Impact Of Maternal Socio-Economic Determinants On Early Childhood Stunting In Maldives: An Analysis Of Maldives Demographic Health Survey 2009

Aminath Adeela, Dr. Kay Seur

Abstract: Under nutrition is a direct consequence of poverty with its' characteristics of low socio-economic status, poor living conditions, poor maternal education, large family size, inadequate access to quality food, safe water and health services. Recently, there have been significant improvements in the overall health of the Maldivian population with an increase in life expectancy and a decline in maternal and infant mortality rates. However, infant under nutrition is still a concern. Field testing of WHO growth standards in 2006 in Maldives indicated that more than one third of children under five years were stunted and that children classified as tall hardly reach the WHO standard for mean height. Examining maternal characteristics that may contribute to under nutrition in Maldivian children will assist in designing/implementing population based public health interventions aimed at improving infant and childhood nutrition. This study is based on secondary analysis of data from the Maldives Demographic Health Survey (MDHS) 2009. The study results showed that height for age z-score was lowest from ages 6 to 29 months. Factors significantly associated with the rate of stunting included: size of child at birth, height of the mother, duration of breastfeeding, difficulties in obtaining money needed for medical help for mother, absence of a health service provider when obtaining medical help for mother, after adjusting for socio-economic factors.

Key words: under nutrition, stunting, malnutrition, breastfeeding, urban and rural, maternal, Maldives.

1. Introduction

Malnutrition is the key nutritional problem faced by the developing world. Approximately 65 % of child deaths under five are due to some form of malnutrition and under-nutrition represents one third of disease burden of children and mothers (Kordas et al., 2008, Bharati et al., 2010, Bryce et al., 2008, Petrou and Kupek, 2010). In 2005, an estimated 178 million under five children were stunted, 112 million were underweight and 55 million were wasted in developing countries (Petrou and Kupek, 2010). Furthermore, there is strong evidence, indicating South East Asia (SEA) and Sub Saharan Africa (SSA) accounts for the highest number of under nutrition of children worldwide (Olusanya and Renner, 2011).

1.1 Costs of malnutrition

According to World Bank, the Maldives has higher rates of stunting than its lower income neighbors (WHO, 2011). Even though Maldives performs better than many of its neighboring countries, its stunting prevalence is higher than many African countries with a much lower per capita income, indicating that nutrition is not only associated with income alone.

1.2 Under nutrition in Maldives

While there have been considerable improvements in infant mortality, infant malnutrition is still of major concern. In Maldives, the field testing of WHO growth standards has shown that 37% of children under the age of five years were stunted and those children who were classified as tall barely reach the WHO standard for mean height (Onyango et al., 2007). The National Nutrition Survey in 1994 estimated that 43% of children under the age of five years were underweight (WHO,2011). The Vulnerability and Poverty Assessment Report in 1997 (MPND, 1998)estimated that 45% of Maldives' children under the age of five years were under nourished, even worse than the situation in Sub Saharan Africa back then (WHO,2011). However, the Multiple Indicator Survey in 2001 revealed that the percentage of under nourished children had gone down to 30% (Ministry of Health, 2002). Likewise, the Vulnerability and Poverty Assessment in 2004 has shown a further decrease to 27% (Ministry of Health, 2004). Although this decline in under nutrition in Maldives is marked, the prevalence of underweight, stunting and wasting is still high. It is estimated that one in every four children in Maldives would still be underweight even by the year 2015 (WHO, 2011). According to recent Maldives Health Statistics, 50 % of women aged 15- 19 and 33% of women aged 20-24 have a body mass index (BMI) below 18 Kg/ m^2 or is under weight (Ministry of Health and Family 2009). Given that the Maldives consists of barren sandy islands, the population is used to a diet consisting of fish without fresh produce and 10% of school children and 20% of pregnant women are suffering from vitamin A deficiency and even furthermore, 82% of preschool children and 55% of pregnant mothers are anemic as well (UNICEF, 2010). In addition to these, according to WHO, fewer than 10% of Maldivian babies are being breastfed exclusively and during the important period of transition from only breast milk to mix of solid foods and breast milk, 15% are not being fed appropriately (WHO, 2011). With a quarter of children under five years being stunted, Maldives is among one of those countries with highest rates of under nutrition in South Asia (UNICEF, 2010).

1.3 Maternal health and under nutrition

The nutritional status of a child is affected by many factors that start even prior to conception. A major factor in child nutritional status is not only the mother's nutritional status but also a number of socio-economic factors. Improvements in women's socio-economic status can positively affect the nutritional status of children in a country (Shroff, 2007). Various maternal factors such as low calorie diet, low intake of iron and smoking can have an adverse impact on fetal growth (Engmann et al., 2008). These can

also have long term effects postnatally and can increase the prevalence of childhood under nutrition (Engmann et al., 2008). In addition, around 50% of pregnant women are found to be having iron deficiency and maternal anemia during pregnancy is found to be associated with low birth weight (Zheng, 2011).The main cause of iron deficiency among pregnant women is an inadequate intake of iron and insufficient intake of vitamin C resulting in poor absorption of iron (Rodríguez et al., 2007).

1.4 Significance of the study

Although there are reported high rates of underweight and stunted children in Maldives, there are no studies in the Maldives that examine the factors that may be contributing to these numbers. This study will provide evidence that can be used by policy makers and public health practitioners to design effective public health intervention strategies for improving the nutritional status of children in Maldives.

1.5 Aim

The aim of this study is to undertake a secondary analysis of data from the Maldives Demographic Health Survey (MDHS) 2009 to describe the prevalence of stunting among infants and under five children and to explore maternal socio-economic characteristics associated with infant and childhood stunting.

1.6 Objectives

- To document the national prevalence of stunting among children under the age of five years in Maldives.
- To determine any difference in stunting prevalence between male and female children in Maldives.
- To identify maternal socio-economic predictors of infant and child stunting (maternal age, maternal height, maternal body mass index (BMI), number of living children, breastfeeding, size of child at birth, maternal education level, socio-economic status, marital status, desire for more children, access to health services, maternal decision-making on various household issues).

1.7 Limitations of the study

The causes of child stunting are complex and reflects long term under nutrition due to many factors including, low quality diet, poor breastfeeding practices, and infections combined with environmental determinants. Such factors cannot be easily measured in a cross-sectional survey. Similarly, the effects of mechanisms associated with the variables could not be studied as a thorough understanding of the causal pathways of different variables is crucial for generating sound policies for improvements in population health (Jehn and Brewis, 2009). Genetic variations for the height and weight of children could not be taken in to consideration when comparing with the reference group although there is a belief in Maldives that stunting in children is due to the short statures of their parents. Information used in the analysis came from the survey that may have been subject to recall bias including the mother's reporting of the birth weight and the size of the child and the number of months breastfed. Moreover, due to the missing data and extreme values, information about 1632 children have been excluded from the study and this may have posed a huge limitation on the results. The excluded sample was different from the study sample by the wealth index and educational level.

2. Literature Review

Under nutrition is a form of malnutrition and includes low height for age (stunting), low weight for age (wasting) as well as micro nutrient deficiencies (Peterson, 2009). Evidence suggests that under nutrition in infants start as early as two months. Under-nourished infants and children who survive often suffer life-long consequences including a delay in cognitive and physical development, increased risk of infections and other morbidities and are at greater risk for diabetes and/or cardiovascular diseases later in their adult life resulting in higher rates of adult mortality (Gupta and Dadhich, 2008). When compared to well-nourished children, the risk of mortality from common childhood illnesses is doubled for mildly malnourished, tripled for moderately malnourished and is as high as eight times the risk for severe cases of malnourished children (Khan et al., 2007). In 2005, around 32% of children under five years in developing countries were stunted with a height for age z-score below -2 standard deviations (Peterson, 2009). Given that under nutrition is highly prevalent amongst children under five, it is important that the factors contributing to the underlying problem are well understood and appropriately addressed across the developing nations to lower the high rates of infant and child mortality and morbidity (Gupta and Dadhich, 2008)

2.1 Childhood Stunting

Growth is a sensitive indicator of the child's nutritional status. Growth can be divided into different periods, starting from prenatal, infancy, childhood to adolescent (Goulet, 2010). Growth in prenatal period is the most remarkable as its velocity is never matched again (Goulet, 2010). The next most rapid growth occurs in infancy with a rate of 20cm per year during the first few months and then slows to 10-20 cm at year one and the other period of most rapid growth is during puberty (Goulet, 2010). Therefore, the first two years of life as well as puberty are the essential periods in growth and development to be taken into consideration (Goulet, 2010).

2.2 Adverse outcomes of infant and child stunting

Stunting in children is linked to poor cognitive, motor and socio-emotional development that continues throughout adulthood resulting in decreased work capacity, adverse health outcomes in women and increased risk for mortality during childbirth (Semba et al., 2008). Grantham-McGregor and colleagues report, after analysing worldwide available data that stunting in children is associated with fewer years of schooling and that stunted children also attain lower grades in school than other children of their age (Grantham-McGregor et al., 2007). Stunted children who show reduced learning capability and/or poor educational achievements may result in failing to complete secondary and even primary education (Black et al., 2010). Research has shown that height for age (stunting) is significantly associated with IQ levels and school performances even after controlling for socio-economic factors in contrast for weight for height (Grantham-McGregor et al., 1996). Most importantly, stunted growth is an important determinant of a country's human capital and economic development (Chen

et al., 2010). Stunted girls, who are often short adults, have increased risk for adverse pregnancy outcomes due to their short stature (Lartey et al., 2000).

2.3.1 Maternal BMI

It has been estimated that around 10-19% of women of reproductive age are under-nourished with a BMI of less than 18.5 and are at risk of delivering low birth weight infants (Bhutta and Haider, 2009, Black et al., 2008). The Dutch famine in 1945 (a classical natural experiment) during which a food embargo resulted in restriction of calorie intake of pregnant women by 30% of the recommended daily intake and this resulted in 8-9% decrease in weight of newborns (Sayers and Lancaster, 2008). In addition to that, teenage pregnancies are at greater risks for infant mortality than women who get pregnant at 20 -29 years (ALAM, 2000). The adverse effects of teenage motherhood is greatest during the neonatal period and as teenagers have much lower Body Mass Index (BMI) than their counterparts, low pre-pregnancy BMI can be associated with increased risk for low birth weight babies and potentially be at higher risk for mortality (ALAM, 2000). According to a study in Malawi, an important causal factor for child stunting is low birth weight as low birth weight babies remain lighter and shorter than their counterparts during infancy (Kalanda et al., 2005). However, early marriages and early pregnancies right after marriages are well desired in rural parts of most Asian and African countries (ALAM, 2000). While prenatal maternal nutrition plays a major role in the brain development as well as neurological development of fetus, deficiencies in some specific micronutrients such as vitamins and minerals including protein, iron, zinc, selenium, iodine , folate, and vitamin A during pregnancy can have a huge impact on growth and development of the fetus as well (Hernández-Martínez et al., 2011). Iron deficiency during pregnancy can increase the risk for low birth weight babies and premature delivery (Barooti et al., 2010). When iron deficiency becomes severe, anemia becomes apparent and develops gradually. Consequently, it is understood that there is a positive relationship between anemic mothers and their children being stunted (Brennan et al., 2004). It has been estimated that 50 % of pregnant mothers and children of age one to two years, almost 25% of pre-school children and 40% of school aged children and 35% of non-pregnant women are anemic, worldwide. Causes of anemia include deficiency of micronutrients such as folate, vitamin B12 and vitamin A; with their combination or even alone and some evidence suggests that deficiencies of vitamin B6, vitamin C, riboflavin can even contribute to the development of anemia (Shamah, Villalpando et al. 2008). Some other important factors contributing to iron deficiency anemia include low dietary intake of iron and low bioavailability of dietary iron as well as loss of iron due to worm infestation and malaria, thalassemia and pregnancy (Shamah et al., 2008, Bhargava et al., 2001, Lynch, 2011). Intakes of meat, fish, poultry together with Vitamin A and C which enhances iron absorption can bring about significant changes in the results of intervention programs (Bhargava et al., 2001, Rodríguez et al., 2007).

2.3.2 Breastfeeding and stunting

Breast feeding during the first year of life is crucial for proper growth and development as it contains all the necessary nutrients in the right amounts for proper digestion, brain development and growth (Li et al., 2010). It contains just the right amounts of fatty acids, lactose, water and amino acids and many other bioactive ingredients such as hormones, growth factors, nucleotides and cytokines for optimal growth and brain development (Li et al., 2010). In the same manner, a study in Kenya showed that continuing breastfeeding in the second year of infant life had a positive significant association between linear growth and duration of breastfeeding and biologically it can be explained by high dense energy content in the breast milk (Onyango et al., 1999). According to the new WHO child growth standard, breastfeeding is the biological norm for optimal growth and development of infants (WHO, 2006). However, impact of duration of breastfeeding on the linear growth of the child is debatable as both negative and positive associations between breastfeeding and linear growth in infants and children had been observed. A study of survey data from nineteen demographic health surveys has shown that there were nutritional differences among children depending on whether they were breastfed or not and that breastfed children were lighter and shorter than weaned children and these differences were apparent between 12- 18 months of age. Prevalence of stunting among children > 12 months was found to be 20 -70% (Caufield et al., 1996). According to another study which compared infants who were breastfed for more than six months and formula fed infants, increased prevalence of stunting was observed among those who had been breastfed for a longer duration than their counterparts. Another study in Ethiopia to assess factors associated with child growth in infants aged 5 to 11 months of age, showed that infants who were fed more than 3 times per day or consumed more than 600 ml per day or received cow's milk in addition to complementary foods had significantly higher rates of z scores than those who consumed less food or did not receive cow's milk (differences: 0.39, 95% confidence interval (CI): 0.04-0.74; 0.17, 95% CI: 0.02-0.32; 0.40, 95% CI: 0.07-0.72) (Umeta et al., 2003). These can be explained by the high levels of protein in formula feed which may lead to higher insulin levels and development of adipose tissue, eventually resulting in increased weight gain and even can increase the risk of obesity and other morbidities later in childhood (Kramer et al., 2011).

2.3.3 Family planning

Due to the wider interval between pregnancies, family planning can have huge benefits on the health and well-being of children, including their nutritional statuses and is considered to be one of the most cost-effective ways of reducing child morbidity and mortality (Cleland et al., 2006). Conceptions less than 18 months from the previous pregnancy are at greater risk for premature birth, low birth weight and even foetal death (Cleland et al., 2006). Higher risks for infant and childhood morbidity and mortality have been related with shorter birth intervals. Birth interval is defined as the time between two live births. An analysis of data from Demographic Health Surveys from 17 developing countries between 1990 and 199 suggested a strong link between relatively short intervals and stunting with 43% of

stunted children having a birth interval shorter than 18 months (Rutstein, 2005). It was also noted that mothers whose birth spacing interval is between two and six years were less likely to have premature babies and a linear decline of stunting has been observed with an increase in birth interval (Rutstein, 2005). In another analysis of the findings from three studies in United States suggest that the risk for adverse outcomes of delivery is lowest when the birth interval is between 18 - 23 months and it increased with the increase in interval from 18 – 23 months (Zhu, 2005).

2.3.4 Educational levels

Good infant feeding practices are influenced by maternal education level. A study conducted in US to explore the maternal characteristics related with important feeding practices has shown that having a college education had more impacts on positive infant feeding behaviors than any other maternal characteristics (Hendricks et al., 2006). Likewise, studies in Bangladesh and Indonesia show a positive association between height- for- age z-score of children with higher levels of formal education of parents (Semba et al., 2008). According to Semba and colleagues, increased use of health promotion activities such as Vitamin A supplementation and vaccination by educated parents has positive influences on the growth of their children. This is also in consistent with another study of data from Demographic Health Surveys from 2004 to 2006 in Peru, showing that mothers with no formal education or incomplete primary education are four times more likely to have stunted children than mothers who have higher education or completed primary education (Urke et al., 2011). As mothers usually take the responsibility of allocating family resources for improving nutritional status of their children, education can also increase mothers' decision making power and thereby improving the nutrition status and eventually physical growth of their children (Wachs, 2008).

3. Methodology

3.1 Study Location

This study is a secondary analysis of the data from the Maldives Demographic Health Survey (MDHS) 2009 conducted by the Ministry of Health and Family with technical assistance from ICF Macro, USA. Data collection and field work for the MDHS 2009 was started in Male' on January 8, 2009, covering all areas of Maldives and was completed in October 2009.

3.2.2 Inclusion/ exclusion criteria

The data set used in this study included survey data containing all relevant socio-demographic information about ever-married women aged 15-49 with at least one child. The original data set contained records of 3817 mothers and their index child (the youngest child if mother had more than one child under 5). From that original sample of 3817 a number of subjects were excluded. These exclusions included (1) 1361 children whose height was missing, (2) 8 children whose age was missing, (3)31 sets of twins, (4) 85 children who had extreme values for height-for-age z-score according to WHO reference standards (likely to due to miscoded data), (5) 12 mothers whose weight was missing and 3 mothers who had extreme values for age (values that were not possible and likely to be miscoded data), and (6) 132 mothers who were pregnant. The final analytical sample included 2185 mothers with at least one singleton child under the age of five years.

3.3 Outcome measure

3.3.1 Child's nutritional status

The three main indicators used for assessing the nutritional status of children under the age of five years were stunting (low height for age), wasting (low weight for height) and malnutrition (low weight for age) (Bronte-Tinkew and DeJong, 2004). The main dependent variable used in this study was stunting (low height for age) as it reflects the child's past nutritional status or chronic nutritional deficiencies Stunting is defined as "the end result of reduced linear growth" and is characterized by slow growth of skeletal stature and repeated periods of malnutrition delay catching up with the normal growth, leading to stunting (Semba et al., 2008). The degree of moderate to severe stunting is the percentage of children who falls below -3 standard deviations from the mean and median height and weight of the reference population (WHO 2006). It has been estimated that 32% (178 millions) of children in developing countries has a z-score of less than -2 for their height and age with reference of WHO standards (Black et al., 2008). Wasting is often due to recent or current episode of under nutrition associated with a disease condition or acute shortage of food (Bronte-Tinkew and DeJong, 2004, Tarozzi, 2008). In this study, height and age of the child was used to calculate the Height for Age z- score, using WHO anthropometric software (ENA SMART) and then compared with WHO reference standard(Erhard and Gross., 2010). **Children whose z-score fell below -2 standard deviations from the reference group are classified as stunted for the purpose of data analysis in this study (WHO, 2006).**

3.4 Exposure Measures

3.4.1 Child Characteristics

Information about child's current age, gender, height, weight, size of child at birth, whether the child was being breastfed at the time of the survey and duration of breastfeeding was used for this study. Gender was used as a dichotomous variable with the value of 1 for males and 0 for females. Age of the child is recorded from 0 to 59 months. Height was measured in centimetres and weight was measured in kilograms at birth. Weight measurements were taken using the lightweight SECA mother infant scales designed by UNICEF. Height measurements were taken standing using a measuring board produced by Shorr and for children less than 24 months and measurements were taken while lying down (Ministry of Health and Family 2009).

3.4.2. Maternal Characteristics

The primary focus of this study was to investigate maternal socio-demographic correlates of childhood stunting. The following demographic information of mothers was extracted from the data: mother's age at the time of the survey, educational status, wealth index, height of the

mother, maternal BMI (Body Mass Index), duration of breastfeeding, marital status, number of children, desire for more children, if mother was giving child tinned/powdered milk, whether mother was having problems for getting money for obtaining medical health, mother's concern over the absence of a health service provider, if mother had final say on purchasing large household items. Maternal under nutrition was calculated using their body mass index (BMI) and defined as having a BMI of 18 Kg/m^2 or less as recommended by WHO.

3.5 Statistical Analysis

The study population's characteristics were summarized using means with standard deviations (SD) for the continuous variables and percentages for the categorical variables. The height-for-age z –score values were calculated using WHO ENA SMART software and using the 2006, WHO growth standard (WHO 2006). Chi square test was used as the test of trend for comparing prevalence of stunting among the study variables. Independent predictors of childhood stunting were investigated using univariate analysis to calculate the differences in various maternal socio-demographic variables with regard to differences in the haz-score of children. Variables significant in the univariate analysis were included in the logistic regression model and crude odds ratio (OR) and adjusted OR were calculated to study the predictive power of independent study variables in relation to childhood stunting. All statistical analyses were performed using SPSS version 18.0 with the statistical significance set at a p value ≤ 0.5.

3.6 Ethical Issues

This study used data previously collected by ICF, Macro for the Maldives Demographic Health Survey 2009. Permission to use data was granted from ICF, Macro and their rules and regulation regarding the use of data were maintained. The data used in this study came from a number of surveys and data sets. The data sets used consisted of de-identified data thus assuring confidentiality.

4. Results

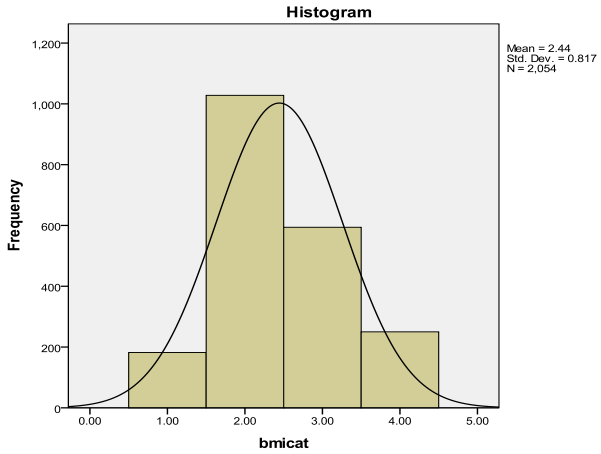
4.1.1 Child Characteristics

The average age of children was 28.3 and the average height was 84.3 centimetres. Average birth weight was 3.045 kilograms. Mother's perception of their baby's size at birth indicated that 13.5% of newborns were small, 15.7% were considered large and 70.6% were thought to be about average in size at birth. According to the mothers, 62.2% children were being breastfed at the time of the survey, however, 37.8% children were given some form of milk other than breastfeed and 27.4% children drank from a bottle with a nipple. The average month of breastfeeding was 17.6. In the last two weeks prior to the survey, 29.2% children had fever, 30.5% children had cough and 5.4 % children had diarrhoea. However, results show that 35.1% children had not received any drugs for intestinal parasites in six months prior to the survey and just 37.8% children had received a Vitamin A dose in their life time while 24.3% had never received any.

4.1.2 Maternal Characteristics

The majority of mothers (58.8%) were less than 30 years of age. The mean age of mothers when they had their first child was 21 years. On average, mothers had given birth to 3 children. Majority of the mothers had BMI within normal range (n=1028, 47%), however, more than one fourth (27.2%) were overweight and 11.4% were obese. It has been found that (n= 182)8.3% were underweight. At the time of the survey, 34.5% mothers were employed while 65.4% were not working. Almost a quarter of mothers (21.7%) had more than three children and 44% mothers had between 1 and 3 and 34.3% mothers had a single child. The average number of children ever born was 3.

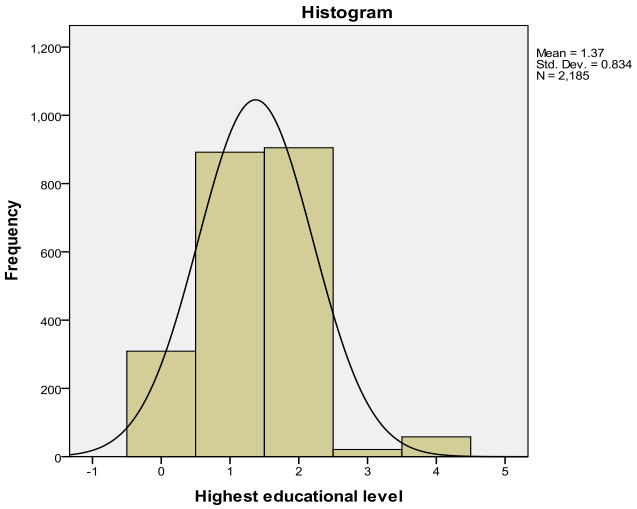
Figure 2: *Frequency distribution of BMI*



1= underweight
2=normal
3= overweight
4= obese

In terms of education, most mothers in this study had either a primary (40.8%) or secondary (41.4%) with a small number having a higher education (2.7%). In addition to that, 14.1% mothers had no education.

Figure 3: *Frequency distribution of maternal educational level*



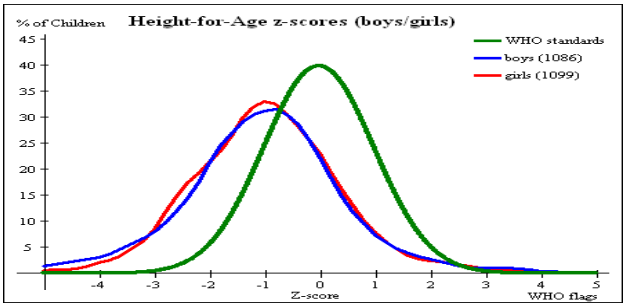
1= No education
2= Primary education
3= Secondary education
4= Unknown
5= Higher

Nearly all of the children's mothers were married (95.3%) and just 4.3% children's mothers were divorced. Few women were widowed (0.1%) and separated (0.2%) as well. The majority of mothers (74.2%) stated their husbands were living with them, however, a fifth (21.0%) indicated that their husbands were not living with the family. Approximately half of the mothers (45%) make decisions with their husbands when purchasing large household items. Another 28.6% depend on their husbands while just 9.3% mothers stated that they made decisions by themselves. Though most mothers wanted their last child (65.8%), 11.2% said they would have preferred to have the child a bit later and 22% said they had not wanted to have any more children then. When asked about future children, approximately one-third of mothers (36.9%) wanted no more children; another third indicated that they wanted another child but only after two years (32.8%). In terms of maternal health majority of mothers (81.2%) had received a tetanus vaccination (TT) before birth of their child while almost one fifth (18.8%) said they had not received it. Out of all mothers, 8.6% mothers cited that getting money for obtaining medical help for self was a big problem and 73.8% cited that getting medical help for self was a big problem as there was no health service provider.

4.2. Childhood Stunting

Mean (SD) height and mean (SD) height for age z-score is 84.27 (14.70) and -0.93(1.40) respectively. As shown in Table 2, the overall prevalence of stunting among children under the age of five years in Maldives is 21.3% (19.6-23.0 95% CI) with 21.2% boys (18.9-23.7 95% CI) and 21.4% girls respectively (19.1-23.9 95% CI). In examining the overall results further, this was broken down into 14.7% moderate stunting and a further 6.6% severely stunted. While there is little difference between boys and girls in overall, it should be noted that girls had higher % of stunting in the moderate and severe categories. The graph in Figure 4 shows that the heights for age z-scores were much lower than WHO standards for both boys and girls in Maldivian population. Gender difference in stunting was not significantly different in this population of Maldivian girls and boys, however it should be noted that height for age z-score was lowest among ages 6 to 17 months and 18 to 29 months (-1.13).

Figure 4: *Percentage of stunted children according to WHO reference standards*



4.2.3 Mother's Educational Background

The educational level of mothers was significantly associated with stunting (x^2(3, n=2185) = 10.74, p = 0.013). Mothers who had no education (23.3%) had the highest percentage of stunted children compared to those with primary (20.7%), secondary (16%) and higher education (17.2%). Educational level of mothers was also significantly associated with the number of children mother was having (x^2 (6, n= 2185) =859.59, p<0.001). Mothers with no education were more likely to have higher number of children (with 88.7% having more than 3 children) while 52.4% of primary, 8.2% of secondary and just 1.7% of mothers with higher education had more than 3 children.

4.2.4 Mother's Marital status and Decision Making in Relation to Stunting

Marital status was not significantly associated with stunting (x^2 (3, n= 2185) =0.46, p=0.93. However, mothers' final say on large household purchases was significantly associated with stunting (x^2(4, n=2081) = 12.85, p =0.012). Mothers who depend on someone else to make a final decision when purchasing large household item (23.1%) were more likely to have stunted children than those mothers who make decisions with their husbands (16.9%).

4.2.5 Mother's Access to Medical care.

Having money to obtain medical help for self was significantly associated with stunting (x^2(1, n=2184) = 12.81, p <0.001). Mothers who stated getting money for medical help was a problem had higher percentage of stunted children (28.9%) compared to those mothers who stated otherwise (18.1%).

4.2.6 Breastfeeding and Complimentary Feeding Practices

Duration of breastfeeding also was significantly associated with stunting (x^2(3, n=2185) = 12.88, p = 0.005). The average breastfeeding duration was one and half years. Those children who were breastfed for more than 24 months were more likely to be stunted (21.1%) than who were breastfed for 6-12 months (15%). Stunting was inversely associated with the fact that the child was given tinned/powdered or fresh milk (x^2(1, n=1593) = 6.43, p <0.06). Children who were given tinned/powdered or fresh milk were less likely to be stunted (18.1%) compared to those who were not given (23.1%). Mothers' BMI was not significantly associated with stunting (x^2(3, n=2054) = 0.17, p = 0.98) based on the results of this study. However, mothers' desire for more children, was also significantly associated with stunting in children (x^2(6, n=2173) = 15.08, p =0.02). Sterilized mothers were more likely to have stunted children (25.6%) and those who wanted after 2 years (20.1%) and those who did not want any more children (19.5%) than who wants a child within 2 years (14.9%). Mothers who want no more children (59.5%) and mothers who were sterilized (20.2%) were more likely to have more than 3 children. Stunting was also significantly associated with the number of children mother had (x^2(2, n=2185) = 9.63, p = 0.008). In further analysis, mothers who had more than 3 children were more likely to have stunted children (22.1%) than mothers who had just one child (18.3%). In univariate analysis, using haz-score as the dependent variable; mother's height, size of child at

birth, duration of breastfeeding, wealth index, getting money for obtaining medical help for self and concern over the absence of a health service provider in the health service unit were significantly associated with haz-score after adjusting for all the other socio-economic independent variables discussed previously which were significantly related with stunting in the chi-square tests. In logistic regression analysis, stunting (yes/no) as the dependent variable and all the variables which were significant in the multivariate analysis were used as independent variables. After adjusting for other variables; smaller in size compared to large in size at birth (OR 2.573, CI 1.671-3.963), mothers who had greater concern over the lack of a health service provider compared to those who stated that it was not a big problem (OR 1.426,CI 1.078-1.886), mothers who stated that getting money for obtaining medical help was a big problem compared to others who stated it was not such a big problem (OR 1.948, CI 1.354-2.801), longer duration of breastfeeding (OR 1.006,CI 1.003-1.009) were significantly associated with higher odds of stunting in children. Every centimeter increase in height of mothers (OR .913, CI .893-.933) were significantly associated with 9% lower odds of stunting in their children.

5. Discussion

5. Background characteristics

The study sample was consisting of almost equal number of boys and girls and the average age of children was 2.3 years. The average height was 84.3 centimetres. Average birth weight was 3.045 kilograms. According to their mothers, most of the children were average in size at birth and on average; children were breastfed for one and half years on average. Almost one fourth of the children had never received a vitamin dose in their life time. The average age of mothers was 30 years and the average age of the mother at first birth was 21 years. Most of the mothers were having a normal BMI however, 8.3% were underweight as well. A large proportion of mothers had either secondary or primary education; nevertheless, 14.1% had no education as well. Majority of the mothers in the study sample were unemployed (65.4%). Most of the mothers had 1-3 children with mothers giving birth to 3 children on average and almost all mothers were married and most mothers stated that their husbands were living with them; however, 21% mothers said that their husbands were not living with them. Most mothers make decisions with their husbands when purchasing large household items however, a large percentage also depended on their husbands to make the decisions (28.6%). Almost one third said they do not want any more children while 33% stated they wanted another child only after two years.

5.1 Prevalence of stunting

The overall prevalence of stunting in Maldives is 21.3% (19.6-23.0 95% CI) with 14.7% children having moderate stunting and 6.6% being severely stunted. This shows a significant improvement compared to the 27% prevalence in 2004 (Ministry of Health, 2004) and 37% in 2006(Onyango et al., 2007). Height for age z-score was lowest among ages 6 to 17 months and 18 to 29 months (-1.13), indicating that the time when solid foods are introduced is the time when most children are more vulnerable to under nutrition and stunting. No significant association between gender and prevalence of stunting was found in this study though gender differences in relation to childhood stunting had been documented elsewhere in the literature (Biswas and Bose, 2010). Although there was a small gender difference in relation to stunting in children, the haz-scores for children of both gender groups were much lower than the WHO reference group.

5.2 Maternal Socio-economic Characteristics

Low maternal Body Mass Index (BMI) is considered an important risk factor for fetal growth retardation as well as perinatal conditions (Black et al., 2008). The results of this study did not find any significant differences in childhood stunting with maternal BMI. Similarly, mothers' age also was not significantly associated with stunting. More mothers in this study belonged to the younger age group of less than 30 years and a large proportion of mothers were in the normal range for BMI. However, height of the mother was a significant independent predictor of stunting in their children. This finding is consistent with other studies done in Bangladesh and Indonesia (Semba et al., 2008). According to Black and colleagues (2008), short stature and maternal under nutrition have independent effects on the outcomes of pregnancies (Black et al., 2008). Maternal under-nutrition was related to low birth weight babies and can be attributed to under-nutrition of mothers prior to conception, short stature of mothers due to under-nutrition or infection in their childhood, low weight gain during pregnancy due to under-nutrition and/ or even combination of all or some of these factors (Sayers and Lancaster, 2008, Black et al., 2008).

5.2.1 Number of children

Evidence shows that children from single parent families and cohabiting households as well as extended families are more prone to less positive nutritional outcomes and are more likely to be stunted than two parent families (Bronte-Tinkew and DeJong, 2004). Data also reveals that children in single parent families and extended families with low incomes are also more at risk for stunting than two parent families (Bronte-Tinkew and DeJong, 2004). Likewise, the availability of foods to the target child highly depends on the number of siblings in the family (Jehn and Brewis, 2009). This is in line with our study as our findings show that stunting was significantly associated the number of children mother was having. Similarly, mothers' desire for more children was significantly related with stunting. Mothers who were sterilized and mothers who wanted another child after 2 years and mothers who did not want any more children were more likely to have stunted children compared to mothers who wanted a child within 2 years.

5.2.2 Breastfeeding

The rate of stunting was highest among children who had been breastfed for more than 24 months. Children who were not given tinned/powdered milk were more likely to be stunted than those children who were.

5.2.3 Maternal educational level

The results showed that uneducated mothers were most likely to have stunted children than better educated mothers. Educated women are more likely to utilize the

available health services and are more aware of the nutritional problems of their children. Mothers with poor education often leads to an inability to generate resources for improving the nutritional status for their children (Fotso and Kuate-Defo, 2005). Mothers' educational level together with the standard of living is found to have a significant influence on the nutritional status of children (Bharati et al., 2010, Tarozzi, 2008, Jehn and Brewis, 2009). Given that stunting in children is caused by chronic under nutrition and/or the consumption of a low quality diet together with infections, morbidity and environmental issues, it is assumed that better educated parents would care for their children better than those less educated (Semba et al., 2008). Poorly educated mothers and fathers have been found to use less Vitamin A supplementation, less iodized salt and use health services less frequently than better educated parents and is linked to stunting in children (Semba et al., 2008). This is consistent with our findings from this study as our results indicated that mother's educational level was significantly related with stunting

5.2.4 Mother's autonomy

A significant association was observed for mother's participation in decision making when purchasing large household items and the percentage of stunting in their children. Mothers who depended on someone else for making a decision were more likely to have stunted children than those who make decisions with their husbands and were less likely to have stunted children.

5.2.5 Wealth index

According to the results of this study, stunting was highest among those mothers who were in the lower socio-economic class. This is in consistent with the literature which had been discussed before. Employed mothers are assumed to have greater control over their life with their income with regard to food choices and food insecurity. A significant relationship was found between educational status and employment. Higher educated women were more likely to be employed than uneducated woman. In the study population around 65% of women were unemployed. According to Sayers and Lancaster (2008), mothers with a high socio-economic status and with greater income opportunities are less likely to give birth to low birth weight babies which can influence the nutritional status of children. Mothers who faced difficulty in getting money for obtaining medical help for self were also more likely to have higher percentage of stunted children. Our results also suggest that stunting was significantly related with mother's concern over the lack of a health service provider in times for getting medical help.

6. Conclusion

Stunting prevalence is found to be significantly high in Maldives in comparison to WHO reference standard. Stunting was observed higher between the ages of 6months and 2 years. The significant predictors of stunting in Maldivian children included: height of mothers, size of the children at birth, duration of breastfeeding, mothers who were having great concern over the lack of a health service provider, presence for getting medical help for self and mothers who were having problems with obtaining money for getting medical help. Therefore, when designing public health programs, these factors need to be taken into consideration. Since size of the child at birth is a significant predictor of childhood stunting, strategies for improving the sizes at birth have to be given a top priority. Similarly, good infant feeding practices together along with breastfeeding awareness needs to be provided to the general public. These public awareness programs need to be addressed to the target population, especially the vulnerable groups. In overall, women of all child bearing ages should be targeted with nutrition health education programs, nationwide. In addition, nutritional information regarding weaning and infant feeding practices as well as breastfeeding needs to be perpetuated in the present post-natal programs. A comprehensive health education program targeted at all staffs in antenatal and post-natal clinics in Maldives, with information on how to prepare good nutritious diets using locally grown foods for pregnant mothers as well as information on good infant feeding practices with information on micro-nutrient supplementation and breast feeding is highly recommended.

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