, or unmonitored mental health disorders, their children face significant risks of various growth and behavioral problems [53, 54]. Children's safe cognitive and developmental health depends entirely on the mental health clarity of the mothers [55]. Children born to mothers who experience chronic stress and mental health issues suffer from physical health

problems, childhood stress, poor nutrition-related issues such as stunting, and academic challenges due to inadequate learning abilities [53]. Maternal mental health disorders are prevalent and have significant implications for both mothers and their children [48].

1.4.1 The role of fathers in early childhood development, a reflection

Although the role of fathers was not the central focus of this thesis, it is essential to acknowledge their relevance in discussions surrounding children's and mothers' well-being. Just as children cannot be considered in isolation from their mothers, neither can mothers be understood independently of fathers [56]. Fathers are often implicated in negative outcomes as well, particularly in cases of IPV, and their influence on mothers' mental health [57]. In many sub-Saharan African contexts, due to prevailing cultural norms and, in some cases, limited education, fatherhood is frequently reduced to the role of economic provider [58]. This narrow perception often excludes fathers from active participation in early childhood development [59]. Existing literature emphasizes that fathers play a vital yet frequently overlooked role in children's early development [59]. Engaged fatherhood through activities such as play, communication, and shared caregiving has been shown to support children's cognitive, emotional, and social outcomes [60]. However, structural challenges such as poverty, unemployment, and rigid gender expectations often hinder paternal involvement [59].

1.5 Child disciplining by mothers and impact on child health

Harsh physical punishment, such as spanking, slapping, or hitting, can have numerous negative consequences for children. Studies indicate that physical punishment is both ineffective and detrimental over time [61, 62]. Aggressiveness and antisocial behavior observed in children are often a result of direct exposure to physical abuse or the indirect observation of family members engaging in physical violence, especially between parents during instances of IPV [46, 63]. Children exposed to physical abuse may develop mental health disorders and an inability to consume nutritious food, which can later lead to poor academic progression if not treated before the age of 3 years [64]. At a young age, they may experience malnutrition, and in chronic cases, they may become stunted [65]. Harsh nonphysical punishment includes actions such as verbal insults, public humiliation, and overly long time-outs [66]. These methods can lead to significant emotional distress, resulting in feelings of guilt, worthlessness, and shame, which in turn can affect

a child's self-esteem and overall mental health [67]. Abusive non-physical discipline, like physical punishment, is linked to negative behaviors such as defiance, withdrawal, and aggression in children [68].

1.6 Theoretical framework

Public health emphasizes the prevention of illnesses and the promotion of well-being within communities. It involves health promotion through the choices and efforts of individuals, families, communities, and the state [69]. Epidemiology, a key field in public health, examines how health-related conditions are distributed and what causes them in specific populations to help manage health issues [70]. Public health and epidemiology research frequently relies on three key theoretical frameworks to guide studies: the Health Belief Model (HBM), the Socio-Ecological Model (SEM), and the Socioeconomic Model of Health and Inequalities. The HBM explains that perceptions of susceptibility, severity, benefits, barriers, triggers to action, and self-efficacy influence individual health behaviors [71]. Researchers and practitioners commonly use it in interventions to promote behavioral changes, such as encouraging the adoption of preventive health practices [72]. The SEM examines the interplay of factors across multiple levels, such as individual, interpersonal, community, organizational, and societal, to understand and address health outcomes [73]. SEM is often used to design multi-tiered interventions, such as community-based health programs. This model serves as a foundation for initiatives aimed at reducing health disparities through structural changes and the distribution of resources [74]. The model of socioeconomic inequalities in health, rooted in decades of epidemiological research, illustrates the persistent link between lower socioeconomic status and adverse health outcomes [75]. Although commonly applied in longitudinal research such as the Whitehall II study, this framework also offers important insights when used in cross-sectional analyses [76].

1.7 Conceptual framework linking child growth challenges to household poverty, gender dynamics, mothers' IPV exposure, mothers' mental health, and disciplinary practices

A socio-economic model was employed to examine the influence of gender dynamics on child nutrition. This model analyzed how household decision-making processes and dependence on male partners affect households' overall health and economic status. It identified that restricted

decision-making authority and limited purchasing power among women create conditions conducive to IPV against women and malnutrition of their children [77].

The SEM was used to study IPV, providing a framework to examine IPV at various levels [78]. HBM was applied to understand mothers' mental health [79]. The SEM was crucial in examining child abuse, revealing how factors like social support and community norms around child disciplining influence harsh parenting practices [80]. It highlighted how societal acceptance of physical punishment and insufficient protective policies contribute to child abuse. In studying child stunting, the three frameworks offered valuable insights. The Socioeconomic Model identified household factors like poverty, poor housing, and inappropriate sanitation while the SEM explored how family dynamics, including mothers' stress and IPV, interact with community and societal influences. The Health Belief Model (HBM) helped understand how mothers' beliefs about nutrition and health impact caregiving and decisions to seek medical care.

1.8 Thesis Rationale

Rwanda has experienced significant economic growth over the past two decades, resulting in notable improvements in the overall quality of life. These gains are reflected in advancements in maternal and child healthcare and a reduction in poverty rates. However, despite these national achievements, child stunting remains a major public health concern. As recently as 2019, approximately 38% of children under the age of five were affected by stunting. Additionally, Rwanda's Human Capital Index for children remains alarmingly low, indicating persistent challenges in ensuring optimal child health.

The persistent high prevalence of child stunting, despite concerted national efforts and comprehensive policy frameworks, highlights key limitations in existing strategies. Most conventional interventions have focused on direct nutritional support for children, often overlooking broader socioecological determinants of child nutrition and development. Critical factors such as household living conditions, including access to adequate sanitation, electricity, and clean water, have not been sufficiently integrated into child nutrition policies.

Moreover, mothers' mental health, which plays a vital role in caregiving practices and child development, has received limited attention in policy and programmatic responses. Gender

dynamics within households also present significant barriers. Although Rwanda has made commendable progress in political gender representation, rural women often face restricted decision-making power over food purchases and healthcare choices. This constraint hampers their ability to ensure adequate nutrition for their children, revealing a disconnect between national gender policies and everyday household realities.

Another underexamined but important factor is IPV against women, which remains prevalent in Rwanda. IPV against women has well-documented negative consequences for mothers' health, pregnancy outcomes, and caregiving behaviors, yet it is rarely addressed within the context of child nutrition. Similarly, harsh child disciplining practices, which are common in many Rwandan households, contribute to a harmful psychosocial environment that can exacerbate the effects of chronic malnutrition. Despite their significant impact on early childhood development, these practices are largely absent from mainstream public health interventions.

This thesis seeks to address these critical gaps by investigating the complex and interconnected influences of household living conditions, maternal mental health, gender dynamics, IPV, and child disciplining practices on child stunting in Rwanda. By adopting an interdisciplinary and holistic approach, the study aims to inform the development of more effective, context-sensitive strategies to reduce chronic undernutrition and promote sustainable child development outcomes in Rwanda.

1.9 Scientific methods

Quantitative research methods have been extensively used to address public health challenges in Rwanda. For instance, surveys and questionnaires have been employed to gather data on sociodemographic factors, household living conditions, and nutritional status. In quantitative research, the investigator systematically gathers and analyzes numerical data to uncover patterns, relationships, and trends [81]. This process often involves designing and administering surveys or experiments, utilizing statistical tools for data analysis, and interpreting the results to draw meaningful conclusions [82]. Quantitative research is essential for testing hypotheses and making data-driven decisions across various fields, including public health, social sciences, and economics [83].

Biostatistics and epidemiology are both applied in scientific research. Epidemiology focuses on studying the determinants of health events in populations and their distribution, using statistical methods to analyze data from surveys, cohort studies, case-control studies, and statistical modeling [84]. This approach helps identify patterns, causes, and effects of diseases, informing public health interventions and policies [85]. Biostatistics utilizes statistical techniques to interpret data from biological, medical, and health research, including clinical trials, epidemiological investigations, and health surveys [86]. This allows researchers to draw valid conclusions about health trends, risk factors, treatment efficacy, and disease prevention, supporting evidence-based decisions in clinical care and public health [85]. In quantitative research, the primary objective is to test a hypothesis [81]. Alpha (α), or the significance level, represents the chance of making a Type I error, incorrectly rejecting the null hypothesis when it is true [87]. Beta (β) indicates the likelihood of a Type II error, which occurs when the null hypothesis is not rejected despite being false [87]. Assessing reliability and validity is essential when evaluating any research data collection method [88]. Reliability denotes the degree to which data are consistent and precise, reflecting how effectively the measurement instrument reduces random errors [88]. Validity refers to the degree to which a tool accurately captures the concept it is designed to measure [88]. Internal validity refers to the extent to which the study design, implementation, and analysis accurately address the research questions without being influenced by bias [89]. External validity evaluates how well the findings of a study can be applied to different environments, groups, or periods outside the original sample [89].

2 AIMS

2.1 General aim

To examine associations between household gender dynamics, intimate partner violence, mothers' mental health, child abuse, and child stunting in Rwanda.

2.2 Specific aims

Study I: To investigate the household living conditions and the impact of gender-related decision-making on child stunting.

Study II: To examine the association between intimate partner violence occurring before and during pregnancy, including both milder and more severe forms of IPV, and child stunting.

Study III: To enhance the understanding of child stunting, this study aims to explore the association between mothers' mental health and child stunting.

Study IV: To assess the prevalence of mothers' behaviors toward child disciplining practices and investigate their associations with stunted growth in children.

3 MATERIALS AND METHODS

3.1 Study setting

Rwanda, situated in Central Africa, is one of the continent's smallest countries and is classified as a low-income nation. Despite its small size and landlocked position, Rwanda is characterized by a dense population of 13,5 million people as of 2023. It is the *country of the thousand hills*, with fertile soil. Since the tragic Genocide against the Tutsi in 1994, which resulted in over a million deaths and numerous orphaned children, Rwanda has maintained political stability [90]. The Rwandan social and economic structures were profoundly damaged, with the health sector being among the hardest hit. Prioritizing the reconstruction of healthcare systems has led to significant progress, particularly in mother and child health, supported by the implementation of universal health insurance, and a village-level community health worker program [91]. The studies included in this thesis were conducted to examine the impact of household living conditions, gender dynamics, mothers' mental health, mothers' exposure to IPV, and mothers' behaviors toward child disciplining on child stunting in Rwanda.

This research initiative is part of a collaborative effort between the University of Rwanda and five Swedish universities, under the interdisciplinary program titled "**Undernutrition—an interdisciplinary program focusing on children and their mothers**". This program adopts an epidemiological design incorporating qualitative elements and is organized into four distinct research projects that engage eight PhD students. The program objectives include addressing the persistent issue of stunting through an integrative approach that combines theories and methodologies from diverse disciplines, including Agriculture, Veterinary Science, Public Health, Obstetrics, Pediatrics, Nutrition, and Geographical Information Systems. Additionally, one of the sub-programs aims to develop a pilot version of a Rwandan Medical Birth Register.

This particular study's design for all investigations was cross-sectional, utilizing various statistical methods outlined in the following table.

3.2 Summary of materials and methods used in all studies included in this thesis

Study	Design	Data collection	Sample (N)	Aims	Analysis
I	Cross-sectional Population-based	Interviewer-administered survey	A randomly selected sample of 601 mother-child pairs.	To investigate the household living conditions and the impact of gender-related decision-making on child stunting.	Descriptive statistics, calculation of the Multidimensional poverty index using the AF method, univariable and multivariable logistic regression modeling
II	Cross-sectional Population-based	Interviewer-administered survey	A randomly selected sample of 601 mother-child pairs.	To examine the association between intimate partner violence occurring before and during pregnancy, including both milder and more severe forms of IPV, and child stunting.	Descriptive statistics, multivariable logistic regression modeling
III	Cross-sectional Population-based	Interviewer-administered survey	A randomly selected sample of 601 mother-child pairs.	To enhance the understanding of child stunting, this study aims to explore the association between mothers' mental health and child stunting.	Descriptive statistics, Interaction analysis ERR, RERI, AP, and SI, multivariable logistic regression modeling, directed acyclic graph, Venn diagram
IV	Cross-sectional Population-based	Interviewer-administered survey	A randomly selected sample of 601 mother-child pairs.	To assess the prevalence of mothers' behaviors toward child disciplining practices and investigate their associations with stunted growth in children.	Descriptive statistics, multilevel and multivariable regression analysis models

AF: Alkire-Foster , IPV: Intimate partner violence, ERR: excess relative risk, RERI: relative excess risk due to interaction, AP: attributable proportion, SI: Synergy index

The materials and methods employed in the studies (I-IV) included in this thesis encompass a range of approaches to ensure comprehensive analysis. They are presented under the sub-headings below.

3.2.1 Study design, study population, sample size, and participants recruitment

All studies employed a cross-sectional, population-based design. They were conducted in the Northern province of Rwanda. Rwanda is composed of four provinces and the city of Kigali [92]. The Northern Province, characterized by its mountainous terrain and predominantly rural landscape, it is divided into five districts [92]. These districts are further subdivided into sectors, cells, and villages. According to the 2022 census, the Northern Province has a population of approximately 2,038,511 people, accounting for 15.4% of Rwanda's total population [92].

Sample size calculation

The sample size for this study was determined on the basis of the estimated prevalence of child stunting in Rwanda, reported as 38% ($p=0.38$) [93]. To achieve a statistically robust estimate, we aimed for a precision of $\pm 4\%$ ($E=0.04$) with a 95% confidence level ($Z=1.96$). The sample size was calculated via the standard formula for estimating a single proportion [94]:

$$n = Z^2 * p * (1-p) / E^2$$

n = required sample size

Z = Z score corresponding to the desired confidence level (for 95% confidence, $Z \approx 1.96$)

p = estimated prevalence (proportion) of the outcome (in this case, the prevalence of child stunting was 38%)

E = margin of error (precision), expressed as a proportion (in this case, 0.04)

$$n = 1.96^2 * 0.38 * (1 - 0.38) / 0.04^2$$

$$n = 565.69 \approx 566$$

To account for potential nonresponses, an adjustment was made via the following formula, which is based on a commonly observed nonresponse rate of 10% in various health surveys and population studies:

$$n = n / (1 - \text{non-response rate}) = 566 / (1 - 0.10) \approx 628.89$$

After rounding, the minimum sample size was estimated to be 630 women with children aged between 1 month and 3 years.

The participants' selection involved several steps. A multistage random selection procedure was employed, beginning with the random selection of 186 out of 2,743 villages in the Northern Province of Rwanda using a geospatial grid system. Within each selected village, community health workers (CHWs) identified households with mothers who had children aged between one month and three years for interviews. If a mother was unavailable in the initially selected household, the nearest household with an eligible mother was approached for participation. Data collection faced limitations, as weight and height measurements were not obtained from 29 households due to reasons such as congenital malformations in children or severe illness. This process resulted in an overall participation rate of 95.4%, yielding a final sample size of 601 mother-child dyads.

3.2.2 Data collection procedures

Between November and December 2021, data were collected using a structured, tablet-based questionnaire administered by interviewers. In close partnership with community health workers (CHWs), a list of all eligible mothers from each village was compiled. From this list, mothers were randomly chosen for interviews and subsequently visited in their homes. The survey was conducted in Kinyarwanda, the local language, by a team of experienced interviewers, comprising six PhD students, eight registered nurses, and one post-doctoral researcher. Data collection was overseen by supervisors from both Rwanda and Sweden. The process included five days of pre-field training followed by two days of piloting the questionnaire in a selected village in the city of Kigali at the border of the Northern Province. At the end of each household interview, the completed questionnaire was carefully reviewed before the team departed. During the data

collection process, mothers in 29 households did not provide the essential data needed for certain analyses, leading to a participation rate of 95.4%.

3.2.3 Variables

This thesis examines child stunting as the sole outcome variable, defined as a height-for-age Z score (HAZ) below -2, indicating chronic undernutrition. This threshold means the child's height is over two standard deviations below the WHO growth standards for their age and sex. Stunting, a key measure of growth impairment, is assessed by comparing a child's height to WHO age- and sex-specific benchmarks [95]. Anthropometric data were collected using standardized procedures. Recumbent length was measured with a ShorrBoard for children under two, while standing height was measured for older children. Weights were recorded using a SECA 874 digital scale [96]. Child stunting was reported as a binary outcome (0/1) in all four papers, with 1 indicating stunted children and 0 indicating non-stunted children.

The independent variables consisted of socio-demographic and psychosocial factors at various levels that could impact child stunting. Individual-level variables included mothers' and partner's age, marital status, educational level, occupation, household income, and assets in the household as a way of measuring the living standard of the household. Child-specific variables comprised age, sex, number of siblings, past medical history, and birth weight.

In Paper II, psychosocial and demographic factors, along with three forms of IPV, were examined in relation to child stunting. Additionally, parental age, educational attainment, occupational status, and household financial income were considered key factors influencing child stunting. Alcohol consumption was categorized as low or non-drinkers versus frequent drinkers to assess its impact on child nutrition. Household economic conditions were evaluated based on access to electricity and improved toilet facilities, with sanitation classified as improved or non-improved according to WHO standards.

IPV was assessed through physical (6 items), sexual (3 items), and psychological (4 items) abuse based on the WHO questionnaire [97]. Participants reported the frequency of these acts (once, 2–3 times, or 4 or more times) both before and during pregnancy. Composite measures were created

for each form of violence, categorizing women as exposed if they experienced any of the violent acts.

In Paper III, the study evaluated various sociodemographic, child-related, and mothers' mental health variables as independent risk factors for child stunting. The sociodemographic factors included mothers' age, marital status, educational level, occupation, and household financial income. Child-related factors encompassed age, birth status, and breastfeeding status. Mothers' mental health was assessed using the Mini International Neuropsychiatric Interview (MINI), which evaluated major depressive disorder (MDD), generalized anxiety disorder, and suicide risk [98]. MDD was diagnosed based on affirmative responses to five or more items from a nine-question screening tool, with past MDD identified if depressive symptoms persisted for at least two weeks or if there was less than a two-month gap between episodes. Generalized anxiety disorder was diagnosed if participants responded positively to three or more anxiety-related questions. Suicide risk was assessed using a nine-item scale, with any positive response indicating current risk. The study also adjusted for IPV to investigate its association with mothers' mental health and its impact on child growth outcomes.

In the fourth paper, sociodemographic factors were categorized and analyzed as independent risk factors for child stunting. Variables assessed included mothers' age, partner's age, child's age, marital status, mothers' age at marriage, number of children, educational attainment of both mothers and their partners, and occupation. Additionally, two key factors; availability of social support at the household level and exposure to IPV were examined to assess mothers' living conditions. For Paper IV, data collection employed a UNICEF-supported Multiple Indicator Cluster Surveys (MICS) questionnaire to evaluate child disciplining methods reported by mothers [99]. This tool captured detailed information on mothers' behaviors towards child disciplining, distinguishing between nonphysical methods (e.g., removing privileges, explaining misbehavior) and physical methods (e.g., spanking, beating).

3.2.4 Instruments

A comprehensive questionnaire was developed to examine various factors associated with child stunting, including sociodemographic and psychosocial aspects, mother and child health

indicators, food accessibility, anthropometric measurements, agricultural practices, and milk quality. The questionnaire development was done by public health scientists from the University of Rwanda, College of Medicine and Health Sciences (CMHS), and five Swedish universities. This thesis utilized questions pertaining to sociodemographic and psychosocial aspects, mother and child health indicators, and anthropometric measurements.

To enhance accessibility and inclusivity, the questionnaire was translated into Kinyarwanda, the national language of Rwanda. The selected questions had been previously validated in earlier studies [100-102]. For efficient data collection and storage, the questionnaire was integrated into an Android-based application on the emGeo platform, enabling digital data entry and centralized cloud-based storage [103].

Standardized measurement techniques were employed to ensure accuracy. For children under 2 years of age, recumbent length was measured using a ShorrBoard® measuring board, while standing height was recorded for those over 2 years. Weight was measured using SECA digital scales (model SECA 874) to ensure precision [104].

To investigate the household living conditions, the MPI was calculated using the Alkire-Foster method (AF) [105]. The AF method has been widely employed to calculate the MPI [106]. The method begins by determining whether an individual or household, depending on the unit of analysis, is deprived or not in each indicator. Each indicator is assigned a weight to reflect its relative significance. An individual's deprivation score is calculated by summing the weights of the indicators in which they experience deprivation. A poverty threshold, or cutoff, is then established to identify the poor. Individuals are classified as poor if their deprivation score meets or exceeds this threshold. To ensure the MPI's reliability, robust tests are conducted to verify that its structure is not overly influenced by its parameters.

Multidimensional poverty is described using three main statistics. The first is *incidence* (H), which measures the percentage of the population identified as multidimensionally poor and is also referred to as the poverty rate or headcount ratio. The second is *intensity* (A), representing the average proportion of weighted indicators in which poor individuals are deprived, essentially reflecting their average deprivation score. Finally, the MPI serves as the primary indicator of

poverty, capturing the overall share of potential deprivations experienced by poor individuals in society. The MPI is calculated by multiplying the incidence by the intensity ($MPI = H \times A$) and ranges from 0 to 1, where 0 indicates no poverty and 1 signifies universal poverty. To avoid confusion with the overall tool's name, the term "MPI value" is often used to specify this summary statistic.

Indicators and dimensions of poverty used to calculate MPI

Dimensions of poverty	Indicator	Deprived if living in the household where...	Weight
Health	Nutrition	Any adult under 70 years of age or any child for whom there is nutritional information is undernourished.	1/6
	Child mortality	Any child under the age of 18 years has died in the family in the five-year period preceding the survey.	1/6
Education	Years of schooling	No household member aged 'school entrance age + six years or older has completed at least six years of schooling.	1/6
	School attendance	Any school-aged child is not attending school up to the age at which he/she would complete class eight.	1/6
Standard of living	Cooking fuel	The household cooks with dung, wood, charcoal or coal.	1/18
	Sanitation	The household's sanitation facility is not improved (according to SDG guidelines) or it is improved but shared with other households.	1/18
	Drinking water	The household does not have access to improved drinking water (according to SDG guidelines) or improved drinking water is at least a 30-minute walk from home, round trip.	1/18
	Electricity	The household has no electricity.	1/18
	Housing	At least one of the three housing materials for roof, walls and floor are inadequate: the floor is of natural materials and/or the roof and/or walls are of natural or rudimentary materials.	1/18
	Assets	The household does not own more than one of these assets: radio, television, telephone, computer, animal cart, bicycle, motorbike or refrigerator, and does not own a car or truck.	1/18

MPI indicators from The global Multidimensional Poverty Index: Harmonized level estimates and their changes over time [107]

To assess the household social support of mothers, the Social Support Questionnaire-Short Form, a 6-item measure of social support, was used [108]. Women's household decision-making power was assessed using the UNECE questionnaire on decision-making processes, along with selected items from the Women's Empowerment questionnaire in the United Kingdom data archive [109,

110]. IPV was assessed using the WHO questionnaire, which evaluated exposure to physical violence (six items), sexual violence (three items), and psychological abuse (four items) (111). The mental health status of mothers was evaluated using four modules from the Mini International Neuropsychiatric Interview (MINI), DSM-IV version 5.0.0 [98]. The child disciplining questionnaire, backed by UNICEF through the Multiple Indicator Cluster Surveys (MICS), was used to evaluate mothers' child disciplining approaches [112].

3.3 Data analyses

This section outlines the statistical methods employed for analyses across all studies (I–IV) in this thesis.

The compiled questionnaire was designed to collect data in real time using GPS coordinates through an Android-based application on the emGeo platform [103]. The data were transmitted from an internet-connected tablet and exported to STATA 17 SE (College Station, Texas, USA) for analysis. Prevalence (n, %) was used to describe participants' characteristics, and differences between groups were assessed by using Pearson's chi-squared test. During analyses, missing data were handled via listwise deletion which was deemed appropriate due to the relatively low proportion of missing values and the assumption that data were missing completely at random, minimizing potential bias in the estimates.

Regression analyses were conducted to examine associations between child stunting and psychosocial factors, including perceived social support, mothers' mental health disorders, IPV, and disciplining practices. Multivariable logistic regression models were applied, with results presented as odds ratios (OR) and 95% confidence intervals (CI). Interaction between mothers' mental health disorders and child stunting was assessed using excess relative risk (ERR), relative excess risk due to interaction (RERI), attributable proportion (AP), and the synergy index (SI). Statistical significance was determined using Z-scores and p-values ≤ 0.05 . Associations with disciplining methods were further examined using multilevel regression models, adjusting for sociodemographic factors, social support, and IPV.

The Multidimensional Poverty Index (MPI) was computed using a stepwise approach with equal weights for each dimension, a deprivation cutoff, and aggregation via the adjusted headcount ratio.

A Venn diagram illustrated the overlap of depression, anxiety, and suicide risk, while a directed acyclic graph depicted the relationships among mothers' mental health, sociodemographic, and psychosocial factors, and child stunting.

In the fourth study, mothers' disciplining practices and child stunting were analyzed through five logistic regression models, progressively adjusting for covariates: Model 1 included crude estimates; Model 2 adjusted for mothers' socio-demographic characteristics (age, age at marriage, occupation, education, marital status); Model 3 added household social support; Model 4 included exposure to physical, sexual, and psychological IPV; and Model 5 incorporated interaction terms between disciplining practices, social support, and IPV to test moderating effects. Adjusted odds ratios (aORs) with 95% CIs were reported for all models.

3.4 Ethical Considerations

This section outlines the ethical considerations applicable to all studies (I–IV) in this thesis.

Ethical approval for the study protocol and research instruments was granted by the Institutional Review Board of the University of Rwanda's College of Medicine and Health Sciences (Approval No. 181/CMHS IRB/2021) and the National Health Research Committee (Approval No. NHRC/2020/PROT/047). Prior to participation, all individuals provided written informed consent after receiving detailed information about the study's purpose, voluntary nature, right to withdraw at any time without consequences, and data management procedures, including the option to have their data removed upon withdrawal without being questioned. If a woman was unable to read or sign the consent form, the interviewer read its content aloud, and the eligible participant provided consent by applying her thumbprint.

Anthropometric assessments were conducted on children as part of the study after the voluntary approval of their mothers. These measurements were non-invasive and posed minimal risk to participating children. To ensure accuracy and the well-being of participants, all procedures were carried out by trained professionals. While mothers had the direct right to withdraw from the study, children's participation depended on their mothers' consent. However, researchers prioritized the children's well-being, responding promptly to any signs of distress to uphold ethical standards of the Helsinki Declaration. Confidentiality was rigorously upheld throughout the study. Participants

were informed of the potential benefits of the research at the individual, family, and community levels. Individuals requiring medical attention were transferred to appropriate healthcare facilities, and immediate assistance was provided for urgent cases. Participants were only included in the study if they completed the full survey.

4 RESULTS

The following section outlines the distribution of socio-demographic and psychosocial characteristics of participants across all studies (I-IV).

This thesis included 601 women and their 601 children, aged between one month and three years. The women's age ranged from 18 to 58 years, with 58.6% (n=352) distributed in the age group between 21 and 34 years. The majority of the women were married, accounting for 88.4% (n=531). Regarding education, 78.2% (n=470) of the women had low educational levels, including no education, incomplete primary, and complete primary education. With this level of education, nearly all women (97.3%; n=574) were employed in unskilled jobs. Men were designated as the heads of households in 92% of all households. The distribution of income showed that the majority of households (57.4%) had a combined monthly income of less than 17,500 RWF (~17 USD) from both women and their partners. In most families, house and land ownership were jointly shared between women and their partners (Table 3). Most households were classified as lacking adequate housing, with 78.4% (n=449) living in substandard conditions. Additionally, 57.4% (n=332) relied on unimproved water sources, 62.2% (n=372) did not have electricity, and 56.7% (n=335) had poor sanitation with unimproved toilets (Table 3). The children were categorized into two groups: those with stunting and those without. Among the 601 children, 51.7% were girls and 48.3% were boys. Among the 601 children, the prevalence of stunting was 27.1% (n = 163). Among stunted children, 60.1% were boys and 39.9% were girls. When stratified by sex, stunting was significantly more prevalent in boys (33.8%) than in girls (20.9%) ($p < 0.001$). With respect to age, the prevalence of stunting increased progressively, reaching its highest level (39.9%) among children aged 25–36 months.

Table 3. Prevalence of child stunting across mothers' sociodemographic factors, child characteristics, and living conditions (N = 601)

Variables	Category (n)	Total n (%)	Child stunting		p value*
			Stunted n (%)	Not stunted n (%)	
Mother's age (in years)	≤20 (n=30)	30 (5.0)	8 (26.7)	22 (73.3)	0.954
	21–34 (n=352)	352 (58.6)	94 (26.7)	258 (73.3)	
	≥35 (n=219)	219 (36.4)	61 (27.9)	158 (72.1)	
Parity	<5 children (n=478)	478 (79.5)	120 (25.1)	358 (74.9)	0.027
	≥5 children (n=123)	123 (20.5)	43 (35.0)	80 (65.0)	
Marital status	Married/cohabiting (n=531)	531 (88.4)	138 (26.0)	393 (74.0)	0.080
	Single/divorced/widowed (n=70)	70 (11.6)	25 (35.7)	45 (64.3)	
Mothers' education	Did not complete primary (n=277)	277 (46.1)	74 (26.7)	203 (73.3)	0.607
	Completed primary (n=193)	193 (32.1)	52 (26.9)	141 (73.1)	
	Secondary+ (n=131)	131 (21.8)	37 (28.2)	94 (71.8)	
Mothers' occupation	Skilled/student (n=16)	16 (2.7)	5 (31.3)	11 (68.7)	0.823
	Non-skilled (n=574)	574 (97.3)	158 (27.5)	416 (72.5)	
Mother's BMI (kg/m ²)	≤18.49 (n=23)	23 (3.9)	7 (30.4)	16 (69.6)	0.080
	18.5–24.9 (n=423)	423 (71.3)	107 (25.3)	316 (74.7)	
	25–29.9 (n=124)	124 (20.9)	38 (30.6)	86 (69.4)	
	≥30 (n=23)	23 (3.9)	7 (30.4)	16 (69.6)	
Child's age	1–12 (n=215)	215 (35.8)	21 (9.8)	194 (90.2)	<0.001
	13–24 (n=213)	213 (35.4)	73 (34.3)	140 (65.7)	
	25–36 (n=173)	173 (28.8)	69 (39.9)	104 (60.1)	
Child's sex	Female (n=311)	311 (51.7)	65 (20.9)	246 (79.1)	<0.001
	Male (n=290)	290 (48.3)	98 (33.8)	192 (66.2)	
Child's birthweight	≤2499 g (n=27)	27 (4.5)	12 (44.4)	15 (55.6)	0.001
	2500–2999 g (n=130)	130 (21.9)	38 (29.2)	92 (70.8)	
	3000–3499 g (n=241)	241 (42.5)	66 (27.4)	175 (72.6)	
	3500–3999 g (n=161)	161 (27.1)	39 (24.2)	122 (75.8)	
	≥4000 g (n=35)	35 (5.9)	8 (22.9)	27 (77.1)	
Still breastfeeding	Yes (n=452)	452 (76.1)	105 (23.2)	347 (76.8)	<0.001
	No (n=142)	142 (23.9)	55 (38.7)	87 (61.3)	
Recent diarrhea (2 weeks before survey)	Yes (n=161)	161 (26.8)	47 (29.2)	114 (70.8)	0.081
	No (n=435)	435 (73.2)	97 (22.3)	338 (77.7)	
Recent fever (2 weeks before survey)	Yes (n=180)	180 (30.2)	54 (30.0)	126 (70.0)	0.340
	No (n=416)	416 (69.8)	109 (26.2)	307 (73.8)	
Self-reported child health	Poor (n=81)	81 (13.5)	31 (38.3)	50 (61.7)	0.014
	Good (n=518)	518 (86.5)	131 (25.3)	387 (74.7)	
Household head sex	Male (n=553)	553 (92.0)	144 (26.0)	409 (74.0)	0.018
	Female (n=48)	48 (8.0)	19 (39.6)	29 (60.4)	
Relationship to household head	Married couple (n=528)	528 (87.8)	141 (26.7)	387 (73.3)	0.144
	Other (n=73)	73 (12.2)	22 (30.1)	51 (69.9)	
	<17,500 RWF (n=345)	345 (57.4)	102 (29.6)	243 (70.4)	0.141

Variables	Category (n)	Total n (%)	Child stunting		p value*
			Stunted n (%)	Not stunted n (%)	
Household income	≥17,500 RWF (n=256)	256 (42.6)	61 (23.8)	195 (76.2)	
House ownership	Personal (n=11)	11 (1.8)	3 (27.3)	8 (72.7)	0.942
	Joint (n=452)	452 (75.2)	119 (26.3)	333 (73.7)	
	None (n=122)	122 (20.3)	34 (27.9)	88 (72.1)	
Land ownership	Personal (n=20)	20 (3.3)	5 (25.0)	15 (75.0)	0.940
	Joint (n=414)	414 (68.9)	109 (26.3)	305 (73.7)	
	None (n=152)	152 (25.3)	42 (27.6)	110 (72.4)	
Housing quality	Adequate (n=124)	124 (21.6)	36 (29.0)	116 (93.5)	0.319
	Inadequate (n=449)	449 (78.4)	127 (28.3)	322 (71.7)	
Electricity access	Yes (n=226)	226 (37.8)	44 (19.5)	182 (80.5)	0.030
	No (n=372)	372 (62.2)	95 (25.5)	277 (74.5)	
Water source	Improved (n=246)	246 (42.5)	63 (25.6)	183 (74.4)	0.054
	Unimproved (n=332)	332 (57.4)	101 (30.4)	231 (69.6)	
Sanitation	Improved toilet (n=256)	256 (43.3)	45 (17.6)	211 (82.4)	0.051
	Unimproved toilet (n=335)	335 (56.7)	94 (28.1)	241 (71.9)	
Household assets	0–1 assets (n=240)	240 (39.9)	72 (30.0)	168 (70.0)	0.230
	≥2 assets (n=361)	361 (60.1)	91 (25.2)	270 (74.8)	
Milking cow ownership	Yes (n=155)	155 (25.8)	36 (23.2)	119 (76.8)	0.092
	No (n=446)	446 (74.2)	127 (28.5)	319 (71.5)	

Values are presented as n (%), row percentages. *p-values were calculated using Pearson's chi-square test.

4.1 Influence of living conditions and gender related decision-making stunting (Paper I)

Women residing in households without electricity were more likely to have stunted children compared to women living in households with electricity (aOR 2.09, 95% CI: 1.34–3.28). Additionally, women living in households with zero or one asset (such as a radio, phone, bicycle, or television) had a higher likelihood of having stunted children compared to those living in households with two or more assets [aOR 1.46 (1.01–2.14)]. The multidimensional assessment of households showed that both groups those with stunted children and those without were characterized by similar levels of poverty, as the confidence intervals for the calculated MPI overlapped [MPI in stunted group: 0.263 (0.216–0.310, SE: 0.024; MPI in non-stunted group: 0.265 (0.237–0.293), SE: 0.014], indicating no statistically significant difference in MPI between the two groups.

Household social support for women

In the Northern Province, this study identified social support as an integral component of daily life. Figure 1 presents various forms of household social support received by women, categorized into the total sample, women with non-stunted children, and women with stunted children. The assessed support types include financial assistance (borrowing money), emotional support (guidance during problems), shared living arrangements (sharing a house), resource sharing (sharing food), healthcare-related support (assistance during illness), and practical assistance for personal challenges. The association between social support and child stunting was statistically significant for the absence of support during illness [1.93 (1.13–3.28)] and the lack of guidance during personal problems [2.44 (1.41–4.26)], even after adjusting for mothers' age, education, household income, and household headship.

Household gender roles

Shared decision-making between mothers and their spouses was the most common practice across all household domains. The prevalence of stunting was highest among children of mothers who made major purchases alone, 45.1% (n = 23), followed by joint decision-making with a partner, 27.8% (n = 78), and was lowest when decisions were made only by the partner or others, 22.5% (n = 57) (p = 0.004). Similarly, stunting was more common among children of mothers who decided alone on family visits, 39.8% (n = 33), compared with joint decision-making, 25.8% (n = 91), and partner-only decision-making, 23.0% (n = 34) (p = 0.016). The highest prevalence of stunting was observed among children of mothers who personally controlled household income,

43.4% (n = 23), compared with joint decision-making, 26.3% (n = 85), and partner-only decision-making, 23.8% (n = 49) (p = 0.015).

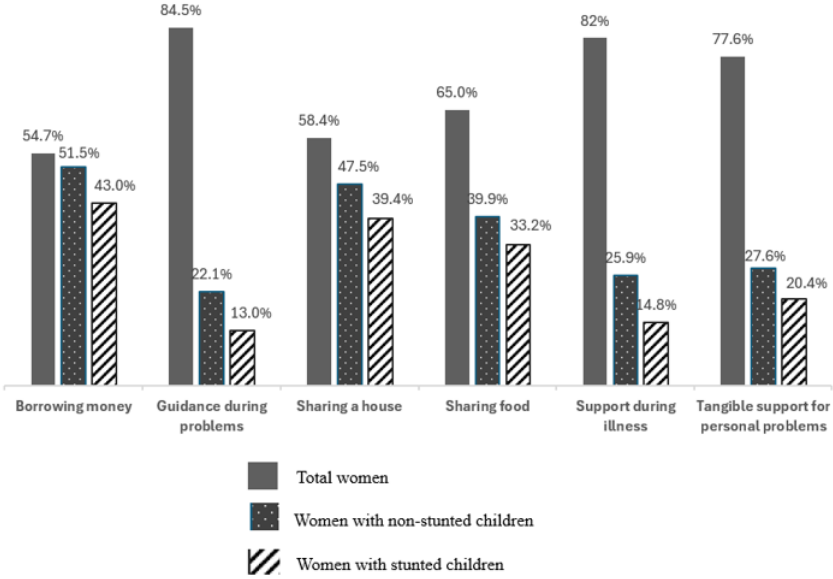


Figure 1. Household social support distribution among women (N=601)

Only a small fraction of women reported owning land individually, while about a quarter had no land ownership at all (Table 3). The majority, however, shared land ownership jointly with their husbands. A similar pattern was observed for housing, where most women co-owned their homes with their husbands, some had no ownership, and only a very small minority reported owning a house personally (Table 3). Importantly, this inequality in asset ownership was not associated with the likelihood of having stunted children.

Among all women, 26.4% (n = 152) reported experiencing forced sexual intercourse within marriage. Child stunting was more prevalent among these women, 33.1% (n = 51), compared with 24.3% (n = 103) among those who did not report such experiences (p = 0.020). This corresponds to an adjusted odds ratio (aOR) of 1.81 (95% CI: 1.15–2.85), indicating that forced sexual intercourse was significantly associated with a higher prevalence of stunting.

The ability to request condom use during sexual intercourse was also reported by 52.5% (n = 301) of women. Among these, 23.6% (n = 71) of children were stunted, compared with 30.1% (n = 82) among those whose mothers lacked this autonomy. This difference was not statistically significant (aOR 1.12; 95% CI: 0.74–1.69).

4.2 Association between women's exposure to IPV and child stunting (Paper II)

Among the 601 women, psychological IPV was the most prevalent form, affecting 38.4% (n = 199), followed by physical IPV at 27.4% (n = 140) and sexual IPV at 21.2% (n = 110) (Table 4).

Psychological and physical IPV were significantly more common among women aged ≥ 35 years compared with those < 35 years (44.6% vs. 35.5%, $p = 0.03$; 33.2% vs. 23.9%, $p = 0.02$). In terms of education, women with primary education or below reported a higher prevalence of physical IPV compared with those with secondary education or higher (26.2% vs. 13.0%, $p < 0.01$), and psychological IPV was also more common in this group (35.3% vs. 25.2%, $p = 0.03$). Partner's education showed similar associations: physical IPV ($p < 0.01$), sexual IPV ($p < 0.01$), and psychological IPV ($p < 0.01$) were all more prevalent among women whose partners had primary education or below compared with those with secondary education or higher (Table 4).

Partner's occupation was associated with physical IPV, which was more common among women whose partners had non-skilled jobs compared with skilled jobs (25.7% vs. 10.0%, $p = 0.02$). Partner's alcohol use was strongly related to IPV: physical IPV (28.8% vs. 17.6%, $p < 0.01$) and psychological IPV (40.9% vs. 25.1%, $p < 0.01$) were both more prevalent among women whose partners drank frequently compared with those whose partners rarely or never drank. Household living conditions also showed associations. Physical IPV was more common among women in households without electricity (25.5% vs. 19.5%, $p = 0.03$) and without improved toilets (28.1% vs. 17.6%, $p < 0.01$). Sexual IPV was also more common among women in households without electricity (20.4% vs. 14.6%, $p = 0.03$) and without improved toilets (21.8% vs. 13.7%, $p = 0.01$).

Table 4. Prevalence of intimate partner violence (IPV) by sociodemographic and household characteristics ($N = 601$)

Variables and categories (n)	Physical IPV		p-value*	Sexual IPV		p-value	Psychological IPV		p-value
	Yes; n (%)	No; n (%)		Yes; n (%)	No; n (%)		Yes; n (%)	No; n (%)	
Total (n=601)	140 (27.4)	371 (72.6)		110 (21.2)	408 (78.8)		199 (38.4)	319 (61.6)	
Age ≤35 years (n=318)	76 (23.9)	242 (76.1)	0.02	70 (22.0)	248 (78.0)	0.72	113 (35.5)	205 (64.5)	0.03
Age ≥35 years (n=193)	64 (33.2)	129 (66.8)		40 (20.7)	153 (79.3)		86 (44.6)	107 (55.4)	
Education ≤Primary (n=470)	123 (26.2)	347 (73.8)	<0.01	91 (19.4)	379 (80.6)	0.27	166 (35.3)	304 (64.7)	0.03
Education Secondary+ (n=131)	17 (13.0)	114 (87.0)		19 (14.5)	112 (85.5)		33 (25.2)	98 (74.8)	
Partner education ≤Primary (n=406)	106 (26.1)	300 (73.9)	<0.01	82 (20.2)	324 (79.8)	<0.01	151 (37.2)	255 (62.8)	<0.01
Partner education Secondary+ (n=103)	11 (10.7)	92 (89.3)		9 (8.7)	94 (91.3)		21 (20.4)	82 (79.6)	
Partner occupation Skilled (n=40)	4 (10.0)	36 (90.0)	0.02	7 (17.5)	33 (82.5)	0.79	14 (35.0)	26 (65.0)	0.86
Partner occupation non-skilled (n=482)	124 (25.7)	358 (74.3)		94 (19.5)	388 (80.5)		173 (35.9)	309 (64.1)	
Partner drinks rarely/never (n=227)	40 (17.6)	187 (82.4)	<0.01	34 (15.0)	193 (85.0)	0.06	57 (25.1)	170 (74.9)	<0.01
Partner drinks many times/month (n=340)	98 (28.8)	242 (71.2)		72 (21.2)	268 (78.8)		139 (40.9)	201 (59.1)	
Household has electricity (n=226)	44 (19.5)	182 (80.5)	0.03	33 (14.6)	193 (85.4)	0.03	75 (33.2)	151 (66.8)	0.64
Household no	95 (25.5)	277 (74.5)		76 (20.4)	296 (79.6)		124 (33.3)	248 (66.7)	

Variables and categories (n)	Physical IPV		p-value ^a	Sexual IPV		p-value	Psychological IPV		p-value
	Yes; n (%)	No; n (%)		Yes; n (%)	No; n (%)		Yes; n (%)	No; n (%)	
electricity (n=372)									
Improved toilet (n=256)	45 (17.6)	211 (82.4)	<0.01	35 (13.7)	221 (86.3)	0.01	79 (30.9)	177 (69.1)	0.28
Unimproved toilet (n=335)	94 (28.1)	241 (71.9)		73 (21.8)	262 (78.2)		119 (35.5)	216 (64.5)	

Values are presented as n (%), row percentages. Totals differ across IPV types due to non-response: Physical IPV (n = 511; 371 No, 140 Yes), Sexual IPV (n = 518; 408 No, 110 Yes), Psychological IPV (n = 518; 319 No, 199 Yes). Percentages are calculated using valid responses. *p-values were calculated using Pearson's chi-square test.

Distribution of different forms of intimate partner violence before and during pregnancy

The analysis of IPV before and during pregnancy reveals notable shifts in its distribution across different forms (Figure 2). Overall, the proportion of women experiencing some form of IPV increased during pregnancy, rising to 47.7% (n=285) compared to 38.8% (n=233) before pregnancy. Physical violence showed the most significant change, with its share increasing from 27.4% (n=140) before pregnancy to 40.9% (n=233) during pregnancy, while sexual violence also rose from 21.2% (n=110) to 26.8% (n=153) over the same period. In contrast, psychological violence accounted for a greater distribution before pregnancy at 38.4% (n=199) than during pregnancy at 18.1% (n=103). Additionally, the proportion of women experiencing all three forms of IPV increased slightly, from 6.7% (n=35) before pregnancy to 8.9% (n=51) during pregnancy.

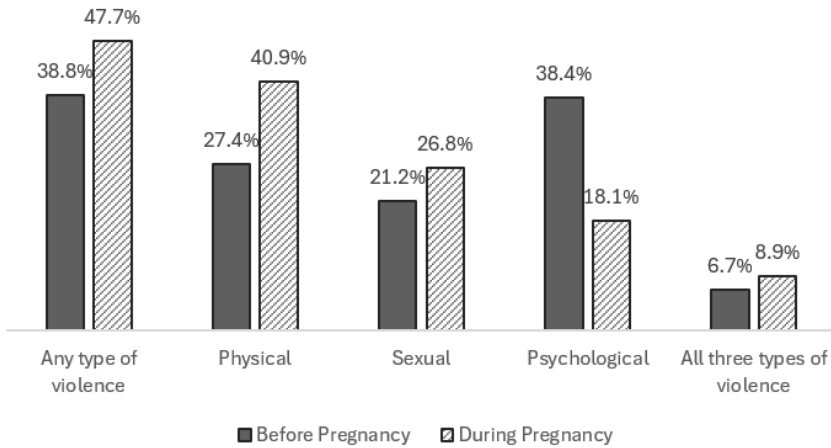


Figure 2. Proportions of different forms of IPV before and during pregnancy (N=601)

Association between women’s exposure to IPV and child stunting

Table 5 presents the associations between various forms of IPV experienced by women and stunting among their children, distinguishing between exposures before and during pregnancy. Among women exposed to IPV prior to pregnancy, the highest prevalence of stunting was observed in children born to women who experienced physical violence (32.1%) and sexual violence (27.3%), measured when the children were between 1 month and 3 years of age. The aOR for physical violence before pregnancy was 1.29 (1.01–2.03), indicating a statistically significant increase in the likelihood of the child becoming stunted. For mothers who were exposed to violence during the pregnancy period, the highest prevalence of child stunting was observed among children born to those who experienced all three types of IPV (37.2%) and sexual violence (31.4%). These children were assessed for stunting between the ages of 1 month and 3 years. The adjusted odds ratios (aORs) indicate significant associations between IPV exposure during pregnancy and increased odds of stunting, particularly for exposure to all three types of IPV [1.76 (1.02–3.65)] and sexual violence [1.25 (1.04–2.01)].

Table 5. Association between women’s exposure to IPV and child stunting (n=163)

IPV types	Women exposed to IPV; n (%)	Child stunting; n (%)	Adjusted Odds Ratio*
		Yes; 27.1% (n=163)	
<i>Before pregnancy</i>			
Any type of violence	233 (38.8)	57 (24.5)	1.27 (0.82–1.96)
Physical	140 (27.4)	45 (32.1)	1.29 (1.01–2.03)**
Sexual	110 (21.2)	30 (27.3)	1.18 (0.68–1.98)
Psychological	199 (38.4)	49 (24.6)	0.78 (0.49–1.25)
All three types combined	35 (6.7)	7 (20.0)	0.73 (0.26–2.02)
<i>During Pregnancy</i>			
Any type of violence	285 (47.4)	79 (27.7)	0.90 (0.61–1.45)
Physical	233 (40.9)	60 (25.7)	0.80 (0.52–1.24)
Sexual	153 (26.8)	48 (31.4)	1.25 (1.04–2.01)
Psychological	103 (18.1)	34 (33.0)	1.70 (0.98–2.94)
All three types combined	51 (8.9)	19 (37.2)	1.76 (1.02–3.65)

*Values are controlled for the woman’s age, partner’s age, education levels of both partners, occupation, partner’s alcohol consumption habits, and household access to electricity.

**Values in bold indicate statistically significant associations.

4.3 Association between mothers’ poor mental health and child stunting (Paper III)

Distribution of maternal mental health disorders across sociodemographic characteristics

Among the 601 mothers, the distribution of mental health disorders varied by sociodemographic characteristics. Generalized anxiety disorder (GAD) accounted for the largest share overall (36.6%, n=138), followed by recurrent major depressive disorder (MDD) (27.3%, n=81), current major depressive disorder (22.7%, n=135), and suicide risk (18.2%, n=108). The prevalence of mothers’ mental health disorders varied by mothers’ age. Among mothers ≤20 years (n=30), GAD was highest at 43.3% (n=13), followed by current MDD at 36.7% (n=11). In the 21–34-year group (n=352), GAD and current MDD were similar (≈21%), while in mothers ≥35 years (n=219), GAD was most common at 25.6% (n=56). Only GAD differed significantly by age (p = 0.024), with the highest prevalence among the youngest mothers.

The prevalence of mental health disorders did not differ significantly by education level. Rates of current MDD ranged from 29.3% (n=17) among mothers with no education to 21.4% (n=28) in

those with secondary or higher, while GAD ranged from 19.0% (n=11) in the least educated to 24.4% (n=32) in the most educated. Among single, widowed, or divorced mothers, prevalence of recurrent MDD (22.9%, n=16) and suicide risk (25.7%, n=18) was higher than in married mothers (12.2% and 17.0%, respectively). However, none of these associations reached statistical significance. Mental health disorders were more common among mothers from low-income households (<36,000 RWF) than among those from higher-income households (≥36,000 RWF). Over 90% of all cases of mental health disorders were concentrated among mothers from lower-income households (<36,000 RWF). Among low-income mothers (n=500), the prevalence was 24.4% (n=122) for current MDD, 15.0% (n=75) for recurrent MDD, 19.4% (n=97) for suicide risk, and 25.0% (n=125) for GAD. In contrast, prevalence among higher-income mothers (n=95) was 12.6% (n=12), 5.3% (n=5), 9.5% (n=9), and 12.6% (n=12), respectively. All four associations were statistically significant ($p < 0.05$).

Children’s anthropometric indicators and prevalence of malnutrition

Table 6. Anthropometric indicators and prevalence of malnutrition by age group ($N=601$)

	Child’s age		
	1–12 months	13–24 months	25–36 months
Z score, mean±SD			
Height-for-age	-0.81±1.21	-1.64±1.25	-1.77±1.13
Weight-for-age	-0.34±1.12	-0.54±0.99	-0.60±0.97
Weight-for-height	0.27±1.27	0.34±1.12	0.51±1.06
Prevalence, % (95% CI)			
Stunting	9.8 (7.6–12.5)	34.3 (30.5–38.2)	39.9 (35.9–43.9)
Underweight	6.1 (4.4–8.4)	7.0 (5.0–9.3)	7.5 (5.5–9.9)
Wasting	3.7 (2.3–5.5)	3.3 (2.0–5.1)	1.2 (0.5–2.4)

SD, standard deviation; CI, confidence interval.

The mean height-for-age Z score declined with age, from -0.81 ± 1.21 in infants aged 1–12 months to -1.77 ± 1.13 in children aged 25–36 months, indicating increasing growth faltering. Similarly, the mean weight-for-age Z score decreased from -0.34 ± 1.12 in the youngest age group to -0.60 ± 0.97 in the oldest group. In contrast, the weight-for-height Z score increased slightly with age, from 0.27 ± 1.27 in the youngest group to 0.51 ± 1.06 in the oldest group. The prevalence of

stunting rose significantly with age, affecting 9.8% (7.6–12.5) of children aged 1–12 months, 34.3% (30.5–38.2) of those aged 13–24 months, and 39.9% (35.9–43.9) of children aged 25–36 months. The prevalence of underweight remained relatively stable across age groups (Table 6).

Association between mothers' mental health and child stunting

The prevalence of stunting was significantly higher among children of mothers with current major depressive disorder compared to children of mothers without the disorder (35.6% vs. 24.4%, $p = 0.010$). The crude odds ratio (OR) was 1.71 (1.14–2.59), and after adjusting for mothers' age, education, household income, breastfeeding status, and social support (Model 1), the association remained statistically significant [1.67 (1.06–2.61)]. Further adjustment for IPV in Model 2 showed that physical [1.81 (1.17–2.81)], sexual [1.67 (1.08–2.60)], and mental IPV [1.61 (1.04–2.48)] also showed statistical significance with child stunting. Mothers experiencing recurrent major depressive episodes also had children with a higher prevalence of stunting (30.6%) compared to those without recurrent depression (23.7%). The crude OR was 1.42 (1.01–2.44), but after adjusting for covariates, the association did not remain statistically significant aOR 1.39 (0.81–2.42)]. Similarly, IPV-related factors did not show statistically significant associations in this group. For mothers assessed as having a suicide risk, no significant association with child stunting was observed, with a crude OR of 0.84 (0.52–1.36) and an adjusted OR of 0.85 (0.52–1.39). IPV factors did not prove statistical significance with child stunting in this group. For generalized anxiety disorder, no statistical significance was found for child stunting, with an adjusted OR of 1.05 (0.66–1.67). None of the IPV-related adjustments showed statistically significant associations with child stunting.

Depression symptoms and child growth indicators

Children of mothers with depression symptoms had significantly lower height-for-age Z scores (mean \pm SD: -1.68 ± 1.36) compared to children of non-depressed mothers (-1.30 ± 1.09 ; $p = 0.004$), indicating a higher risk of stunting (Table 7). Similarly, weight-for-age Z scores were significantly lower in children of depressed mothers (-0.72 ± 1.05) than in children of non-depressed mothers (-0.34 ± 0.06 ; $p < 0.001$), suggesting an increased risk of underweight. For weight-for-height, the Z score was slightly lower in children of mothers with depression symptoms (0.28 ± 0.09) compared

to those without depression (0.50±0.08), but this difference was not statistically significant (p=0.072).

Table 7. Associations between depression symptoms and child growth indicators: stunting, underweight, and wasting (n=363)

Variables	Mothers with depression symptoms		p-value
	Yes (40.2%; n = 146)	No (59.8%; n = 217)	
Stunting (height-for-age)*	-1.68±1.36	-1.30±1.09	0.004
Underweight (weight-for-age)	-0.72±1.05	-0.34±0.06	<0.001
Wasting (weight-for-height)	0.28±0.09	0.50±0.08	0.072

*Z score (mean ± standard deviation).

4.4 Child disciplining practices and their association with child stunting (Paper IV)

The majority of mothers (76.5%, n=449) reported utilizing physical disciplining methods, such as spanking or hitting, to manage their children's behavior, while a smaller proportion (38.3%, n=225) reported employing nonphysical disciplinary strategies, like verbal reprimands or timeouts. Among mothers aged 18–30 years (n=262), 80.1% (n=210) reported using physical punishment compared with 70.5% (n=239) of mothers aged ≥30 years (n=339) (p = 0.002). Marital status did not significantly influence the type of disciplining method, as there were no statistically significant differences between married and divorced, separated, or single mothers in either nonphysical or physical disciplining methods. For educational background, no statistically significant differences were found in the use of nonphysical or physical disciplining methods based on mothers' or partners' educational levels. Mothers' occupation did not significantly impact the type of disciplining method used either. The occupation of the partner (husband) was associated with the physical disciplining method used by their partners (wives). Mothers whose partners held nonskilled jobs (n=505) more frequently used physical disciplining methods 74.8% (n=384) compared to those whose partners had skilled jobs (n=46), 65.6% (n=28) (p = 0.034).

Nonphysical disciplining was more prevalent among mothers of children aged >12 months (n=401), 45.4% (n=182), compared with 21.5% (n=43) among those with children aged ≤12 months (n=200) (p<0.001). Additionally, exposure to IPV showed statistically significant associations with both nonphysical and physical disciplining methods. Nonphysical disciplining was more common among mothers exposed to sexual IPV (n=110), 49.1% (n=54), compared with

those not exposed (n=408), 33.8% (n=138) (p=0.003), and among those exposed to psychological IPV (n=199), 43.2% (n=86), versus those not exposed (n=319), 33.5% (n=107) (p=0.025). Physical disciplining was more prevalent among mothers exposed to physical IPV (n=140), 85.7% (n=120), compared with those not exposed (n=371), 70.6% (n=262) (p<0.001); among those exposed to sexual IPV (n=110), 82.7% (n=91), versus those not exposed (n=408), 72.8% (n=297) (p=0.036); and among those exposed to psychological IPV (n=199), 81.9% (n=163), compared with those not exposed (n=319), 70.8% (n=226) (p=0.004).

Table 8. Prevalence and associations between reported child disciplining methods (physical, nonphysical, and combined) and child stunting stratified by age group (≤ 12 months and >12 months) (N=601)

Variables (n)	Children's age			
	≤ 12 months		>12 months	
	n	Percent	n	Percent
Child stunting (n=163)	19	11.7	144	88.3
Physical discipline (n=449)	140	31.2	309	68.8
Physical discipline * child stunting	15	78.9	117	83.6
OR with its 95% CI ²	1.47 (0.46–4.65)		1.64 (0.97–2.79)	
Nonphysical discipline, n=225	43	19.1	182	80.9
Nonphysical discipline*child stunting	3	15.8	72	51.4
(OR with its 95% CI) ³	0.63 (0.17–2.26)		1.39 (0.92–2.09)	
Both physical and nonphysical discipline, n=461	141	30.6	320	69.4
Child stunting and both physical and nonphysical discipline	15	78.9	122	87.1
(OR with its 95% CI) ⁴	1.43 (0.45–4.52)		1.92 (1.08–3.41)¹	

¹**Bold** denotes statistical significance

²Univariate regression analysis examining the association between physical discipline and child stunting

³Univariate regression analysis examining the association between nonphysical discipline and child stunting

⁴Univariate regression analysis examining the association between combined physical and nonphysical discipline and child stunting

Among the 163 stunted children, 19 (11.7%) were aged ≤ 12 months, while 144 (88.3%) were older than 12 months (Table 8). Of the 449 children who experienced physical discipline, 140 (31.2%) were younger children, while 309 (68.8%) were older children. Among stunted children, the prevalence of physical discipline was 78.9% in the ≤ 12 -month group and 83.6% in the >12 -month group. Among the 225 children who experienced non-physical discipline, 182 (80.9%) were older children and 43 (19.1%) were younger children. Among the stunted children who experienced non-physical discipline, 15.8% were aged ≤ 12 months and 51.4% were aged >12 months (Table 8). Among the 461 children who experienced both physical and non-physical disciplining methods,

141 (30.6%) were aged ≤ 12 months and 320 (69.4%) were aged > 12 months. Among stunted children, the prevalence of experiencing both physical and non-physical disciplining methods was 78.9% in the ≤ 12 -month group and 87.1% in the > 12 -month group. The odds of stunting were significantly higher in older children subjected to both physical and non-physical discipline [1.92 (1.08–3.41)], whereas no significant association was found in younger children [1.43 (0.45–4.52)].

Table 9. Women’s reported use of child disciplining methods and their associations with child stunting, adjusted consecutively for sociodemographic variables, social support, and IPV (N= 601)

	Child stunting, OR (95% CI)				
Variables^a	Model 1^b	Model 2^c	Model 3^d	Model 4^e	Model 5^f
Physical punishment n=449	1.71 (1.07–2.73)*	1.65 (1.02–2.68)	1.68 (1.05–2.69)	1.75 (1.09–2.79)	1.71 (1.07–2.74)
Nonphysical punishment n=225	1.65 (1.14–2.39)	1.74 (1.19–2.55)	1.61 (1.11–2.34)	1.68 (1.16–2.44)	1.64 (1.13–2.38)
Use of both physical and nonphysical punishments n=461	1.99 (1.21–3.30)	1.96 (1.16–3.29)	1.96 (1.18–3.24)	2.04 (1.23–3.39)	2.00 (1.20–3.31)

^aVariables: Types of disciplining methods used by mothers.

^bModel 1: Crude (unadjusted) analysis.

^cModel 2: Adjusted for sociodemographic factors, including mothers’ age, age at marriage, mothers’ occupation, education level, and marital status.

^dModel 3: Adjusted for sociodemographic factors and social support.

^eModel 4: Adjusted for sociodemographic factors, social support, and mothers’ exposure to IPV.

^fModel 5: Includes interaction terms between disciplinary practices, social support, and IPV.

The association between mothers’ use of child disciplining methods and child stunting was examined across five models, progressively adjusting for sociodemographic factors, social support, and mothers’ exposure to IPV (Table 9). In the crude analysis (Model 1), physical punishment was significantly associated with increased odds of child stunting [1.71(1.07–2.73)]. This association remained significant across all adjusted models, with the highest odds observed in Model 4 [1.75 (1.09–2.79)]. Similarly, non-physical punishment was significantly associated with child stunting, with an OR of 1.65 (1.14–2.39) in Model 1. The association persisted across all adjusted models, with Model 4 showing the strongest association [1.68 (1.16–2.44)]. The combined use of both physical and non-physical punishments was consistently associated with the

highest odds of child stunting. In Model 1, the odds were 1.99 (1.21–3.30), and the association remained significant across all models, reaching OR = 2.04 (1.23–3.39) in Model 4. Even after accounting for interaction effects in Model 5, the association remained strong [2.00 (1.20–3.31)].

5 DISCUSSION

Stunting among children continues to be a major health challenge worldwide, especially in low- and middle-income nations [113]. WHO reports that around 22% of under-5 children globally experience stunting, which may lead to sustained detrimental effects on knowledge and skill acquisition, and on functional capacity in adult life [114]. Africa bears an unequal share of the burden of child stunting. In Sub-Saharan Africa, the prevalence of stunting is particularly high, with an estimated 34% of children being affected [115]. Countries like Ethiopia (47.9%) and Nigeria (37%) have reported high rates of stunting [116]. Although the government has implemented various measures to combat it, child stunting remains a pressing health concern in Rwanda. Data from the 2019/2020 Rwanda DHS indicate that 33% of under-5 children were stunted countrywide, with the highest prevalence recorded in the Northern Province at 41% [5]. The government has introduced several strategies to reduce stunting, such as enhancing maternal and child health services, expanding antenatal care access, promoting community health insurance, and implementing broad nutrition education programs [117, 118]. However, persistent challenges such as poverty, poor sanitation, and inadequate maternal well-being continue to contribute to high stunting rates.

5.1 Household gender roles: The overlooked yet crucial factor in childhood development

Women continue to be the primary caregivers for children, managing household food, care, and health [119]. In many African families, women are still undervalued when it comes to independently carrying out key household roles, such as making major purchasing decisions that influence the selection of healthy food for family members, particularly children [120]. In our study, only a small proportion of women had the autonomy to independently decide on the allocation of household earnings, as joint decision-making between mothers and their partners was the most common practice across all domains examined. This finding is particularly concerning given the well-documented positive relationship between mothers' decision-making power and

child health outcomes [121]. Specifically, our results indicate that mothers in households with stunted children had significantly lower autonomy in making major household purchases ($p=0.004$), suggesting that restricted financial decision-making may limit mothers' ability to allocate resources toward essential nutrition and healthcare for her child [122]. These findings highlight the importance of mothers' empowerment in promoting child growth and highlight the necessity for focused efforts to strengthen women's economic strength in rural Rwandan households. Beyond power at the household level, women require a strong social support system to effectively fulfill their roles as mothers [123], not only for the well-being of the entire family but, most critically, for the health and development of their children [124]. Our study has demonstrated that women with stunted children received less social support than those with non-stunted children. A lack of support during illness and personal challenges was associated with child stunting, even after accounting for maternal and household factors. Strengthening social support networks for mothers is an important strategy to reduce child stunting.

5.2 Multidimensional poverty index: A holistic view of poverty beyond income

This thesis demonstrated that household living conditions are key determinants of child stunting in Rwanda. Inadequate living environments, marked by the absence of electricity and essential household assets, were associated with child stunting. This finding aligns with previous research confirming the association between environmental factors and stunting [125]. Factors such as housing conditions, flooring materials, access to clean water, drinking water sources, and household electricity have been widely recognized as influential factors [126]. Notably, a prior review provides substantial evidence linking childhood stunting to inadequate sanitation, poor community waste management, unclean household flooring, food contamination with mycotoxins, and indoor air pollution from solid fuel use [127, 128]. All these factors are determinants of poverty. The MPI provides a unique approach to measuring poverty by offering a more comprehensive view of deprivation that extends beyond income alone [129]. It incorporates various dimensions such as well-being, learning opportunities, and quality of life, allowing for a deeper understanding of the intensity of poverty faced by individuals [106]. Traditional poverty measures often focus narrowly on income or consumption, overlooking other vital factors influencing well-being [36]. In contrast, the MPI evaluates poverty across multiple domains, providing a more holistic understanding of poverty. The MPI identifies poverty by assessing

whether individuals experience multiple deprivations in key areas and quantifies the severity of poverty based on the number of deprivations an individual endures [130]. It is often described as a "high-resolution lens" because it enables in-depth analysis of poverty's composition, allowing for detailed comparisons across countries, regions, and specific demographic groups such as urban and rural status. As a powerful analytical tool, the MPI helps identify the most prevalent deprivations within populations, providing critical insights to guide targeted policy interventions aimed at reducing poverty and improving overall well-being. In this thesis, we made a close observation of child stunting data together with MPI data in Rwanda, derived from DHS. The analysis reveals a similar pattern between higher MPI scores and increased child stunting prevalence, particularly in the Northern, Western, and Southern provinces. In contrast, Kigali City, with a lower MPI score, demonstrates a significantly lower stunting rate. However, on individual levels, the multidimensional assessment of households with stunted and non-stunted children revealed that poverty levels are similar across both groups in the study area. There was no clear distinction between the poverty levels of the two groups, as indicated by the overlapping confidence intervals of the calculated MPI. This suggests that both groups experience comparable levels of poverty. These findings highlight the critical need for integrated interventions that address both poverty and child stunting. Improving living conditions, education, and health services in regions with high MPI and stunting rates is essential to enhancing the overall well-being of the population.

5.3 Women's exposure to IPV increases the likelihood of stunting in their children

In Study I, we argued that a household must be free from poverty and that women must be empowered with sufficient economic resources to fulfil the comprehensive dietary requirements of children under three years of age. However, is economic empowerment alone sufficient? The second study examines a critical and ongoing challenge in Sub-Saharan Africa, and particularly in Rwanda: IPV. While women may experience favorable economic conditions, persistent exposure to IPV severely impairs their ability to provide the necessary care and nutrition for their children. The psychological and physical toll of IPV can undermine mothers' health and well-being, limiting the resources and capacity needed to meet the nutritional needs of young children [131]. Therefore, addressing IPV is crucial in the broader effort to reduce child stunting and ensure optimal child

health outcomes. This thesis examined women's experience of IPV and its link to child growth failure. The main findings indicate that all forms of IPV, occurring prior to and throughout pregnancy, are associated with growth retardation among children between the ages of 1 month and 3 years. Women who had lower levels of education and cohabited with partners possessing limited schooling and problematic alcohol consumption were more likely to experience IPV. The prevalence of child stunting was notably higher in cases where women were exposed to IPV during pregnancy compared to before pregnancy, suggesting a cumulative effect of abuse on mothers' health and child development. The findings are consistent with existing literature, which has established that women's exposure to IPV can negatively impact mothers' health and, subsequently, child growth [132]. In particular, our study found that physical and sexual abuse during pregnancy were strongly associated with stunting, with sexual violence emerging as a significant factor during pregnancy. Previous research demonstrates that IPV induces stress and depression, which can affect maternal nutrition and the growth of the unborn child, resulting in negative birth outcomes such as reduced birth weight and impaired growth [133].

Our study highlighted several critical sociodemographic factors, such as lower educational levels, limited access to essential resources like electricity and improved sanitation, and employment in unskilled jobs that significantly increase women's vulnerability to IPV. These factors are strongly associated with poverty and act as amplifiers of IPV risk. Women living in poverty often face greater economic dependency, which reduces their ability to leave abusive relationships [134]. Additionally, the stress and instability caused by financial insecurity can escalate tensions within households, creating environments where IPV is more likely to occur [135].

Furthermore, poverty can restrict individuals' access to crucial support networks, including social services and secure environments, that might otherwise help safeguard them from gender-based violence [136]. In this context, IPV becomes not just a consequence of personal relationships, but a broader issue tied to economic hardship and inequality. The interplay of poverty and IPV also exacerbates the risk of child stunting, as women in these circumstances often struggle to meet their children's nutritional needs, either due to emotional stress, poor mental health, or a lack of resources. Addressing poverty is thus not only critical for reducing IPV but also for improving child health outcomes, making it a key public health priority. Our study also established that

recurrent IPV, including both physical and sexual violence, had a lasting impact on child health, aligning with other studies that report long-term physiological and psychological consequences of violence on both mothers and children [46, 137]. In conclusion, the combined effects of IPV across various stages of mothers' life highlight the critical importance of implementing comprehensive interventions. These interventions should involve specific programs focused on preventing gender-based violence such as Isange One stop centers operational at both health centers and district hospitals, reinforcing legal protections for survivors, and expanding social support networks to aid women impacted by IPV. Tackling IPV is essential, not only to ensure the safety and well-being of women but also to enhance mother and child health outcomes.

5.4 Poor mental health in mothers is associated with child stunting

In Studies I and II, we have shown that women living in challenging socioeconomic conditions face significant risks, including the stunting of their children (Study I). These adverse poverty conditions contribute substantially to gender-based violence, exposing women to various forms of IPV, which subsequently impacts their children's growth. The combined burden of poverty, lack of social support, and exposure to IPV has severe repercussions on mothers' mental health. Therefore, Study III aimed to investigate the prevalence of mental health disorders among mothers and to determine their association with child stunting in rural Rwanda.

Generalized anxiety disorder was the most prevalent mental health condition among mothers in the study, followed by recurrent and current major depressive disorder (MDD) and suicide risk. Younger mothers, particularly those under 20 years of age, were more likely to experience generalized anxiety disorder. Lower household income was strongly associated with higher rates of both forms of MDD, suicide risk, and anxiety. Additionally, mothers with low birth-weight children had higher rates of mental health disorders across all conditions. These findings underscore the impact of age, income, and child birthweight on mothers' mental health. These findings are consistent with existing literature, which has highlighted a strong association between mental health disorders and sociodemographic factors such as age, income, and birth outcomes [51]. Young mothers are highly vulnerable to mental health issues due to various factors [138]. The transition to parenthood during a critical developmental stage, financial struggles, and social isolation contribute to stress and emotional distress [139]. Stigma and societal judgment further

worsen their mental well-being. Notably, postnatal depression is nearly twice as common in teenage mothers compared to older mothers, and they face higher risks of anxiety, depression, and hyperactivity [138, 140].

Our study has shown a statistically significant association between mothers' mental health disorders, particularly depression, and child stunting. Specifically, children of mothers experiencing depression exhibited lower height-for-age Z scores, indicative of chronic undernutrition. This relationship can be attributed to depression's impact on suboptimal feeding practices, inadequate caregiving behaviors, and reduced mother-child interactions, all of which impede child growth [141].

5.5 Child disciplining practices are associated with child stunting

Our final study (Study IV) provided a comprehensive reflection on the household environments in which children live, building on findings from our previous three studies (Study I, II, and III) conducted in 601 households. These families experience poverty, with women facing limited access to basic amenities, low decision-making power, low social support, high exposure to IPV, and a high prevalence of mental health disorders. A key concern is that, even if children in these households receive adequate nutrition, they may still encounter challenges linked to their living conditions. One documented issue is the frustration experienced by mothers living in poverty and constantly being abused by their intimate partner (husband), which may manifest in harsh child disciplining practices. This study examined the prevalence of these child disciplining practices, adjusted for various influencing factors, and assessed their association with child stunting in rural Rwanda. Our Study found a strong association between violent child disciplining practices and stunting. Younger mothers (aged 18-30 years) were more likely to employ physical punishment, which adversely affected child growth. This finding aligns with studies conducted two decades ago that assessed the detrimental effects of child punishment in the United States [142]. Young mothers may resort to using physical discipline due to several factors. Limited experience and knowledge of non-violent disciplinary methods can make alternative approaches less accessible [143]. Economic hardships within their households often heighten stress levels, increasing the likelihood of frustration-driven, impulsive disciplinary actions [144]. Additionally, young mothers may replicate the disciplinary methods they experienced in childhood, perpetuating the cycle of

physical punishment across generations [145]. In addition to the age of mothers, our study demonstrated that exposure to IPV significantly increases the likelihood of mothers using physical violence towards their children. This finding is consistent with other research that has reported an overlap between IPV and violence against children, highlighting common contributing factors [146]. Additionally, studies consistently show that children exposed to interparental conflicts face long-term health consequences, including an increased risk of experiencing physical violence themselves [147].

Furthermore, the lack of social support significantly contributed to the issue, as mothers with limited external support were more likely to resort to harsh disciplining methods. These findings are consistent with previous studies suggesting that parents should have access to environments where social capital (i.e. community saving groups that can support financially in case of urgent financial needs, early childhood support groups in communities, church groups for psychological support, etc.) is well-established to prevent harsh parenting practices. Supporting mothers in building social capital may be an effective strategy to reduce harsh discipline towards children [148].

Our study determined the association between child disciplining methods and child stunting among 601 children. Over a quarter of the children were classified as stunted, with the majority being older than 12 months. Physical punishment was more prevalent in this age group, with common forms including hitting on the bottom with bare hands and striking with a belt. The rise in physical punishment among children older than 12 months can be linked to various developmental and contextual factors. As children move beyond infancy, they start to assert their independence and may display behaviors that caregivers find difficult to manage [149]. This shift in behavior can prompt parents to use more direct disciplinary methods, including physical punishment. For example, a study conducted in Jamaica reveals that nearly 30% of children aged 9-12 months were slapped, with the frequency of physical and emotional violence increasing as children grow older [150]. These disciplinary practices were significantly associated with child stunting, underscoring the potential adverse effects of harsh parenting methods on child growth. Our study also found that nonphysical punishments, such as shouting, yelling, calling names, and assigning additional tasks, were also linked to stunting, highlighting the broader impact of psychological stress on child

development. A study confirms that no type of punishment benefits a child's development during early childhood [151]. Psychological and physical aggression were found to be detrimental to children's socioemotional development across various countries [151]. The association between child violence and child stunting has been corroborated by previous studies, which report that cases of child maltreatment are often characterized by acute undernutrition and stunting [152]. Regression analyses demonstrated that the use of physical punishment remained a strong predictor of child stunting, even after adjusting for sociodemographic factors, social support, and mothers' exposure to IPV. Physical punishment can have several adverse effects on a child's growth and development. It can create significant stress and trauma, which may interfere with normal physical growth [143]. Additionally, children who experience physical punishment might also face neglect in other areas, such as nutrition, if caregivers become less responsive to their needs [144, 145]. The psychological distress caused by punishment can reduce appetite and hinder nutrient absorption, further impacting growth [145, 153]. Furthermore, strained caregiver-child relationships due to physical punishment can lead to less effective caregiving, which is essential for healthy development [153]. Notably, the risk of stunting was highest among children whose mothers experienced psychological and sexual violence, as well as those in households lacking critical social support for illness, shelter, and psychological well-being. These findings are consistent with other studies that confirm the association between family violence, including child abuse and neglect, and child stunting [154].

Our findings suggest that addressing child stunting and harsh parenting practices requires a multifaceted approach. Ensuring adequate nutrition for children is crucial to prevent stunting. Educating parents, especially young mothers, on non-violent disciplinary methods can reduce physical punishment. Providing mental health services to mothers can mitigate issues related to depression and anxiety. Strengthening social support networks can reduce isolation and stress, while interventions to reduce IPV are critical for creating a safer environment.

Additionally, implementing and enforcing child protection laws can safeguard children from abuse. Screening for child abuse at all healthcare levels in Rwanda can ensure early intervention. Sensitizing women about the dangers of child abuse during antenatal care can promote healthier parenting practices. Economic empowerment programs can alleviate stress and reduce harsh

parenting methods. Finally, ensuring access to comprehensive health services can support overall well-being and growth. Implementing these interventions in a coordinated manner can effectively address child stunting and harsh parenting practices.

5.6 Methodological considerations

The methodological strengths of this thesis include a representative sample of mothers with children aged 1–36 months, a low non-response rate, and the use of validated survey instruments and anthropometric measurements. Internationally recognized tools were employed to ensure robust and reliable data collection across studies.

In Study I, the MPI, social support, and gender dimensions were assessed using standardized, globally recognized instruments.

Study II evaluated IPV using the WHO questionnaire, which included six items on physical violence, three on sexual violence, and four on psychological abuse.

In Study III, mothers' mental health was assessed using four modules of the Mini International Neuropsychiatric Interview (MINI) DSM-IV version 5.0.0, covering current and past major depressive episodes, generalized anxiety disorder, and suicide risk. The MINI, a standardized diagnostic tool, aligns with DSM-IV and ICD-10 criteria (1993 version in Chapter 5) and has demonstrated validity and reliability comparable to the WHO Composite International Diagnostic Interview [98].

Finally, Study IV assessed mothers' reported behaviors towards child disciplining using the UNICEF Multiple Indicator Cluster Surveys (MICS) questionnaire. By utilizing well-established and validated instruments, this study ensures robust data collection, thereby strengthening the reliability and comparability of the results. Another key strength is the homogeneity of rural communities in Rwanda, which enhances the generalizability of the findings to rural households across the country.

Additionally, data collection was carried out using an Android-based app on the emGeo platform, ensuring efficient digital data capture and secure storage in a centralized cloud-based database [103]. Furthermore, our team included skilled data collectors and supervisors with extensive

expertise in various research methodologies. However, the studies have certain limitations, particularly the cross-sectional design, which makes it challenging to establish causal relationships from the findings. The following paragraphs will examine potential limitations of the study, including selection bias, information bias, and the influence of confounding factors.

Selection bias

Selection bias is a systematic error that arises from the methods used to recruit participants and factors that affect the composition of the study population [155]. Selection bias occurs when the relationship between the determinant and the outcome differs between those who participate in the study and those who are eligible but do not take part [156]. In this thesis, we employed a multi-stage random sampling approach to select the study participants. Initially, 186 villages were randomly selected from the 2,743 villages in the Northern Province using the geospatial grid system before the village visits began. Then, the number of households in each selected village was chosen proportionally to the total number of households in that village. Finally, a mother with a child aged 1-36 months was randomly selected from each household. The community health worker responsible for each village provided a list of all eligible households, which constituted the village sampling frame. The first participant was selected using a random number, and a calculated sampling interval was then applied to select the next household. If the eligible person was absent, the closest household on the list was selected, assuming similar living conditions between neighboring households.

The study achieved a high participation rate of 95.4%, with only 29 households failing to provide the necessary data. By selecting the closest available household, we aimed to maintain the representativeness of the sample and minimize potential differences between the included households and those with missing data. This helped address the concern that the 29 households with missing data may have systematically different characteristics compared to the rest of the sample. By using a multi-stage random sampling approach and ensuring a high participation rate, the study design and methodology helped mitigate potential selection bias. The random selection of villages and households, along with the inclusion of a representative sample of the target population, enhances the generalizability of the study findings in rural Rwanda. Therefore, it is highly unlikely that selection bias is a significant issue in this thesis.

Information bias

Information bias in public health research refers to systematic errors that can arise from the way data is collected, measured, or recorded [157]. This type of bias can lead to inaccurate or distorted information, which can then impact the validity and reliability of the study findings [158]. One common source of information bias is recall bias, where study participants may not accurately remember or report relevant information, such as past exposures, behaviors, or health outcomes [159]. This can be particularly problematic in studies that rely on self-reported data [160]. Another example of information bias is measurement bias, which can occur when the tools or methods used to collect data are not accurate or consistent [161]. This can happen when using imprecise or unreliable instruments, or when there are errors in the data collection process [161].

In our thesis, we used a comprehensive questionnaire in collaboration between Rwandan and Swedish researchers, and the questions had been validated in previous studies. The questionnaire was translated into the local language to ease its comprehension and implemented as a digital, Android-based app, to facilitate accurate data collection and storage. A team of experienced interviewers received extensive training and conducted the survey under the supervision of Rwandan and Swedish supervisors. Standardized techniques were used to measure the children's weight and height following WHO protocols. However, self-reported data on IPV, mental health, child disciplining practices, and household conditions may have been subject to underreporting due to social desirability bias. To mitigate this, we used a comprehensive set of questions on household living conditions, covering financial income, asset ownership, access to basic amenities such as electricity and sanitation, and the type of housing. For mental health disorders, we utilized a standardized diagnostic tool with scientifically validated questions. Regarding IPV exposure and child disciplining methods, interviewers ensured privacy and worked to establish trust with the participants, creating an environment conducive to accurate and honest reporting. These measures helped reduce information bias related to social desirability.

Confounding factors

In public health research, a confounding factor (or confounder) is a variable that is related to both the exposure and the outcome of interest, which may create a misleading relationship between

them [162, 163]. Confounders can distort the true effect of the exposure on the outcome, potentially exaggerating, reducing, or even reversing the perceived association [163].

Our thesis has identified several potential sources of confounding related to child stunting, including sociodemographic factors (mothers' age, education, occupation), child characteristics (age, birth weight, sex), household conditions (income, living conditions, asset ownership), and maternal health (weight, height, parity). We have mitigated these confounders by collecting comprehensive data on various factors and employing multivariable logistic regression models to adjust for them in all four studies. Additionally, we calculated the MPI to assess overall living conditions. Although these efforts help mitigate confounding, the observational nature of the study still limits the ability to make causal inferences, and some residual confounding may persist, such as climate and partner' (husband) factors in our case. Residual confounding refers to the remaining confounding bias that persists in an analysis despite efforts by researchers to account for known confounders [164].

6 CONCLUSIONS AND IMPLICATIONS

6.1 Conclusions

Childhood stunting remains a critical public health challenge in low- and middle-income countries, particularly in Rwanda, where it reflects broader challenges in human capital development linked to poverty. This study has identified several key findings that highlight the complex nature of childhood stunting and its associations with various social and health factors.

Firstly, the prevalence of stunting is notably higher in households with low social support for women and poor living conditions. The study also revealed concerning levels of physical, sexual, and psychological violence against women both before and during pregnancy, with statistically significant associations between IPV and child stunting. Different forms of IPV uniquely contribute to stunting prevalence, with exposure to both physical and sexual violence markedly increasing the risk of child stunting. Additionally, the findings have shown the association between mothers' depression and child stunting, with children of depressed mothers exhibiting significantly lower height-for-age Z scores. Lastly, our study demonstrated that mothers' disciplining methods, especially those involving violence, are associated with increased risks of stunting in children. Mothers who were exposed to IPV were more likely to use physical punishment, further

exacerbating the risk of poor nutritional outcomes for their children. This highlights the need for a comprehensive framework to address the intertwined issues of childhood stunting, IPV, mothers' mental health, and parenting practices.

Addressing child stunting in Rwanda requires a comprehensive, interdisciplinary, and multisectoral approach that targets both direct and underlying contributors to poor child growth. Interventions should prioritize improving household living conditions and expanding social support systems for women. Strengthening programs to prevent and respond to IPV is essential, alongside integrating routine IPV screening and support services into maternal and child health programs. Mothers' mental health services, including early detection and treatment of depression, must be scaled up and embedded within antenatal, Isange One Stop Centers (Rwanda special clinics for reporting gender violence incidents), and postnatal care. In addition, positive parenting programs should be promoted to replace violent disciplining practices with nurturing and non-violent alternatives. These interventions, implemented in a coordinated manner, have the potential to significantly reduce stunting and enhance the overall well-being and development of children in Rwanda.

6.2 Implications

Rwanda's policy approach to child nutrition and stunting focuses on a holistic strategy to improve the nutritional status of vulnerable groups, particularly children and women. Key initiatives include the National Nutrition Policy, which aims to reduce malnutrition, as well as Rwanda Vision 2050 and the National Strategy for Transformation (NST1), which targeted reducing stunting rates from 38% to below 19% by 2024, a goal that was not realized. Community-based health programs are also in place to enhance access to nutrition education. The government promotes food security through sustainable agricultural practices and school feeding programs, while fostering multi-sectoral collaboration between the health, agriculture, and education sectors. Monitoring and evaluation systems have been strengthened to assess the impact of these interventions, complemented by advocacy campaigns to raise awareness about children's nutritional rights. These efforts align with Sustainable Development Goal (SDG) 2, which seeks to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture by 2030. The findings of this thesis will contribute to integrating a comprehensive understanding of household living

conditions, including IPV and maternal mental health screenings during antenatal care visits, as well as child abuse screening and related information for women during pregnancy. The section below outlines suggested measures that can be implemented at various levels of society.

Individual Level (Women)

Provide educational programs focused on nutrition, childcare, and non-violent disciplining methods. Facilitate access to mental health resources and support for women experiencing depression. Offer training in financial literacy and income-generating activities to enhance economic independence for women.

Family Level (Household)

To continue encouraging families to prioritize balanced diets by increasing awareness of dietary diversity and healthy feeding practices for children. Organize family-oriented workshops on the significance of breastfeeding and complementary feeding. Support positive parenting through community-driven initiatives that focus on non-violent discipline and nurturing caregiving practices.

Community Level

Create community support groups for mothers to share experiences, challenges, and solutions related to parenting and nutrition. Launch awareness campaigns to educate communities about the effects of IPV, the importance of mental health, and the risks associated with violent child disciplining methods. Increase awareness of the laws in Rwanda that criminalize child abuse.

Local governance level

Ensure the effective implementation of existing nutrition and health policies at the local level, with a particular focus on vulnerable populations. Advocate for local governments to allocate resources for community health initiatives aimed at improving child nutrition. Strengthen partnerships between local governments and NGOs to enhance community outreach programs focused on child health and nutrition.

Health care institutions

Incorporate mental health screenings into standard maternal and child health services to identify and assist women experiencing depression. Train healthcare providers (especially midwives, physicians, and obstetrics/gynecologists who are specially trained) to recognize and respond to signs of IPV, child abuse, and mental health disorders, and understand their impact on child health. Offer nutrition counseling during routine health visits, focusing on the importance of dietary diversity and promoting healthy eating habits for both mothers and children.

Specific programs (Antenatal care consultations)

From the first ANC visit to the last, a checklist for IPV screening and mental health (including depression screening) should be included. During the final ANC visit, an information sheet on child abuse should be provided, detailing the laws against child abuse, the dangers of physical child discipline, and alternative, non-violent disciplinary methods, and where to seek help and support in case needed.

An important step to take is to train midwives and ANC nurses about tailored support for women at risk of IPV, connecting them with local resources such as Isange One Stop Centers and counseling services. Reinforce regular monitoring of child growth parameters during antenatal care visits, ensuring that mothers understand the importance of nutrition for fetal development.

Policy level (Interdisciplinary)

To effectively address childhood stunting in Rwanda, it is imperative to advocate for the adoption of policies that promote a robust interdisciplinary approach to nutrition. This approach should integrate key sectors including health, agriculture, education, geospatial analysis (e.g., geofencing), and social protection, fostering coordinated and comprehensive responses. Collaboration with the Rwanda National Child Development Agency (NCDA) is recommended to establish a high-level stunting steering committee. This committee should comprise professionals from diverse disciplines, enabling the formulation and implementation of evidence-based, cross-sectoral strategies to reduce stunting and advance child development outcomes. Additionally, it is essential to strengthen the use of the MPI in national poverty assessments, particularly within the

context of the Integrated Household Living Conditions Surveys (EICVs) conducted by the National Institute of Statistics of Rwanda (NISR). Emphasizing MPI will help elucidate the paradox of higher child stunting rates in economically better-off provinces and uncover hidden drivers of deprivation affecting child health. Partnership with the Rwanda Biomedical Center (RBC) is also critical to enhance national research and data systems. Specifically, there is a need to integrate data on household living conditions, IPV, and maternal mental health into the Health Management Information System (HMIS). This will provide timely, disaggregated, and policy-relevant evidence to guide decision-making and monitor progress in reducing stunting and improving maternal and child health.

By implementing these strategic recommendations through coordinated, multisectoral action, Rwanda will be better positioned to address the multifaceted causes of childhood stunting and strengthen the foundations for long-term human capital development.

7 FUTURE PERSPECTIVES

In this thesis, we explored the associations between household living conditions, gender dynamics, women's exposure to IPV, mothers' mental health, child disciplining practices, and child stunting in Rwanda's Northern Province. While cross-sectional design limits the ability to draw causal conclusions, the findings offer a strong empirical foundation for future longitudinal research. Such studies are essential to unravel the causal pathways linking IPV and related social determinants to child health outcomes. A deeper understanding of these mechanisms will inform the design of effective, evidence-based interventions and underscore the necessity for multisectoral and interdisciplinary approaches to tackling child stunting.

Given the growing body of evidence linking mothers' exposure to IPV and poor mental health with negative child health outcomes particularly during the first 1,000 days of life; this thesis emphasizes the need to prioritize IPV prevention and mental health support within child health programs. The impact of IPV during pregnancy on fetal development further reinforces the importance of early detection and intervention. Future research should investigate the longitudinal effects of IPV on child growth and development, including the cumulative impact of repeated exposure to violence in early childhood.

This study also highlights the urgent need to address violent child disciplining practices, which remain widespread in Rwanda despite existing legal protections and child rights frameworks. A nationally representative survey on disciplining methods is recommended to generate comprehensive data that can guide public awareness campaigns and inform the development of targeted clinical and community-based interventions. These could include routine screening for violence against both mothers and children in maternal and child health services, integration of positive parenting education in antenatal care, and broader strategies to reduce children's exposure to violence in the home.

Finally, this research reveals a critical gap in the inclusion of men in child health and development discourse. The role of fathers or male partners remains under-researched, both in academic literature and in programmatic implementation in Rwanda. While initiatives such as Rwanda's "Men Engage" program represent an important step forward, their impact has not been adequately studied or documented. Future studies should focus on understanding and reshaping the role of men in parenting, particularly in the context of preventing stunting and fostering healthier family dynamics. Integrating men meaningfully into child and maternal health interventions could enhance their effectiveness and promote more equitable caregiving practices.

ACKNOWLEDGEMENT

This journey would not have been possible without the unwavering support, guidance, and kindness of many people, to whom I owe my deepest gratitude.

To the *women* who graciously welcomed us into their lives, taking time out of their days to answer our questions, and to *the children* who patiently endured anthropometric examinations, your willingness to participate made this research a reality. I am truly indebted to you.

To my main supervisor, *Gunilla Krantz*, who saw potential in me from the beginning, taking a chance on someone from a district hospital and believing I could navigate this PhD journey. From the very start, applying to Gothenburg University, enduring the challenges of data collection, adjusting to life in Sweden, and later working remotely from Rwanda, you stood by me. Your motivation never faltered, and your visits to Rwanda when I couldn't travel meant more than words can express. I will forever be grateful for the opportunity to work on this inspiring project under your guidance.

To my co-supervisor, *Ingrid Mogren*, your meticulous attention to detail and expertise in maternal and child health shaped my ability to write and publish scientifically. Your timely and insightful feedback made an enormous difference, and I could not have accomplished certain aspects of this work without your valuable input.

To my co-supervisor, *Ali Mansourian*, your expertise in geospatial analysis played a pivotal role in shaping this project from its very foundation to its completion. The integration of GPS-guided tablets and secured data storage was instrumental in ensuring smooth data collection and analysis. Your technological insights enriched this research, and I will always appreciate your contributions.

To my co-supervisor, *Aline Umubyeyi*, you have been more than a mentor, you have been a guiding light. As a key promoter of this PhD project and one of the pioneers from Gothenburg University under Gunilla Krantz, you showed me what was possible. Your support, both in navigating academic life and settling into Gothenburg, gave me the confidence to succeed. The trust you placed in me from my transition at the district hospital to the University of Rwanda, and throughout this PhD, is something I will cherish forever.

A special thank you to *Kristina Elfving*, whose contributions to this project have been truly invaluable. From the very beginning, your expertise played a crucial role in shaping the project design and refining our data collection tools during fieldwork. Your keen eye and thoughtful feedback on my manuscripts strengthened this research in ways I cannot express enough.

Beyond academia, you introduced me to the medical services at Sahlgrenska Hospital, opening doors to a deeper understanding of clinical perspectives. Your dedication to child health not only enriched this work but also ensured its clinical relevance. This thesis is undoubtedly stronger because of your unwavering support, expertise, and commitment. I am deeply grateful.

I am sincerely grateful to the half-time seminar review panel members for their constructive feedback, which played a crucial role in strengthening this thesis. Your insights were invaluable.

To my PhD colleagues, post-docs and programme leaders in the Undernutrition Programme, *Clarisse Kagoyire, Albert Ndagijimana, Jean Pierre Mpatswenumugabo, Anne Mukasafari, Gilbert Nduwayezu, Diane Rinda, Vedaste Nahindwa, Theogene Dusingizimana, Madeleine Mukeshimana; Theoneste Ntakirutimana, and Eric Matsiko*. Our discussions, collaborations, and unwavering support, especially during data collection, made this journey less daunting and more enriching. Thank you for standing by me.

To the PhD students and staff at Zoologia Medicinargatan 18 and the Department of Public Health and Community Medicine at the University of Gothenburg; your camaraderie made my time in Sweden so much easier. The cherished moments during Thursday Fika reminded me that even far from home, I had a family here.

To *Raymond Ndikumana*, who encouraged me to apply for the UR-Sweden scholarship despite not coming from the traditional University of Rwanda lecturer pool I will always remember your belief in me and the confidence you had in my potential.

To the leadership of Gothenburg University at Sahlgrenska Academy, thank you for understanding my limited travel opportunities and for allowing my supervisor, Gunilla Krantz, to continue mentoring me with frequent visits to Rwanda. This flexibility enabled me to balance my PhD studies while serving as a Cabinet Minister in the Government of Rwanda, something I will always be grateful for.

To my father, *Mathias Sebwege*, who left us when I was only 15, your final words urging me never to stop studying, to care for my mother, and to ensure my siblings received an education have guided my life ever since. Today, I stand on the threshold of achieving a PhD, my mother remains strong and with us, and all my siblings have completed their university education. I know you are looking down with pride. I only wish you were here to witness what we have become. I miss you deeply.

To my mother, *Agnes Mukampamira*, the bedrock of our family. Every achievement I celebrate is rooted in your sacrifices and strength. From the moment you carried the weight of our family alone in 1997, you never wavered. You are, and will always be, my greatest source of inspiration.

To my wife, *Nassin Uwimana*, my rock, my unwavering supporter, you are the force behind everything I have done and achieved. In the moments when I doubted myself, you believed in me. When I felt overwhelmed, you lifted me up. I could not have done this without you, and for that, I am eternally grateful.

To my beloved children, *Inas, Inam, Iwan, and Ihan*, this PhD represents the pinnacle of what I have achieved so far, but my greatest achievement will always be being your father. Your love and presence have given me strength and motivation every single day. I pray that you go even further than I have, and that you reach your own dreams sooner than I did.

With immense gratitude and love.

Jean Nepo Utumatwishima

REFERENCES

1. De Sanctis V, Soliman A, Alaaraj N, Ahmed S, Alyafei F, Hamed N. Early and Long-term Consequences of Nutritional Stunting: From Childhood to Adulthood. *Acta Biomed.* 2021;92(1):e2021168.
2. Morales F, Montserrat-de la Paz S, Leon MJ, Rivero-Pino F. Effects of Malnutrition on the Immune System and Infection and the Role of Nutritional Strategies Regarding Improvements in Children's Health Status: A Literature Review. *Nutrients.* 2023;16(1).
3. de Onis M, Branca F. Childhood stunting: a global perspective. *Matern Child Nutr.* 2016;12 Suppl 1(Suppl 1):12-26.
4. National Institute of Statistics of Rwanda, Finance Mo, Economic Planning/Rwanda, Ministry of Health/Rwanda, ICF International. Rwanda Demographic and Health Survey 2014-15. Kigali, Rwanda: National Institute of Statistics of Rwanda, Ministry of Finance and Economic Planning/Rwanda, Ministry of Health/Rwanda, and ICF International; 2016.
5. National Institute of Statistics of Rwanda - NISR, Ministry of Health - MOH, ICF. Rwanda demographic and health survey 2019-20. Kigali, Rwanda and Rockville, Maryland, USA: NISR/MOH/ICF; 2021.
6. GoR. Government launches a comprehensive plan to eradicate child stunting 2023 [Available from: <https://www.gov.rw/blog-detail/government-launches-a-comprehensive-plan-to-eradicate-child-stunting>].
7. World_Bank. Tackling Stunting in Rwanda to Build Human Capital: Early Achievements and Strategic Priorities 2021 [Available from: <https://www.worldbank.org/en/results/2021/01/14/tackling-stunting-in-rwanda-to-build-human-capital-early-achievements-and-strategic-priorities#:~:text=The%20SPRP%20aims%20to%20raise,childhood%20development%2C%20providing%20poor%20children>].
8. Mahmood L, Flores-Barrantes P, Moreno LA, Manios Y, Gonzalez-Gil EM. The Influence of Parental Dietary Behaviors and Practices on Children's Eating Habits. *Nutrients.* 2021;13(4).
9. Walsh A, Kearney L, Dennis N. Factors influencing first-time mothers' introduction of complementary foods: a qualitative exploration. *BMC public health.* 2015;15:939.
10. Broilo MC, Vitolo MR, Stenzel LM, Levandowski DC. Mothers' perceptions of their own diets and the diets of their children at 2-3 years of age. *Psicol Reflex Crit.* 2017;30(1):13.

11. Lokossou YUA, Tambe AB, Azandjèmè C, Mbhenyane X. Socio-cultural beliefs influence feeding practices of mothers and their children in Grand Popo, Benin. *J Health Popul Nutr.* 2021;40(1):33.
12. Taylor M, Tapkigen J, Ali I, Liu Q, Long Q, Nabwera H. The impact of growth monitoring and promotion on health indicators in children under five years of age in low- and middle-income countries. *Cochrane Database Syst Rev.* 2023;10(10):Cd014785.
13. Oderinde TM, Ilesanmi OS, Afolabi AA. Food insecurity and associated factors among households with under-5 children in slum communities in Ibadan, Nigeria. *BMC public health.* 2023;23(1):2144.
14. Daniel C. Is healthy eating too expensive?: How low-income parents evaluate the cost of food. *Soc Sci Med.* 2020;248:112823.
15. Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, Friedman JE, et al. The importance of nutrition in pregnancy and lactation: lifelong consequences. *Am J Obstet Gynecol.* 2022;226(5):607-32.
16. Lokossou YUA, Tambe AB, Azandjèmè C, Mbhenyane X. Socio-cultural beliefs influence feeding practices of mothers and their children in Grand Popo, Benin. *Journal of Health, Population and Nutrition.* 2021;40(1):33.
17. Silva P, Araújo R, Lopes F, Ray S. Nutrition and Food Literacy: Framing the Challenges to Health Communication. *Nutrients.* 2023;15(22).
18. Vijaykumar S, McNeill A, Simpson J. Associations between conflicting nutrition information, nutrition confusion and backlash among consumers in the UK. *Public Health Nutr.* 2021;24(5):914-23.
19. Kavle JA, Landry M. Addressing barriers to maternal nutrition in low- and middle-income countries: A review of the evidence and programme implications. *Matern Child Nutr.* 2018;14(1).
20. Scaglioni S, De Cosmi V, Ciappolino V, Parazzini F, Brambilla P, Agostoni C. Factors Influencing Children's Eating Behaviours. *Nutrients.* 2018;10(6).
21. Siddiqui F, Salam RA, Lassi ZS, Das JK. The Intertwined Relationship Between Malnutrition and Poverty. *Front Public Health.* 2020;8:453.
22. Gallegos D, Eivers A, Sondergeld P, Pattinson C. Food Insecurity and Child Development: A State-of-the-Art Review. *International journal of environmental research and public health.* 2021;18(17).

23. Pai S, Bahadur K. The Impact of Food Insecurity on Child Health. *Pediatr Clin North Am.* 2020;67(2):387-96.
24. Katre A, Raddatz B. Low-Income Families' Direct Participation in Food-Systems Innovation to Promote Healthy Food Behaviors. *Nutrients.* 2023;15(5).
25. Odoms-Young A, Brown AGM, Agurs-Collins T, Glanz K. Food Insecurity, Neighborhood Food Environment, and Health Disparities: State of the Science, Research Gaps and Opportunities. *Am J Clin Nutr.* 2024;119(3):850-61.
26. Brewis A, Workman C, Wutich A, Jepson W, Young S. Household water insecurity is strongly associated with food insecurity: Evidence from 27 sites in low- and middle-income countries. *Am J Hum Biol.* 2020;32(1):e23309.
27. Laurence J, Russell H, Smyth E. Housing adequacy and child outcomes in early and middle childhood. *ESRI;* 2023.
28. Mshida HA, Kassim N, Mpolya E, Kimanya M. Water, Sanitation, and Hygiene Practices Associated with Nutritional Status of Under-Five Children in Semi-Pastoral Communities Tanzania. *The American journal of tropical medicine and hygiene.* 2018;98(5):1242-9.
29. Ho LLK, Li WHC, Cheung AT, Luo Y, Xia W, Chung JOK. Impact of Poverty on Parent–Child Relationships, Parental Stress, and Parenting Practices. *Frontiers in Public Health.* 2022;Volume 10 - 2022.
30. Ho LLK, Li WHC, Cheung AT, Luo Y, Xia W, Chung JOK. Impact of Poverty on Parent–Child Relationships, Parental Stress, and Parenting Practices. *Front Public Health.* 2022;10:849408.
31. Martins VJ, Toledo Florêncio TM, Grillo LP, do Carmo PFM, Martins PA, Clemente AP, et al. Long-lasting effects of undernutrition. *International journal of environmental research and public health.* 2011;8(6):1817-46.
32. Pan J, Chen C, Yang Y. Building a global community of shared future free from poverty. *Glob Health J.* 2021;5(3):113-5.
33. Hjelm L, Mathiassen A, Wadhwa A. Measuring Poverty for Food Security Analysis: Consumption- Versus Asset-Based Approaches. *Food Nutr Bull.* 2016;37(3):275-89.
34. OPHI. What is the global MPI? 2022 [Available from: <https://ophi.org.uk/multidimensional-poverty-index/>].
35. UN. End poverty in all its forms everywhere 2023 [Available from: <https://sdgs.un.org/goals/goal1>].

36. Kingdon GG, and Knight J. Subjective well-being poverty vs. Income poverty and capabilities poverty? *The Journal of Development Studies*. 2006;42(7):1199-224.
37. OPHDI. "Rwanda Country Briefing" University of Oxford: University of Oxford; 2022 [updated October 2022. Available from: <https://ophi.org.uk/national-mpi-directory/rwanda-mpi>].
38. CDC. About Intimate Partner Violence 2023 [Available from: <https://www.cdc.gov/intimate-partner-violence/about/index.html>].
39. WHO. Understanding and addressing violence against women: Intimate partner violence 2012 [Available from: https://iris.who.int/bitstream/handle/10665/77432/WHO_RHR_12.36_eng.pdf].
40. SPARC. Stalking and Intimate Partner Violence: Fact Sheet 2018 [Available from: <https://www.stalkingawareness.org/wp-content/uploads/2018/11/Stalking-IPV-Fact-Sheet.pdf>].
41. Mossie TB, Mekonnen Fenta H, Tadesse M, Tadele A. Mapping the disparities in intimate partner violence prevalence and determinants across Sub-Saharan Africa. *Frontiers in Public Health*. 2023;11.
42. Melkam M, Fentahun S, Rtbey G, Andualem F, Nakie G, Tinsae T, et al. Domestic violence and associated factors among pregnant women in sub-Saharan African countries from the recent demographic and health survey data: a multilevel analysis. *Frontiers in Public Health*. 2024;12.
43. White SJ, Sin J, Sweeney A, Salisbury T, Wahlich C, Montesinos Guevara CM, et al. Global Prevalence and Mental Health Outcomes of Intimate Partner Violence Among Women: A Systematic Review and Meta-Analysis. *Trauma Violence Abuse*. 2024;25(1):494-511.
44. Moffitt TE. Childhood exposure to violence and lifelong health: clinical intervention science and stress-biology research join forces. *Dev Psychopathol*. 2013;25(4 Pt 2):1619-34.
45. Kitzmann KM, Gaylord NK, Holt AR, Kenny ED. Child witnesses to domestic violence: a meta-analytic review. *J Consult Clin Psychol*. 2003;71(2):339-52.
46. Wathen CN, Macmillan HL. Children's exposure to intimate partner violence: Impacts and interventions. *Paediatr Child Health*. 2013;18(8):419-22.
47. Howell KH, Barnes SE, Miller LE, Graham-Bermann SA. Developmental variations in the impact of intimate partner violence exposure during childhood. *J Inj Violence Res*. 2016;8(1):43-57.

48. Satyanarayana VA, Lukose A, Srinivasan K. Maternal mental health in pregnancy and child behavior. *Indian J Psychiatry*. 2011;53(4):351-61.
49. Alliance" MMHL. Maternal Mental Health Conditions and Statistics 2023 [Available from: <https://www.mmhla.org/articles/maternal-mental-health-conditions-and-statistics>].
50. Seng JS, D'Andrea W, Ford JD. Complex Mental Health Sequelae of Psychological Trauma Among Women in Prenatal Care. *Psychol Trauma*. 2014;6(1):41-9.
51. Kirkbride JB, Anglin DM, Colman I, Dykxhoorn J, Jones PB, Patalay P, et al. The social determinants of mental health and disorder: evidence, prevention and recommendations. *World Psychiatry*. 2024;23(1):58-90.
52. Winston R, Chicot R. The importance of early bonding on the long-term mental health and resilience of children. *London J Prim Care (Abingdon)*. 2016;8(1):12-4.
53. Naaz A, Muneshwar KN. How Maternal Nutritional and Mental Health Affects Child Health During Pregnancy: A Narrative Review. *Cureus*. 2023;15(11):e48763.
54. Bernard-Bonnin A-C. Maternal depression and child development. *Paediatr Child Health*. 2004;9(8):575-98.
55. Modak A, Ronghe V, Gomase KP, Mahakalkar MG, Taksande V. A Comprehensive Review of Motherhood and Mental Health: Postpartum Mood Disorders in Focus. *Cureus*. 2023;15(9):e46209.
56. Cabrera NJ, Fagan J, Wight V, Schadler C. Influence of mother, father, and child risk on parenting and children's cognitive and social behaviors. *Child Dev*. 2011;82(6):1985-2005.
57. Stover CS, Morgos D. Fatherhood and Intimate Partner Violence: Bringing the Parenting Role into Intervention Strategies. *Prof Psychol Res Pr*. 2013;44(4):247-56.
58. Panter-Brick C, Burgess A, Eggerman M, McAllister F, Pruett K, Leckman JF. Practitioner review: Engaging fathers--recommendations for a game change in parenting interventions based on a systematic review of the global evidence. *J Child Psychol Psychiatry*. 2014;55(11):1187-212.
59. Robinson EL, StGeorge J, Freeman EE. A Systematic Review of Father-Child Play Interactions and the Impacts on Child Development. *Children (Basel)*. 2021;8(5).
60. Osborne A, Ahinkorah BO. The paternal influence on early childhood development in Africa: implications for child and adolescent mental health. *Child and Adolescent Psychiatry and Mental Health*. 2024;18(1):156.

61. Association AP. Physical Discipline Can Harm Children 2019 [Available from: <https://www.apa.org/monitor/2019/05/physical-discipline>].
62. Medicine EUSo. Alternatives to Physical Punishment 2024 [Available from: <https://med.emory.edu/departments/pediatrics/divisions/neonatology/dpc/alternatives-physical-punishment.html>].
63. Greene CA, Haisley L, Wallace C, Ford JD. Intergenerational effects of childhood maltreatment: A systematic review of the parenting practices of adult survivors of childhood abuse, neglect, and violence. *Clin Psychol Rev.* 2020;80:101891.
64. Gershoff ET. Spanking and Child Development: We Know Enough Now To Stop Hitting Our Children. *Child Dev Perspect.* 2013;7(3):133-7.
65. Lippard ETC, Nemeroff CB. The Devastating Clinical Consequences of Child Abuse and Neglect: Increased Disease Vulnerability and Poor Treatment Response in Mood Disorders. *Am J Psychiatry.* 2020;177(1):20-36.
66. Ferrara P, Franceschini G, Villani A, Corsello G. Physical, psychological and social impact of school violence on children. *Italian Journal of Pediatrics.* 2019;45(1):76.
67. Bennett DS, Sullivan MW, Lewis M. Neglected children, shame-proneness, and depressive symptoms. *Child Maltreat.* 2010;15(4):305-14.
68. Wiggers M, Paas F. Harsh Physical Discipline and Externalizing Behaviors in Children: A Systematic Review. *International journal of environmental research and public health.* 2022;19(21).
69. Gershuni O, Czabanowska K, Burazeri G, Bjegovic-Mikanovic V, Juszczyk G, Myrup AC, et al. Aligning Best Practices: A Guiding Framework as a Valuable Tool for Public Health Workforce Development with the Example of Ukraine. *International journal of environmental research and public health.* 2021;18(17).
70. Brachman PS. *Epidemiology. Medical Microbiology.* 4th edition ed: University of Texas Medical Branch at Galveston; 1996.
71. Alyafei Anees E-CR. *The Health Belief Model of Behavior Change.* StatPearls: StatPearls Publishing; 2024.
72. Davis R, Campbell R, Hildon Z, Hobbs L, Michie S. Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. *Health Psychol Rev.* 2015;9(3):323-44.

73. Caperon L, Saville F, Ahern S. Developing a socio-ecological model for community engagement in a health programme in an underserved urban area. *PloS one*. 2022;17(9):e0275092.
74. Brown AF, Ma GX, Miranda J, Eng E, Castille D, Brockie T, et al. Structural Interventions to Reduce and Eliminate Health Disparities. *Am J Public Health*. 2019;109(S1):S72-s8.
75. Lawlor DA, Sterne JA. Socioeconomic inequalities in health. *BMJ (Clinical research ed)*. 2007;334(7601):963-4.
76. Marmot MG, Smith GD, Stansfeld S, Patel C, North F, Head J, et al. Health inequalities among British civil servants: the Whitehall II study. *Lancet*. 1991;337(8754):1387-93.
77. Utumatwishima JN, Mogren I, Umubyeyi A, Mansourian A, Krantz G. How do household living conditions and gender-related decision-making influence child stunting in Rwanda? A population-based study. *PloS one*. 2024;19(3):e0290919.
78. Willie TC, Kershaw TS. An ecological analysis of gender inequality and intimate partner violence in the United States. *Prev Med*. 2019;118:257-63.
79. Jones CL, Jensen JD, Scherr CL, Brown NR, Christy K, Weaver J. The Health Belief Model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. *Health Commun*. 2015;30(6):566-76.
80. Sidebotham P. An ecological approach to child abuse: a creative use of scientific models in research and practice. *Child Abuse Review*. 2001;10(2):97-112.
81. Barroga E, Matanguihan GJ. A Practical Guide to Writing Quantitative and Qualitative Research Questions and Hypotheses in Scholarly Articles. *J Korean Med Sci*. 2022;37(16):e121.
82. Tipton E, Hallberg K, Hedges LV, Chan W. Implications of Small Samples for Generalization: Adjustments and Rules of Thumb. *Eval Rev*. 2017;41(5):472-505.
83. Brownson RC, Chiqui JF, Stamatakis KA. Understanding evidence-based public health policy. *Am J Public Health*. 2009;99(9):1576-83.
84. Hajat C. An introduction to epidemiology. *Methods Mol Biol*. 2011;713:27-39.
85. Brownson RC, Fielding JE, Maylahn CM. Evidence-based public health: a fundamental concept for public health practice. *Annu Rev Public Health*. 2009;30:175-201.
86. Gaddis ML, Gaddis GM. Introduction to biostatistics: Part 1, Basic concepts. *Ann Emerg Med*. 1990;19(1):86-9.

87. Banerjee A, Chitnis UB, Jadhav SL, Bhawalkar JS, Chaudhury S. Hypothesis testing, type I and type II errors. *Ind Psychiatry J*. 2009;18(2):127-31.
88. Ahmed I, Ishtiaq S. Reliability and validity: Importance in Medical Research. *J Pak Med Assoc*. 2021;71(10):2401-6.
89. Andrade C. Internal, External, and Ecological Validity in Research Design, Conduct, and Evaluation. *Indian J Psychol Med*. 2018;40(5):498-9.
90. SURF_Survivors_Fund. Statistics of the Genocide 2019 [Available from: <https://survivors-fund.org.uk/learn/statistics/>].
91. Sayinzoga F, Bijlmakers L. Drivers of improved health sector performance in Rwanda: a qualitative view from within. *BMC health services research*. 2016;16:123.
92. NISR R. KEY FIGURES: 5th Rwanda Population and Housing Census (PHC) 2023 [Available from: <https://statistics.gov.rw/publication/key-figures-5th-rwanda-population-and-housing-census-phc>].
93. Ndagijimana S, Kabano IH, Masabo E, Ntaganda JM. Prediction of Stunting Among Under-5 Children in Rwanda Using Machine Learning Techniques. *J Prev Med Public Health*. 2023;56(1):41-9.
94. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. *Gastroenterology and hepatology from bed to bench*. 2013;6(1):14-7.
95. Who U, Bank W. Levels and trends in child malnutrition. UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates. 2019.
96. WHO. Training Course on Child Growth Assessment WHO Child Growth Standards 2024 [cited 2024. Available from: https://iris.who.int/bitstream/handle/10665/43601/9789241595070_JobaidWeighing_eng.pdf?ua=1].
97. Ellsberg M, Jansen HA, Heise L, Watts CH, Garcia-Moreno C. Intimate partner violence and women's physical and mental health in the WHO multi-country study on women's health and domestic violence: an observational study. *Lancet*. 2008;371(9619):1165-72.
98. Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of clinical psychiatry*. 1998;59 Suppl 20:22-33;quiz 4-57.
99. Khan S, Hancioglu A. Multiple Indicator Cluster Surveys: Delivering Robust Data on Children and Women across the Globe. *Stud Fam Plann*. 2019;50(3):279-86.

100. Abimana MC, Karangwa E, Hakizimana I, Kirk CM, Beck K, Miller AC, et al. Assessing factors associated with poor maternal mental health among mothers of children born small and sick at 24-47 months in rural Rwanda. *BMC Pregnancy Childbirth*. 2020;20(1):643.
101. Ferraro AA, Rohde LA, Polanczyk GV, Argeu A, Miguel EC, Grisi SJFE, et al. The specific and combined role of domestic violence and mental health disorders during pregnancy on new-born health. *BMC Pregnancy and Childbirth*. 2017;17(1):257.
102. Çalgi B. The Relationship Between Mothers' Mental Health and Violence Against Their Children. *J Health Rep Technol*. 2020;7(1):e109265.
103. Mansourian A, Matchanov M, Farnaghi M, Pilesjö P. Chapter 12 - iMSEP: a GIT-based digital solution for disaster management. In: Shroder JF, Paron P, Di Baldassarre G, editors. *Hydro-Meteorological Hazards, Risks, and Disasters (Second Edition)*. 5. Boston: Elsevier; 2023. p. 323-34.
104. Zaragoza Cortes J, Trejo Osti LE, Ocampo Torres M, Maldonado Vargas L, Ortiz Gress AA. Poor breastfeeding, complementary feeding and dietary diversity in children and their relationship with stunting in rural communities. *Nutr Hosp*. 2018;35(2):271-8.
105. Alkire S. A methodological note on the global Multidimensional Poverty Index (MPI). Oxford Poverty and Human Development Initiative (OPHI); 2022 [Available from: https://www.ophi.org.uk/wp-content/uploads/OPHI_MPI_MN_54_2022.pdf].
106. OPHI. Multidimensional Poverty and the AF method [Available from: <https://ophi.org.uk/md-poverty-and-AF-method>].
107. Suppa N, Kanagaratnam U. The global Multidimensional Poverty Index: Harmonised level estimates and their changes over time. *Sci Data*. 2025;12(1):153.
108. Sarason IG, Sarason BR, Shearin EN, Pierce GR. A Brief Measure of Social Support: Practical and Theoretical Implications. *Journal of Social and Personal Relationships*. 1987;4(4):497-510.
109. UNEC_Steering_committee. Measuring power and decision-making within the household 2016 [Available from: https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.30/2016/WS/WP19_UNECE_Willis.pdf].
110. UK_Dataservice_PAWE. Household Survey for Evaluation of Indonesia Women's Empowerment Project 2013 [Available from: http://doc.ukdataservice.ac.uk/doc/7888/mrdoc/pdf/7888_indonesia_pawe_questionnaire.pdf].

111. WHO. WHO multi-country study on women's health and domestic violence against women: summary report 2005 [Available from: <https://www.who.int/publications/i/item/9241593512>].
112. UNICEF. MICS6 TOOLS 2019 [Available from: <https://mics.unicef.org/tools>].
113. Victora CG, Christian P, Vdaletti LP, Gatica-Domínguez G, Menon P, Black RE. Revisiting maternal and child undernutrition in low-income and middle-income countries: variable progress towards an unfinished agenda. *Lancet*. 2021;397(10282):1388-99.
114. Dewey KG, Begum K. Long-term consequences of stunting in early life. *Matern Child Nutr*. 2011;7 Suppl 3(Suppl 3):5-18.
115. Prendergast AJ, Humphrey JH. The stunting syndrome in developing countries. *Paediatr Int Child Health*. 2014;34(4):250-65.
116. Mengesha A, Hailu S, Birhane M, Belay MM. The Prevalence of Stunting and Associated Factors among Children Under Five years of age in Southern Ethiopia: Community Based Cross-Sectional Study. *Ann Glob Health*. 2021;87(1):111.
117. Thomson DR, Amoroso C, Atwood S, Bonds MH, Rwabukwisi FC, Drobac P, et al. Impact of a health system strengthening intervention on maternal and child health outputs and outcomes in rural Rwanda 2005-2010. *BMJ global health*. 2018;3(2):e000674.
118. Lu C, Mejía-Guevara I, Hill K, Farmer P, Subramanian SV, Binagwaho A. Community-Based Health Financing and Child Stunting in Rural Rwanda. *Am J Public Health*. 2016;106(1):49-55.
119. Mkandawire E, Bisai C, Dyke E, Dressel A, Kantayeni H, Molosoni B, et al. A qualitative assessment of gender roles in child nutrition in Central Malawi. *BMC public health*. 2022;22(1):1392.
120. Njuki J, Eissler S, Malapit H, Meinzen-Dick R, Bryan E, Quisumbing A. A review of evidence on gender equality, women's empowerment, and food systems. *Global Food Security*. 2022;33:100622.
121. Adediran OA. The effect of women's decision-making on child nutritional outcomes in South Africa. *Economics & Human Biology*. 2024;53:101355.
122. Carlson GJ, Kordas K, Murray-Kolb LE. Associations between women's autonomy and child nutritional status: a review of the literature. *Matern Child Nutr*. 2015;11(4):452-82.
123. De Sousa Machado T, Chur-Hansen A, Due C. First-time mothers' perceptions of social support: Recommendations for best practice. *Health Psychol Open*. 2020;7(1):2055102919898611.

124. Langford CP, Bowsher J, Maloney JP, Lillis PP. Social support: a conceptual analysis. *J Adv Nurs*. 1997;25(1):95-100.
125. Rahut DB, Mishra R, Bera S. Geospatial and environmental determinants of stunting, wasting, and underweight: Empirical evidence from rural South and Southeast Asia. *Nutrition*. 2024;120:112346.
126. Bradley RH, Putnick DL. Housing quality and access to material and learning resources within the home environment in developing countries. *Child Dev*. 2012;83(1):76-91.
127. Yani DI, Rahayuwati L, Sari CWM, Komariah M, Fauziah SR. Family Household Characteristics and Stunting: An Update Scoping Review. *Nutrients*. 2023;15(1).
128. Vilcins D, Sly PD, Jagals P. Environmental Risk Factors Associated with Child Stunting: A Systematic Review of the Literature. *Ann Glob Health*. 2018;84(4):551-62.
129. Chan SM, and Wong H. Measurement and determinants of multidimensional poverty: the case of Hong Kong. *Journal of Asian Public Policy*.1-21.
130. Ismail MK, Zailani SHM, Muhamad MZ, Alias NA, Zailani MN. Exploring the Multidimensional Poverty Index: National and Children's Dimensions in Malaysia. *World*. 2025;6(1):30.
131. Rahman M, Poudel KC, Yasuoka J, Otsuka K, Yoshikawa K, Jimba M. Maternal exposure to intimate partner violence and the risk of undernutrition among children younger than 5 years in Bangladesh. *Am J Public Health*. 2012;102(7):1336-45.
132. Agarwal S, Prasad R, Mantri S, Chandrakar R, Gupta S, Babhulkar V, et al. A Comprehensive Review of Intimate Partner Violence During Pregnancy and Its Adverse Effects on Maternal and Fetal Health. *Cureus*. 2023;15(5):e39262.
133. Bhatt Carreno S, Orjuela-Grimm M, Vahedi L, Roesch E, Heckman C, Beckingham A, et al. Linkages between maternal experience of intimate partner violence and child nutrition outcomes: A rapid evidence assessment. *PLoS one*. 2024;19(3):e0298364.
134. Johnson L, Chen Y, Stylianou A, Arnold A. Examining the impact of economic abuse on survivors of intimate partner violence: a scoping review. *BMC public health*. 2022;22(1):1014.
135. Lanchimba C, Díaz-Sánchez JP, Velasco F. Exploring factors influencing domestic violence: a comprehensive study on intrafamily dynamics. *Front Psychiatry*. 2023;14:1243558.
136. Giacomini SG, Machado MM, de Santana OM, Rocha SG, de Aquino CM, Gomes LG, et al. Intimate Partner Violence among women living in families with children under the

- poverty line and its association with common mental disorders during COVID-19 pandemics in Ceará, Brazil. *BMC public health*. 2023;23(1):1299.
137. Asiedu E, Baliki AVA. The mental health of children exposed to intimate partner violence: A systematic literature review. *Developmental Child Welfare*.0(0):25161032251324862.
 138. Hodgkinson S, Beers L, Southammakosane C, Lewin A. Addressing the mental health needs of pregnant and parenting adolescents. *Pediatrics*. 2014;133(1):114-22.
 139. Nomaguchi K, Milkie MA. Parenthood and Well-Being: A Decade in Review. *J Marriage Fam*. 2020;82(1):198-223.
 140. Jack SM, Duku E, Whitty H, Van Lieshout RJ, Niccols A, Georgiades K, et al. Young mothers' use of and experiences with mental health care services in Ontario, Canada: a qualitative descriptive study. *BMC Womens Health*. 2022;22(1):214.
 141. Chee Din MA, Mohd Fahmi Teng NI, Abdul Manaf Z. Maternal depression and child feeding practices: Determinants to malnutrition among young children in Malaysian rural area. *Womens Health (Lond)*. 2023;19:17455057221147800.
 142. Durrant J, Ensom R. Physical punishment of children: lessons from 20 years of research. *Cmaj*. 2012;184(12):1373-7.
 143. Gershoff ET, Grogan-Kaylor A. Spanking and child outcomes: Old controversies and new meta-analyses. *J Fam Psychol*. 2016;30(4):453-69.
 144. Lee SJ, Altschul I, Gershoff ET. Does warmth moderate longitudinal associations between maternal spanking and child aggression in early childhood? *Dev Psychol*. 2013;49(11):2017-28.
 145. Lansford JE, Deater-Deckard K. Childrearing discipline and violence in developing countries. *Child Dev*. 2012;83(1):62-75.
 146. Carlson C, Namy S, Norcini Pala A, Wainberg ML, Michau L, Nakuti J, et al. Violence against children and intimate partner violence against women: overlap and common contributing factors among caregiver-adolescent dyads. *BMC public health*. 2020;20(1):124.
 147. Cui C, Liu L, Li H, Qi Y, Song J, Han N, et al. Childhood Exposure to Interparental Physical Violence and Adult Cardiovascular Disease. *JAMA Network Open*. 2024;7(12):e2451806-e.
 148. Kim S, Runyan DK, Lee Y. Lack of Maternal Social Capital Increases the Likelihood of Harsh Parenting. *Children (Basel)*. 2022;9(1).

149. Lulla D, Mascarenhas SS, How CH, Yeleswarapu SP. An approach to problem behaviours in children. *Singapore Med J.* 2019;60(4):168-72.
150. Samms-Vaughan M, Coore-Desai C, Reece JA, Pellington S. Epidemiology of violence against young children in Jamaica. *Psychol Health Med.* 2024;29(6):1155-64.
151. Ward KP, Grogan-Kaylor A, Ma J, Pace GT, Lee S. Associations between 11 parental discipline behaviours and child outcomes across 60 countries. *BMJ Open.* 2023;13(10):e058439.
152. Martín-Martín V, Romo-González C, González-Zamora JF. Frequency of malnutrition in children and adolescents with child maltreatment. *Nutr Hosp.* 2022;39(2):282-9.
153. Berlin LJ, Appleyard K, Dodge KA. Intergenerational continuity in child maltreatment: mediating mechanisms and implications for prevention. *Child Dev.* 2011;82(1):162-76.
154. Lakhtdir MPA, Ambreen S, Sameen S, Asim M, Batool S, Azam I, et al. Association between maternal experiences of intimate partner violence and child stunting: a secondary analysis of the Demographic Health Surveys of four South Asian countries. *BMJ Open.* 2024;14(1):e071882.
155. Pannucci CJ, Wilkins EG. Identifying and avoiding bias in research. *Plast Reconstr Surg.* 2010;126(2):619-25.
156. Haneuse S. Distinguishing Selection Bias and Confounding Bias in Comparative Effectiveness Research. *Med Care.* 2016;54(4):e23-9.
157. Delgado-Rodríguez M, Llorca J. Bias. *Journal of Epidemiology and Community Health.* 2004;58(8):635.
158. Simundić AM. Bias in research. *Biochem Med (Zagreb).* 2013;23(1):12-5.
159. Althubaiti A. Information bias in health research: definition, pitfalls, and adjustment methods. *J Multidiscip Healthc.* 2016;9:211-7.
160. Rosenman R, Tennekoon V, Hill LG. Measuring bias in self-reported data. *Int J Behav Healthc Res.* 2011;2(4):320-32.
161. Coskun A. Bias in Laboratory Medicine: The Dark Side of the Moon. *Ann Lab Med.* 2024;44(1):6-20.
162. Ahrens W, Krickeberg K, Pigeot I. An Introduction to Epidemiology. In: Ahrens W, Pigeot I, editors. *Handbook of Epidemiology.* Berlin, Heidelberg: Springer Berlin Heidelberg; 2005. p. 1-40.

163. Jager KJ, Zoccali C, Macleod A, Dekker FW. Confounding: what it is and how to deal with it. *Kidney Int.* 2008;73(3):256-60.
164. Greenland S, Morgenstern H. Confounding in health research. *Annu Rev Public Health.* 2001;22:189-212.