

Research report

The prevalence of undernutrition of the children, age 7-13 years, at the Maxonia primary school in Grabouw, South Africa: A descriptive research.



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Abstract

Objective: Child *under nutrition* is still a big health problem in South Africa. A descriptive study will be done to assess the prevalence of *under nutrition* of the children, age 7-13 years, at Maxonia primary school in Grabouw, South Africa.

Methodology: The research is done at the Maxonia primary school in the Grabouw area, South Africa. The measurements took place on the 8th of April, 2014. The research consists out of literature and field research. First literature research is done to determine the cause and consequences of undernutrition and to see which measurements can be done to screen for undernutrition. After that field research is performed to the anthropometric status of the children, for that weight and height are measured and compared with the WHO growth curves for school-aged children and adolescents (WHO,2007). The *BMI* is used to determine thinness and the height for age to determine *stunting*. For all the children of ten years and younger also weight-for-age will be used to determine underweight. Also a food security questionnaire is performed on the children of grade five and six, this to determine the risk of hunger. In total 87 children were included for the anthropometric measurements and 31 children for the food insecurity questionnaire. The data of the measurements and questionnaire is filled in on a registration form and is analyzed with Microsoft Excel 2013 and WHO AnthroPlus.

Results: If a child has an nutritional intake lower than it needs for growth, activities, learning and developing, *undernutrition* occurs. There are two manifestations of *undernutrition*; growth failure and micronutrient malnutrition. Growth failure can result in three forms of undernutrition; *thinness or wasting* (low BMI-for-age/low weight-for-height), *stunting* (low height-for-age) and underweight (low weight-for-age). The cause of *undernutrition* is a complicated combination of basic, underlying and immediate causes all leading to an inadequate food intake or disease. To screen children for *stunting*, thinness or underweight the weight, height, gender and age can be used to compare the weight and height in the growth curve of WHO. Because hunger and an inadequate nutritional intake can lead to *undernutrition* it can also be used to determine whether there is a risk of *undernutrition*. There are many consequences of undernutrition like, vitamin deficiency, hunger and disease. Stunting can lead to suboptimal function later in life. The field research is used to determine the prevalence of undernutrition at the Maxonia school. 87 children were included in the study. The largest represented age group was nine years old. The average age was 9,5 years old with a standard deviation of +0,58 years. 5,7% of the children appear to be too thin for their age, 78,1% appear have a normal BMI for their age and the rest of the children are; overweight, obese or morbidly obese (10,3%, 4,6%,1,1%). In the height-for-age curve 11,5% appear to be moderate stunted and 6,9% is stunted. The most of the children, 73,6%, have a normal height-for-age. 31,3% of the children under ten years are moderately underweight and 2,1% is severely underweight. After analyzing the results of the questionnaire 24 children of grade five and six are at risk of hunger. Because stunting is the result of long term undernutrition these result have been compared with the result of the food insecurity questionnaire. Of the children who are at risk of hunger three are moderately stunted and three are stunted, the remaining children (N=18) have a normal height for their age.

Discussion: The expectations of the study where to see that, although it is declining, undernutrition is still a problem in a rural primary school in Grabouw. After analyzing the results of the measurements it showed that the prevalence of undernutrition is lower than in other studies. An important limitation of the study is that because of the time only one primary school in the Grabouw area had been studied. Because of that, the study population is too small to make a proper conclusion of the prevalence of undernutrition in the Grabouw area. Also there was no growth history available of the children to determine if there were changes in their growth. The children at the Maxonia school also seems to be more food secure, but the largest amount (80,0%) are at risk of hunger. Though this can also be the result of the reliability of the children answers. It can be the case that children felt afraid or put under pressure to answer and therefore not answered honestly.

Conclusion: This study shows that undernutrition and food insecurity is a problem at the Maxonia primary school in Grabouw. If you take in account that thinness, stunting, underweight and risk of hunger are all signs of undernutrition, 42,5% (N=37) of the children are undernourished. The outcomes can be used to do further study to the prevalence of undernutrition in other primary schools in the Grabouw area or to set up an intervention program to make the parents aware of the importance of nutrition for growth and development of their child.

List of abbreviations

Deficiency	A lack of micro- or macronutrients that causes health problems.
Undernutrition	A lack of energy- and/or protein intake that causes low weight, low muscle percentage or lack of growth.
Nutritional status	'An internal state of the availability and utilization of the nutrients in the body on cellular level.' (UNICEF, no date)
Stunting	Low height for the age, below -2 standard deviations, due to long term undernutrition.
BMI	Body Mass Index, measures the ratio between weight and height and compares it with age.
Nutritional indices	Standards to compare an individual's measurements with that of a reference population. (UNICEF, no date)
Mortality	The rate that say's something about the number of people that die from an certain disease or condition.
Morbidity	The rate that say's something about the number of people being ill.
Food poverty line	R305 per person per month. The food poverty line refers to the amount of money that an individual will need to consume the required energy intake.(Statistics South Africa, 2012)
Food security	'Sustainable access to safe food of sufficient quality and quantity to ensure adequate intake and a healthy life for all members of the family' (UNICEF, no date)
Hunger	The CCHIP (1991) defines it as; the mental and physical condition that results from not eating enough food, caused by insufficient family, community and economic resources.

Preface & acknowledgement

This research report is written within the framework of my graduation project of Nutrition and Dietetics at the HAN University for Applied Sciences Nijmegen. It has been performed in Grabouw, South Africa for the Theewaterskloof project. That project is a community development based project within the collaboration of the HAN and the University of Western Cape (UWC) South Africa.

This report is intended for the Maxonia primary school and is also usable for other schools, daycare center and other professionals who work with children and/or nutrition. The study is also usable for other community based workers in the Theewaterskloof region.

This research is made possible because of the cooperation of the HAN University of Applied Sciences for Food and Dietetics in the Netherlands, the University of Western Cape South Africa and the Theewaterskloof municipality. I would like to thank these organizations for giving me the opportunity to work on this study. I also would like to thank Mr. Baard, the principal of the Maxonia primary school, for letting me perform the study at his school and for giving me all the help and information I needed. Last but not least I would like to thank my supervisor from the Netherlands; Annemarie Nijhof for all her feedback and my supervisor here in South Africa; Elsabe Nel for helping me set up this research and giving me feedback.

Inhoud

Abstract.....	2
List of abbreviations	3
Preface & acknowledgement	4
Introduction	6
Problem description	6
Aim.....	6
Working methodology	6
Research and sub questions.....	6
Bookmark.....	7
Methodology	7
Results.....	9
Results literature research	9
Results field research.....	13
Discussion.....	14
Recommendations	16
Conclusion	16
Literature.....	17
Attachments	19
1. Search report	20
2. Flyer announcement project.....	21
3. Measurement protocol	22
4. Registrationform anthropometric measurements	23
5. Informed consent	24
6. Pictures	25

Introduction

For the graduation program of my study Nutrition and Dietetics, at the HAN University of Applied Sciences, I am doing research to the prevalence of *undernutrition* of primary school children, aged 7-13 years, in Grabouw; South Africa.

The HAN is working together with the University of Western Cape (UWC) to improve the society in the *Theewaterskloof municipality* in the Western Cape of South Africa by focusing on the economic and social development of the municipality and setting up sustainable projects together with students from different study's.

To gain experience outside the Netherlands and to learn about a different culture I choose to do my research within the Theewaterskloof municipality project. I want to assist the society by giving them my experience and knowledge about nutrition and the importance of a well-nourished child.

Problem description

The Theewaterskloof municipality is a true rural community, due to its agricultural based economy. Mainly the rural areas are considered as one of the poorest, 30,1% of the households are registered as poor and aren't able to provide in their basic needs such as food, water and electricity. The unemployment rate is 42% and 31% of the households have no income. (Theewaterskloof Municipality, 2013)

Child *undernutrition* is still a big health problem in South Africa. (Black et al., 2013. Labadarios et al., 2000. Lutter et al., 2011. UNICEF, no date.) *Undernutrition* results in *stunting*, *wasting* and micronutrient deficiencies, that causes many problems such as an higher risk at getting infectious diseases, learning disabilities and cognitive problems. (Black et al., 2008.) One of the main causes is poverty; many households have to live with little incomes and struggle to get a sufficient intake of the right foods. Therefore many children in the rural area's depend on their school meals.

To do research to assess *under nutrition* of primary school children, the research will be performed at the Maxonia primary school in Grabouw. This school is chosen because of the burden of malnutrition that is still a problem in a rural area like Grabouw. In Grabouw 37% of the households are considered poor and are not able to provide in their basic needs. (Theewaterskloof Municipality, 2013)

Maxonia is one of the farm schools in the Grabouw area, the children who are going there are from farmers households and are considered poor.

Aim

After consultation with the principal of Maxonia primary school and my supervisor of UWC; Elsabe Nel, a descriptive research will be done to the prevalence of *under nutrition* of the learners of Maxonia primary school. The learners are children in the age of seven to thirteen years. The research will consist out of a literature study and field research. The field research will consist of anthropometric measurements of weight and height and a questionnaire about hunger experience. The outcomes will give an description of the *prevalence of under nutrition of children, between the ages of seven to thirteen years old*, at Maxonia primary school.

Working methodology

First the literature research will be done to obtain information about under nutrition, the causes and the consequences of it. For the research methodology the book; *Onderzoek in de Gezondheidszorg* by Bakker & van Buuren (2009) will be used. This book gives guidelines for setting up health research and working methodical.

The Conceptual Framework of UNICEF (1990) will be used to look into causes of *under nutrition* and their effects on each other. This Framework is a valid and trustful methodize to look into the underlying causes of *undernutrition* in a community. It is designed by UNICEF in 1990 and since then regularly updated and used in lots of research.

After having done the desk research there will be field research; the weight and height of children of the school will be measured and some questions about hunger will be asked.

Research and sub questions

According to Black et al. (2013); *undernutrition* is still a large scale problem in South Africa and can result in health problems or death. On the other hand overweight and obesity is becoming a bigger problem. (Black et al. 2013, Kimani-Murage, 2011. de Villiers et al. 2012) During observation in

Grabouw and at primary schools I have seen that mainly *undernutrition* is still a big problem in that population. Therefore, this study assesses whether the children, at the Maxonia primary school in Grabouw, suffer from *undernutrition* using anthropometric measurements and food security questionnaires.

Research question: *What is the prevalence of undernutrition of the children, aged 7-13 years, at the Maxonia primary school in Grabouw, South Africa.*

Sub-questions:

- ❖ What is the definition of child *undernutrition*?
- ❖ How can *undernutrition* be determined?
- ❖ What are the short- and long term consequences of child *undernutrition*?
- ❖ What are the causes of child *undernutrition*?
- ❖ What is the anthropometric status of the children of the Maxonia primary school?
- ❖ What is the food security score of the children, grade five and six, at the Maxonia primary school?

Bookmark

This thesis starts with an introduction, in this chapter the problem description and research questions are cleared. Also the assignment of the study is described. In the second chapter the methodology of the study is explained, the study population, study design and data analysis are made clear. Chapter three will describe the results of the literature- and field research. Following by the discussion and conclusion. In the last chapter recommendations are made.

Methodology

This research aims to describe the prevalence of undernutrition at the Maxonia primary school in Grabouw, South Africa. This will be done with the analysis of weight and height of all the children and the food security score of grade five and six.

Study population

The Maxonia primary school is chosen for the research because it is a rural farm school and the children at the school have a low socio-economic status. (Statistics South Africa, 2012. Theewaterskloof Municipality, 2013.) The study population is chosen, because this population has the same dietary guidelines in the South African Food guidelines and therefore have the same dietary needs (Department of Health, 2004). Also because according to literature this population is at risk of *undernutrition* and is most affected by *undernutrition*, *stunting*, hunger or disease. (Kimani-Murage, 2013. Labadarios et al., 2000. WHO, 2013.)

The school has 101 learners. Inclusion criteria for the research were; the learners have to be between the age of seven and thirteen years, the children have to speak Afrikaans or English and they have to consent verbal for the measurements and questionnaire. All the children meet the criteria on language and consent. Six children were absent during the measurement day and were therefore excluded from the study. Eight children did not meet the inclusion criteria for age, so they were excluded from the study. In total 87 children were included for the anthropometric measurements. For the Food insecurity questionnaire 31 children were included.

The parents of the children were informed about the study by an announcement flyer, see attachment 2.

Study design

First literature research is done to determine the definition, cause, consequences and prevalence of *undernutrition*. For the literature study different databases such as PubMed and Cochrane are used to find scientific evidence. Also websites from institutions such as the World Health Organisation (WHO), UNICEF and Lancet journal are used to obtain information about *undernutrition*. Thereby I received lots of literature, websites, articles and books from my supervisor Elsabe Nel. This is all valid research from WHO, Lancet and Department of Health South Africa. Keywords that are used to find articles are: *micronutrient deficiency*, *hunger*, *stunting* and *underweight*, *undernutrition*, *malnutrition*, *South Africa*, *school-aged children*, *food insecurity*. See attachment 1 for the search report.

After literature research, field research is done. All the children at the school have undergone anthropometric measurement too determine weight and height. For the measurement of weight a digital scale is used. The children are weight without heavy clothes or shoes, the weight is registered

to the nearest 0,1 KG. The height is measured standing without shoes against a height board. The height is registered to the last completed 0,1 cm. The measurements are done by trained Nutrition students of the University of Western Cape (UWC), with the use of the WHO Job-aid – Weighing and Measuring a Child standards (WHO, no date), see attachment 3. Subsequently the data will be used to determine whether a child is *stunted*, thin or overweight, this will be done with the use of the WHO growth-charts for school-aged children and adolescents (2007).

The children of only grade five and six are also questioned in a structured interview about hunger experience. This questionnaire is based on the Household Food Insecurity Access Scale (HFIAS) (Swindale & Billinski, 2006). According to Coates, Swindale and Billinski (2006); *'this method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale'*. The questions are adapted to fit the needs of children, so information about the child's hunger experience can be obtained. The questionnaires are done in a separate room where the children have privacy to speak out.

Research conditions

The research is done at the Maxonia primary school in the Grabouw area, South Africa. The measurements took place on the 8th of April, 2014. All the children were measured by me with the help of Nutrition students of UWC, there were no parents present. The measurements took place in the principal's office, where four children were measured at the same time. For every child two students were available to measure. In the office extra two students took care of the registration and the collection of the forms. The Food Insecurity questionnaire is done in a separate room. All communication with the children took place in Afrikaans or English, based on the child's home language.

Data analysis

The data of the measurements and questionnaire is filled in on a registration form (attachment 4) and is analyzed with Microsoft Excel 2013. The data of the measurements are analyzed with the WHO AnthroPlus anthropometric calculator. The BMI-for-age will be used to determine thinness. The height-for-age will be used to determine *stunting*. (WHO, 2007) Weight-for-age is used to determine underweight in children under ten years old.

Whether a child is at risk of hunger is determined with the 'Household Food Insecurity questionnaire' (HFIAS). When a child answers "yes" to a question that it gets one point, when it answers "no" than it will get none points. The score can differ between 0 and 8, with 0-score the child is considered: *food secure*, a score between 1-4 at risk of hunger and of five or more; experiencing hunger. (see table 1)

Ethical approval

The HAN has an agreement with the Theewaterskloof municipality about students doing research in this area. Therefore that is the approval for the research. The school principal gave written informed consent to do the study at the school (see attachment 5). The children gave verbal consent to the measurements and questionnaire.

Table 1 Food insecurity questionnaire. (Adapted from reference: Coates, Swindale and Billinski, 2006)

Food insecurity questionnaire
Anxiety and uncertainty 1. Do you worry that at your home your caregivers have not enough money to buy food? Quality and variety 2. Do you eat the same foods day after day because there is no other food? 3. Do you eat foods that you like not because those foods are not available at home? Food intake and hunger 4. Do you eat a smaller meal than you would like because there is not enough food? 5. Do you eat fewer meals in a day because there is not enough food? 6. Do you go to sleep at night hungry because there is not enough food? 7. Do you sometimes go a whole day without eating because there is not enough food? 8. Was there ever no food at all in your home?

Results

Results literature research

If a child has a nutritional intake lower than it needs for growth, activities, learning and developing *undernutrition* occurs. *Undernutrition* can be described as a condition where the body has too little nutrients out food. The term '*hunger*' also refers to undernutrition because when hunger occurs that means that someone cannot exceed their nutritional needs. (Black, et al., 2008, Hunger Notes, 2013)

There are two manifestations of undernutrition; growth failure and micronutrient malnutrition, see figure 1.

Growth failure

Growth failure can result in three forms of *undernutrition*, all measure the extension of a child being underweight; first *thinness or wasting* (low BMI-for-age/low weight-for-height), indicating acute weight loss, *stunting* (low height-for-age), indicating chronic *undernutrition* that has caused the growth to stop and underweight, a combination of acute and chronic malnutrition causing the child's weight to be too low for their age. It all compares the weight with the weight of an well-nourished child. (Black et al., 2008. UNICEF, no date. WHO,2007)

Micronutrient malnutrition

Such as previously mentioned micronutrient deficiencies also classifies as a form of *undernutrition*, that because it can give lots of problems for the child's development and quality of life. Micronutrient *deficiency* occurs when a child's intake of certain micronutrients are too low for a longer period of time.

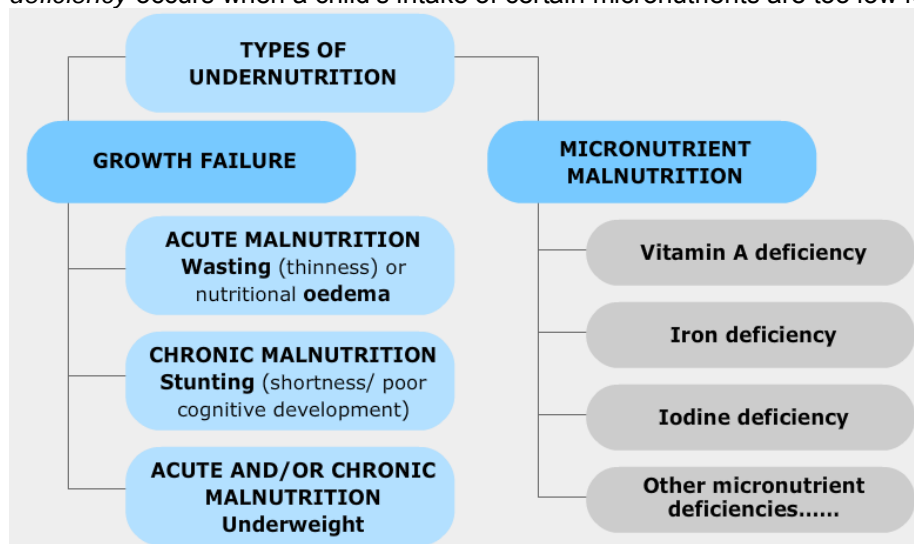


Figure 1 Types of undernutrition (UNICEF, no date)

Causes of undernutrition

According to Black et al.(2008), the cause of *undernutrition* is a complicated combination of basic, underlying and immediate causes. In 1990 UNICEF designed a Conceptual Framework that outlines the causes of undernutrition in a diagram. The causes are in different lines of society, starting with the underlying causes and working up to the immediate causes. The causes of undernutrition can differ in every living area and household and should be looked at from the different layers of the Conceptual Framework.(Black et al., 2008. UNICEF,1990.)

As you can see in figure 2, the origin of *undernutrition* starts with economic, social en political context, that causes people to have a lack of capital, financial as well as social and physical. These factors occur more often in development countries. In these countries more people are unemployed, and therefore have less financial income. An important factor for food security is that food is not only be safe and available but also affordable. (UNICEF, no date.) In South Africa all provinces have a burden of inequality as one of the underlying causes.(Statistics South Africa, 2012) When a household has less financial income;*food insecurity*, poor (health)care and unhealthy household environment occur. For example these household have less or no access to clean (drinking)water and live in unhealthy

environments. In South Africa many people living in rural informal areas have little income and live below the *food poverty line*. (Statistics South Africa, 2012) The direct consequence of these factors is inadequate nutritional intake and disease. A healthy *nutritional status* requires enough access to nutritious and safe foods to meet nutritional needs. (Faber, Laurie, Ball & Andrade, 2013) But certain illnesses can interfere with the absorption of nutrients, therefore to obtain the full benefits of foods people have to be healthy. For example; children with diarrhoea will not or less absorb nutrients that have to be absorbed in the digestive system. Thereby if people are suffering from infection disease they have a higher need for certain nutrients such as vitamin A and iron. If not treated infections can lead to poor nutrient absorption resulting in malnutrition and at long term in *undernutrition* (Faber et al., 2013) These two factors directly have influence on each other; when a child has an inadequate nutritional intake it is more likely to get ill and when a child is ill it has a higher nutritional need. Therefore that are immediate causes of child *undernutrition*. (Black et al., 2008. Faber et al., 2013. NFCS, 2000)

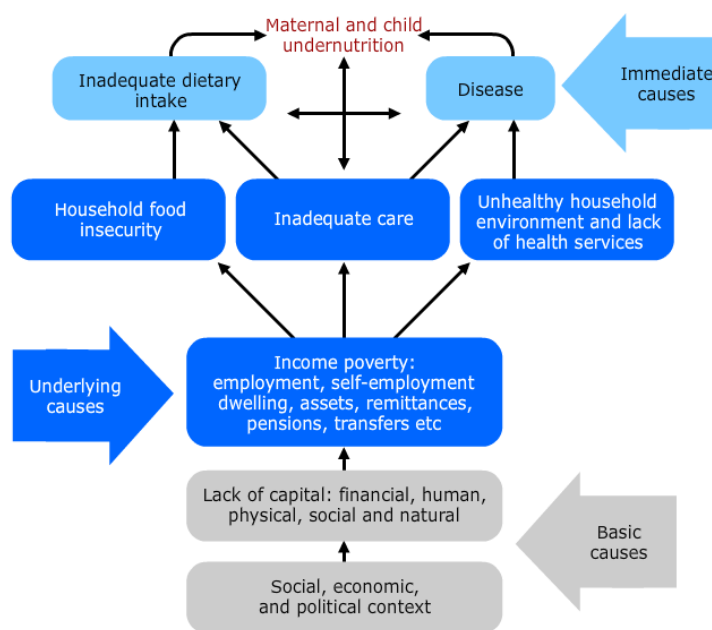


Figure 2 Conceptual Framework of the underlying and immediate causes of child undernutrition (UNICEF, 1990 adapted by Black et al. in 2008)

As previously mentioned *under nutrition* occurs in two types; growth failure and micronutrient *deficiency*. The direct cause of micronutrient *deficiency* is inadequate intake. The National Food Consumption Survey (Labadarios, 2000) indicates that general children in South Africa have an intake of only the half of their energy levels and a shortage of several important micronutrients such as calcium, iron, zinc, selenium, vitamin A, vitamin D, vitamin C, vitamin E, riboflavin, niacin, folic acid and vitamin B6. (Black, et al., 2008. Labadarios et al., 2007) The main problems in South Africa are; vitamin A, iron and zinc *deficiency*.

Vitamin A *deficiency* is caused by a low intake of animal derived foods such as eggs, meat and dairy or a low intake of vitamin A rich, orange/yellow colored, vegetables such as carrots, pumpkin, orange sweet potatoes or dark green leafy vegetables such as spinach. The major cause of iron *deficiency* anemia is low consumption of meat, fish, poultry, whole wheat and legumes. (Black et al., 2008) and also a low intake of the iron absorption promoting vitamin C out of fruits and vegetables. Staple foods such as bread, can retard iron absorption. Zinc *deficiency* is mostly caused by a low intake of proteins such as meat, poultry, eggs, legumes, nuts and seeds.

Screening for under nutrition

Undernutrition can be identified by measuring the *nutritional status* of a child. According to UNICEF (no date), there are four indicators for measuring *undernutrition*; anthropometry, biochemical tests, clinical symptoms and dietary intake.

Anthropometry measurements uses the body weight, height and/or mid upper-arm circumference together with age and sex to determine if a child is failing to grow or losing weight and therefore is

underweight. Using anthropometric measurement one can detect whether a child, over five years old, is *stunting*, thin or underweight. (UNICEF, no date. WHO, 2007)

To screen children for *stunting*, thinness or underweight there are different tools to use. The first is the growth curve, see figure 3. To use the growth curve you have to measure the weight and height of a child. There are three growth charts for children over five years old; weight-for-age, height-for-age and *BMI*-for-age. When a child has a low *BMI* for their age, below the -2 standard deviation line on the growth chart or below the reference, the child is considered thin. Below the -3 standard deviation line the child is considered to be severely thin. To measure whether a child has chronic *undernutrition*, the growth curve height for age also has to be completed. When a child is too short for their age, below the -2 standard deviation line on the growth chart, then the child is considered *stunted*. Before becoming truly stunted the child can be below the -1 standard deviation line and is then considered to be moderately stunted. Below the -3 standard deviation line the child is severely stunted. Stunting is a result of chronic undernutrition, caused by long term too low nutritional intake for the child's needs. When a child has a too low weight for the child's age, under the -1 standard deviation line than the child is considered moderate underweight, below the -2 standard deviation line on the growth chart, a child is underweight and below the -3 standard deviation line severely underweight. (WHO, 2007) This is mostly the effect of acute undernutrition. According to the WHO (2007); 'for a child over ten years old the weight-for-age can't be used to determine underweight because many children are experiencing the pubertal growth spurt and may appear as having excess weight (by weight-for-age) when in fact they are just tall.'

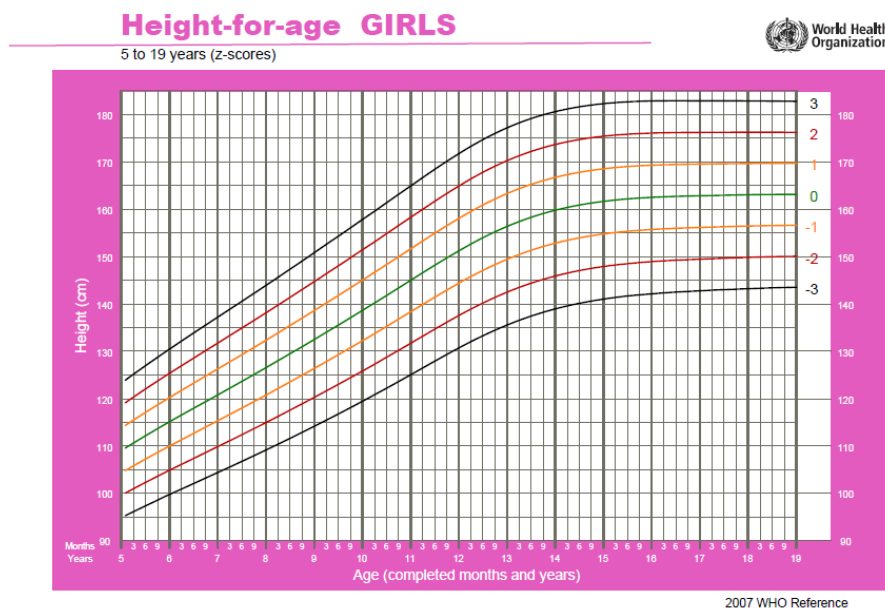


Figure 3 Growth chart height-for-age (World Health Organization; Growth reference 5-19 years, 2007)

Because hunger and an inadequate nutritional intake can lead to *undernutrition* it can also be used to determine whether there is a risk of *undernutrition*. A questionnaire about hunger experience, food security or nutritional intake can be used to determine the risk of hunger. (Black et al, 2008, Labadarios et al, 2011, World Hunger Education Service, 2013)

Consequences of undernutrition

Undernutrition occurs when a child is ill or has an insufficient nutrient intake. It has lots of consequences and can lead to death. In relation with infectious disease, *under nutrition* has a large impact on child *mortality*. (UNICEF, no date)

Hunger can be both cause and consequence of *under nutrition*. When a child does not get enough food for their needs it will be hunger and after a longer period it can develop *under nutrition*. (Black et al, 2008. World Hunger Education Service, 2013)

After a longer period of *under nutrition* a child can develop *stunting* (too short for their age). *Stunting* is a risk factor for diminished learning capacity of children, health and survival. Whether a child gets *stunted* depends on different situations, such as health status, growth in height and economic status. There is a high risk of becoming *stunted* when a child has frequent infections and a diet poor of nutrients.(Dewey & Begum, 2011) According to Dewey & Begum, (2011): ‘Childhood *stunting* is related to long-term consequences in two ways:

- as a direct *cause* of short adult height and suboptimal function later in life
- as a key *marker* of the underlying processes in early life that lead to poor growth and other adverse outcomes.’

As you can see in figure 4 that *stunting* leads to consequences which can lead to *mortality* and *morbidity*.

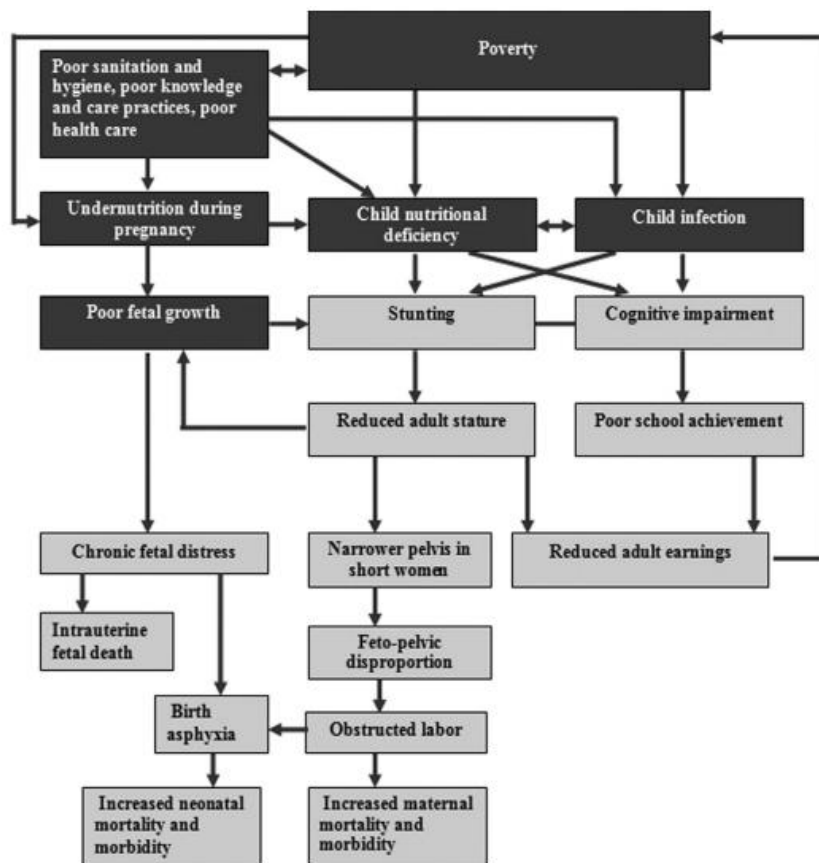


Figure 4 Causal pathways for long-term consequences of stunting(Dewey & Begum, 2011).

Micronutrient deficiencies can cause lots of health problems and can even result in death. As mentioned earlier the main problem in South Africa is vitamin A, zinc and iron *deficiency*. (Black et al. 2008) Children who have *under nutrition* have higher requirements for micronutrients, because their body do not have enough reserves for growth and metabolism and are less able to restore nutrients. That is why children with *undernutrition* have more risk to become ill and are less likely to recover. (Black et al. 2008. UNICEF, no date)

Vitamin A is an important vitamin for the integrity of the immune system, development of the eyes and protection against night blindness. Vitamin A *deficiency* remains a large-scale problem for children in Africa. The first sign of a *deficiency* is often night blindness and in the worst cases it leads to irreversible blindness. Vitamin A *deficiency* can also lead to poor child growth and development, infections such as diarrhoea and respiratory infections. Because it weakens the immune system and therefor making a child more vulnerable for infectious deceases such as HIV/AIDS and will eventually lead to death. (Black et al. 2013. Faber et al., 2013)

Zinc is important for the brain and it also plays an important role in the metabolism, the building of proteins, growth and development as well as the functioning of the immune system. A *deficiency* leads

to delays in the development, can cause pneumonia, diarrhoea and growth restriction (Black et al., 2013). A *deficiency* of zinc is only visible when the body has a shortage for a long time. Evidence suggests that zinc *deficiency* may be associated with deficits in activity and difficulties in attention and motor development. (Black, 1998)

Another mineral that is a common *deficiency* in South Africa is iron. It is a very important mineral that is necessary for the oxygen transport in blood and metabolism, if iron *deficiency* is present the risk of anemia increases. Anemia is particularly harmful for children because children have increased needs due to the growth period. Due to that a *deficiency* causes growth and learning difficulties. (Black, et al., 2008) *Deficiency* is often not recognized, because iron *deficiency* occurs before there is anemia. Except that iron *deficiency* leads to anemia, it can also lead to impaired concentration, breathlessness and dizziness. The consequences are of great importance later in life when children drop out of school early and are unproductive as adults.

Results field research

Study population clinical signs

The overall study population was between the age of seven and thirteen years old. The largest represented age group was nine years old. The average age was 9,5 years old with a standard deviation of 0,58 years. 52,9% is Female (N=46) and 47,1% is male (N=41) (See table 2). 100% of the population is coloured and live in the rural area surrounding the school.

Table 2 age/study population

Age	N=	Percentage
7	13	14,9%
8	12	13,8%
9	22	25,3%
10	13	14,9%
11	16	18,4%
12	7	8,0%
13	4	4,6%
Total	87	100%

Results anthropometric measurements

For the anthropometric measurement the gender, age, height and weight have been used to determine BMI-for-age, height-for-age and weight-for-age. The first two have been determined for all the children (N=87), weight-for-age is only applicable for the children <10 years old (N=48). 5,7% of the children appear to be too thin for their age, 78,1% appear to have a normal BMI for their age and the rest of the children are; overweight, obese or morbidly obese (10,3%, 4,6%, 1,1%). In the height-for-age curve 11,5% appear to be moderately stunted and 6,9% is stunted. The most of the children have a normal height for their age, 73,6%. 31,3% of the children under ten years are moderately underweight and 2,1% is severely underweight. 54,5% have a normal weight for their age and the rest is slightly overweight (8,3%) or overweight (4,2%). See table 3.

Table 3 Cut-off points growth curves adapted from source: WHO,2007 and results

	Cut-off points	
BMI N=87	>+3	Morbidly obese
	+2 to +3	Obese
	+1 to +2	Overweight
	+1 to -2	Normal
	-2 to -3	Thinness
	>-3	Severe thinness
Height-for-age N=87	>1	Tall
	1 to -1	Normal
	-1 to -2	Moderate stunting
	-2 to -3	Stunting

	>-3	Severe stunting	0,0% (N=0)
Weight-for-age N=48	>+2	Overweight	4,2% (N=2)
	+1 to +2	Slightly overweight	8,3% (N=4)
	1 to -1	Normal	54,2% (N=26)
	-1 to -2	Moderate underweight	31,3% (N=15)
	-2 to -3	Underweight	0,0% (N=0)
	>-3	Severe underweight	2,1% (N=1)

Results of the Food insecurity questionnaire

see Figure 5 The child Food insecurity questionnaire showed that 24 children of grade five and six are at risk of hunger, eight children appear to be food secure.

Because stunting is the result of chronic under nutrition and house hold food insecurity this has been compared with the results of the Food insecurity questionnaire (Table 4). According to the questionnaire 24 children are at risk of hunger and therefor also at risk of under nutrition. To see if there is a relation between the food security and undernutrition the data has been compared in a crosstab. In total six children are food secure, two children of them are moderately stunted and four have a normal height for their age. Of the children who are at risk of hunger three are moderately stunted and three are stunted, the remaining children (N=18) have a normal height for their age.

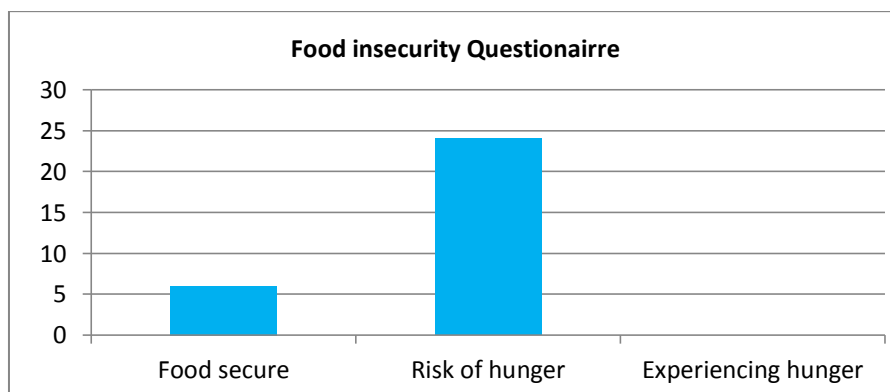


Figure5 Results Child Food Insecurity Questionnaire in N=31

Table4 Results Food insecurity questionnaire compared with stunting rates

Food insecurity Questionnaire	Height-for-age					
			<i>Normal</i>	<i>Moderate stunting</i>	<i>Stunting</i>	<i>Total</i>
<i>Food secure</i>	<i>N=</i>		4	2	0	6
	<i>%</i>		66,7%	33,3%	0,0%	100%
<i>Risk of hunger</i>	<i>N=</i>		18	3	3	24
	<i>%</i>		75,0%	12,5%	12,5%	100%
<i>Total</i>	<i>N=</i>		22	5	3	30
	<i>%</i>		73,3%	16,7%	10,0%	100%

Discussion

This research studied the prevalence of under nutrition of the children, aged 7-13 years, at the Maxonia primary school in Grabouw, South Africa. For the study anthropometric measurements of weight and height has been performed and compared with the growth curves of WHO for school-aged children and adolescents (WHO,2007). Although it is declining, undernutrition is still a problem at the Maxonia primary school in Grabouw. After analyzing the results of the measurements it showed that in BMI-for-age the most children had a normal healthy BMI-for-age (N=68) and that only five children were too thin for their age. Although the BMI-for-age score was mostly normal, overweight is seen in fourteen children. This shows that overweight is becoming a problem at the school. This is consistent

with research that has been done the last couple of years, it shows that there is a double burden of malnutrition in South Africa, next to undernutrition, overweight is a growing problem. (Black et al. 2013. Kimani-Murage et al., 2011. de Villiers et al. 2012.) Also height-for-age has been determined to see whether the children are stunted. In this study only six children seem to be stunted (<-2 standard deviations), but also ten children are moderate stunted (between -1 and -2 standard deviations). Although the stunting rates are declining, stunting seems to be still a big problem in South Africa, according to the NFCS-FB stunting appears in almost one out of five children. (Labadarios et al., 2005) Also a research that has been done in 2007 shows that 18% of the children in rural areas of South Africa were stunted. (Kimani-Murage et al., 2011) Both studies show the largest prevalence of stunting among children between the age 1-4 years old and a lowest prevalence in children aged 5-9 years (5%). This is also seen in the National Food consumption survey that has been done in 1999. (Labadarios et al., 1990). But the prevalence went up between the age of 14-15 years to 15%. (Kimani-Murage et al., 2011). Because in this study the age 5-6 and 14-15 not has been included, this is maybe why the prevalence of stunting is lower than national.

Underweight seems to be still a large scale problem in South Africa, affecting almost one out of ten children in the age of 1-9 years. (Labadarios et al., 2005) According to a research that has been performed at low resource primary schools in the Western Cape underweight is an important priority and is seen as a health problem at the schools (de Villiers et al. 2012). In this study 15 children of the study population (7-10 years) ($N=48$) is moderate underweight (-1 to -2 standard deviation). Only one child is severe underweight (<-3 standard deviation). This shows that underweight is still a problem at the Maxonia school. An important limitation of the study is that because of the time only one primary school in the Grabouw area had been studied. Because of this the study population is too small to make a proper conclusion of the prevalence of under nutrition at primary schools in the Grabouw area. Only the prevalence of undernutrition at the Maxonia primary school can be determined. Also there was no growth history available of the children to determine if there were changes in their growth. The parents were hard to reach and was not doable within the timeframe of the study.

In 2012 de Villiers et al. performed research about health situations on low resource primary schools in the Western cape province. In this research 84% of the principals indicated that they were concerned about the poverty and unemployment in the areas of the schools. This is also seen in the Conceptual Framework of UNICEF (1990), that framework shows that low resources is a basic cause for inadequate food access, care and insufficient access to health services leading to inadequate food intake or disease and is therefore a big risk factor for undernutrition. In my study I also discovered that, according to the results of the Food insecurity questionnaire, poverty and food insecurity is an important problem at the Maxonia school. When I asked the principal about it, he also indicates that he sees a lot of poverty in the families. Though in comparison with the National Food Consumption Survey-fortification baseline (Labadarios et al., 2005) the children at the Maxonia school seem to be more food secure, but the largest amount (80,0%) are at risk of hunger. 'According to the NFCS-FB (Labadarios et al., 2005) 'at national level one out of two households are experiencing hunger, one out of three are at risk of hunger and one out of five seem to be food secure.' However this can also be the result of the reliability of the children's answers. It can be the case that children felt afraid or put under pressure to answer and therefore not answered honestly. It would be best to do the questionnaires again to see if the children answer the same or also question the mother. Also it would be better if all the children of the school could be questioned, this has not been done because the children of the grades one to four are younger and their answers would not be reliable without the presence of their mothers. In this study this has not been done because of the short time frame. Also the association between stunting and food security is interesting, this because according to the NFCS-FB (Labadarios et al., 2005) there is an overall association between the hunger risk classification and anthropometric status. However in this study the association seems to be minimal, the most of the children who are at risk of hunger seem to have a normal height-for-age (75,0%), the rest (25,0%) are either moderately stunted (12,5%) or stunted (12,5%). This outcome shows only a minimal association between the risk of hunger and the height-for-age. However this outcome can also be minimal, because mainly the children of lower age seem to be stunted in this research. To make a good comparison all the children should be questioned and new comparisons should be made to see if there is an association.

Recommendations

- Set up an annual anthropometric plan and keep growth references of the children. To see if the growth is improving or deflecting a statistical paired T-test can be performed. The references of this study should be compared with next year's measurements.
- For a next study the mothers of the children under ten years can be questioned about food security to determine their hunger risk.
- To get a better idea about the prevalence of undernutrition at the Grabouw area, other schools should be included in research. For example next research can study the prevalence of undernutrition at other primary schools in the Grabouw area and make a comparison to the Maxonia primary school. This results can be statistically analyzed with a paired T-test to see if there are differences in outcome.
- To improve the risk of hunger parents should be informed of the importance of nutrition for growth and development. For example an intervention program can be set up.
- The Maxonia school should offer nutritious in between snacks to improve the anthropometric status of the children.

Conclusion

This study shows that the prevalence of undernutrition at the Maxonia primary school is still high. If you take in account that thinness, stunting, underweight and risk of hunger are all signs of undernutrition, 42,5% (N=37) of the children are undernourished, they are either thin (N=5), moderate stunted (N=10), stunted (N=6), moderate underweight (N=15) or severe underweight (N=1). The outcome of the Food security questionnaire shows that 24 children of the study population (N=30) are at risk of hunger and therefor at risk of undernutrition.

This study shows that undernutrition and food insecurity is a problem at the Maxonia primary school in Grabouw. The outcomes can be used to further study the prevalence of undernutrition in other primary schools in the Grabouw area. It can also be used to set up an intervention program to make parents aware of the importance of nutrition for growth and development of their child. The Maxonia school can use the outcomes to improve their school nutrition program to fit the needs of the children and to set up an annual anthropometric measuring to follow the growth of the children.

The main limitation of this study is the short time frame and limited study population. Therefor next research should be performed at multiple primary schools in the area.

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Attachments



1. Search report

Keywords	Database	Limits	Hits	Date	Product
("Malnutrition/diagnosis"[Mesh] OR "Malnutrition/prevention and control"[Mesh])AND South Africa AND children	PubMed	<5 years	11	19 March, 2014	Kimani-Murage, E.W., Norris, S.A., Pettifor, J.M., Tollman, S.M.,Klipstein-Grobusch, K., Gómez-Olivé, X.F., Dunger, D.B. & Kahn, K. (2011). Nutritional status and HIV in rural South Africa. <i>BMC Pediatrics</i> , 11:23
food security OR food insecurity AND measurement AND indicators	PubMed	Sort by relevance	32	31 March, 2014	Swindale, A., & Bilinsky, P.(2006). Development of a universally applicable household food insecurity measurement tool: process, current status, and outstanding issues. <i>Journal Nutrition</i> , a136:1449S–52S.
food security AND "South Africa"[Mesh]) AND household AND children	Pubmed	Sort by relevance	64	31 March, 2014	Labadarios, D., Mchiza, Z.J., Steyn, N.P., Gericke, G., Maunder, E.M.W., Davids, Y.D. & Parker, W. (2011). Food security in South Africa: a review of national surveys. <i>Bull World Health Organ</i> 2011;89:891–899
("Child"[Mesh]) AND "South Africa"[Mesh]) AND Stunting	PubMed	Sort by relevance	46	31 March, 2014	Kimani-Murage, E.W. (2013). Exploring the paradox: double burden of malnutrition in rural South Africa. <i>Global Health Action</i> , 24 (6).
("Child"[Mesh]) AND "South Africa"[Mesh]) AND Stunting	PubMed	Sort by relevance	46	20 March, 2014	Kimani-Murage, E.W., Norris, S.A., Pettifor, J.M., Tollman, S.M.,Klipstein-Grobusch, K., Gómez-Olivé, X.F., Dunger, D.B. & Kahn, K. (2011). Nutritional status and HIV in rural South Africa. <i>BMC Pediatrics</i> , 11:23
("Child"[Mesh]) AND "South Africa"[Mesh]) AND "School health"AND Nutrition	PubMed	none	6	31 March, 2014	De Villiers, A., Steyn, P.N., Draper, C.E., Fourie J.M, Barkhuizen, G., Lombard, C.J.(....) Lambert.E.V.(2010). "HealthKick": Formative assessment of the health environment in low-resource primary schools in the Western Cape Province of South Africa. <i>BMC Public Health</i> . 6;10:398.
("Child"[Mesh]) AND "South Africa"[Mesh]) AND Stunting	PubMed	none	46	15 April, 2014	Steyn, N.P., Labadarios, D., Maunder, E., Nel, J., & Lombard, C.(2005). Secondary anthropometric data analysis of the national food consumption survey in South Africa: The double burden. <i>Nutrition</i> . 21, 4-13.



3.Measurement protocol

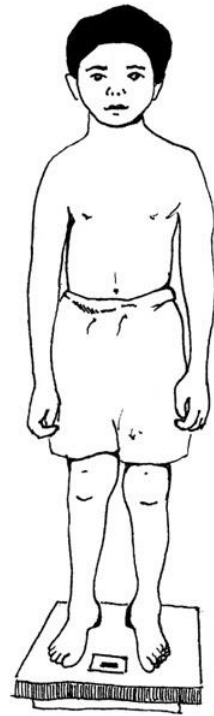
Weight:

1. Ask the child to take of shoes and outer clothing
2. Turn on the scale, cover the solar panel for a second. When the number 0.0 appears, the scale is ready.
3. Ask the child to stand in the middle of the scale, feet slightly apart (on the footprints, if marked), and to remain still until the weight appears on the display.
4. Record the child's weight to the nearest 0.1 kg.

Height:

Measure height immediately after weighing, while the child's clothes are still off

1. Remove any hear ornaments or buns that can interfere with the measurements.
2. Let the child stand against the wall, with the feet in 90 degrees and the head against the wall with the chin straight.
3. Keep the head in position and push the measuring board against the top of the head.
4. Read the height of the child, while keeping the child in position.
5. Record the child's height to the nearest of 0,1 cm.



(Adapted from source: WHO Job-aid – Weighing and Measuring a Child standards. WHO, No date)

4.Registrationform anthropometric measurements

NAME AND SURNAME / NAAM EN VAN
GENDER/GESLAG M/F
DATE OF BIRTH AND AGE/GEBOORTEDATUM AND OUDERDOM /...../...../
WEIGHT/GEWIG -----KG
HEIGHT/HOOGTE -----CM

5. Informed consent

Informed consent

Anthropometric measurements

On the 8th of April 2014, an anthropometric measurements will take place at the Maxonia primary school. The weight and height of all the children of grade 1A to 6A will be measured. The goal is to determine whether the children are undernourished or at risk of undernutrition. With the outcomes the prevalence of undernutrition at the school can be identified.

The measurements will include measuring the weight and height of the children. Also the children of 10 years and older will be asked questions about food insecurity. This with the goal to determine whether a child is at risk of hunger.

The measurements will take approximately 5 minutes per child and the questionnaire approximately 10 minutes. The children will be picked up in the classroom and brought back afterward. In order to let everything go more smooth and quick, fifteen students from UWC will be there to assist.

The measurements start at 10h00 am and end at 12h30 pm.

The children are not obligated to participate, but this will be appreciated. All the children will have to give verbal consent before any measurements take place. After the measurement all the children will get a little bag with nuts and raisins as a thank you.

Participation

By signing this informed consent you agree on letting the measurements take place at the Maxonia primary school.

Name: Fraser Baard

Function: Measure & weigh of children in Maxonia
Principal Grabouw

Date and place: 2014/04/08

Signature: [Signature]

Researcher:

By signing this informed consent I declare that I have given all the important information about this research on the 8th of April 2014.

Name: Lindsey Langenhof

Date and Place: Grabouw 2014/04/08

Signature: [Signature]

6. Pictures

