Prevalence of Stunting in Mozambique in 1997 and 2003

Prevalence of Stunting in Children below three years of age in Mozambique in 1997 and 2003: A comparison between two cross-sectional studies from Demographic and Health Surveys

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Abstract

**Background:** There are 842 million people in the world suffering from undernourishment. Mozambique is one of the countries in the world with a high prevalence of different kinds of malnutrition, stunting being one of these.

**Aim:** To investigate the prevalence of stunting among children below three years of age and determinants for stunting on a national level in Mozambique comparing data from 1997 and 2003 in order to find out what possibly could have contributed to an eventual change.

**Methods:** Two cross-sectional studies, conducted by the DHS, in 1997 (n=3773) and in 2003 (n=5502) in Mozambique were compared. Numerous Pearson’s chi-squared tests, independent t-tests and descriptive calculations were made in order to achieve the results.

**Results:** No significant difference was found in the prevalence of stunting between the years. Determinants such as residential area, wealth index, educational levels, time required to get to a source of drinking water, birth weight, having a health card, antenatal visits, prevalence of diarrhea and fever all showed a significant difference.

**Discussion:** Only the mother’s height and duration of breastfeeding showed no significant differences out of the chosen determinants. An improvement was found for most of the determinants and as poverty decreased during the studied time period, naturally a decreased prevalence of stunting should have occurred.

**Conclusion:** No significant difference in stunting among children below three years of age in Mozambique on a national level in 1997 and 2003 was found.

**Keywords:** Mozambique, malnutrition, undernourishment, stunting, child health
**Abbreviations**

**DHS:** Demographic and Health Surveys  
**HDI:** Human Development Index  
**MDG:** Millennium Development Goal  
**PTSD:** Post-traumatic stress disorder  
**SD:** Standard deviation/s  
**UN:** United Nations  
**WHO:** World Health Organization
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1 Introduction

1.1 Malnutrition

Malnutrition includes both over- and under-nutrition (1). Over-nutrition occurs when a person exceeds his or her intake of the body’s energy requirements and under-nutrition occurs when the intake of nutrients is not enough (1). Almost half of the child mortality worldwide is caused by under-nutrition, where around three million children annually die due to this issue (2). One of the United Nation’s (UN) Millennium Development goals (MDG) during 1990-2015 was to “eradicate extreme poverty and hunger” with the sub goal of “halve...the proportion of people who suffer from hunger” (3). Even though this goal is estimated to be met in time, there are still 842 million undernourished people worldwide (3). It is not only food shortage that results in under-nutrition but it is also due to deficiencies in macro- and micronutrients, diseases, infections, poor sanitation or the lack of health services among other reasons (4). There are numerous long lasting effects that under-nutrition brings that can affect people’s health negatively, such as insulin resistance, increased risk of diabetes, hypertension, accumulation of fat particularly in the central part of the body, lower energy expenditure and dyslipidemia, along with other effects (5).

Under-nutrition can be divided into underweight, wasting and stunting (2). A child is considered underweight if he or she has a low weight for his or her age according to the World Health Organization’s (WHO) growth standards for children (6). About 98 million children under the age of five were underweight in 2013, which at that point had decreased from 25 percent in 1990 to 15 percent (6). If the weight of a child is too low in proportion to his or her height, the child is considered to be suffering from wasting, which is a severe problem with 52 million children under the age of five suffering from this condition, 17 million of these being severely wasted (7).

1.1.1 Stunting

An inadequate intake of proper nutrition for a longer period of time can lead to stunting in a child (8). Stunting is a major problem and it is only possible to prevent this disease from the time of conception until the child is two years old (9). Globally, around 165 million children below five years of age were stunted in 2011 (10) , most of these being located in Africa or Asia (figure 1). Stunting means that the child is much shorter than they should be according to
their age as they fall below two standard deviations of the median grow standards developed by the WHO (7). Long term consequences of stunting must be taken seriously and a few examples of the consequences are; delayed puberty (11), poor mental- and cognitive development (12,13) and obesity (14,15). Girls who are stunted will also more likely face complications when giving birth later on in their adult life (9).

![Worldwide overview of stunted children below five years of age shown by percentages and color in 2008-2013](image)

**Figure 1.** Worldwide overview of stunted children below five years of age shown by percentages and color in 2008-2013 (2).

### 1.2 Determinants for stunting

There are numerous of determinants that can influence the development of stunting in a child (figure 2). These can be categorized into; basic influences, underlying social and economic influences, underlying biological and behavioral influences and immediate influences.
1.2.1 Basic influences

Area of residence has shown to influence the development of stunting in several conducted studies, for example in China (17), Ecuador (18) Nigeria (19), Ghana (20) and Pakistan (21) where stunting was more prevalent in poor residential areas, both present in urban and rural areas. The results differ as some of these studies show a higher prevalence of stunting in urban areas, and others in rural areas. However, rural areas still seem to have a greater prevalence of undernourished children as can be seen in another study by Sommerfelt et al, that studied Demographic and Health Survey (DHS)-data from 28 different countries from 1985-1990 (22).

Poverty has often been shown to be associated with the development of stunting (23–29). For one example, an Ethiopian study discovered that children living in poor households had a 1.9 greater likelihood of being stunted compared to children living in households having above-average income (25). One study (29) carried out by Carlos Augusto Monteiro et al observed the same pattern with poverty as they followed the prevalence of stunting in Brazil between 1974 and 2007. There was a noticeable stable decrease in stunting on a national level,
especially the last ten years of the study, at the same time as the gaps of access to education, water, sanitation and health care etc. decreased between rich and poor families who had children below five years of age. The prevalence of stunting decreased from 37 percent to 7 percent. During periods of poverty, women are also more likely to be treated unequally than men, which makes them more vulnerable to develop malnutrition, which in turn becomes dangerous for the child if the woman is pregnant or breastfeeding (30).

1.2.2 Underlying social and economic influences
A study carried out in Iran in 2009 found that the mother’s educational level was the most important factor for developing stunting out of variables including socio-economic status, gender, monthly income, mother’s education, father’s education and age (31). Another study, published in 2008, studied parental education along with stunting in Indonesia and Bangladesh, and they found that both the mother’s and the father’s education were important factors in stunting (32). In Indonesia, an association was found between a higher parental education and an increase of a care-giving behavior of the child by the parents, for example by giving the child proper sanitation and immunizations (32). In both Indonesia and Bangladesh, the impact of the mother’s education was equal between the countries, although in Bangladesh, the fathers’ education showed to have a stronger impact than in Indonesia on stunting (32). Other studies have also confirmed the association between stunting and parental educational level (28,33–36).

Access to proper sanitation and drinking water is also an important factor and have indicated, in several studies, to be associated with a decreased prevalence of stunting (28,37,38), such as access to a flushing toilet, which has a strong association to a decreased prevalence of stunting (22). Through disasters, which tends to hit harder in low-income countries than in high-income countries (39), sanitation systems can easily become affected negatively and broken down, which makes this a high priority in rescue and disaster relief (40).

1.2.3 Underlying biological and behavioral influences
The development of stunting originates in the womb, which is one of the reasons why it is crucial for the mother to receive proper nutrition and health care before and during the pregnancy (41). Women have greater nutritional needs during pregnancy and breastfeeding than at other times (30). If mothers do not receive adequate nutrition, there will be an
increased risk for the child to become stunted (41). Infants (under 12 months) who weigh less than 3000 grams at birth are more likely to be stunted compared to infants who weigh more than 3000 grams at birth (42). Other studies support the fact that a infant’s risk of being stunted will increase as the birth weight decreases (23,32,33,35). It is also important for the infant that the mother receives nutrition that is proper in quality and quantity after the delivery so that the breast milk will contain enough nutrients (43). Notably, it has been shown that if breast milk contains low levels of zinc, there is a higher risk for the development of stunting (43).

Özaltin et al (2010) have found early life factors that add to the development of stunting (44). In their study, conducted in 54 low- and middle income countries based on DHS, Özatlin et al were able to show a significant association between maternal height and child stunting. The results showed a decreased prevalence of stunting when the height of the mother increased. The highest risk of child stunting was for children whose mothers were shorter than 145 cm, a notable attribute as the height of a mother is an indicator of her own long-term health status as a lower height can mean that the mother herself did not get adequate nutrition through her development as a child. This association has also been confirmed by other studies (32).

It is important for the child to be up to date with necessary vaccinations, such as those against measles, (22,45) as this has also been shown to be associated with a lower prevalence of stunting. Receiving vaccinations is a sign of proper access to health services (25). The number of times the mother receives antenatal care during pregnancy plays a vital role in avoiding the development of stunting (24,25), which is also associated with having access to health care, (46) as a high number of antenatal visits can indicate good access and communication with health services (25). It is also a sign of that the mother is reaching out for help to learn about child health (25). One study carried out in Ethiopia noticed a significant difference of stunting between children whose mothers had been to five or more antenatal visits compared to the mothers having no visits at all (25). The prevalence of stunting was 33 percent in the infants whose mothers had five or more antenatal visits compared to 47 percent where no visits occurred.
1.2.4 Immediate influences
One intervention has proven to be more effective than others in preventing child deaths: breastfeeding infants exclusively in the first six months of their lives and then continuing breastfeeding, along with giving other food, for another six months (47). Stunted growth for infants normally occurs either when the infant is introduced to other fluids other food in its diet than breast milk before six months of age (48). The reason why stunting normally occurs when the infant is introduced to additional fluids can partly be because additional fluids have been found to increase the risk for the infant receiving infections as well as making it harder for him or her to return to exclusive breastfeeding (48). The intake of additional food at a premature age will also increase the risk for the infant receiving infections which will raise the risk for falling under under-nutrition (48).

Several types of infections, such as Trichuris Trichura, STH and Geohelminth and other infections, act as major contributors in the development of stunting which various studies have confirmed (34–36,49). General symptoms for infections include fever and diarrhea (50), both symptoms which have been proven to be associated with stunting in children (28,35,49,51,52).

1.3 Mozambique
Mozambique is a country located in the south-east part of Africa along the coast with approximately 25 million inhabitants (53). The country is divided into 11 provinces which are called; Maputo City, Maputo, Gaza, Inhambane, Niassa, Sofala, Zambezia, Cabo Delgado, Nampula, Manica and Tete (figure 3) (54). The primary spoken language is Portuguese and the largest religions practiced in the country are Christianity (Catholicism), Islam and Zionism along with a great amount of people who do not practice any specific type of religion (55). The Human Development Index (HDI) ranked Mozambique’s development at number 178 out of 187 countries in 2013, which is considered to be very low (56). Mozambique was regarded to be the poorest country on earth in the beginning of the 90’s, and even though they are still considered to be one of the poorest countries in the world, the situation has improved due to several governmental reforms in education, health, vaccinations etc (57). Mozambique has problems with a low educational level with an average of only three completed years of education per capita, along with a low life expectancy rate of 50 years (56). It is a country
with a high prevalence of farmers as 70 percent of the population lives in rural areas with agriculture as their main source of income (55).

Mozambique also has a high prevalence of stunting with as much as 43 percent of all the children under the age of five years being stunted in 2011 (58). The prevalence of exclusive breastfeeding is low in Mozambique, with only 43 percent of the children under the age of six months being breastfed. The under-five mortality rate was high with 87 deaths per 1000 live births in 2013. This is still an improvement from 2002 when this number was as high as 153 deaths per 1000 live births. The prevalence of low birth weight, which is a birth weight lower than 2500 grams, was also high with a prevalence of 17 percent. (58)

Figure 3. Map of Mozambique by province (59).
1.4 Rationale
Stunting must be prevented in order to prevent its negative long lasting effects. It is specifically important to begin this prevention within the so called “1000-day window”, which is the first 1000 days in a child’s life from conception to two years of age (9). To prevent the development of stunting, both the mother and the child requires an intake of enough nutrients (9). During the time period of 1997 and 2003, the child mortality in Mozambique decreased 18 percent, partly due to reduced poverty (60). Unfortunately this did not lead to a decrease of chronic malnutrition for the children below five years of age and the underlying cause for roughly half of the child mortality in Mozambique was under-nutrition (60).

1.5 Aim and research question
The aim of this thesis is to compare data from DHS and investigate if there was a difference in the prevalence of stunting on a national level in Mozambique comparing 1997 and 2003. The aim is also to compare determinants to stunting in order to see if any differences for these occurred, comparing the same years, to find out what could possibly have contributed to the eventual change in the prevalence of stunting. The research question for this thesis is therefore;

Is there a significant difference in stunting for children below three years of age in Mozambique on a national level comparing 1997 and 2003?

1.6 Objectives
The objectives of this thesis are to:
- Compare the prevalence of stunting in Mozambique with data from 1997 and 2003.
- Compare determining factors that could possibly have contributed to an eventual change in the prevalence of stunting in Mozambique from 1997 and 2003 such as;

1.6.1 Basic influences:
- Residential area
- Wealth index
1.6.2 Underlying social and economic influences:
- Educational levels of the participants
- Educational levels of the current or most recent husbands or partners
- Time required to get to a source of drinking water

1.6.3 Underlying biological and behavioral influences:
- Birth weight
- Mother’s height
- Having a health card
- Antenatal visits

1.6.4 Immediate influences:
- Duration of breastfeeding
- Prevalence of diarrhea
- Prevalence of fever

2 Methods
The DHS’ final reports of Mozambique from 1997 and 2003 were both written in Portuguese. Translation was done by people fluent in Portuguese and through “Google Translate” (61).

2.1 Study design
The study design for this thesis is a comparison of secondary data from two cross-sectional studies provided by DHS in 1997 and 2003.

2.2 Study settings
The data for the first DHS study (54) was collected between March and June of 1997 by “Instituto Nacional de Estatística e pelo Ministério da Saúde” (National Statistical Institute) based on a survey model produced by DHS in the third phase. The data from the second DHS study (62) was collected between August and December of 2003 by the same institute, however this survey was from the fourth phase model from DHS. The participants were recruited through house visits all over the country.
2.3 Participants

The selection of the sample for the first study (54) was first made in two steps. 388 areas called “Áreas de Enumeração” were first selected from the 11 provinces in Mozambique with probability selection proportional to their sizes. Each of these areas included 100-200 households and households within these areas were then selected, again with probability proportional to their sizes. A total of 11,059 households were selected (figure 4) and 9279 of these completed the survey. From these households, 3773 children below three years of age were included.

The sample from the second study (62) was also selected from the 11 provinces in Mozambique but through three steps, also with probability selection proportional to the sizes. The first stage of selection was the selection of units called “Unidades Primárias de Amostragem”. In each of these units, another selection was made which resulted in a total of 604 areas from “Áreas de Enumeração”. Each of these areas included 80-120 households and of these, about 24 households were finally selected from each area. A total of 14,475 households (figure 4) were selected and 12,318 of these completed the survey, which included 5502 children below three years of age.

The samples were taken in order to represent the country on national and provincial levels and for both urban and rural areas. Hotels, hospitals, military residents and people living in non-residential institutions were excluded from the studies. The surveys were written in local languages and were collected by teams with a total of 50 women and 22 men in the first study and 80 women and 40 men in the second study. The teams went through a 3.5 weeks theoretical and practical course before collecting the data.

The study that was conducted in 1997 (54) examined children that were below three years of age and information was only collected from the youngest and next-to-youngest children of the participants. The study conducted in 2003 included all children in the households below five years of age (62). This thesis excluded the older children from 2003 so that the same age groups could be compared.

The study carried out in 2003 was a follow-up study from the study in 1997. Other follow-up studies were made in Mozambique by DHS 2009 and 2011 (63).
2.4 Variables

The outcome variable for this thesis is stunting. The height was measured in centimeters by DHS supervisors and the age of the children was self-reported by the participants. The collected measurements of height and age were analyzed by DHS through the WHO standard growth chart. The height and age measurements for the children were collected from the women’s survey in the first study and from the household’s survey in the second study. The variable, called “height for age standard deviation” in the DHS manual, was recoded to “Stunting” from the datasets in the statistical program R. The variable included values that were not applicable and these were all recoded from 9996-9998 to blank which automatically turned into “NA”, which is the code used in R for missing values. Left was the standard deviation that the children had, presented by hundreds. If a child, for example, was minus two standard deviations, it was noted as 200. The variable was then recoded into a categorical variable through dividing the children’s values to “Non-stunted”, “Below 2 SD”, “Below 3 SD”, “Below 4 SD” and “Below 5 SD” (table 2). Another variable was created that recoded the values to “Stunted” and “Non-stunted”. This made it possible to compare not only stunted children but also to do comparisons between the severities of stunting. The variable was also used as a numerical variable in its original form.

2.4.1 Determinants

The determinants of stunting selected for this thesis were residential area, wealth index, educational levels of the participants and their current or most recent husbands or partners, time required to get to a source of drinking water, birth weight, mother’s height, having a health card, antenatal visits, duration of breastfeeding, prevalence of diarrhea and fever. The determining variables such as educational levels, birth weight, antenatal visits, duration of breastfeeding, prevalence of diarrhea and fever were all self-reported by the participants.

All variables were directly related to the children except from the wealth index, which includes all the households in the studies as this variable was not possible to connect to the children in the datasets.
2.4.1.1 Basic influences
The residential areas were originally divided into urban or rural areas (table 5) in the datasets and were kept as such in the analyzing.

The variable “wealth index” is a cumulative measurement of the households’ standard of living and was calculated through adding up chosen assets in the households. The households were then divided into five quintiles of wealth, called; “poorest”, “poorer”, “middle”, “richer” and “richest” (table 6). This variable was chosen as an indicator of poverty.

2.4.1.2 Underlying social and economic influences
The educational levels for both the participants and the participants’ current or most recent husbands or partners were used as categorical variables (table 7 and 8). Except from the answering alternative “don’t know” for the husbands/partners, the answer alternatives for the participants and the husbands/partners were; “no education”, “primary education”, “secondary education” and “higher education”.

As an indicator for sanitation and drinking water, “time required to get to a source of drinking water” was chosen as a determinant (table 9). This included all participants, except those that had access to drinking water through a pipe or a well in their household, plot or yard or those who used bottled water or rainwater. The question was answered in minutes. No other indicators for sanitation could be used as there were no data for both years that could be compared as indicators for sanitation such as type of toilet.

2.4.1.3 Underlying biological and behavioral influences
The birth weights were divided into sections of 500 grams; 500-999 grams, 1000-1499 grams, 1500-1999 grams, 2000-2499 grams and more than 2499 grams (table 10) and used as a categorical variable but also as a numerical variable with the original numbers to find out the means. It was also divided into low birth weight (<2500 grams) and normal birth weight (2500+ grams).

In order to find out how tall the mothers were, data for height was collected through measurement in centimeters by DHS supervisors. The values in the variable “mother’s height” were divided in two groups (table 11) where the first group was called “short” which included all women that were shorter than 145 centimeters. The second group was called
“non-short” and included all women that were 145 centimeters or taller. In order to find out the mean heights, the variable was also used as a numerical variable.

The participants were asked if the children in the households had health cards or not, and if they could show them to the DHS’s team. The possible answers were “no card”, “no card anymore” (had a card before but did not have it anymore), “yes, though not seen” and “yes, seen it” (table 12).

Antenatal visits is presented as number of visits per pregnancy (table 13) from zero to ten and all visits greater than ten is presented together in the descriptive statistics. The original numbers were also used as a numerical variable. This variable, together with having a health card were chosen as indicators of access to health care.

2.4.1.4 Immediate influences

The duration of breastfeeding was divided into different spans (table 14) of six months up to 23 months and all remaining durations above 23 months were reported together where it is possible to see the percentage of breastfeeding in each span. The duration in its original data was used as well for the means and statistical testing.

Prevalence of diarrhea was used as a categorical variable and the participants were able to choose options for the children such as; “no”, “yes, the last 24 hours”, “yes, the last two weeks” and “don’t know” (table 15) when asked if the children in their households had had diarrhea or not. As no information was collected about if the children had infections or not, prevalence of diarrhea and fever were included as indicators for this.

The last determinant included in this thesis is prevalence of fever, which was also used as a categorical variable. The participants were asked if the children in their households had fever the last two weeks prior to the survey and were able to answer either; “yes”, “no” or “don’t know” (table 16).
2.5 Data collection
The data collection took place in all 11 provinces of Mozambique, including the capital Maputo City, through surveys. The collection was made in the participants’ houses by teams that were trained specifically for collection of the data.

2.6 Sample size
All the samples of DHS-studies are designed to cover at least 1000 women in each area between 15-49 years old so that the results can be generalized to the whole country. From these women, information about the children from their households was collected. A flow chart showing how the sample sizes were arrived at is shown in figure 4.

2.7 Statistical methods
Data produced by DHS was attained to compare the variable of stunting within Mozambique in 1997 and 2003 to see if a significant difference between these surveys could be found. All statistical tests, along with all the descriptive data represented in this thesis, were made in the statistical program R version 3.1.2 (65). The same procedures were done for both studies with a chosen significance level of 0.05 for all tests.

For the variable “stunting”, descriptive data was used to find out the means from both years (table 2). One statistical test was made with Pearson’s chi-squared test (table 2) which tested stunting as a whole against non-stunted as a whole. An independent t-test was also used to find out if there was a significant difference between the means.

All categorical determinant variables, such as residential area, wealth index, educational levels, birth weight, mother’s height, having a health card, prevalence of diarrhea and fever were all tested with Pearson’s chi-squared tests. Independent t-tests were made for time required to get to a source of drinking water and duration of breastfeeding.
2.8 Ethics

DHS is a professional organization that works with collecting data in different countries, something that they have done since 1984 (67). The organization has collected over 240 surveys in more than 85 countries, giving them a great experience in the field (67). All the surveys used by DHS have been approved by the “ICF International Institutional Review Board” which guarantees that the surveys abide by the regulations of the “U.S Department of Health and Human Services” in order to protect human subjects. DHS uses rigid measurements in order to keep privacy and confidentiality of the participants and their household members. The participants were compelled to accept, or deny, a consent form. The form informed the participants about the purpose of the survey, expected duration, procedures, potential risks and benefits along with contact information in case the participants had more questions or wanted more information. The participants were also informed that the participation was voluntary and that they were allowed to withdraw at any point. In cases where the participant was a minor, the guardian or parent had to approve the consent form before the survey was completed. The data collected was recoded so that none of the information could be traced back to a specific participant. (66) Approval of using the DHS dataset for this thesis was given through the DHS’ website and was received within 24 hours. The datasets were only used by the author of this thesis and no others were able to reach it.

3 Results

The sample size for the studies from DHS compared in this thesis evolved from all 11 provinces in Mozambique as shown in figure 3. The data of the children in the first study were taken from the “Women’s questionnaire” and the data of the children in the second study were taken from the “Household questionnaire”. After the women and the households were chosen for the studies, more drop outs were made by the children included in the studies, due to various reasons (figure 4). The total number of children eligible and used for this thesis was 3773 children in the first study and 5502 in the second study. The determinants that have been compared in this thesis include all the children below three years of age from the surveys. The number of children or adults who were included in each determinant is described in table 3. Characteristics of the children in both of the studies are shown in table 1.
Figure 4. Flow chart for the evolving of the sample sizes for the DHS studies 1997 and 2003 in Mozambique (54,62).
Table 1. Characteristics of stunted children in Mozambique in 1997 and 2003 divided by severity of stunting, age, sex, residential area and province (54,62).

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<tr>
<td>&lt; 6 months</td>
<td>n=20 (3%)</td>
<td>n=21 (2%)</td>
<td>n=79 (14%)</td>
<td>n=109 (12%)</td>
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<td>6-11 months</td>
<td>n=33 (6%)</td>
<td>n=71 (11%)</td>
<td>n=139 (25%)</td>
<td>n=171 (26%)</td>
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<td>6-9 months</td>
<td>n=34 (13%)</td>
<td>n=34 (13%)</td>
<td>-</td>
<td>n=87 (34%)</td>
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<tr>
<td>10-11 months</td>
<td>n=200 (21%)</td>
<td>n=384 (22%)</td>
<td>n=407 (34%)</td>
<td>n=853 (48%)</td>
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<td>12-23 months</td>
<td>n=192 (26%)</td>
<td>n=299 (19%)</td>
<td>n=396 (54%)</td>
<td>n=697 (44%)</td>
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<td>24-35 months</td>
<td>n=1312 (21%)</td>
<td>n=826 (39%)</td>
<td>n=2829 (46%)</td>
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<tr>
<td>Male</td>
<td>n=235 (16%)</td>
<td>n=833 (19%)</td>
<td>n=523 (36%)</td>
<td>n=1838 (43%)</td>
</tr>
<tr>
<td>Female</td>
<td>n=211 (15%)</td>
<td>n=741 (17%)</td>
<td>n=497 (36%)</td>
<td>n=1727 (39%)</td>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>n=70 (10%)</td>
<td>n=261 (10%)</td>
<td>n=195 (27%)</td>
<td>n=732 (29%)</td>
</tr>
<tr>
<td>Rural</td>
<td>n=376 (18%)</td>
<td>n=1312 (21%)</td>
<td>n=826 (39%)</td>
<td>n=2829 (46%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Niassa</td>
<td>n=53 (30%)</td>
<td>n=92 (24%)</td>
<td>n=97 (55%)</td>
<td>n=180 (47%)</td>
</tr>
<tr>
<td>Cabo Delgado</td>
<td>n=50 (30%)</td>
<td>n=211 (30%)</td>
<td>n=95 (57%)</td>
<td>n=385 (56%)</td>
</tr>
<tr>
<td>Nampula</td>
<td>n=63 (20%)</td>
<td>n=341 (19%)</td>
<td>n=122 (38%)</td>
<td>n=767 (42%)</td>
</tr>
<tr>
<td>Zambézia</td>
<td>n=56 (17%)</td>
<td>n=333 (25%)</td>
<td>n=119 (37%)</td>
<td>n=640 (47%)</td>
</tr>
<tr>
<td>Tete</td>
<td>n=32 (21%)</td>
<td>n=172 (18%)</td>
<td>n=69 (46%)</td>
<td>n=432 (46%)</td>
</tr>
<tr>
<td>Manica</td>
<td>n=51 (20%)</td>
<td>n=114 (17%)</td>
<td>n=105 (41%)</td>
<td>n=264 (39%)</td>
</tr>
<tr>
<td>Sofala</td>
<td>n=54 (14%)</td>
<td>n=109 (17%)</td>
<td>n=150 (39%)</td>
<td>n=264 (42%)</td>
</tr>
<tr>
<td>Inhambane</td>
<td>n=28 (9%)</td>
<td>n=91 (12%)</td>
<td>n=83 (26%)</td>
<td>n=245 (33%)</td>
</tr>
<tr>
<td>Gaza</td>
<td>n=40 (11%)</td>
<td>n=59 (12%)</td>
<td>n=114 (30%)</td>
<td>n=169 (34%)</td>
</tr>
<tr>
<td>Maputo</td>
<td>n=4 (2%)</td>
<td>n=29 (5%)</td>
<td>n=30 (16%)</td>
<td>n=130 (24%)</td>
</tr>
<tr>
<td>Maputo City</td>
<td>n=15 (9%)</td>
<td>n=24 (6%)</td>
<td>n=36 (22%)</td>
<td>n=84 (21%)</td>
</tr>
</tbody>
</table>
3.1 Stunting

Shown from the two studies, the prevalence of stunting in children below three years of age was 36 percent in both 1997 and 2003 (table 2). The mean decreased between the years, a difference which showed to be significant (p=0.017) with an independent t-test and a confidence interval between 1.5 and 15.19. A Pearson’s chi-squared test were used to test all the stunted children against the non-stunted children between the years which did not show a significant difference (p=0.735). A total of 692 (18%) children were drop outs in 1997 and 472 (9%) children in 2003 for this variable.

Table 2. Mean standard deviations and distribution of severity of stunting, stunting in total and no stunting divided into years in Mozambique 1997 and 2003 (56.74).

<table>
<thead>
<tr>
<th>Height for age</th>
<th>1997</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean SD</td>
<td>-1.46 SD</td>
<td>-1.54 SD</td>
</tr>
<tr>
<td>Below -2 to -3 SD</td>
<td>n=625 (20%)</td>
<td>n=1080 (21%)</td>
</tr>
<tr>
<td>Below -3 to -4 SD</td>
<td>n=324 (11%)</td>
<td>n=507 (10%)</td>
</tr>
<tr>
<td>Below -4 to -5 SD</td>
<td>n=139 (5%)</td>
<td>n=152 (3%)</td>
</tr>
<tr>
<td>Below -5 SD</td>
<td>n=26 (1%)</td>
<td>n=61 (1%)</td>
</tr>
<tr>
<td>(Total Stunting)</td>
<td>n=1114 (36%)</td>
<td>n=1800 (35%)</td>
</tr>
<tr>
<td>Non-Stunted</td>
<td>n=1967 (64%)</td>
<td>n=3230 (64%)</td>
</tr>
<tr>
<td>Total participants</td>
<td>n=3081 (100%)</td>
<td>n=5030 (100%)</td>
</tr>
</tbody>
</table>

3.2 Determinants

12 different determinants (table 3) from the conceptual framework (figure 2) were compared and tested with statistical tests. These include residential area, wealth index, educational levels for the participants and the participants’ current or most recent husbands or partners, time required to get to a source of drinking water, birth weight, mother’s height, having a health card, antenatal visits, duration of breastfeeding, prevalence of diarrhea and fever. Differences (table 4) were found comparing the means between the determinants from 1997 to 2003 and significant differences were found in all except for mother’s height and duration of breastfeeding.
Table 3. Dropouts and total number of participants after drop outs for each determinant in the DHS studies in Mozambique 1997 and 2003.

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Dropout</th>
<th>Total participants</th>
<th>1997</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential area</td>
<td>n=0 (0%)</td>
<td>n=1 (0%)</td>
<td>n=3773</td>
<td>n=5499</td>
</tr>
<tr>
<td>Wealth index</td>
<td>n=0 (0%)</td>
<td>n=0 (0%)</td>
<td>n=9282</td>
<td>n=12315</td>
</tr>
<tr>
<td>Educational level of the participant</td>
<td>n=0 (0%)</td>
<td>n=1 (0%)</td>
<td>n=3773</td>
<td>n=5499</td>
</tr>
<tr>
<td>Educational level of the current or most recent</td>
<td>n=472 (13%)</td>
<td>n=325 (6%)</td>
<td>n=3301</td>
<td>n=5177</td>
</tr>
<tr>
<td>husband or partner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time required to get to a source of drinking water</td>
<td>n=417 (11%)</td>
<td>n=505 (9%)</td>
<td>n=3356</td>
<td>n=4997</td>
</tr>
<tr>
<td>Birth weight</td>
<td>n=1943 (51%)</td>
<td>n=2459 (45%)</td>
<td>n=1830</td>
<td>n=3043</td>
</tr>
<tr>
<td>Mother’s height</td>
<td>n=34 (0%)</td>
<td>n=219 (0%)</td>
<td>n=3739</td>
<td>n=5283</td>
</tr>
<tr>
<td>Having a health card</td>
<td>n=13 (0%)</td>
<td>n=6 (0%)</td>
<td>n=3760</td>
<td>n=5496</td>
</tr>
<tr>
<td>Antenatal visits</td>
<td>n=311 (8%)</td>
<td>n=491 (9%)</td>
<td>n=3462</td>
<td>n=5011</td>
</tr>
<tr>
<td>Duration of breastfeeding</td>
<td>n=2755 (74%)</td>
<td>n=3865 (70%)</td>
<td>n=1018</td>
<td>n=1637</td>
</tr>
<tr>
<td>Prevalence of diarrhea</td>
<td>n=60 (2%)</td>
<td>n=17 (0%)</td>
<td>n=3713</td>
<td>n=5485</td>
</tr>
<tr>
<td>Prevalence of fever</td>
<td>n=67 (2%)</td>
<td>n=18 (0%)</td>
<td>n=3706</td>
<td>n=5484</td>
</tr>
</tbody>
</table>
Table 4. Means for determinants to stunting in Mozambique 1997 and 2003, differences between the years and p-values for testing the differences.

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Mean/categorical factors in 1997</th>
<th>Mean/categorical factors in 2003</th>
<th>Differences and p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential area</td>
<td>Rural/Urban</td>
<td>Rural/Urban</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Wealth index</td>
<td>Poorest, poorer, middle, richer and richest</td>
<td>Poorest, poorer, middle, richer and richest</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Educational level of the participants</td>
<td>No education, primary-, secondary-, higher level</td>
<td>No education, primary-, secondary-, higher level</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Educational level of the current or most recent husband or partner</td>
<td>No education, primary-, secondary-, higher level, don’t know</td>
<td>No education, primary-, secondary-, higher level, don’t know</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Time required to get to a source of drinking water</td>
<td>30 minutes</td>
<td>34 minutes</td>
<td>+4 minutes p&lt;0.001</td>
</tr>
<tr>
<td>Birth weight</td>
<td>3027 grams</td>
<td>3015 grams</td>
<td>-12 grams p&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Low/non-low weight</td>
<td>Low/non-low weight</td>
<td></td>
</tr>
<tr>
<td>Mother’s height</td>
<td>156 cm</td>
<td>155 cm</td>
<td>-1 cm p=0.082</td>
</tr>
<tr>
<td></td>
<td>&lt;145 cm</td>
<td>145+ cm</td>
<td></td>
</tr>
<tr>
<td>Having a health card</td>
<td>No card, no card anymore, yes though not seen, yes seen it</td>
<td>No card, no card anymore, yes though not seen, yes seen it</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Antenatal visits</td>
<td>3.4 visits</td>
<td>3.8 visits</td>
<td>+0.4 visits p&lt;0.001</td>
</tr>
<tr>
<td>Duration of breastfeeding</td>
<td>18 months</td>
<td>17 months</td>
<td>-1 months p=0.102</td>
</tr>
<tr>
<td>Prevalence of diarrhea</td>
<td>No, yes last 24 h, yes last two weeks, don’t know</td>
<td>No, yes last 24 h, yes last two weeks, don’t know</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Prevalence of fever</td>
<td>No, yes, don’t know</td>
<td>No, yes, don’t know</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>
3.2.1 Basic influences

3.2.1.1 Residential area

Through a Pearson’s chi-squared test, a significant difference (p<0.001) was found in residential area between the years where a nine percent increase was shown for people living in urban areas instead of in rural areas 2003 compared to 1997 (table 5).

Table 5. Residential living area for the people in the DHS studies in Mozambique 1997 and 2003 divided into urban and rural residential areas (p<0.001).

<table>
<thead>
<tr>
<th>Residential area</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=962 (26%)</td>
<td>n=2811 (75%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=1940 (35%)</td>
<td>n=3559 (65%)</td>
</tr>
</tbody>
</table>

3.2.1.2 Wealth index

The same percentages of people were considered to be in the “poorest” and “richest” quintiles of wealth (table 6) in 1997 and 2003. Less people were considered to fall within the quintiles “poorer” and “middle” and an increase was shown for the “richer” quintile in 2003 than in 1997 which indicates that the overall wealth improved. A Pearson’s chi-squared tests showed that the difference was significant (p<0.001).

Table 6. Wealth index for the participants in the DHS studies in Mozambique 1997 and 2003 divided into poorest, poorer, middle, richer and richest (p<0.001).

<table>
<thead>
<tr>
<th>Wealth index</th>
<th>Poorest</th>
<th>Poorer</th>
<th>Middle</th>
<th>Richer</th>
<th>Richest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=1501 (16%)</td>
<td>n=2022 (22%)</td>
<td>n=1974 (21%)</td>
<td>n=1970 (21%)</td>
<td>n=1815 (20%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=2015 (16%)</td>
<td>n=2522 (20%)</td>
<td>n=2427 (20%)</td>
<td>n=2854 (23%)</td>
<td>n=2497 (20%)</td>
</tr>
</tbody>
</table>

3.2.2 Underlying social and economic influences

3.2.2.1 Educational levels of the participants

Table 7 shows the different educational levels for the participants in 1997 and 2003. A significant difference (p<0.001) was found, using Pearson’s chi-squared tests, with a higher percentage of participants that did not have any education in 2003 compared to in 1997. There
was also a decrease of participants that had gone through primary level, however a one percent increase of participants that had gone to secondary level of education was observed.

Table 7. Educational levels for the participants in the DHS studies in Mozambique 1997 and 2003 divided into no education, primary-, secondary- and higher level (p<0.001).

<table>
<thead>
<tr>
<th>Educational levels</th>
<th>No education</th>
<th>Primary</th>
<th>Secondary</th>
<th>Higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=11450 (38%)</td>
<td>n=2175 (58%)</td>
<td>n=145 (4%)</td>
<td>n=3 (0%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=2241 (41%)</td>
<td>n=2952 (54%)</td>
<td>n=295 (5%)</td>
<td>n=11 (0%)</td>
</tr>
</tbody>
</table>

3.2.2.2 Educational levels of the current or most recent husbands or partners
The educational levels for the current or most recent husbands or partners of the participants were compared between the studies (table 8), which showed an increase for all different educational levels and a decrease in the options “don’t know” and “no education” from 1997 to 2003. The difference was shown to be significant (p<0.001) through Pearson’s chi-squared test.

Table 8. Educational levels of the current or most recent husbands or partners in the DHS studies in Mozambique 1997 and 2003 divided into no education, primary-, secondary-, higher level and don’t know (p<0.001).

<table>
<thead>
<tr>
<th>Educational levels</th>
<th>No education</th>
<th>Primary</th>
<th>Secondary</th>
<th>Higher</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=719 (22%)</td>
<td>n=1895 (57%)</td>
<td>n=342 (10%)</td>
<td>n=10 (0%)</td>
<td>n=335 (10%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=1061 (20%)</td>
<td>n=3220 (62%)</td>
<td>n=660 (13%)</td>
<td>n=25 (0%)</td>
<td>n=211 (4%)</td>
</tr>
</tbody>
</table>

3.2.2.3 Time required to get to a source of drinking water
There was a four minute difference on the mean of how long it took to get to a source of drinking water where an increase occurred from 1997 to 2003 (table 4). An independent t-test was performed and showed that the difference was significant (p<0.001) (table 4) with a confidence interval of 2.48 to 29.63. The distribution of time required to get to a source of drinking water is presented in table 9.
Table 9. Time required to get to a source of drinking water for the participants in the DHS studies in Mozambique 1997 and 2003 divided into minutes.

<table>
<thead>
<tr>
<th>Duration of time</th>
<th>1997</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15 min</td>
<td>n=1694 (50%)</td>
<td>n=1894 (39%)</td>
</tr>
<tr>
<td>16-30 min</td>
<td>n=850 (25%)</td>
<td>n=1499 (31%)</td>
</tr>
<tr>
<td>31-45 min</td>
<td>n=224 (7%)</td>
<td>n=322 (7%)</td>
</tr>
<tr>
<td>46-60 min</td>
<td>n=282 (8%)</td>
<td>n=722 (15%)</td>
</tr>
<tr>
<td>61-90 min</td>
<td>n=81 (2%)</td>
<td>n=125 (3%)</td>
</tr>
<tr>
<td>91-120 min</td>
<td>n=63 (2%)</td>
<td>n=186 (4%)</td>
</tr>
<tr>
<td>&gt;120 min</td>
<td>n=58 (2%)</td>
<td>n=95 (2%)</td>
</tr>
</tbody>
</table>

3.2.3 Underlying biological and behavioral influences

3.2.3.1 Birth weight

The mean of the birth weights differed 12 grams with a decrease from 1997 to 2003 (table 4), however, both of the means were above 2500 grams which is considered to be the limit indicating a lack of a low birth weight. The children with a low birth weight (below 2500 grams) were divided (table 10) into 500 grams spans to see if any differences between the two studies occurred. All the children with a low birth weight were compared with a Pearson’s chi-squared test to the children with a normal birth weight between the years which showed that there was a significant difference (p<0.001). A large dropout rate was shown for both years (table 3) with a larger percentage of dropouts 1997 which was also the year with a lower participation rate.

Table 10. Birth weights in grams for the children in the DHS studies in Mozambique 1997 and 2003 divided into 500 gram spans up to 2499 gram and above 2499 grams together.

<table>
<thead>
<tr>
<th>Birth weight</th>
<th>500-999 g</th>
<th>1000-1499 g</th>
<th>1500-1999 g</th>
<th>2000-2499 g</th>
<th>&gt;2499 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=9 (0%)</td>
<td>n=4 (0%)</td>
<td>n=21 (1%)</td>
<td>n=175 (10%)</td>
<td>n=1621 (89%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=0 (0%)</td>
<td>n=6 (0%)</td>
<td>n=53 (2%)</td>
<td>n=311 (10%)</td>
<td>n=2673 (88%)</td>
</tr>
</tbody>
</table>
3.2.3.2 Mother’s height

When comparing the means (table 4), mothers that participated in the survey in 2003 were one centimeter shorter than the mothers that participated 1997. However, in statistical testing using Pearson’s chi-squared test, the difference was not significant when testing “short” (<145 cm) versus “non-short” (145+ cm) (p-value=0.082). The percentages of “short” and “non-short” had one percent difference between the years (table 11) and low levels of dropouts were shown in both years (table 3).

Table 11. Height in centimeters for the mothers to the children in the DHS studies in Mozambique 1997 and 2003 divided into <145 centimeters and 145+ centimeters (p=0.082).

<table>
<thead>
<tr>
<th>Height</th>
<th>Short (&lt;145 cm)</th>
<th>Non-short (145+ cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>125 (3%)</td>
<td>3614 (97%)</td>
</tr>
<tr>
<td>2003</td>
<td>214 (4%)</td>
<td>5069 (96%)</td>
</tr>
</tbody>
</table>

3.2.3.3 Having a health card

A significant difference was found through a Pearson’s chi-squared test (p<0.001) between the years for the participants having access to a health card or not for the children in their households. The greatest difference (table 12) was found for the children that had a health card and were able to show it to the DHS team where a ten percent increase was found, which was also the most common alternative that was reported for both years. The total percentages of participants that said that they had a health card, both seen and not seen by the team, increased with four percent from 1997 to 2003.

Table 12. Owning of a health card for the children in the DHS studies in Mozambique 1997 and 2003 divided into no card, no card anymore, yes though not seen and yes seen it (p<0.001).

<table>
<thead>
<tr>
<th>Year</th>
<th>1997</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>No card</td>
<td>n=575 (15%)</td>
<td>n=556 (10%)</td>
</tr>
<tr>
<td>No card anymore</td>
<td>n=150 (4%)</td>
<td>n=236 (4%)</td>
</tr>
<tr>
<td>Yes, though not seen</td>
<td>n=547 (15%)</td>
<td>n=520 (9%)</td>
</tr>
<tr>
<td>Yes, seen it</td>
<td>n=2488 (66%)</td>
<td>n=4184 (76%)</td>
</tr>
</tbody>
</table>
3.2.3.4 Antenatal visits
An increase of 0.4 visits per pregnancy was seen from 1997 to 2003 (table 4). An independent t-test tested the means which showed a significant difference (p<0.001) with a confidence interval of -0.48 to -0.28. The participants in 2003 also had a lower prevalence of zero antenatal visits and equal or higher prevalence for most of the other number of visits compared to 1997 (table 13).

Table 13. Antenatal visits for the mothers of the children in the DHS studies in Mozambique 1997 and 2003 divided into number of visits.

<table>
<thead>
<tr>
<th>Visits</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=691 (20%)</td>
<td>n=125 (4%)</td>
<td>n=324 (9%)</td>
<td>n=620 (18%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=690 (12%)</td>
<td>n=147 (3%)</td>
<td>n=455 (9%)</td>
<td>n=992 (20%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visits</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=541 (16%)</td>
<td>n=474 (14%)</td>
<td>n=411 (12%)</td>
<td>n=165 (5%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=976 (19%)</td>
<td>n=800 (16%)</td>
<td>n=564 (11%)</td>
<td>n=222 (4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visits</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>10+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=61 (2%)</td>
<td>n=21 (1%)</td>
<td>n=15 (0%)</td>
<td>n=14 (0%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=135 (3%)</td>
<td>n=51 (1%)</td>
<td>n=36 (1%)</td>
<td>n=13 (0%)</td>
</tr>
</tbody>
</table>

3.2.4 Immediate influences
3.2.4.1 Duration of breastfeeding
When comparing the studies from the different years, breastfeeding in months differed between the previously mentioned durations (table 14). Calculations of the means (table 4) showed a decrease of one month of breastfeeding in 2003 compared to 1997. An independent t-test was made on the original numerical data which did not show a significant difference (p=0.102) with a confidence interval of -0.08 and 0.85. This means that the children were breastfed for a shorter time 2003 compared to 1997. High numbers of dropouts, or missing information, were seen in both years.
Table 14. Months of breastfeeding for the mothers of the children in the DHS studies in Mozambique 1997 and 2003 divided into six months up to 23 months and all above 23 months together.

<table>
<thead>
<tr>
<th>Months</th>
<th>0-5</th>
<th>6-11</th>
<th>12-17</th>
<th>18-23</th>
<th>&gt;23</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=41 (4%)</td>
<td>n=72 (7%)</td>
<td>n=286 (28%)</td>
<td>n=364 (36%)</td>
<td>n=255 (25%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=55 (3%)</td>
<td>n=171 (10%)</td>
<td>n=524 (32%)</td>
<td>n=509 (31%)</td>
<td>n=378 (23%)</td>
</tr>
</tbody>
</table>

3.2.4.2 Prevalence of diarrhea

The participants were asked if the children in their households that were below three years of age experienced diarrhea within the last 24 hours or the last two weeks before the time of the participation in the survey. A Pearson’s chi-squared test was made which showed a significant difference (p<0.001). There was a five percent increase of children in 2003 (table 15) that was reported to not have had diarrhea at all the last 24 hours or the last two weeks leading up to the participation. At the same time, there was a three percent decrease of the children in 2003 that had had diarrhea the last two weeks. No child was reported to have had diarrhea the last 24 hours in either 1997 or 2003.

Table 15. Prevalence of diarrhea for the children in the DHS studies in Mozambique 1997 and 2003 answered by no, yes the last 24 hours, yes the last two weeks or don’t know (p<0.001).

<table>
<thead>
<tr>
<th>Answer</th>
<th>No</th>
<th>Yes, last 24-h</th>
<th>Yes, last two weeks</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=2913 (77%)</td>
<td>n=0 (0%)</td>
<td>n=800 (21%)</td>
<td>n=37 (1%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=4519 (82%)</td>
<td>n=0 (0%)</td>
<td>n=966 (18%)</td>
<td>n=10 (0%)</td>
</tr>
</tbody>
</table>

3.2.4.3 Prevalence of fever

Whether the child had fever or not the last two weeks leading up to the time of participation in the survey was also asked for. The last Pearson’s chi-squared test for the determinants were tested on this variable and it showed a significant difference between the years (p<0.001). An increase was shown (table 16) in children that did not have fever in 2003 from 1997 and a decrease for the children who had suffered from it.

Table 16. Prevalence of fever for the children for the last two weeks in the DHS studies in Mozambique 1997 and 2003 answered by no, yes or don’t know (p<0.001).

<table>
<thead>
<tr>
<th>Answer</th>
<th>No</th>
<th>Yes</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>n=2027 (54%)</td>
<td>n=1679 (45%)</td>
<td>n=43 (1%)</td>
</tr>
<tr>
<td>2003</td>
<td>n=3806 (69%)</td>
<td>n=1678 (30%)</td>
<td>n=12 (0%)</td>
</tr>
</tbody>
</table>
4 Discussion

No significant difference was found comparing stunted and non-stunted children below three years of age in 1997 versus 2003. The determinants to stunting that were tested for the same years were residential area, wealth index, educational levels for the participants and the participants’ current or most recent husbands or partners, time required to get to a source of drinking water, birth weight, mother’s height, having a health card, antenatal visits, duration of breastfeeding, prevalence of diarrhea and fever. No significant difference between the two years was found for the mother’s height and the duration of breastfeeding. However, significant differences were found for the remaining determinants. This showed an increase for participants living in urban areas, wealth index, educational levels for the participants’ most recent or current husbands or partners, time required to get to a source of drinking water, participants who had health cards and antenatal visits. A decrease was shown for educational level for the participants, birth weight and prevalence of diarrhea and fever.

4.1 Methodological strengths and limitations

The high experience that the DHS has, gives the results in this thesis high internal validity, as the data has been collected in a professional way. The two cross-sectional studies from DHS used surveys to collect data. This is an efficient method when collecting quantitative material, as it can easily be applied for a large quantity of people in order to generalize the results to a larger population. In order to produce results that can be generalizable to a national level, a great number of the population must participate, which is possible with a survey as the data takes less time to collect in comparison to other methods such as in-depth interviews. The two surveys collected in Mozambique were both made in a way that the results can be generalizable to a national level. This was done by dividing the samples in a way so that everyone in every province that was eligible for participation had an equal chance to be chosen for the studies. This results in a high external validity for the outcome. The team, that collected the data, also went through a thorough preparation course in order to help the participants answer the questions as correctly and comfortably as possible.

The two studies used for this thesis are cross-sectional studies which is a good study design when trying to find associations between determinants and an outcome, although it is not possible to find causal effects as to why the stunting remained stagnant, which is also not the aim of this thesis.
A limitation in the DHS’s studies is that many of the questions were answered through the participants reporting the answers by themselves without any proof for the team to check that the information the participants gave was correct or not. Some measurements can therefore have been collected with different measuring tools that were not being calibrated with each other. Self-reporting answers can also have been taken out of the participants’ memory, without any proof of that the answer is correct or not. Memory can fail and even if the participants gave answers that they thought was right, this might not actually have been right, especially when being asked for information for others than themselves.

Another limitation for this thesis is that a great amount of the information given about the two studies in Mozambique had to be translated through “google translate” as it was written in Portuguese, a language the author did not speak. “Google translate” was used as much as possible but where no answers could be found, people who spoke Portuguese fluently were recruited to assist. There is still a risk that mistakes of understanding information has been made as “google translate” is not a perfect tool, however, the text was translated both to English and to Swedish multiple times to cross-check that the translation was correct. Yet another limitation is that the author of this thesis was not involved in the collecting of the data, nor ever present in Mozambique.

The drop outs for the outcome variable (stunting) was 18 percent in 1997 and nine percent in 2003. There is a chance that if the dropouts had a higher prevalence of stunting than the participants, the prevalence stunting may have showed a change from 1997 to 2003 instead of remaining stagnant as seen in this thesis. High drop outs were also present for the determining factors such as birth weight and duration of breastfeeding.

As previously mentioned, the children included in the two studies were below three years of age in both years. Research on when the risk for developing stunting in a child’s life agrees with each other. One study made in Ethiopia showed that the risk is higher to develop stunting in the age group of 12-23 months rather than for 24-36 months (25). Another study from Kenya observed that the two year old children were more likely to become stunted compared to all children under the age of five (45) and another study (68) mentions ages 6-24 months as the most sensitive age for development of stunting. Yet another study analyzed 54 low-income countries in Asia and Africa (69) which also suggested that stunting starts to appear
within the first 24 months in life. These studies show that most likely, the development of stunting starts before two years of age, a time period included in both studies from 1997 and 2003. Therefore, there is a high chance that not many new cases of stunting were developed for children three years and older (>35 months) and below three years of age is therefore a good cut off point for comparison.

4.2 Stunting

Even though poverty and child mortality decreased during the studied period, chronic malnutrition (which includes stunting) did not decrease (60). This is an important issue, as previously mentioned, as malnutrition is the underlying cause of about half of the deaths of children that occurs in Mozambique (60). Poverty is a determinant to malnutrition (16) and if poverty decreases but the prevalence of chronic malnutrition is stagnant, this might indicate that other reasons for chronic malnutrition have become greater to “compensate” for the decreased poverty.

Mozambique suffers from drought and floods frequently (70), but in 2000, the southern and central parts of Mozambique were struck with the worst flood they have had in 50 years (71). Around 700 people died and 500,000 people had to flee their homes (72). It has also been estimated that around two million people became affected through large amount of damaged crops and long-term negative impacts were felt despite the involvement of many relief organizations (72). This could possibly have contributed to that stunting did not decrease as victims of a natural disaster will be at an increased risk of malnutrition (73) due to food shortages among other reasons (74). However is it not possible to know if or how this flood affected the prevalence of stunting as a longitudinal study on stunting in Mozambique before, during and after the flood would be needed for that, which does not exist.

The prevalence of stunting did not change comparing 1997 and 2003 in Mozambique (table 2). The positive side of the results is that the more severe cases of stunting (between -3 and -5 SD) decreased, which is instead seen as an increase for the less severe cases (between -2 SD and -3 SD). The child mortality decreased during the studied time period by 18 percent and as half of the child mortality occurred due to malnutrition or the effects by malnutrition in Mozambique (60), perhaps the country improved at dealing with malnutrition which in that
case possibly could have led to a higher survival rate among stunted children, which in that case would have raised the prevalence.

4.3 Determinants

4.3.1 Basic influences

4.3.1.1 Residential area

A nine percent increase was shown for participants living in urban areas instead of rural areas from 1997 to 2003 (table 5). Stunting has been shown to be more prevalent in poor residential areas, both in urban and in rural areas (17–21), however there seems to be a higher prevalence of stunting in rural areas compared to urban areas (22). As a large migration of the population from rural areas to urban areas occurred between the years, according to previous research (22), this should have contributed to a lower prevalence of stunting rather than a higher or stagnant prevalence that instead took place. One contribution to the transferring of residential area could perhaps be due to the flood in 2000 that forced 500,000 people flee their homes (72), however, it is not known where these people ended up. From table 1, we can see that stunting was more prevalent in rural areas than in urban areas in Mozambique both in 1997 and 2003. In 1997, the prevalence of stunting was 12 percent less in the urban areas than in rural areas and in 2003 it was 17 percent less. This means that the difference of the prevalence of stunting between urban and rural areas was greater in 2003 compared to 1997, with most of the increase seen in rural areas.

4.3.1.2 Wealth index

A pattern of an overall increased wealth is shown between 1997 and 2003 (table 6). Other research has shown that poverty decreased during the same period (60) in Mozambique which the results of the wealth index between these years also indicate. Poverty has many times been associated with stunting (23–29), which this thesis was not able to confirm. The wealth index however, only looked at assets in the households such as bicycles and televisions, which means that other types of wealth such as education, health, employment or money was not included. Sanitation and water access was also included in the index which will soon be discussed.
4.3.2 Underlying social and economic influences

4.3.2.1 Educational levels of the participants

An overall lower educational level was found among participants in 2003 than in 1997 with significant differences (table 7). The prevalence of participants that did not have any education at all had increased by three percent during the same time period. The only level that showed an improvement was the secondary level where a one percent increase occurred. Research has shown that parents’ educational level is associated with the development of stunting in their children, where a low level of education correlates to an increased risk for stunting (32,36,49). It is not certain that the participants answering this variable are parents to the children in the household. However, they do live in the same household as the children and therefore they most likely have some influence over the children’s lifestyle, even if some of them are not the biological parents, which indirectly could play a part in the development of stunting. As 97 percent of the children (below three years of age) in 1997 (54) and 96 percent of the children (below five years of age) in 2003 (62) lived with either both their parents or at least one of them, there is a high chance that many of the participants that answered this question are the parents. This result does not confirm former research of that a lower level of education is associated with a larger prevalence of stunting, as no change was seen in prevalence of stunting, even though the educational level decreased.

4.3.2.2 Educational level for the current or most recent husband or partner

Similarly to the educational levels of the participants, it is not possible to know whether or not the current or most recent husbands or partners were the fathers of the children. However, the same goes as for the category of observed participants that most likely these people were living with the children, or had lived with the children at some point, and therefore most likely they had some sort of influence on them. This variable had an additional alternative within the answers than the educational level for the participants, which was; “don’t know”. As it is not necessary to compare the educational levels for the participants and their husbands’ or partners’, this is not causing a problem. According to previous research (32–36), it has been shown that the educational level for the fathers is a determining factor for stunting where a lower level of education is associated with a higher risk of stunting. As the husbands or partners, who could possibly be the fathers in these studies, had a significant higher level of education in 2003 than in 1997 (table 8), this cannot explain stunting remaining the same prevalence as shown for the same time period. There was a higher drop out (table 3) in 1997
for the participants’ current or most recent husband or partner which can have affected the results. Also, as these determinants were self-reported, the validity becomes weaker. For example, if the participant did not know what educational level the former partner had, an incorrect answer might have been recorded.

4.3.2.3 Time required to get to a source of drinking water
Stunting is strongly associated with sanitation, such as drinking water and type of toilet (22,28,37,38). A four minute increase in mean time required to get to a source of drinking water occurred from 1997 to 2003 (table 4). It is difficult to know if the difference was large enough to have an impact on the access to good sanitation and drinking water and on the prevalence of stunting. The difference was still significant which indicates worsened access to drinking water, which should have led to an increase of stunting, which did not occur. The greatest difference between the years was seen for 0-15 minutes to get to a source of drinking water, where a decrease of 11 percent occurred, which in turn mainly caused an increase of 16-30 minutes and 46-60 minutes (table 9). Unfortunately, almost all variables concerning sanitation and drinking water in the datasets were unsuitable for comparison between the years as they had different answering alternatives for the participants. However, the wealth index also included the households’ sanitation and water access which could instead indicate an improved sanitation as the wealth index improved.

4.3.3 Underlying biological and behavioral influences
4.3.3.1 Birth weight
Research has shown that a child’s birth weight is associated with the development of stunting (32,36,42). A low birth weight is considered to increase the risk and is considered to be a contributing factor to stunting (32). The comparison of the birth weights, divided into “low birth weight” (<2500 g) and “normal birth weight” (2500+ g) in Mozambique in 1997 and 2003 showed a significant difference where a larger prevalence of “low birth weight” occurred. The means of the children’s birth weight (table 4) showed a 12 grams decrease between 1997 and 2003. One study (34) observed not only what was considered to be low birth weight (<2500 g) but saw that a higher risk for developing of stunting exists for birth weights lower than 3000 grams, compared to infants being born with a birth weight above 3000 grams. However, in the studies, both of the means of birth weight were above 3000 grams. Both years had high dropouts (table 3) due to missing information (not being weighted
at birth) of about half of the sample sizes which make the collected information difficult to confirm for authenticity. Perhaps people living in poverty have a lower opportunity to weigh their babies at birth. If this was the case, and at the same time as both low birth weight and poverty contributes to the development of stunting, the dropouts might have had a much higher prevalence of low birth weight than the babies that were weighted at birth. For all the mentioned reasons, it is therefore not possible to determine if the birth weights had any influence on the prevalence of stunting between 1997 and 2003.

4.3.3.2 Mother’s height
The mothers’ mean height was one centimeter shorter in 2003 than in 1997 (table 4). However, there was no significant difference when comparing the heights below and above 145 centimeters (table 11), even though a one percent increase of short mothers occurred. Height below and above 145 centimeters is what has been shown to be the cut-off point of where the risk of stunting for the infant is at its largest (44). The drop-out rate for this variable was almost non-existing with less than one percent for both years which higher the trustworthiness of these results. As mothers that are shorter than 145 cm have a higher risk of giving birth to babies that are stunted (32,44), this could have contributed to an increase in prevalence of stunting if the difference was significant, which it was not in this case.

4.3.3.3 Having a health card
Fewer participants had never had a health card for the children in their households in 2003 than in 1997 (table 12) and the largest difference was seen for those who had a health card and was able to show it to the team where a ten percent increase occurred. The Pearson’s chi-squared test showed a significant difference for having a health card. A health card was used for the health care services to note when the child received vaccinations. Therefore, a child that never received a health card might not have received any vaccinations and this option of never having a health card showed a five percentage decrease, indicating that perhaps more children received vaccinations in 2003 than in 1997. Receiving vaccinations is associated with a lower prevalence of stunting (22,45) and this can also be used as a sign of good access to health care (25). Having a health card is only one way of measuring access to health care and there might be great differences between the vaccinations received. Either way, a four percent increase was found for participants informing that they had a health card for the children, seen or not seen by the team. This could have led to a decreased prevalence of stunting. However, perhaps an improved access to health care or an increase of vaccination
could have contributed to a higher survival rate for stunted children which could mean that the incidence rate decreased even though the prevalence remained the same.

4.3.3.4 Antenatal visits
Number of antenatal visits was also used as an indicator for health care (25,46). Many hospitals were destroyed in the flood in 2000 (75) which most likely affected the health care in a negative way, even if for a short period. We can see an overall improvement for antenatal visits as we see a decrease among women who had zero antenatal visits during their pregnancies and an increased mean of visits (table 4 and 13). It is not possible to know if the improvement was developed during the whole time period, before or after the flood. Either way, we see an overall improvement even though the health system was damaged from the flood. Antenatal visits in itself are also associated with the prevalence of stunting (24,25) where a higher number of visits is associated with a lower prevalence. As an improvement was seen in the number of visits, the result does not confirm previous research as the prevalence of stunting did not decrease.

4.3.4 Immediate influences
4.3.4.1 Duration of breastfeeding
No significant difference in the duration of breastfeeding occurred even though a one month decrease was found in the means from 1997 to 2003 (table 4). Breastfeeding infants lowers their risk for developing malnutrition, and especially when exclusively breastfed for at least six months and an additional six months as this has been shown to be an effective method in decreasing the child mortality (47). Breastfeeding for at least six months showed the same prevalence for both years and breastfeeding for at least 12 months were less prevalent among children in 2003 than in 1997 (table 14). However, as previously mentioned, the difference was not significant. We can therefore not know if or how this contributed to the prevalence of stunting. There is however high drop outs rate for this variable (table 3) with only 26 (1997) and 30 percent (2003) of the children being included. This makes the collected information difficult to verify for reliability. The breastfeeding in itself is not always a good measurement in cases of bad quality of breast milk, for instance if the mother has not received enough nutrients herself so that the breastmilk become less nutritious (27). Breastmilk is also not enough after six months of age, but additional food becomes necessary (47). The studies do not contain any information about in what condition the breast milk was or how frequently the
babies were breastfed. It also does not contain information about quantity and what kind of food or other fluids, if any, the children received in addition to the breast milk.

4.3.4.2 Prevalence of diarrhea

Five percent more children were reported (table 15) to not have had diarrhea the last 24 hours or the last two weeks prior to the participation in the survey in 2003 than in 1997. No cases of diarrhea the last 24 hours were reported but a decrease of three percent occurred for the children that had had diarrhea the last two weeks, a difference that was significant. This does not support the association between prevalence of diarrhea and development of stunting that previous studies have shown (36,49,51,52) as the prevalence of stunting did not change at the same time as prevalence of diarrhea decreased from 1997 to 2003. However, we do not know how many episodes of diarrhea the children had had the last years, and perhaps many of the stunted children had several episodes of diarrhea in the past but not prior to the survey. There is also no indication about how severe the diarrhea was or what the reason behind it was. Both prevalence of diarrhea and fever were used as indicators for infections in this thesis, due to that both of these are common symptoms in infection but there could still have been other reasons to these symptoms’ occurrence. Either way, diarrhea cause the body to lose fluids and nutrients (76), which means that even if there were no infection inducing it, diarrhea in itself can cause losses that can contribute to malnutrition (76).

4.3.4.3 Prevalence of fever

The largest difference between the years for all determinants was seen in the prevalence of fever. A 15 percent increase was found for the children that did not suffer from fever and a 15 percent decrease for the children that were reported to have had it the last two weeks before the collection of the surveys (table 16). As fever can be a sign for infections, this also does not confirm previous research about that stunting is associated with infections (28,36,49,51,52), and cannot be used as an explanation to why the stunting remained on the same level. Just as for diarrhea, we do not know how severe the fever was for the children and how often they had it.
4.4 The importance of the results

Child mortality in Mozambique reduced 18 percent during the studied time period, and half of the child mortality was considered to be due to malnutrition (60). One might therefore expect a decrease of stunting instead of the non-change that occurred. Poverty decreased, which was a contributing factor to why the child mortality was reduced (60). This gives more reasons to believe that other determinants might have impacted the prevalence of stunting in a non-beneficial way. Stunting is a world-wide problem with a prevalence of 165 million children under five years of age (10) and it is important to understand what lays behind the development of stunting so that prevention can be made in a beneficial way.

4.5 Suggestions for future studies

Not many of the 12 determinants could confirm any associations to stunting in this thesis. Most of the determinants improved between 1997 and 2003, but a decrease in stunting was not shown. More studies are therefore needed in finding out what causes the high prevalence of stunting in Mozambique and what it is that makes it continue to be high, even though many of the determining factors are improving. More studies are also needed in finding out how natural disasters, including floods, affect malnutrition such as stunting. Research concerning this is scarce due to the difficulties to conduct such studies in a proper way. We know that a major flood occurred in 2000 in Mozambique, but we do not know what the long-term consequences were that could have contributed to the prevalence and incidence of stunting. Longitudinal studies are therefore needed for countries that are prone to be hit by different natural disasters so that the effect of disasters on stunting can be investigated, but also the long term effects concerning other variables such as education, diseases, health systems, and infrastructure and so on. Determinants that are associated with stunting are not always giving us the real answer behind what causes stunting. As not many of the studied determinants could explain the result of stunting, there must be other factors causing this that have yet to be considered or observed that further needs to be studied.
5 Conclusion

The conclusion of this paper is that there was not a significant difference in the prevalence of stunting in Mozambique on a national level comparing 1997 and 2003. 12 determinants were compared between the years; residential area, wealth index, educational levels for both the participants and the participants’ current or most recent husbands or partners, time required to get to a source of drinking water, birth weight, mother’s height, having a health card, antenatal visits, duration of breastfeeding, prevalence of diarrhea and fever. The country’s poverty declined during the time period and positive differences were found for residential area, wealth index, educational level for the participant’s current or most recent husband or partner, having a health card, antenatal visits and prevalence of diarrhea and fever. Negative differences were also found in educational levels for the participants, time required to get to a source of drinking water and birth weight. Although all of these differences occurred, stunting did not change, indicating that other determinants must have caused this stagnation. The determinants intended to lead to a decreased prevalence showed results that did not play as vital a role as presumed.

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