Sociodemographic Determinants of Essential Health Interventions for Pregnant Women and Newborns in Papua New Guinea: A Retrospective Exploratory Secondary Analysis of Parental Attributes of Four Provinces.

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A dissertation submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of Master of Public Health

2022

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Abstract

The World Health Organization's *Global Strategy for Women's, Children's and Adolescents' Health* has underlined the key role of essential health interventions (EHIs). EHIs are considered crucial for addressing major causes of morbidity and mortality, especially those EHIs that have demonstrated high effectiveness and are critical for the health of women, children, and adolescents. These include the interventions that were the focus of this study: antenatal care (ANC) visits, delivery by skilled birth providers (SBPs), and the early initiation of breastfeeding after birth.

The need for accelerated EHI efforts is recognised in Papua New Guinea (PNG) and underlined by a lifetime maternal mortality risk that is eight times higher than elsewhere in the East Asia Pacific region. The need for EHIs is also reflected in marked urban–rural disparities in under-five health, with children in rural areas being twice as likely to die before the age of five than their peers in urban centres. While these continuing health challenges for children in rural areas are well-recognised, there has been limited research on the impact of broader socio-economic and related conditions on maternal and newborn health in PNG's lowland areas.

With a geographic focus on the four lowland provinces of East Sepik, West Sepik, Madang and the Autonomous Region of Bougainville, the study investigated the association between parental sociodemographic characteristics and the application of EHIs for pregnant women and newborns. It specifically examined relationships between the sociodemographic attributes of household heads and mothers, and the implementation of ANC, delivery support by an SBP and the early initiation of breastfeeding after delivery.

The study applied a quantitative research approach through a secondary analysis of data collected in 2018 by the International Food Policy Research Institute (IFPRI). The original 2018 study involved a rural household survey on food systems, conducted in the four lowland areas of PNG listed above. The current study utilised de-identified data for 291 households available from the open-source dataset accessed via the Harvard Dataverse site.

The study investigated the relationship between parental characteristics and EHI practices. Results showed that two household head attributes were statistically significant: the level of education in relation to SBP delivery support ($p<.05$), and literacy in relation to the number of antenatal visits made ($p<.01$). Findings on the relationship between the mothers' characteristics and EHI practices also showed that education, literacy level and primary occupation were statistically significant. Mothers' level of education was positively associated with the number of ANC visits made ($p<.01$) and

with SBP delivery support (p<.001). Mothers' primary occupation in agriculture was also statistically significant in relation to the early initiation of breastfeeding (p<.001).

In conclusion, this exploratory study found that household heads' and mothers' levels of education and literacy were positively associated with the number of ANC visits made and SBP support. It also highlighted the crucial, but under-researched, role that male household heads play in enabling women's access to ANC and SBP support, and profiled research gaps in the understanding of how sociodemographic attributes such as male education and literacy can improve maternal and newborn health outcomes.

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List of Abbreviations

ANC	Antenatal Care
ARoB	Autonomous Region of Bougainville
CAPI	Computer Assisted Personal Interviewing
DHS	Demographic and Health Survey
EBF	Exclusive Breastfeeding
EHIs	Essential Health Interventions
EWEC	Every Woman, Every Child
GoB	Government of Bougainville
IFPRI	International Food Policy Research Institute
LMICs	Low-Middle-Income Countries
MMR	Maternal Mortality Rate
MNAR	Missing Not at Random
NDoH	National Department of Health
NHP	National Health Plan
NSO	National Statistical Office
PNC	Postnatal Care
PNG	Papua New Guinea
SBP	Skilled Birth Provider
SDGs	Sustainable Development Goals
U5	Under Five
UNICEF	United Nations International Children's Emergency Fund
UNIGME	United Nations Inter-agency Group for Child Mortality Estimation
WBG	World Bank Group
WHO	World Health Organization
WVI	World Vision International

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signature

Date 10th June 2022

Acknowledgements

It was challenging for me to accomplish this undertaking during the global pandemic. The achievement of this research could not have been accomplished without the generous support of many people, as mentioned below.

First and foremost, I would like to express my sincere gratitude to my principal supervisor, Dr Ailsa Holloway, and co-supervisor, Dr Melanie Moylan, for their continuous support and guidance in all phases of this research and in writing this dissertation. I would not have been able to complete this dissertation without their guidance, motivation, patience, and immense knowledge.

I am particularly grateful to Ei Mon Thinn Kyu for her generous support and guidance in working with the dataset.

I would also like to thank the original research team from the International Food Policy Research Institute (IFPRI) for their support of this project, especially the principal researcher, Emily Schmidt.

I am indebted to the New Zealand Ministry of Foreign Affairs and Trade (MFAT) for its dedication and support for my study. This dissertation would not have been possible without the generous opportunity offered by MFAT and the Auckland University of Technology, Faculty of Environment and Health Sciences. Most importantly, I am deeply grateful to the AUT scholarship team, especially Sacha, George, Sandelyn, Petrina, and Prerna, who trusted in me and encouraged me to complete this challenging journey.

I would also like to take this time to acknowledge the church executives and the members of the Faith Baptist Church for their prayers as well as physical support during my research journey.

Finally, I thank my family for providing me with the assurance, strength, support, and courage to pursue this aspiration. Most specifically, I thank my dear parents for inculcating in me the significance of education. I also acknowledge my husband's endless support and sacrifices around our children's well-being and enduring the struggle with me in my pursuit of knowledge, not forgetting all my siblings and relatives in Port Moresby, Enga, and other parts of the country for their support throughout my academic journey.

Chapter 1. Introduction

1.1 Overview

In 2015, the World Health Organization (WHO) updated its *Global Strategy for Women's, Children's and Adolescents' Health (2016-2030)*. This strategy sought to speed efforts to improve the health and wellbeing of women, children, and adolescents. Guided by the three objectives of "survive" (end preventable deaths), "thrive" (ensure health and well-being), and "transform" (expand enabling environments), the new strategy comprised seven identifiable action areas (WHO, 2015). Central to addressing Action Area 3 (Health system resilience) and Action Area 7 (Humanitarian and fragile settings) was the implementation of "essential health interventions" (EHIs) (WHO, 2015). Despite differences in implementation between countries, EHIs were viewed as crucial for addressing major causes of morbidity and mortality for women, children, and adolescents. This especially applied to interventions that had demonstrated high effectiveness and were critical for the health of women, children and adolescents (WHO, 2015).

This heightened emphasis on EHIs is particularly relevant to countries such as Papua New Guinea (PNG). For instance, UNICEF (2020a) reported that PNG "remains one of the poorest performing countries" in its East Asia Pacific Region (p. 1). This is evidenced by a lifetime maternal mortality risk that is eight times higher in PNG than elsewhere in East Asia Pacific. It is also reflected in troubling urban–rural disparities in under-five (U5) health, with children in rural areas being twice as likely to die before the age of five than their peers in urban centres (UNICEF, 2020a). While these persistent health challenges facing children in rural areas are well-documented in PNG (UNICEF 2016a), focused studies to understand the impact of broader socio-economic and related conditions on maternal and child health have been primarily undertaken in the country's highlands areas (Maviso et al., 2022). However, there has been limited research examining the key factors affecting mothers' and young children's health in rural lowland provinces such as the Autonomous Region of Bougainville (ARoB), East Sepik province, Madang province, and West Sepik province.

This study sought to address this knowledge gap for PNG's lowland areas. It specifically focused on understanding the sociodemographic factors that influence parental uptake of EHI practices for pregnant women and newborns in ARoB, East Sepik, Madang, and West Sepik provinces.

This chapter introduces the key concepts that informed the research. It gives an overview of progress made in advancing EHIs globally and in the Asia-Pacific region. The chapter

continues by outlining the study's research context, at national and then at provincial levels. It also details the research rationale, as well as study aim, research questions and hypotheses. It concludes by outlining the dissertation structure and organisation.

1.2 Key concepts: Essential health interventions

EHIs primarily refer to interventions across the life course. There are four major areas of EHIs. These are: women's health; pregnancy, childbirth and postnatal care; child health and development; and adolescent health and development (WHO, 2015). While WHO has identified 27 specific EHIs across these broad areas, for the purpose of this study, the research focused on three: antenatal care (ANC); postnatal care (PNC), specifically delivery by skilled birth providers (SBPs); and the initiation of breastfeeding within the first hour after delivery. These crucial EHIs for pregnant women and newborns and their intended health outcomes are described below.

ANC is defined by Mallisngorar et al. (2019) as "a program that is planned in the form of observation, education and medical treatment in pregnant women, for obtaining a process of pregnancy and childbirth [that is] safe and satisfying" (p. 3263). It involves routine contact with a medical professional, skilled nurse, or midwife during pregnancy which ensures women receive essential health care for themselves and their unborn child (Basha, 2019). While WHO recommends a minimum of four ANC visits during pregnancy, it is estimated that only half of all mothers receive this recommended amount of ANC worldwide (Basha, 2019).

While ANC is crucial for women during pregnancy, PNC is essential for both mother and the newborn after delivery. WHO (2008, as cited in Wudineh et al., 2018) defined PNC as care offered to the mother and the neonate immediately after the placenta is delivered and continued care for the first six weeks of life. PNC includes two phases of care, post-partum and post-natal. Post-partum is the period which begins immediately after the birth of the newborn as the mother's physiological body experiences some changes including a change of hormonal levels and the uterus size returning to a non-gestational state (Wudineh et al., 2018). WHO recommends post-partum care within 24 hours of birth, irrespective of where the newborn is born, in order to avoid serious complications such as post-partum haemorrhage (excessive vaginal bleeding after birth) (Vogel et al., 2019). This is a crucial period where close observation and essential management are paramount to provide the appropriate care such as early detection and treatment of illness.

The second phase of PNC is postnatal. Lythgoe et al. (2021) defined postnatal as a period of six weeks after birth where the survival of the mother and the newborn are in a critical state since both are vulnerable during this time. Additionally, the goal of care

during this period is to support the parents of the newborn in breastfeeding practices, especially for first time parents, as well as to identity and interpret the child's needs (Wiklund et al., 2018). PNC should be family centred and not only for the newborn (Wiklund et al., 2018). Also, the promotion of the importance of breastfeeding, nutrition, immunisation, and birth spacing is provided during this time (Ndugga et al., 2020). Despite its importance, maternal and newborn survival during this initial period, where quality of care is most neglected, has received limited attention from skilled health care providers (Ndugga et al., 2020).

Breastfeeding is also viewed as a key EHI for children under two years. Mirghafourvand et al. (2018) estimated that 800,000 children's lives could be saved globally through optimum breastfeeding from the first day of life to two months. Breastfeeding practice is categorised in two distinct phases, initial breastfeeding and exclusive breastfeeding (EBF). WHO (2015) defines initial breastfeeding as offering breast milk to newborns within one hour of birth and making sure that the child receives the first milk (colostrum) which is rich in antibodies (protective factors). In contrast, EBF is defined as feeding infants with only breast milk for the first six months of life to achieve optimal growth and health (WHO, 2019b). Universal EBF has the potential to reduce U5 deaths by 11.6% (Patel et al., 2018).

1.3 Essential health interventions

1.3.1 Global dimensions

Global progress to achieve widespread application of EHIs has been unequal. For instance, the 2020 Every Woman, Every Child (EWEC) report showed strong progress in some indicators, while others underlined the need for urgent improvement. These included ANC, PNC, and breastfeeding (UNICEF/WHO, 2020).

There have been improvements in ANC coverage and skilled delivery care, as well as reductions in gender inequality, in some parts of the world (UNICEF/WHO, 2020). Approximately 64% of pregnant women were estimated to have received ANC in the first trimester of pregnancy, as recommended (UNICEF/WHO, 2020). However, in 2019, in low-income countries, only 35% of pregnant women received this care, compared with 83% of pregnant women in developed countries (UNICEF/WHO, 2020). Developing nations were far from achieving universal coverage for ANC as well as many other essential interventions.

The postnatal period is also a critical time for both the mother and the newborn and is when most maternal and neonatal deaths occur (Wudineh et al., 2018). Over the past two decades, maternal and newborn deaths including still births have declined

substantially. This includes an average annual decline of 2.9% for postnatal deaths of mothers. Improvements have also been shown with a 2.9% reduction for newborn deaths and 2.3% for still birth (2000-2019). Table 1 (see next page) presents the results for these key indicators, their global targets and global implementation status, as well as their status in PNG.

Despite progress in reducing the numbers of postnatal and newborn deaths, regions such as sub-Saharan Africa still have high maternal and newborn mortality rates and would need at least twice the annual rate of decline from 2010-2020 to reach the EWEC targets (United Nations Inter-agency Group for Child Mortality Estimation [UNIGME], 2020).

Breastmilk remains an essential source of nutrients for newborns and infants. While global breastfeeding rates have remained largely unchanged at 69% in 2010 and 66% in 2020, the prevalence of breastfeeding is higher in low-income countries than in their wealthier counterparts (UNICEF, 2021a). WHO also recommends immediate or early initiation of breastfeeding within 10 minutes of birth, and even though prevalence is higher in low income countries, Asia and the Pacific have the lowest early initiation of breastfeeding at 32% as well as the lowest EBF at 22% (UNICEF, 2018).

1.3.2 PNG progress and challenges

While PNG's health indicators have improved in the past 25 years, this progress has been slower than anticipated (World Bank Group [WBG], 2017). In 2009, maternal health was declared a national emergency due to an extremely high maternal mortality rate of 733 per 100,000 livebirths (National Department of Health [NDoH], 2009).

In 2015, PNG's maternal and infant mortality maternal deaths per 100,000 births, and 33 deaths of children under 12 months of age per 1,000 live births (WBG, 2017). Almost half (47%) of neonatal deaths occurred in the first month of life, while 67% of U5 children died before their first birthday (WBG, 2017). This led to strategies that included midwifery education and enhanced access to modern birth-control methods (Robbers et al., 2019).

According to the 2006 Demographic and Health Survey (DHS), the neonatal mortality rate fell from 32 per 1,000 live births in 1996 to 29 per 1,000 live births (Lagani et al., 2010). It is now 21 per 1,000 live births (UNIGME, 2021).

Table 1. Summary table of key indicators

Indicator Name	Indicator Definition	Global Target	Global Implementation Status	Status in PNG
Maternal Mortality Rate (MMR)	Number of deaths per 100,000 live births during the same time period (WHO, 2019c).	SDG 3.1.1: Reduce global maternal mortality to less than 70 deaths per 100,000 livebirths (Grundy et al., 2019).	211 deaths per 100,000 livebirths (WHO, 2019c).	171 deaths per 100,000 livebirths (NSO, 2019).
Child Mortality Rate	Probability of a child dying between birth and 5 years of age, expressed per 1,000 live births (UNIGME, 2020).	SDG 3.2.1: Reduce child mortality to at least as low as 25 deaths per 1,000 livebirths (WHO, 2019c).	37 deaths per 1,000 livebirths (UNIGME, 2021).	44 deaths per 1,000 livebirths (UNIGME, 2021).
Neonatal Mortality Rate	Number of deaths during first 28 days of life per 1,000 live births (UNIGME, 2020).	SDG 3.2.2: Reduce neonatal mortality to at least as low as 12 deaths per 1,000 livebirths (UNIGME, 2021).	17 deaths per 1,000 livebirths (UNIGME, 2021).	21 deaths per 1,000 livebirths (UNIGME, 2021).

1.4 Research context

1.4.1 Overview of PNG

PNG is the most culturally diverse country in the Asia-Pacific region, with a population of around 9 million people. It has over 800 ethnic languages, with three major official languages: English, Tok Pisin, and Hiri Motu (Kitur et al., 2019). The majority (80%) of the country's population lives in rural areas (Kitur et al., 2019). The country is administratively divided into 22 provinces, with the capital located in the National Capital District (Port Moresby) (Grundy et al., 2019). Each of the provinces has five to six districts, every one with a diversity of languages spoken (Grundy et al., 2019).

1.4.2 PNG health services profile

The basic health care services are delivered at aid posts, health centres, district hospitals and referral hospitals. These are further classified into two national referral hospitals, 19 provincial hospitals, and 45 urban clinics, as well as approximately 500 health centres and more than 3,000 aid posts (WHO, 2020b). The main health service providers in PNG include the government and the mission health services, with a small proportion of services provided by the private health sector (WHO, 2020b).

However, most of these health facilities and services are inadequate. This is due to a range of factors, including shortages of skilled health care workers, limited procurement of medical commodities, and poor water and sanitation. It is also reflected in geographical constraints on access to services, as well as the diversity of languages spoken (Field et al., 2018).

The proportion of doctors, health extension officers, nurses, community health workers and midwives has risen from 0.55 per 1,000 population (2009) to 1.03 per 1,000 (2018) population. However, despite this improvement, PNG's health workforce still falls well below the WHO threshold of 4.45 per 1,000 population needed to meet Sustainable Development Goals (SDGs) and universal health coverage targets (WHO, 2020b).

1.5 Introduction to the study provinces

This research draws on a previous study conducted in the Momase and Islands regions of PNG (Schmidt et al., 2019). Data were gathered from three out of four provinces in Momase region (East Sepik, West Sepik ("Sandaun"), and Madang), as well as from the ARoB in the Islands region. Figure 1 shows the location of these four provinces and Table 2 indicates their towns, districts, and their provincial population.

Figure 1. Map of provinces and their districts in PNG

Note. The red tear-drop symbols show the four study sites. Map reprinted from Grundy et al. (2019) at p. 3.

Table 2. Summary table for the four study sites

Province & Town	District Name	District Capital	Population
East Sepik (Wewak)	Ambunti-Dreikikir	Ambunti	450,530
	Angoram	Angoram	
	Maprik	Maprik	
	Wewak	Wewak	
	Wosera-Gaui	Wosera	
	Yangoru-Saussia	Yangoru	
West Sepik (Vanimo)	Aitape-Lumi	Aitape	248,411
	Nuku	Nuku	
	Telefomin	Telefomin	
	Vanimo-Green River	Vanimo	
Madang (Madang)	Bogia	Bogia	493,906
	Madang	Madang	
	Middle-Ramu	Simbai	
	Rai-Coast	Saidor	
	Sumkar	Karkar	
	Usino-Bundi	Usino	
Bougainville (Buka Town)	Central Bougainville	Arawa-Kieta	249,358
	North Bougainville	Buka	
	South Bougainville	Buin	
Total			1,192,847

Note. Reproduced from National Statistical Office [NSO] (2014).

1.5.1 Overview of the Momase region

The Momase region is characterised by four provinces containing 25 administrative districts and an estimated population of 1,867,675. The inland districts are isolated and remote due to the mountainous topography (Mount Wilhelm and the Bismarck Range) which limits road access. As a result, air access and sea transport are the most convenient routes (Sekac et al., 2016). There are smaller scattered volcanic islands offshore. PNG's largest river, the Sepik river, flows through the region (Sekac et al., 2016). The Momase region is also characterised by low-lying areas known as the Markham, Ramu, and Sepik plains. These areas experience recurrent and severe flooding, posing logistic difficulties for ground access due to the absence of bridges (Sekac et al., 2016). The region's topography including its climatic conditions, mountains, and swamps, limits scope for agricultural productivity (Sekac et al., 2016).

The Momase region has a wide diversity of cultural groups with approximately 200 languages spoken. Its 2011 population of 1,867,675 contributes around 25% of PNG's population (Sekac et al., 2016). Approximately 20% of the population is under seven years of age (Sekac et al., 2020). In 2013, the Momase region's health infrastructure comprised 157 health facilities, four provincial hospitals for each province (NDoH, 2013). The region had 15 urban clinics, 58 health centres and 68 health subcentres as well as 896 rural aid posts. These health facilities are managed by both the government and faith-based organisations. For instance, 47% of the facilities operate with the support of missions (NDoH, 2013). In 2013, the total number of

health care workers comprised 50 community health workers and 25 nursing officers as well as five health extension officers working in the rural health facilities of Momase region (NDoH, 2013).

Population access to health facilities is challenging across the Momase region. Only the Madang and Morobe provinces have modest road networks. However, road conditions are characterised by poor maintenance and covered by “rough” sections over the mountain ranges (Sekac et al., 2016). In the East and West Sepik provinces, there are similar constraints with air and sea access to health care services (Sekac et al., 2016). This is in part due to the already limited flights being disrupted by adverse weather conditions, affecting access to isolated aid posts and health centres.

In some remote areas, people travel many hours both on land and on water to reach health facilities. For example, people living in the Middle Ramu district in Madang province must travel more than eight hours by canoe and dinghy to reach a health facility or walk for three to four days (Schmidt et al., 2021).

On health service delivery, Momase has performed below the national average on the crucial health status indicators (NDoH, 2013). In 2014, East Sepik, West Sepik, Madang and Morobe in the Momase region had immunisation coverage of 38%, 32%, 28%, and 35% respectively. However, ANC coverage varies between provinces. For example, one 2014 study reported that Modilion Hospital in Madang province had the lowest ANC coverage with 35%, while East Sepik province had 55-71%, which was the highest ANC coverage in the region (Robbers et al., 2019).

1.5.2 Autonomous Region of Bougainville (Islands Region)

ARoB is a semi-independent region of its own with a 2011 population estimated at 249,358. It comprises two main islands, Bougainville Island and Buka Island, as well as three regions (North, South, and Central) (Government of Bougainville [GoB], n.d.). Geographically, Bougainville Island is the largest island of the Solomon Islands with many scattered small islands and atolls (GoB, n.d.). The landscape features coastal and mountainous areas including the highest peak, Mount Balbi, with an altitude of 2,715 metres above sea level (Walton et al., 2020). The majority of ARoB’s inhabitants live in remote areas where they rely heavily on agricultural activities (Walton et al., 2020).

ARoB is characterised by many indigenous languages. These are broadly classified into two major language categories: Austronesian and non-Austronesian (Papuan) language groups (NSO, 2014; Tryon, 2021). However, none of ARoB’s many languages are spoken by more

than 20% of the population, and the majority of Bougainvillians use Tok Pisin for general communication (Tryon, 2021).

ARoB's health infrastructure is limited to health facilities in each of the two main islands (Buka and Bougainville). There is only one public hospital located in Buka while the districts have a small number of health centres and an aid post in Torokina located in the western part of Bougainville Island. However, health workers from the Torokina Health Centre often visit the aid post while conducting maternal and child health campaigns, including when carrying out antenatal clinics, and childhood vaccinations (GoB, n.d.).

Access to health care is also challenged by ARoB's geography, remoteness and the scattered locations of its island communities. For example, the Karato community in South Bougainville faces great difficulties in reaching the nearest health care services in Arawa. Such constraints highlight the immense challenges in establishing a reliable health system in ARoB. This is particularly due to the population distribution reflected in dispersed, small communities with poor road access.

Over the past decade, ARoB's health indicators have been slow to improve. This is illustrated by its 2006-2010 National Health Plan which targeted 22.4% immunisation coverage levels in U5 children, compared with the national rate of 35.3% (Grundy et al., 2019) (Table 3). However, one performance indicator revealed encouraging results showing that most of the women in ARoB had used family planning methods over the past decade (NDoH, 2011).

Table 3. ANC and basic immunisation status for the four provinces

	National	Madang	Morobe	East Sepik	West Sepik	ARoB
ANC	76%	65.80%	77%%	61.40%	60.40%	87.60%
Basic immunisation	35.30%	24.90%	38.4%%	21.8%%	33.20%	22.40%

1.6 Research rationale, research aim and questions

1.6.1 Research rationale

Public research on infant and U5 child health in PNG has profiled the urgent need to improve infant and child health. This includes reducing maternal and infant mortality rates and enhancing good nutrition for U5 children (WHO, 2018). Other studies have stressed the need to improve access to modern contraception, as well as measures to address HIV/AIDS,

malaria and tuberculosis (NDoH, 2018). While these studies have underlined EHI measures, they have given less attention to the social determinants that influence parental actions related to infant and child health. These include ANC visits, PNC and breastfeeding practices (Basha, 2019; Wudineh et al., 2018).

The rural household survey on food systems conducted by the International Food Policy Research Institute (IFPRI) in four PNG lowland provinces provided an opportunity to examine the relationship between parental sociodemographic attributes and their subsequent actions. Although the IFPRI researchers collected valuable information on the social determinants of health (such as parental education levels), they did not investigate the relationship between these attributes and the application of EHIs, including for pregnant women and newborns. Specifically, they did not investigate the relationship between parental sociodemographic characteristics and the EHI practices that WHO has identified are highly protective for pregnant women and newborns (WHO, 2015).

The present study sought to address this knowledge gap, recognising both the limited information available on EHIs in PNG's lowland areas, and the need to better understand how key sociodemographic attributes affect parental practice of EHIs, especially as this relates to pregnant women and newborns.

1.6.2 Research aim, questions, and hypothesis

Research aim

With a specific focus on the four lowland provinces of East Sepik, West Sepik, Madang and ARoB, this study aimed to investigate the association between sociodemographic characteristics and the application of EHIs for pregnant women and newborns.

Research questions

1. What were the sociodemographic attributes (gender, age, marital status, primary occupation, education, and literacy level) of the household heads in the IFPRI study?

2. What was the prevalence of selected essential health interventions applied for pregnant women and newborn (antenatal care, delivery with skilled birth provider support and early initiation of breastfeeding), and how were these distributed between provinces?

3. What sociodemographic characteristics of household heads were associated with the application of selected essential health practices for pregnant women and newborns?

4. What sociodemographic attributes of mothers were associated with the application of selected essential health interventions for pregnant women and newborns?

Hypotheses

• The first null hypothesis was that there would be no difference in the application of EHIs for pregnant women and newborn due to the sociodemographic attributes of household heads in the four provinces studied.

• The first alternative hypothesis was that there would be differences in the application of EHIs for pregnant women and newborn due to the sociodemographic attributes of household heads in the four provinces studied.

• The second null hypothesis was that there would be no differences in the application of EHIs due to the sociodemographic attributes of mothers in the four provinces studied.

• The second alternative hypothesis was that there would be differences in the application of EHIs for mothers in the four provinces studied.

1.7 Dissertation structure and organisation

This dissertation comprises five chapters:

Chapter One, the current chapter, introduces the research and leads to the problem context including the key concepts, the rationale, and the aim. It further describes the research questions and the study's hypotheses.

Chapter Two critically reviews credible publications on the selected EHIs including the current practice and their prevalence. The chapter continues by focusing on the barriers encountered while delivering the EHIs in rural areas. It also explores the knowledge gap in empirical studies.

Chapter Three examines the study's methodology which is a quantitative secondary data analysis. This chapter presents the rationale for using the dataset for the household survey conducted by IFPRI and connects this with the present study's aim. It continues by describing the study's methodology, including ethical considerations.

Chapter Four provides the findings and results of this study after analysing data gathered from the PNG household survey.

Chapter Five includes the discussion and conclusion. It discusses the prevalence of EHIs in the four provinces. The chapter continues by considering the barriers identified as well as those that are not significant. The chapter concludes by revisiting the study's research questions and hypotheses as well as its implications on the national scale.

1.8 Chapter summary

Chapter 1 has introduced the concept of EHIs and their global dimensions. It has provided an overview of PNG, including the health services profile, and introduced the study provinces. The chapter has presented the study's rationale, aim, and hypotheses, and concluded with an outline of the dissertation structure.

Chapter 2. Literature Review

2.1 Introduction

The study's emphasis on the implementation of EHIs in PNG required a careful review of relevant literature. Focusing specifically on pregnant women and infants, this chapter begins by providing an overview of the global progress on the implementation of EHIs for these groups. This includes the social determinants that underpin EHIs, as well as health sector shortcomings and social inequities. The chapter continues by addressing the application of selected EHIs in PNG and concludes by identifying the knowledge gap that underlies the purpose of this research.

The literature search took place throughout 2019 and 2020. The study employed two databases accessible through the AUT Library, namely Scopus and PubMed, as well as Google Scholar to obtain the necessary literature that corresponded to the practice of EHIs. To broaden the search, truncation techniques with various spellings and word endings were applied. These included words such as, "antenatal", "antenatal care" AND "antenatal visits"; "postnatal", "postnatal care" AND "postnatal visits"; "breastfeeding" AND "breastfeeding practices", "initial breastfeeding" AND "exclusive breastfeeding". The literature search was sharpened by using the terms "barriers" AND "essential health interventions" to identify articles that related to the factors that hampers as well as aid EHIs.

2.2 Progress in essential health interventions

WHO (2015) has highlighted the unequal global progress in implementing EHIs for women, newborns, and young children. This is reflected by indicators from low-middle-income countries (LMICs) that track trends in ANC, PNC, SBP and breastfeeding practices.

On ANC, for example, although WHO recommends at least four antenatal contacts during pregnancy, Konje et al. (2018) noted that in developing countries, the number of visits might not exceed two or three. These reduced levels of ANC translate into unidentified pregnancy-related complications that increase the risk of stillbirths, newborn deaths and maternal deaths. This is despite the preventable nature of these complications if appropriate interventions had been applied during gestation, labour, delivery and the postnatal period (Konje et al., 2018).

The unequal implementation of PNC is also apparent in LMICs. On the one hand, by 2017, global efforts to reduce maternal and neonatal deaths through enhanced PNC had reduced maternal deaths by 35% compared with 2000 levels (Grundy et al., 2019). Despite this, in 2017, 94% of the 295,000 maternal deaths were still reported by LMICs (Grundy et al., 2019).

Similar patterns have been noted for the early initiation of breastfeeding and EBF, key EHIs. In a study of EBF prevalence from 2000 to 2018 across 94 LMICs, Bhattacharjee et al. (2021) projected that only six LMICs would meet WHO's global nutrition target of more than 70% prevalence of EBF by 2030. Of these countries, only three (Burundi, Lesotho and Rwanda) were expected to meet this target at province and district levels.

Breastmilk remains an essential source of nutrients for infants and young children. Globally, the frequency of continued breastfeeding among children under two years of age has remained almost unchanged from 2010 (69%) to 2020 (66%) (UNICEF, 2021b). There are variations in the prevalence of breastfeeding practices within a country and between nations or regions. For instance, the prevalence of continued breastfeeding among children of low-income regions is higher than that of their affluent counterparts (UNICEF, 2021b).

2.3 Global socio-economic determinants that underpin EHIs

Many socio-economic factors enable or discourage the application of EHIs. These include socio-economic inequalities in health care service delivery (WBG, 2017). They also include factors such as maternal education, culture, and tradition.

2.3.1 Socio-economic inequities

Inequalities in health care delivery are evident in both high- and low-income countries. Comparative studies suggest that unequal health care service delivery levels are associated with low health coverage when these services are primarily used by affluent groups (Pulok et al., 2018). Wang et al. (2018) noted that increasing the rates of "user pays" policies for health care imposes a burden on poor households and creates barriers to access. Sahoo et al. (2021) also noted that women living in households with constrained incomes faced difficulties in using antenatal services and other EHIs.

Urban–rural differences have also been highlighted on access to health services, with Qin et al. (2020) noting that health care inequalities in urban areas were more visible than in remote settings (Aleemi et al., 2018). However, Varela et al. (2019) also underlined that while everyone has the right to quality and effective health care, rural health care services are less accessible than those in urban areas. This includes the location and number of facilities, distance from the home to a health facility, transportation infrastructure, as well as the financial status of the population (Aleemi et al., 2018).

These urban–rural disparities particularly apply to LMICs such as PNG where ANC attendance by pregnant women is low in rural areas (Robbers et al., 2019). In PNG, as well as globally, socio-economic deprivation of marginalised populations is reflected by poverty and adverse health outcomes.

2.3.2 Parental education and literacy and essential health interventions

While the relationship between limited maternal education and ill health for mothers and children is acknowledged globally, it is more prevalent in LMICs (Ekholuenetale et al., 2020). For instance, Ali and Chauhan (2020) argued that inequality in the utilisation of EHIs disproportionately affected less educated and poor women, while educated and wealthier women have been more likely to attend protective health services such as ANC. Numerous studies have also suggested that secondary and higher education and exposure to mass media, contributed significantly to reducing inequality in resource-poor countries (Selebano & Ataguba, 2022).

Partners' education

Emerging literature from developing countries such as Ghana (Apanga et al., 2022) increasingly highlights the role of partners' education in EHI practices. This has been widely demonstrated across developing countries (Adjiwanou et al., 2018). Studies from Zambia (Muyunda et al., 2016), Myanmar (Toe et al., 2021) and Guinea (Ahinkorah et al., 2021) note the benefits of ANC attendance and SBP assistance when both pregnant women and their partners had higher levels of education.

Cultural practices

Cultural determinants such as dietary practices and food taboos practised by pregnant women may hamper them from obtaining nutritious foods for themselves and their unborn children (Chakona & Shackleton, 2019). Chakona and Shackleton (2019) found that, in South Africa, 37% of pregnant women avoided eating foods rich in protein such as meat products and fish to avoid increasing the size of the foetus (unborn child) to prevent delivery complications.

2.3.3 Health system shortcomings and implementation of EHIs

National efforts to implement EHIs are also influenced by health system capabilities and the availability of a skilled health workforce. The correlation between poor maintenance of health facilities and EHIs has been widely investigated. On average, countries achieve significant service coverage and financial security results when governments direct more financial support to health infrastructure (WHO, 2015). Lack of repair and renovation of deteriorating health facility buildings represent factors contributing to the poor performance of EHIs in these settings (Kapologwe et al., 2020). Studies show that inadequate infrastructure, such as insufficient water supply and sanitation systems in primary health facilities, has resulted in poor health indicators, including childbirth and newborn care in East Asia and the Pacific (Mannava et al., 2019).

Access to limited numbers of skilled health care providers at community level represents another barrier to effective maternal and child health (WHO, 2017) This unequal distribution of health workers has led to disparities between LMICs and developed countries (WHO, 2017).

2.4 Geographical implications for implementing EHIs

There is growing recognition of the role that geographical factors play in enabling or impeding access to health care. This is reflected in geographical barriers including difficult topographies, waterways, the distance to facilities, cost, and travel time (Ahmed et al., 2019). Geographical accessibility to health care is defined as the absence of environmental barriers, including physical challenges such as distance or travel time in accessing care when needed (Yasuoka et al., 2018).

Inaccessibility to health care in terms of road infrastructure is seen as a major challenge in achieving universal health coverage and disproportionately affects women and children in resource-poor settings (Varela et al., 2019). Poor transportation systems and the time to reach health facilities are among the essential non-income-related barriers to accessing health care services (Varela et al., 2019). In this context, inadequate road networks undermine progress in key health indicators, including EHIs (Ali et al., 2021). In contrast, well-maintained roads and effective transportation systems reduce maternal and infant mortality in resource-poor countries (Ali et al., 2021).

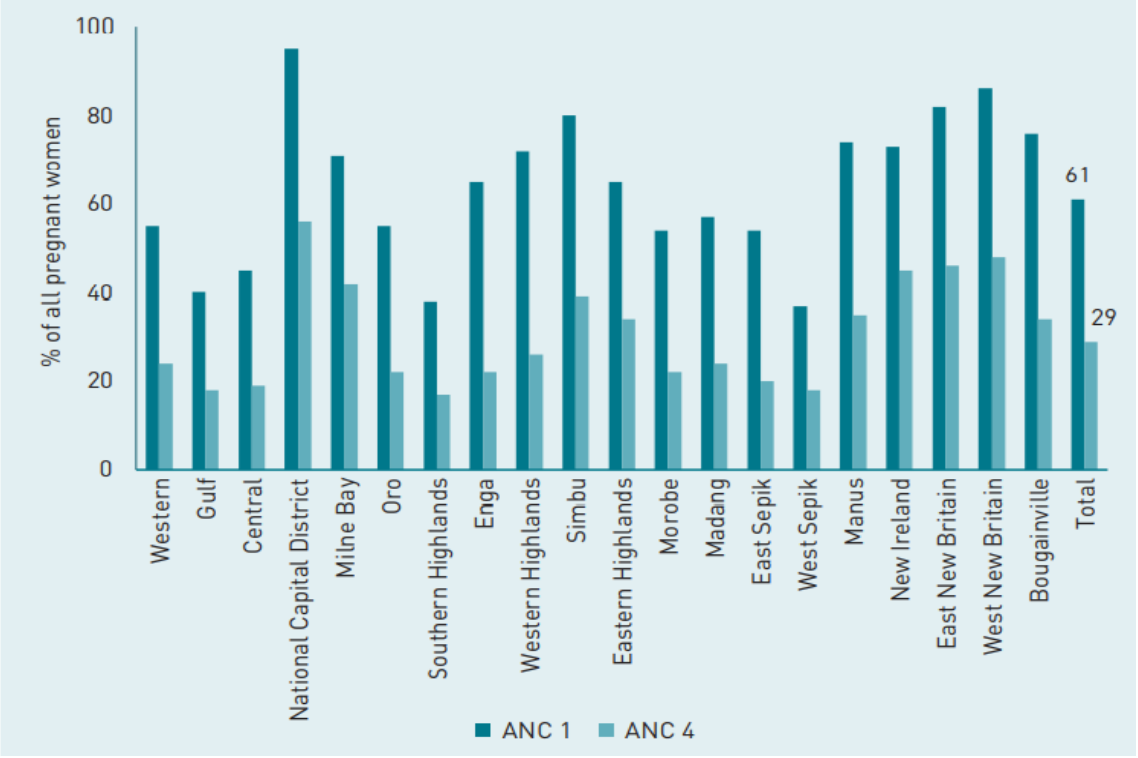
While Aleemi et al. (2018) argued that everyone has the right to quality and effective health care that is affordable, available, acceptable, and accessible, the level of accessibility to rural health care services is lower than that in urban areas. As noted earlier, this includes the location and number of facilities, distance from the home to the health facility, transportation infrastructure, as well as the financial status of the population (Aleemi et al., 2018).

The distance to health facilities is an essential geographical determinant for progress in improving EHIs. According to Steinbrook et al. (2021), the high prevalence of pregnant women lost to follow-up (17.4%) in Thailand-Myanmar is due to long travel distances to clinics, with health care users more likely to utilise those health facilities if they are situated close by. In the case of ANC, the dispersed nature of health facilities in rural areas also contributes to poor adherence to routine antenatal follow-ups (Ntoimo et al., 2019). For example, referral of high-risk antenatal women from a rural health centre to a district or provincial hospital may fail due to the distant location of urban health facilities, and may result in poor adherence to health care.

2.5 Progress in implementing essential health interventions in PNG

Despite efforts to improve maternal and newborn health in PNG, there has been slow progress in advancing EHIs for these groups. Regarding ANC, in 2016-2018, only 49% of pregnant women in PNG had experienced at least four antenatal visits (NSO, 2019) compared with 64% reported globally (Moron-Duarte et al., 2019). ANC disparities between urban and rural areas were also reflected by delivery statistics, with 87% of urban births in 2016-2018 supported by an SBP, which contrasted with only 53% of births in rural communities (NSO, 2019). These urban–rural differences were further increased by household wealth, with 91.1% of women in affluent households delivering with the aid of an SBP. This was in sharp contrast with the experienced of poorer women, where only 33.4% of those in the lowest economic quintile delivered with a skilled birth attendant's support (Ayele et al., 2019). Figure 2 shows the great urban–rural variation in ANC attendance in PNG, with more than 50% of pregnant women attending four visits in the National Capital District, compared with less than 20% in the Gulf, Central, and Southern Highlands provinces.

Figure 2. Indicators of ANC for first and fourth visits in various provinces in PNG in 2012



Note. From Grundy et al. (2019).

Data suggest that PNG must accelerate its efforts to achieve its SDG targets for maternal and neonatal mortality. While the 2030 SDG maternal mortality rate (MMR) target is less than 70 maternal deaths per 100,000 live births, PNG's 2016-2018 MMR was estimated at 171

maternal deaths per 100,000 live births (NSO, 2019). This represents a positive change from the 2010 MMR estimate of 342/100,000 (Grundy et al., 2019). In 2016-2018, the country's neonatal mortality rate was still almost double the projected 2030 SDG target of 12/1,000 live births reported by UNIGME (2021).

In contrast, the 2016-2018 national DHS reported more favourable results for indicators such as EBF. This was reflected in 62% of PNG infants being exclusively breastfed up until six months of age, compared with 41% globally (NSO, 2019; WHO, 2019a). However, at sub-national levels, there is a significant variation in reported EBF. For example, Seidu et al. (2020) noted that EBF in the Gulf and Madang provinces differed at 69% and 36.1%, respectively. Robbers et al. (2019) highlighted the absence of research on breastfeeding and infant feeding practices within PNG.

Regarding early initiation of breastfeeding, 60% of women in PNG generally initiated breastfeeding within the first hour after delivery (Seidu et al., 2020). The prevalence of early breastfeeding differs between provinces within PNG. For instance, the rate of early breastfeeding in Morobe province in the Momase region was lowest at 36% compared to East New Britain province in the Islands region with 75% in recent years (2017 & 2018) prior to this survey (NSO, 2019). According to this report, 37% of highly educated mothers were less likely to initiate breastfeeding within one hour than children born to mothers with no education (NSO, 2019).

Early breastfeeding is more common among children whose deliveries were assisted by health personnel (52%) than those whose deliveries were assisted by traditional birth attendants (47%). The prevalence of early breastfeeding is lowest in the Morobe and West New Britain provinces (36% each) and highest in the East New Britain (75%) and Central (74%) provinces. Children born to mothers with higher education were less likely to start breastfeeding within an hour of birth (37%) than those born to mothers without education (54%).

Table 4. Summary table for the specific EHI indicators in this study

Indicator Name	Indicator Definition	Global Implementation Status	Implementation Status in PNG (from Demographic Health Survey 2016-2018)
ANC	At least four antenatal visits (Dennis, 2018; WHO, 2016a)	59% of pregnant women had at least four antenatal visits: 73% urban, 49% rural (WHO, 2016b)	49% of pregnant women had > 4 antenatal visits. 63% in urban areas, 47% in rural areas (NSO, 2019).
Delivery by SBP (WHO, 2020a)	Births delivered with medical professionals including doctors, midwives, nurses as well as trained health volunteers (NSO, 2019)	83% deliveries by SBP, 90% for urban mothers, 70% for rural mothers (WHO, 2020a)	Skilled assistance during delivery increased from 54% in 2006 to 56% in 2016-18 (NSO, 2019).
Early initiation of breastfeeding	Initiation of breastfeeding within 1 hour of delivery	Initiation of breastfeeding within 1hr of delivery was 43% in multiple countries (Tahsina et al., 2021).	53% began breastfeeding in the first hour (NSO, 2019).

2.6 Barriers to advancing essential health interventions in PNG

Multiple barriers to advancing EHIs in PNG have been identified. These include socio-cultural and economic obstacles, health sector constraints, geographic obstacles and climate threats.

2.6.1 Socio-cultural obstacles

Although socio-cultural norms, traditions and practices are changing in PNG due to the influences of globalisation, urbanisation, religious beliefs and colonisation, its diverse cultures and customs remain well preserved, valued and respected. This has led to their continued role in regulating lifestyles and behaviours (Maulingin-Gumbaketi et al., 2021). However, some of these beliefs and practices have been documented as obstacles to the accessibility, availability and uptake of EHIs, especially those that apply to pregnancy and childbirth (Moores et al., 2016).

Studies have revealed that socio-cultural factors and food taboos are linked to undernutrition in under five-year-olds, as well as high infant mortality rates (Maviso et al., 2022). For example, in the highlands areas of PNG, Hall et al. (2020) noted that colostrum is often considered to be “unclean” milk and therefore “squeezed out” prior to feeding newborns. This is counter to medical and scientific advice on colostrum’s nutrients and antibodies that are crucial for a newborn’s growth and health (Rodriguez-Camejo et al., 2018). In some areas of PNG, including fish in the diet during pregnancy is also forbidden.

Gender inequality is another pivotal issue in implementing EHIs in PNG where women and girls have limited opportunities to access educational services. Gender inequality is regarded as the unequal treatment of men and women where certain distinctions are raised from cultural norms including status in the society as well as differences in education, employment, and political affiliation (Azad et al., 2020).

In PNG, men’s participation in EHIs remains limited (Davis et al., 2018). For instance, in a study of expectant fathers’ engagement with antenatal care, Davis et al. (2018) found that PNG men did not view their involvement in ANC, PNC, and family planning as appropriate. This also applied to providing care and support during breastfeeding (Davis et al., 2018).

Limited household income and employment represent crucial obstacles in implementing EHIs. More generally, Cooper and Stewart (2020) highlighted that a lack of income leads to poor health outcomes for families in the poorest quintiles compared to those in the richest quintiles (Cooper & Stewart, 2020). Seidu et al. (2020) underscored this by noting that working mothers, including those who work in the public and private sectors, have

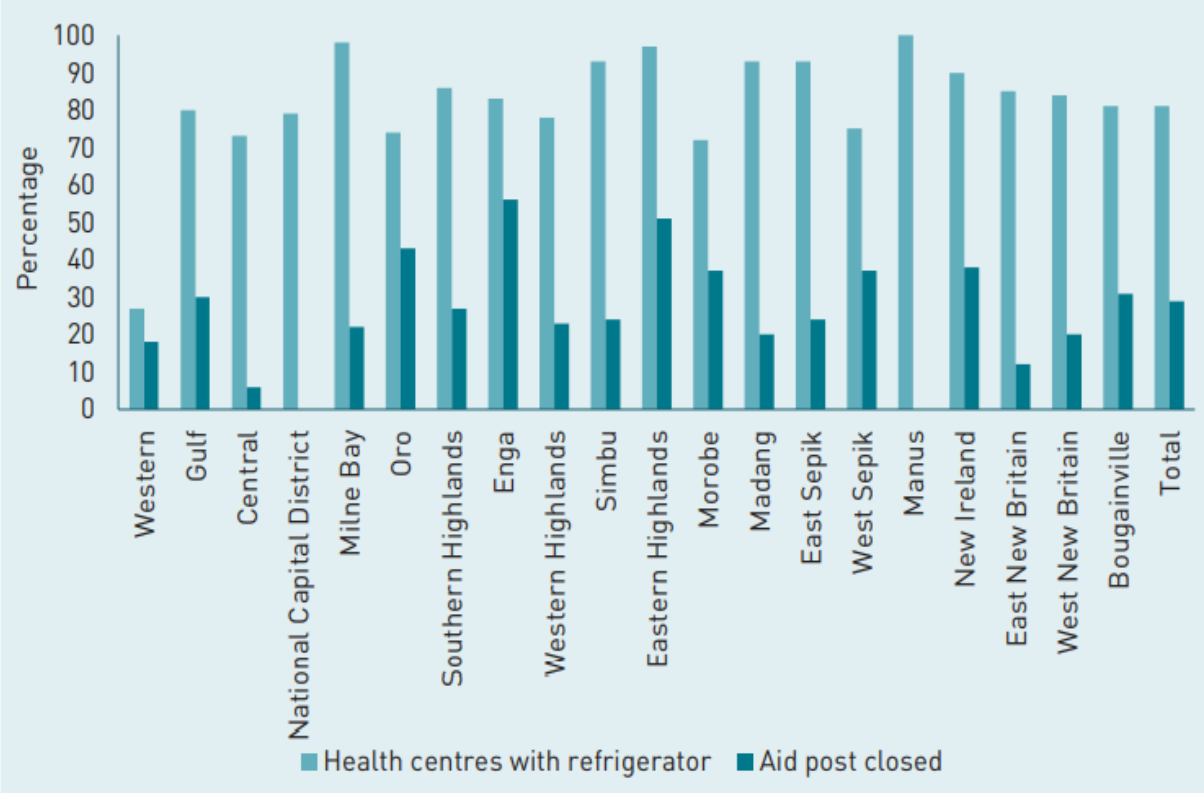
more ANC visits compared to women who earn low wages or even those who are not working. They found that working mothers whom the government and the private sector employed had higher odds of initial ANC attendance, while those not employed had lower odds of ANC attendance (Seidu et al., 2020).

2.6.2 Health sector constraints to implementing EHIs

PNG's health system faces multiple challenges. This is not only because of low levels of economic and infrastructure development; it is also due to difficulties in providing access to a rural population dispersed across remote and geographically inaccessible terrain (Grundy et al., 2019). PNG's Country Cooperation Strategy 2016-2020 highlighted four strategic priorities for improving health outcomes (WHO, 2016b). While these included "strengthening health systems", there has been only a modest improvement in this area, with WHO (2016b) identifying outstanding gaps in service delivery, physical infrastructure and the country's limited health workforce.

Significant urban–rural disparities persist in access to health care. For instance, from 1983 to 2013 as many as 30% of aid posts were closed due to shortages in funding, staff, and other resources (Figure 3) (NDoH, 2012; WBG, 2017; WHO, 2016b). Assessments conducted in 2012 also indicated that only 55% of facilities had a year-round water supply, while 68% had received no maintenance in the previous year (Grundy et al., 2019). Limited investment in health facility maintenance and construction has been specifically highlighted by the slow expansion of equipped obstetric facilities capable of supporting emergency deliveries and the management of newborn conditions. As recently as 2016, WHO noted that no new comprehensive obstetric care facilities had been established since 2010 (WHO, 2016a). This constrained access to delivery and newborn support is reflected in disparities between urban and rural areas. For instance, the 2016-2018 national DHS reported that 85% of urban mothers gave birth in a health facility, compared with only 51% of mothers in rural areas (NSO, 2019).

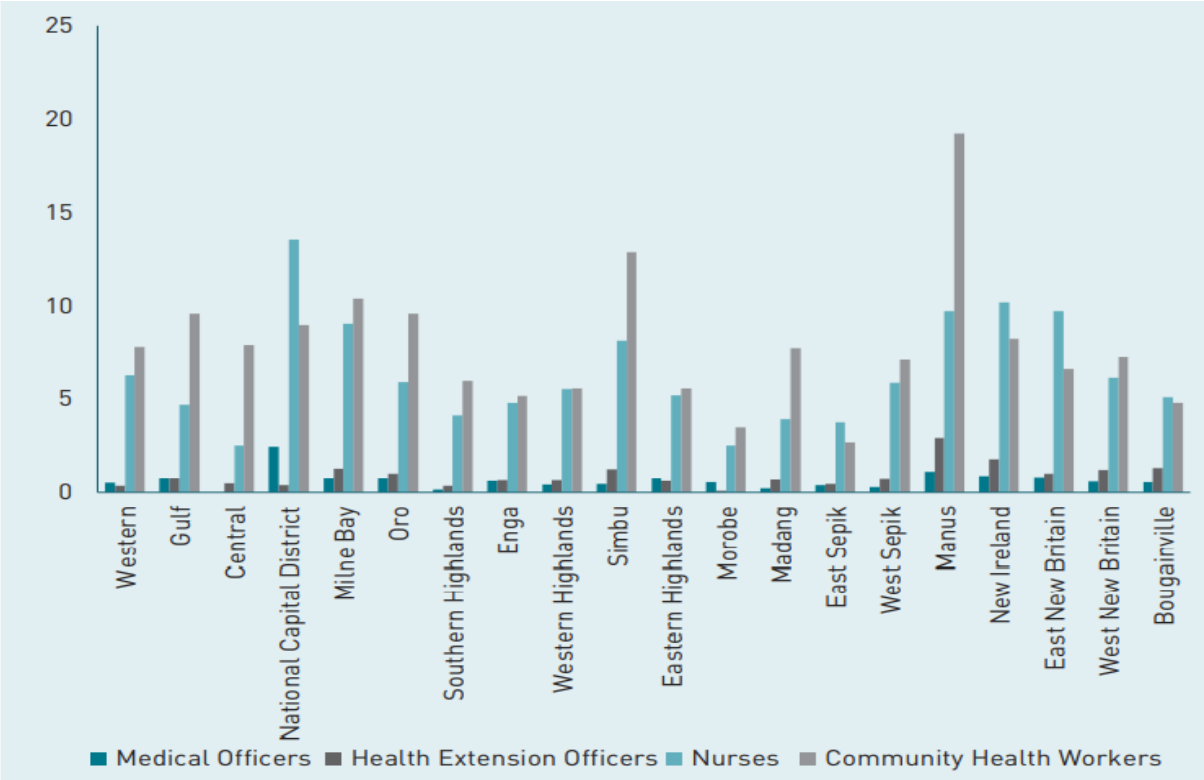
Figure 3. Provincial distribution of health facilities closed over the past decade



Note. From Grundy et al. (2019).

Health workforce constraints also represent a significant obstacle to accessible maternal-child health care. WHO (2020b) reported a health workforce comprising of 15,237 personnel in 2018. This included government workers, employees from church-run organisations and private health care providers. Grundy et al. (2019) cautioned that PNG had the lowest health staff-to-population ratios in WHO's Western Pacific region and maldistribution across the country. Figure 4 represents the distribution of health staff per 100,000 population. This shows marked disparities, with approximately 20 community health workers per 100,000 based in Manus province, compared to less than five per 100,000 in East Sepik.

Figure 4. Maldistribution of health staff per 100,000 population, by province in 2018



Note. From Grundy et al. (2019).

Inequalities in resource distribution are also seen in the implementation of EHIs. This inequality includes the utilisation of facility-based supervised deliveries. For example, supervised delivery rates are greater than 100% in some urban areas compared to 50% in rural areas (Grundy et al., 2019). This suggests rural services are being bypassed by clients for better equipped and staffed urban services. As such, inequalities are worsening due to the investment being directed to provinces or locations closer to provincial capitals (Grundy et al., 2019).

To help address disparities in health care delivery and improve access to basic obstetric care, PNG's National Health Plan (NHP) has recommended the introduction of new 'Community Health Posts' to serve the rural majority (Grundy et al., 2019). This new type of facility will have an equipped delivery room and be staffed by three health professionals, of whom one will be skilled in emergency obstetric care. This proposed facility is intended to correct the gaps between urban and rural populations in reproductive health (Grundy et al., 2019).

2.6.3 Geographic constraints and climate threats

PNG's unique geographical features comprising difficult terrain with limited road infrastructure and transportation as well as scattered islands, pose significant challenges in providing EHIs to isolated districts and communities (Garchitorena et al., 2021). This

is due to the effect of geographical constraints on health providers' abilities to implement EHIs and the obstacles posed by the country's topography for a vulnerable population to seek health care (WHO, 2016a). For instance, Schmidt et al. (2021) noted that antenatal and postnatal women and mothers with young children often felt discouraged from attending health centres and district hospitals for deliveries, vaccinations, and nutrition education sessions due to the fear of the long travel time both on land and on water.

2.7 Advancing essential health interventions in PNG: Addressing knowledge gaps

There is an urgent need to advance EHIs in PNG to improve infant and child health outcomes, especially in remote rural areas with low health service coverage (NSO, 2019). While there is a growing understanding of the factors that enhance the adoption of EHIs in PNG, much of the prevailing research has taken place in the highland regions, rather than in lowland areas. In addition, while existing research has focused on the influence of mothers' sociodemographic characteristics, such as education level and literacy, there are few studies on the attributes of male partners in relation to protective EHI actions. Given the patriarchal character of PNG's rural communities, this knowledge gap highlights the need to strengthen understanding of the role played by the sociodemographic attributes of both women and their partners in advancing EHI. It particularly applies to the EHIs focused on antenatal and delivery practices, given PNG's high MMR (Robbers et al., 2019). Analysis of the secondary data accessible through the IFPRI Papua New Guinea Rural Household Survey on Food Systems (Schmidt et al., 2019) enabled the examination of the relationships between parental characteristics and key EHI practices for ANC, SBP support and early initiation of breastfeeding.

2.8 Summary

This chapter discussed the practice of EHIs, particularly in the rural communities of PNG, and described the barriers that hamper their implementation. The chapter also described the geographical constraints on seeking health care, especially in rural areas. The chapter concluded by describing the knowledge gap the study sought to address.

Chapter 3 Methodology

3.1 Introduction

The primary aim of this study was to establish relationships between parental sociodemographic characteristics and the application of EHIs for pregnant women and newborns in four provinces of PNG.

Previous studies have found that mothers' sociodemographic characteristics play a vital role in the health and well-being of mothers and children. For instance, in Nigeria, Fasina et al. (2020) reported that both mothers' and fathers' sociodemographic attributes, including residence, age, education, and wealth status, played essential roles in shaping young children's health intervention. Another study in Pakistan found that mothers with primary education were more likely to initiate early breastfeeding compared with mothers who had never attended school (Syeda et al., 2020).

These findings resonate with the experience of PNG mothers who live in rural areas and where sociodemographic barriers such as limited access to primary and secondary education influence maternal and child health outcomes (NDoH, 2015). They also are consistent with the research, although limited, on the relationship between male literacy and involvement in and support for sexual and reproductive health services as a barrier to accessing services (Kura et al., 2013). This study, conducted at Upper Mendi in the Southern Highlands province in PNG, found that most male respondents viewed ANC as an essential service. However, they felt reluctant to support their wives and children in utilising this type of health service.

Therefore, this research sought to explore whether fathers' and mothers' sociodemographic attributes, including education, literacy, marital status, gender, and primary occupation, were associated with the application of EHIs for pregnant women and newborns. This was achieved by examining four research questions:

1. What were the sociodemographic attributes (gender, age, marital status, primary occupation, education, and literacy level) of the household heads in the IFPRI study?

2. What was the prevalence of selected essential health interventions applied for pregnant women and newborns (antenatal care, delivery with skilled birth attendant support and early initiation of breastfeeding), and how were these distributed between provinces?

3. What sociodemographic characteristics of household heads were associated with the application of selected essential health practices for pregnant women and newborns?

4. What sociodemographic attributes of mothers were associated with the application of selected essential health interventions for pregnant women and newborns?

This chapter presents the research methodology applied to address these questions. It begins by introducing and describing the rationale for using a secondary dataset, including assessing its benefits and appropriateness for secondary data analysis. The chapter then describes the statistical approaches used for data analysis and procedures to ensure ethical requirements compliance.

3.2 Rationale for using the International Food Policy Research Institute dataset

Studies have shown several benefits in the use of a secondary dataset. Trinh (2018) highlighted how using secondary datasets can eliminate many financial constraints and logistical obstacles associated with primary data collection. Dunn et al. (2015) also noted that analysing secondary datasets involves less time and fewer resources. It is also low risk to participants and provides access to large datasets.

However, there are drawbacks in analysing secondary data. Sardanelli et al. (2018) noted the possibility of misinterpretation of the data if researchers cannot use the whole dataset. A further drawback is that secondary data may not provide all information of interest (Pederson et al., 2020). In the current study, as the secondary dataset did not include information on all variables of interest, the research questions were amended according to the information available in the dataset. These amendments led to questions on the undernutrition of children under two years and EBF, which are relevant to two of the EHIs, being removed from the analysis.

Due to the time and logistics constraints associated with completing a 60-point research project in PNG, an accessible secondary dataset relevant to EHIs was identified for the current study. However, applying a thorough and systematic approach was necessary to ensure the quality of the initial study's procedures and the study's relevance for application to this new research topic.

A systematic evaluation was undertaken to examine the original data-gathering process conducted by the IFPRI researchers as the present study sought to utilise their dataset. This examination included: alignment of the aims of both the original and present studies, the scientific background of the original authors, clarity of the data gathered and its timing, procedures used in the initial data collection, and management of the original data (Dunn et al., 2015).

3.3 Examination of the IFRI dataset

3.3.1 Alignment between the aims of the IFRI screening survey and the current research

From May to July 2018, the IFPRI conducted a rural household survey to examine the food practices of rural households in four lowland PNG provinces, East Sepik, West Sepik, Madang, and the ARoB. The initial study had two objectives. First, it sought to provide evidence that would inform policy on agricultural productivity, strengthen food security, and improve nutrition policies in PNG. Second, it aimed to provide baseline data for World Vision International (WVI), which was already working with the communities studied (Schmidt et al., 2019).

While the original research aimed to focus on agricultural activities and household food insecurity, the data collected also included information on maternal and child health practices (number of ANC visits, SBP presence at delivery, and early initiation of breastfeeding). The original dataset also contained information on household heads' and the mothers' attributes (age, gender, marital status, education level, literacy, primary activity or occupation). These unanalysed data were relevant to the present study's aim to explore the relationship between household heads' and mothers' characteristics and EHI practices in the four provinces.

3.3.2 The scientific reputation of the primary researchers

The IFPRI gathered the original data. This organisation, established in 1975, has a long history of providing evidence-based policy solutions to sustainably combat poverty and end hunger and malnutrition (Schmidt et al., 2019). The IFPRI is globally recognised and works collaboratively with partners worldwide with highly reputable research integrity and professional performance. The original authors have published papers on food-related issues in peer-reviewed journals. One relevant publication focused on food policy was titled "Rural households in Papua New Guinea afford better diets with income from small businesses" (Schmidt et al., 2020). A second relevant study was titled "Poverty analysis in the lowlands of Papua New Guinea underscores climate vulnerability and need for income flexibility" (Schmidt et al., 2021). While these are two food-related studies conducted in PNG, IFPRI has conducted numerous studies worldwide for more than 40 years (Hazell & Slade, 2015).

As this study analysed secondary data from the IFPRI baseline study, it was necessary to examine and verify the data-gathering instruments initially used. The household questionnaire was obtained through the IFPRI report portal (Schmidt et al., 2019). The open-source dataset was also accessed via the Harvard Dataverse site (Schmidt et al.,

2019) and downloaded in Fixed Format. It was not possible to view the original data. The IFPRI principal investigator explained the original research process (personal communication, September 1, 2021). She also drew attention to a comprehensive discussion paper (Schmidt et al., 2019) that outlined the procedures used in the initial study.

3.3.3 Methods used in the original study

An essential element in evaluating the appropriateness of a secondary dataset involves understanding the primary data collection methods (Johnston, 2014). This assesses compliance with the New Zealand National Ethical Standards for Health and Disability Research and Quality Improvement (National Ethics Advisory Committee, 2019).

Informed consent and validity and reliability of indicators

To ensure compliance with ethical requirements, it was necessary for participants in the initial IFPRI study to provide informed consent. The IFPRI principal investigator confirmed that, prior to the interview, randomly selected household heads were provided with a letter explaining the purpose of the study, its voluntary nature, and a request for informed consent. Consent was voluntary, with clear scope for participants to decline the invitation. Altogether, 1,026 household heads gave consent to participate (Schmidt et al., 2019).

The validity and reliability of the indicators used also required examination. This was achieved through the compilation of data dictionaries (Appendix 2). For example, a key outcome indicator was delivery with support by an SBP. To ensure this indicator aligned with the globally recognised definition, the original study defined SBPs as “doctors and midwives” (Schmidt et al., 2019).

Prior to carrying out data collection, the questionnaires were tested in two pilot studies, resulting in adjustments to the survey instruments. Trained enumerators then collected data from May 7 until July 31, 2018, across the four provinces, using Survey CTO computer-assisted personal interviewing (CAPI) software (Schmidt et al., 2019). Two questionnaires were administered, one focused on household information and the second on key community characteristics.

Sampling design

A vital component of the original study was its sampling design. The initial study adopted a two-stage cluster sampling method, widely used to gather household and other development data over-dispersed geographic areas, especially when there are time and resource constraints (Collins, 2004; Milligan et al., 2004). Cluster sampling is also used when there is no predefined list of households for other random sampling purposes

(Collins, 2004). This method's implementation involved community consultations before data gathering, separated the survey sample into WVI-supported communities and communities that had not received WVI support. In each province, two or three districts were identified based on areas where WVI was implementing programmes. Within these districts, 16-20 communities were selected from which 15 households were identified for interviews in each community cluster (Schmidt et al., 2019).

At the community level, participating households were identified using a “random walk” protocol. This involved drawing community boundaries with satellite imagery that local residents then verified. Following the random selection of a “northing and easting” (latitude and longitude) coordinate that established the start-point for the random walk, the nearest household to this location was chosen as the first survey household. Subsequent households were identified by choosing every third household along a “navigable footpath or motorised track” (Schmidt et al., 2019).

While the initial research team acknowledged that the data gathered were neither nationally nor provincially representative, they underlined that the data provided useful insights on rural livelihoods within a few hours travel radius of the survey cluster centre point. The final survey included 1,026 households across the four provinces (Table 5). The cluster sampling method used in the original study was consistent with similar applications of cluster sampling in resource-constrained developing country contexts (Collins, 2004; Milligan et al., 2004).

Table 5. Number of households by survey area and programme type

	ARoB	**East Sepik**	**Madang**	**West Sepik**	**Total Sample**
Non-WVI	181	123	168	193	665
WVI	70	122	124	45	361
Total	251	245	292	238	1,026

Determining the adequacy of sample size

This research is limited to secondary data analysis, and the maximum number of cases available from the IFPRI dataset was 291. Although the sample size was set, it was important to identify if the initial study’s data was adequate for calculating statistically significant results.

To understand this, it was necessary to identify the proportion of cases that contained the variable of interest (in this study, a child under two years old). This was determined to be approximately 28% (291/1026). Then the total number of households in the four

study provinces was determined by dividing the estimated 2017 population of 1,731,156 (McMurray & Lavu, 2020) by the average household size for East Sepik and ARoB (5.3) and for Madang and West Sepik (5.9) (NSO, 2012). This resulted in an estimated 309,518 households across the four provinces. This determined the population to be approximately 87,787 households (28% of the total number of households in the four provinces). As the population size was >5,000 and the available sample size was 291, it was possible to retrospectively determine that this sample would provide a margin of error between ±5 and ±7.5% (see Table 6). As this research was considered exploratory, the precision was deemed acceptable for this study's purpose.

Table 6. Determining sample size for simple prevalence studies

Acceptable margin of error	Size of population					
	Large	**5000**	**2500**	**1000**	**500**	**200**
±20%	24	24	24	23	23	22
±15%	43	42	42	41	39	35
±10%	96	94	93	88	81	65
±7.5%	171	165	160	146	127	92
±5%	384	357	333	278	217	132
±3%	1067	880	748	516	341	169

Note. Reproduced from Conroy (2018).

3.4 Research Methodology

3.4.1 Selecting household heads with children under two years old

Across the 1,026 households surveyed, 896 children were reported as less than five years old (Schmidt et al., 2019). However, as the original study sought to understand breastfeeding and early childhood feeding practices, the researchers focused on identifying household heads with at least one child under two years of age. In these households, one child was randomly selected, with specific health-related questions about the child's biological mother. This information was collected by paper questionnaire. Altogether, 291 households were identified with at least one child under two years of age (Table 7).

Table 7. Provincial distribution of children under five and households with at least one child under two years of age

Province	Children under five years	Households with child under two years
ARoB	161	52
East Sepik	198	70
Madang	327	101
West Sepik	210	68
Total	896	291

This study analysed the relationship between independent variables (sociodemographic characteristics of household heads and mothers) and the application of selected EHIs for pregnant women and newborns derived from the IFPRI dataset (Table 5.2 in the IFPRI report – Schmidt et al., 2019).

3.4.2 Data treatment

The data were exported electronically from Excel into IBM SPSS Statistics for Windows, (Version 25.0). Data cleaning and checking were conducted. As this study focused on EHIs related to the antenatal and perinatal periods, it was necessary to extract specific survey records for households with children under two years of age. This was because the IFPRI study had collected detailed data on the ANC, SBP delivery support and early initiation of breastfeeding for children less than two years old.

3.4.3 Missing data

In the initial dataset, all variables had one or more missing values. As the initial IFPRI research was prospective, missing data were not expected. Because the original records could not be obtained to confirm the missing data, these were viewed as missing not at random (MNAR). Pairwise exclusion of missing data was applied. This ensured that even if data for one variable was missing, the case could be used to analyse other variables where values were not missing.

3.4.4 Coding technique

All independent and dependent variables were recoded. The eight original household head age categories were collapsed into two categories: 36 years and below, and over 36 years. The household heads' and mothers' primary activity data were also collapsed into two categories: agriculture and non-agricultural activities. Both household heads' and mothers' education were recoded into three categories: attended primary school, attended post-primary school, and did not go to school. The literacy of household heads

and mothers were grouped into two: could read texts and could not read or read with difficulty.

For the dependent variables, the ANC visits were categorised into four cases: no visits, one visit, two visits, and three visits. Two categories were formed in the delivery variable: SBPs and non-SBPs. Initiation of breastfeeding was categorised into: less than one hour, 1-24 hours, and more than 24 hours (Table 8).

Table 8. Variable labels and coding in SPSS software

Variable Type	Variable Name	Variable Label	Coding Instruction
Dependent Variables	ANC Visits	Antenatal care visits	0=No visit, 1=ANC visit 1, 2=ANC visit 2, 3=ANC visit 3
	SBP & NSBP	Delivery by skilled birth provider (SBP) and non-skilled birth provider (NSBP)	1= SBP 2= NSBP
	Breastfeeding	Initiation of breastfeeding within 1 hour of delivery	1=less than 1 hr, 2=1-24 hrs, 3=more than 24 hrs
Independent Variables	Province	Province	Four provinces
	Age	Age	Age in years
	Gender	Gender	1=Male, 2=Female
	Occupation	Primary Activity	1=Agriculture, 2=Non-agricultural activities
	Education	Highest Education	1=Primary school, 2=Post-primary, 3=Did not go to school
	Literacy	Literacy level	1=Could read text (Yes), 2=Could not read text or read with difficulty

3.5 Ethical considerations

It was unnecessary to obtain ethical approval as this study analysed secondary data in an open-access IFPRI dataset hosted on Harvard University's Dataverse site (Crosas, 2018). The IFPRI principal investigator also confirmed the availability of the open-access dataset to conduct the secondary analysis for this current research.

3.6 Chapter summary

Chapter 3 has described the rationale for utilising the IFPRI dataset. It has shown that the initial study's processes and methods were valid and appropriate for the current study's purpose. The research methodology for the IFPRI study and analysis of secondary data were described. The chapter also presented the research methodologies, measures, and protocols for both the original and present studies. The purpose of this research was accepted and verified upon checking the validity and reliability of the initial data.

Chapter 4: Findings

4.1 Chapter overview

This study sought to identify associations between parental sociodemographic characteristics and the application of EHIs for pregnant women and newborns in four lowland provinces of PNG. This study focused on three EHIs related to the antenatal and delivery period: the number of ANC visits undertaken, SBP support during delivery, and the early initiation of breastfeeding. The study objective was researched through four questions:

1. What were the sociodemographic attributes (gender, age, marital status, primary occupation, education, and literacy level) of the household heads in the IFPRI study?

2. What was the prevalence of selected essential health interventions applied for pregnant women and newborns (antenatal care, delivery with skilled birth attendant support and early initiation of breastfeeding), and how were these distributed between provinces?

3. What sociodemographic characteristics of household heads were associated with the application of selected essential health practices for pregnant women and newborns?

4. What sociodemographic attributes of mothers were associated with the application of selected essential health interventions for pregnant women and newborns?

The chapter begins by presenting baseline information for the household heads and mothers studied and their reported application of EHI practices. This includes frequencies (*n*) and percentages (*%*) as well as the range of values (minimum and maximum values). The chapter describes the application of EHIs across the four provinces and the associations between parental sociodemographic attributes and the EHIs under investigation. The chapter concludes by summarising the findings.

4.2 Baseline sociodemographic characteristics

4.2.1 Characteristics of household heads

Sociodemographic information was compiled for 291 household heads (Table 9). Of these, 261 (89.7%) were male, and 30 (10.3%) were female. Household head ages ranged from 25 to 60 years, with 170 (60.3%) below 36 years of age. Two hundred and twenty-six (77.7%) reported agriculture as their primary occupation, although 65 (22.3%) were engaged in other activities, including professional work, handcraft, and sales and services. Across both genders, most (*n*=172, 59.1%) had attended primary school, although fewer than one-third (*n*=92, 31.6%) reported post-primary education. Two

hundred and nine household heads (71.8%) could read a simple prepared text. The household heads surveyed were located in four provinces, ranging from 52 (17.9%) in the ARoB to 101 (34.7%) situated in Madang province.

Table 9. Sociodemographic characteristics of household heads

Characteristics of Household Heads		Frequency (N)	Percentage (%)
Province			
	Autonomous Region of Bougainville	52	17.9
	East Sepik Province	70	24.1
	Madang Province	101	34.7
	West Sepik (Sandaun) Province	68	23.4
Gender			
	Male	261	89.7
	Female	30	10.3
Age			
	Below 36 years old	170	58.4
	36 years old and over	113	38.8
	Not reported	8	2.7
Occupation			
	Agriculture	226	77.7
	Non-Agriculture	65	22.3
Education			
	Did not go to school	27	9.3
	Primary School	172	59.1
	Post-Primary School	92	31.6
Literacy			
	Could read text	209	71.8
	Could not read text or only with difficulty	82	28.2

4.2.2 Sociodemographic characteristics of mothers

Sociodemographic information was available for 291 mothers of children under two years of age. Of these, 261 were the wives of the household heads, while 30 were single. Table 10 summarises the key characteristics of the mothers surveyed. Two hundred and thirty (79%) were younger than 36 years of age, with 199 (68.4%) primarily involved in agriculture. Fifty-one (17.5%) had not attended any school, with only 181 (62.2%) attending primary school. Of the mothers surveyed, 176 (60.5%) were able to read a simple prepared text.

Of the 30 mothers who were also household heads, a higher percentage (*n*=8, 26.7%) had attended post-primary school compared with other mothers (*n*=59, 20.3%) and could read a simple text (*n*=20, 66.7%) compared with mothers who were partnered *(n*=176, 60.5%).

Table 10. Mothers' sociodemographic characteristics

Mothers' Characteristics		Frequency (N)	Percentage (%)
Age			
	Below 36 years old	230	79
	36 years old and over	55	18.9
	Not reported	6	2.1
Occupation			
	Agriculture	199	68.4
	non-agriculture	92	31.6
Education			
	Did not go to school	51	17.5
	Primary school	181	62.2
	Post-primary school	59	20.3
Literacy			
	Could read text	176	60.5
	Could not read text or only with difficulty	115	39.5

4.3 Provincial application of EHI practices

Survey data showed an equal application of EHIs for the households included in the four provinces (Table 11). This was reflected in households from ARoB consistently showing more favourable results for ANC visits and SBP support at delivery compared with other provinces.

4.3.1 Antenatal care

Only 40 (13.8%) of all mothers reported three ANC visits, with 31 (77.5%) of these high ANC attendees residing in ARoB. The majority of mothers (n=167, 57.6 %) could recall only one visit, with 45 (15.5%) not reporting any visit at all. ARoB mothers' ANC attendance contrasted markedly with East Sepik, where no mothers reported three ANC visits, and Madang, where only one mother reported three ANC visits. In Madang, 23 (22%), and in East Sepik, 14 (20.3%) mothers reported no ANC visits at all. In comparison, 100% (*n*= 52) of ARoB mothers reported at least one ANC visit.

A statistically significant difference was shown in ANC visits across the four provinces, X^2 (9, *n*=291)=134.605, p<.0001.

Table 11. Number of antenatal care visits by province

Province		No visits	One visit	Two visits	Three visits	Total
ARoB	Frequency (*n*)	0	12	9	31	52
	Percentage (%)	0.0	23.1	17.3	59.6	100.0
East Sepik	Frequency (*n*)	14	49	6	0	69
	Percentage (%)	20.3	71.0	8.7	0.0	100.0
Madang	Frequency (*n*)	23	68	9	1	101
	Percentage (%)	22.8	67.3	8.9	1.0	100.0
West Sepik	Frequency (*n*)	8	38	14	8	68
(Sandaun)	Percentage (%)	11.8	55.9	20.6	11.8	100.0
Total	Frequency (*n*)	45	167	38	40	290*
	Percentage (%)	15.5	57.6	13.1	13.8	100.0

Note. *1 questionnaire is missing data.

4.3.2 Skilled birth provider support during delivery

Consistent with PNG's high levels of maternal mortality (Robbers et al., 2019), results showed that 152 (52.2%) of births were not supported by an SBP such as a doctor, midwife, or auxiliary nurse (WHO, 2019b). Many of these births were attended by friends/relatives (*n*=106, 36.4%) or traditional birth attendants (*n*=33, 11.3%).

Fifty-one (98.1%) of ARoB mothers reported that their deliveries were supported by an SBP, such as a doctor, midwife, or auxiliary nurse, as indicated in Table 12. Only 18 (26.5%) mothers from West Sepik reported that SBPs supported their deliveries, with 50 (73.5%) births in this province attended by non-SBPs. In Madang and East Sepik, 63 (62.4%) and 38 (54.3%) mothers also reported delivery support by non-skilled providers.

Table 12. Skilled birth provider support at delivery by provincial location

Province		Skilled birth providers	Non-skilled birth providers	Total
ARoB	Frequency (*n*)	51	1	52
	Percentage (%)	98.1	1.9	100.0
East Sepik	Frequency *(n*)	32	38	70
	Percentage (%)	45.7	54.3	100.0
Madang	Frequency (*n*)	38	63	101
	Percentage (%)	37.6	62.4	100.0
West Sepik	Frequency (*n*)	18	50	68
(Sandaun)	Percentage (%)	26.5	73.5	100.0
Total	Frequency (*n*)	139	152	291
	Percentage (%)	47.8	52.2	100.0

A statistically significant difference was shown in SBP delivery support between provinces, X^2 (3, *n*=291)=69.4, p<.001.

4.3.3 Early initiation of breastfeeding by provincial location

Chi-squared tests of independence showed no significant association between provincial location and the early initiation of breastfeeding, X^2 (6, *n*=291)=151.8, p<.001. The majority of mothers (*n*=179, 63.5%) reported initiating early breastfeeding after delivery, with a further 82 (29.1%) commencing breastfeeding within 24 hours of delivery.

4.4 Household head characteristics in relation to EHI practices

This study sought to investigate the relationship between household head characteristics and EHI practices for pregnant women and newborns.

4.4.1 Household head education level and skilled birth provider delivery support

The household head's level of education was found to be statistically significant in relation to an SBP being present at delivery, X^2 (2, *n*=291) = 8.8, p<.05. Table 13 shows that 59.8% (*n*=55) of deliveries were attended by SBPs when the household heads had post-primary education. This contrasted with only 43.6% (*n*=75) and 33.3% (*n*=9) of deliveries taking place with SBP support when the household heads had only attended primary school or had no formal education.

Table 13. Household head education level in relation to skilled birth provider delivery support

Household Head Education		Skilled birth providers	Non-skilled birth providers	Total
Did not go to school	Frequency (*n*)	9	18	27
	Percentage (%)	33.3	66.7	100.0
Primary School	Frequency (*n*)	75	97	172
	Percentage (%)	43.6	56.4	100.0
Post-Primary School	Frequency (*n*)	55	37	92
	Percentage (%)	59.8	40.2	100.0
Total	Frequency (*n*)	139	152	291
	Percentage (%)	47.8	52.2	100.0

4.4.2 Household head literacy in relation to mothers' antenatal care visits

Household head literacy was positively associated with the number of ANC visits by mothers during pregnancy, X^2 (3, *n*=290)=11.5, p<.01. Table 14 shows that 16.8% (*n*=35) of mothers made three ANC visits when the household head could read a simple text, compared with only 6.1% (*n*=5) when the household head was non-literate. Results also show that 23.2 % (*n*=19) of mothers did not access an ANC visit when the household head had limited or no literacy, compared with 12.5% (*n*=26) of mothers who did not access an ANC visit when the household head could read.

Table 14. Household heads' literacy in relation to antenatal care visit.

Household Head Literacy Level		No ANC visits	One visit	Two visits	Three visits	Total visits
Could read text	Frequency (*n*)	26	116	31	35	208
	Percentage (%)	12.5	55.8	14.9	16.8	100.0
Could not read text or read with difficulty	Frequency (*n*)	19	51	7	5	82
	Percentage (%)	23.2	62.2	8.5	6.1	100.0
Total	Frequency (*n*)	45	167	38	40	290*
	Percentage (%)	15.5	57.6	13.1	13.8	100.0

Note *1 questionnaire is missing data.

4.5 Mothers' characteristics in relation to essential health intervention practices

The study also investigated the relationship between mothers ' characteristics and their EHI practices, recognising the important role that mothers' education and socio-economic status play in promoting child health.

4.5.1 Mothers' education in relation to antenatal care visits and skilled birth provider delivery support

Mothers' levels of education were also positively associated with the number of antenatal care visits they made, X^2 (6, *n*=290) = 20.6, p<.01. Table 15 shows that 15 (25.4%) of mothers with post-primary education accessed three ANC visits. This contrasted with 22 (12.2%) mothers with only primary education and 3 (6.0%) mothers who had never attended school.

Results also reinforced the important role that mothers' post-primary education plays in ANC. Only 3 (5.1%) mothers with post-primary education did not attend ANC while 27 (14.9%) mothers with primary education and 15 (30.0%) mothers with no education did not undertake a single ANC visit. Altogether, only 78 (26.9%) of all mothers surveyed accessed more than one ANC visit.

Table 15. Mothers' education level in relation to antenatal care visits

Education of Mother		No ANC visits	One visit	Two visits	Three visits	Total visits
Did not go to	Frequency (*n*)	15	27	5	3	50
school	Percentage (%)	30.0	54.0	10.0	6.0	100.0
Primary school	Frequency (*n*)	27	105	27	22	181
	Percentage (%)	14.9	58.0	14.9	12.2	100.0
Post-primary	Frequency (*n*)	3	35	6	15	59
school	Percentage (%)	5.1	59.3	10.2	25.4	100.0
Total	Frequency (*n*)	45	167	38	40	290*
	Percentage (%)	15.5	57.6	13.1	13.8	100.0

Note *1 questionnaire is missing data.

Mothers' education levels were also found to be statistically significant in relation to SBP support, X^2 (2, *n*=291)=27.0, p<.001 (Table 16). Forty-two (71.2%) mothers with post-primary education were supported by SBP during delivery compared to 86 (47.5%) of mothers who had only attended primary school and 11 (21.6%) of mothers with no formal education. In contrast, 40 (78.6%) of mothers who had never been to school were

assisted by non-SBPs compared with 95 (52.5%) and 17 (28.6%) of mothers who had primary and post-primary education, respectively.

Table 16. Education of mother in relation to skilled birth provider delivery support

Education of Mother		Skilled birth providers	Non-skilled birth providers	Total
Did not go to school	Frequency (*n*)	11	40	51
	Percentage (%)	21.6	78.4	100.0
Primary school	Frequency (*n*)	86	95	181
	Percentage (%)	47.5	52.5	100.0
Post-primary school	Frequency (*n*)	42	17	59
	Percentage (%)	71.2	28.8	100.0
Total	Frequency (*n*)	139	152	291
	Percentage (%)	47.8	52.2	100.0

4.5.2 Mothers' literacy in relation to antenatal care visits and skilled birth provider delivery support

Consistent with the household head attributes findings, mothers' literacy levels were positively associated with the number of antenatal visits made, X^2 (3, *n*=290)=12.9, p<.01. Table 17 shows that 31 (17.6%) mothers who could read a simple text made three ANC visits, compared with only 9 (7.9%) mothers who were not literate. While 27 (23.7%) of non-literate mothers did not make a single ANC visit, this non-attendance fell to 18 (10.2%) for those who could read.

Table 17. Mothers' literacy in relation to the number of antenatal care visits made

Literacy of Mother		No visits	One visit	Two visits	Three visits	Total visits
Could read text	Frequency (*n*)	18	103	24	31	176
	Percentage (%)	10.2	58.5	13.6	17.6	100.0
Could not read text or read with difficulty	Frequency (*n*)	27	64	14	9	114
	Percentage (%)	23.7	56.1	12.3	7.9	100.0
Total	Frequency (*n*)	45	167	38	40	290*
	Percentage (%)	15.5	57.6	13.1	13.8	100.0

Note *1 questionnaire is missing data.

Mothers' literacy was also positively associated with skilled delivery support. A chi-squared test for independence showed a statistically significant relationship between mothers' literacy and SBP assistance, X^2 (1, *n*=291)=24.1, p<.001. This was shown by the high percentage (*n*=105, 59.7%) of literate mothers reporting the presence of an SBP

at delivery, compared with only 29.6% (*n*=34) for non-literate mothers. Of the 115 mothers who could not read, 81 (70.4%) were assisted by non-SBPs. This contrasted with 71 (40.3%) literate mothers who did not have SBP assistance.

Table 18. Mother's literacy in relation to skilled birth provider delivery support

Literacy of Mother		Skilled birth providers	Non-skilled birth providers	Total
Could read text	Frequency (*n*)	105	71	176
	Percentage (%)	59.7	40.3	100.0
Could not read text or read with difficulty	Frequency (*n*)	34	81	115
	Percentage (%)	29.6	70.4	100.0
Total	Frequency (*n*)	139	152	291
	Percentage (%)	47.8	52.2	100.0

4.5.3 Mothers' occupation in relation to early initiation of breastfeeding

Mothers' occupations or primary activities within agriculture were positively associated with the early initiation of breastfeeding within an hour of delivery, X^2 (2, *n*=282)=15.8, p<.001. Table 19 shows that 71.1% (*n*=138) of mothers whose primary occupation was agriculture initiated breastfeeding within one hour of delivery, compared with less than half of the mothers involved in other occupations (*n*=41, 46.6%). However, these differences were less evident in the following 23 hours, with a further 80.3% (*n*= 45) of mothers involved in agriculture and 78.7% (*n*=37) of those engaged in other activities commencing breastfeeding within one day of childbirth.

Table 19. Occupation of mother in relation to early initiation of breastfeeding after delivery

Occupation of Mother		Breastfed in less than 1 hour	Breastfed in 1-24 hours	Breastfed begun after 24 hours	Total
Agriculture	Frequency (*n*)	138	45	11	194
	Percentage (%)	71.1	23.2	5.7	100.0
Non-Agriculture	Frequency (*n*)	41	37	10	88
	Percentage (%)	46.6	42.0	11.4	100.0
Total	Frequency (*n*)	179	82	21	282*
	Percentage (%)	63.5	29.1	7.4	100.0

Note. *9 questionnaires are missing data.

4.6 Summarised findings

Study results show that the profile of household heads was primarily male (*n*=261, 89.6%), under 36 years of age (*n*=170, 58.4%) and engaged in agriculture (*n*=226, 77.7%). More than 90% had attended primary or post-primary education, and 71.8% (*n*=209) were literate.

The mothers surveyed were younger than household heads, with 230 (79%) under 36 years of age; 10% fewer had a formal education compared to household heads, with 82.5% (*n*=240) of mothers having at least a primary or post-primary education. Mothers' literacy levels were also lower, with 60.5% (*n*=176) being able to read.

Results revealed differences in the provincial distribution of EHI practices. There were statistically significant differences between provincial locations in relation to the number of ANC visits mothers reported. These differences were especially marked between ARoB, where 59.6% (*n*=52) of mothers made three ANC visits, and Madang, where only one mother (1%) made three ANC visits. In East Sepik, none of the 70 study mothers made three ANC visits.

Provincial location was also shown to be statistically significant in relation to the presence of an SBP during delivery. In ARoB, 98% (*n*=51) of all deliveries were supported by SBPs, compared to 26.5% (*n*=18) in West Sepik and 37.6% (*n*=38) in Madang.

Results on the relationship between the household heads' characteristics and EHI practices showed that two attributes were statistically significant: level of education to SBP delivery support ($p<.05$), and literacy to the number of antenatal visits made ($p<.01$). Findings revealed that 59.8% (*n*=55) of deliveries were attended by SBPs when the household heads had post-primary education. This contrasted with only 43.6% (*n*=75) and 33.3% (*n*=9) of deliveries with SBP support when the household heads had only attended primary school or had no formal education. Household head literacy was also positively associated with the number of antenatal visits made, with 23.2% (*n*=9) of mothers not making a single ANC visit when the household head could not read. Antenatal non-attendance was reduced to 12.5% (*n*=26) when the household head was literate.

Findings on the relationship between mothers' characteristics and EHI practices showed that education, literacy level and primary occupation were statistically significant. The level of education was again positively associated with the number of ANC visits made ($p<.01$). Fifteen (25.4%) mothers who had post-primary education had three ANC visits, compared to 22 (12.2%) mothers who had primary education, and 3 (6.0%) mothers who never attended school. Mothers' education was also statistically significant in relation to

SBP delivery support (p<.001). Forty-two (71.2%) mothers with post-primary education were supported by SBPs during delivery compared with 86 (47.5%) mothers who had only attended primary school, and 11 (21.6%) mothers with no formal education.

Results showed that mothers' literacy levels were statistically significant in relation to both ANC visits (p<.01) and SBP delivery support (p<.001). Thirty-one (17.6%) mothers who could read a simple text made three ANC visits, compared with only 9 (7.9%) mothers who were non-literate. Findings also revealed a high percentage (*n*=105, 59.7%) of literate mothers reporting the presence of an SBP at delivery, compared with only 29.6% (*n*=34) for non-literate mothers.

Study results revealed mothers' primary occupation to be statistically significant to the early initiation of breastfeeding (p<.001). eThe majority,138 (71%), of mothers who worked in agriculture initiating breastfeeding within the first hour, compared to 41 (47%) of mothers who were engaged in the non-agriculture sector.

4.7 Chapter summary

This chapter described the sociodemographic attributes of the household heads and mothers with children less than two years of age, including gender, age, marital status, primary occupation, education, and literacy level. It highlighted the prevalence of selected EHIs, specifically ANC visits, delivery with skilled birth attendant support and early initiation of breastfeeding, and how these practices were distributed between provinces. The chapter described the relationship between parental sociodemographic attributes and the application of selected essential health practices for pregnant women and newborns. It concluded with a summary of key findings.

Chapter 5: Discussion and Conclusion

5.1 Chapter introduction

This research aimed to strengthen understanding of the application of specific EHIs to maternal and newborn health for four lowland provinces of PNG. Drawing on secondary data collected by the IFRI (Schmidt et al., 2019), the study investigated whether parental sociodemographic characteristics were associated with the implementation of EHI practices in these areas.

This chapter examines the study findings in relation to the four main research questions. It discusses the study's strengths, limitations and challenges, and concludes by highlighting theimplications for health service development and research in PNG.

5.2 Sociodemographic attributes of household heads and mothers

In this study, 261 (89.7%) household heads were males, and 30 (10.3%) were females. 170 (60.3%) were below 36 years of age, with 226 (77.7%) reporting agriculture as their primary occupation. While most (*n*=209, 71.8%) were literate and had attended primary school (*n*=172, 59.2%), less than one-third (*n*=92, 31.6%) reported post-primary education. These educational attainment results were higher than those reported for the Momase region in PNG's DHS 2016-2018 (NSO, 2019). The DHS assessment reported only 38.9% of men aged 15-49 have some primary education and 20.3% have secondary education (NSO, 2019). Household head literacy findings of 71.8% (*n*=209) aligned more closely with DHS results, with 83.1% male literacy reported for the Momase region and 90% for ARoB (NSO, 2019).

Mothers in this research were younger than the household heads, with 230 (79%) less than 36 years of age. Most of the mothers (*n*=181, 62.2%) had attended primary school and could read a text (*n*=176, 60.5%). These results were also higher than those reported in the DHS, where only 39% (Momase region) and 45% (ARoB) of women aged 15-49 had attended primary school (NSO, 2019). However, higher levels of female primary educational attainment did not translate into increased literacy capabilities. While the national DHS reported that 69% and 88% of women from the Momase region and ARoB were literate (NSO, 2019), this study's results showed 60.5% could read a simple text.

The diverging results between the IFPRI and national DHS results reflect differences in the research methodologies used, especially in relation to their respective sampling approaches. The IFPRI study focused on several distinct sub-province administrative units in each province, while the DHS sampled households across entire provinces.

5.3 Essential health interventions: prevalence and provincial distribution

5.3.1 Prevalence of antenatal care, skilled birth provider support, and breastfeeding

Study findings for two crucial EHIs, ANC and SBP support, showed their low application compared to PNG's national rates. In this research, only 13.7% (*n*=40) of women recalled three ANC visits, compared with 47% of rural women who reported making four ANC visits in the DHS (NSO, 2019). These results also fall below global ANC rates, where 59% of pregnant women made at least four ANC visits (WHO, 2016b).

In this study, the level of SBP delivery support was broadly consistent with national findings but fell well below global rates. Study findings on skilled delivery assistance showed that 47.8% of all deliveries were assisted by a formally qualified birth provider, compared with national estimates of 53% for rural areas and 87% for urban settings (NSO, 2019). Levels of SBP support were also much lower than the 83% global rate arising from reports that SBPs attended 90% of all urban deliveries and 70% of rural births (WHO, 2020b).

Concerning the early initiation of breastfeeding, findings showed that 63.5% (*n*=179) of mothers commenced breastfeeding within an hour of delivery, compared with 53% nationwide (NSO, 2019) and 43% globally (WHO, 2019b). These results align favourably with the 2030 global target of 70% early breastfeeding (WHO, 2019b).

5.3.2 Essential health interventions: Provincial distribution

Study findings also revealed the uneven distribution of EHI practice across the four provinces. Provincial location was found to be statistically significant (p<.001) in the number of ANC visits made, with the majority (*n*=31, 77.5%) of mothers who attended three ANC visits being located in ARoB. While 100% (*n*=52) of all ARoB mothers made at least one ANC visit, in East Sepik, 22% (*n*=23) and Madang, 20.3% (*n*=14) mothers reported no ANC visits at all.

Provincial residence was also statistically significant (p<.001) in findings on SBP presence at delivery, with almost all (*n*=51, 98.1%) ARoB mothers reporting support from a qualified birth provider. In contrast, most deliveries in East Sepik, Madang and West Sepik provinces were supported by non-SBPs, such as friends or relatives (*n*=106, 36.4%) or traditional birth attendants (n=33, 11.3%). This ranged from 54.3% (*n*=38) in East Sepik, 62.4% (*n*=63) in Madang to 73.5% (n=50) in West Sepik.

However, while this study's results showed that SBP support in the Momase provinces ranged from 26.5% (*n*=18) in West Sepik to 45.7% (*n*=32) in Madang, these findings

were lower than those reported by the DHS, where 60.4% and 65.8% of all births in West Sepik and Madang respectively had SBP assistance (NSO, 2019).

These contrasting results between the IFPRI and the national DHS results could reflect differences in the research methodologies used. This particularly applies to their respective sampling approaches and spatial scales in a rural PNG context, characterised by diverse but geographically scattered settlements.

However, the low levels of ANC attendance and SBP support reported in this study are consistent with research by Robbers et al. (2019) and Schmidt et al. (2020) where limited road access was identified as a major obstacle for accessing EHIs in West Sepik, highlighting the numerous geographical and logistical challenges in providing EHIs to PNG's remote rural districts and communities (Grundy et al., 2019). In the context of this study, Schmidt et al. (2021) described these challenges for women living in Middle Ramu district in Madang province. Here, women were required to travel for up to eight hours by canoes and dinghies to reach a health facility or walk for up to four days to access health care. Such logistical obstacles pose significant barriers to ANC and access to SBP support.

5.4 Sociodemographic attributes of household heads and EHI practices

PNG society is characterised by patriarchal power relations that define women's access to essential services, including health care (Peake & Spark, 2021). Recognising that 89% (*n*=260) of the household heads in this study were male, the research sought to identify and examine household head characteristics in relation to three crucial EHIs: ANC, SBP presence at delivery and early initiation of breastfeeding. The attributes specifically investigated were gender, age, marital status, education level, literacy, and primary occupation.

Of these attributes, the household head education level was found to be statistically significant ($p<.05$) in relation to SBP attendance at delivery. Study findings showed that 59.8% (*n*=55) of deliveries were attended by SBPs when the household heads had received post-primary education. This percentage of SBP support declined to 43.6% (*n*=75) and 33.3% (*n*=9), respectively, when household heads had only received primary education or had never attended school.

Household head literacy was also statistically significant ($p<.01$) in relation to the number of ANC visits made, with 23.2% (*n*=9) of pregnant women not making any ANC visits when their partner could not read.

These findings resonate with insights from an earlier study in PNG's Mendi district on male involvement in reproductive health (Kura et al., 2013). This found that male literacy

was positively associated with sexual and reproductive health knowledge. In the Mendi research, male literacy was also statistically significant for mothers' attendance at ANC clinics ($p<.0001$) and delivery at a health facility ($p<.001$) (Kura et al., 2013). Such results are consistent with findings on the role of partner education and literacy in advancing ANC and SBP support from countries such as Ghana (Saah et al., 2019) and research on the role that parental education and literacy play in promoting ANC, delivery at a facility and breastfeeding practices (Adjiwanou et al., 2018).

5.5 Sociodemographic attributes of mothers to EHI practices

Study findings on mothers' characteristics broadly aligned with those of the household heads. These showed that mothers' education, literacy level and primary occupation were positively related to at least one essential health practice.

Mothers' education level was statistically significant ($p<.01$) in relation to the number of ANC visits made, as well as SBP delivery support ($p<.001$). Results show that mothers with post-primary education (*n*=15, 25.4%) reported three ANC visits, compared with more mothers with post-primary education (*n*=22, 12.2%) or those who had never attended school (*n*=3, 6%). Forty-two (71.2%) mothers with post-primary education also reported SBP delivery support, compared with 86 (47.5%) who had only attended primary school and 11 (21.6%) mothers with no formal education.

Results also showed that mothers' literacy was statistically significant in relation to ANC visits ($p<.01$) and SBP delivery support ($p<.001$). Findings showed that 17.6% (*n*=31) of mothers who could read a simple text made three ANC visits, compared with only 7.9% (*n*=9) of mothers who were not literate. In parallel, 59.7% (*n*=105) of literate mothers reported the presence of an SBP at delivery compared with only 29.6% (*n*=34) for mothers who could not read.

These results resonate with research at global, national, and local levels. In their global study of 175 countries between 1970 and 2009, Mensch et al. (2021) showed that increased years of maternal formal schooling significantly reduced child mortality. They also reinforce results on the role of maternal formal education in promoting the importance of antenatal clinics (Adjiwanou et al., 2018; Duodu et al., 2022) and SBP support in Asia and Southeast Asia (Bhowmik et al., 2020).

In addition, the study's findings revealed mothers' primary occupation to be statistically significant in relation to early initiation of breastfeeding ($p<.001$). This was shown by the 138 (71%) mothers who worked in agriculture initiating breastfeeding within the first hour, compared with 41 (47%) mothers who were engaged in the non-agriculture sector.

5.6 Conclusion

5.6.1 Revisiting aims and objectives

The importance of understanding how sociodemographic attributes influence the application of EHIs for children under two years of age is a priority focus for WHO's updated *Global Strategy for Women's Children's and Adolescent's Health (2016-2030)* (WHO, 2015). While it was understood that their actual implementation might vary between countries, EHIs were considered crucial for addressing significant causes of morbidity and mortality for women, children, and adolescents (WHO, 2015). In this context, UNICEF reported that PNG "remains one of the poorest performing countries" in its East Asia Pacific Region (UNICEF, 2020a, p. 1). This is evidenced by a life-time maternal mortality risk that is eight times higher in PNG than elsewhere in the East Asia Pacific region. It is also reflected in marked urban–rural disparities in under five health, with children in rural areas being twice as likely to die before age five than their peers in urban centres (UNICEF, 2020a).

While these persisting health challenges facing children in rural areas are well-documented in PNG (UNICEF, 2016b), there has been limited focused research on the parental sociodemographic characteristics and newborn EHIs in PNG's lowland areas. Through the analysis of the secondary data gathered by IFPRI in the lowland provinces of Madang, East Sepik, West Sepik and ARoB; this study has examined the role that household heads' and mothers' characteristics play in advancing the key EHI practices of ANC, SBP delivery support and early initiation of breastfeeding. It identified that the provincial location was statistically significant in relation to the number of ANC visits made ($p<.0001$) and SBP delivery assistance ($p<.001$). The study also revealed the importance of household head education and literacy. Higher education levels were positively associated SBP support ($p<.05$), while household head literacy was positively related to the number of ANC visits made ($p<0.009$).

The mothers' level of education was found to be statistically significant for both the number of ANC visits made ($p<.01$) and SBP assistance ($p<.001$). At the same time, maternal literacy was positively related to the number of ANC visits made ($p<.01$) and SBP support ($p<.001$). Mothers' primary occupation was also found to be statistically significant in relation to the early initiation of breastfeeding ($p<.001$), with the majority of mothers working in agriculture (n=138, 71%) initiating breastfeeding within an hour of birth.

5.6.2 Study strengths

This research showed several strengths. The study used previously recorded data in an open-access IFPRI dataset to provide new insights on maternal and newborn health interventions in PNG. It may also be the first study in PNG to examine the relationship between household heads' and mothers' sociodemographic attributes and EHIs for pregnant women and newborns. It has revealed new knowledge on the role that fathers' education and literacy play in advancing ANC and SBP support in four PNG provinces.

5.6.3 Study limitations

This research also has limitations and constraints. The study used secondary data initially collected by IFPRI for the purpose of a rural household survey on food systems (Schmidt et al., 2019). This posed challenges for assessing the quality of the initial survey processes and methods. Fortunately, the principal investigator for the IFPRI study helped clarify these steps, which were also detailed in a comprehensive report (Schmidt et al., 2019) and another related publication (Schmidt et al., 2021).

The initial IFPRI study was undertaken in no more than two or three sub-province administrative units across the four provinces and applied a cluster sampling method. As a result, the original study researchers clearly stated that findings should not be considered nationally representative nor representative of the provinces researched. They specified, however, that their results provided useful insights on the livelihoods of rural households within a four-hour travel distance from the centre points of their survey sample clusters (Schmidt et al., 2019). This resulted in some of the current findings not aligning with province-wide data derived from PNG's DHS 2016-2018 (NSO, 2019). It was also not possible to access individual records from the dataset to complete any missing values for the 291 households. However, there were sufficient records to complete the analysis.

Lastly, given the different purposes of the IFPRI research and the current study, there were challenges in identifying appropriate EHIs within the IFPRI dataset. This resulted in outcome variables such as "fourth ANC visit" and "EBF for six months," both crucial EHIs, being removed from the analysis.

5.7 Study implications

5.7.1 Implications for health services in PNG

This study has various implications. First, it emphasises the value of secondary data analysis in examining the association between household heads' and mothers' sociodemographic characteristics and EHI practices for pregnant women and newborns.

It also underscores the crucial role that maternal education and literacy play in protective antenatal and newborn care for women in remote PNG settings. While these findings are well established in the global literature on maternal and child health (Neves et al., 2021; Sabates & Di Cesare, 2019), this study's results reinforce the importance of maternal post-primary education for strengthening ANC coverage and SBP support.

Furthermore, this research has highlighted the crucial but the under-researched role that male household heads play in enabling women's access to ANC and SBP support. It has also profiled research gaps in understanding how sociodemographic attributes such as male education and literacy can improve maternal and newborn health outcomes. Results also reinforce increasing health policy interest in the role of partners and fathers in advancing women's access to reproductive health services in the Pacific, including ANC and SBP support (Davis et al., 2016).

The present study's findings underline the benefit of a strengthened understanding in PNG of men's role in advancing maternal and newborn care, and the urgency of gaining such an understanding. This is given that there is limited research on this topic, despite the pressing need to improve maternal and child health in rural areas such as Madang, East Sepik, West Sepik and ARoB.

5.8 Chapter summary

This chapter discussed the study's findings in the context of existing literature and emphasised both the application and the research implications of these findings. It revisited the findings from four provinces of PNG that household heads' and mothers' sociodemographic attributes, emphasising the importance of education and literacy. The results of this study showed that education and literacy were the most influential factors in improving the application of EHIs, such as ANC visits, delivery of SBP support, and the initiation of breastfeeding within the first hour after delivery. These findings highlight the challenges to and the benefits of parental education and literacy in the application of EHIs for pregnant women and newborns in the four PNG provinces studied.

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Appendices

Appendix 1. PGR approval letter

29 September 2021

Princess John
96 Greenslade Crescent
Northcote
Auckland 0627

Dear Princess,

Thank you for submitting your PGR1 Research Proposal for the Master of Public Health.

Your proposal has been reviewed and approved by the Faculty of Health and Environmental Sciences, which will be noted at the Postgraduate Research Committee November 2021 meeting.

Your research details are:

Programme:	Master of Public Health
Paper enrolment:	HEAL901 Dissertation
Student ID:	1253049
Working title:	Sociodemographic determinants of essential health interventions and nutrition outcomes for young children in Papua New Guinea (PNG): A retrospective exploratory study of household survey data from four provinces of PNG
Primary supervisor:	Dr Ailsa Holloway
Secondary supervisor:	Dr Melanie Moylan
Start date:	12 July 2021
Expected completion date:	14 January 2022

For more information about the programme of study, please refer to the *Postgraduate Handbook*.

The AUT website for forms and handbooks is:
https://sdw.aut.ac.nz/postgraduate-research/pg-forms-policies-and-processes

Yours sincerely

Professor Susan Crowther
Acting Associate Dean Postgraduate Research · Hoa Mautaki Taura Rangahau
Faculty of Health and Environmental Sciences · Te Ara Hauora A Pūtaiao
Auckland University of Technology · Te Wānanga Aronui o Tāmaki Makau Rau
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Cc Primary supervisor Dr Ailsa Holloway

Appendix 2. Data dictionaries showing how the variables were measured

Appendix 2a. Data dictionary showing the key dependant variables and their definition by WHO and how these were described by the IFPRI researchers

Variable Name	Global Definition	Application from IFRI dataset
1.ANC		
1st visit	Confirmation of pregnancy and risk identification (WHO, 2016b).	NB: No specific activity indicated for the three visits.
2nd visit	Routine lab-tests and assessments of the unborn baby's growth (WHO, 2016b).	
3rd visit	Similar objectives for second visit, but also detect for multiple pregnancies (WHO, 2016b).	
2. Delivery with skilled birth attendant	Specialised health personals including doctors and midwives (WHO, 2018a).	Health personnel, doctor, nurse/midwife, auxiliary midwife who had assisted the delivery.
3. Early initiation of breastfeeding	Breastfeeding within 1 hr of delivery (WHO, 2018b).	At 1hr, 1-24hrs, > 24hrs of delivery where the mothers gave the first breastmilk.

Appendix 2b. Data dictionary indicating how the independent variables were assessed

Variables	Description	How assessed
Household head	The person in the house who is responsible for making decisions and earning income.	Especially the male or female irrespective of age.
Gender	Household head (HHH) gender: Male/Female	Either male or female who was the head of the family.
Age	HHH age breaks from 16-24; 25-35; 36-50; 51-64; over 64	Age was selected ranging from 16 years to over 64 who were the HHHs.
Provincial location	A place where a provincial capital is situated where most of the administrative activities are carried out.	Example, Wewak in East Sepik province, Vanimo in West Sepik province, while Madang is Madang and Arawa/Buka in ARoB
Mother	Is a female parent equivalent of a father.	Mothers who had children less than 2 years old.
Primary occupation	Primary activity of the HHH where this activity generates income for the household.	Example: weaving or crafting.
Education	Education level of the HHHs	Primary school included grade 6-10, secondary from 11-12, & tertiary education inclusive of universities & colleges.
Literacy	HHHs who can read and write	Those adults who had attended any courses on adult literacy & and able to read and write.