# Optimizing Care for Low Birth Weight Infants in Rural Malawi

The Harvard community has made this article openly available. **Please share** how this access benefits you. Your story matters

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Citable link</td>
<td><a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:17613732">http://nrs.harvard.edu/urn-3:HUL.InstRepos:17613732</a></td>
</tr>
<tr>
<td>Terms of Use</td>
<td>This article was downloaded from Harvard University’s DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at <a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA">http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA</a></td>
</tr>
</tbody>
</table>
OPTIMIZING CARE FOR LOW BIRTH WEIGHT INFANTS IN RURAL MALAWI

NOEL KALANGA

A Thesis Submitted to the Faculty of
The Harvard Medical School
in Partial Fulfillment of the Requirements
for the Degree of Master of Medical Sciences in Global Health Delivery
in the Department of Global Health and Social Medicine
Harvard University
Boston, Massachusetts.
May 2015
OPTIMIZING CARE FOR LOW BIRTH WEIGHT INFANTS IN RURAL MALAWI

Abstract

The aim of our study was to explore and understand the factors that affect growth of low birth weight (LBW) infants in a rural district of Neno in Malawi in order to optimize their care.

We surveyed 64 households of LBW infants born between April and June 2014. We collected quantitative data on socio-demographics and food security and performed nutrition and development assessments of the LBW infants at six months of age. We also conducted qualitative in-depth interviews with a subset of 10 mothers of the LBW infants and with 3 nurses at postnatal clinics. We then merged the quantitative and qualitative datasets for a final interpretation.

At six months of age, LBW infants were more likely to be underweight (mean weight-for-age Z-score -3.01±0.97) or stunted (mean height-for-age Z-score -2.45 ±1.34) than the WHO reference group. The majority (93.8%) of the households had moderate to severe food insecurity. Contributing factors to these poor outcomes included recurrent illness, resource scarcity and lack of social support. Most mothers opted for mixed feeding as a coping mechanism for the LBW infant’s slow growth. This mixed feeding without clean water and proper hygiene could even worsen the health outcomes of these infants.

Structural violence in poor households causes poor health outcomes of LBW infants. The responsibility of caring for LBW infants is so challenging because these children have so many unmet needs. Optimum care can be achieved with a variety of biosocial interventions.
Table of contents

List of Figures ................................................................................................................................ iv
List of Tables .................................................................................................................................. v
Acknowledgements ........................................................................................................................ vi
1. Introduction ................................................................................................................................... 1
2. Data and Methods ........................................................................................................................ 3
   2.1. Overall approach ..................................................................................................................... 3
   2.2. Setting and study population ................................................................................................... 4
   2.3. Quantitative measures ........................................................................................................... 5
   2.4. Qualitative assessments ........................................................................................................ 5
   2.5. Data analysis ......................................................................................................................... 6
3. Results .......................................................................................................................................... 7
   3.1. Quantitative findings ............................................................................................................. 8
   3.2. Qualitative findings ............................................................................................................... 13
4. Discussion ...................................................................................................................................... 20
5. Limitations .................................................................................................................................... 21
6. Conclusion ..................................................................................................................................... 25
7. References ..................................................................................................................................... 26
List of Figures

Figure 1: Research design showing both qualitative and quantitative aspects of the study .......... 3
Figure 2: Map of Neno district indicating all the health facilities .................................................. 5
Figure 3: Flow chart of number of identified participants .............................................................. 9
List of Tables

Table 1: Socio-demographic characteristics of the study participants.......................... 11

Table 2: Nutrition outcomes for LBW infants at the age of six months.......................... 12
Acknowledgements

This work was conducted with support from Students in the Master of Medical Sciences in Global Health Delivery program of Harvard Medical School Department of Global Health and Social Medicine and financial contributions from Harvard University and the Abundance Fund. The content is solely the responsibility of the author’s and does not necessarily represent the official views of Harvard University and its affiliated academic health care centers.

Special gratitude goes to my thesis advisor, Dr. Louise Ivers, for her continuous guidance through out the study period. I wish to sincerely thank Ann Miller, Sid Atwood, Sarah Anoke, Christina Lively, Jessica Teng and Hannah Gilbert for their technical support during the analysis and writing of this thesis.

I appreciate the local leadership of the Neno District Health Office (DHO) and Abwenzi Pa Za Umoyo /Partners In Health (APZU/PIH) for support during the study period. I also acknowledge the dedicated frontline service providers and the in-charges of the different health facilities providing care for the LBW infants. Most importantly I wish to extend the gratitude to all the participants in the study for sparing their precious time to talk to the research team.

To Joia Mukherjee and Paul Farmer, I am so grateful for giving me the opportunity to study my masters degree at Harvard University, and for the continuous words of wisdom.
1. Introduction

The World Health Organization (WHO) defines low birth weight (LBW) as weight at birth of less than 2,500 grams (5.5 pounds). This is based on epidemiological observations that infants weighing less than 2,500g are approximately 20 times more likely to die than heavier babies [1]. In addition, these infants also face an increased risk of malnutrition and neurodevelopmental delay when compared to normal birth weight infants [2].

LBW is a complex problem arising from bio-social-economic factors affecting the mother pre-conception and during pregnancy [3, 4, 5]. Because of these factors the burden of LBW is high in developing countries. Each year 20.6 million infants are born with LBW and 96.5% of these children live in developing countries [6].

In developed countries, most LBW infants attain normal anthropometric measurements within their first years of life and they continue to grow normally thereafter. However, in resource-poor countries most of these children do not attain their catch-up growth and remain stunted throughout childhood [7]. Studies done in Malawi showed that LBW infants were shorter and lighter throughout the whole infant period [8, 9].

Malawi is a landlocked country in southeastern Africa. It is one of the least developed and most densely populated countries in Africa. With an estimated population of 16 million, 80% live in rural areas and 61.6% live under USD 1.25 per day. Malawi’s economy depends on agriculture, which accounts for one-third of the Gross Domestic Product (GDP). With seasonal variations, the agricultural produce also varies according to time of the year. Most households have food during the first 4 months of the harvest period (April through July) and live with severe food insecurity for the rest of the year. Apart from agriculture, the country also relies
heavily on foreign aid from donors such as the International Monetary Fund (IMF), the World Bank, and individual countries. The donors provide over 65% of total health expenditures making Malawi’s health sector one of the most donor-dependent in the world [10, 11].

In Malawi, most interventions implemented to address LBW, malnutrition, and developmental delay either target expectant mothers or children after six months of age. Few interventions target children from birth to the age of six months, even though the period of birth to six months of age is a time of critical growth and development for children [10,11].

Currently, the standard of care in Malawi recommends that mothers exclusively breastfeed all infants from birth to the age of six months. However, only 71% of Malawian mothers follow this recommendation and complementary foods are introduced early [12].

Most studies done in this area have only managed to demonstrate increased morbidity, mortality, and poor growth and developmental outcomes among LBW infants but have not explored the reasons behind such poor outcomes [8, 9] We conducted this study to assess the factors associated with malnutrition and developmental delay amongst LBW infants, and specifically to understand the experiences from the perspectives of the mothers and nurses who take care of these infants. A deeper understanding of the various factors contributing to this issue would ensure better program design and implementation of care delivery value chain programs for LBW infants, and ultimately reduce the burden of morbidity, malnutrition and developmental problems in Malawi.
2. Data and Methods

2.1. Overall approach

We used both quantitative and qualitative research methods to answer the research question. We collected the two aspects of data concurrently, analyzed each data set separately, and finally merged the two sets of results to construct an overall interpretation.
2.2. Setting and study population

Neno district, Malawi

We conducted this study from October 2014 to March 2015 in an impoverished rural district of Neno southwest of Malawi. Neno’s population of 130,000 is among the country’s most economically vulnerable and isolated, facing the most severe topography of any district. These structural barriers conspire to prevent thousands, including LBW infants, from accessing needed health services.

Neno district has some of the highest prevalences of both stunting (54.6%) and underweight (24.7 %) compared to the national average of 47.1% and 12.8% respectively. The prevalence of LBW in the district (16.9%) is also higher than the national average (12.3%) [12]. There is no data available on child development in the district.

The list of participants who were recruited for the study was taken from the health registers at 2 hospitals and 7 health centers: Neno District Hospital, Lisungwi Community Hospital, Nsambe Health Center, Matandani Health Center, Neno Parish Health Center, Magaleta Health Center, Chifunga Health Centre, Luwani Health Center, and Matope Health Center. These facilities are fully equipped to conduct deliveries of babies and growth monitoring clinics for children under-five years of age.
2.3. Quantitative measures

From October to December 2014, we reviewed maternity registers from the nine hospitals and clinics in the district. From these registers, we recorded every LBW infant who had turned six months of age by the study enrollment date. This identified a cohort of low birth weight infants born in the months between April 2014 and June 2014.
We listed all names and gave them to the community health workers according to their respective communities to identify the homes of these infants. We traced 64 of 71 (90.1%) households of LBW infants that we had identified in the registers.

After consenting the mothers, we collected data about the infant, mother, and their household using a semi-structured questionnaire, which had six sections: a) birth history (such as the birth weight, gestation at birth, etc.); b) nutritional status of both the mother and the infant by measuring weight, height, and assessing for presence of edema; c) developmental growth of the infants assessing fine motor, gross motor, language, and social functions at six months; d) household socio-demographic background; e) household food security status; and f) infant feeding and medical history. Parts of the questionnaire were adapted from the validated data collecting instruments such as Malawi Developmental Assessment Tool [13] and Household Food Insecurity Access Scale (HFIAS) Measurement Tool [14].

2.4. Qualitative assessments

We used a purposeful sampling design, with the goal of systematically representing a variety of perspectives on the topic under study. In our purposeful sampling, we aimed to capture a wide range of perspectives such as place of delivery, age, and parity variations, in order to gain greater insights into the care of LBW infants by looking at the issue from multiple angles.

We selected a subset of 10 mothers of LBW infants from the total list of 64 and conducted qualitative in-depth interviews with each of these mothers in their homes at a time of their choosing. We used an interview guide with questions which explored what and how
the child eats, what challenges the mothers face with feeding practices, and what they would like to see happening differently.

We also conducted qualitative in-depth interview with three nurses who were selected from the clinics who had more experience with LBW deliveries. We asked questions related to their experience as they provided care to LBW infants, and what they thoughts could be improved in the LBW infants program. We conducted all interviews in the local language, Chichewa. We took notes and audio-recorded each interview session, which lasted approximately 60 minutes.

2.5. Data analysis

We entered quantitative data in Microsoft Excel and analyzed it with STATA version 11.2. We categorized households into different food security status groups by using a validated tool, Household Food Insecurity Access Scale (HFIAS), which provides a score based on the households’ exposure to insufficient quality and quantity of food, and anxiety related to uncertainty of food sources and availability. The actual formula and details of calculation are described elsewhere [14]. We categorized each household into three different categories: not or mildly food insecure, moderately food insecure, and severely food insecure.

For the outcome variables, we calculated Z-scores from WHO references for weight-for-age, weight-for-height, and height-for-age. We calculated the developmental scores for the LBW infants through a numerical scoring system applied to each of four domains of development and compared with the Malawi Developmental Assessment Tool (MDAT).
We examined the associations of exposure variables such as socio-demographic data and household food insecurity status with outcome variables such as anthropometric measurements for nutritional status Z-scores for weight-for-age.

We performed descriptive statistics to describe the socio-demographic characteristics of the respondents. We presented continuous variables as means and standard deviations (SD), and presented categorical data as frequencies and percentages. In addition, we used chi-square tests and t-tests to examine associations in the data. We used 95% confidence intervals and p-values to determine the significance of the results.

For our qualitative data, we transcribed the interviews in Chichewa and translated the data to English before analysis using grounded theory. Grounded theory refers to a set of systematic inductive and analytic approach for conducting qualitative research aimed toward theory development. We created a codebook and categorized similar codes to identify common themes described by the mothers and nurses about their experiences caring for LBW infants.

3. Results

3.1. Quantitative findings

A total of 593 facility-based deliveries had occurred during the months of April, May and June 2014. We identified 71 documented LBW infants from the maternity registers and managed to trace 56 (79%) of them to their homes. We were unable to find 7 (10 %), and 8 (11%) were reported dead by the time we started data collection. All infant deaths, except for one, had occurred within the first two weeks after birth. We were unable to ascertain the real causes of deaths but all the participants stated some febrile illness as the cause.
Figure 3: Flow chart of number of identified participants

- Total number of facility-based deliveries (n = 593)
  - Birth weights not documented (n = 86)
    - Fully documented birth weights (n = 507)
      - Normal birth weight (n = 436)
        - LBW infants identified from the maternity registers (n = 71)
          - Could not find (n = 7)
            - Households of low birth weight infants identified and surveyed (n = 64)
              - LBW infants reported dead (n = 8)
                - Nutrition and development assessment of low birth weight infants completed (n = 56)
                  - Qualitative in depth interviews with mothers of low birth weight infants (n = 10)
Social demographic characteristics of the study participants

Our low birth weight cohort was comprised of 33 males and 31 females. The mean birth weight of the infants was 1955g ±364.1g, ranging from 1000g to 2450g. Seven of the infants were born with very low birth weight (less than 1500g). The majority of the infants (64.1%) were born before 37 weeks gestation age. Most of the infants (53, or 82.8%) were born by spontaneous vaginal deliveries; 8 (12.5%) were delivered by caesarian section, and the other 3 were delivered by vacuum extraction. There were no twins in the group.

At the time of assessment, the average age of the 56 LBW infants was 6.2 months ± 0.3 months. They had a mean weight of 5430.3g ± 582g and an average height of 61.6 cm ± 2.7cm. Two of the infants had pitting edema of the feet consistent with protein energy malnutrition. In terms of feeding, only three of the infants had been exclusively breastfed to six months; the rest were given some complementary drinks or food such as water, tea or juice 53 (94.6%), infant formula five (8.9%), corn porridge or nsima (thick porridge) 39 (69.6%). Verbal affirmation from the mothers indicated that the following were the common infections that the infants had ever suffered: diarrhea 38 (67.9%), malaria 35 (62.5%), and pneumonia 21 (37.5%).

The following data summarizes the socio-demographic characteristics of the mother participants and their households.
<table>
<thead>
<tr>
<th>Mother's characteristics</th>
<th>$(N = 64)$</th>
<th>Households' characteristics</th>
<th>$(N = 64)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td>Gender of household head</td>
<td></td>
</tr>
<tr>
<td>$&lt; 20$</td>
<td>17 (26.6)</td>
<td>Male</td>
<td>54 (84.4)</td>
</tr>
<tr>
<td>$\geq 20 &lt; 30$</td>
<td>29 (45.3)</td>
<td>Female</td>
<td>10 (15.6)</td>
</tr>
<tr>
<td>$\geq 30$</td>
<td>18 (28.1)</td>
<td>Marital status of household head</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td></td>
<td>Separated/ divorced</td>
<td>4 (6.2)</td>
</tr>
<tr>
<td>$&lt; 150$</td>
<td>22 (34.4)</td>
<td>Married</td>
<td>53 (82.8)</td>
</tr>
<tr>
<td>$\geq 150 &lt; 155$</td>
<td>26 (40.6)</td>
<td>Widowed</td>
<td>7 (11)</td>
</tr>
<tr>
<td>$\geq 155$</td>
<td>16 (25)</td>
<td>Household size (people)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td></td>
<td>$&lt; 18.5$</td>
<td></td>
</tr>
<tr>
<td>$&lt; 18.5$</td>
<td>3 (4.7)</td>
<td>$\geq 5$</td>
<td></td>
</tr>
<tr>
<td>$18.5 &lt; 25$</td>
<td>61 (95.3)</td>
<td>Distance to the clinic (km)</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td>$&lt; 8$</td>
<td></td>
</tr>
<tr>
<td>Para 1</td>
<td>16 (25)</td>
<td>$\geq 8$</td>
<td></td>
</tr>
<tr>
<td>Para 2 - 4</td>
<td>33 (51.6)</td>
<td>Main source of food</td>
<td></td>
</tr>
<tr>
<td>Para $\geq 5$</td>
<td>15 (23.4)</td>
<td>Purchased food</td>
<td>38 (59.4)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td>Food aid</td>
<td>6 (9.4)</td>
</tr>
<tr>
<td>Single</td>
<td>7 (10.9)</td>
<td>Food for work</td>
<td>9 (14.1)</td>
</tr>
<tr>
<td>Married</td>
<td>47 (73.4)</td>
<td>Farm produce</td>
<td>11 (17.2)</td>
</tr>
<tr>
<td>Widowed</td>
<td>4 (6.3)</td>
<td>Food insecurity status</td>
<td></td>
</tr>
<tr>
<td>Separated</td>
<td>6 (9.4)</td>
<td>No/Mild</td>
<td>4 (6.2)</td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td>Moderate</td>
<td>11 (17.2)</td>
</tr>
<tr>
<td>Farming</td>
<td>14 (21.9)</td>
<td>Severe</td>
<td>49 (76.6)</td>
</tr>
<tr>
<td>Small business</td>
<td>16 (25)</td>
<td>Source of water</td>
<td></td>
</tr>
<tr>
<td>Casual labor</td>
<td>27 (42.2)</td>
<td>Unprotected well</td>
<td>23 (36)</td>
</tr>
<tr>
<td>Office work</td>
<td>7 (10.9)</td>
<td>River/ stream</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Highest education level</td>
<td></td>
<td>Borehole</td>
<td>37 (57.8)</td>
</tr>
<tr>
<td>Primary</td>
<td>52 (81.2)</td>
<td>Piped water</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Secondary</td>
<td>11 (17.2)</td>
<td>Type of toilet</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>1 (1.6)</td>
<td>Improved pit latrine</td>
<td>49 (76.6)</td>
</tr>
<tr>
<td>HIV status</td>
<td></td>
<td>No toilet</td>
<td>8 (12.5)</td>
</tr>
<tr>
<td>Negative</td>
<td>41 (64.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>8 (12.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>15 (23.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Socio-demographic characteristics of the study participants

**Nutrition outcomes**

At the age of 6 months, the majority (57.1%) of the LBW infants were moderately
underweight (weight-for-age Z score – 2SD) and more than a quarter (26.8%) were severely underweight (weight for age Z score – 3SD), with a mean Z-scores weight-for-age of -3.0 ± 0.97 standard deviation (SD). Most of the LBW infants were also stunted; 35.7% of LBW infants were moderately stunted (height-for-age below −2 SD), and 23.2% were severely stunted (height-for-age below −3 SD), with a mean height for age of -2.45 ±1.34 SD. Almost one-quarter (26.4%) of LBW infants were moderately wasted (below −2 SD weight-for-height) and 20.8% were severely wasted (below −3 SD Weight for height). The infants in this category had a mean weight-for-height of -1.64 ±1.75.

Data below compares the nutrition outcomes between male infants and female infants.

The major difference between the two groups was that the mean Z-scores weight for age for male infants, -3.52±0.81, was far less than that of female infants -2.45± 0.82. So too was the mean Z- scores height for age: -2.81± 1.45 for males versus 2.08 ± 1.13 for females.

<table>
<thead>
<tr>
<th>Nutrition outcomes</th>
<th>Females (N=28)</th>
<th>Males (N=28)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Weight for height (Z scores)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal/ mild</td>
<td>16 (57.1)</td>
<td>13 (48.0)</td>
</tr>
<tr>
<td>Moderate (-&lt;2SD)</td>
<td>7 (25.0)</td>
<td>9 (32.0)</td>
</tr>
<tr>
<td>Severe (-&lt;3SD)</td>
<td>6 (21.4)</td>
<td>6 (20.0)</td>
</tr>
<tr>
<td>Weight for age (Z-scores)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal/ mild</td>
<td>7 (25.0)</td>
<td>2 (7.1)</td>
</tr>
<tr>
<td>Moderate (-&lt;2SD)</td>
<td>10 (35.7)</td>
<td>22 (78.6)</td>
</tr>
<tr>
<td>Severe (-&lt;3SD)</td>
<td>11 (39.3)</td>
<td>4 (14.3)</td>
</tr>
<tr>
<td>Height for age (Z-scores)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal/ mild</td>
<td>16 (55.6)</td>
<td>8 (28.6)</td>
</tr>
<tr>
<td>Moderate (-&lt;2SD)</td>
<td>7 (25.0)</td>
<td>13 (46.4)</td>
</tr>
<tr>
<td>Severe (-&lt;3SD)</td>
<td>6 (21.4)</td>
<td>7 (25.0)</td>
</tr>
</tbody>
</table>

Table 2: Nutrition outcomes for LBW infants at the age of six months
3.2. **Qualitative findings**

**Characteristics of study participants**

The 10 mothers of LBW infants whom we interviewed ranged in age from 17 to 39 years. Four of them were first-time mothers. Six were married, two were single, and the other two were separated. The two separated women happened to be the heads of their households. In regards to ethnicity, 6 participants belonged to the Chewa ethnic group while the other four belonged to the Ngoni tribe. All of them were Christians by religion. Their levels of education ranged from primary school to secondary school. Two participants had HIV infection and one had been previously admitted in the nutrition rehabilitation unit due to the infants’ severe malnutrition. One woman was around 20 weeks pregnant during the time of interviews. One of the participants was reported to have defaulted from the hospital during her prolonged stay soon after delivering a LBW infant.

Based on the interviews with the mothers, five common occurring themes that could contribute to poor LBW outcomes were extracted: resource scarcity, lack of social support, mother’s emotional distress, recurrent illness, and mixed feeding.

**Resource scarcity**

The most common infant-care challenge that mothers reported facing was related to resource scarcity. Resource scarcity exists when there is insufficiency or shortness of basic commodities required for daily living. The most important of these necessities is food. Food scarcity contributed to food insecurity in most households of LBW infants, which affected the nutrition of the mother and was also perceived to directly affect the child’s nutrition.
Some mothers, especially those who had previously had other children, reported feeling that their milk production was inadequate for the baby.

With my previous babies I could produce enough milk but not now. (33 years old, Married, Para 5)

I think the child is lacking some food that is why she is not growing up. Look at me. I am so thin, if I myself I am lacking food where will the child get his food from. (24 years old, Married, Para 3)

I know the baby needs a lot of milk to grow but look when I am breastfeeding I also need to eat more otherwise it does not balance. (20 years old, Separated, Para 2)

Limited finances tended to cause care disruption of the LBW infants in the study. For example, despite the fact that health services at the clinics are provided free of charge, most mothers missed their postnatal appointments. They described how lack of money for transport affected their schedules for clinic appointments. A mother of a LBW infant who had to walk for some five hours to get to the clinic reported how difficult it was for her to keep appointments.

The clinic is far, I cannot manage to walk there every two weeks. I wish I had enough money or other means of transport. (39 years old, Married, Para 8)

I was advised to go after one month but I did not go, with these rains the conditions of the roads are very bad and the transport is even more expensive. Where will I get the money? (32 years old, Widow, Para 5)
Apart from the lack of transport, a few mothers described how challenging it is to provide the best for their infants when the families were struggling to make their ends meet. Other basic necessities such as clothes were also scarce.

*To get money we depend on business and piecework. It is hard work and very tiresome.*
*After working the whole day sometimes I come back home with only K1000 (equivalent to $2), I cannot even buy her nappies. (25 years old, Separated, Para 4)*

*When he developed diarrhea they advised me to go and buy “Thanzi” (referring to oral rehydration solution) but I could not manage. I did not have the money. (22 years old, Married, Para 3)*

Conversely the care demands from the LBW infant caused work disruption, preventing the mother from attending to other activities, leading to further loss of income for the household. Participants reported how they were disrupted from completing other duties necessary for the income generation. The two mothers who were the heads of their households emphasized how challenging it was to find resources for their families.

*I was still in the hospital with my son by the time my friends were planting. I do not know how I am going to survive this year, only God knows. (20 years old, Married, Para 2)*

*As for me everyone depends on me here, I told you I do small businesses, but now I spend more time taking care of the child and my business is disrupted. (25 years old, Separated, Para 4)*

Some of the LBW infants are born prematurely, and mothers are accordingly instructed to practice kangaroo care, a skin to skin bonding method that transfers heat from the mother to
the baby to keep the baby warm. This requires continuous direct contact between the mother and the baby. This practice, according to some participants, prevented the mothers from doing the usual income generating activities, such as farming.

At the clinic they told me to carry my daughter on my belly all the time, but when I do that I cannot do anything else... how do I manage with the baby in front? (35 years old, Married, Para 7)

Even after discharge I had to follow the nurse’s instructions, never to leave my son alone. I could not go to the farm, I am not sure if we will harvest anything this year. (20 years old, Married, Para 2)

Lack of support

Another prominent theme that emerged from the interviews was the perceived lack of social support. There was a general feeling that the mothers were not getting the necessary support from family, friends and the society at large. Most of the burden of taking care of the LBW infant was left on the mother’s shoulders. Most of the women who had previous deliveries of normal birth weight infants compared the level of support that they had received. Some mothers and nurses described the lack of support from the communities they lived in.

Participant: most of my friends never came to see me when I was at the hospital with her; even friends that previously were very close. Interviewer: why do you think they did not come? Participant: I do not know. Maybe they thought he was not going to survive, but God is great! (35 years old, Married, Para 7)
They say children do not survive “mmagetsi” (referring to an incubator), that is why most people lose hope. Even if such children die it is only women who conduct the burial ceremony. (Clinic nurse, 28 years old)

The lack of support was even experienced at home where some husbands were considered unsupportive. In these rural households, the responsibility of taking care of an infant belongs solely to the wife. Generally, husbands do little to support childcare. The lack of husbands’ support was particularly lamented in the cases of LBW infants because mothers felt the care demands of the LBW infant were too much to be managed by mothers alone.

I do everything alone. His father would be sleeping when my son and I are still awake. Sometimes I cannot figure out what his problem is. He cries a lot, sometimes he refuses to feed. I expected my husband to help out but to no avail. Taking care of him has been so difficult I tell you. (22 years old, Married, Para 3)

I really wanted most help from my husband but with her the story was different, her father does not seem to care much. (20 years old, Married, Para 2)

Some husbands leave their families to marry other wives soon after delivery. It is even more common when a woman is admitted with a baby for a long period. That’s why some women default from in-hospital treatment. (clinic nurse, 26 years)

Sometimes mothers felt that they were faced with the same problem even at the hospitals where they were supposed to get necessary advice and medical support. In general nurses at the clinics were described to be unapproachable and this particularly prevented women from seeking advice on the care of the LBW infants.
Interviewer: *Why did you not go the nurse to ask?* Participant: *Eeee eeeeh where would I even start from? I do not want to be embarrassed in front of all the people.* Interviewer: *What do you mean?* Participant: *I am telling you that nurse can shout.* (25 years old, Separated, Para 4)

The nurse at the “scale” (referring to the growth-monitoring clinic) *usually yells at us whenever our children are not gaining weight.* She always thinks I am not breastfeeding my child. She forgets that my son was already small at birth. (39 years old, Married, Para 8)

In general, participants complained about the services at the clinic. This was a problem equally shared among the participants, some of whom expected their LBW infants to receive priority treatment due to the nature of the condition.

When my child was admitted “kumagulu” (referring to the nutrition rehabilitation unit) I was told that he was in a special category because he is too tiny, but I did not see anything special with the medical care. Interviewer: *What were you expecting?* Participant: *They had earlier told me that I would also need some “chiponde” (plumpy nut) but I was never given because they said they had only enough for children not me. I was discharged without anything.* (17 years old, Single, Para 1)

The lack of medical support affected even the health-seeking behavior of a few mothers, who got to the point of losing trust in the health system.

*I even lost trust in that clinic, last time I went with my child they only gave me Aspirin.*

*They did not even test for malaria.* (33 years old, Married, Para 6)
They always tell us to go to the ‘scale’ (growth monitoring clinic) but we just go and sing songs. That is why sometimes I only go when sick. (24 years old, Married, Para 3)

Another participant who had walked four hours to the clinic could not hide her anger and frustration regarding the lack of the essential medical drugs at the hospital:

I went there to be assisted, how could they tell me to go buy “Thanzi” (referring to oral rehydration solution), when I do not have anything? Can you imagine after walking for many hours? (22 years old, Married, Para 3)

Mixed feeding

All mothers interviewed in the study reported understanding the importance of breastfeeding. They described the reasons that breast milk protects infants from diseases, helps their bowels develop, and gives them energy. They named breast milk as the primary source of food for babies, but admitted to have given several other foods to their infants within the first 6 months in addition to breast milk. This practice of combining milk with other foods is referred to as mixed feeding. The commonly used food substance was corn porridge, or water, tea, and “nsima,” a very thick starchy porridge made from corn flour.

The common reasons stated for introduction of other foods were crying and not growing. The crying of a baby was seen as a sign of poor care or hunger and an indication that the baby was not getting enough food from breast milk. Solid foods seem to be a remedy whenever a child is crying.

Aaaaaah him, when you give him porridge he stops crying, I think he likes it more. (24 years old, Married, Para 3)
She was crying day and night. I could not sleep, but I devised a mechanism to make her sleep. Once I started giving her porridge she is able to sleep. (24 years old, Married, Para 3)

Likewise, most women believed that LBW children needed a wide variety of foods to grow better. This was a coping mechanism whenever they noted that the infant was not child was not growing. Vigorous discussions with older mothers who had previous experience indicated a very strong belief that breast milk was not adequate for young babies.

He was very small...I think he needed additional food, something solid, now you see, that is why I said nsima made him grow strong. I am telling you; milk alone cannot help. (23 years old, Married, Para 3)

When it came to decisions about the child’s feeding, the mother was most often the decision maker, but in a few circumstances, the mothers-in-law were also important decision makers, particularly with regard to foods that were given to protect the child. These mothers-in-law were considered to be more experienced in taking care of the children, and as such, their advice mattered most.

My mother-in-law told me that some babies are born hungry and may have to be fed porridge at a very early age. (24 years old, Married, Para 3)

Preferences

In these communities, most women expressed a preference for community support programs through which women with LBW infants could share ideas with each other. Others also recommended having village clinics or mobile clinics where the community health
workers could do simple things like growth monitoring within the communities reach.

*If it is just a matter of “scale” why don’t you come to the villages to do that? (37 years old, Married, Para 6)*

*If we could meet and talk with friends about some of the experiences. Maybe I could get a relief. You know, sometimes talking to a friend helps. (28 years old, Separated, Para 6)*

*Maybe someone is going through the same issues and could help me with ideas; sometimes you never know where help comes from. (24 years old, Married, Para 3)*

4. Discussion

The ultimate goal of our study was to explore how we can optimize the care of LBW infants, given these infants’ poor outcomes. We therefore assessed the factors that affect the growth and development of the LBW infants in the rural setting of Neno in Malawi, with a particular interest in understanding the lived experiences of the mothers of these LBW infants.

As expected, our results show that LBW infants were more likely to have higher rates of malnutrition than the standard reference groups. We used all three standard measures malnutrition: weight-for-height, height-for-age and weight-for-age. In the categories, the Z-scores for our LBW infants at six months fell below the -1, -2, and -3 standard deviation, respectively. The results are consistent with what other studies in similar resource-limited settings have reported on LBW infants who do not meet the same growth targets as their normal birth weight counterparts. This is well documented in larger studies from Tanzania, India, Pakistan, China and Brazil [15, 16, 17, 18, 19]. Some of the studies have demonstrated a lack of complete catch-up growth even up to years of adulthood, which in the case of stunting
the risk of delivering a LBW infant [20, 21]. Therefore, this trend could pass on from generation to generation if no intervention was implemented.

Although we did not have large enough numbers to make statistical inference, the trends in poor outcomes could be attributed to the high levels of poverty, food insecurity and poor follow up system within the health system. There is some evidence from developing countries which indicates that the poor outcomes of LBW infants are as a result of high levels of poverty, poor postnatal care, and high infection rates [22, 23].

These results are completely different from those documented in developed countries, where, with the exception of very low birth weight infants (<1500g), most LBW infants attain catch up growth during the first year of life and continue growing normally thereafter [24]. The differences in outcomes could be explained by varying socio-economic statuses, which impact the care and interventions given to the infants. For example, LBW infants in the United States are given caloric dense milk supplements in order to boost growth velocity [25, 26] whereas in Malawi and most resource-limited settings the standard of care is to encourage exclusive breastfeeding.

The main strength of our study is the addition of qualitative methodologies, which is appropriate for exploring local understanding of the lived experience of mothers of LBW infants and the social context of childcare. The actual process of listening to the participants and observing their day-to-day life adds a depth of knowledge to the research question. The qualitative findings further explain how these socio-economic challenges affect the care of the LBW infants, which can eventually lead to poor nutrition and development outcomes. We identified the unmet biosocial needs from the participants’ stories and experiences in caring for
LBW infants. The term ‘unmet needs” refers to the requirements that a person didn't manage to satisfy yet. Participants in our study reported on several perceived medical, socio-economical, and psychological gaps that exist in the care of the LBW infants. These unmet biosocial needs were recurrent illness, resource scarcity, lack of personhood, lack of care support, and emotional distress.

The care of a LBW infant is largely dependent on the availability of the resources. Neno district as one of the poorest districts in Malawi, has a lot of households living in poverty [27]. It is therefore, not surprising that in our quantitative results more than 90% of the families were living with moderate to severe food shortages. As such, there are many consequences that structural violence of resource scarcity exerts on the LBW infants from these households resulting in poor outcomes. Mothers of low birth weight infants, like any other mothers, have the responsibility to do household chores, such as cooking and washing, but they also support the family financially by generating income for the family in several ways, such as farming and running small businesses. However, these essential activities are severely tested and often undermined by the ways in which the demanding task of caring for the infant can structure and restrict other engagement in other priorities. As a result, these households suffer further deterioration in their poverty levels, a vicious cycle that further compromises the care given to these infants.

Amidst all of these resource constraints, social support is an important element of family functioning [28] and is likely to have implications for the quality of childcare. Studies conducted in other resource-limited countries have shown that mothers with high levels of support have better health services, reduced anxiety, and in turn, fewer disruptions [29, 30]. Likewise, our findings show that mothers are in dire need of support in the care of the LBW infants.
Furthermore, a study done in Gambia showed that the risk of being left isolated and unsupported was heightened by societal expectations that childbearing and childcare are the exclusive domain of women [31]. Such gender inequality exists in rural Malawi where women carry the burden of domestic work, including childcare, and lack financial and decision-making independence [32].

The social detachment that results from the perceived lack of personhood especially during the first days of life may have detrimental effects on the child’s growth and development. In these instances, studies have shown that infants tend to lack the basic proximity with the resources they depend upon as such their development is impaired [33]. For enhanced growth and development, children need to experience early, warm, intimate, and continuous relationships with their mothers and the society around them [34].

Our qualitative findings indicate that there is a high level of distress among the mothers of LBW infants. Though we did not screen these mothers for depression, we would expect the prevalence of depression to be high. This correlates with the previous findings that postpartum depression is associated with low birth weight deliveries [35]. Compared with parents of normal birth weight children, parents of children with LBW had more symptoms of stress, including depressive symptoms [36]. This depression could further affect the care given to the infants and in turn affect the feeding, weight gain, and development of the child [37]. Mothers may feel overwhelmed and exhausted by the care demands [38]. They often feel isolated and without support [39]. Their energy is depleted by care requirements, affecting their personal health and energy [40]. Just as our results have demonstrated, uncertainty about the future of the child may add to parental stress [41].
The main biological demand that is not met by the LBW infants is the frequent occurrence of illness without proper consultation or medication. Studies have described that the main cause of deaths in LBW infants living in resource-limited countries is recurrent infections [42]. Our findings have further shown that there is a lack of standard treatment procedures or at least a lack of knowledge on the part of the health workers of the existence of such treatment procedures. A study in Malawi recommended coordination of existing services, particularly in rural areas [43].

As seen in the results, mixed feeding was a way of coping with LBW infants who were not perceived to be growing well enough and who were crying often. Mothers had some good knowledge about the importance of breast milk, but circumstances forced them to introduce mixed feeding. While supplementation helps in developed countries, the case is usually different in most developing countries where there is no provision of caloric dense breast milk supplements. Infant foods other than breast milk during the first 6 months of life displace the more nutritious breast milk from the infant’s diet and risk introducing diarrhea to the child [44]. Poor nutrition will affect immune status and further lead to an increased risk of infection [45].

5. Limitations

Selection bias may be a validity threat to our findings because we reported only on LBW weight infants who were delivered at the health facilities, leaving out a great percentage of those infants who had delivered at home and whose birth weight may not have been recorded.

We had smaller numbers in the quantitative data and therefore could not fully demonstrate the associations between exposure variables such as the socio-demographic factors and the nutrition outcomes among the LBW infants.

6. Conclusion
Poor nutrition and development outcomes in LBW infants are caused by several structural makings in these poor households, which leave the women with few options. As such, caring of the LBW infants is challenging; it requires both medical and socio-economic support systems. A good health system should have all the necessary provisions to care for vulnerable infants. Our findings show that it is imperative to improve the care of the LBW infants. Intervention to optimize the care of the LBW infants should address the social and economic barriers that these mothers experience.

7. References


15. Webb AL, Manji K, Fawzi WW, Villamor E. Time-independent maternal and infant factors and time-dependent infant morbidities including HIV infection, contribute to


