

**MOTHER'S PERCEPTION OF HER CHILD'S GROWTH IN
RURAL MALAWI**

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Background

Childhood stunting (i.e. linear growth failure) is recognized to be a major global health priority with 165 million children under the age of five years affected worldwide. Although the prevalence of stunting has decreased over the past years, the number of stunted children is still on the rise. Children of educated mothers have a lower prevalence of stunting in general. There are no consistent results of how well mothers recognize their child's growth failure.

Aims

The aim of this study is to determine whether mother's perception of the growth of her child is in line with the measured growth and if mother's education affects the perception.

Methods

This study is a part of a two-center, randomized, single-blind, parallel group controlled trial in rural Malawi called iLiNS-DOSE. It was carried out in Mangochi District, southern Malawi. The study population was N=1119 of 4.8-7.1-month-old infants and their mothers. The data used in this study was collected when children entered the iLiNS-DOSE trial and the intervention had not yet taken place. The anthropometric measurements of children were compared to mother's perception retrieved from a "Knowledge, Attitudes and Practices" questionnaire where mothers were asked if their baby is growing well currently. The association between mother's perception and dichotomized child growth (Not stunted, Stunted) was assessed with crosstabulation. Sensitivity and specificity were used to examine the accuracy of detection. The mean values of child growth as continuous length-for-age z-score for both mother's perception groups were compared using independent samples t-test. The association with mother's perception and education was evaluated using Pearson's Chi-Square Test.

Results

28 % of the children in our study population were stunted. The prevalence differed in relation to mothers' schooling: 32 % of children of uneducated mothers were stunted, 29 % of children of mothers with 1-8 years of schooling and 20 % with 9-12 years of schooling were stunted. The sensitivity of the mothers' assessment was 12 %. Specificity of mothers' assessment was 95 %. There was a statistically significant difference between the mean values of length-for-age z-scores in the two groups of mothers' assessments (growing well; not growing well). 6 % of mothers with no schooling detected their stunted children weren't growing well, whereas 2 % in mothers with 9-12 years of schooling detected their child's stunting.

Conclusion

The results indicate that mothers detect their child's stunting poorly, although most mothers are accurate when evaluating their not stunted child to grow normally. The group of unschooled mothers detected stunted growth in their children better than the highest education group. This implies that formal education does not significantly improve the detection of stunted growth. The prevalence of stunting is however smaller in children with educated mothers.

Key words

Child undernutrition, stunting, length-for-age, child growth, mother's detection, mother's assessment, maternal education

TABLE OF CONTENTS

ABBREVIATIONS	6
1 INTRODUCTION	1
2 REVIEW OF LITERATURE	3
2.1 <i>Child undernutrition</i>	3
2.1.1 Definition	3
2.1.2 Prevalence	3
2.2 <i>Child undernutrition in Malawi</i>	3
2.3 <i>Determinants of growth</i>	4
2.4 <i>Stunting</i>	4
2.4.1 Stunting in comparison with other signs of undernutrition	4
2.4.2 Timing of growth faltering	5
2.4.3 The burden of stunting	5
2.4.4 Stunting as a sign of undernutrition	6
2.4.5 The role of stunting in the intergenerational cycle of poverty	6
2.4.6 Underlying factors of stunting	7
2.5 <i>Interventions to improve child health and nutrition</i>	8
2.5.1 Growth monitoring and promotion	11
2.6 <i>Mother's detection</i>	12
2.6.1 Detecting overweight and underweight	12
2.6.2 Detecting faltered growth in middle- and low-income settings	13
3 THE AIM OF THE STUDY	15
4 MATERIALS AND METHODS	16
4.1 <i>The host study: iLiNS DOSE</i>	16
4.2 <i>Inclusion and exclusion criteria</i>	16
4.3 <i>Study site</i>	17
4.4 <i>Participants</i>	17
4.5 <i>Study design</i>	18
4.6 <i>Description of the main study variables</i>	18
4.6.1 Mother's perception	18
4.6.2 Child growth	19
4.6.3 Growth standards	19
4.6.4 Background information of the mother	19
4.7 <i>Data handling</i>	20
4.8 <i>Data analysis and statistical methods</i>	20
5 RESULTS	22
5.1 <i>Background characteristics of the participants</i>	22
5.1.1 Children	22
5.1.2 Mothers	22
5.2 <i>Stunting and mother's education</i>	24
5.3 <i>Detection of stunted growth</i>	24
5.4 <i>Accuracy in detection in relation to schooling</i>	25
6 DISCUSSION	27
6.1 <i>Summary of the main findings</i>	27

6.2	<i>Specificity in mothers' detection</i>	27
6.3	<i>Sensitivity in mothers' detection</i>	28
6.3.1	Reasons for low sensitivity	28
6.3.2	Contradictory results of comparing mean values	30
6.4	<i>Maternal education in relation to their assessment of their child's growth</i>	30
6.5	<i>Maternal education as a means to reduce the prevalence of stunting</i>	31
6.6	<i>Addressing the key determinants of stunting</i>	32
6.7	<i>Limitations of this study</i>	33
7.	CONCLUSIONS	35
	REFERENCES	36

ABBREVIATIONS

DALY	Disability adjusted life-years
DHS	Demographic and Health Survey
GMP	Growth monitoring and promoting
HAZ	Height-for-age z-score
KAP	Knowledge, attitudes and practices
LAZ	Length-for-age z-score
NCHS	National Center for Health Statistics
SD	Standard deviation
UNICEF	United Nations Children's Fund
WAZ	Weight-for-age z-score
WB	World Bank
WHO	World Health Organization
WLZ	Weight-for-length z-score

1 INTRODUCTION

It is estimated that 165 million children under five years of age are stunted in the world (UNICEF-WHO-WB 2012). Three fourths of them live in Sub-Saharan Africa and South Asia (UNICEF 2013). Stunting means linear growth faltering and is typically caused by long-lasting inadequate diet and illness (Richard et al. 2012). It does not only mean that adults remain shorter, but affects their school performance and future income (Grantham-McGregor et al. 2007). Stunted parents also often get stunted children (Prendergast et al. 2014). That is why stunting is said to be a part of an intergenerational cycle of poverty (Grantham-McGregor et al. 2007; Prendergast et al. 2014). The most important time for healthy growth is the time from conception to a child's second birthday (Black et al. 2013). A World Bank study names the key determinants of growth faltering as parental education, food prices, household resources and maternal nutritional knowledge (Christiaensen et al. 2001).

There is a vivid discussion in the international community about the best ways to address the problem of linear growth faltering. The suggested interventions contain promotion of breastfeeding and complementary feeding, micronutrient interventions, general supportive strategies to improve family and community nutrition and reduce the disease burden, and proper management of severe and moderate acute malnutrition. (Bhutta et al. 2008; Bhutta et al. 2013) Also providing women primary education is seen as a somewhat effective intervention as is improving communities' ability to diagnose stunting. (Christiaensen et al. 2001)

The aim of this study is to examine if mothers are aware of their child's possible stunting and if education helps them to detect poor growth. This study also aims discuss if educating mothers was a valid intervention against childhood stunting. The study site is located in Malawi, a country with a high burden of stunting. 47 % of children younger than five years old suffer from stunting in Malawi (UNICEF 2013).

Findings of the few former studies about mothers' ability to detect stunting are not in line. Mothers detected their stunted and/or underweight children to grow poorly in 16.1 % of cases in Mexico (Turnbull et al. 2009), 49.5 % of cases in Ethiopia (Christiaensen

et al. 2001) and 68.4 % of cases in Nepal (Moffat 2000). Hager et al. comments that mother's educational status was not associated with the accuracy of growth assessments (Hager et al. 2012). Many studies show however that mothers' education is a protective factor against stunting (Glewwe 1999; Grantham-McGregor et al. 2007; Urke et al. 2011; Menezes et al. 2011). Children whose mothers are educated are also more likely to recover from stunting (Adair 1999).

Some of the former studies already suggest that educating mothers about stunting as a sign of malnutrition is recommended and that educating communities to diagnose growth faltering would be a complementary, timely and effective way to address the problem of stunting. (Turnbull et al. 2009; Christiaensen et al. 2001)

2 REVIEW OF LITERATURE

2.1 Child undernutrition

2.1.1 Definition

Child undernutrition continues to be a widespread condition that alters the development of many children in middle and low-income countries (Black et al. 2008). Stunting (i.e. linear growth failure) is recognized to be the most prevalent form of undernutrition in the world (Prendergast et al. 2014). Undernutrition means the result of inadequate food intake and repeated infectious diseases. By UNICEF's definition the term undernutrition comprehends "being underweight for one's age, too short for one's age (stunted), dangerously thin (wasted), and deficient in vitamins and minerals (micronutrient malnutrition)". Malnutrition in turn can mean both undernutrition and overnutrition. (UNICEF 2006)

2.1.2 Prevalence

"Levels and trends in child malnutrition: UNICEF-WHO-The World Bank joint child malnutrition estimates" from 2012 reported that there were 165 million stunted children under five years of age in the world in 2011. The global prevalence of stunting in this age group has decreased from an estimated 40 % in 1990 to an estimated 26 % in 2011 (UNICEF-WHO-WB 2012). A systematic analysis published in 2012 looked into the trends of stunting and underweight in under-five-year-olds in 141 developing countries. In those 141 countries the mean height-for-age (HAZ) improved from -1.86 in 1985 to -1.16 in 2011 (Stevens et al. 2012). Despite the improvements in prevalence and mean height-for-age, the least developed countries suffer from an increase in the number of stunted children, because of the increasing population of under-five-year-olds. (UNICEF-WHO-WB 2012)

2.2 Child undernutrition in Malawi

UNICEF reported that in Malawi 47 % of children younger than five years old suffer from moderate or severe stunting (UNICEF 2013). Malawi Demographic and Health Survey 2010 added that 20 % of them were severely stunted (NSO 2011). 13 % of children under the age of five were moderately or severely underweight. Malawi held

place seven in the list of highest prevalence in stunting globally (UNICEF 2013). Despite the high rank, the prevalence of stunting has decreased also in Malawi from 56 % in 1992. (UNICEF 2013) In Malawi, the prevalence of stunting increased as the children grew older. Marriot et al. reported the prevalence of stunting by age group with data attained from the Malawi Demographic and Health Survey 2004. In 0-5-month-old infants the prevalence of stunting was 25.3 %, in 6-11-month-olds 38.3 %, and in 18-23 month-olds the highest 69.5 %. (Marriot et al. 2012) Based on the information from Malawi Demographic and Health Survey 2010, rural children had a higher prevalence of stunting (48 %) than urban children (41 %). Children of more educated mothers had a lower prevalence of stunting. 53.4 % of children of uneducated mothers were stunted, whereas only 38.8 % of children of mothers, who have gone to secondary school, were stunted. (NSO 2011)

2.3 Determinants of growth

Based on the WHO Multicentre Growth Reference study de Onis et al. state that the growth of the children from various locations with different ethnicities is alike, when their environments are alike in healthy features (de Onis et al. 2006). The UNICEF report from 2013 points out that child undernutrition is not merely lack of nutritious food, but that combined to poor care practices, frequent illness and lack of access to health and other social services (UNICEF 2013). Black et al. describe the proximate determinants of child nutritional status to be health, adequate care and food security. Infections, mostly diarrheal diseases affect linear growth. Every episode of diarrhea increases the odds of stunting multiplicatively. (Black et al. 2008) Animal-source foods are important in child diets, because they contain protein and micronutrients. The lack of these foods increases the risk for stunting (Black et al. 2008).

2.4 Stunting

2.4.1 Stunting in comparison with other signs of undernutrition

In this thesis, when examining growth failure, the focus is on stunting (i.e. linear growth failure). Stunting is defined as length/height-for-age z-score being less than -2 standard deviations (SD) from the median (WHO 2006). It is caused by long-standing poor diet and illness and thus reflects child's living conditions better than for example wasting, which is caused by a shorter period of inadequate dietary intake or illness (Richard et al.

2012). In stunting the potential growth of the child is chronically restricted, whereas wasting refers to acute weight loss. (Black et al. 2008) All in all, weight is more susceptible to acute changes in the environment and echoes for example political or economic situations. (Stevens et al. 2012) A child can be both stunted and wasted, and that is a sign of acute malnutrition (Shrimpton et al. 2001). Although according to the UNICEF definition malnutrition includes both undernutrition and overnutrition, in this thesis, malnutrition was observed from an undernutrition point of view (UNICEF 2006).

2.4.2 Timing of growth faltering

Shrimpton et al. reported the timing of growth faltering using 39 nationally representative and recent datasets from developing countries on Child Growth and Malnutrition and using the NCHS growth reference. They found that the patterns of stunting and wasting are different. Linear growth faltering starts right after birth and is steep during the first 24 months of life. After that it continues steadily until the age of three years. Wasting occurs differently: it starts around the age of 3 months and stops at 12 months, after which apparent recovery happens. (Shrimpton et al. 2001) A similar research was conducted in 2010 using the WHO growth standards (Victora et al. 2010). When using the WHO growth standards prevalence of stunting is higher. The authors used anthropometric data from 54 surveys in their study. Based on this newer data and the use of WHO growth standards, they noticed that height-for-age is already below the standard at birth and growth faltering is, as in the earlier findings, steepest for the first 24 months. Weight-for-length starts faltering at the age of two months and continues until the age of nine months, after that getting closer to the standard. (Victora et al. 2010) It has been acknowledged that the first 1000 days, from conception to a child's second birthday, are crucial in terms of gaining healthy growth (Black et al. 2013).

2.4.3 The burden of stunting

Stunting causes 14.7 % of all deaths of under-five-year-old children globally (Black et al. 2013). Black et al. also reported in 2008 that in eastern, middle and western Africa 1.1 million deaths were caused by undernutrition (stunting, severe wasting, and intrauterine growth restriction-low birthweight) in 2004. It was also mentioned that it is not alone undernutrition that causes deaths, but the synergistic relationship it has with

infectious diseases. (Black et al. 2008)

The burden of stunting is unevenly distributed - three fourths of stunted children live in Sub-Saharan Africa and South Asia. A UNICEF report from 2013 says that in Sub-Saharan Africa an estimated 40 % and in South Asia an estimated 39 % of children below five were stunted. The same report listed 14 countries that have the largest number of stunted children. 6 of those 14 countries are in Sub-Saharan Africa. (UNICEF 2013) Although the percentage is higher in Africa, the number of children affected is bigger in Asia. (Lutter et al. 2011; UNICEF-WHO-WB 2012)

2.4.4 Stunting as a sign of undernutrition

Before, underweight has been used as the main anthropometric indicator for undernutrition. For example, it was used as an indicator of the first Millennium Development Goal, which was “to halve, between 1990 and 2015, the proportion of people who suffer from hunger” (United Nations 2015). However, Black et al. wrote in 2008 that stunting and wasting are better anthropometric indicators (Black et al. 2008). Prendergast et al. state that after years of neglect, stunting has finally been identified as a major global health priority (Prendergast et al. 2014). One example of the wider use of stunting as an undernutrition indicator is the new WHO goal of a 40% reduction in the number of stunted children under-five between 2010 and 2025 (WHO).

2.4.5 The role of stunting in the intergenerational cycle of poverty

To explain the complex nature of childhood stunting, Grantham-McGregor et al. described in a wide review article in the Lancet in 2007 the hypothesized relations between poverty, stunting, child development and school achievement. In their description poverty leads to primary caretaker’s stress and depression, low education and low responsivity, which further lead to poor care and home stimulation. Poverty leads to nutritional deficiencies and infections. Poor care due to the mentioned afflictions of the caretaker, as well as poor nutrition and infections lead to stunting of the child. As mentioned earlier, stunting and poor stimulation at home lead to poor cognitive, motor and socio-emotional development that in turn cause poor school achievement. Through these steps of development poverty and stunting cause reduced adult income and poverty. (Grantham-McGregor et al. 2007) Gandhi et al. studied a

Malawian population and found a positive association between height gain in 18-60 months of age and mathematic competence in 12 years of age, as well as a negative association with above mentioned height gain and the number of times one repeats a grade. (Gandhi et al. 2011) Stunted mothers also tend to have stunted children, which leads to an intergenerational cycle of poverty and reduced human capital (Prendergast et al. 2014).

Prendergast et al. present a concept “stunting syndrome” which signifies that the problem of stunting is not short stature but the many pathological changes that linear growth retardation causes. Stunting is associated with “increased morbidity and mortality, reduced physical, neurodevelopmental and economic capacity and elevated risk of metabolic disease in adulthood”. (Prendergast et al. 2014)

2.4.6 Underlying factors of stunting

A World Bank study conducted in Ethiopia finds the key determinants of growth faltering to be parental education, food prices, household resources and maternal nutritional knowledge (Christiaensen et al. 2001).

Menezes et al. found that the prevalence of stunting was lower in families of mothers who had gone to school for four years or more. Stunting was less prevalent also in families with high income, fewer members in their family, better sanitation facilities and access to listed consumer goods. They also presented that the occurrence of stunting was three times higher in low birth weight children of mothers with short stature than with over 2500 g birth weight children with mothers above 1.50 m height. Menezes et al. used data from PESN –State Health and Nutrition Survey from a state in Northeastern Brazil in 1997 and 2006. (Menezes et al. 2011) Some other studies from Brazil also reported that underweight was more prevalent among children with unschooled mothers or mothers with less than eight years of education (Molina Mdel et al. 2009).

The association of poverty with stunting was also reported in a Ugandan study. Lowest household wealth was associated with stunting, as was mixed feeding or replacement feeding of children 0-11 months old. Having siblings was reported as a protective factor

in this study. (Engebretsen et al. 2008) A study from Peru investigated the association between parents' socioeconomic status and stunting of children. Socioeconomic status was measured using parental education, occupation, and household wealth index. In the national and regional (Andean) study samples there was an association between socioeconomic status and stunting. The odds of stunting were higher in the poorest household wealth index quintile than in the richest household wealth index quintile. (Urke et al. 2011) Age of the mother also plays a role. "First time mothers up to the age of 27 have a higher risk of having a stunted child, diarrhea and moderate or severe anemia." (Finlay et al. 2011)

Maternal education is an important protective factor against child's stunting (Christiaensen et al. 2001; Menezes et al. 2011; Molina Mdel et al. 2009). Glewwe introduces three main ways in which education of mothers enhances child health. It is not only the health information taught in school that is worthy to future mothers, but also the literacy and numeracy skills that help mothers obtain more information after finishing school and the exposure to modern society through schooling that increases their trust in modern health practices. (Glewwe 1999) High maternal education is also a predicting factor to recovering from stunting after infancy. (Adair 1999; Crookston 2010)

2.5 Interventions to improve child health and nutrition

Marriot et al. studied Demographic and Health Survey (DHS) data from 14 low-income countries, including Malawi. Their results indicate that the strongest interventions to enhance the nutritional status of under-five-year-olds, and hence reduce the mortality, are maternal education, early initiation of breastfeeding (< 1 h from birth), complementary feeding practices (i.e. introducing solid, semi-solid or soft foods in addition to breast milk at the age of 6 months) and young child dietary diversity (receiving food from at least 4 food groups in one day). They specified that higher maternal education and complementary feeding at the age of six months had strongest association with lowered risk of stunting and underweight. (Marriot et al. 2012) A study from rural Malawi suggested that participatory nutrition education to mothers about complementary feeding practices does increase the amount of complementary feeding and energy intake in their children. (Hotz et al. 2005) The article by Lutter et al. commented that only adequate energy and weight gain should not be the focus, but that

interventions should also be targeted directly to improving the quality and diversity of the diet. Nutritional interventions should also be integrated to the prevention and treatment of common childhood illnesses. (Lutter et al. 2011)

Victora et al. suggested that interventions to prevent low birth weight and ensure appropriate infant feeding practices should be targeted to the time from pregnancy and the first two years of life due to the timing of stunting. (Victora et al. 2010) Bhutta et al. stated that interventions on preconception care in adolescence are also needed (Bhutta et al. 2013).

In the Lancet Series on Maternal and Child Undernutrition in 2008 Bhutta et al. studied the effect of different interventions on stunting prevalence and DALYs due to stunting in those 36 countries where 90 % of the world's stunted children live. Interventions were promotion on breastfeeding, micronutrient interventions, strategies to promote complementary feeding (with or without provision of food supplements), general supportive strategies to improve family and community nutrition, and reduction of disease burden through promoting handwashing and strategies to reduce malaria during pregnancy. The results on stunting are presented in **Table 1**. (Bhutta et al. 2008)

In 2013, Bhutta et al. researched a set of nutrition-specific interventions that potentially seek solutions to undernutrition and micronutrient deficiencies in woman and children in the 34 countries where 90 % of world's stunted children live. Interventions are called nutrition-specific when they address the direct determinants of fetal and child nutrition and development (Ruel et al. 2013). The ten core interventions^[1] were periconceptual folic acid supplementation, multiple micronutrient supplementation as well as calcium and balanced energy protein supplementation for pregnant women and exclusive breast feeding of infants with the appropriate complementary feeding introduced at the age of six months, vitamin A supplementation from the age of six months and preventive zinc supplementation. In addition to these, a proper management of severe and moderate acute malnutrition was included in the core interventions. The results are presented in the **Table 1** with a special emphasis on mothers' education. (Bhutta et al. 2013)

In Ethiopia, a study by Christiaensen et al. noticed that providing at least one female adult in a household a primary education, stunting prevalence would be reduced by 6-11

%). Providing one male in the household primary education also reduces stunting, but only by 2-8 %. A 25 percentage point increase in community's ability to diagnose growth faltering, would reduce stunting prevalence by 3-8 % and with 50 percentage point increase, stunting prevalence would be reduced by 5-16 %. A summary of results is provided in **Table 1**. Their findings suggest that improving communities' knowledge about growth faltering and increasing their ability to identify it would be a complementary, timely and effective way to address growth faltering in Ethiopia. (Christiaensen et al. 2001)

Ruel et al. introduced a set of nutrition-sensitive programs that seek to affect the key underlying factors of nutrition. The interventions reviewed were in four sectors: agriculture, social safety nets, early child development and schooling. Their results showed that agricultural programs enhance food security, dietary diversity and women's empowerment, but do not yet show strong evidence in improving nutrition. Social safety nets seek to reduce poverty and through that are expected to improve nutrition, but yet lack evidence on their nutritional impact. Early child development programs combine stimulation and nutritional interventions in early childhood and hold promise on both better nutrition and child development. Parental schooling is repeatedly associated with improved nutrition outcomes. They also included the provision of delivery platforms to nutrition-sensitive interventions. They conclude their findings stating "The immense potential of programmes addressing the underlying determinants of undernutrition to complement and enhance the effectiveness of nutrition-specific interventions is real, but is yet to be unleashed." (Ruel et al. 2013).

Table 1. Summary of the intervention's effect on stunting

Study	Study site	Intervention	Effect on stunting
Bhutta et al. 2008	36 countries	Education about complementary feeding (no food supplementation, food secure population)	HAZ increased 0.25
		Education about complementary feeding (food supplementation, food insecure population)	HAZ increased 0.41
		99 % coverage on feeding interventions	19.8 % relative reduction in stunting
		99 % coverage in zinc supplementation	9.1 % reduction in stunting
		99 % coverage in balanced energy protein supplementation	1.9 % relative reduction in stunting
Bhutta et al. 2013	34 countries	90 % coverage in ten core interventions[1]	20.3 % reduction in stunting
		Nutrition education (food secure population)	HAZ increased 0.22, no statistical significance on stunting
		Nutrition education (food insecure population)	HAZ increased 0.25
Christiaensen et al. 2001	Ethiopia	Primary education to one female in household	6-11 % reduction in stunting prevalence
		50 percentage point increase in community's ability to diagnose growth faltering	5-16 % reduction in stunting prevalence

2.5.1 Growth monitoring and promotion

One way to address the problem of undernutrition could be growth monitoring and promotion (GMP) programs. They are not a new invention, such programs have been running for decades. The WHO defined the task of GMP in 1986 “not only to measure and chart weight of children, but use this information on physical growth to counsel parents in order to motivate actions that improve growth” (Mangasarian 2008). Although this sounds like the solution to the problem of undernutrition, the GMP programs have been criticized for low participation rates, inadequate health worker

performance and the weakness in health system infrastructures that hinders effective growth promotion. (Ashworth et al. 2008) UNICEF's Dr. Mangasarian comments in her presentation that GMP should be seen more of a preventive tool than a corrective intervention. (Mangasarian 2008)

A study from Ghana suggested that although exposure to growth monitoring and promotion was not associated with child feeding knowledge and practices in children above six months of age, there was a positive association in under-six-month-olds. (Gyampoh et al. 2014) Charlton et al. researched the effectiveness of the growth monitoring and promotion (GMP) program in Zambia using data from Demographic and Health Survey (DHS) 2003. They found out that the GMP program was not working ideally. Although the anthropometric status of children was deteriorating, the trained staff did not present individually tailored feeding advice or health information to parents to improve the nutritional status of children. It was also noted that communities did not engage in GMP programs and that the impact of underlying determinants of malnutrition, such as poverty and unstable living conditions, was bigger on health behavior than GMP programs regardless of their quality and effectiveness. It suggested that further research is needed to find the most effective way to support mothers of young children in developing counties. (Charlton et al. 2009)

As stated before GMP programs have mostly concentrated on child weighing, although recent studies suggest that length measuring would be more advisable, because it gives more information about the long-term nutrition and health of the child. (Richard et al. 2012; Prendergast et al. 2014) Turnbull et al. did rightly suggest that mothers should be provided with information on stunting as a sign of malnutrition. (Turnbull et al. 2009) Moffat wrote that parents should be taken seriously as experts of their children's nutritional and health status and be incorporated in the growth monitoring and community surveillance program. (Moffat 2000)

2.6 Mother's detection

2.6.1 Detecting overweight and underweight

Based on articles from Brazil, Greece and the United States, mothers tend to underestimate the weight of their overweight children. The Brazilian study suggests that there is low correspondence of mother's perception and child's nutritional status in

overweight and obese children in the age of 7-10 years. Mother's estimated their overweight children to be overweight in 33.0 % of cases and obese children to be obese in 10.4 % of cases. Mother's estimation was however 72.6 % correct in estimating their underweight child to be underweight. Boys were more likely to be estimated to be underweight than girls. At the same time, girls were more likely to be estimated as overweight. (Molina Mdel et al. 2009) A Greek study studied the perception of mothers in the growth of their 2-5-year-old children. The study says that 44.2 % of overweight children are classified by their mothers as having a weight status of higher or much higher than normal such and 41.3 % of underweight children are classified as having a lower or much lower weight by their mothers. (Manios et al. 2009) A study from the United States examined how accurate mothers were in assessing their toddler's body size. About 70 % of mothers were incorrect in their assessments. Mothers of underweight toddlers were 9.13 times more likely to have a correct assessment than healthy-weight babies. The accuracy of assessments was not affected by toddler's sex, race or age or mother's educational status or weight. (Hager et al. 2012)

2.6.2 Detecting faltered growth in middle- and low-income settings

Ethiopia. A study from Southern Ethiopia presented in The 17th Annual Conference of the Ethiopian Statistical Association in 2008 gave more insight on mother's perceptions of child's growth in African surroundings. 71 low-income mothers and their under-five-year-old children were studied. More than 50 % of the mother's believed their children appeared physically healthy and were satisfied with the development of their children although 74.7 % of the children were underweight and 66.2 % were stunted. (Abebe et al. 2008)

Another study from Ethiopia has a similar research setting as this thesis. They acquired the information from three different household surveys from years 1996-1998 and had an extensive sample size of almost 30 000 participants. As done in this thesis, they have compared the anthropometric measurements of children (focusing on HAZ) to the assessment of mothers of their child's growth. 53.7 % of mothers were correct in the growth assessments of their children. Mothers found stunted children not to grow normally in 49.5 % of cases (sensitivity) and not stunted children to grow normally in

75.7 % of cases (specificity). The study also pointed out that caregiver's nutritional knowledge and correct diagnosis of their child's nutritional status led to correct action, which in turn improved child's nutritional status (Christiaensen et al. 2001).

Nepal. A study from Nepal asked 283 mothers if they evaluated the size of their under five-year-old child to be small, medium or large. Mothers' evaluations were compared with anthropometric measurements of their children. The study had two main outcomes: the majority of mothers (68.4 %) did distinguish their child to be small when the child was moderately to severely stunted and underweight (HAZ and WAZ <-2SD). The mothers were more accurate in distinguishing their children to be "small" before the age of 36 months and less so after that. (Moffat 2000)

Mexico. Turnbull et al conducted a study in rural Mexico with 31 mothers of under 5-year-old children. They compared the child's anthropometry with mother's assessment of the nutritional status. It became apparent that mothers based their assessment of malnutrition on weight and not on limited height. Mother's assessment was 45.2 % correct when compared with weight-for-age and weight-for-height, but only 16.1 % when compared with height-for-age. (Turnbull et al. 2009)

The results of the above mentioned studies are not in line. The result of the Ethiopian study from 2008 suggests that improvement in mother's detection could be needed and the Ethiopian study from 2001 shows the majority of mothers (53.7%) being correct in their assessment. The study from Nepal shows that mothers are mostly aware (68.4 %) of their children's poor linear growth. The study from Mexico shows the opposite. (Abebe et al. 2008; Moffat 2000; Turnbull et al. 2009; Christiaensen et al. 2001)

3 THE AIM OF THE STUDY

The aim of this study was to determine whether mother's perception of the growth of her child is in line with the measured growth and if mother's education affects the perception.

Research questions:

- What is the congruence between mother's perception of her child's growth and the measured growth?
- How does mother's education impact her perception of her child's growth?

4 MATERIALS AND METHODS

4.1 The host study: iLiNS DOSE

This study is a sub study of a two-center, randomized, single-blind, parallel group controlled trial in rural Malawi called iLiNS-DOSE. It was testing the growth promoting effect of long-term complementary feeding of infants with different doses and formulations of high-energy, micronutrient fortified Lipid-based Nutrient Supplements (LNS).

This study used data collected for the iLiNS-DOSE study before the breaking of the code of the clinical trial. The inclusion and exclusion criteria for the sub-study were the same as in the trial, with one exception of participant age group that is wider in this sub-study.

4.2 Inclusion and exclusion criteria

Inclusion criteria:

- Signed informed consent from at least one guardian
- Age 4.8 months to 7.1 months
- Availability during the period of the study.
- Permanent resident of Mangochi District Hospital or Namwera Health Centre catchment area

Exclusion criteria:

- Weight-for-length Z score (WLZ) < -2.0
- Presence of oedema
- Severe anaemia (Hb <50 g / l)
- Severe illness warranting hospital referral
- History of allergy towards peanut
- History of anaphylaxis or serious allergic reaction to any substance, requiring emergency medical care
- Concurrent participation in any other clinical trial

4.3 Study site

The iLiNS-DOSE project was carried out in areas served by the Mangochi district hospital and the Namwera government health center in Mangochi District, southern Malawi. Mangochi is one of Malawi's 28 districts.

Mangochi district hospital outpatient clinic served an estimated population of 72,000 while Namwera health center served approximately 22,000. The hospital catchment area was partly semi-urban, as it is the headquarters of the district, while Namwera was primarily rural. Both sites could be accessed through all-weather roads. The population was mostly chi-yao speaking and earned a living mostly on farming and fishing.

Malawi has 15.3 million inhabitants. 47 % of the under-5-population in Malawi was stunted in 2011, the prevalence having decreased from 53% in 2006. The under-five population of Malawi is 2.82 million, which means approximately 18 % of the total population. (UNICEF 2013) 17% of the people living in Mangochi district are under 5 years of age, which is in line with the country's demographics. However, Mangochi district's population is considered to be relatively poor when compared to the Malawian context. (ICEIDA, 2012)

4.4 Participants

The target population for enrollment included healthy, 6-month-old infants who met all the inclusion and none of the exclusion criteria and who live in Mangochi or Namwera area, Mangochi District, Malawi. Eligible participants were identified through community surveys in the study area. Infants with eligible age and whose guardians showed interest in the trial were invited to trial office for a detailed eligibility assessment. In the trial office guardians were informed about the study and procedures related to enrollment. If the guardians wanted their children to undergo a full eligibility assessment, they were asked to sign a consent form. If the child met the enrollment criteria, were the guardians again informed of the study and its' practical implementation after which they signed a second consent form.

The infants enrolled to the trial between November 2009 and May 2011. Data used in this sub-study was collected from November 2009 to March 2011.

4.5 Study design

This sub study is a cross-sectional quantitative study with data collected as a part of a randomized clinical trial iLiNS-DOSE before the intervention started.

The children entered the clinical trial in the age of approximately 6 months and the intervention continued until the age of 18 months. During this time, there were six groups with different randomized feeding interventions.

A background interview of the study participants' family was done in the beginning of the trial (week 0). It contained questions about the age and the education of the parents, which was recorded as, completed years of education.

The caregivers were administered a questionnaire about knowledge, attitudes and practices (KAP) towards feeding practices, diet and growth of the child in the beginning of the trial (0 weeks), in the middle of the trial (25 weeks) and in the end of the trial (51 weeks).

In the KAP questionnaire caregivers were asked: "According to your opinion, is your child developing / growing well currently?" The answer was categorized as yes, no and not known. The caregiver was given a chance to specify why they think the child is not developing/growing well currently.

Child's length, weight, middle underarm circumference and head circumference were measured in weeks 0, 26 and 52 of the trial. As mentioned before, the data collected in the beginning of the trial (0 weeks) was used: the background interview to get information on mother's age and education, the KAP questionnaire to find out mother's perception of her child's growth and growth measures, especially length-for-age z-scores. Only data that was collected before the intervention took place was used to avoid the possible confounding of the LNS intervention.

4.6 Description of the main study variables

4.6.1 Mother's perception

Mother's perception was derived from the questionnaire given to the caregivers in week

0. In the questionnaire they answered question “According to your opinion, is your child developing / growing well currently?” The answer was categorized as yes, no and not known. Only “Yes” and “No” were included as valid answers, since there was only one answer stating “Not known”. Because of the research question, the desirable answers were the ones given by mothers and for that reason only mothers’ answers were taken into account.

4.6.2 Child growth

Child growth was measured as length-for-age z-score in week 0, when entering the intervention. It was grouped into two groups: stunted and not stunted. Child growth was examined both as a dichotomous and a continuous variable.

Length was assessed using a high quality length board (infantometer, Child Growth Foundation, London, UK) and recorded to the nearest 1 mm. Length-for-age (LAZ) and weight-for-age (WAZ) z-scores were calculated by using the WHO Child Growth Standards and computer software (WHO 2006). In the iLiNS-DOSE trial, LAZ was compared between intervention groups. In this study child growth was assessed cross-sectionally in one point of time with a variable length-for-age (LAZ).

4.6.3 Growth standards

Z-scores of the anthropometric data were calculated using the WHO growth standards. By using the WHO standards, the prevalence of stunting is higher than when using the National Center for Health Statistics (NCHS) growth reference. Study participants in the WHO growth standard population were from healthy environments and the infants were breast-fed unlike in the NCHS Growth reference population. It is said that the WHO standard is better in monitoring the changes in growth rate in early infancy. (de Onis et al. 2006)

4.6.4 Background information of the mother

Mother’s education was measured in years and also grouped into three categories: 0 years of school, 1-8 years of school and 9-12 years of school. In Malawi primary school consists of 1-8 years of education and secondary school 9-12 years of education. That means the first group was non-schooled mothers, second group was mothers who

attended 1-8 years of primary school and the third group was mothers who attended secondary school. Mother's age was given in years.

4.7 Data handling

Field workers in Malawi collected the data using paper forms. Data collection forms were reviewed daily by field supervisors for accuracy and completeness and then transferred to the data entry clerks for double data entry.

4.8 Data analysis and statistical methods

Data was entered and analyzed using SPSS statistical software for Windows versions 20-22. To get an overview of the data, descriptive statistics including frequencies were run on the age of children in the time of anthropometric measurements, the age of mothers, the length-for-age and weight-for-age of the children and the years of schooling of mothers. Mean values and standard deviation were presented in normally distributed values and median and interquartile range were presented with skewed distribution of values.

To make sure that only mothers' perceptions were taken into account according to the research question, the answers of the KAP questionnaire answered by other caregiver than the mother were excluded.

Mother's perception was examined in a dichotomized Yes (baby growing well) and No (baby not growing well). When examining the association with mother's perception, child growth was presented in two ways. Firstly, the association between mother's perception and dichotomized child growth (Not stunted, Stunted) was assessed with crosstabulation. Sensitivity and specificity were drawn from crosstabulation. Sensitivity is the ability of the mothers to correctly identify children who are stunted, whereas specificity is the ability of the mothers to correctly identify those who grow normally. Secondly, child growth using LAZ as a continuous variable were compared in the two groups of mothers' perception using independent samples t-test. The level of statistical significance was set at $p < 0.05$.

To examine if weight-for-age differed remarkably in the stunted and not stunted groups, the weight-for-age z-score mean values were calculated to both groups. Also weight-

for-age mean values were calculated to two groups of mothers' estimations "Yes, baby growing well" and "No, baby not growing well".

Mothers' perceptions were grouped into "correct" and "incorrect" perceptions. There were two "correct" groups: 1) mothers who detected their child to be growing well when their child was not stunted and 2) mothers who detected that their child was not growing well and their child was stunted. Also two "incorrect" groups were made: 3) mothers who thought their child wasn't growing well but the child was not stunted and 4) the mothers who said their child was growing well although their child was stunted.

The question "Is there an association with mother's correct perception and level of education?" was first examined comparing mean values for years of education to the four groups (1,2,3,4) explained above. Second, the level of education was grouped into 3 groups: 0 years of education, 1-8 years of education and 9-12 years of education. The association with mother's perception here was evaluated using crosstabulation. Statistical significance was assessed using Pearson's Chi-Square Test, assumptions having been met.

A possible association between mother's correct perception and age was evaluated by comparing group medians. Age medians were also compared between different education groups. Mother's age was taken into account to evaluate if it confounded the results by being a strong determinant of education groups.

5 RESULTS

5.1 Background characteristics of the participants

5.1.1 Children

There were 1932 children aged 4.7-7.1 months that participated in this study. Only the children, whose mothers answered the KAP questionnaire, were included. That makes 1119 children aged 4.8-7.1 months old. The median age of the child participants was 5.9 months (Q₁ 5.6; Q₃ 6.2). The length-for-age z-score of the child participants was between -5.73 SD and 1.80 SD. The mean value was -1.4 (standard deviation, SD ±1.05) SD. 28.4 % of the children participating this study were stunted. The mean weight-for-age z-score was -0.73 (SD ±1.18). 13.1 % of the children were underweight (weight-for-age <- 2 SD). The mean weight-for-age z-score for the not stunted group was -0.32 SD (SD ±0.99) and for the stunted group -1.76 SD (SD ±0.98). There were underweight members in both the stunted group and the not stunted group, but neither of the groups was clearly consisted of underweight children, which could be a confounding factor in mothers' assessment of child growth. Assessed with t-test, there was a statistically significant difference in the mean values in weight-for-age of those two groups: stunted and not stunted (p<0.001). See **Table 2** for summarized characteristics.

5.1.2 Mothers

In this sub study, the focus was on the 1119 mothers who had answered the KAP questionnaire. Also three fathers and ten with a status "other" had answered the questionnaire, but their answers were excluded due to the focus on mothers. There were 800 missing values in determining the respondent of the questionnaire.

The mothers that participated were between 15-51 years of age. Median was 25 years (Q₁ 21; Q₃ 29). 21.4 % of mothers had never gone to school, 64.8 % had gone to primary school for 1-8 years and 11.1 % had proceeded to secondary school, having a total of 9-12 years of education. Median was 4 years of schooling (Q₁ 1.5; Q₃ 7). The distribution of mothers' schooling in years can be seen in **Figure 1**.

The median age of uneducated mothers was 30 years (Q₁ 24; Q₃ 36). Mothers that had 1-8 years of education were on average 24 years old (Q₁ 20,5; Q₃ 27,5). And mothers

with the highest education, 9-12 years of school, were on average 25 years old (Q₁ 21; Q₃ 28).

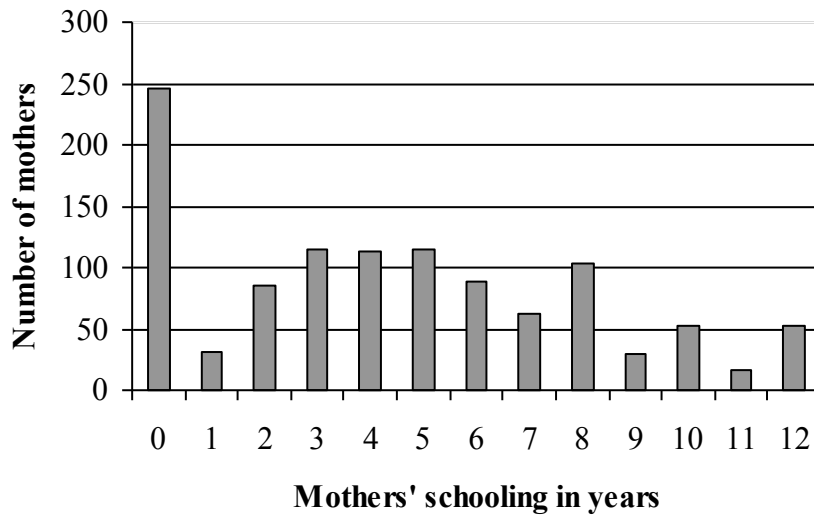


Figure 1. The distribution of mothers' schooling.

Table 2. Summary statistics.

Variable	N	Mean	Std. deviation	Median	Q₁; Q₃
Age of children in months	1119			5.9	5.6; 6.2
Length-for-age z-score of children	1114	-1.4	1.05		
Weight-for-age z-score of children	1119	-0.73	1.18		
Age of mother in years	1038			25.0	21.0; 29.0
The education of mothers in years	1108			4.0	1.5; 7.0

5.2 Stunting and mother's education

31.6 % of children of uneducated mothers were stunted. When mothers had gone to school 1-8 years, the percentage of stunted children was 29.2 % and with 9-12 years of schooling it was 20.0 %.

5.3 Detection of stunted growth

1087 mothers answered the question: "Is your baby growing well currently?". 74 mothers answered "No" and 1013 mothers answered "Yes". Half of the children whose mother answered "No (not growing well)" were in fact stunted and half of them weren't. 11.8 % of the mothers detected their stunted children to not grow well, hence sensitivity of mothers' detection was 11.8 %. 95.2 % of mothers assessed their children to grow well when their children were not stunted. Specificity was therefore 95.2 %. The cross-tabulation with above mentioned results can be seen in **Table 3**.

The children of the mothers who answered "No (baby not growing well)" had length-for-age z-score mean value -2.05 SD (SD \pm 0.96). It varied from -5.22 SD to 0.19 SD. The children of mothers who answered "Yes (baby growing well)" had length-for-age z-score mean value -1.36 SD (SD \pm 1.05). It varied from -5.73 SD to 1.80 SD. The mean value of the group that mothers detected to not be growing well referred to stunting (< -2 SD), whereas the mean of the children whose mothers thought they are growing well did not refer to stunting (≥ -2 SD). T-test showed that there was a statistically significant difference in the mean values of the two groups ($p < 0.001$). To compare with length measurements, mean values of weight measurements were examined. The mean weight-for-age z-score in children whose mothers answered "No (baby not growing well)" is -1.67 SD (SD \pm 1.03) and in children whose mothers answered "Yes (baby growing well)" -0.66 SD (SD \pm 1.17). Statistical significance was assessed with t-test and there was a statistically significant difference in the mean values of the two groups ($p < 0.001$).

Table 3. Crosstabulation of mothers' perception and children's measured growth. Sensitivity and specificity emphasized.

			Not stunted	Stunted	Total	
Mother's perception	Not growing well	Count	37	37	74	
		Percentage within the not stunted/stunted group	4.8 %	11.8 %	6.8 %	
			Percentage of total	3.4 %	3.4 %	6.8 %
	Yes, growing well	Count	737	276	1013	
Percentage within the not stunted/stunted group		95.2 %	88.2 %	93.2 %		
		Percentage of total	67.8 %	25.4 %	93.2 %	
		Count	774	313	1087	
Total			Percentage within the not stunted/stunted group	100.0 %	100.0 %	100.0 %
			Percentage of total	71.2 %	28.8 %	100.0 %

5.4 Accuracy in detection in relation to schooling

As seen in **Table 3**, 774 mothers (71.2 %) correctly estimated their children to be growing well or not growing well in congruence with their length-for-age z-score. 313 (28.8 %) of mothers' estimations were incorrect. There were 32 missing values among the 1119 mothers, which makes a total of 1087 valid answers.

The mothers who correctly estimated their stunted child not to grow well had gone to school for 3.0 years (Q₁ 0; Q₃ 6) on average. The mothers who correctly estimated their normally growing child to grow well had gone to school for 5.0 (Q₁ 2; Q₃ 8) years on average. The mothers who thought their child was not growing well when they in fact were had a median of 4.0 (Q₁ 1; Q₃ 7) years of schooling. The mothers who incorrectly estimated their child to be growing well, when they weren't had a median of 4.0 (Q₁ 1; Q₃ 7) years of school completed.

Mothers schooling was categorized in three groups: 0 years of school, 1-8 years of school and 9-12 years of schooling. 70.2 % of mothers with 0 years of schooling were correct in their assessment of child's growth. 70.7 % of mothers with 1-8 years of

schooling were correct in their assessment of child's growth. 76.8 % of mothers with 9-12 years of schooling were correct in their assessment.

Mothers' correct and incorrect detections (four groups presented below) were categorized by their three groups of schooling. As presented in **Table 4**, 5.9 % of mothers with no schooling detected their stunted children weren't growing well, when 2.1 % of mothers with 9-12 years of schooling detected their stunted child not to grow well. In contrast, the percentage of correct answers when normally growing child is perceived to be growing normally, is highest among mothers who have attended secondary school (74.7 %) and lowest in mothers with no education (64.3 %).

Table 4. Crosstabulation of mothers' schooling and the different groups of mothers' assessment combined with their child's stunting status.

	0 years of school	1-8 years of school	9-12 years of school	Total
Groups** 1	14	20	3	37
Percentage within the group of school years	5.9 %	2.9 %	2.1 %	
2	153	469	109	731
Percentage within the group of school years	64.3 %	67.8 %	74.7 %	
3	9	19	8	36
Percentage within the group of school years	3.8 %	2.7 %	5.5 %	
4	62	184	26	272
Percentage within the group of school years	26.1%	26.6 %	17.8 %	
Total	238	692	146	1076

** Groups of mothers' assessment combined with child's stunting status

- 1) Mother assessed child to not be growing well - Child measured as stunted
- 2) Mother assessed child to be growing well – Child measured as growing normally
- 3) Mother assessed child to not be growing well – Child measured as growing normally
- 4) Mother assessed child to be growing well - Child measured as stunted

6 DISCUSSION

6.1 Summary of the main findings

The congruence between mother's perception of her child's growth and the measured growth was examined in two ways. First, sensitivity and specificity of mothers' assessment were counted. 11,8 % of the mothers was able to detect their stunted children to not grow well. 95.2 % of mothers assessed their children to grow well when their children were not stunted. Second, the mean values of children's height (HAZ) in the two groups of mothers' assessment were compared and there was a statistically significant difference between the mean values of the two groups. These results are somewhat contradictory and are discussed further on in this chapter.

The impact of mother's education on her perception of her child's growth was evaluated comparing median values of school years in the different groups of mothers' detection and the mothers who correctly estimated their stunted child not to grow well had gone to school for 3 years on average. The mothers who correctly estimated their normally growing child to grow well had gone to school for 5 years on average. The mothers who were incorrect in their assessment had gone to school 4 years on average. In crosstabulation of the correct and incorrect groups of mothers' assessment and the years of maternal schooling, 5.9 % of mothers with no schooling detected their stunted children weren't growing well, whereas 2.1 % in mothers with 9-12 years of schooling detected their child's stunting. Both these results indicate that formal education does not improve mothers' detection of stunting.

6.2 Specificity in mothers' detection

The former studies showed implications of low correspondence between mothers' perception and child growth. However, in this thesis, mothers were mostly correct about their assessment of their child's growth. Mothers detected their normally growing (i.e. not stunted) children to be growing well excellently in this study. The specificity was 95.2 %, which means that almost all mothers evaluated their child that was measured to grow according to the growth standards, to be growing normally. Many of the former studies did not present similar research settings, but the results of a large Ethiopian study gave comparable specificity and sensitivity numbers. In their study mothers

evaluated their normally growing children to grow normally with 76 % specificity. That made specificity of this study, 95 %, to stand out. (Christiaensen et al. 2001)

In our study sample of 4.7-7.1 month-old infants, stunting prevalence was 28.4 %. That is lower than the Malawian prevalence of stunting in children under five years, 47 %. However, it is similar to the prevalence of stunting given for age groups: 25.3 % 0-5 month-olds and 38.8 % in 6-11 month-olds (Marriot et al. 2012). Most mothers (93.2 %) thought their child was growing well and in fact most children were. In many similar studies presented in the literature review, the majority of mothers thought that their child is growing well. In overweight detection articles 61 % of mothers in Brazil (Molina Mdel et al. 2009) and 78 % of mothers in Greece (Manios et al. 2009) considered their child's weight as normal. In an Ethiopian study 59 % of mothers thought their child appeared physically healthy (Abebe et al. 2008). It seems mothers tend to estimate their child's health and growth to be normal.

Most children in our study population were growing well (i.e. not stunted). Mangochi in Malawi is estimated to have a little higher prevalence in stunting than the national average (Maleta 2006). Although the sample had a stunting prevalence similar to the average in the age group, it is noteworthy to consider if mothers who show interest in attending a clinical trial are more aware of health issues and nutrition than the average mother.

6.3 Sensitivity in mothers' detection

The objective of this study was to determine the congruence between mother's perception of her child's growth and measured growth. The specific question of interest was how well mothers detect their child to be stunted. It seemed that not too well. Sensitivity was 11.8 %. Christiaensen et al. found Ethiopian mothers to evaluate their stunted children not to grow well with 50 % sensitivity.

6.3.1 Reasons for low sensitivity

As noted in former studies, detecting underweight was easier for mothers than detecting stunting (Turnbull et al. 2009). In Malawi, children go to health check-ups regularly, but only weight is measured because of its feasibility. It is only lately that height has been internationally acknowledged to be an important determinant of health (Prendergast et al. 2014) and it seems that the message of the importance of measuring height has yet

not reached the grass roots, not the primary health care nor the mothers. If the weight is measured to be normal, a mother has no reason to believe her child is not growing well. In fact, 86.9 % of children were normal weight. And comparing the mean values of the stunted group and not stunted group, the mean weight-for-age was significantly lower in the stunted group, but still categorized as normal (-1.76 SD).

It was asked in the KAP questionnaire if the baby was growing well, and it was not specified on height gain. Because height is traditionally not measured in Malawi, there has been no scale for a mother to evaluate her child's height. Generally, children's height and weight are evaluated using standardized growth curves to track the growth in a comprehensible manner. The WHO growth standards and NCHS growth reference are presented in the literature review. Growth curves help caretakers to get a good understanding of child growth, but when they are not used, mothers need to use other manners to evaluate child growth. One could think that without growth curves any mother would have difficulty in assessing the growth of her child, in Malawi or in Finland. However, a study by Ruel et al. indicated that teaching mothers how to read growth curves did not add value to mothers' nutritional education (Ruel et al. 1992).

When growth curves are not used, comparing one's child to same age peers could be helpful manner to evaluate growth. In this study group children were on average six months old, which means they were not standing or walking yet. That poses a complication in comparison of heights of children. When growth curves on height are not used and comparison to same age peers is difficult, a mother does not really possess a scale to evaluate her child's growth. Mothers' assessment is said to be more accurate before the child turns 36 months (Moffat et al. 2000). The results of this study cannot comment on if mothers' assessments improve, as their children become toddlers, because it is focused on one point of time.

All in all, considering the somewhat recent awakening to the importance of height gain and risks of stunting, and combining that information to the low sensitivity of mothers' assessment in this study, it seems likely that mothers in the rural Malawi do not pay special attention on height gain of their children.

6.3.2 Contradictory results of comparing mean values

When comparing the mean values of the two groups of mothers' perception, there is a statistically significant difference in the mean values of the two groups of mothers' perception: not growing well and growing well ($p < 0.001$). Children of the mothers who thought their child was not growing well had a mean length-for-age z-score of -2.05, which is classified as stunting (< -2 SD). Children whose mothers thought they were growing well had a mean of -1.36 SD, which is classified as normal growth. This indicates that mothers do detect the poor growth of their children, which is contrary to the low sensitivity. This result might be affected by the fact that a vast majority of mothers were correct in their estimation, although detection of stunting wasn't high.

6.4 Maternal education in relation to their assessment of their child's growth

The second objective of this study was to examine the relation of mother's schooling to the accuracy of her perception of her child's growth. As mentioned earlier, mother's education has identified as an important underlying factor in child's stunting (Menezes et al 2009, NSO 2011, and Grantham-McGregor et al. 2007). Only one of the studies presented in the literature review commented on the relation of maternal education and mother's accuracy in assessing child's growth. Hager et al. noted that maternal education was not related to accuracy of mother's assessment of her child's growth. (Hager et al. 2012)

The prevailing fact that the prevalence of stunting in children decreases as the amount mother's school years increase was also true in this study. Stunting prevalence was 32 % in children of non-schooled mothers; where as stunting prevalence was 20 % in children who had gone to secondary school.

The group of mothers with highest schooling (9-12 years) was 77% correct in their assessments of child growth, whereas non-schooled mothers were 70 % correct. Interestingly, uneducated mothers detected poor growth (5.9 % of the mothers in the uneducated group) better than mothers with secondary education (2.1 %). The mothers who detected poor growth had an average of 3 years of schooling, where as incorrectly estimated mothers had gone to school for 4 years on average. Hence, uneducated

mothers are more accurate in detecting stunted growth, but are more likely to answer correctly when assessing both good and poor growth.

To search for an explanation for this, age averages of non-schooled, primary schooled and secondary schooled mothers were compared. The mothers in the non-schooled group were on average 5 years older than the mothers who had gone to school any number of years. Parity of mothers was not included as a background factor to this study. One can only ponder if older mothers had more experience in child upbringing and therefore detected poor growth better. The results of Burchi in Mozambique showed that mother's primary education was associated with a better nutritional status of the child, but that the nutritional information that improves the diet was obtained outside the classroom (Burchi 2010). Perhaps older mothers have gained more non-formal education on nutrition even though they have not been formally educated. In contrast, the mothers with secondary schooling in this study detected normal growth accurately on 74.7 % of cases, where as the unschooled mothers detected 64.3 %. Finlay et al. wrote that young under 27-year-old first time mothers have a higher risk of having a stunted child (Finlay et al. 2011). Although not directly applicable to why older uneducated mothers detect their children's poor growth better than the educated mothers, it could imply that experience in child upbringing protects from stunting through a pathway not specified.

6.5 Maternal education as a means to reduce the prevalence of stunting

The results of this thesis do strongly indicate that the accuracy of mothers' detection of poor growth is needed. Although based on the results, formal education of mothers does not seem to improve mother's ability to diagnose stunting, some of the former studies still suggested that education in general would be beneficial. Christiaensen et al. suggested that teaching communities to detect growth faltering would be an effective way to address growth faltering in Ethiopia (Christiaensen et al. 2001). Burchi wrote that although mother's primary education in Mozambique was clearly associated with better nutritional status of the child, better nutritional information that enhances the diversity and nutritive qualities of the diet are obtained outside the classroom in non-formal education programs. (Burchi 2010) Bhutta et al. wrote that the effect of nutrition education on stunting was only statistically significant in food insecure populations, yet

nutrition education increased HAZ in both food secure and food insecure groups (Bhutta et al. 2008). Charlton et al. noted that the impact of underlying determinants of malnutrition, such as poverty and unstable living conditions, was bigger on health behavior than the growth monitoring and promotion (GMP) programs, regardless of their quality and effectiveness (Charlton et al. 2009). Teaching mothers or communities to detect stunting, would be beneficial, but not a comprehensive approach against childhood stunting.

6.6 Addressing the key determinants of stunting

It is important to acknowledge that the problem of child malnutrition is complex and one single intervention cannot solve it. Future implications should therefore be targeted to the key determinants. Black et al. wrote that child's nutritional status is mostly determined by health, food security and adequate care (Black et al. 2008). These determinants are in turn affected by a variety of factors. For example being food secure means having enough nutritious food available at all times and having the knowledge and means to use it properly (FAO, 2006). In addition to ensuring food security, providing equal schooling opportunities for all the children in the world would solve many of the problems of child malnutrition.

Key determinants of stunting are said to be parental education, food prices, household resources and maternal nutritional knowledge (Christiaensen et al. 2001). The Millennium Development Goals addressed these very matters directly or indirectly. The first Millennium Development Goal was to eradicate extreme poverty and hunger and the proportion of undernourished people did fall from 23.3 % in 1990 to 12.9 % in 2014. The number of people living in extreme poverty (living on less than \$1.25 a day) declined from 1.9 billion in 1990 to 836 million in 2015. The second Millennium Development Goal was to achieve universal primary education and as a result the net enrollment rate to primary school in the developing regions did rise from 83 % in 2000 to 91 % in 2015. The Sub-Saharan Africa had the best record of improvement. (United Nations 2015) Thus, progress supposedly leading to a decrease of the prevalence of stunting has already been made. In addition to the Millennium Development Goals, four sectors of programs that are also targeted to affect the key underlying factors of nutrition were presented by Ruel et al.. The four sectors included agriculture, social

safety nets, early child development and schooling. The intervention that showed the strongest association with improved nutrition outcomes was parental education; associations with interventions from other sectors were left weak. (Ruel et al. 2013)

The long-term outcomes of the Millennium Development Goals on nutrition will present themselves in the future. The exact effect on stunting will turn out in generations to come, when more future mothers have achieved primary education, poverty is less extensive and food security has reached a wider population.

6.7 Limitations of this study

This study was located in Malawi that has a high burden of stunting in under-five-year-olds, the prevalence being 47 % (UNICEF 2013). The global prevalence of stunting was 26 % in 2011 (UNICEF-WHO-WB 2012). Therefore the results of this study cannot be generalized globally since, as noted, the burden is unevenly distributed. The variety of presented percentages in mothers' detection 16.1-68.4 % in former studies imply that generalizing these results even in the countries where the prevalence of stunting is high, is not reliable. Study designs also vary significantly and the question of interest still requires more research in order to reach some congruence to the results globally.

The age of the study participant children, six months on the average, is significant when thinking about the timing of stunting. However, estimating linear growth in six-month-olds can be challenging. Only one point of time was examined, the time when children entered the trial in the age of six months. It helped to avoid the confounding factor that the intervention of the iLiNS-DOSE clinical trial could have presented. Yet, some follow-up information on how the children are growing and if the estimations of mothers change, would have been valuable. It was not specified in the KAP questionnaire, if mothers were expected to assess their baby's growth in terms of linear growth or weight. The answers of mothers were however compared primarily with length-for-age measurements.

The number of variables in this thesis was somewhat limited when considering all the possibilities that more family background information could have brought. Parity of mothers, family income, feeding practices would have been interesting aspects of

research. Nevertheless, including a wide range of variables wouldn't have helped me to answer my research questions.

7. CONCLUSIONS

The focus of this study was to examine how mothers detect poor linear growth of their children. The results show that the congruence between Malawian mothers' perception of their child's growth and the measured growth is remarkably low in stunted children when comparing to former studies. Mothers do, however, identify their not stunted child to grow normally rather accurately. The impact of mothers' schooling on the accurate detection of stunting proved to be a scarcely researched matter, which is why a wide comparison to former studies is difficult. The results of this study show that higher education does not help mothers to detect stunting any better. As a matter of fact, the least educated group of mothers was the most correct in their assessments. This study is not able to answer why that is and the reasons can only be discussed in the light of previous studies.

Based on an extensive review of literature and the results of this study, I suggest the following first steps to be implemented in order to reduce the prevalence of stunting in countries with a high burden of stunting. Firstly, growth monitoring programs or health check-ups in primary health care should entail the measuring of length. Growth monitoring should not only rely on weighing. Secondly, children would benefit from mothers' or community's education on the importance of height gain in early childhood and how to improve it. This means, however, that also primary health care nurses or community health workers should be aware of stunting as a sign of malnutrition and how to address it already when length starts to falter. These steps would perhaps not need extensive resources. Their effect should surely be researched further. The presented interventions such as promotion on breastfeeding and timely and adequate complementary feeding could be presented concurrently. I do not think that the ten core interventions introduced by Bhutta et al. should not be implemented, but if resources are scarce, these are the steps I suggest to be taken first. (Christiaensen et al. 2001; Bhutta et al. 2013)

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