Contributing factors to chronic malnutrition (stunting) in children under the age of five in Yemen

Amal Abdullah Atef
Yemen

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Contributing factors to chronic malnutrition (stunting) in children under the age of five in Yemen.

A thesis submitted in partial fulfilment of the requirement for the degree of Master of International health

By

Amal Abdullah Atef

Yemen

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Abbreviations

ANC	Antenatal Care
ARI	Acute Respiratory Infections
BMI	Body Mass Index
CMAM	Community Based Nutrition
CF	Complementary feeding
CFSS	Comprehensive Food Security Survey
DALYs	Disability-Adjusted Life Years
EBF	Exclusive Breastfeeding
EFSNA	Emergency Food Security and Nutrition Assessment
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GMP	Growth Monitoring and Promotion
HDI	Human Development Index
HFA	Weight-For-Height
HAZ	Height-for-age z-scores
HFI	Household Food Insecurity
HH	Household
IMCI	Integrated management of childhood illness
IUGR	Intra-Uterine Growth Retardation
IYCF	Infant and Young Child Feeding practice
MAM	Moderate Acute Malnutrition
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MMR	Maternal Mortality Ratio
MNH	Maternal and New-born Health
MOPIC	Ministry of Planning and International Cooperation
MOH	Ministry Of Health
MUAC	Middle Upper Arm Circumference

NGO	Non-Governmental Organization
NNS	National Nutrition Strategy
ORS	Oral Rehydration Solution/Salts
OTP	Outpatient Therapeutic Program
PHC	Primary Health Care
PLW	Pregnant and Lactating Women
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SDG	Sustainable Developments Goal
SWF	Social Welfare Fund
SMART	Standardized Monitoring and Assessment for Relief and Transition
SUN	Scaling Up Nutrition
SFP	Supplementary feeding program
THE	Total Health Expenditure
TFC	Therapeutic Feeding Centres
UNICEF	United Nations Children's Emergency Fund
USI	Universal Salt Iodization
U5	Under five
VAD	Vitamin A deficiency
WFA	Weight-For-Age
WFP	World food program
WFH	Weight-For-Height
YNDHS	Yemen Nutrition Demography and Health Survey

Glossary

Breast milk substitute: any food being marketed or otherwise represented as a partial or total replacement for breast milk, whether or not it is suitable for that purpose (1).

Bottle feeding: Proportion of children 0–23 months of age who are fed with a bottle (2).

Complementary feeding: the process starting when breast milk alone or infant formula alone is no longer sufficient to meet the nutritional requirements of an infant, and therefore other foods and liquids are needed along with breast milk or a breast milk substitution. The target range for complementary feeding is generally considered to be 6–23 months (1).

Exclusive Breastfeeding (EBF): The feeding of an infant only with breast milk from his/her mother or a wet nurse, or expressed breast milk, and no other liquids or solids except vitamins, mineral supplements, or medicines in drop or syrup form (2).

Global Acute Malnutrition (GAM) is the presence of both MAM and SAM in a population. A GAM value of more than 10 percent indicates an emergency. High prevalence rates outside of the seasonal norm are cause for concern. Commonly used thresholds for GAM are: <5% acceptable ;5% to 9.9% poor; 10% to 14.9% serious; >15% critical (3).

Low birth weight: An infant weighing less than 2,500 grams at birth (1).

Malnutrition: A broad term commonly used as an alternative to under nutrition, but technically it also refers to over nutrition. People are malnourished if their diet does not provide adequate nutrients for growth and maintenance or they are unable to fully utilize the food they eat due to illness (undernutrition).They are also malnourished if they consume too many calories(overnutrition) (1).

Micronutrients: Essential vitamins and minerals required by the body throughout the lifecycle in miniscule amounts (1).

Micronutrient deficiency: occurs when the body does not have sufficient amounts of a vitamin or mineral due to insufficient dietary intake and/or insufficient absorption and/or suboptimal utilization of the vitamin or mineral (1).

Mid-Upper Arm Circumference (MUAC): The circumference of the upper arm measured at the midpoint between the tip of the acromion process (at the shoulder) and the tip of the olecranon process (at the elbow) (3).

Minimum dietary diversity: Proportion of children 6–23 months of age who receive foods from 4 or more food groups (2).

Moderate Acute Malnutrition (MAM): is defined as weight for height between minus two and minus three standard deviations from the median weight for height of the standard reference population (1).

Overweight: is defined as weight for height above two standard deviations from the median weight for height of the standard reference population (1).

Stunting: defined as height for age below minus two standard deviations from the median height for age of the standard reference population (1).

Severe Acute Malnutrition (SAM): defined as weight for height below minus three standard deviations from the median weight for height of the standard reference population, mid-upper arm circumference (MUAC) less than 115 mm, visible severe thinness, or the presence of nutritional oedema (1).

SUN (scaling up nutrition) movement is a unique movement founded on the principle that all people have a right to food and good nutrition. It unites people from governments, civil society, the United Nations, donors, businesses and researchers in a collective effort to improve nutrition.

Undernutrition: is the outcome of insufficient food intake, inadequate care and infectious diseases. It includes being underweight for one's age, too short for one's age (stunting), dangerously thin for one's height (wasting) and deficient in vitamins and minerals (micronutrient deficiencies) (1).

Underweight: is a composite form of under nutrition that includes elements of stunting and wasting and is defined as weight for age below minus two standard deviations from the median weight for age of the standard reference population (1).

Wasting: is defined as weight for height below minus two standard deviations from the median weight for height of the standard reference population. A child can be moderately wasted (between minus two and minus three standard deviations from the median weight for height) or severely wasted (below minus three standard deviations from the median weight for height) (1).

Infant and Young Child Feeding (IYCF): refers to specific recommendations and guiding principles for optimal nutrition, health, and development of children. A set of eight population-level IYCF indicators have been developed to: (i) assess IYCF trends over time; (ii) improve targeting of interventions; and (iii) monitor progress in achieving goals and evaluate the impact of interventions (2).

International Code on Marketing of Breast milk Substitutes (BMS): is a set of recommendations to regulate the marketing of breast milk substitutes, feeding bottles, and teats. This code aims to contribute "to the provision of safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of breast milk substitutes, when these are necessary, based on adequate information and through appropriate marketing and distribution" (4).

Food security: Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (5).

Dedication

To my dear parents Mr.Abdullah Atef and Mrs.Lutfiah Shrahan and my son Yunis; as well as to my husband for supporting me through my master’s degree.

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Abstract

Introduction: Stunting in children under five has been a major health threat in Yemen for decades. At present, more than half of the children are stunted, leading to profound effects on children's cognitive development and future chronic diseases.

Objective: This study identifies and analyses the determinants of stunting among children under five to provide recommendations for policy decision makers on interventions to prevent stunting.

Methodology: The WHO conceptual framework for stunting was used as a guide for literature review, where the focus is on the context and causes.

Findings: The maternal factors are the most significant determinants for stunting in Yemen. These include a high rate of maternal undernutrition and mother's anaemia, frequent deliveries, and the low socioeconomic status of women. Moreover, exclusive breastfeeding for infants under six months is infrequent and complementary feeding of children under two years is inadequate in the Yemeni society, particularly among mothers of low education. Household food insecurity and lack of food diversity are also important causes of stunting. The latter two factors are much due to increases in food prices and the loss of jobs due to conflict. In addition, an important contextual factor is the lack of access to safe drinking water and poor hygiene which is associated with frequent recurrent episodes of diarrhoea in children under five. The conflicts in Yemen is one of the major contextual factors which have direct and indirect effect on children stunting.

Conclusion and recommendations: Stunting is a complex issue where the causal and contextual factors are intrinsically linked. For this reason, an integrated multi sectoral approach is essential to reduce its prevalence in Yemen. There is a need to enhance the societal status of women, as well as their level of nutrition and health. An increased community awareness of exclusive breastfeeding and adequate complementary feeding practices are also required. Furthermore, improving access to safe water and hygiene promotion with a focus in the 1000 days of child age holds potential as a factor to reduce stunting. Finally, further research regarding these determinants and how they influence each other is recommended to produce future interventions with a better response.

Key words: Stunting, under five children, risk factors and Yemen.

Word count: 12,792

Introduction

I am a medical doctor working with UNICEF Yemen, as nutrition and health officer. I have been working in the emergency nutrition program, since 2013. I have worked in a poor setting with limited resources in different places in Yemen. I have realized that malnutrition in children is a complex and vital subject. I have chosen the contributing factors of stunting for my thesis because I feel it is a very interesting subject. And I want to explore studies conducted about stunting in Yemen. Stunting is a good indicator of child health being. It impairs cognitive development, lower the immune system and greater risk of future chronic disease. Stunting is almost irreversible, but it can be prevented by improving nutrition for women and children in the first 1,000 days. Yemen is suffering from this problem for decades. Thus, if more than half of children are stunted, that means is a serious public health problem. Indeed, prompt procedures and action must be taken to reduce the rate of stunting among under-five children. Globally the World Health Assembly endorsed a global stunting target to reduce the number of children under age five who are stunted by 40% by 2025. However, Yemen still lag in achieving the target. This paper will derive recommendation to policy decision maker in Yemen, which can help in reducing stunting in Yemen.

Chapter one: Country background

Geography and Climate

Yemen is located south of Saudi Arabia and west of Oman, with borders to the Red Sea, the Gulf of Aden and the Arabian Sea. The country can be divided geographically into five major areas: The Mountainous-, the Coastal-, the Plateau-, the Desert- (Al-Ruba Al-Khali) areas, and the Yemeni islands. Yemen's climate is varied, but much of it is desert meaning it is generally dry and warm. There are two rainy seasons, from February to April and from July to August (6,7). The administrative division of Yemen is divided into two: governorates and districts. Governorates are the highest administrative divisions which are subdivided into districts. There are 22 governorates and 333 districts. (8).

Population Characteristics

According to the Yemen Central Statistical Organization (CSO), the population of Yemen is about 27.58 million, and the annual population growth rate is about 2.4%. The UNDP in Yemen has projected that the population will almost double in the coming 23 years, to around 40 million (9). In 2015, Yemen's birth rate was 32.2 per 1,000 people. Fertility rates for Yemen fell gradually from 7.7 births per woman in 1966, to 4.1 births per woman in 2015 (7,10). The majority of Yemen's population falls within the under 15 age band (40%), and only 4% of the population is above the age of 60(7). With respect to geographic distribution, 70 % of the population reside in rural areas.

Political Situation

Yemen has been political unstable for many years. The situation escalated in 2011 when several demonstrations and protests from the youth against the previous president, Ali Saleh, took place. In 2012, president Saleh agreed to hand over the power to his deputy, Abdrabbuh Mansour Hadi. In 2014 however, The Houthi group *(an Islamic religious-political-armed movement that emerged from Sa'dah in northern Yemen in the 1990s)* took control over the capital Sana'a, effectively ending the presidency of Abd Rabbu Mansour Hadi (11). Since then, the Houthis, who are allied with Hadi's predecessor Ali Abdullah Saleh and believed to have

Iranian backing, have pushed south. In 2015, Saudi Arabia with the United Arab Emirates (UAE) launched an intensive bombing and ground intervention campaign to restore Hadi to power, but the Houthis have managed to retain significant gains on the ground. Al-Qaeda in the Arabian Peninsula (AQAP) has exploited the conflict to seize parts of eastern Yemen and develop a working relationship with anti-Houthi tribal militias (5,6). Political analysts conclude that it seems that the future of Yemen will be decided by conflict that will fulfil the agenda of AQAP, and not only cause immense damage to Yemenis and their country, but also put at risk Yemen's long history of sectarian cooperation (12).

Socio-Economic Conditions

Religion and language

The vast majority of Yemeni citizens are Muslims, and a minority (less than 55000) are Jews of which most have migrated to Israel and the US (13). The constitution provides freedom of religion, but Islam is the state religion and the Sharia (Islamic) law is the basis of all legislations. Arabic is the official language, with no other local languages. English is taught at schools from the 7th grade, but English proficiency mainly exists among those who received private education (7).

Education

The education cycle consists of nine years of primary education, followed by three years of secondary level study (14). Education overviews show that Yemen is one of the poorest countries in the Middle East, ranking as number 154 of 187 countries on the Human Development Index. The illiteracy rate in Yemen is high among women (65%), compared to 27% among men (5). Around 43% percent of females and 21 % of males of age 6 and older have never attended school (7). Yemen spends 5 % of its GDP on education (15). Unfortunately, the education situation has been greatly affected by three years of conflict. UNICEF reports that since the conflict escalated in March 2015, around two million children are out of school, and around 2500 schools are either partially or completely damaged due to airstrikes and shelling or occupied by armed groups (16).

Economy

Yemen is one of the poorest countries in the middle east and the north African region (MENA) (9). After 2015 the GDP has declined by nearly 32.9%. The public sector contributes to 46% of GDP,52.6% of aggregate demand and provides employment opportunities to around 31% of the employed population (17). According to the Ministry of Planning and International Cooperation (MOPIC), 80% of the governmental income comes from the oil and gas sector. The remaining part comes from the agricultural sector (17,18). After the escalation of the conflict in March 2015, oil and gas exports have been suspended. The limited financial resources that exist have since then been directed toward spending on military and public-sector wages, leaving millions of Yemenis at risk of famine. Clearly, the economy of Yemen is severely affected by the conflict. According to the world bank, poverty levels have dramatically increased to over 80 % after the conflict (19). Before 2015, poverty was also high and growing. In 2009, 43% of the population lived in poverty, and this figure increased to 55 percent by 2011. Poverty is particularly high in rural areas (20). After the war, millions of Yemeni citizens lost their jobs and livelihoods (19,21). In the last two years, the government was not able to pay salaries for all their governmental staff. Even before the war in 2015, the economic situation was not steady, and mismanagement, depletion of natural resources and corruption was present in most governmental bodies (20).

Health System

The Health System in Yemen

The health system in Yemen is mainly public and is operated by the government and a sizable private sector. The public care sector contains three components: primary health care (PHC) which is most active in rural areas, supported by secondary care at district level and the tertiary care level in the capital city. PHC was introduced in Yemen in 1979, and it now reaches 30% of the population in rural areas, and 50% of the population overall. The PHC has a preventative focus, aiming at health promotion, vaccination, maternal, child health and family planning (22). As opposed to the preventative focus of the public PHC, the private sector is mainly curative and chiefly available in and around urban areas. At present, private care acts more as a competitor than as a compliment to public health care services. (22,23). In addition to the public and private sectors, the charitable (private non-profit) health sector offers

specific health services through a number of National Non-Governmental (NNGOs) and International Non-Governmental Organizations (INGOs) (7,22). Currently there are 20 INGOs, 120 NNGOs and 7 UN agencies involved in the implementation of critical health activities in the country. All are working under the coordination of the local authority and health cluster which is led by the WHO (24).

The total health expenditures in Yemen amounts to nearly 4% of the GDP and the total expenditure on health per capita (Intl $, 2014) is 202 (25). In the last years, the out of pocket (OOP) expenditure exceeds 70% of the total health expenditure, due to a declining public health expenditure (23).

The health system also suffers from poor infrastructure and a scarcity of human resources, as well as to the maldistribution and poor utilization of available staff. The public health sector is currently composed of about 3853 health facilities distributed over three key levels (2774 health units, 842 health centres and 237 hospitals), see Annex 1 (22,23).

Current Health in Yemen

Late in 2015, after Saudi Arabia collations interfered, the health system became more fragile and neared full collapse (26). Reports from humanitarian actors, such as the WHO and UNICEF, the escalation of the conflict has left around 14.1 million people, including 7.4 million children, in need of health care access (27,28). The WHO has reported that around 46% of health facilities are not functioning due to war and conflict. These facilities were either attacked by air strike or closed due to highly defect resources (29). Currently, the country has around 3 doctors per 10 000 people. In comparison, the highly developed country Switzerland has 40 doctors for the same number of people (30). Moreover, the ongoing conflict and crises in Yemen has left people with limited access to safe water and basic hygiene and sanitation services (21). Reports from the he cholera outbreak in December 2017 showed that around one million people were infected, and thousands of people died from this treatable disease (21,24). In addition to cholera, other contagious diseases such as diphtheria are spreading (31). Adding insult to injury, the shortage of medical supplies add an extra burden to the ministry of health, who currently relies almost exclusively on humanitarian actors to provide medical supplies to the country (24).

Yemen remains in the early stages of epidemiological transition, with morbidity and mortality from communicable diseases still predominating over non-communicable diseases, and with high levels of malnutrition (7,32). Diarrhoea, malnutrition, acute respiratory infections and malaria are most common. Although these existed before the war, they have been exacerbated to new levels due to war and conflict (22,24,33).

The Yemen Nutrition Demography and Health Survey (YNDHS) conducted in 2013 showed that under-five mortality has been reduced from 150 deaths per 1,000 live births in 1985 to 53 deaths per 1,000 live births in 2011. Similarly, the maternal mortality ratio (MMR) fell gradually from 365 deaths per 100,000 live births in 2003 to 148 deaths per 100,000 live births in 2013. Despite the positive trend, these indicators are still high compared to many other countries in the world (7,34). It is worth mentioning that one study conducted in 2016 that measured the impact of war on child and maternal health showed the contrary, namely that under-five child mortality increased from 53 deaths per 1000 live births in 2013 to 56·8 in 2016 (35). Similarly, the national MMR has increased since the war from 1.3% from 2013 to 213.4 deaths per 100,000 live births in 2016 (35).

According to the 2013 YNDHS, 43% of Yemeni children age 12–23 months, have received all recommended vaccines. Vaccination coverage is higher in urban (59%) than in rural areas (37%). The national Immunization coverage for children in Yemen, is fluctuating due to the countries instability and the inability of the ministry of health to cope with such changes in the country context e.g. the BCG vaccine coverage (See Figure 1) (36).

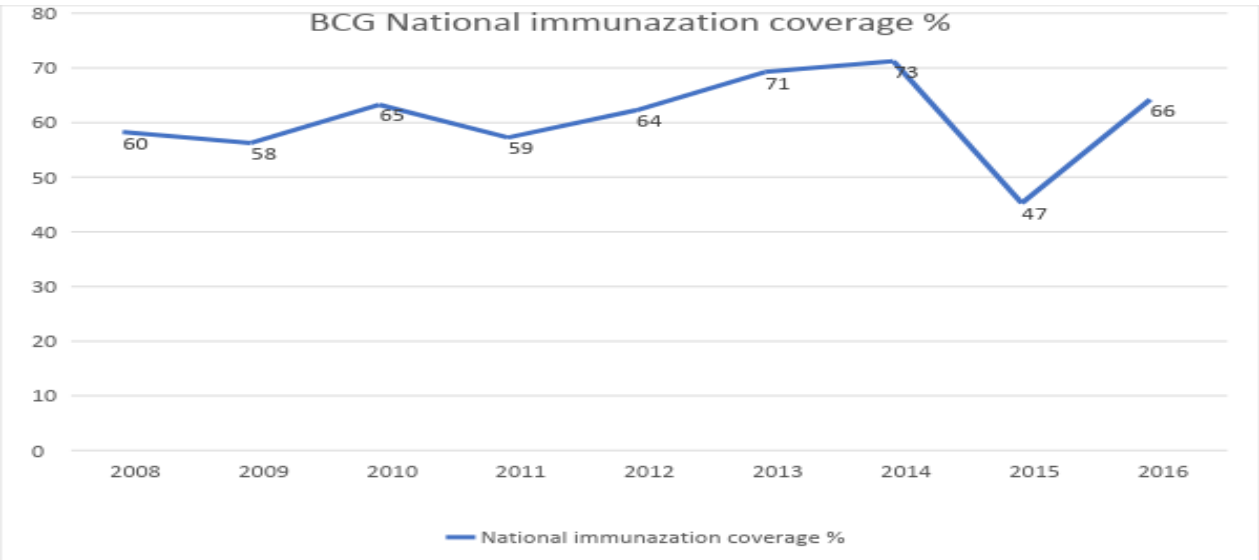


Figure 1: BCG National immunization coverage source WHO & UNICEF

Chapter two: General introduction about childhood malnutrition

General background and types of childhood malnutrition

Nutrition is crucial for the health of human beings at all ages, particularly for children. An imbalanced diet and inadequate nutrition lead to one of the major global health problems, namely malnutrition (37). The WHO has classified child malnutrition in three broad types. The first type is undernutrition, which refers to wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age). The second type is overweight, which is referring to overweight and obesity. The third is micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess (38). Malnutrition is a multidimensional problem and almost every country in the world is suffering from at least one form of malnutrition. However, most malnutrition is present mainly in low and middle-income countries. Undernutrition can put children at high risk of infection, as children become more susceptible to infections and non-infectious diseases which can further deteriorate the nutritional status of children. A child will undergo a vicious cycle and it eventually will lead to child death (1). Around 49 % of child mortality is due to undernutrition (39). Malnutrition during the first 1000 days of a child's life will lead to stunting and chronic malnutrition and mental retardation (40).

Global perspective and trends on stunting

Stunting, in children under five, is a major global problem and particularly challenges low and middle-income countries. According to the last global nutrition report (2017), the current prevalence for stunting has reached 23.9%, or an estimated 155 million children (41). The majority of stunted children are living in Asia and Africa, where they account for 56% and 36% from the global trend respectively (42). Globally there is a reduction in the prevalence of stunting from 39.7% to 23.9 % in the last decades. In 2010 the prevalence was 26.7% and in 1990 it was 39.7%, which equals around 171 million and 253 million children respectively (42,43). According to the World Health Assembly, the number of stunted children in 2025, will be reduced to 100 million children, which constitutes a 40% reduction of the number of stunted children. The target has been included in the Sustainable Development Goals (SDG

target 2.2) (41,42). Currently the prevalence of stunting remains high in several world regions, and improvement is lagging behind in African and the south east Asian regions. The south east Asian region has shown a better improvement than the African region, where prevalence of stunting has improved from 51.3 % in 2000 to 35 % in 2017. The African region has shown suboptimal improvement, with an overall prevalence decline from 45.3% to 34.1% (39). In 2018 UNICEF reported a significantly increased number of stunted children in the west and central Africa region, from 22.8 million to 28.9 million (39). Similarly, six countries are still suffering from a highest rate of stunting compared to the rest of the world, with around 50% of population is still stunted (5,4). These countries are Afghanistan, Burundi, Ethiopia, Madagascar, East Timor, and Yemen (43). These countries have the

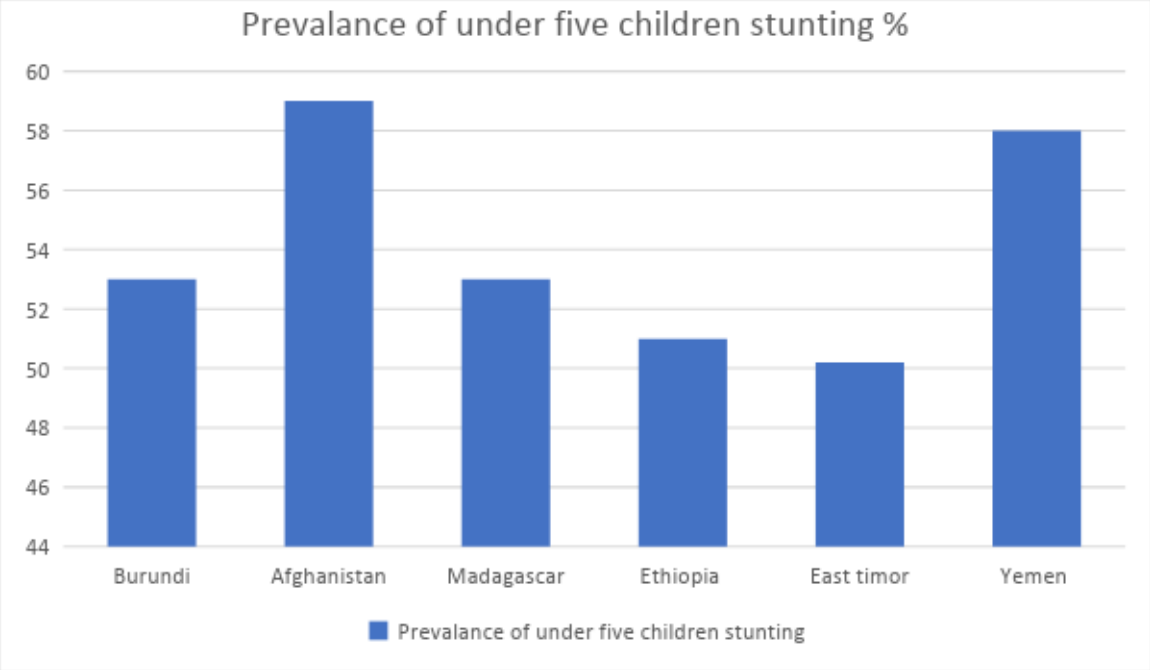


Figure 2: Highest countries stunting prevalence, source UNICEF (1).

In other regions, like Latin America and the Caribbean, the prevalence of stunting is low, and it has been reduced from 16.9 % in 2000, to 9.6 % in 2017 (39). It is estimated that the Latin American level of stunting will be reduced even more in the coming decades (43). The European region has shown a very low prevalence of stunting for decades, declining from 18.6 % in 2000 to 8.5% in 2017 (39). However, there are still variations and discrepancies in inter-regional levels of stunting. For example, Haiti still has high rates of stunting despite being in the relatively low stunting region of Latin America (39,42).

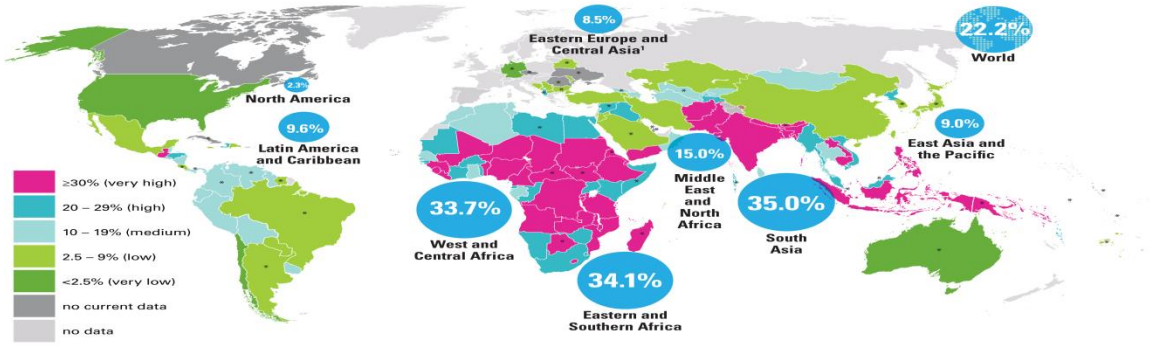


Figure 3: Source (UNICEF, WHO, World Bank Joint Child Malnutrition dataset, May 2018 (39).

Consequences of stunting

Stunting has profound consequences during human life, and consequences may be short or long-term (44). Insufficient growth during childhood can lead to poor health outcomes and an increase of under-five mortality. Stunting alone cause 14 % of under-five child mortality (45). Stunting is irreversible and leads to a reduced adult stature (46,47). It is a chronic type of malnutrition, as the stunted child cannot regain its height. In contrast, the wasted child can regain its weight if a proper management is introduced (46). One prospective multi-country cohort study shows that catch-up growth for early stunting is possible (48), yet some scholars consider the possibility of catch-up growth limited, because children remain in environments that contribute to growth restriction (46). Another cohort study on stunting outcomes conducted in adults concluded that stunting is strongly associated with a decreased level of school performance, decreased per capita household expenditure and more liability by living in poverty. Women who were stunted in childhood have a higher chance of having an earlier first child and a greater number of children. Similarly, stunted males have less earnings were 1.0% increase in height leads to a 2.4% increase in the adult male earnings (46,47). More evidence exists that exposure to famine among people in China 1959-1961 has resulted to short stature and lower income (49). Growth failure in childhood and perinatal undernutrition, especially during the infancy period, *could* lead to chronic diseases like cardiovascular disease, hypertension and high blood glucose, however this association is still not clear enough to draw a firm conclusion (47,50). Undernutrition during infancy can be risk a factor for adult obesity. One study conducted in five Arab countries shows that the risk ratio of overweight in stunted children ranges from 3.85 in Libya to 0.76 in Yemen (51). Another longitudinal cohort study conducted in India showed that undernutrition in infancy is a

leading cause for an increased adult body mass index and glucose intolerance (52). Chronic malnutrition in the first 1000 days of life also has neurological consequences which can lead to cognitive impairments. In essence, nutritional deprivation during brain tissue development of the hippocampus in early infancy reduces dendrite density and causes cognitive damage (53). Two cohort studies also show an association of stunting in the first two years of life with less schooling and lower school performance with a loss of 4.64 grades of schooling (46).

Under five malnutrition situations in Yemen

Yemen has the highest rate of under-five (U5) child malnutrition in the world, and three distinct types of U5 malnutrition exists in the country.

- Acute malnutrition (severe and moderate wasting).
- Chronic malnutrition (stunting).
- Underweight.

The GAM rate for U5 children reflects figures of both severe acute malnutrition rates (SAM) and moderate acute malnutrition (MAM) rates (See Annex 2), and It is used as an indicator to reflect the national nutritional situation through surveys and nutrition assessments of children under five. Several assessments have been conducted to assess the U5 children nutrition situation in several parts of Yemen, such as the Standardized Monitoring and Assessment for Relief and Transition (SMART) survey conducted by UNICEF and MOPH, a family health survey conducted by MOPH, and a Comprehensive food security survey (CFSS) conducted by the World food program (WFP) (2,51,53). The prevalence of a global acute malnutrition rate (GAM) in Yemen is persistently high at more than 15%, which constitutes a critical situation. In several areas in Yemen, the GAM rate has reached above 30% (7,54). Figure 4 shows the variation of GAM in different parts of the country. Although the whole country suffers from high GAM (or wasting) rates, the highest is found in the coastal areas (55). In four out of nineteen governorates, acute wasting levels are surpassing the emergency threshold of 15 percent, with the highest rates recorded in Al-Hodeida (54).

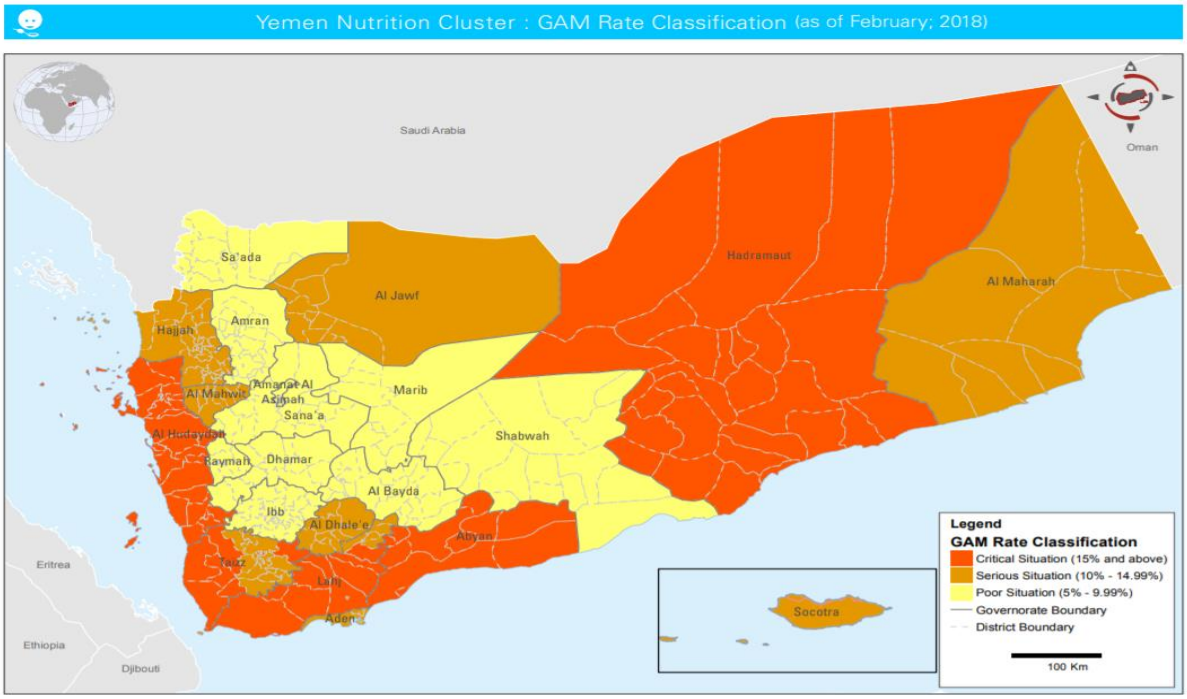


Figure 4: GAM classification rate in Yemen 2018 (56)

In the Hodeida governorate, where the malnutrition rate is continuously the highest, the GAM rate has increased to above 30% after the conflict escalation. The figure below shows the result of different surveys in recent years that have shown undernutrition trends in Hodeida governorate (54).

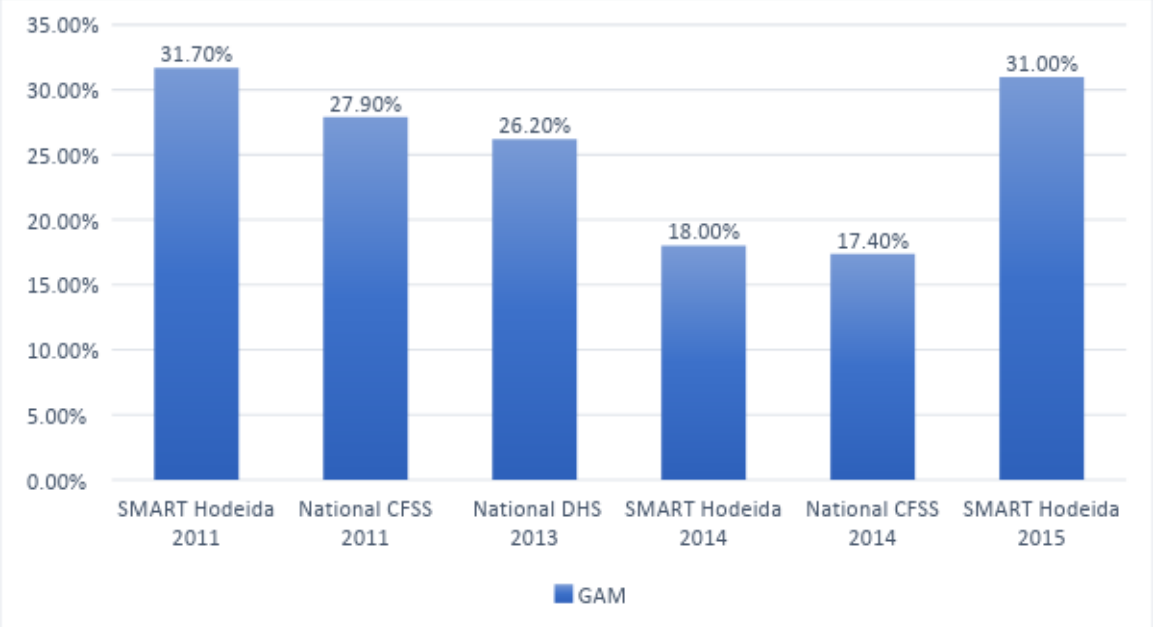


Figure 5: Trends of malnutrition under five children in Hodeida governorate Yemen (51)

It is also worth mentioning that the situation of Yemeni children after conflict has become more serious. According to a 2017 UNICEF report, around 2.2 million children are acutely malnourished (GAM), from which around 462,000 suffer from severe wasting (SAM) and 1.7 million suffer from moderate wasting (MAM) (57,58). Since 2015, the conflict has caused a significant increase of the undernutrition trend by 200% (14). Furthermore, the level of underweight, which measures also the low weight for age, is also high in Yemen. The results of the 2016 Emergency Food Security and Nutrition Assessment (EFSNA) showed that the prevalence of global underweight ranges from 15.6% in Hadhramaut to 55.9% in the Hodeida governorate (55).

Stunting situation in Yemen

Stunting has remained persistently high in the last decades, with nearly half of children under five suffering from chronic malnutrition. In 2013, around 46.5% of Yemeni children under five years old were stunted, with no difference between males or females. Between 2011 and 2014, the stunting prevalence fell from 46.6 % to 41.3 % in 2014 (60). However, after conflict, the level rose to more than 60 % in several areas (54). This is more than double the regional percentage in the middle east and north Africa (MENA) region (57,59). Figure 4 shows the different stunting trends in recent years, and Annex 3 shows different stunting levels across Yemen.

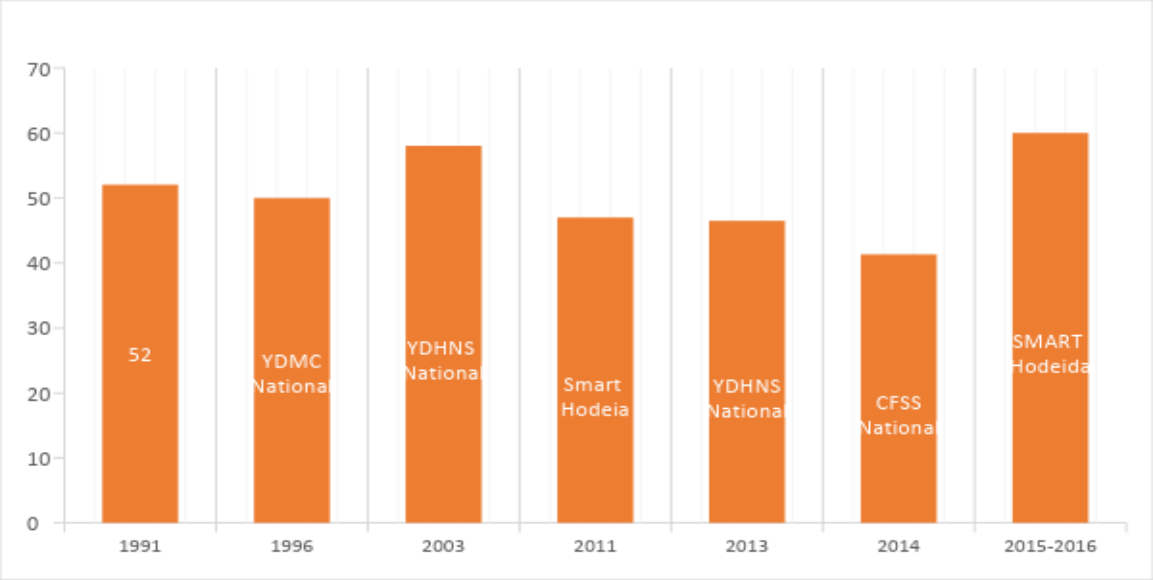


Figure 6: Prevalence of under five-stunting in the last decade in Yemen (7,19,34,54,60).

Chapter three: Problem statement, objective and methodology

Problem statement

Stunting is the impaired growth and development of children due to long term nutrient intake insufficiency and frequent infection (44), and it is considered the best indicator for child well-being (9). According to the WHO, children are defined as stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median (44). Stunting usually occurs before two years of age, and its effects have irreversible consequences (42). Childhood stunting leads to reduced adult stature (46), it is associated with an underdeveloped brain, and other long-lasting harmful consequences, including diminished mental ability and learning capacity, poor childhood school performance, reduced adulthood earnings and increased risk of nutrition-related chronic diseases (e.g. diabetes, hypertension and obesity) in the future (42,46).

The first two years after birth are characterized by rapid growth and high nutritional requirements. Children under two are also at high risk to infections. These factors combined make children under two particularly vulnerable to growth failure. Children with frequent growth failure remain small for their age or become “stunted”, with the negative long-term consequences listed above.

Yemen has the second highest rate of stunting in the world, after Afghanistan (39). Due to political instability and the recent war crisis, the number of stunted children has increased from 1.693 million in 2012 to 1.860 million in 2015 (61).

Stunting often starts from pre-conception, when an adolescent future mother girl is undernourished and anaemic. This gets worse as the infant is born into a poor diet without access to safe water and proper hygiene (62). In Yemen, more than 522,000 pregnant women are prone to higher risk pregnancies and 1.1 million pregnant or lactating women suffer from Moderate Acute Malnutrition (MAM) (11,12,63). The high prevalence of child stunting is the result of multiple factors and intertwined relationships rather than a single causal relationship. This will be explored further in this research.

Main goal

To explore the determinants of stunting in children under five in Yemen and thereby provide recommendations for policy decision makers on interventions to prevent stunting.

Specific objectives

a. To analyse and identify the determinants of stunting in children under 5 in Yemen.

b. To analyse the nutrition programme of Yemen and explore how it meets its objectives.

c. To make recommendations to the policy decision makers of the Yemen Ministry of Health regarding improving preventative interventions for stunting in children under five and their implementation.

Methodology

The methodology for this study is a literature review based on data from google scholar and PubMed. In addition, national data available from official websites of the Yemen ministry of health, reports of organisations working in Yemen (e.g. UNICEF, WHO, WFP), the official nutrition cluster website and other grey literature will be used. Snowballing will also be used to collect supporting information.

The literature review used following inclusion criteria: i) published in the past ten years, ii) including undernutrition in children under five, iii) full text available in English. Literature on HIV related topics with nutrition were excluded.

Key words

The database searches were conducted using the following keywords: Stunting in Yemen, determinants, risk factors, undernutrition, exclusive breastfeeding, complementary feeding, maternal education, maternal malnutrition, child development, water & sanitation and food security in Yemen.

Conceptual framework

The model employed to critically analyse the research findings was the WHO conceptual framework of stunting (Figure 1) (64). This model was chosen because it is comprehensive and inclusive about all determinants and consequences of stunting and gives a clear idea of how to analyse the stunting determinants in a systematic manner. The main pillars of this

framework are the context, causes and consequences. The first pillar, stunting consequences, is defined in the short and long-term consequence. This has been discussed briefly in the introduction using international research articles. The other two parts, causes and context, constitute the main part of the study findings, and will be discussed in detail. The most proximal factors derive from the causes pillar, and. includes household and family factors, inadequate complementary feeding, inadequate breastfeeding practices and infection. The second result part presents the contextual factors which include political economy, health and health care systems, education, society and culture, agriculture and food systems, and water, sanitation and environment. These appear individually in the framework, but in reality they overlap and interact to compromise growth and development.

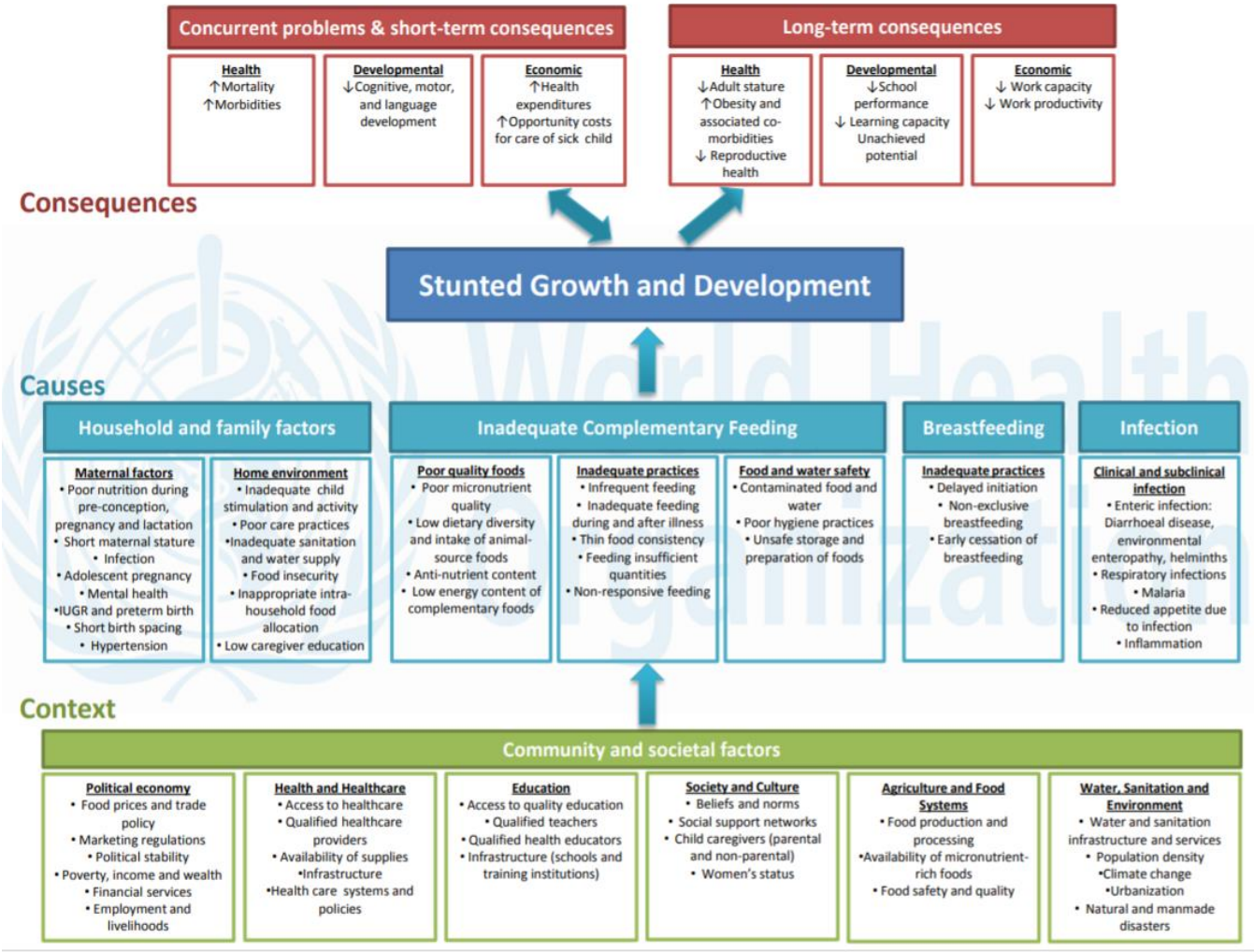


Figure 7: WHO conceptual framework on Childhood Stunting: Context, Causes, and Consequences (64).

Limitation

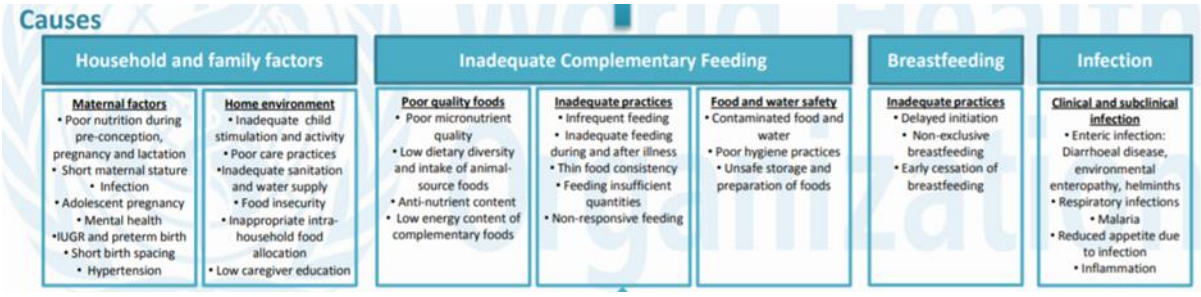
Stunting is a complex issue, and abundant research has been conducted with hundreds of articles published. Access to full text articles however, is limited, especially for recent publications. In Yemen, most of the studies were conducted in one governorate and did thus not reflect the whole country´s situation. The only exception was the nationwide survey conduct by WFP, UNICEF and MOH. The research framework used was comprehensive, yet it was still difficult to find good quality articles for example on the association between the child stimulation and stunting. Although several studies show the association and chance of determinants and stunting, clear evidence is lacking in some parts.

Significance of the study

This study is crucial because more than half of Yemeni children are stunted. Stunting is not limited to short stature, but also extends to cognitive development failure and becomes a basis for development of chronic diseases. Stunting in Yemen is a historically chronic problem, not a recent one because of the conflict. Political instability for decades may be a major determinant. The issue has irreversible consequences, but future high prevalence is still preventable. By critically exploring the determinants we can conclude with recommendations for proper intervention to prevent further stunting in the future.

Chapter Four: Findings

Causes



Household and family factors

Maternal factors

A poor nutritional status and inadequate intake of nutrients during preconception, pregnancy and lactation is a key determinant in early and later child growth and development. Maternal

undernutrition contributes to fetal growth restriction which increases the risk of neonatal deaths and stunting by 2 years of age for the new-born. Micronutrients deficiency during pregnancy, specifically iodine and iron, can contribute to neonatal growth restriction causing children to not meet their developmental potential (62,65,66). The nutritional situation of women in reproductive age, according to CFSS 2014, shows that 25% of pregnant women between 15 and 49 years are underweight, of whom 14.4 percent were severely malnourished and where the mid upper arm circumference (MUAC) is less than 21.3 cm. More than four fifths are anaemic (60,67). According to a world bank report, 58% of pregnant women in Yemen, are suffering from iron deficiency anaemia (68). One study conducted in Yemen has shown significant association between maternal undernutrition and anaemia with a high percentage of low birth weight (68). Another study conducted in Yemen, by Souza in 2015, demonstrates that when a mother is undernourished, she has a higher chance to have stunted child (odds Ratio was 0.61) (69).

Adolescent pregnancy interferes with nutrient availability to the foetus, due to the competing demands of ongoing growth (70). Around 12% of women aged 20–24 years in Yemen were married before they reached 15 years of age (63). One of the consequences of early marriage is adolescent pregnancy and frequent pregnancies, which may contribute to the vicious circle of malnutrition. Adolescent girls are less likely to finish growing before their first pregnancy. These girls rapidly develop malnutrition because they cannot compensate the body needs for growing and pregnancy in the same time. This mechanism also leads to a compromise on the nutritional available for their child during pregnancy and lactation, which later affects child growth (67,68,71).

Maternal infection, related to malaria, helminths and other conditions may lead to intrauterine growth retardation (IUGR) and a later stunted growth of the infant (72). Malaria is endemic in the coastal areas in Yemen (73). One cross sectional study conducted in Hodeida governorate showed a strong association between maternal malaria and low birth weight (OR 5.7, 95% CI 1.7–18.5; *P* = 0.004) (74). Another study showed that maternal infection equals a 9.44 times higher risk of preterm delivery and a 12.2 times greater risk of low birth weight .(75)

Low birth weight (LBW) is a good indicator for infant growth and survival. LBW accounts around 23.8 % of all births worldwide (76). One study conducted in south Asian and sub

Saharan developing countries in 2008, showed that the IUGR-LBW infants who survive, have low chances of reaching their full growth potentials (76–78). The incidence of low birth weight in Yemen is around 30% and it is significantly associated with maternal nutrition, maternal anaemia (68).

Short birth spacing increases the risk for depleted maternal reserves in subsequent pregnancies, with negative consequences for both mother and child (79). According to the YNHDS, 29% of married women in Yemen have an unmet need for family planning services (15 % for spacing births and 14 % for stopping childbearing). The most common FP in Yemen is the contraceptive pill, injection and an intrauterine device (7).

Short maternal stature was associated with low birth weight and stunting in the offspring (80). A study conducted in low and middle-income countries showed that a 1-cm increase in height was associated with a decreased stunting risk (RR, 0.968; 95% CI, 0.967-0.968) (81).

A number of recent studies have explored the impact of maternal mental health on child growth and development (82). The prevalence of maternal depressive symptoms across developed and developing countries range from 3% to 60%, with significantly higher rates in developing countries. Around 10% of pregnant women and 13% of women who have just given birth, experience a mental disorder (82,83). Maternal depression, particularly after delivery, decreases mother-to-child attachment, which in turn negatively affects child feeding (79,84). In Yemen, information on the prevalence of depression in women or studies of the relation between high level of stunting and maternal mental health are unavailable.

Home environment

Within the home environment, several economic and caring determinants are associated with stunted growth. Some of these factors relate closely to other contexts but are included here to underscore the importance of addressing modifiable household factors including inadequate child stimulation and activity, poor care practices, inadequate sanitation and water supply, inappropriate intrahousehold food allocation and low caregiver education.

A low educational level of the caregiver is strongly linked to a poor nutritional outcome (66,85). In Yemen, 42% of women of reproductive age have no education (7). Two studies conducted in rural areas have shown a strong association between low educational levels and a high level of stunting. The children, whose caregiver (Father, mother, grandmother) were

educated, had significantly lower odds of undernutrition compared to peers with an illiterate caregiver (63,86). Similarly, an educated mother reduces the likelihood of a child being stunted child by 47% (87). One study, conducted in Yemen in 2016, showed the effect of adequate child care on stunting, namely that adequate child care associates with a lower stunting level (86). This study used specific practices to reflect the child care level. The indicators used were adult family members leaving the children alone, number of children in the household aged 5–14 years, and children engaged in labour. The practice of not leaving children alone was significantly associated with a lower stunting prevalence (OR, 0.80; 95% CI, 0.69–0.93; P = 0.004). The same relationship to lower stunting levels were shown in households where older children were not working (OR, 0.82; 95% CI, 0.69–0.97; P = 0.024) (86). The average number of household family members in Yemen is 6.7 (7). Having more siblings often suggests more competition for food, which directly associated with child undernutrition among children under five (88).

Water and sanitation are substantial determinants of stunting (89). According to data from the YNHDS in 2013, 59% of Yemen´s households (HH) use an improved source of drinking water, less than half of the households use improved toilets that are not shared with other households, and 25% of HH have no toilet at all (7). Only 34% of the total population in Yemen have access to pipe water. One national study conducted, showed the relationship between stunting and factors like access to pipe water and hand washing. It stated that 37% of children living in HH with access to pipe water are stunted, whilst the percentage is 50% in HHs without running water or no use of soap (87). Water and sanitation will be discussed more in depth in the context part.

Inadequate child stimulation and activity can interact with poor nutrition which later leads to growth delay (79). A study conducted by the WHO in several developing countries showed a strong association between adequate child stimulation on early childhood development and children's nutritional outcomes (90).

Household Food insecurity (HFI) is a key determinant for undernutrition in the most critical period of child growth and development (i.e. under five years) (91). The risk of stunting increases by 12% among children from food insecure households. In addition, a household with a female-head is 11.7 percentage points more likely to have stunted children compared

to a household with a male-head (7,60,92). Yemen has suffered from food insecurity in recent years. According to a survey conducted by WFP in 2014 by WFP, 40% of people are food insecure, with the majority living in rural areas (60). Households headed by females are more food insecure (7,60). In 2014, a nutritional survey of Hodeida revealed that 48.7% household members in the highland and 39.6% in the lowland reduced meal sizes due to food resource scarcity at HH level (54). In 2017, the WFP reported that due to the 2015 conflict escalation, food insecurity increased to 65 %, meaning that 17 million people became food insure. Simultaneously, the level of under-five stunting increased to 67% (67). Household food insecurity is also related to food access and other contextual factors like political economy and food system and agriculture policies which will be discussed further under contextual factors.

Inadequate complementary feeding

Poor quality foods

Even with adequate breast feeding, suboptimal complementary feeding after six months leads to delayed child growth and development (2,93,94). The WHO has defined an indicator to measure the complementary feeding for children under two, namely the minimum diet diversity which is set at four out of seven foods (2). A study conducted in Bangladesh has demonstrated that reduced dietary diversity is a strong predictor of stunting and inadequate child development (95). Other studies conducted in rural areas of developing countries show that the food intake is dominated by cereal staples (70-60%) and only 12% is protein, most of which is plant protein. These plant diets contain high phytate content and impairs micronutrient absorption, thus jeopardizing child micronutrients status. (45,96) (93). In addition, a low diversity diet correlates to the insufficient quantity of micronutrients needed for optimal child growth.

In Yemen, the WFP and UNICEF conducted a survey to measure the optimal complementary feeding by assessing a minimum diversity diet for children under two as defined by the WHO. It showed that only 12.4 % of children between six and 24 months met the WHO recommended minimum dietary diversity. More than 85 % of children do not consume a minimum dietary diversity and are likely to have poor micronutrient density in their diet (60).

Inadequate practice

In many developing countries, wrong feeding practices are common, and breast milk is usually replaced with fruit juice or other sweet drinks or cereal-based gruels, all of which are micronutrient-poor (97,98). An old study conducted for Toddler showed that breast milk together with an animal food diet after the age of six months produced significant improvement in linear growth among children (97). A study conducted in rural areas in the Dhamer governorate revealed poor dietary practices among both mothers and children e.g. sugary biscuits were a popular first food for babies (63). Another study conducted in Sanaa showed that the introduction of complementary food is initiated too early. Here, 22.4% of infants were receiving complementary foods before the age of six months, and only 5% of the study population met the minimum diversity diet (99). There are significant differences between rural and urban consumption patterns. About 30% of urban children had at least 4 food groups per day, which was significantly more than to rural children (60,99). `

Food and water safety

Household-level hygiene practices such as hand washing, safe water sources and storage and sanitation conditions, affect the risk of diarrhoea and other morbidities which can interfere with growth. In a study conducted by Souza in Yemen, using soap and having water available translated to a lower chance of being stunted. The practices of handwashing with soap before feeding a child and after cleaning a child faeces were associated with 36% less chance of child stunting. The same study further showed that good food storage (in the fridge) reduced in the likelihood of having a stunted child by 51% (87).

Food preparation techniques, such as inadequate cleaning or cooking time, can also increase the risk of contamination. There are recent concerns about the potential role of mycotoxins, such as aflatoxin, in poor child growth and development. The mycotoxins can contaminate a wide range of staple foods, including maize and groundnuts in many diets of developing countries (100). The WHO has reported that diarrhoea episodes, due to contaminated food in children under five could reach 217 million infections globally. Contamination of complementary foods introduced to infants may result in serious enteric infections despite partial breastfeeding (101). One study conducted in Sanaa governorate showed that diarrhoea prevalence was high in an age less than one year and the prevalence was more in

non-breastfed children. The mixed fed children had 46% chance of contracting diarrhoea as a result of early introduction of complementary food before six months and bottle feeding (33).

Breast feeding

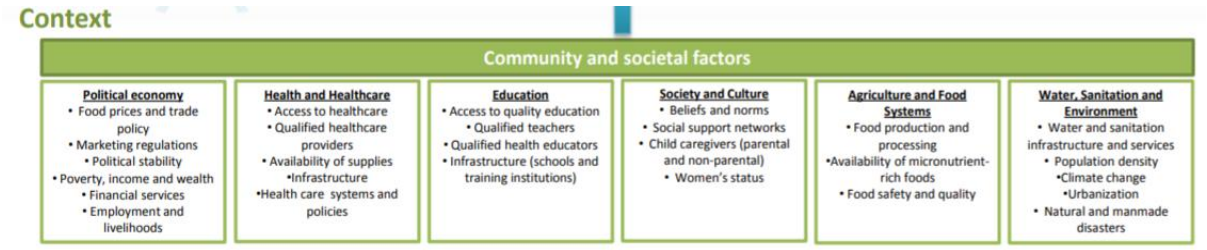
Studies in developing countries demonstrate that continuous and frequent breastfeeding is associated with greater linear growth and it further protects child health by delaying maternal fertility postpartum and reduces the child's risk of morbidity and mortality. Continued breastfeeding may also prevent dehydration in those recovering from infections (102–104). Conversely, delayed initiation of breastfeeding, not breastfeeding and non-exclusive breast feeding all increase the risk of morbidity and lead to a compromised linear growth (89,102). Early termination of breastfeeding (before six months) can also lead to stunted growth and development through multiple pathways including inadequate energy intake, nutrient deficiencies and removal of passive immunity provided by human milk (103). According to the YNHDS, 10% of infants of under the age of six months, were exclusively breast fed in 2013, although around 97% of children are breastfed to some extent Annex 4 shows more indicators of breast feeding (7). In the CFSS it shows that only 12 % of children under six months are exclusively breastfed. There was no significant difference between the rate of breastfeeding between the urban and rural areas (60). One study, conducted in rural areas in Dhamer governorate, also showed a poor level of exclusive breastfeeding. Water and animal milk were the most common liquids introduced (63). Another study conducted in Sanaa city showed that 10% of children under six months are exclusively breast fed and 55% of mothers provided bottle foods with breast milk to their child. This study showed that the reason for low Exclusive Breastfeeding (EBF) is associated with maternal age and level of education. EBF was higher among older and more educated mothers (99).

Infection

Diarrhoeal disease, respiratory illnesses, malaria, fever and helminth infection are known determinants for poor nutritional outcomes. Similarly, undernutrition decreases child immunity, making them more at risk to infection. This vicious cycle of malnutrition is common in developing countries (105,106). For years, diarrhoea and pneumonia have been a leading cause for under five mortalities where half of these mortalities are due to secondary malnutrition (107,108). Recent studies in developing countries have demonstrated a relation

between stunting and diarrhoea where persistent enteric infections lead to malabsorption of important nutrients for growth (107). Another study conducted in developing countries show that frequent diarrhoea episodes in the first two years of life could lead to an 8 cm decrease of child height. In this article it is demonstrated that diarrhoea causes up to 43% of child growth and cognitive development delays, most of which occurs in developing countries (109). Diarrhoea is an endemic disease in Yemen. According to the last national demographic survey, 32% of children under five had diarrhoea in the two weeks before preceding the survey. One cross sectional study conducted in Sanaa city showed that the prevalence of diarrhoea is 29%. In this study, diarrhoea was common in children living with large families due to infective agents which were likely to be transmitted from person to person. Also, caregivers of large families find it more difficulties to uphold hygiene and daily food requirements for their children (33). Another study conducted in Yemen showed that children who had diarrhoea had a higher chance to be stunted than children with no diarrhoea history, with an Odds Ratio of 1.25 (110). Intestinal parasites are common in Yemen and constitute a serious problem with a prevalence ranging from 18% to 27%. Parasitic infections impair nutrients needed for child nutrient absorption, which can affect child growth and anaemia (111). Diarrheal and parasitic infections are also related to water and hygiene practices which will be discussed in the context part. Similarly, in pneumonia studies, a significant interaction between pneumonia outcome and the nutritional status children has been shown. Pneumonia leads to delayed child growth and stunting, which in turn leads to poor pneumonia outcomes (106,112). The prevalence of acute respiratory tract infections is also high in Yemen (12 %) (7). Fever can be a sign of inflammation or malaria, and accordingly to the YNDHS survey, it 35% of children under five had been ill with fever in the last two weeks before the survey (7).

Contextual factors



Political and economy

Political and economic factors are a contextual baseline factor which influences the nutritional status of children. (79). Yemen's poverty is both the cause and consequence of several factors including political crisis, low educational level, improper infrastructure and extremely high unemployment rates (19,110). According to the CFSS in 2014, it shows that more than half of the Yemeni population, around 10.6 million, are food insured. The percentage of food insecure is higher in rural than in urban areas (60). After the escalation of the conflict, the number of food insecure people has grown rapidly to reach 17.8 million or 60% of the population (58). The most prominent reasons of food insecurity include rising prices for food, fuel, water and medicine accompanied by the loss of job and income opportunities as well as internal displacement of millions of citizens. In addition, agriculture and fishery and food imports were all interrupted by the crisis. All these factors have contributed to a reduced family capacity to feed their children (58,60,113). Inequality between rural and urban areas in Yemen is significant both with respect to child stunting and food insecurity levels. A study conducted in five Arab countries showed that the gap between the level of stunting between urban and rural areas is the highest in Yemen, at 17%, in comparison to the other countries in the MENA region. Egypt and Jordan for example, have gaps of 2.3% and 1.5% respectively (114). Similar results in the WFP survey found that around 48% of the total rural Yemeni population were found to be food insecure, compared to 26% in urban areas. Politics can directly relate to nutrition, for example by making regulatory policy and national guidelines for infant and young child feeding (IYCF) (79). Yemen's law complies with the International Code of Marketing of Breast Milk Substitutes. This is an important component of efforts to promote breastfeeding. According to the Yemeni Labour Code, employed women can leave work early to breastfeed their babies. However, employers are not required to provide breastfeeding facilities (115).

Education

Caregiver education is a strong predictor for both child health and nutrition outcome (79). Much evidence shows that the educational levels of for both mother and father influence child growth faltering. Two studies conducted in developing countries, including Bangladesh and Palestine, have verified that both maternal and paternal education are strong determinants of child stunting (116,117). It showed that a mother's education was associated

with a 4.6% reduction in the likelihood of the child being stunted, and if the father was educated there was a 3% reduction (118). In Yemen, the educational level of parents is low. Only 43% of females and 21% of males are attending school (7). Several constraints prevent them from access to good quality education, particularly for females. One of these constraints is a prevailing access inequality, which remains a potential obstacle to improve the quality of learning. So does the insufficient number of school buildings and teachers, especially in rural areas (15). Furthermore, the low number of qualified teachers is a crucial problem in Yemen as it impedes the quality of education (15,119). Results of a study conducted by Souza in 2015, 44% of stunned children have mothers without a secondary education, while only 24.5% of those whose mothers have secondary education are stunted (87). Another study by Sunil, showed that Yemeni children who have non-educated mothers have a higher chance of being stunted (OR=0.81) (120). The caregivers' education is significantly associated with exclusive breastfeeding, complementary feeding and the diversity of food. The result of a study conducted in Sanaa city shows that a higher education level can improve the caregivers' ability to understand and respond to nutrition behaviour change messages. The mothers' education is also associated with longer exclusive breastfeeding and less bottle feeding (99). Evidence also shows a lack of awareness among health workers and educators, about the proper CF and EB and its role in child growth (79). Unfortunately, due to financial constraints and lack of strategic qualified staff, Yemen has no clear plan for health worker career development and training in its national health strategies (22).

Society and culture

Society and culture are key determinants for child stunting in developing countries, particularly among low socio-economic status and less educated people. Community beliefs and norms, social networks and women's empowerment have profound effect on child feeding practices, which later has consequences on child growth and development (79). One systematic review concluded that grandmothers have the capacity to influence exclusive breastfeeding and the type of young child complementary feeding practices (121). In Yemen, multiple and different believes that have a negative effect on complementary feeding and exclusive breast-feeding practices. One qualitative study conducted in the Dhamer governorate, showed that most of participating mothers and fathers had misguided beliefs about the colostrum milk (milk during first hours of delivery). They believed it is not sufficient

food for the new-born and either added prelacteal feed or replaced it completely. In this, grandmothers believe had a strong influence on the child feeding practices (63).

The picture is not different from a study conducted in the Sanaa governorate which showed the effect of societal factors about misconceived habits of introducing milk and juices or water before the age of six months (99).

There is an association between the level of low socioeconomic status (SES) and the chance of being a stunted child. One study by Sunil in Yemen showed that a low SES increases the chance to have stunted children (OR=1.73) (110). Women's empowerment is also a key factor for child growth and development, because women tend to be the main caretaker for their children (79). The YNHDS shows that Yemeni women had less power to make decisions about their health, own care and household purchase, and only 8% of women have the power to make decisions themselves (7). Culture strongly affects the household life pattern in Yemen, and women tend to be completely dependent on their husbands for food and healthcare (7). Low levels of women's empowerment in Yemen also affects the household allocation of food. Women and children eat after men. This is more common in rural areas and leads to less quantity and quality of food allocated to them (122).

Agriculture and food system

Agriculture and nutrition are intrinsically intertwined, and agriculture's impact pathways on nutrition are diverse and interconnected (123). Agriculture also interacts with other different contextual conditions such as the environment and political economy to drive food availability and access (124). Food systems have an impact on the nutritional status of children through child food processing, production and food safety pathways (79,123). Food processing has an enormous potential to both increase dietary diversity and enhance concentrations of micronutrients in commonly consumed foods (125). One study conducted in 170 developing countries showed that the level of a country's agricultural infrastructure is an important determinant in the rate of chronic malnutrition in children (126). Moreover, agriculture is fundamental to structural transformation of economies and poverty reduction which has effect on stunting (124). One study conducted by Ruel shows that a 10% increase in gross domestic production (GDP) leads to a 5.9% reduction on child stunting (127). Yemen is an agricultural society where agriculture is the main livelihood for more than half of the Yemeni population (53%) (7,55), even though agriculture contributes to less than 20 % to the

country's GDP. Crop production in Yemen covers around 25-30% of the country's needs, either from cereal and or from cultivation production. Around 90% of wheat, the main staple food, is imported from outside and only 3% is local production. Regarding the local livestock production, this covers more than 60% of the livestock products needs in the country. The agricultural sector has been heavily constrained by conflict due to continued insecurity, less access to land and disruption of the market system which leads to an increased food insecurity level from 47 % before conflict to 63% after conflict, and this was also associated with an increased level of children stunting (55,60). In 2017, a nationwide survey was conducted, the Emergency Food Security and Nutrition Assessment (EFSNA). This survey demonstrated that the food consumption score (FCS), which is used to identify food access, consumption problems and the household diversity diet, has a statistically significant association with stunting, more so than that of wasting (OR= 24.9 and 0.75 respectively) (55). Souza´s study showed that the percentage of stunted children who live in an household that owns agricultural land is less than among those who live in rented land (36% and 57% respectively) (87). Lack of micronutrient rich food is common in Yemen, where 41% have a poor diet because of high food prices, and most families are not able to afford nutritious food (55,79). The pregnant and lactating women and children under five are the most vulnerable groups in terms of negative outcomes due to lack of micronutrients rich foods. According to the WHO and the world bank, the anaemia rates for young children and pregnant women in Yemen are 68 percent and 58 % respectively.

Health and health care system

The health care system has profound effects on child growth and development in various ways. According to the WHO´s conceptual framework, effects can be derived from access to health care; availability of qualified healthcare providers; availability of supplies; health infrastructure and health policies. The framework also helps in identification and early diagnosis of the faltering of child growth (79). In Yemen, access to the healthcare system is very low compared to neighbouring countries such as Egypt and Jordan (115). According to the world bank, more than half of the Yemenis have no access to health care services due to lack of health facilities (23). The health care access for pregnant women is crucial to reduce the stunting rate among children. One study conducted in Yemen by Al-Sobaihi in 2016 showed the association between access to antenatal maternal care and the level of stunting

among children. It showed that antenatal care provision is significantly associated with lower prevalence of stunting OR=.78 (OR, 0.78; 95% CI, 0.66– 0.92; P = 0.003) (86). Poverty was identified as the main factor that kept women from seeking antenatal care (128).

One study conducted in Malawi showed that living far from the health facilities is associated with a higher prevalence of stunting (129). According to Souza´s study in Yemen, living far from the health facilities is less associated with stunting. Souza argued that those who live far from the health facilities are generally of good wealth (87). The lack of access to health care is mainly due to lack of health facilities. Around half of the existing facilities are not functioning after the conflict either due to being destroyed, partially destroyed or due to lack of staff and medical supplies (23,130). In Yemen, the number of qualified staffs are not sufficient, with only 1 doctor per 3600 citizens. Additionally, there is maldistribution of staff, where they majority are located in urban areas with 42% of total doctors concentrated in four governorates. Recently, all health workers in the public sector have been without salaries for more than one year which leads to more challenges in the already constrained system. The level of dissatisfaction among health workers and patients is high, mainly due to poorly equipped facilities, the acute drug and supplies shortages and the low coverage of health services (23). According to the world bank and WHO, only 45 % are fully functioning after the conflict, and from these, only 35% are providing maternal and new-born health services (MNH), whilst 42 % are providing nutritional services (23). More details of types and existing nutrition interventions in Yemen will be discussed later.

Water, sanitation and environment

Unsafe drinking water and poor sanitation services is a key determinant for undernutrition. Diarrhoea, which is mainly due to lack of potable water, is a significant driver of undernutrition and under five child–mortality, especially in developing countries. As mentioned earlier in the discussion of infections, stunting is strongly linked to high rates of diarrhoea. There is clear evidence that chronic exposure to microbes, due to environmental contamination leads to malabsorption and chronic inflammation that causes chronic activation of the immune system which diverts the available nutrients to fight microbes than rather growth (131). Improved water and sanitation services help improve nutrition, but they may have better outcomes if they are focussed on infants and young children (132). Additionally, improved sanitation is associated with decreased stunting levels, especially in

rural areas where open space defecation is common (131,133). A study conducted in Bangladesh showed that children who had access to clean drinking water, improved toilets, and facilities for handwashing with soap had 50% improvement their stature (134). In Yemen, open defecation is still practiced by 20% of the population in the rural areas where low hygiene levels and sanitation standards is also common (135). In Yemen, there is a strong association between stunting and hygiene practices like using soap after defecation, with those washing with soap having 36% less chance to be stunted (87). According to UNICEF´s Knowledge, Attitude and Practice (KAP) survey in 2014, access to improved water sources in Yemen has declined in recent years, and less than 8% of Yemeni HH treat their drinking water whether it is from an improved or unimproved source (135). The KAP survey further revealed the weakness of the national sanitary hygiene knowledge and practices. For, most people believe that washing hands by water alone is enough, and that child faeces is less harmful that of adults (135). Due to that groundwater levels have lowered by 6-7 meters annually in recent years, making it more difficult to access pipe water and keeping a good level of hygiene and sanitation, Yemen has and continues to suffer from water scarcity (136). The water and sanitation situation in Yemen dramatically worsened by man-made disaster and war that caused the water and sanitation system to collapse, leading to the largest cholera outbreak in recent times (137). The last conflict also left around 13·4 million without access to drinking water and 12 million people without proper sanitation (138). Moreover, the war also relocated of 10.3% of the total population as internal displaced persons (IDP), and access to safe water became even harder for this vulnerable group (136).

Chapter five: Interventions to address stunting in Yemen

In the previous chapter, the problem was described with respect to the influencing factors related to stunting, and this chapter will describe the existing interventions related to stunting in Yemen.

Developing national stunting targets

In 2013, the MOH set the national strategy from 2013 until 2020 with a nutritional target to reduce the stunting rate to 23.3% by 2020. This is also in accordance with the WHA target. According to the DHS, the number of stunted children were 1.60 million in 2013 (7). The

government´s national plan is to reduce the number of stunted children to 0.96 million by 2020, whilst the WHA target in Yemen is to reduce number of stunted children to 1.02 million by 2025 (139). The European commission in Yemen anticipates that the number of stunted children will increase to 1.83 million by 2025 due to population growth and the current escalation of the conflict. The rate of decline in the number of children stunted had slightly accelerated from 0.51 in 2012 to 0.69% in 2016 as it is shown in Figure 8 (140). Thus, the government and the national WHA stunting target will not achieve their objective target unless drastic changes are made.

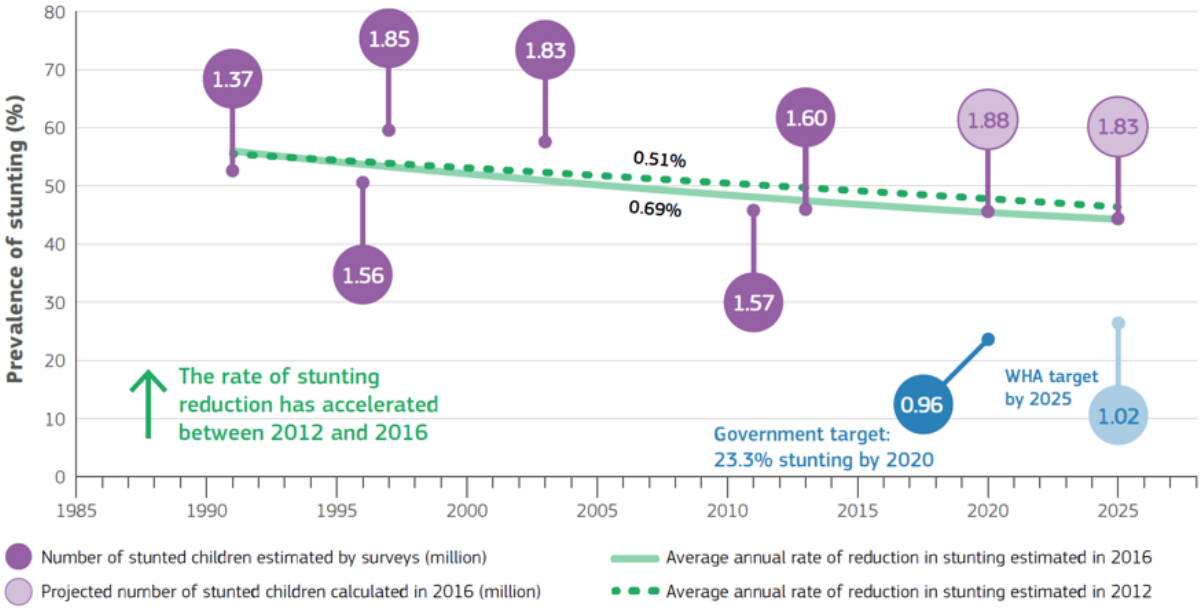


Figure 9: Trends and Target in the U5 stunted children (61) *(Source EU Yemen).*

Scaling Up Nutrition (SUN) movement in Yemen and the Nutrition Cluster

There are two initiatives which work to address malnutrition in Yemen through ensuring government commitment and multisectoral incorporation. The movements are the SUN movement and the nutrition cluster (141). Yemen joined the movement in 2012 when the Yemeni government committed to be part of this movement and appointed the Minister of MOPIC as the SUN focal point. The SUN movement in Yemen is linked directly to Nutrition Cluster activities, where all stakeholders operate on one platform. The overall progress for the SUN movement in Yemenis 41%. The figure below shows its four main objective progresses (142). Similarly, the Yemeni Nutrition Cluster was started in 2009 to ensure

coordination among nutrition partners as well as to coordinate with other sectors to ensure integrated response (143).

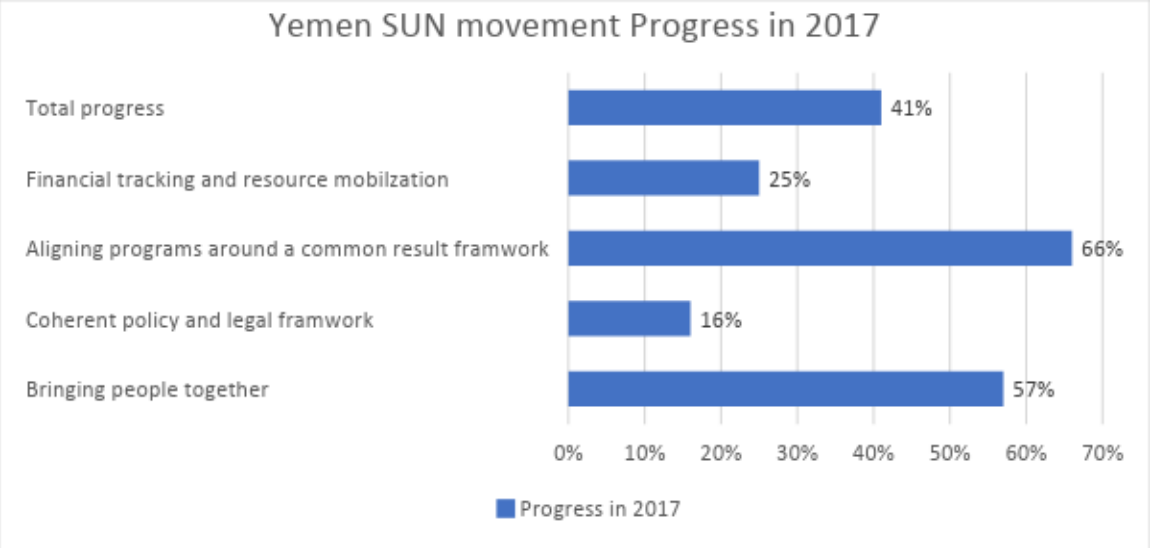


Figure 10: SUN Movement progress in Yemen 2017.Source: SUN YEMEN.

Nutrition programs in Yemen

Community-based Management of Acute Malnutrition (CMAM) program

The CMAM is a program for management of under-five malnutrition (SAM and MAM) with a community approach and It has four components described in table 1. It is one of the most sensitive programs to reduce stunting (144). As studies have shown, CMAM is a highly cost-effective program in developing countries (145). In Yemen, the CMAM program commenced in 2008. The Ministry of Health with the support of UN agencies (UNICEF, WHO & WFP), has developed national guidelines on CMAM that were tailored to the Yemeni context. The CMAM protocol is meant for all nutritional partners and all health workers in the field (146). The program is conducted both at the level of the health facilities and the communities, and through mobile teams. The government with support of UNICEF and WHO, constitutes 80% of the interventions and 20% is by NNGOs and INGOs (141). The table below shows the four CMAM components and the number of facilities achieved by the nutrition cluster partners in 2017 (See Table 1) (146,147).

Table 1: The CMAM program in Yemen with achieved target in 2017

Outpatient Therapeutic program (OTP).	Treatment of SAM U5 with complication at level of health facility or mobile team, where children are receiving treatment and read to used food (RUTF) as per national guideline.	Number of OTP open: 308.3
Therapeutic Feeding Centres (TFC) or Stabilisation Centres (SC).	Treatment of SAM U5 with complication as inpatient care where patients receive 24-hour care.	Number of SC open: 42.
The supplementary feeding program (SFP).	Treatment of MAM U5 children with Ready-to-use Supplementary Food (RUSF).	Number of SFP open: 1942.
Community mobilisation.	Activities included training community health volunteers (CHV) on screening for acute malnutrition through the measurement of mid-upper-arm circumference (MUAC)in addition to increase nutrition awareness of the community.	Number of trained CHVs: **11,029.**

As shown in figure 10, the progress of CMAM is good (148). Nevertheless, the coverage for the CMAM had not reached its target by 2017. The coverage for the SAM, according to the last nutrition cluster report, is 72% and MAM coverage is 48%. It seems that the coverage is not matched, and this reflects less integration of the Yemen nutrition program. This program has not achieved its target mainly because of the low funding of CMAM, the limited number of CHVs and unpaid salaries for health workers (148).

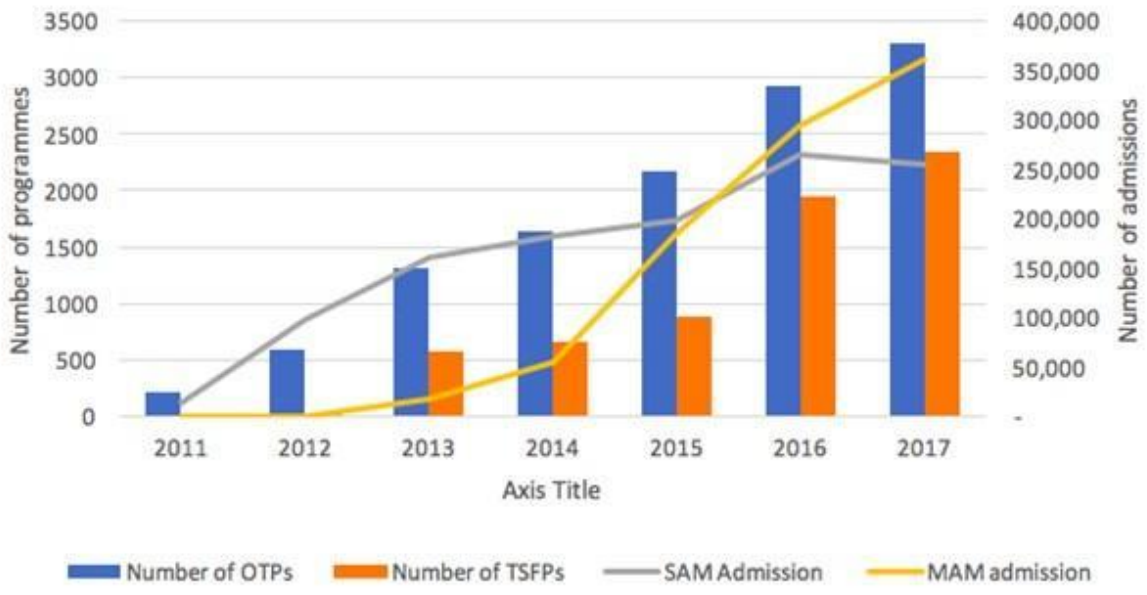


Figure 11: progress of CMAM program in Yemen source (UNICEF-Yemen)

Improving the nutrition status of mothers

Addressing maternal wasting and food insecurity with a balanced energy and protein supplementation is one of the most sensitive interventions that can help to reduce stunting (149) The world food program in Yemen has taken the lead in treating wasting in pregnant and lactating women (PLW). This is conducted through screening of malnourished mothers by MUAC and providing those with an MUAC less than 21 cm with 6 kg of Super Cereal for mothers monthly. In the 2017 WFP report it was mentioned that 85,919 PLW's have been admitted in their program (150).

Improving the micronutrient status of the under five children and pregnant and lactating women

Interventions which work to improve micronutrient deficiency of both mother and child can make a significant difference on the mother and child health outcomes (144). The Micronutrient supplementation activities in Yemen include vitamin A supplementation, iron/folic acid supplementation for pregnant and lactating women and multiple micro-nutrient powders for children U5 and PLW. One of the most widespread activities is distribution of micronutrients powder for U5 children and PLW (151) (123). Vitamin A supplementation happens through measles vaccination activities to children at the age of 9 months old and 1.5-year-old trough MOPHP with support of UNICEF and WHO (153).
Deworming activities are conducted as part of improving the micronutrients status of U5 children though the deworming drug campaign (152,153).

Infant and young child feeding (IYCF) program in Yemen

IYCF counselling is an important intervention in addressing childhood stunting because it focuses on the first two years of the child´s life. The IYCF program focuses on prompting EBF and increasing awareness about complementary feeding with an emphasis on diet diversification (149). The Yemeni ministry of health has produced a national policy and training guideline for the IYCF program. At the national level, IYCF technical workings were made through discussions between technical people about how the nutrition partners can be efficiently included in the IYCF program efficiently (154). The IYCF in Yemen is implemented at the community level through community health workers as an integrated part of CMAM,

as well through opening of the IYCF corner in health facilities that are run by midwives (141). The progress for IYCF has begun recently, and its progress has not yet been sufficient, nor has it reached the target objective (147). EBF is still low, and inadequate complementary feeding remains prevalent among mothers (155). To date, no studies show the impact of IYCF intervention in Yemen.

Summary for nutrition program with their target and people reached in 2017:

Type of nutrition intervention	People reached	Target 2017
Number of SAM child admitted	86,464	323,218
Number of MAM U5 child admitted	125,730	870,896
Number of PLW admitted in SFP program	75,944	552,484
Number Caretakers and PLW participated in IYCF counselling	181,156	1,988,941
Number of children receiving micronutrient powder	67,114	566,484

Table 2: Summary of most significant nutrition intervention In Yemen. (Source: Nutrition Cluster).

IMCI, Improving children under-five's health status

In 1998, Yemen developed a program to treat childhood illness as an integrated package. This program is referred to as the integrated childhood management of childhood illness (IMCI). A program like IMCI has proved successful in Tanzania, where its implementation improved children stunting nationally (156). Likewise, the IMCI program in Yemen has helped to reduce the U5 child mortality. However, one challenge limits the program´s progress, namely the shortage of supplies and unavailability of health workers due to unpaid salaries (141,157). Also, the low perception of the community through community leaders is adding an extra limitation to this program (158).

Other sectors intervention (wash and food security)

Several studies have been conducted to address malnutrition by a multisectoral approach instead of only focusing on the health sector (127,144,159). Reducing the child stunting rate through integration of a nutrition program with wash intervention has proven successful in several literature sources (131,160). One study proved that reducing fecal-oral microbial transmission by improving water, sanitation and hygiene (WASH) helps improve the linear growth of children (161). The table below show the most significant interventions reported

by wash cluster partners (INGO&NNGOs) with the target, number of people reached and coverage (162).

Type of wash intervention	Target	No of people reached	Coverage
Hygiene promotion and community mobilization	2,852,196	1,300,393	46%
Distribution of basic hygiene kits	1,379,678	558,491	40 %
Water sources improvement through rehabilitations and/or constructions	1,428,624	462,821	46%
Institutional Latrine improvement through rehabilitations and/or construction	1,428,624	462,821	32%
Water Filter distribution	963,118	155,480	16%
Chlorine tablet distribution	3,383,416	1,118,328	33%

Table 3: Wash intervention in Yemen by wash cluster partners (source: Yemen Wash Cluster).

The second program is improving the food security level through general food distribution, cash transfer and improving livelihoods for the most vulnerable group, i.e. IDP and female headed families (163). The safety nets program is a program that helps reduce poverty through cash and food transfers (164). Pooled evidence showed limited effects of these program on child nutrition though individual evidence shows that these programs can have an effect on younger and poorer children if they are exposed to a longer program duration (165). The social safety nets in Yemen aim to reduce poverty and improve social care through activities mentioned in the box below.

Box 1: Main safety net activities in Yemen (166)

- Providing cash assistance for poor households that meet specific criteria.
- Implementing projects that aim to create job opportunities, lead to ownership of assets or provide the basic social services.
- Providing social protection for military and non-military employees during old age and illness.
- Supporting productive activities in agriculture or fisheries.

The Main implementer of this activities is the Social Welfare Fund (SWF). Other INGO and NNGO actors also participate in these programs. These programs seem to be very limited and weak and are not achieving the intended changes (166).

Discussion

Causes

Yemen has one of the highest national stunting rates globally, and the country has suffered from this problem for decades. Stunting is of concern not only in the short term, but also on the long term as it has significant effect on the cognitive development and future disease of today´s children. The first 1000 days of a child´s life, from conception until two years of age, is the most sensitive period of development. Any factor affecting nutrition intake or child health during this period will negatively affect a child´s further growth and development. Several reviews have found that a high rate of maternal undernutrition, including anaemia, is a key determinant of stunting in Yemen, causing a chronicity of stunting and a continuous vicious circle of malnutrition. Indeed, improving the nutritional status of mothers is one of the most crucial specific nutrition interventions needed in order to reduce the stunting rate. The WHO has presented Peru as an example of one of the most successful interventions in reducing the stunting rate (167). The Peruvian intervention focussed on improving maternal nutrition status of the mother, and subsequently reduced stunting rates from 54% to 20% (168). Low levels of mothers education in Yemen also corresponds to child stunting. One study conducted in neighbouring Oman has showed that targeting an increased educational level of the mother leads to increased child height (169).

The present review shows a low rate of adequate IYCF practices in Yemen. For example, Yemen´s EBF rate in Yemen is the lowest in comparison to its neighbouring countries. In Lebanon, the EBF rate is 27.4% (170), in Saudi Arabia it is 13.7% and in Kuwait it is 26.5% (171). It seems that a low EBF rate is not a local issue in Yemen, but rather a general issue in the MENA region. In a study conducted in Kuwait in 2014, separate family housing, higher maternal age, late initiation of breastfeeding and employment without the ability to breastfeed at work are presented as propelling factors for low EBF rates (172). The high maternal age in Yemen was also seen as factor for Low EBF.

This paper has revealed that a low rate of EBS and improper complementary feeding is linked with low maternal educational levels, and thus suggests that the education level of mothers regarding the IYCF practice will help increase their awareness and prevent misguided practices. This review has illuminated that inadequate complementary feeding after six

months of age is common in Yemen. This is due to many factors: less diversity of food in the diet, low food safety and improper hygiene practices for infant feeding. Improving the diet quality of children also depends on household food security as most families cannot cope with the inflation of food prices due to the recent crisis. The findings presented also show that early introduction of non-milk fluids, such as sweetened water and biscuits, is common practice in Yemen. It has been reported that early introduction of complementary food concerns 80% of infants in the MENA region (173). There is an urgent need to prompt good IYCF practices at community level and to increase maternal awareness of adequate complementary foods through health workers and the media.

Another significant risk factor for stunting is household food insecurity (HFI). This review has revealed that half of Yemenis are food insecure, with HFI being more prominent in poor household and female headed families. HFI leads to reduced diet diversity which compromises the required nutrients for optimal child growth. Studies in various countries, like Vietnam, Ethiopia and Nigeria show that the likelihood of child stunting is higher in food insecure households and low-income families (176,177). In Afghanistan, children living in poor households have a 49.4% higher chance to be stunted, in comparison to 31.1% among children living in rich households (176). The recent safety nets program intervention in Yemen failed to meet the people needs and faced many challenges. There is a high need to increase the coverage of such a program. One good example presented by the WHO is the safety net program in Ethiopia which has had a good impact on reducing the chronic food insecurity in rural areas through prompting the empowerment of women, increasing the purchasing power of its target population and promoting access to nutritional foods (144,167).

Diarrhoea, pneumonia and malaria and parasitic infections are common diseases in Yemen, also constituting direct causes for stunting. The present review findings show that more than 32% of children in a national survey had a history of diarrhoea within two weeks of the survey, with a strong correlation to a high stunting rate. A similar study in Ethiopia showed that a high stunting prevalence was observed among children who had diarrhoea in the two weeks before the survey (177). This review finds that not having diarrhoea is associated with a 36% reduction in the likelihood of being stunted. In Yemen, implementation of IMCI to treat such diseases is still limited and faces several challenges. Although this program has reduced U5 mortality by 50%, the effect on stunting rates is not tangible yet. Conversely, the IMCI

program in Bangladesh has improved child health level and reduced stunting rapidly in recent years (178).

Context

The ongoing conflict and political instability in Yemen have influenced child growth indirectly by affecting direct causes like food insecurity, the collapse of the health system, and the wash system, and the deterioration of the economic condition of people. Evidence shows that the prevalence of hunger increased up to 4.4% in countries with conflict (179). According to a global nutrition report, undernourishment will never end without peace and stability. The SDG goal **16** underscores that nutrition should be included in disaster reduction and in conflict resolution and prevention (41).

This review has also shown that water and sanitation is a fundamental challenge in Yemen, that has a direct effect on the high national stunting rate. In Yemen, open defecation remains a common practice, particularly in rural areas where the level of stunting is higher. One study showed that to normalise child growth, the provision of toilets is a prerequisite (180). It has become clear that nutritional interventions are only part of the solution to stunted growth. In countries such as India, for instance, stunting occurs even among well-fed children, and that has led investigators to consider other causes, especially poor sanitation and hygiene (181). Diarrhoea is also related to access to safe water and hand washing. Indeed, high rates of diarrhoea in Yemen are related to improper hygiene practices and the lack of access to safe water. There is a need to increase the coverage of wash interventions in Yemen as study evidences has shown that 90% in coverage of wash interventions, beside integration with other sectors, can lead to a decrease of 25% of the stunting rate (89).

Additionally, this review has shown the important impacts of health access to child health. The association between child growth and access or distance to a health facility has no strong evidence, and in a study by Al-Sobaihi no clear reason for the relationships between the access of pregnant women to ANC services and stunting was found (86). In the intervention part it was shown that the CMAM program still meets several challenges in coverage and in reaching more children, especially for MAM.

Generally, the low levels of socioeconomic status and education in Yemen were clearly revealed in this review. The level of caregiver education has a strong impact on nutritional

behaviour and child caring practice, which in turn influences on child growth. In this review, a low SES was closely associated with stunting in Yemen. A Similar study conducted in Oman shows that a child on a higher SES has less chance to be stunted (169). Rural and urban difference is significant in Yemen. This can be explained by the inequalities of socioeconomic status and health services as well as the difference of literacy level between rural and urban areas. The rural to urban gaps in child stunting in Yemen are 17.7%, the highest in comparison to other Arab countries like Jordan and Egypt (1.5% and 2.3% respectively) (114). Also, social norms regarding breast feeding and child feeding practices showed an impact on the nutrition status of children, particularly in less educated families and rural areas.

A significant association was also found between child stunting and a low status of women in society. This affects both the quality of infant care and nutrition. In Yemen, the majority of the women have no decision-making power over their health and food purchase for the family. A study in India showed that women with more autonomy (indicated by access to money and freedom to choose to go to the market) were significantly less likely to have a stunted child when compared with their peers who had less autonomy (182).

Conclusion & Recommendations

Conclusion

The maternal factor is one of the most significant determinants of child stunting in Yemen. It involves a high rate of maternal undernutrition and anaemia during the reproductive age, high illiteracy rate among women, frequent deliveries and a gender inequality. All these factors compromise the essential nutrients needed for the mother and their children's growth in various way. Other important key factors are the low IYCF practices and the effect of the caregiver's education and social norms on the adequate complementary feeding and exclusive breast-feeding practices. Proper child feeding is also strongly linked to household food insecurity and availability of the minimum diet diversity required for adequate child feeding. Important contextual factors in Yemen are the lack of access to water, and low hygiene and sanitation levels which leads to frequent episodes of diarrhoea that in turn depletes the nutrients that are needed for child growth and deteriorates child immunity leading to a vicious circle of malnutrition. Conflicts in Yemen are playing a major role in the

collapsing of vital services like health, incomes and infrastructure which later has impact on health and nutritional status of the most vulnerable group, the PLW and U5 children. Finally, it seems that influencing factors of stunting are broad and interlinked. Therefore, intervention to reduce stunting requires a multi-sectoral approach, political commitment and adequate cooperation with all stakeholders in the country.

Recommendation

To reduce child stunting in Yemen a multi-sectoral approach is needed because the causes and determinants of stunting are complex and multiple. Political commitment is crucial at all levels, starting from national- to regional- and up to global level. Also, strengthening the integration and coordination among different sectors is important. The proposed intervention must focus on the following points:

- Improve household food security and empowerment of women through increasing the safety net program coverage and prompt programs that improve community livelihoods.
- Improve mothers´ and other caregivers´ awareness about the importance of EBF and adequate complementary feeding at community level through community health volunteers and at health facilities level through health workers.
- Enhance the health and nutritional status of under five children through improving the CMAM coverage, especially in rural and remote areas together with the IMCI program.
- Enhance the health and nutrition status of the mother at reproductive age through facilitating the access to ANC/PNC services and enhancing their nutrition diet through a supplementary feeding program.
- Improve access to safe drinking water and community hygiene promotion, especially in the rural areas.
- Advocacy for the important role of the agricultural sector in mother and child nutrition.
- Focusing on the quality of all interventions to assure that all program meets their objective.

Finally, further research is needed to investigate the depth of causes of stunting in Yemen e.g. conducting nutritional causal analysis. Research is also needed to reveal the impact of the existing program and how it can be improved to reach the stunting reduction target by 2025.

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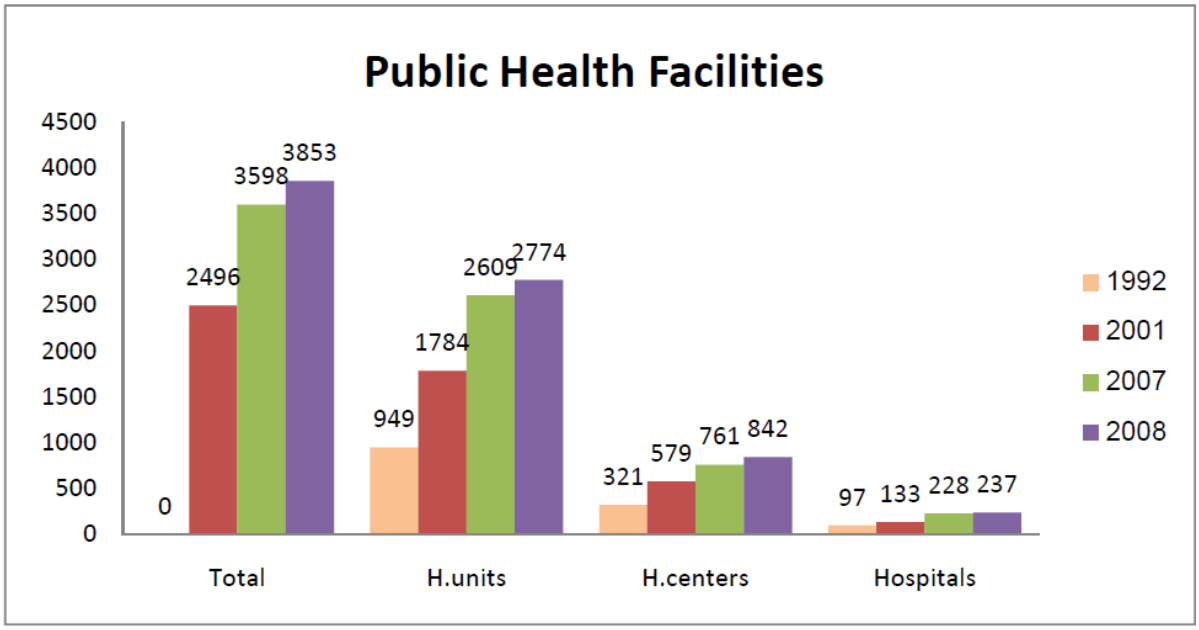
Annexes

Annex one :**Shows the types and Numbers of the public H. facilities during the years 1992,2001,2007,2008**



Source (National health strategy Yemen 2013)

Annex two: **Cut-off values for public health significance**

Indicator	Prevalence cut-off values for public health significance
Underweight	< 10%: Low prevalence 10-19%: Medium prevalence 20-29%: High prevalence ≥ 30%: Very high prevalence
Stunting	< 20%: Low prevalence 20-29%: Medium prevalence 30-39%: High prevalence ≥ 40%: Very high prevalence
Wasting	< 5%: Acceptable 5-9%: Poor 10-14%: Serious ≥ 15%: Critical

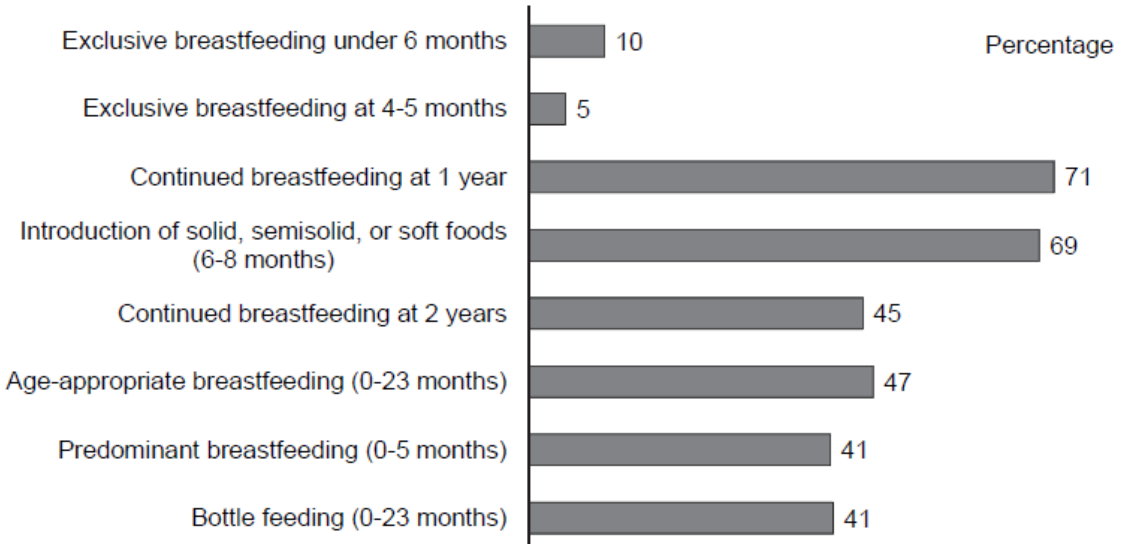
Source (WHO2010)

Annex Three: Children U5 Nutrition Status, by group of age and by Governorate in Yemen

Governorates	GAM		Global Stunting		Global Underweight		Total
	6-23 Months	24-59 Months	6-23 Months	24-59 Months	6-23 Months	24-59 Months	N
Abyan	20,4%	14,4%	24,8%	39,7%	27,9%	36,1%	455
Aden	19,5%	11,3%	22,8%	28,3%	26,6%	29,8%	473
Al Dale'e	14,9%	8,9%	32,5%	52,1%	24,7%	35,6%	465
Al Baidha	8,1%	6,4%	40,1%	47,5%	22,2%	26,8%	455
Al Jawf	15,3%	9,0%	38,3%	46,2%	33,1%	34,7%	410
Al Mahweet	16,0%	10,1%	57,8%	66,2%	42,0%	40,3%	486
Amran	6,7%	5,3%	46,4%	64,1%	27,9%	36,4%	516
Dhamar	8,2%	9,4%	56,9%	64,4%	32,5%	41,5%	490
Hadhramout	13,8%	23,8%	9,6%	10,4%	17,0%	15,2%	429
Hajjah	14,3%	9,7%	64,0%	62,2%	44,8%	43,1%	512
Hodeidah	40,3%	17,5%	61,1%	54,1%	63,5%	52,2%	440
Ibb	10,5%	6,6%	42,4%	58,6%	25,5%	37,4%	415
Lahj	12,7%	12,3%	41,3%	43,3%	31,6%	38,4%	419
Mareb	12,7%	5,7%	33,1%	38,3%	23,5%	27,5%	482
Raymah	11,2%	5,3%	61,2%	70,2%	40,9%	44,9%	435
Sana'a	5,8%	5,5%	49,2%	58,7%	31,1%	34,0%	446
Sanaa City	6,3%	6,1%	29,5%	36,7%	17,6%	23,0%	375
Shabwa	17,2%	8,9%	26,7%	31,7%	20,3%	27,1%	533

Source (EFSNA Yemen 2017)

Annex four: **IYCF indicators on breastfeeding status in under two children Yemen**



Source DHS 2013