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Drivers of Stunting Reduction in Kenya

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Drivers of Stunting Reduction in Kenya

Violet Nyabaro, Florence Mugo, and Grace Waweru

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Abbreviations and Acronyms

ANC	Antenatal Care
CHP	Community Health Promoters
FAO	Food and Agriculture Organization
FNSP	Food and Nutrition Security Policy
GDP	Gross Domestic Product
GoK	Government of Kenya
IFA	Iron Folic Acid
IMAM	Integrated Management of Acute Malnutrition
KDHS	Kenya Demographic Health Survey
KNAP	Kenya Nutrition Action Plan
NCDs	Non-Communicable Diseases
MIYCN	Maternal, Infant, and Young Child Nutrition
UNICEF	United Nations Children's Fund
VAS+D	Vitamin A Supplementation and Deworming
WFP	World Food Programme
WHO	World Health Organization

Abstract

Stunting, a significant public health concern, affects millions of children globally, including those in Kenya. Significant progress has been made, which led to stunting reduction from 26 per cent in 2014 to 18 per cent in 2022. Notwithstanding, stunting remains a major challenge in the country, with the prevalence being higher in rural areas and among children from poorer households. The overall objective of the study was to identify the factors that drive the reduction of stunting in Kenya and identify evidence-based practices that can be used. The study characterized stunting prevalence by various factors and examined the drivers of stunting in Kenya in the overall population and by place of residence. The Kenya Demographic Health Surveys of 2014 and 2022 were used in undertaking the analysis. The study finds that maternal education significantly reduces both overall and severe stunting prevalence, with secondary education being more effective than primary education. The highest impact on stunting reduction is observed among children of mothers with post-secondary education. Regression analysis indicates that stunting prevalence is higher among children of teenage mothers while children of unemployed mothers have lower stunting rates. Stunting prevalence is highest among children of working mothers, particularly those in the agricultural sector. Access to improved water sources had a protective effect on stunting prevalence and increased access to improved sanitation consistently reduced stunting prevalence. Finally, higher household income is associated with lower overall and severe stunting prevalence, where stunting reduction is evident in children from non-poor households compared to poor households. Elimination of stunting requires concerted efforts that are multisectoral. These include enhancing access to maternal education to improve the knowledge and skills of mothers on nutrition, childcare, and health practices by expanding access to education for girls and women and strengthening community engagement and utilize media campaigns to promote antenatal care visits. Although access to work opportunities and higher incomes is crucial for mothers, it is essential to strengthen the implementation of existing workplace policies for maternal and child health. This includes ensuring flexible working hours and enforcement of decent work guidelines in sectors such as agriculture to create a supportive work environment for working mothers. There is also a need to expand access to improved sources of water and improved sanitation to keep up with needs of the expanding population.

Introduction

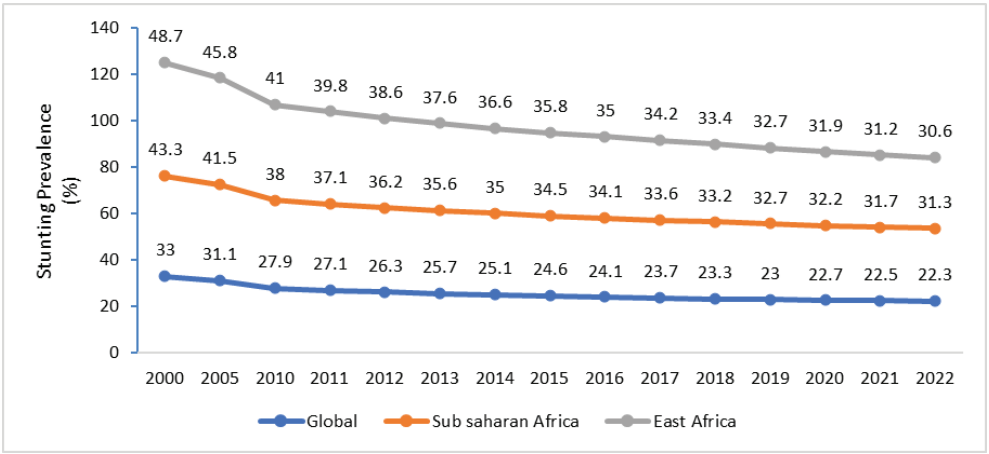
Adequate nutrition is the key determinant of health and development. However, malnutrition–undernutrition (wasting, stunting and underweight), overnutrition (overweight and obesity), and micronutrient deficiencies area global health problem. The World Health Organization (WHO) considers 'poor nutrition' to be the single most important threat to the world's health. Malnutrition, which is a broader term encompassing a range of nutritional imbalances that can include stunting, affects the economic growth of a country and transmits poverty through loss of human capital and economic productivity. Malnutrition includes undernutrition, micronutrient deficiency, and overnutrition. Children affected by undernutrition and micronutrient deficiency in childhood are more likely to be affected by stunting and to develop Non-Communicable Diseases (NCDs) such as diabetes and heart ailments later in life, causing costly inefficiencies in the health sector. According to the Government of Kenya (2019), the economic impact of undernutrition in health-related aspects was equivalent to 0.34 per cent of GDP in 2014, which was equivalent to Ksh 18.6 billion or US$ 211.8 million. The World Bank estimates that the economic cost of malnutrition to be 2.0 to 3.0 per cent of GDP to as much as 16 per cent in highly affected developing countries (World Bank, 2020). Globally, about 149 million children under five years are estimated to be stunted (FAO et al., 2022).

Stunting, described as linear growth failure, is a form of undernutrition that occurs among children under five years of age due to their fast-growing spurt and development. A child is deemed to be stunted when their height relative to age is less than minus two standard deviations (<-2SD) World Health Organization (WHO) child growth standards (WHO, 2015). Stunting has severe short-term and long-term consequences (Government of Kenya, 2021 ; Oluoko et al., 2021; Aguayo and Menon, 2016; Onis and Branca, 2016). Childhood stunting particularly in the first 1,000 days from conception until the age of two is strongly linked to a range of adverse short-term and long-term health and economic consequences including increased risk of childhood infections, particularly pneumonia and diarrhoea (Guyatt et al., 2020; Nyarko et al., 2023). In addition, evidence shows that stunting has functional consequences that hamper the development of entire societies, lower productivity, and reduced earnings in adult men and women. For example, in Kenya, productivity-related losses contributed the largest costs at 6.5 per cent of GDP, followed by health and education at 0.34 per cent and 0.06 per cent, respectively (Government of Kenya, 2019). In Sub-Sahara Africa, including Kenya, Government of Kenya (2019) and Beckmann et al. (2021) found that stunting leads to poor cognition and low intellectual quotient, which contributes to school dropout and poor educational performance in school-age children.

Some of the key drivers of childhood stunting include poor infant and young child feeding practices, disease and infections, insufficient care practices, poor

environmental conditions, and inadequate access to health services (Dewey and Begum, 2011; Jonah, Sambu and May 2018; Julianti and Elni, 2020). Over the last decade, the global prevalence of stunting declined from 26.3 per cent in 2012 to 22.3 per cent in 2022. Although Sub-Saharan Africa has had a modest decline in the levels of stunting, the region still bears a high burden of childhood stunting with a pooled prevalence of about 31.3 per cent, which is higher than the global prevalence. East Africa also carries a high burden of childhood stunting with a prevalence of approximately 30.6 per cent (Figure 1.1) (UNICEF, WHO and World Bank Group, 2023).

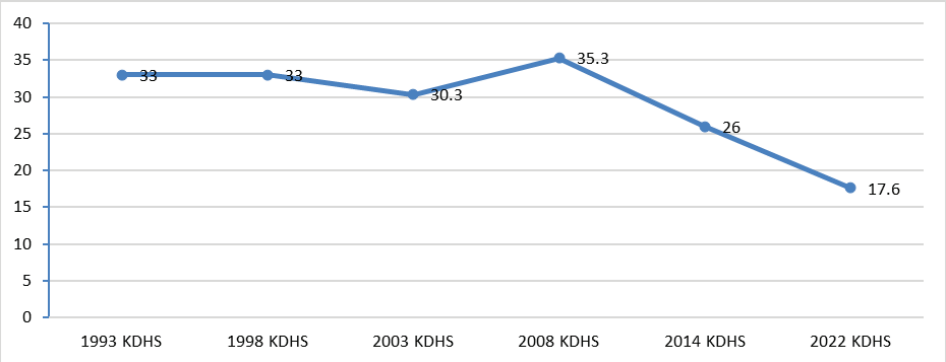
Figure 1.1: Global and regional stunting prevalence, 2000-2022



Data source: UNICEF, WHO, World Bank Group Joint Malnutrition Estimates (2023)

In Kenya, the prevalence of stunting has decreased markedly since 1993, with the greatest decrease between 2008-2009 and 2022 from 35 per cent to 18 per cent, respectively (Kenya Demographic Health Survey (KDHS), 1993-2022) (Figure 2). According to the KDHS (2022), stunting is higher among children in rural areas (20%) than children in urban areas (12%). Stunting decreases with increasing wealth, from 28 per cent in the lowest quintile to 9.0 per cent in the highest quintile. Twenty-two (22) per cent of children born to mothers with no education are stunted, compared with 9.0 per cent of children born to mothers with more than a secondary education.

Figure 1.2: Stunting trends in Kenya from 1993-2022



Data Source: KNBS (Various)

Despite national progress, stunting levels remain high in some counties, with more than half (51%) of the counties having a prevalence above the national average of 17.6 per cent. There are also wide variations across counties. The highest percentages in stunting are in Kilifi, West Pokot, and Samburu counties at 37 per cent, 34 per cent, and 31 per cent respectively, which is classified as very high prevalence while the lowest is in Kisumu, Garissa and Murang'a counties with a prevalence of 9, 9.1 and 10.1 per cent, respectively, classified as low prevalence (KDHS, 2022). Additionally, some counties have seen enormous improvements in stunting levels. For instance, between 2014 and 2022, the greatest improvement in stunting was seen in Kitui, Uasin Gichu and Kakamega counties, with reductions of 20.7, 17, and 16.9 percentage points, respectively. On the other hand, the levels in Samburu County deteriorated by 1.3 percentage points from 30.1 per cent in 2014 to 31.4 per cent in 2022. Stunting levels in Meru County stagnated at 25.2 per cent.

The drivers of stunting are complex and require a holistic multi-stakeholder approach with clear understanding of the interplay of different factors in different contexts. Understanding the drivers contributing to the trends in stunting is crucial to meeting the World Health Assembly's global target of 40 per cent stunting reduction by 2025, and the Kenya Vision 2030 target of reducing stunting to 14.7 per cent. Stunting is a key indicator in the second Sustainable Development Goal of Zero Hunger. This knowledge is also key to designing sustainable interventions tailored to meet the diverse needs of the Kenyan population and to ensure that no county is left behind.

However, there are few studies that would allow for a more thorough contextual evaluation of the drivers of stunting in Kenya across different regions. There are also gaps in published literature on the specific interventions, programmes and policy implementation that influence stunting trends in different parts of the country. Therefore, it is essential to investigate the factors driving stunting reduction in Kenya and identify evidence-based best practices that can be used to accelerate stunting reduction in counties with poor stunting outcomes.

The overall objective of this research is to identify the drivers of stunting reduction in Kenya and identify evidence-based best practices that can be used to accelerate stunting reduction. The specific objectives are to: (1) characterize stunting prevalences by various factors; (2) determine the drivers of stunting; (3) estimate the drivers of stunting in the rural and urban areas.

Overview of Policies, Programmes, and Strategies

The right to food is enshrined in the 2010 Kenyan Constitution, with Article 43(1)c stating that every person has the right to be free from hunger, and to have adequate food of acceptable quality. This is reinforced with respect to children in Article 53(1) c, which states that every child has the right to basic nutrition, shelter, and health care. In Article 21(2), the Constitution urges the state to take legislative, policy, and other measures, including the setting of standards, to achieve progressive realization of the rights guaranteed under Article 43. Further, Article 27 guarantees protection from discrimination and mandates the state to take legislative and other measures, including affirmative action programmes and policies, to redress any disadvantage suffered by individuals or groups because of past discrimination (Government of Kenya, 2010).

To implement these constitutional rights, the Government of Kenya has enacted several measures to address hunger and tackle malnutrition. The country's long-term development agenda, the Kenya Vision 2030, under the social pillar, outlines health as a crucial social strategy. The Kenya Health Policy 2014-2030 aims to significantly improve the overall health status in Kenya, aligning with the Constitution of Kenya 2010, the Kenya Vision 2030, and global commitments. This policy demonstrates the health sector's commitment to achieving the highest levels of health in a manner responsive to population needs, under governmental stewardship. It focuses on minimizing health risk factors by strengthening health promotion interventions and encouraging the use of health-promoting products and services across all life stages through culturally appropriate strategies (Ministry of Health, 2014).

The Kenya Food and Nutrition Security Policy (FNSP) 2012, along with its Implementation Framework 2017 to 2022, aims to address multiple dimensions of food security and nutrition. The FNSP highlights chronic food insecurity and malnutrition issues, emphasizing the government's role in ensuring all Kenyans have access to affordable, adequate, nutritious, and safe food. It includes special nutrition interventions for vulnerable populations, such as infants and young children, through innovative and cost-effective safety nets linked to long-term development. This policy underscores the necessity of multi-public and private sector involvement, recognizing that hunger eradication and nutrition improvement is a shared responsibility (Government of Kenya, 2011).

The Ministry of Health, through the Division of Nutrition and Dietetics, is tasked with developing policies and strategies to combat all forms of malnutrition. The Kenya Nutrition Action Plan (KNAP) 2018-2022 aims to accelerate and scale up efforts

towards eliminating malnutrition through a well-coordinated, multisectoral, and community-centred approach. The KNAP outlines several key result areas aimed at addressing stunting and improving overall nutrition in the country. These key result areas collectively contribute to reducing stunting by addressing the various underlying and immediate causes of malnutrition, improving food security, and enhancing the overall nutritional status of vulnerable populations, particularly children and pregnant women and thereof reduction in stunting. These areas include the following:

Maternal, Infant, and Young Child Nutrition (MIYCN)

The area highlights interventions such as promoting optimal breastfeeding practices and enhancing complementary feeding practices for children aged 6-23 months and providing micronutrient supplementation for mothers and children. Further, to enhance Maternal, Infant, and Young Child Nutrition (MIYCN) practices, the programme developed the Maternal and Infant Young Child Nutrition Strategy 2023-2028. This strategy promotes breastfeeding and complementary feeding, even in emergencies, to improve health, nutritional status, and development outcomes. Additionally, initiatives such as the Baby Friendly Hospital and Community Initiatives (BFHI and BFCI) extend these practices to broader communities (Ministry of Health, 2023). The Code of Breast Milk Substitute Act of 2012 regulates the marketing and distribution of breast milk substitutes.

Micronutrient Deficiency Control

The area focuses on fortifying staple foods with essential vitamins and minerals, providing vitamin A supplementation for children under five years and distributing iron and folic acid supplements to pregnant women. Recognizing that micronutrient deficiencies contribute to stunting, the programme developed the Food Fortification Strategic Framework 2018-2022 and the Integrated Vitamin A Supplementation and Deworming (VAS+D) guideline. The National Policy Guideline on Combined Iron Folic Acid (IFA) Supplementation for Pregnant Mothers with an aim to reduce anaemia, low birth weight, neural tube defects, and improve pregnancy outcomes. The legislation supporting the reduction of stunting includes mandatory fortification of all packaged maize flour, wheat flours, and edible fats/oils with specific vitamins and minerals. The Food, Drug, and Chemical Substance Act ensures access to safe food. These frameworks foster an environment conducive to food fortification through improved policy, governance, adoption, regulation, and monitoring.

Management of Acute Malnutrition

To ensure early identification and treatment of acute malnutrition that contributes to stunting, the division developed the National Guideline for Integrated Management of Acute Malnutrition (IMAM). The management of acute malnutrition aims at establishing community-based management programmes for acute malnutrition, strengthening health facility capacity to treat severe and moderate acute malnutrition and providing therapeutic and supplementary feeding programmes for affected children. The programme also focuses on developing and implementing nutrition response plans for emergencies, ensuring the availability of emergency nutrition supplies and services that are used in the treatment of acute malnutrition and training personnel in emergency nutrition interventions.

Research, Monitoring, and Evaluation

The programme steers efforts towards conducting nutrition-related research to inform policy and programme development, establishing robust monitoring and evaluation systems to track progress and using data and evidence to improve nutrition interventions and outcomes including stunting. The programme is guided by the Kenya Nutrition Monitoring and Evaluation Framework 2018-2022, whose rationale is to ensure continuous tracking of progress, document lessons learned and replicate best practices of nutrition interventions as outlined in the KNAP 2018-2022.

Additionally, guidelines on healthy diets and physical activity aim to promote healthy eating and active living as preventive measures against malnutrition and disease. It also encourages physical activity and creates public awareness on the risks of poor nutrition and diet-related non-communicable diseases (NCDs). However, challenges remain, as evidenced by low acceptable diet scores for children and women of reproductive age, and inadequate intake of fruits and vegetables among the adult population, which may contribute to stunting (KDHS, 2022).

Other enablers such as Advocacy Communication, and Social Mobilization (ACSM) works towards raising awareness about the importance of good nutrition for growth and development to the population, engaging communities and stakeholders in nutrition initiatives, and using media and communication channels to disseminate nutrition information. To achieve this, strengthening governance, coordination, and partnerships is also emphasized to foster collective efforts in addressing stunting. This is guided by ACSM strategy that aims for a malnutrition-free Kenya through strengthened governance, systems, empowered communities, and adequate nutrition financing (Ministry of Health, 2022).

The multisectoral KNAP has strengthened synergy in implementing initiatives to ensure other sectors contribute towards curbing stunting. These include the Ministry of Agriculture, which developed the Nutrition Implementation Strategy (ANIS) 2020-2025. The strategy focuses on nutrition-sensitive agriculture to reduce malnutrition. The Ministry of Labour and Social Protection developed an operational manual for Nutrition Improvements through Cash and Health Education (NICHE), combining social protection, nutrition, and child protection programming for integrated service delivery. The Kenya Rural Sanitation and Hygiene Protocol that marks a pivotal step for the Ministry of Health collective journey to transform rural sanitation and hygiene. It provides a roadmap for action, offering guidance on the progressive grading system that encompasses open defecation free, safe and sustainable, and clean and healthy environments. Focusing on behaviour change, safe management practices, and sustainability will ensure there is a long-term impact of the efforts made. In the education sector, the KNAP highlighted the importance of integrating nutrition in education. This has resulted in strengthened synergy in implementing initiatives to ensure school children are well-nourished and healthy to learn effectively. The sector is guided by the Kenya School Health Policy second edition 2018, National School Meal Strategy 2017-2022, and Homegrown School meals Programme Implementation Guideline. Table 2.1 summarizes the scope of the policy framework.

Table 2.1: Summary of selected nutrition specific and sensitive policy framework in Kenya

Period	Policy Documents	Objective	Institution	Programme
2012	Kenya Food and Nutrition Security Policy	To ensure that all Kenyans enjoy at all times safe food and water in sufficient quantity and quality to satisfy their nutritional needs for optimal health throughout their life course	Ministry of Agriculture	Food security and nutrition issues
2018	Kenya Nutrition Action Plan	To reduce all forms of malnutrition in Kenya using well-coordinated multisectoral and community-centred approaches	Ministry of Health	Nutrition and dietetics
2009	National Guideline for Integrated Management of Acute Malnutrition	To be used as a tool to assist health workers in the assessment and appropriate management with services and/or counselling for the treatment of acute malnutrition, both moderate, acute and severe malnutrition	Ministry of Health	Nutrition and dietetics
2023	Maternal and Infant Young Child Nutrition Strategy 2023-2028	To contribute towards improved health, nutritional status, development and survival of mothers, infants and young children in Kenya	Ministry of Health	Maternal and child nutrition practices
2018	Food Fortification Strategic Framework 2018-2022	To contribute to the reduction of the prevalence of Micronutrient Deficiency (MND) among the population to levels deemed acceptable by WHO	Ministry of Health	Food fortification and nutrition
2020	Integrated Vitamin A Supplementation and Deworming (VAS+D) guideline	To give guidance to health managers and key stakeholders in implementing VAS and deworming services at the national and county levels	Ministry of Health	Micronutrient deficiencies
2020	Agriculture Nutrition Implementation Strategy (ANIS 2020-2025)	To contribute towards improved coordination and provide technical guidance on using nutrition-sensitive agriculture interventions in addressing the underlying and basic causes of malnutrition	Ministry of Agriculture	Agri nutrition

2018	Kenya School Health Policy second edition 2018	To provide a healthy, safe and friendly environment for all learners in Kenya	Ministry of Health	Nutrition in schools
2017	National School Meal Strategy 2017-2021	To provide, promote and coordinate school-meal and nutrition initiatives in Kenya	Ministry of Education	Child nutrition in schools
2021	Operations Manual - Nutrition Improvements Through Cash and Health	To ensure that most vulnerable children in intervention areas of selected counties, show improved well-being in the areas of nutrition, social protection and child protection	Ministry of Labour and Social Protection - State Department of Social Protection	Social safety nets and child nutrition for children under two (2) years

Data source: Government documents (various)

Literature Review

3.1 Theoretical Literature

Bronfenbrenner's Ecological Systems Theory

The Ecological Systems Theory, developed by Urie Bronfenbrenner in 1977, explains how various systems interact and influence a child's growth and development. Using the Ecological Systems Theory to explain the drivers of stunting underscores the importance of a comprehensive approach to reduce the prevalence of stunting. The five systems as explained in the Bronfenbrenner's theory include the microsystem, mesosystem, exosystem, macrosystem and the chronosystem (Bronfenbrenner,1977).

The microsystem refers to the immediate environment in which the child interacts directly. In the context of stunting, the microsystem includes the family, caregivers, and household dynamics. Factors such as inadequate maternal nutrition, poor breastfeeding practices, inappropriate complementary feeding, and lack of responsive caregiving can contribute to stunting. The mesosystem involves the interactions between different microsystems. For example, the linkages between the home and the healthcare system can impact stunting. Limited access to quality healthcare services, inadequate antenatal care, and lack of nutritional counseling can hinder early detection and management of factors contributing to stunting. The exosystem comprises settings that indirectly affect the child. This could include the community, local health facilities, and social services. Factors such as limited availability of nutritious foods, poor sanitation and hygiene practices, and inadequate access to clean water can all contribute to stunting. The macrosystem represents the larger cultural, economic, and social context. Socio-economic status, cultural norms, gender dynamics, and societal values play a significant role in determining access to resources, opportunities, and services that influence stunting risk. For example, gender inequalities may affect the allocation of resources within the household, impacting the child's nutrition. The chronosystem considers how changes over time impact development. Historical factors such as past famines, economic shifts, and policy changes can have lasting effects on a population's nutritional status.

Social Determinants of Health

The Social Determinants of Health (SDH) is a framework that highlights the social, economic, and environmental conditions (non-medical factors) that influence health outcomes. This framework recognizes that health is not solely determined by medical care but is profoundly influenced by a range of factors related to individuals' social and economic circumstances. For instance, socio-economic factors such as income, employment, and economic opportunities significantly affect health. Poverty, job insecurity, and income inequality can lead to stress and limited access

to healthcare and nutritious food, contributing to poor health outcomes, including stunting.

Educational attainment is also linked to health. Higher levels of education tend to correlate with better health outcomes. Education equips individuals with knowledge and skills to make informed health decisions, and it opens better employment opportunities. Additionally, the quality and safety of neighbourhoods and communities influence health as factors such as crime prevalences, access to social support networks, and community resources play a role in shaping health behaviours and outcomes.

Access to quality healthcare services, including preventive care and treatment, is also a crucial determinant of health. The barriers to healthcare access, such as lack of insurance or healthcare facilities, can lead to unmet medical needs and poor health outcomes. The physical environment, including housing quality, access to green spaces, transportation options, and exposure to environmental toxins can affect health. Poor housing conditions or living in areas with high pollution levels can have detrimental health effects. Food security is also another important determinant of health. Populations living in areas with limited access to nutritious food are at a higher risk of poor dietary habits and nutrition outcomes. On the other hand, the structure and organization of the healthcare system, including its affordability and quality, impact health outcomes as accessible and affordable healthcare services are critical for promoting health equity.

The social determinants of health underscore that addressing health disparities and improving overall health – including nutrition – requires interventions that go beyond the healthcare system. Research shows that the contribution of social determinants to health outcomes exceeds the contribution of health care and lifestyle choices (WHO, n.d.; Braveman and Gottlieb, 2014). Therefore, addressing the socio determinants of health is essential for enhancing health and lowering enduring health inequities, which calls for effort from all sectors and civil society.

3.2 Empirical Literature

Stunting is a significant public health concern in Kenya, as it is in many developing countries. Several drivers have been associated with stunting prevalence, including child related characteristics, maternal characteristics and household characteristics.

3.2.1 Child characteristics and stunting prevalence

Child characteristics such as sex and birthweight are significantly associated with stunting among children under five years old. El Taguri et al. (2009) used logistic regression to determine individual risk factors for stunting among children under five years of age in Libya using a nationally representative cross-sectional survey. The results showed that the risk factors for stunting were young age, being a boy and low birth weight. Nshimyiryo et al. (2019), used data from the Rwanda Demographic and Health Survey (DHS) 2014/2015 to determine the risk factors for stunting among children under five years of age using logistic regression analysis. The research found that child characteristics among them sex, and low birth weight were major drivers

of stunting among the children. In Kenya, a study that examined the predictors of stunting in Eastern Kenya found that male children had higher risk of being stunted.

Male children have a higher likelihood of being stunted compared to females (Mansur et al., 2021). The prevalence of stunting is higher among boys than girls, with boys being 2.68 times more likely to be stunted compared to girls. The higher prevalence of stunting in boys may be because their growth and development are more influenced by environmental and nutritional stress compared to girls. Moreover, boys are biologically more vulnerable to stunting due to their higher energy requirements and faster growth prevalences compared to girls (Bork and Diallo, 2017; Wamani et al., 2007).

Low birth weight is a crucial determinant of stunting, with low-birth-weight children having a much higher risk of stunting compared to normal birth weight children. Low birth weight (LBW) has been consistently linked to an increased risk of stunting in children under five years old (Linawati, 2022; Putri et al., 2021; Rohmawati et al., 2022). LBW infants are at a higher risk of morbidity, mortality, infectious diseases, being underweight, and stunting, highlighting the long-term consequences of inadequate birth weight on child growth and development. Children born with low birth weight were also more likely to be stunted (Guyatt, 2020).

3.2.2 Maternal factors related with stunting prevalence

Maternal characteristics such as age of the mother, employment status, sector of employment, antenatal care visits, and level of education have been found to be important drivers of stunting. It is postulated that lower levels of maternal education are associated with suboptimal childcare practices, including feeding practices and healthcare-seeking behaviour, which may contribute to stunting. Contrary to this belief, Kasmita, Tasrif and Santi (2023), carried out a survey on stunting in toddlers and found no significant association between mothers' education and stunting. Guyatt (2020) found that children whose mothers worked as merchants were more likely to be stunted compared to children whose mothers were housewives.

The age of the mother is significantly associated with stunting in children, as evidenced by the strong correlation between maternal age and the incidence of stunting. A systematic review of multiple countries shows a significant correlation between young maternal age (<20 years) and the increased risk of stunting in children aged 0-59 months. Studies indicate that mothers under 20 years old have a higher likelihood of giving birth to stunted children compared to older mothers, with risks ranging from 1.3 to 7.56 times higher (Astutiet al., 2022). This is because teenage mothers struggle to provide the necessary resources and support for their children, increasing the risk of stunting. In contrast, women giving birth between the ages of 20-30 years may significantly reduce the risk of stunting in their children compared to younger mothers. Additionally, early marriage and adolescent pregnancy are highlighted as key factors influencing stunting incidence, emphasizing the importance of addressing maternal age as a critical determinant in combating stunting.

The employment status and sector of employment of the mother is significantly associated with stunting among children. Empirical evidence highlights the association between maternal work participation and childhood stunting, indicating

that children of working mothers have higher odds of being stunted, especially in the absence of adequate family support (Win et al., 2022). The factors contributing to this association include maternal working hours, with longer hours correlating with higher odds of underweight and stunting in children under five years. Furthermore, children of mothers who are engaged in manual or unskilled work, such as domestic workers, are more likely to experience stunting compared to children of mothers in other sectors.

Studies have shown that the number of ANC visits a mother receives during pregnancy is directly associated with the reduced risk of stunting among children under the age of five years. Mothers who do not meet the standard number of ANC visits are at a higher risk of having a stunted child compared to those who complete the recommended ANC visits (Walimah and Rahmah, 2022). This is because inadequate ANC leads to suboptimal monitoring of maternal and fetal health, increasing the likelihood of complications that may impact the child's growth and development (Walimah and Rahmah, 2022; Correa, 2022). During ANC visits, pregnant women receive essential services such as nutritional counseling, supplementation with folic acid and iron, and health education. These interventions help prevent maternal anaemia, preterm birth, and ensure the foetus receives adequate nutrition in utero, ultimately reducing the risk of stunting.

3.2.3 Household factors and stunting prevalence

Household factors such as place of residence, access to improved sources of water and sanitation, and household income level influence childhood stunting prevalences. Multivariable Poisson regression models were used to estimate relative risk of stunting among children in Vietnam. This study used a nationally representative cross-sectional survey from the Vietnam Nutritional Surveillance System. The results found that region of residence had strong association with stunting among children aged 6-59 months (Beal et al., 2019). Evidence on the effect of place of residence on stunting prevalences is mixed. Studies have shown that children residing in urban areas are more likely to experience stunting compared to those living in rural areas. This association is observed in both Angola and Nepal, where urban children are at a higher risk of stunting due to factors such as decreased maternal contact time, shorter breastfeeding periods, and less diverse diets (Adhikari et al., 2019). In Zambia, the prevalence of stunting is higher among children in urban areas, which may be attributed to the urban poor living in informal settlements with poor water and sanitation, high food insecurity, and limited access to nutritious foods (Mzumara et al., 2018).

Conversely, rural regions, characterized by poorer access to healthcare, sanitation, and clean water, tend to have higher stunting prevalences compared to urban areas. A study by Tasic et al. (2020) on the drivers of stunting reduction found that slightly greater reductions occurred for children in urban areas compared to rural areas. Zegeye et al. (2021) investigated both the extent and over time dynamics of stunting inequality. The study found that rural areas and specific regions in Ethiopia experienced higher burden of stunting. A comparative analysis of socio-economic inequities in stunting in Kenya, Zambia and Ghana showed that stunting is more prevalent in rural areas than in urban areas in all the three countries (Jonah, Sambu and May 2018).

A systematic review of literature of the environmental risk factors associated with stunting found that a lack of adequate sanitation, dirty floors in the home, poor quality cooking fuels, and inadequate local waste disposal were associated with an increased risk of childhood stunting. As an example, a review of child stunting determinants in Indonesia showed that children from households with both unimproved latrines and untreated drinking water were at increased risk of stunting. A scoping review on risk factors for stunting in developing countries further showed that environmental factors are risk factors of stunting in children under five years (Huriah and Nurjannah, 2020).

Income quintiles play a crucial role in understanding child stunting and health inequalities. Studies consistently show that children from lower income quintiles are more likely to be stunted. For example, a systematic review and meta-analysis of 1,642 records found that children from households with a medium or low/poor wealth index had higher odds of stunting (Kassaw et al., 2020). Similarly, a study in Bangladesh found that children from the lowest wealth quintile were twice as likely to be stunted as those from the highest quintile (Islam and Biswas, 2015). The prevalence of stunting has been shown to decrease over time, with faster reductions observed among the most disadvantaged groups, such as those in the poorest wealth quintile living in rural areas (Fink et al., 2017).

4 Methodology

4.1 Theoretical Framework

The study is anchored on the Social Determinants of Health (SDH) Theory, which argues that health inequalities are driven by various political, social and economic factors. According to the World Health Organization (WHO), the social determinants of health (SDH) are "the conditions, in which people are born, grow, work, live, and age and the wider set of forces and systems shaping the conditions of daily life." The SDH framework highlights the importance of addressing these determinants in a multisectoral approach to effectively reduce child stunting. The SDH theory also emphasizes the importance of addressing the broader social and economic conditions that contribute to health inequities. Studies have consistently shown that prevalence in stunting is attributable to various child, maternal and household characteristics. Child characteristics such as age of the child, sex of the child, and weight at birth of the child are critical determinants of stunting. Maternal characteristics, including age of the mother, maternal education, number of antenatal care visits, employment status, and sector of employment of the mother can lead to limited access to healthcare and nutritious food, contributing to poor health outcomes among children. Other household characteristics such as place of residence, access to improved sources of water, access to improved sanitation and income quintiles are also determinants of childhood stunting.

4.2 Empirical Estimation

This study uses the Probit model to compute the probabilities of stunting prevalence given child, maternal and household characteristics in 2014 and 2022. The dependent variable represents households that had experienced a child who is stunted. The variable takes the value one (1) if the household had a stunted child, zero (0) if otherwise. Since the outcome variable is dichotomous, unordered Probit is the appropriate model to apply. In this Probit model, it is assumed that the probability of being stunted is determined by underlying response variable of child, maternal, and household characteristics, whose disturbance term is normally distributed with mean zero (0) and constant variance one (1). The estimated model is of the form:

$$y = \beta' x + \varepsilon \quad (1)$$

$$y = 1 \quad \text{if } y^* > 0 \quad (2)$$

$$y = 0 \quad \text{if } y^* \leq 0 \quad (3)$$

Where y is dependent dichotomous variable taking one (1) if there is a stunted child in the household and zero (0) if otherwise. β is a vector of unknown parameters, x

is a vector of observed independent variables and ε are the unobserved factors that cause stunting. The independent variables used in the model include sex of the child, weight at birth, age of the mother, maternal education, employment status of the mother, place of residence, access to water and access to sanitation. Consequently, the model controls for all the other listed variables to avoid their effects being captured in the error term. Therefore, the binary response model can be denoted as:

$$Prob\ (y=1|x)=f(x,\beta) \quad (4)$$

To obtain the marginal effects of the regressors x, on the probabilities, the derivative of the function that the probability of the child is stunted is computed.

$$(\partial\ Prob\ (y=1)/(\partial\ x)=\partial\ f(x'\ \beta) \quad (5)$$

Since the occurrence of stunting is a dummy variable, the study computes the difference in probability of the dummy taking value one (1) and value zero (0).

$$P(y=1x)=P(y=1x,x_j=1)-Pr(y=1|x,x_j=0) \quad (6)$$

To estimate the drivers of stunting, the study estimates a first regression on the effect of predictors on stunting prevalent in 2014 and 2022. Thus, stunting is modelled as a function of birthweight of the child, gender of the child, age of the mother, highest level of education attained by the mother, employment status of the mother, place of residence, access to improved sources of water and access to improved sources of sanitation. The study estimates the general probit using an empirical function as described below:

$$y_1=\beta_0+\beta_1 X_1+ \beta_2 xX_2+ \beta_3 X_3+...+\beta_n X_n+\varepsilon_i \quad (7)$$

Where:

y_1=Stunting prevalence (8)

β_0=Constant

$\beta_n X_n$= the coefficients and regressors respectively;

And:

Stunting prevalence=β_0+β_1 sex of the child+β_2 birthweight+β_3 age of the mother+β_4 highest level of education attained by the mother+β_5 employment status of the mother+ β_6 place of residence+β_7 access to improved sources of water+β_8 access to improved sanitation+β_9 income level

To further understand the independent variables, additional regressions were estimated that introduced interactions terms between age of mother (teenage mothers' and income quintile (rich households) and employment status of the mother; that is mothers not working but reside in wealthy households.

In the second stage of the estimation, the drivers of stunting in both rural and urban regions in 2014 and 2022 are assessed. The study therefore estimates regressions that are derived from the general regressions (9) through (11):

$$y_1\ \text{place of resid}=\beta_0+\beta_1 X_1+ \beta_2 xX_2+ \beta_3 X_3+...+\beta_n X_n+\varepsilon_i \quad (9)$$

Where:

y_1 place of resid=Stunting prevalence by place of residence (10)

And:

$$\textit{Stunting prevalence by residence} = \beta_0 + \beta_1 \textit{ sex of the child} + \beta_2 \textit{ birthweight} + \beta_3 \textit{ age of the mother} + \beta_4 \textit{ highest level of education attained by the mother} + \beta_5 \textit{ employment status of the mother} + \beta_6 \textit{ access to improved sources of water} + \beta_7 \textit{ access to improved sanitation} + \beta_8 \textit{ Income level} \quad (11)$$

4.3 Definition and Measurement of Variables

4.3.1 Dependent variable

Stunting prevalence

The dependent variable in this study is stunting (HAZ) among children below five years of age in Kenya. Height/length and age were used to determine height/age Z scores of the children. A child is categorized as being stunted when their height relative to their age is less than minus two standard deviations (<-2SD) and below the World Health Organization (WHO) child growth standards (WHO, 2015). Furthermore, a child is severely stunted when their height relative to their age is less than minus three standard deviations (<-3SD). In the regression analysis, the dependent variable was binary with either stunted (1) or not stunted (0).

4.3.2 Independent variables

The independent variables were determined based on UNICEF's conceptual framework for the causes of malnutrition and the Social Determinants of Health Theory on the factors influencing a child's growth and development. The variables were also based on availability of data in the KDHS 2022 and KDHS 2014 databases. These variables were categorized as child, maternal, household and geographical factors. Child characteristics included sex of the child and birthweight. Maternal characteristics included age of the mother, education level, and employment status. Household variables include place of residence (rural or urban), access to water sources, and access to sanitation. Table 4.1 provides details about the variables included in the model and how they were measured.

Table 4.1: Measurement and description of variables

Dependent variable	Description	Measurement
Overall stunting prevalence	Child's height for age	Height relative to their age is less than minus two standard deviations (<-2SD). Dummy (1=stunted (<-2SD); 0=Otherwise) Child is severely stunted when their height relative to their age is less than minus three standard deviations (<-3SD)

Severe stunting prevalence	Child's height for age	Height relative to their age is less than minus three standard deviations (<-3SD). Dummy (1=severely stunted (<-3SD; 0=Otherwise)
Child characteristics		
Child sex	Child sex whether male or female	Dummy where: 1= Male 0= Female
Birth weight	Weight at birth in grams (gms)	Categorical variable where: 1= 600gm-1,499gm (extremely low and very low BW) 2= 1500g -2499g Low BW 3= above 2500g Normal BW
Age of the child	Child's age in months	Categorical variable where: 1= below 6 months 2= between 6 and 11 months 3= between 12 and 23 months 4= between 24 and 35 months 5= between 36 and 47 months 6= between 48 and 59 months)
Maternal characteristics (15-49 years)		
Age	Age of the mother (years)	Categorical variable where: 1= Between 15 and 18 years (teenage mothers) 2= Between 19 to 34 years (Young adult mothers) 3= Between 35 and 49 years (Adult mothers)
Maternal education	Highest level of education attained by the mother	Categorical variable where: 1= No education 2= Primary education 3= Secondary education 4= Higher education
Antenatal visits	Number of antenatal visits during pregnancy. The recommended ANC visits are at least four during the pregnancy period	Binary variable where: 1= Attended at least four (4) ANC visits 0= Attended less than four (4) ANC visits
Mother's employment status	Whether the mother is working or not	Binary variable where: 1= Working 0= Not working

Sector of employment of the mother	The sector where the mother is employed	Categorical variable where: 1= Formal employment 2= Agriculture 3= Household and domestic work 4= Services 5= Manual labourers
Household characteristics		
Place of residence	Residence whether rural or urban	Binary variable where: 1= Urban 0= Rural
Access to water	Household access to sources of water	Binary variable where: 1= Improved sources of water 0= Unimproved sources of water
Access to sanitation (improved sanitation)	Household access to sanitation	Binary variable where: 1= Improved sanitation 0= Unimproved sanitation
Income quintile	A household's composite measure of cumulative living standard	Categorical (1= Poorest; 2=Poorer; 3= Middle; 4=Richer; 5: Richest)

Source: Author's measurement

4.4 Research Design

The study used secondary cross-sectional data. The main data source for this study was the Kenya Demographic Health Survey (KDHS) 2014 and 2022 data produced by the Kenya National Bureau of Statistics (KNBS). In 2014, the sample was drawn from the KNBS master sampling frame, which contained 5,360 clusters from 96,251 enumeration areas based on the 2009 census survey. The total sample had 1,612 clusters across the country: 995 clusters in rural areas and 617 in urban areas. The sample was stratified and selected in two stages from the master sample frame.

Data was collected from 47 counties using household, woman's and man's questionnaires. Following data cleaning, our study sample mainly constituted households with children between zero (0) and 59 months and their characteristics and maternal and household characteristics. Similar to 2014, the sampling frame was constructed from the master sampling frame in 2022, with a total of 129,067 enumeration areas. As a result, there were 1,692 clusters spread across the country with 1,026 clusters in rural areas and 666 in urban areas. Following data cleaning, the total sample size was 18,656 and 17,327 in 2014 and 2022, respectively.

4.5 Descriptive Statistics

Appendix 1 and Appendix 2 present a description of the factors used in this analysis and the regression models in 2014 and 2022. The tables describes the characteristics of children aged 59 months and below, maternal characteristics and characteristics of their households as obtained from the KDHS datasets. The proportion of stunted children was 18 per cent and severe stunting prevalence was at 4 per cent in 2022, a significant decline from 26 per cent and 8 per cent in 2014, respectively. The number of male and female children included in the study was almost equal, with over 50 per cent being male in 2014 and 2022. Most of the children in this sample were between 36 and 47 months at 21.3 per cent in 2022. In 2014, children between 12 and 24 months formed the largest proportion of sampled children.

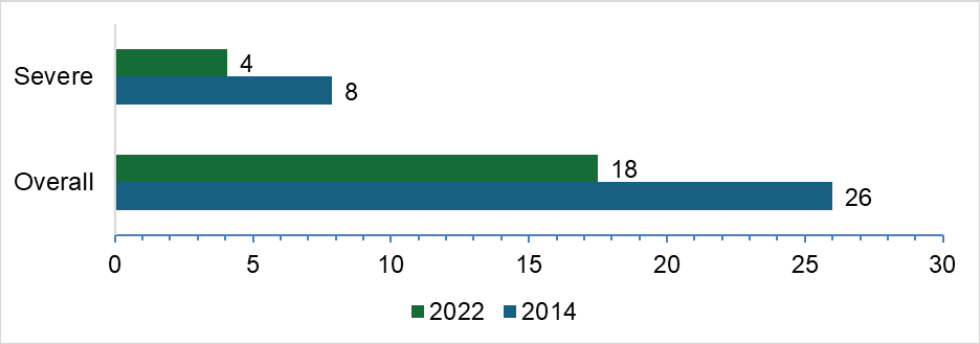
The statistics also show that most of the children had a mean birthweight of 3.3kg and 3.2kg in 2014 and 2022, respectively. On average, mothers had mainly primary education in both 2014 and 2022. Nevertheless, a higher percentage of the mothers were working (58.0%) compared to those not working (48.0%) in 2022, which represents a decline from 67.8 per cent in 2014. The average ANC visits were 1.0 and 1.4 in 2014 and 2022, respectively, and only 3 per cent of mothers attended the recommended four (4) ANC visits in 2022 compared to 0.02 per cent in 2014. The average age of a mother was 29 in 2014 and 2022.

Mothers between 20 and 24 years formed the largest proportion of respondents at 72.3 per cent and 74.6 per cent in 2022 and 2014, respectively. Only 35 per cent of the respondents resided in urban areas in 2022; a 1 per cent increase from 34 per cent in 2014. Regarding access to improved water sources, more households (66%) had access in 2022 compared to 63 per cent in 2014, whereas the proportion of households with improved sanitation was slightly more than half at 61 per cent in 2022 compared to 45 per cent in 2014. About a third (30.6%) of the households were in the poorest quintile in 2022, an increment from 29 per cent in 2014.

4.6 Characterization of Stunting

There was a notable reduction in severe stunting from 8 per cent in 2014 to 4.0 per cent in 2022, whereas overall stunting prevalences decreased from 26 per cent to 18 per cent during the same period (Figure 4.1). The decline in both severe and overall stunting prevalence may indicate the effectiveness of implemented strategies in improving child health and nutrition outcomes such as nutrition education, growth monitoring, immunization, water, sanitation, hygiene, and social safety nets. Specific government initiatives include the introduction of stunting into the community health strategies to improve nutrition education. Notwithstanding, the persistence of stunting highlights the need for sustained efforts in addressing the various underlying causes of stunting. Stunting prevalence varies significantly by the different income groups, maternal education levels, regions, among other factors.

Figure 4.1: Stunting prevalence, 2014-2022 (%)

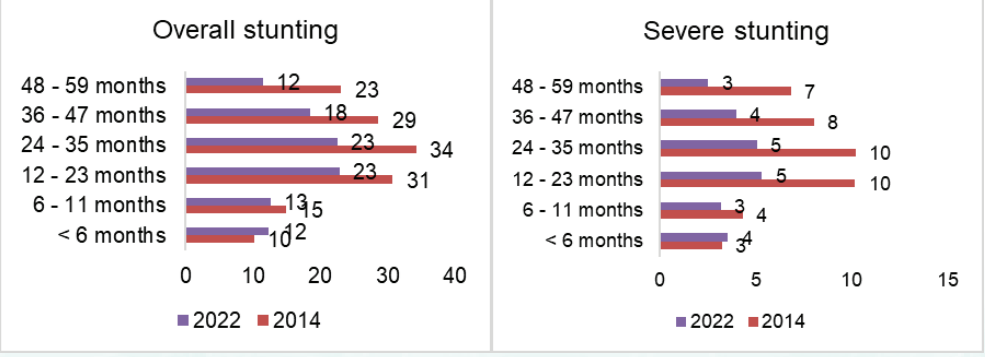


Data source: KNBS (2014 and 2022), KDHS

Despite a reduction in stunting in Kenya, on average, stunting prevalence in some counties is of great concern (Appendix 3). There are wide variations across counties and the highest percentages were in Kilifi, West Pokot, and Samburu counties at 37 per cent, 34 per cent, and 31 per cent, respectively, which is classified as very high prevalence while the lowest in Kisumu and Garissa counties with a prevalence of 9 per cent each, classified as low prevalence (KDHS, 2022). In comparison to 2014, Kitui County had the highest reduction from 46 per cent to 23 per cent while Samburu County increased by one (1) per cent.

Stunting prevalence varies across the different ages of children. In terms of overall stunting prevalence, there was a decline in stunting prevalence cross all children under five years. The highest proportion of stunting was in children between the ages of 24 months to 35 months at 23 per cent in 2022 from 34 per cent in 2014. The same age band had the highest stunting prevalences in 2014 (Figure 4.2). Addressing stunting requires a comprehensive approach that considers the critical periods of growth and age-specific risk factors. Continued support through early childhood may make it possible to improve stunting beyond the 1,000 days.

Figure 4.2: Age of the child and stunting prevalence, 2014-2022 (%)

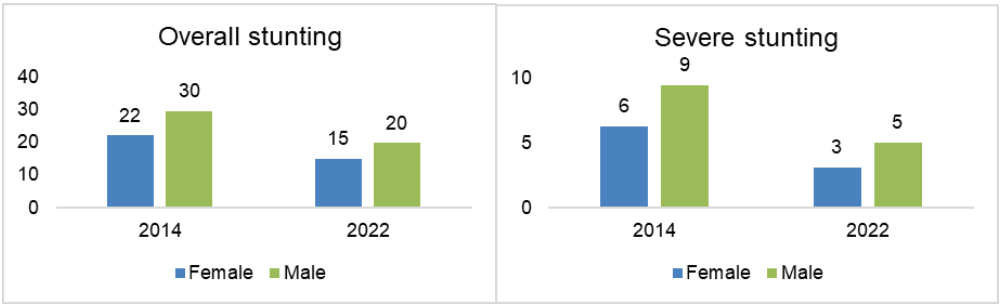


Data source: KNBS (2014 and 2022), KDHS

The sex of the child plays a significant role in stunting prevalences. There was a noted decline in stunting in both sexes in 2022 relative to 2014. Despite observable decline

in stunting prevalences, when disaggregated by sex, the study observes significant differences between boys and girls. Overall stunting prevalences were higher in 2014 and 2022 at 30 per cent and 20 per cent, respectively, for boys compared to female children at 22 per cent and 15 per cent during the same period (Figure 4.3). Similar findings were observed in severe stunting prevalences among boys, which were higher than the national average at 9 per cent and 5 per cent in 2014 and 2022, respectively. Sex differences in stunting highlight the need for gender-sensitive approaches to addressing malnutrition and promoting child growth.

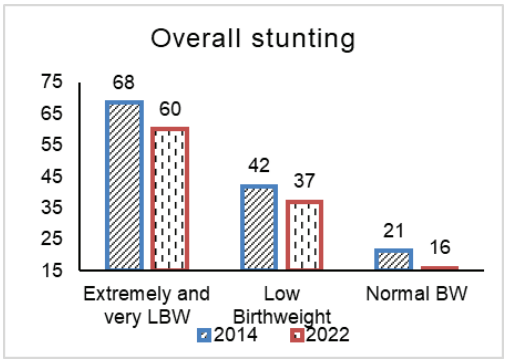
Figure 4.3: Sex of the child and stunting prevalence, 2014-2022 (%)

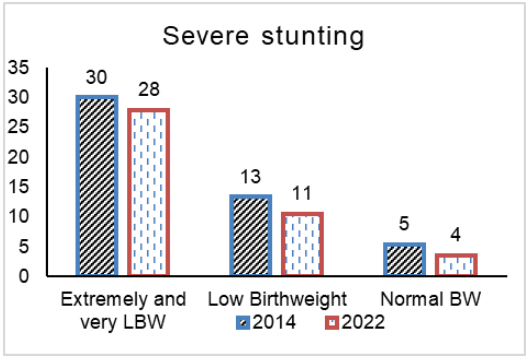


Data source: KNBS (2014 and 2022), KDHS

The relationship between a child's birth weight and stunting prevalence is significant, with children born with low birth weight (LBW) being more likely to be stunted. The proportion of stunted children with extremely Low Birth Weight (ELBW) decreased from 68 per cent in 2014 to 60 per cent in 2022 (Figure 4.4). The same decline is observed among children with LBW and Normal weight with a 5 per cent reduction in 2022 from 2014. With respect to severe stunting prevalences, there was a 2 per cent decline in the proportion of children with extremely low and very low birth weights. Across the stunting severity levels, children with extremely low and very low birthweights are disproportionally stunted compared to the other categories. Despite the decrease, children with extremely low birth weight continue to experience significantly higher severe stunting levels compared to those with normal birth weight.

Figure 4.4: Birth weight and stunting prevalence, 2014-2022 (%)

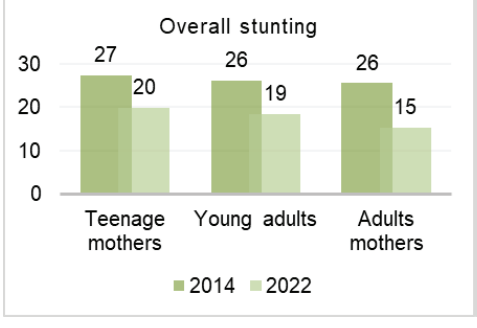


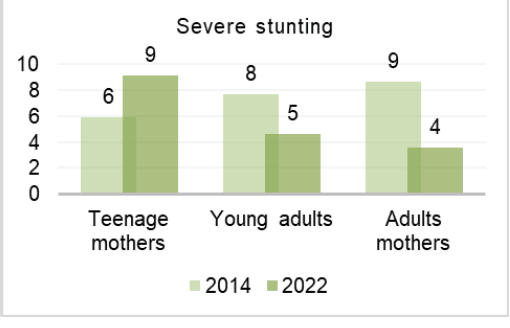


Data source: KNBS (2014 and 2022), KDHS

Maternal age is a critical determinant of child stunting, with both very young and older mothers facing unique challenges. The analysis showed that the highest stunting prevalence were recorded in children born to teenage mothers at 20 per cent compared to adult mothers at 15 per cent in 2022 (Figure 4.5). This was a decline from 27 per cent in 2014 among children of teenage mothers. When disaggregated by severe stunting, findings indicate a significant increase in severe stunting prevalence among teenage mothers from 6 per cent in 2014 to 9 per cent in 2022. This is despite a decline in teenage pregnancy from 18 per cent in 2014 to 15 per cent in 2022. Provision of targeted support and interventions that address the specific needs of mothers based on their age could possibly reduce the risk of stunting.

Figure 4.5: Age of the mother and stunting prevalence, 2014-2022 (%)

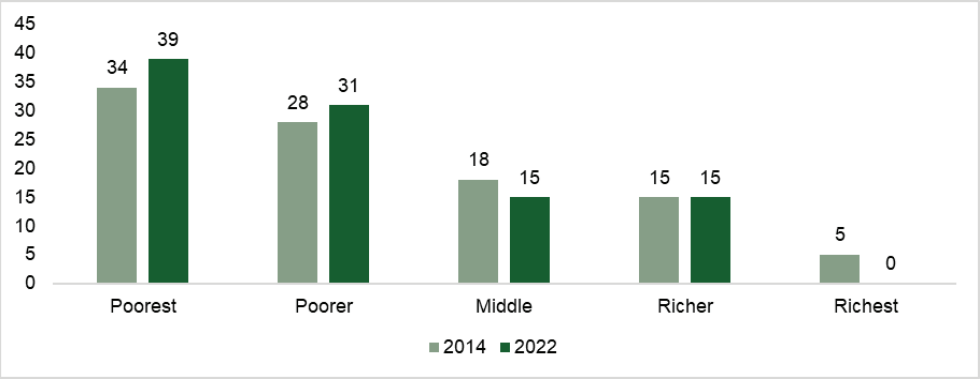




Data source: KNBS (2014 and 2022), KDHS

Further analysis on teenage mothers and income quintile shows that 34 per cent and 39 per cent of the teenage mothers in 2014 and 2022, respectively, were from the poorest quintile (Figure 4.6). This indicates that the percentage of teenage mothers in the poorest quintile increased by 5 per cent over the 8-year period, suggesting a lack of progress in reducing adolescent pregnancy prevalences among the country's poorest populations. Moreover, there was an increase in the proportion of teenage mothers from 28 per cent to 31 per cent in 2022. Children born to teenage mothers from poor backgrounds are at a higher risk of stunting due to limited access to healthcare, nutrition, and other essential services.

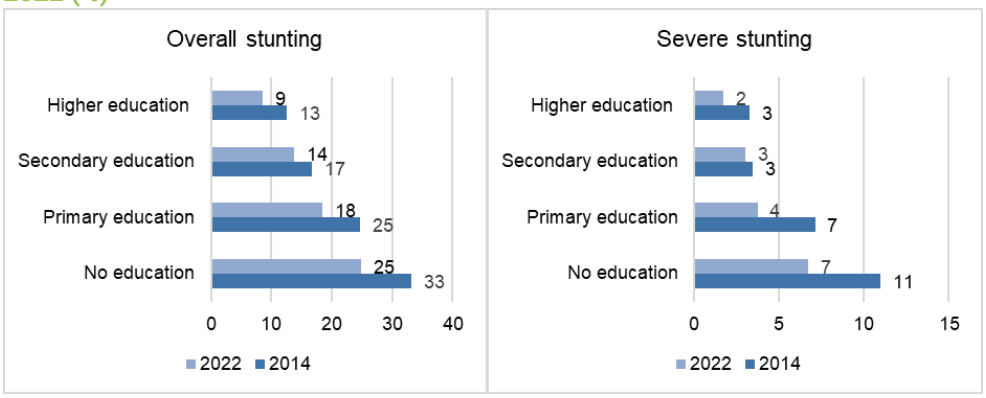
Figure 4.6: Distribution of teenage mothers by income quintile 2014-2022 (%)



Data source: KNBS (2014 and 2022), KDHS

Maternal education is crucial in influencing child health outcomes, including stunting prevalence. In 2014, the highest stunting prevalence was observed among children of mothers with no education at 33 per cent, while the lowest prevalence was among children of mothers with post-secondary or higher education at 13 per cent (Figure 4.7). By 2022, the prevalence decreased significantly, with the highest stunting prevalence among children of mothers with no education at 25 per cent and the lowest prevalence in mothers with higher education at 9 per cent in 2022. Similar findings were observed in terms of severe stunting prevalence where children of mothers with no education were more likely to be stunted at 11 per cent and 7 per cent in 2014 and 2022, respectively.

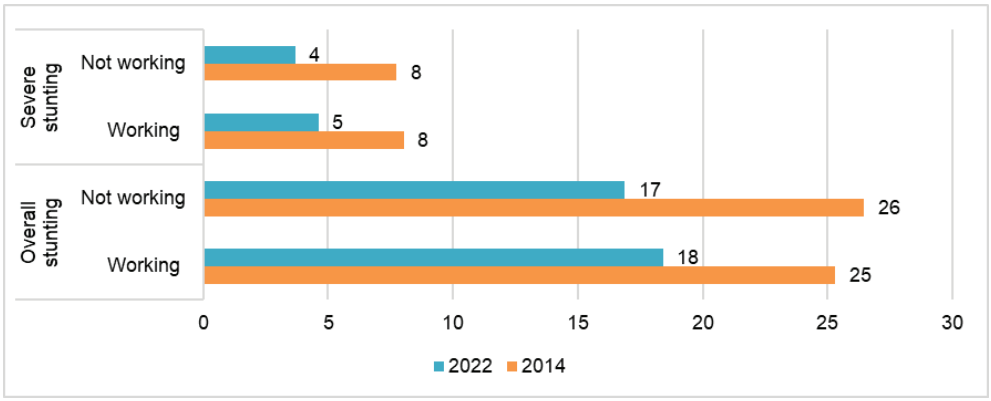
Figure 4.7: Mother's highest level of education and stunting prevalence, 2014-2022 (%)



Data source: KNBS (2014 and 2022), KDHS

In terms of employment status of mothers, in 2014, stunting prevalence was highest among children of non-working mothers at 26 per cent compared to children of working mothers at 25 per cent (Figure 4.8). This declined to 17 per cent and 18 per cent in 2014 and 2022, respectively, an indication that in 2022, children of working mothers were more likely to be stunted. This could be attributed to low involvement of working mothers in childcare practices, which could lead to increased stunting prevalence. In terms of severe stunting prevalence, children of both working and non-working mothers had stunting at 8 per cent in 2014 and 2022.

Figure 4.8: Employment status of the mother and stunting prevalence, 2014-2022 (%)



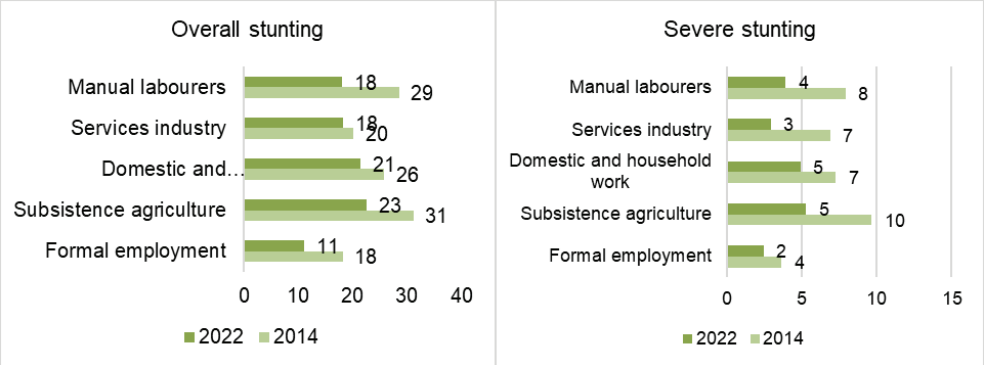
Data source: KNBS (2014 and 2022), KDHS

When disaggregated by sector of employment in 2014, there is a strong association of stunting and mothers working in subsistence agriculture, manual labourers, and domestic workers with 31 per cent, 29 per cent, and 26 per cent stunting prevalence, respectively. The same sectors took the lead in 2022, with subsistence agriculture having the highest prevalence at 23 per cent. This can be linked to the low incomes and long working hours associated with these sectors. Women working in these

sectors are likely to be poorer owing to their lower wages and are likely to be prone to time poverty due to long working hours.

A similar observation was made in severe stunting prevalence where children of mothers working in subsistence agriculture were more likely to be stunted at 10 per cent and 5 per cent in 2014 and 2022, respectively. The sector of employment of the mother significantly affects the risk of stunting in children. By understanding the unique challenges and opportunities associated with different employment sectors, policies, and interventions can be tailored to support working mothers and promote better nutritional and health outcomes for their children.

Figure 4.9: Sector of employment and stunting prevalence, 2014-2022 (%)



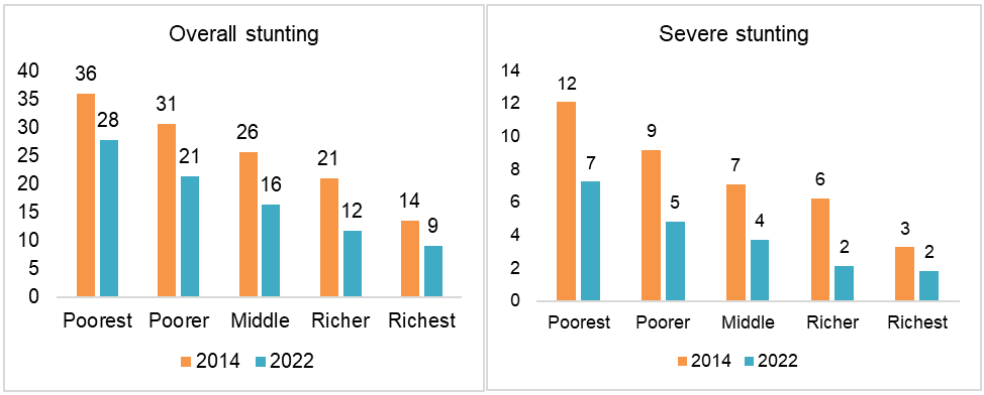
Data source: KNBS (2014 and 2022), KDHS

The relationship between antenatal care (ANC) visits and stunting prevalence is crucial in addressing child health outcomes, including reduction in stunting prevalence. The frequency of antenatal care visits is important, and the WHO recommends attendance of at least four (4) visits during the gestation period. In 2014, less than 1 per cent of the population attended the recommended ANC clinics while in 2022 this increased to 3 per cent of expectant mothers. In terms of place of residence, ANC+4 attendance was higher in urban regions compared to rural areas. Further disaggregation by age of the mother, the findings indicate that in 2014, teenage mothers did not attend ANC+4 clinics whereas in 2022 it was 1.5 per cent of the mothers. Across the age groups, more adult mothers attended ANC+4 clinics in 2022. In terms of stunting prevalence, in 2014, children of mothers who did not attend ANC+4 clinics had a stunting prevalence of 26 per cent compared to 19 per cent in 2022. The lower ANC+4 attendance of teenage mothers is a well-documented phenomena associated with socio-cultural, economic, and healthcare-related factors. The social factors include social stigma, embarrassment, lack of family and partner support (even if the family is wealthy) while healthcare system barriers include inadequate communication and education tailored to teenage mothers and negative attitudes from healthcare providers.

Analysis by income quintiles shows a consistent decline in stunting prevalence across all income groups from 2014 to 2022 (Figure 4.10). This positive trend signifies improvements in child nutrition and health outcomes. In 2014, the richest group had the lowest stunting prevalence at 14 per cent, while the poorest group had

the highest prevalence at 36 per cent. By 2022, this prevalence further decreased, with the richest group showing the lowest stunting prevalence of 9 per cent and the richest group at 28 per cent. A significant reduction was observed in the poorer group at a 10 per cent reduction in 2022. Similar findings were observed in stunting prevalences where the poorest and poorer quintiles had the highest child stunting prevalence compared to the richer and richest quintiles in both time periods.

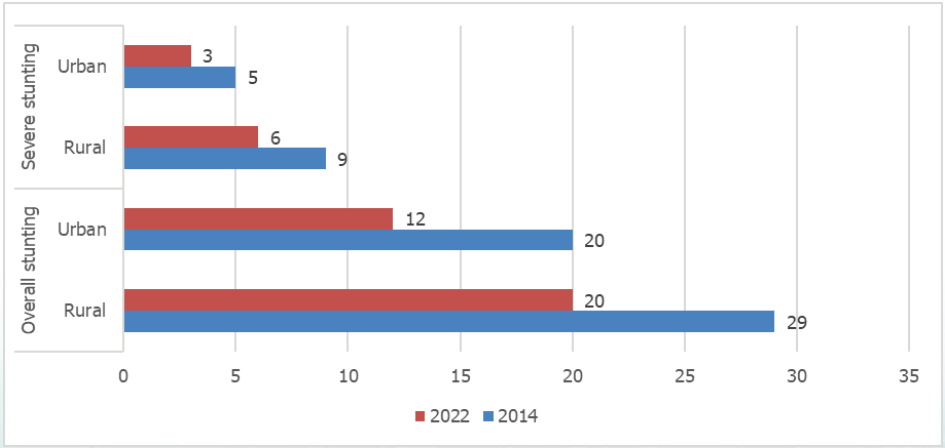
Figure 4.10: Income quintile and stunting prevalence, 2014-2022 (%)



Data source: KNBS (2014 and 2022), KDHS

Stunting prevalence in rural areas decreased from 29 per cent in 2014 to 20 per cent in 2022, indicating a significant improvement. A similar decline was observed in urban areas where the prevalence decreased from 20 per cent in 2014 to 12 per cent in 2022 (Figure 4.11). The decline in both regions suggests the effectiveness of interventions targeting communities, such as improved access to healthcare and nutrition programmes. While improvements are evident in both settings, rural areas continue to experience higher severe stunting prevalence than urban areas, emphasizing the need for targeted interventions in rural communities.

Figure 4.11: Place of residence and stunting prevalence, 2014-2022 (%)



Data source: KNBS (2014 and 2022), KDHS

Improving access to clean water is vital in the fight against stunting. By ensuring that communities have reliable sources of clean water, promoting good sanitation practices, and integrating these efforts with nutritional programmes, the prevalence of stunting can be significantly reduced. The stunting prevalence were high in households that accessed water from unimproved sources at 31 per cent and 20 per cent, in 2014 and in 2022, respectively. The households that accessed improved sources of water had the lowest stunting prevalence at 13 per cent (Table 4.2).

Table 4.2: Access to improved water sources and stunting prevalence, 2014-2022 (%)

Access to improved water	2014		2022	
	Unimproved sources	Improved sources	Unimproved sources	Improved sources
Overall stunting and access to improved sources of water	31%	23%	20%	17%
Access to improved sources of water and stunting prevalences in rural areas	33%	27%	23%	19%
Access to improved sources of water and stunting prevalences in urban areas	24%	19%	10%	13%

Data source: KNBS (2014 and 2022), KDHS

Improving sanitation is a fundamental aspect of reducing stunting in children. By preventing infections, reducing exposure to harmful pathogens, and promoting better hygiene practices, enhanced sanitation can significantly contribute to sustainable reductions in stunting prevalence. Overall, the households that accessed unimproved sources had the highest prevalence of stunting, and it reduced significantly from 30 per cent in 2014 to 23 per cent in 2022 (Table 4.3).

Table 4.3: Access to improved sanitation and stunting prevalence, 2014-2022 (%)

Access to sanitation	2014		2022	
	Unimproved sources	Improved sources	Unimproved sources	Improved sources
Overall stunting and access to improved sanitation	30%	21%	23%	14%
Access to improved sanitation and stunting prevalences in rural areas	31%	26%	24%	17%
Access to improved sanitation and stunting prevalences in urban areas	27%	18%	15%	12%

Data source: KNBS (2014 and 2022), KDHS

5 Results and Discussion

This section reports marginal effects from regression analysis on the drivers of stunting in the overall population and by place of residence in 2014 and 2022. A multicollinearity analysis shows that there is strong correlation between employment status of the mother and the sector of employment. Therefore, the sector of employment of the mother was omitted from the regressions. Due to skewness of the data on ANC+4 visit, the variable was also omitted in the regression analysis.

5.1 Drivers of Overall and Severe Stunting Prevalence

Table 5.1 presents regression analysis results on the drivers of overall stunting prevalence in 2014 and 2022, the interaction terms between the age of the mother, employment status, and wealth quintile. The results on severe stunting are included in Appendix 4 for both 2014 and 2022. The results show that a child's sex influences both overall and severe stunting in 2014 and 2022. Other variables that influence both overall and severe prevalence of stunting include birth weight, secondary school and tertiary or higher education attainment levels and income level. Age of the mother, in particular teenage mother, has a significant influence on severe stunting prevalence while its influence on overall stunting prevalence is insignificant. The interaction terms between teenage mothers and income level and that of working mothers and income levels were insignificant in 2014 and 2022 for overall and severe stunting prevalence.

In 2014, overall stunting prevalence was 6.1 percentage points higher among male children compared to female children while the probability of severe stunting was 2.1 percentage points higher for males (Table 5.1). These results are similar to several other empirical studies that showed that boys are more likely to be stunted than girls (Guyatt, 2020; El Taguri et al., 2009; Wamani et al., 2007). One explanation is that males are more likely to be impacted much more adversely by poor nutrition of the mother owing to their higher nutritional needs before and after birth (Thurstans et al., 2022).

There was a lower probability for both overall and severe stunting prevalence in children born with normal birth weight by 45.2 and 19.0 percentage points in 2014, whereas in 2022 this probability reduced by 45.5 and 24.6 percentage points, respectively. This is compared to the base category of children born with extremely low birth weight. These findings are similar to Guyatt et al. (2020), who found that children with a birth weight under 2.5kg were 4-5 times more likely to be stunted compared to those with a normal birth weight.

Table 5.1: Marginal effects of overall and severe stunting prevalence 2014 and 2022

Variable	Overall stunting 2014 (1)	Overall stunting 2022 (1)	Overall stunting 2014 (2)	Overall stunting 2022 (2)	Overall stunting 2014 (3)	Overall stunting 2022 (3)	Severe stunting 2014 (4)	Severe stunting 2022 (4)	Severe stunting 2014 (5)	Severe stunting 2022 (5)	Severe stunting 2014 (6)	Severe stunting 2022 (6)
Sex of child (male=1)	0.061***	0.067***	0.061***	0.067***	0.061***	0.067***	0.021***	0.022***	0.022**	0.022**	0.022**	0.022**
Low birth weight	-0.252**	-0.263**	-0.252**	-0.262**	-0.252**	-0.262**	-0.086	-0.188**	-0.089	-0.189**	-0.088	-0.188**
Normal birth weight	-0.452***	-0.456***	-0.452**	-0.455***	-0.452***	-0.454**	-0.190*	-0.246**	-0.193*	-0.246**	-0.192*	-0.246**
Teenage mother	0.0060	-0.001	-0.005	-0.033	0.006	-0.001	-0.027*	0.046*	-0.042**	0.055*	-0.027*	0.046*
Teenage mother*Rich	-	-	0.027	0.093	-	-	-	-	0.059	-0.017	-	-
Adult mother	-0.0040	-0.022	-0.005	-0.022	-0.005	-0.022	0.003	-0.003	0.003	-0.003	0.003	-0.003
Primary	-0.024*	-0.017	-0.025*	-0.017	-0.024*	-0.017	-0.019**	-0.015*	-0.019**	-0.015*	-0.018**	-0.015*
Secondary	-0.079***	-0.028	-0.079***	-0.027	-0.079***	-0.029	-0.053***	-0.022**	-0.052***	-0.023**	-0.053***	-0.022**
Higher education	-0.091***	-0.065**	-0.09***	-0.063**	-0.091***	-0.064**	-0.044***	-0.041**	-0.043***	-0.042***	-0.045***	-0.041***
Employment status (Mother not working=1)	-0.034**	-0.016	-0.034**	-0.016	-0.026	-0.021	-0.013*	-0.008	-0.013*	-0.008	-0.003	-0.009
Mother not working *Not poor	-	-	-	-	-0.015	0.010	-	-	-	-	-0.019	0.002
Income (Not poor=1)	-0.051***	-0.071***	-0.052***	-0.075***	-0.047**	-0.076***	-0.029***	-0.016*	-0.030***	-0.015*	-0.023**	-0.017*
Residence (urban=1)	0.010	-0.022	0.010	-0.021	0.011	-0.022	0.019**	0.002	0.018**	0.002	0.020**	0.002
Improved sources of water	-0.043**	-0.008	-0.043**	-0.008	-0.043**	-0.008	-0.011	-0.001	-0.011	-0.001	-0.012	-0.001
Improved sanitation	-0.040**	-0.023	-0.040**	-0.022	-0.039**	-0.022	-0.008	-0.012	-0.008	-0.012	-0.007	-0.012

Significance levels: *p < .05; **p < .01;***p < .001

Data source: KNBS (2014 and 2022), KDHS

In 2014, the probability of children of teenage mothers being severely stunted was reduced by 2.7 percentage points compared to the base category (young adult mothers aged 19-35 years). However, in 2022, the probability of severe stunting among children of teenage mothers increased by 4.6 percentage points, an indication that children of teenage mothers were more likely to be stunted in 2022 than in 2014. Similarly, there was no significant effect of the interaction term between teenage mothers from rich households on stunting prevalence. This is despite the decline in teenage pregnancy rate from 18 per cent in 2014 to 15 per cent in 2022. Other factors such as poverty can be attributed to the positive effect in 2022. For example, the percentage of teenage mothers in poorest and poorer households increased from 34.2 per cent in 2014 to 39.4 per cent in 2022, indicating that poverty remains a significant driver of teenage pregnancy.

A mother's highest education level is associated with a reduction in overall and severe stunting prevalence, where prevalence was lower by probabilities of 7.9 and 5.3 percentage points for children with mothers who had attained secondary education in 2014 in comparison to those without education (base category). Similar findings were observed in 2022, where overall and severe stunting prevalence reduced by 2.8 and 2.2 percentage points, respectively, among children with mothers who had attained secondary education. The highest overall stunting reduction was observed in children whose mothers had post-secondary education in 2014 and 2022, respectively. These findings show that maternal education is a significant predictor of stunting in children under five years old. This finding concurs with several empirical evidence, which suggests that an increase in the percentage of women with secondary or higher education significantly decreases all forms of malnutrition, including stunting (Ahmed et al., 2022).

Notably, the probability of overall and severe stunting prevalence reduced in children of mothers who were not employed by 3.4 and 1.3 percentage points in 2014, respectively. These findings are supported by descriptive statistics where the stunting prevalence was higher among children of mothers engaged in subsistence agriculture at 31 per cent. The stunting prevalence for children whose mothers were skilled and unskilled labourers' was at 29 per cent, whereas for mothers working in domestic and household roles the prevalence was at 26 per cent in 2014. The lowest stunting prevalences were observed in children of mothers working in formal employment, such as professional or clerical jobs at 18 per cent while those employed in the services industry had a lower prevalence of 20 per cent, an indication that the sector of employment plays a crucial role in child nutrition outcomes. In particular, the formal forms of work are likely to be associated with provision of supportive interventions, such as parental paid leave. The association between maternal work status and sector of employment highlights the significance of creating decent work opportunities that support maternal and child well-being, including stunting reduction. In assessing the interaction between unemployed mothers from rich households, the study found no significant effect on overall stunting prevalence in both 2014 and 2022.

Income level has significant reduction effects on both overall and severe stunting prevalence in both 2014 and 2022. In 2014 and 2022, overall stunting prevalence was reduced by 5.1 and 7.1 percentage points among children living in rich households compared to those residing in poor households, respectively. Severe stunting prevalence was reduced by 2.9 and 1.6 percentage points among children living

in rich households in 2014 and 2022, respectively. Severe stunting rates increased among children living in urban households by 1.9 percentage points in 2014. Access to improved sources of water led to a reduction in overall stunting prevalence by 4.3 percentage points while the effect on severe stunting prevalence was insignificant in both years. Access to improved sanitation also had protective effect on overall stunting prevalence, resulting in reduced probability of stunting prevalence by 4.0 percentage points in 2014. In 2022, the protective effects of access to sanitation on stunting prevalence were insignificant despite an increase in the proportion of the population that has access to improved sanitation facilities from 46.1 per cent in 2014 to 59.0 per cent in 2022. This implies that the expansion of improved sanitation infrastructure may not be keeping pace with population growth, resulting in a weaker impact on stunting prevalences. In other words, while more people have access to improved sanitation facilities, the quality or effectiveness of these services may not be sufficient to significantly reduce stunting prevalences, particularly in the context of a growing population.

5.2 Drivers of Overall and Severe Stunting Prevalence in Rural and Urban Areas

This section reports marginal effects from the regression results disaggregated by place of residence in 2014 and 2022. In 2014, overall stunting prevalence was exacerbated by the sex of the child. The factors that led to stunting reduction in both rural and urban residences were a child's birth weight, education of the mother, access to improved sources of water and access to improved sanitation (Table 5.2). Overall stunting prevalence was likely to increase among male children living in both urban and rural areas. However, the marginal effect of increased stunting among male children was more pronounced in urban areas by 7.3 percentage points compared to 5.3 percentage points in rural areas. Similar findings were reported in South Africa, where Marais et al. (2022) found that stunting prevalence was higher among male children living in informal urban regions compared to their counterparts in rural areas. This is because urban informal areas have higher levels of socio-economic inequality compared to rural areas, which contributes to disparities in child stunting, including higher stunting prevalences among male children (Hunde, 2022).

In terms of birth weight, normal birth weight significantly led to a reduction in stunting in both rural and urban areas. The probability of stunting prevalence reduced among children born within the normal birth weight range by 53.7 percentage points in urban areas compared to 33.8 percentage points in rural areas in 2014. Interestingly, in 2022, the reduction in stunting among children born within the normal birth weight was 46.5 percentage points in rural areas, which was larger than the reduction effects in 2014, whereas in urban areas, the reduction effects were 43.7 percentage points.

Further, results show that overall stunting prevalence in most cases incrementally reduced among children of mothers with primary, secondary and higher levels of education in both rural and urban areas. In rural areas, a 3.2 percentage point reduction in stunting occurred among children of mothers with primary education, whereas the effect was insignificant in urban areas in 2014. In urban areas, stunting reduction among children of mothers with secondary education was higher by a probability of 9.4 percentage points compared to rural areas at 8.4 percentage points in 2014. In 2022, a reduction in stunting prevalence was also observed at 4.9

Table 5.2: Marginal effects on overall and severe stunting prevalence by place of residence, 2014 and 2022

Variable	Overall stunting urban 2014 (1)	Overall stunting urban 2014 (1)	Overall stunting rural 2014 (2)	Overall stunting rural 2014 (2)	Overall stunting urban 2022 (3)	Overall stunting urban 2022 (3)	Overall stunting rural 2022 (4)	Overall stunting rural 2022 (4)	Severe stunting urban 2014 (5)	Severe stunting urban 2014 (5)	Severe stunting rural 2014 (6)	Severe stunting rural 2014 (6)	Severe stunting urban 2022 (7)	Severe stunting urban 2022 (7)	Severe stunting rural 2022 (8)	Severe stunting rural 2022 (8)
Sex of child (Male=1)	0.073***	0.074***	0.053***	0.053***	0.055***	0.055**	0.073***	0.073***	0.024**	0.024**	0.020**	0.020**	0.003	0.003	0.033***	0.033***
Low birth weight	-0.335**	-0.328**	-0.140	-0.140	-0.275	-0.270	-0.253**	-0.253**	-0.092	-0.089	-0.074	-0.074	-0.204	-0.222	-0.159	-0.159
Normal birthweight	-0.537***	-0.530***	-0.338*	-0.338*	-0.437**	-0.432**	-0.465***	-0.465***	-0.196	-0.193	-0.175	-0.175	-0.249	-0.265	-0.230**	-0.230**
Teenage mothers	0.021	0.024	0.000	0.000	-0.006	-0.006	0.004	0.004	0.007	0.008	-0.046**	-0.046**	0.012	0.013	0.053*	0.053*
Adult mothers	0.010	0.009	-0.012	-0.012	-0.024	-0.024	-0.019	-0.019	0.012	0.011	-0.002	-0.002	-0.008	-0.008	0.000	-0.053*
Primary education	-0.011	-0.011	-0.032*	-0.032*	-0.012	-0.011	-0.019	-0.020	-0.024*	-0.024*	-0.013	-0.012	-0.001	-0.000	-0.022*	-0.022*
Secondary education	-0.094***	-0.095***	-0.055*	-0.055*	0.004	0.004	-0.049*	-0.050*	-0.065***	-0.065***	-0.040**	-0.039**	0.010	0.010	-0.041***	-0.041***
Higher education	-0.091***	-0.094**	-0.081**	-0.081**	-0.046*	-0.045	-0.073**	-0.072**	-0.049***	-0.050**	-0.044**	-0.044**	-0.008	-0.009	-0.067***	-0.067***
Employment status (Mother not working =1)	-0.025	0.030	-0.044**	-0.045*	-0.014	-0.036	-0.016	-0.022	-0.022*	-0.005	-0.006	-0.001	0.001	0.029	-0.012	-0.013
Mother not working*not poor	-	-0.072*	-	0.002	-	0.024	-	0.017		-0.024		-0.020		-0.031		0.004
Improved sources of water	-0.050**	-0.052**	-0.040**	-0.040**	0.009	0.009	-0.016	-0.016	-0.029**	-0.030**	-0.001	-0.002	0.008	0.008	-0.004	-0.004
Improved sanitation	-0.044**	-0.043**	-0.040**	-0.040**	0.013	0.014	-0.034*	-0.034*	0.001	0.001	-0.017*	-0.017	-0.008	-0.009	-0.012	-0.012
Income level (Not poor=1)	-0.030	-0.003	-0.066**	-0.067**	-0.076**	-0.093*	-0.070***	-0.077**	-0.009	-0.001	-0.041***	-0.036**	-0.012	- 0.011	-0.018	-0.020

Significance levels: *p < .05; **p < 0.01;***p < 0.001

Data source: KNBS (2014 and 2022), KDHS

percentage points among children whose mothers had secondary education and living in rural areas. The probability of stunting prevalence reduction among children of mothers with higher education was higher in urban areas at 9.1 percentage points compared to urban regions at 8.1 percentage points in 2014. In 2022, the probability of stunting reduction was 4.6 and 7.3 percentage points in urban and rural areas, respectively.

Similarly, the probability of stunting prevalence reduced by 4.4 percentage points among children of working mothers living in rural areas in 2014. The protective effects of access to improved sources of water were more pronounced in urban areas where it led to 5.0 percentage point reduction, whereas in rural areas access to improved sources of water led to a 4.0 percentage point reduction in stunting prevalence in 2014. Similar findings were observed in access to improved sanitation where stunting reduced by 4.4 and 4.0 percentage points in urban and rural areas, respectively in 2014. In 2022, access to improved sanitation had a protective effect on stunting in the rural population where the probability of stunting prevalence was reduced by 3.4 percentage points in rural households. Household income also had an effect on overall stunting prevalence. In 2022, in rich households, overall stunting prevalence was reduced by 7.6 and 7.0 percentage points in urban and rural areas, respectively.

The drivers of severe stunting reduction in urban areas in 2014 were primary, secondary and higher education attainment, employment status of the mother and access to improved sources of water at 2.4, 6.5, 4.9, 2.2, 2.9 percentage points, respectively, whereas severe stunting prevalence was exacerbated by 2.4 percentage points among male children. In rural areas, the probability of stunting reduction was driven by educational attainment at primary, secondary and higher education, age of the mother, that is teenage mothers, access to improved sanitation and level of household income whereas stunting probability increased among male children by 2.0 percentage points. Notably, in 2022, none of the variables had a significant effect on severe stunting in urban areas. In rural areas, the probabilities of stunting reduction were observed in children born within the normal birth weight, primary, secondary and higher education attainment at 23.0, 2.2, 4.1, and 6.7 percentage points, respectively. The probability of stunting prevalence among children of teenage mothers increased by 5.3 percentage points while that of male children also increased by 3.3 percentage points during the same period.

Conclusion and Recommendations

Reduction in stunting prevalence among children under five years in Kenya is significant and has implications for the country's human capital and economic productivity. Findings from this study show that child characteristics such as sex of the child and birth weight influence stunting prevalence. In both 2014 and 2022, stunting prevalence was higher among male children, with the marginal effects being higher in 2022. Weight at birth also plays a significant role in stunting reduction. Furthermore, from the descriptive statistics, it is observed that male children have higher stunting rates in both rural and urban regions compared to female children. Stunting prevalence was greatly reduced among children born within the normal birth weight; that is >2,500g and those with low birth weight (1,500g-2,499g) compared to those with extremely low and very low birth weights (<1,500g). The level of education of the mother was also found to result in a reduction in stunting prevalence across all regressions. More stunting reduction effects were observed in children of mothers with post-secondary education when compared to other levels of education. Children of teenage mothers were more likely to be stunted in 2022. Stunting reduction was also observed among children of non-working mothers, highlighting a complex interplay between maternal employment and child nutrition outcomes. From the descriptive statistics, there was higher stunting prevalence among children of mothers working in the agricultural sector and manual labourers. This is because agricultural work involves long hours of work, unpaid leave, non-adherence to minimum wage, inadequate access to social protection, and low unionization, which can lead to reduced access to basic needs such as adequate food and healthcare services, which exacerbates stunting in children. Severe stunting prevalence increased in urban areas compared to rural areas in 2014. Both overall and severe stunting prevalence reduced among children from non-poor households. This is supported by descriptive statistics that indicate that stunting prevalence is higher among children from lower-income households compared to wealthier households. Finally, the effect of access to improved sources of water and sanitation was negative, thus they have protective effects on stunting reduction among children.

To enhance stunting reduction, there is need to:

1. Reduce the incidence of low birth weight by ensuring pregnant women receive early and regular prenatal care and providing nutritional support such as folic acid and iron.
2. Develop and implement specialized child health and nutrition-targeted nutrition programmes for infants born with low or very low birth weights to

ensure they receive adequate nutrition care and gender-specific nutritional support targeting male children who are more susceptible to stunting.

3. Enhance not only maternal education to improve the knowledge and skills of mothers on nutrition, childcare, and health practices but also access to child services for working mothers. This can be done through:
   (i) Expanding access to education for girls and women, focusing on secondary and higher education.
   (ii) Enhancing access to prenatal and postnatal care information using community health promoters (CHPs). This can be done in collaboration between the national government and county governments in the mobilization of community health promoters (CHPs).
   (iii) Strengthen community engagement and use media campaigns through local leaders and health workers to raise awareness on malnutrition, its causes, and preventive measures.
4. Strengthen the implementation of existing workplace policies for maternal and child health, such as paid maternity leave, flexible working hours, and breastfeeding-friendly environments.
5. Improve conditions in agricultural and manual labour sectors by developing and implementing policies that promote workers welfare, such as decent work conditions, including adherence to minimum wage laws and access to social protection to ensure income stability for households, improving their ability to afford adequate food and healthcare.
6. Improve access to water and sanitation facilities by investing in infrastructure to ensure all households have access to improved water sources and sanitation facilities and promote hygiene education campaigns to encourage practices that reduce the risk of infections and diseases.

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Appendix

Appendix 1: Descriptive statistics, 2014

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Stunting	18,656	26	44	0	1
Severe stunting	18,656	8	27	0	1
Sex of the child	18,656	51	50	0	1
Age of the child (months)	18,656	29	17	0	59
Birth weight	5,320	3260	634	600	6700
Age of the mother	9,039	29	6	15	49
Mother's highest level of education	18,656	2	1	1	4
Employment status	8,998	1	0	0	1
Sector of employment	5,669	3	1	1	5
ANC4+ visit	18,656	0	0	0	1
Place of residence	18,656	34	47	0	1
Wealth quintile	18,656	3	1	1	5
Access to improved sources of water	18,059	65	48	0	1
Access to improved sources of sanitation	18,264	46	50	0	1

Data source: KNBS (2014 and 2022), KDHS

Appendix 2: Descriptive statistics, 2022

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Stunting	17,327	18	0	0	1
Severe stunting	17,327	4	0	0	1
Sex of the child	17,327	51	0	0	1
Age of the child (months)	17,327	28	17	0	59
Birth weight	4,363	3202	593	600	6000
Age of the mother	9,121	29	6	15	49
Mother's highest level of education	17,327	2	1	1	4
Employment status	17,182	1	0	0	1
Sector of employment	17,327	3	2	0	1
ANC4+ visit	8,611	2	1	1	5

Place of residence	17,327	35	48	0	1
Wealth quintile	17,327	3	1	1	5
Access to improved sources of water	16,742	68	47	0	1
Access to improved sources of sanitation	16,894	65	48	0	1

Data source: KNBS (2014 and 2022), KDHS

Appendix 3: Stunting prevalences by county

County	**2014**		**2022**	
	Overall stunting prevalences	Severe stunting prevalences	Overall stunting prevalences	Severe stunting prevalences
Baringo	30	9	20	4
Bomet	35	11	24	5
Bungoma	24	6	19	3
Busia	21	4	16	2
Elgeyo Marakwet	31	7	21	3
Embu	27	6	19	6
Garissa	16	6	10	1
Homa Bay	19	4	11	2
Isiolo	20	5	13	4
Kajiado	18	7	15	5
Kakamega	28	12	12	1
Kericho	30	11	20	3
Kiambu	16	4	15	4
Kilifi	39	12	37	14
Kirinyaga	17	3	11	2
Kisii	26	8	17	4
Kisumu	19	7	9	1
Kitui	46	13	23	7
Kwale	29	10	23	6
Laikipia	26	7	12	2
Lamu	28	7	15	3
Machakos	26	8	14	3
Makueni	25	7	21	4
Mandera	35	18	20	6
Marsabit	27	11	20	5
Meru	27	7	26	4
Migori	27	10	14	2
Mombasa	21	7	13	3
Murang'a	19	4	8	1
Nairobi	18	4	12	2

Nakuru	28	7	19	6
Nandi	30	8	16	2
Narok	33	9	20	3
Nyamira	26	10	15	3
Nyandarua	28	7	19	3
Nyeri	16	6	12	2
Samburu	31	9	31	9
Siaya	24	7	20	6
Taita Taveta	23	5	17	4
Tana River	29	10	20	5
Tharaka	34	7	20	3
Trans Nzoia	28	9	21	5
Turkana	23	6	22	7
Uasin Gishu	31	11	14	2
Vihiga	24	6	16	4
Wajir	26	10	12	4
West Pokot	47	19	34	10