Discussion Paper Series

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

Socio-Demographic Effects of Child Stunting in Arid and Semi-Arid Regions of Kenya

Elizabeth Mang'eni and Jedidiah Muriithi Maitai

DP/319/2023

THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

YOUNG PROFESSIONALS (YPs) TRAINING PROGRAMME

Socio-Demographic Effects of Child Stunting in Arid and Semi-Arid Regions of Kenya

Elizabeth Mang'eni and Jedidiah Muriithi Maitai

Kenya Institute for Public Policy Research and Analysis

KIPPRA Discussion Paper No. 319
2023

KIPPRA in Brief

The Kenya Institute for Public Policy Research and Analysis (KIPPRA) is an autonomous institute whose primary mission is to conduct public policy research leading to policy advice. KIPPRA's mission is to produce consistently high-quality analysis of key issues of public policy and to contribute to the achievement of national long-term development objectives by positively influencing the decision-making process. These goals are met through effective dissemination of recommendations resulting from analysis and by training policy analysts in the public sector. KIPPRA therefore produces a body of well-researched and documented information on public policy, and in the process assists in formulating long-term strategic perspectives. KIPPRA serves as a centralized source from which the Government and the private sector may obtain information and advice on public policy issues.

Published 2023

Bishops Garden Towers, Bishops Road
PO Box 56445-00200 Nairobi, Kenya
tel: +254 20 2719933/4; fax: +254 20 2719951
email: admin@kippra.or.ke
website: http://www.kippra.org

ISBN 978 9914 738 44 5

The Discussion Paper Series disseminates results and reflections from ongoing research activities of the Institute's programmes. The papers are internally refereed and are disseminated to inform and invoke debate on policy issues. Opinions expressed in the papers are entirely those of the authors and do not necessarily reflect the views of the Institute.

This paper is produced under the KIPPRA Young Professionals (YPs) programme. The programme targets young scholars from the public and private sector, who undertake an intensive one-year course on public policy research and analysis, and during which they write a research paper on a selected public policy issue, with supervision from senior researchers at the Institute.

Abstract

Maternal and child health (MCH) is a global priority, yet child stunting remains a significant concern particularly in arid and semi-arid regions of Kenya. This study investigated the socio-demographic factors influencing child stunting, examining child-specific attributes, household features, and community factors. The study was informed by the Theory of Human Capital Expenditure and Household Production Framework. The main data source was the Kenya Demographic and Health Survey 2022 (KDHS 2022). The study adopted the Ordinary Least Squares and the binary choice model. The analysis revealed associations between socio-demographic factors and child stunting. Longer breast feeding duration exhibited a significant positive correlation with stunting, while higher birth weight demonstrated a positive effect on reducing the likelihood of stunting. Younger maternal age and higher numbers of children under 5 years in households showed an increased likelihood of stunting. Notably, education and antenatal visits had a positive impact on reducing the prevalence of stunting. However, sanitation and water improvements showed inconsistent and insignificant effects on stunting across models. To address child stunting, it is important to encourage longer breast feeding periods for healthy child growth. Initiatives focused on maternal health during pregnancy may lead to increased birth weights and subsequently reduce stunting. The strategies targeting younger mothers and households with multiple young children are crucial. Improving maternal education and healthcare services, especially in high-stunting regions, could be beneficial in improving the health of children. While findings regarding water and sanitation were inconclusive, integrated programmes promoting proper sanitation habits and safe water access are suggested. This study underscores the multifaceted nature of child stunting in arid and semi-arid lands (ASALs) and proposes targeted interventions to mitigate its prevalence. Understanding socio-demographic factors influencing stunting is critical in formulating effective policies and interventions to improve child health outcomes in these vulnerable regions.

Abbreviations and Acronyms

ANC	Antenatal Clinics
ASALs	Arid and Semi-Arid Lands
MCH	Maternal and Child Health
WHO	World Health Organization
LBW	Low Birth Weight
UNICEF	United Nations International Children's Emergency Fund
KNBS	Kenya National Bureau of Statistics
KDHS	Kenya Demographic Health Survey

Table of Contents

List of Tables

List of Figures

1. Introduction

Maternal and child health (MCH) is a critical global priority that has garnered attention for many decades. The well-being of mothers and children during pregnancy, childbirth, and the postnatal period has far-reaching implications for both individuals and societies. Maternal health refers to the health and well-being of women during pregnancy, childbirth, and the postpartum period (WHO, 2023). Maternal health involves physical health, mental, emotional, and social well-being. Healthy pregnancies and safe deliveries contribute to reducing maternal mortality rates and improving the overall health of mothers. Adequate nutrition, vaccination and access to essential healthcare services are pivotal in reducing child mortality rate and fostering healthy development. MCH initiatives reduce maternal mortality, ensure safe childbirth practices, prevent infant and child deaths, promote healthy growth and address health issues (Elmusharaf et al., 2015).

Anthropometry finds frequent application in assessing the nutritional status of children. Anthropometric measurements are employed to report indicators of child growth (Ferreira, 2020). In children, the measurements estimate body fat, lean body mass, and assess their distribution and change over time. They encompass weight, height, body mass index, specific skinfold thicknesses, waist-to-hip ratio and the body circumferences of the head, waist, hip, and arm. Inadequate diets are associated with low body fat stores and growth failure of children. Three extensively recognized indicators of children's nutritional status are stunting, which indicates chronic malnutrition (height-for-age), wasting a sign of acute malnutrition (weight-for-height) and underweight (weight-for-age), which is chronic and acute malnutrition (WHO, 2006). Stunting is one of the measures of malnutrition in childhood, a predictor for long-term morbidity and mortality, and has long-term societal costs. A child is stunted if their height for age is over two standard deviations below the median of the World Health Organization (WHO, 2015).

Stunting is influenced by social, economic, nutritional, and environmental factors, which include socio-economic inequality, geographic differences, feeding practices, food insecurity, micronutrient deficiencies, education and awareness, childhood morbidity and infections. If stunting persists for 2 years in children, it leads to irreversible impairments in brain and physical growth, resulting in poor cognitive outcomes and economic repercussions. This condition diminishes productivity and limits children's cognitive potential. Stunted children are too short for their age, and brains may never develop to full cognitive potential. Stunting hinders children's ability to learn, which reduces education performance, increases the risk of non-communicable diseases, and leads to reduced productivity, thus diminishing their contribution to the economy later.

The period after childbirth is a critical time for ensuring both the mother's recovery and the newborn's health and development. Postnatal care provides an opportunity to monitor the health and well-being of mother and the newborn (WHO, 2014). Through regular check-ups, healthcare providers identify potential issues that affect the child's growth and development, such as infections, malnutrition, and complications related to childbirth. Postnatal care ensures that any signs of infections, such as fever and respiratory issues are addressed and the visits also provide an opportunity to educate mothers about proper newborn care, hygiene practices, and recognizing signs of illness. Proper and early initiation of breast feeding is crucial for providing newborns with nutrients, antibodies that promote healthy growth and reduce the risk of stunting. Knowledgeable mothers are better equipped to provide care, nutrition, and hygiene, which are essential for preventing stunting. Mothers' access to nutrition and health-related information is critical for improving dietary quality and nutritional outcomes (Ngigi and Mwange, 2023).

A high level of malnutrition in a country reflects children's low nutritional status and health under five years (Forh et al., 2022). Therefore, recognizing the factors linked to malnutrition is crucial for averting long-term negative consequences. The current study is aimed at identifying socio-demographic factors associated with malnutrition in children under 5 years old, with the aim of informing public health interventions.

The objective of this study is to analyze the role of social demographic factors in child stunting in ASALs. The specific objective is to explore the influence of social demographic factors on child stunting in ASALs. By addressing this objective, the study aims to provide valuable insights into the specific factors contributing to child stunting in ASALs, thereby informing potential interventions and policies tailored to the demographic characteristics of the population in these areas.

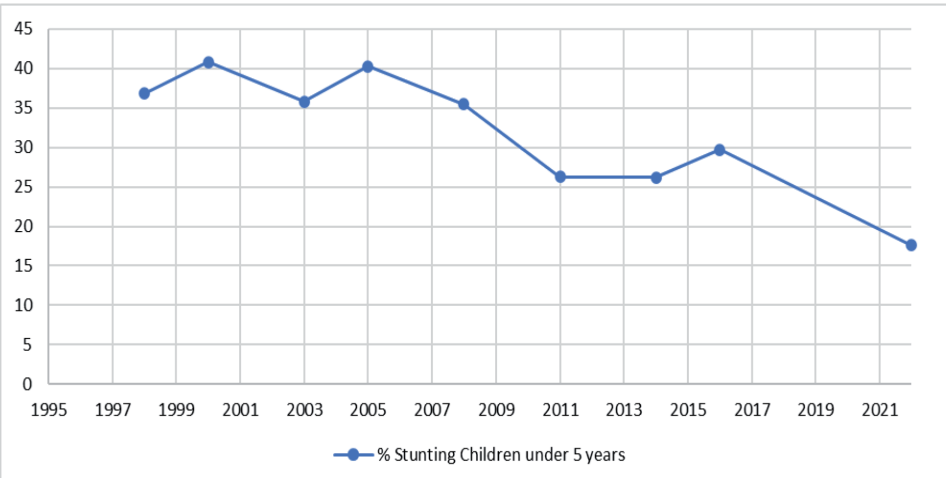
The rest of the paper is organized as follows: section 2 introduces the situational analysis of stunting in the country; section 3 presents the literature review; section 4 discusses data and methodology. Results are discussed in section 5 while section 6 concludes the study.

2. Situation Analysis of Child Stunting in Kenya

Over the last decade, stunting has been declining steadily with 148.1 million, which is around 22.3 per cent, of children under age 5 worldwide affected. In 2022, two out of five children under 5 affected by stunting lived in Africa, which was 43 per cent of the global share (UNICEF, WHO and World Bank, 2022). Children in low-income countries are more likely to lose their lives before age five compared to children in high-income countries because of malnutrition, which is a public health issue. The World Health Assembly in 2012 prioritized reduction of stunting by 40 per cent among the global targets for maternal, infant, and young child nutrition to be achieved by 2025. However, Africa still lags with high levels of stunting and other forms of undernutrition (WHO and UNICEF, 2020).

There has been progress towards achieving the low-birth-weight target, with 11.5 per cent of infants that have low birth weight. Kenya is making significant strides towards achieving an exclusive breast feeding target, with 61.4 per cent of infants aged 0 to 5 months being exclusively breast fed. Additionally, Kenya is on track to meet the stunting target, as stunting rate declined from 26.2 per cent among children under 5 years in 2014 to 18.0 per cent in 2022, which is lower than the Africa region's average of 30.7 per cent. Over the years, Kenya has reduced malnutrition among children under 5 years. Stunting prevalence has steadily decreased since 1998, with the most significant drop occurring between 2008 and 2014, reaching just 18 per cent in 2022, as illustrated in Figure 2.1. This was associated with improved access to maternity care, feeding practices and reduced incidence of diseases (Buisman, 2019).

Figure 2.1: Prevalence of child stunting in Kenya

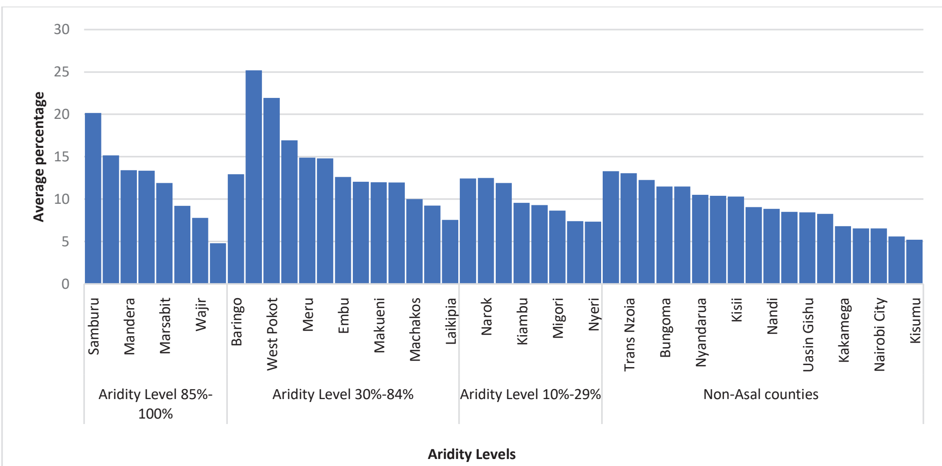


Data Source: KNBS (2022), Kenya Demographic Household Survey

Governments provide guidelines to promote healthy eating habits, prevent diseases, recommend intakes of different nutrients, advise on balanced diets, and guide on food choices. The first Sustainable Development Goal envisages safe, nutritious, and sufficient food to end hunger particularly in vulnerable situations, including infants. The Africa Union Agenda 2063 envisions wealthy and well-nourished citizens while ensuring healthy lives and promoting well-being. The Kenya Health Policy gives directions to ensure significant improvement in the health status in line with the Constitution of Kenya 2010 and the Kenya Vision 2030. In Food and Nutrition Security Policy 2011, Kenyans are to have access to safe food of sufficient quantity and quality to satisfy their nutritional needs for optimal health.

There are geographic and socio-demographic variations in the severity of malnutrition in Kenya. Out of 47 counties, 19 per cent experience a stunting prevalence of over 30 per cent, a level categorized as severe and of public health concern (KIPPRA, 2023). The ASALs make up 89 per cent, with approximately 38 per cent of Kenya's population covering 29 counties and a population of about 16 million people (Michael, 2016). The ASALs face challenges that contribute to high rates of malnutrition, including limited access to nutritious food, poor water and sanitation facilities, inadequate healthcare services and droughts. Despite stunting in Kenya having decreased over the years, more than 10 counties, namely Kilifi, West Pokot, Samburu, Meru, Kitui, Turkana, Kwale, Elgeyo Marakwet, Narok, Bomet, Tharaka Nithi, Trans Nzoia, Baringo, Tana River, Embu and Makueni have stunting rates above 20 per cent, with a wide variation in ASALs. The counties with the lowest stunting percentage include Garissa and Kisumu, which were at 9 per cent. Malnutrition continues to pose a challenge with rates being high within ASAL counties. The highest percentages of chronic stunting were witnessed in Kilifi, which recorded an average of 25 per cent, West Pokot 22 per cent and Samburu 20 per cent (KNBS, 2022) as shown in Figure 2.2 below.

Figure 2.2: Average percentage of moderate and severe stunting rates in Kenya



Data Source: KNBS (2022), Kenya Demographic and Health Survey

About 22 per cent of children born to mothers with no education were stunted, compared with 9 per cent of children born to mothers with more than secondary education (KNBS, 2022). At around the age of 6 months, an infant's need for nutrients starts to exceed what is provided by breast milk, and complementary foods are necessary to meet these needs. If complementary foods are not introduced around the age of 6 months, or the foods are given inappropriately, an infant's growth may falter (WHO, 2021).

Poor childcare practices and environment, morbidities and inadequate access to care services continue to impact negatively on the health and nutrition situation in arid counties. The estimated number of children 6 to 59 months requiring treatment of acute malnutrition is 541,309, severe acute malnutrition is 113,941 and moderate acute malnutrition is 427,368 while 30,712 pregnant lactating women require treatment in arid areas. Mortality rates among infants and under-five have also improved over time in Kenya. However, the prevalence of stunting among children under five years was 18 per cent in 2022, representing a significant decrease from 35 per cent in 2008/09. This indicates a reduction in chronic undernutrition. Moreover, 80 per cent of children aged 12-23 months received all basic vaccinations in 2022.

3. Literature Review

3.1 Theoretical Foundation

There are two main theories underpinning this study, which are the Theory of Human Capital Expenditure and the Household Production Framework.

3.1.1 Theory of Human Capital

Adam Smith (1973) initiated an improvement in human capability that is important to production. Human capital was later introduced by Theodore W. Schultz (1961), called investment in human capital. Gary Becker later initiated "human capital theory", stating that individuals make investments in their education and skill development, which is much like investing in physical capital (Becker, 1965). To most people, capital means assets that yield income and other useful outputs over extended periods of time. Becker (1965) confirms that such tangible forms of capital are not the only type of capital, but education, training, and health are also investments in human capital. Unlike financial and physical assets, which can be detached from individuals, people remain inseparable from their knowledge, skills, health, and values. Later, Thomas Davenport (1999) advanced that the component of human capital consisted of abilities, knowledge, skills, personal talent, behaviour, and effort plus time.

Human capital theory acknowledges the significant impact of families on the development of their children's knowledge, skills, health, values, and habits. Poor health in childhood depresses the formation of human capital. This is because much of a person's physiological and cognitive development happens in childhood, and human capital investments need to be made early in life. From the moment of birth until the age of five, children begin constructing a fundamental groundwork upon which their future development rests. Home environment wields a powerful influence over a child's readiness for learning later in life. During the preschool years, families make investments that can be likened to nurturing "childhood capital", and these investments establish the backdrop against which schools educate students more effectively, shape the ability to learn on the job as individuals enter the workforce, and facilitate various forms of learning throughout their lives (Thomas, 1999).

3.1.2 Household Production Framework

Becker's (1965) household production model posits that a household is both a producing and a consuming unit. The consumer has a utility function that depends on household produced goods and services, and time spent in leisure activities. The Household Production framework considers households as units of production responsible for generating both market and non-market goods and services (Strauss and Thomas, 1995). Goods and services are produced by household members, for their own consumption, using their capital and their unpaid labour. Goods and services produced by households for their own use include accommodation, meals, clean clothes, and childcare. The process of household production involves the transformation of purchased intermediate commodities into final consumption commodities.

The formal elements of the Becker model include a utility function:

$$u = f\ [(hhproducedgoods), (leisuretime)] \ldots\ldots\ldots\ldots (1)$$

The consumer maximizes utility subject to a household (hh) production function:

$$hh\ goods = g[(timeinhhproduction), (marketgoods), (humancapital)] \ldots\ldots\ldots (2)$$

Households are viewed as producing the health, educational, cognitive, and socio-emotional outcomes for their children by the application of inputs. These inputs include nutritional intake, medical, schools, educational materials, extra tutoring in school, housing, neighbourhood environment, parents' time and supervision, siblings' input, relatives and peers, and other cognitive stimulation. Family stability and location stability serve as environmental inputs. The education of parents or guardians in the family is postulated as an environmental variable that increases efficiency of the production function. The model exogenously determines the educational level of parents/guardians.

3.2 Empirical Literature

Strauss and Thomas (1995) outline the relationship between child growth and child, maternal and household resources. Child health is generated by biological production function in which input allocated, such as nutrient intake and care is because of decisions in the household. At a future date, children may contribute to household income by providing labour time, remittances, and other transfers. These contributions are the expected wages that vary by sex, age and health, which are linked to cultural factors or community characteristics. Measuring height, weight, and mortality has proven indispensable in establishing strong evidence for a positive correlation between household resources and health outcomes as demonstrated by Strauss and Thomas. However, these restrict insights into the well-being of individuals not at the lower extremes of the distribution, such as those stunted, wasted, or deceased.

Pitt and Rozenzweig (1997) review approaches to estimating the demand for goods within the household conditional on some individual or household-specific endogenous choice and suggest cross-person restrictions on demands within the household as one possible direction. The cross-person restriction is used on regression parameters to estimate the effect of infant illness on the time allocation of the male and female teenage siblings and the mother of the infant.

Sahn and Stifel (2003) show that income is generally the measure of choice in developed countries while the preferred metric in developing countries is an aggregate of a household's consumption expenditure. Their study shows that the asset index is an important measure of wealth as it ranks children according to their well-being and takes into account the household endowment of income factors. An asset-index approach to the measuring of poverty is one alternative to income or consumption and expenditure. This approach, despite lacking data on income, consumption, and expenditure, collects information on ownership of assets such as car, refrigerator, television, radio and bicycle, among others, and housing characteristics, which includes roofing/wall material used, toilet facilities, access to basic services such as electricity and source of drinking water.

Human capital (Thomas Davenport 1999) encompasses knowledge, experience, trained skills, endowed abilities, attitudes, and behaviour, later he added time. Individuals are required to engage with work and commit to the organization if effective utilization of human capital is to happen. Furthermore, Thomas et al. (2013) proposed the method to measure human capital by using human capital dashboards to monitor by separating measurement into three types. First, measure every possible measurement, namely headcounts, turnover, promotions, trend lines, data from the primary human resource information systems (HRIS), and data quality issues. Second, measurement is a simplification and expansion, which includes focusing on select metrics, improved data quality, data from HRIS and supplemental databases such as recruiting, payroll, and engagement surveys. Lastly, the third consists of operational data integrations, which are data from non-HR sources such as finance, marketing, quality control and metrics such as revenue per employee, value added per employee and customer service levels.

The socio-demographic and environmental determinants of under-5 stunting in the Rwanda study (Chester et al;, 2023) assessed individual and community-level determinants of under-5 stunting essential for designing appropriate policy and programme responses for addressing stunting in Rwanda. A cross-sectional study was conducted in five districts of Rwanda, where 2,788 children and their caregivers were enrolled in the study and data on the individual level and community-level variables were collected. A multilevel logistic regression model was used to determine the influence of individual and community-level factors on stunting. Stunting prevalence was 31.4 per cent. Additionally, male gender, age above 11 months, child disability, more than six people in the household, having two children below the age of five, a child having diarrhea before the study, eating from their own plate when feeding, toilet sharing, and open defecation increased child stunting. The socio-demographic and environmental factors were found to be significant determinants of childhood stunting in Rwanda. Therefore, interventions to address under-five stunting require addressing individual factors at household and community levels to improve the nutritional status and early development of children.

Sari et al. (2017) analyzed the factors that influence stunting cases in toddlers in Banjarmasin. The research used case control with 190 toddlers as the sample consisting of 74 stunting children under five and 116 toddlers with stunting, and was analyzed using Chi-Square test. The results showed that there was a correlation between birth weight and stunting in infants; there was a correlation between gestational age and stunting incidence in children under five. Whereas exclusive breast feeding was not related to stunting incidence in under-five children and there was no association of basic immunization status with stunting incidence. The study concluded that low birth weight infants, pre-term gestational age and less than normal birth weight were the factors that influenced stunting cases, while the history of exclusive breast feeding and primary immunization had no relationship with the incidence of stunting.

Kabubo-Mariara et al (2008) carried out a study on the determinants of children's nutritional status in Kenya. They investigated the impact of child, parental, household, and community characteristics on children's height and on the probability of stunting. Descriptive and econometric analysis, supplemented by policy simulations, was employed to achieve the study objectives. The results from the study indicated that maternal education is a more important determinant of children's nutritional status than paternal education. Household assets are also important determinants of children's nutritional status, but nutrition improves at a decreasing rate with assets. Policy simulations affirmed the potential role of parental, household, and community characteristics in reducing long-term malnutrition in Kenya and suggested that a correct policy mix would make a substantial reduction in the current high levels of malnutrition.

The prevalence of stunting in young Indonesian children is the highest among countries belonging to the Association of Southeast Asian Nations (Hamam et al., 2021). Breast fed children were reported to grow better than non-breast fed children. The study examined the protective effect of exclusive breast feeding against stunting in children under two years old and its interaction with monthly household expenditure. Secondary analyses were conducted based on a 2012 cross-sectional study including 408 children aged 6-24 months and their caregivers. Data on breast feeding history, child care, and household expenditures were collected using structured questionnaires. Focus Group Discussions were conducted to caregivers who identified as the biological mother exclusively breast fed their child at 6 months. Exclusively breast fed from poorer households were 20 per cent less likely to be stunted than their non-exclusively breasted peers. Further, exclusively breast fed children from wealthier households were 50 per cent less likely to be stunted than non-exclusively breast fed from poorer households. Exclusive breast feeding may protect low-income children against stunting.

A study on investigating birth weight and its correlates in Kenya in the early 1990s (Mwabu, 2008) used data from a sample of over 10,000 households by the Kenya National Bureau of Statistics and the Ministry of Planning and National Development. The analytic sample consisted of mothers with children aged 1-5 years and the unit of observation was a child aged 1-5 years. The information available for each child was weight and sex, and parents' characteristics such as age and education. The findings indicate that immunization of the mother against tetanus during pregnancy was strongly associated with improvements in birth weight. The factors significantly correlated with birth weight include age of mother at first birth and birth order of siblings. Mwabu (2008) further found out that birth weight is positively associated with mother's age at first birth and with higher birth orders, with the firstborn child being lighter than subsequent children. Infants born in urban areas are heavier than those from rural areas and females are lighter than males. Lastly, a baby born at a clinic is heavier than a newborn baby drawn randomly from the general population.

Prayudhy and Mei Ahyant (2022) studied the risk factors of stunting in children of age 6-59 months in the horticultural areas where a case control study was conducted to compare stunted children and non-stunted children. A case control study was conducted to compare stunted children and non-stunted children. Measurements and interviews were conducted with 160 participants, including mothers or caregivers. SPSS was used for $\chi 2$ statistical analysis, multiple logistic regression, and odds ratios. The study found four factors associated with stunting; length at birth, LBW, protein intake and access to sanitation, which indicated malnutrition during pregnancy. Therefore, it needs intervention and nutrition programmes for pregnant women and empowerment of women in families to affect household access to resources.

Darteh et al. (2014) collected data on the stunting of children by measuring the height of all children under six years of age. A measuring board was used to obtain the height of the children. Children under 2 years of age were measured lying down on the board while those above 2 years were measured standing. A z-score was given for the child's height relative to the age in the DHS data. Both bivariate and multivariate statistics are used to examine the correlates of stunting. Stunting was more common among males than females. The age of child was a significant determinant of stunting, with the highest odds of stunting being among children aged 36-47 months. The number of children in households was significantly related to stunting and children in households with 5-8 children were 1.3 times more likely to be stunted compared to those with 1-4 children. Lastly, the mother's age was a significant predictor of stunting, with children whose mothers were aged 35-49 years being more likely to be stunted.

Batool et al.(2021) carried out a secondary analysis of the Pakistan Survey with 1,072 children aged 3 years. The relationship between breast feeding duration and undernutrition status was estimated through multiple logistic regression analysis. Breast feeding in the 2^{nd} and 3^{rd} year of life was found to have significant relationship with stunting and severe stunting. The study confirmed that breast feeding duration has a significant association with stunting and severe stunting but does not seem to have any significant relationship with wasting and severe wasting and undernutrition or severe undernutrition.

Esfarjani et al. (2013) carried out a case-control study of 3,147 school children selected by multistage cluster random sampling method. Anthropometric measurements were done. Eighty six (86) stunted children were identified and considered as case groups. After matching for age, sex, and residence area, 308 non-stunted children were randomly selected as a control group. Stunting was prevalent among 3.7 per cent of the study population, children with a birth weight of >3000g were less likely to be stunted (OR: compared with those with a birth weight of <3000g). Being born to older mothers (>35 years) was associated with greater odds of being stunted compared with being born to younger mothers (<35 years). Those with fathers' height of >160 cm were also less likely to be stunted than those whose fathers' height was less than 160 cm. The birth weight, maternal age and fathers' height were found to be major contributing factors to stunting in this group of Iranian children.

Kuht and Sebastian (2017) used nationally representative health and welfare data from 193 Demographic and Health Surveys conducted between 1990 and 2013 from 69 low-income and middle-income countries for women of reproductive age (15-49 years), their children and their respective households. The analytical sample consisted of 752,635 observations for neonatal mortality, 574,675 observations for infant mortality, 400,426 observations for low birth weight, 501,484 observations for stunting and 512,424 observations for underweight. At least one ANC (Antenatal Clinics) visit was associated with a reduced probability of neonatal mortality and lower probability of infant mortality. Having at least four ANC visits, and visiting a skilled provider at least once reduced the probability. At least one ANC visit is associated with reduced probability of giving birth to a low birth weight baby.

Musbah and Worku (2016) carried out a study whose objective was to assess the magnitude of stunting among children less than five years of age and to explore its association with maternal education in SNNPR, Ethiopia. Pre-tested standardized questionnaires and trained data collectors were used. Descriptive, binary, and multiple logistic regression analyses were performed using the Statistical Package for Social Sciences (SPSS) version 20.0 (SPSS Illinois, Chicago). The prevalence of child stunting was 39.1 per cent in SNNPR. Child age, maternal education, household wealth index, maternal autonomy, maternal BMI, and mother's height were independent predictors of child stunting. Mothers who completed secondary and above schooling were 52 per cent less likely to have stunted children than mothers who had never attended any formal schooling. Child stunting is still a public health problem in the region. Women empowerment, maternal education, and a multi-sector approach were recommended.

A study employed by Laksono et al. (2022) used secondary data from the 2017 Indonesia Nutritional Status Monitoring Survey. The unit of analysis was children under two years, and the study obtained weighted samples of 70,293 children. Besides maternal education, other independent variables analyzed in this study were residence, maternal age, maternal marital status, maternal employment, children's age, and gender. The study occupied a multivariate test by binary logistic regression test. The results showed the proportion of stunted children under two years in Indonesia nationally was 20.1 per cent. Mothers in primary school and under education categories were more likely than mothers with a college education to have stunted children under two years. Meanwhile, mothers with a junior high school education had a higher chance than mothers with a college education to have stunted children under two years. Moreover, mothers with education in the senior high school category had more chances than mothers with a college education to have stunted children under two years.

4. Methodology

4.1 Theoretical Framework

Stunting is defined as height for age z-score <-2 standard deviations using the WHO growth standards. Furthermore, using WHO classifications, children with height for age z-score of ≤-2 standard deviations and ≥-3 standard deviation are classified as moderately stunted while those with height for age z-score <-3 standard deviations are classified as severely stunted. It is measured using a specific indicator called Height-for-Age (HAZ) or Height-for-Age Z-score.

This study is underpinned on the Theory of Human Capital Expenditure, which posits that individuals make investments in their education and skills development while the Household Production Framework considers households as units of production responsible for generating both market and non-market goods and services.

The fundamental premise of the model is that households allocate their resources and time to produce various goods and services, some of which are traded in markets, some consumed within the household, and some not exchangeable in any market. These households are driven by preferences represented by a utility function denoted as U, contingent on the consumption of a set of commodities, X, and a leisure vector, L.

$$U = u(X, L) \tag{1}$$

The production of consumer goods is influenced by a set of resources available to the household. The household optimizes its consumption by considering the available resources and a financial constraint, which ensures that total consumption, including the value of leisure time, does not exceed total income. This optimization process involves selecting the most beneficial combination of goods and services to maximize utility within budgetary constraints. Strauss and Thomas (1995) demonstrate the possibility to adapt the household model to encompass human capital outcomes by relaxing the assumption of perfect interchangeability between goods produced within the home and those available in the market. This adaptation is warranted because, in real-life scenarios, many human capital outcomes cannot be acquired through market transactions. Furthermore, the household production framework readily lends itself to the incorporation of biological, demographic, and economic factors.

Child nutrition is an outcome that originates from a biological production process, wherein various inputs such as nutrient intake and overall care are determined by decisions made within the household. Households strive to optimize child nutrition within the limitations imposed by their available resources and information. To construct a model for child nutrition, Equation 1 is adjusted to incorporate the aspect of promoting child growth (*N*). This adjustment assumes that maintaining a favourable nutritional status is valuable, and households make consumption choices influenced by factors beyond just child growth (Pitt and Rozenzweig, 1995). Equation 1 can therefore be modified to:

$$U = u\ (X, L, N) \quad (2)$$

The associated financial constraint can likewise be adjusted to encompass contributions to a child health production process. Subsequently, the constrained utility function is solved to determine the most favourable quantities of child nutrition that can be provided to the market. In line with insights drawn from existing literature and empirical findings (Strauss and Thomas, 1995; Thomas et al., 1996), the simplified nutritional production model enables us to derive the following equation for each child:

$$Ni = f\ (Wi, Hj, Zk, \varepsilon i) \quad (3)$$

N represents an indicator of a child's nutritional well-being, with two metrics applied: height-for-age scores and the probability of experiencing stunted growth. *W* denotes a set of child-specific attributes for child *i*, encompassing factors such as age, birth order, gender, and whether the child is part of multiple births or a singleton. *H* constitutes a collection of household-specific features for household j, which includes parental characteristics such as the mother's height, parental age, educational background, household's structure such as the proportion of adult women and household size and its assets, in line with the approach of Sahn and Stifel (2002b). *Z* is a compilation of community-level characteristics for community k, designed to capture access to public healthcare services, water resources, and sanitation facilities, building upon the insights of Strauss and Thomas (1995). *ε* is the child-specific disturbance term.

4.2 Model Specification

The study adopts a binary choice model. In this model, the authors rely on the WHO threshold for stunting to construct a categorical variable with two choices. The first category relates to children under 5 whose height-for-age falls below two standard deviations (or -2 SD) from the median of the WHO Child Growth Standards. Children in this category are considered stunted whereas the second category encompasses children considered not stunted (height-for-age >-2SD). Probit estimation criteria was utilized to determine the effect of selected regressors on stunting. In general, the binary choice models can be expressed as:

$$Pr\ Pr\ (x) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_1 x_k) \quad (4)$$

Equation 4 can be compactly written as:

$$Pr\ Pr\ (x) = G(x\beta) \quad (5)$$

The values for G are by default restricted between 0 and 1. More so, in the probit model, G denotes the standard normal cumulative distribution function. For simplicity, the probit model is often expressed as:

$$Pr\,Pr\,(x) = \phi(x\beta) \tag{6}$$

Equation 6 is an equivalent of equations 4 and 5 but specific to the probit model. Herein, x represents a vector of independent variables with their corresponding coefficients denoted by β whereas y is the probability of observing a dependent variable given independent variables. Specific to this study, y as illustrated in equation 6 represents the probability of a child below 5 years being stunted given selected child and household-specific attributes. The child-specific attributes include exclusive breast feeding, month of breast feeding and weight at birth. On the other hand, household-specific features include mother's age, mother's level of education, number of children under 5 in the household, age of the mother at first birth, mother's residence, antenatal visits and access to improved sanitation. In the estimation, antenatal visits and education of the mother are interacted to generate the variable used in the model. This interaction assumed that educated mothers are more likely to make more ANC visits compared to their non-educated counterparts.

To enhance robustness of the results, the probit regression results were complemented by Ordinary Least Square (OLS) regression results. The explicit linear regression model estimated is represented as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + \varepsilon \tag{7}$$

The OLS regression involved substituting the stunting y measured as a categorical variable as used in equation 6, with stunting measured as height-for-age standard deviations. The rest of the regressors (x_i) in equation 7 are as defined in equation 6 while ε represents the error term.

4.3 Data Source

The study used the Kenya Demographic and Health Survey (KDHS 2022) by the Kenya National Bureau of Statistics. Kenya has 29 ASAL counties, where 8 counties' aridity level is 85-100 per cent, 13 counties are 30-84 per cent level while 8 counties are at 10-20 per cent aridity level (Government of Kenya, 2019). Both the household and child level data used in this paper was extracted from the KDHS 2022. This study focused on 29 ASAL counties that have aridity levels of 10 per cent and above. However, to enhance robustness of the results, all the counties were used in the estimation but controlled for aridity level by introducing aridity dummies in the estimation.

Table 4.1: Description and measurement of variable

Variables	Description of Variable	Unit of Measurement
Child-specific Attributes		
Stunted	Whether a child is stunted or not	Not stunted = 0 Stunted = 1
Height for age	Height of the child - median height for age) / Standard deviation of height for age	Height of the child in centimetres
Exclusive breast feeding	Gave the child nothing other than breast milk within 24 hours before the interview. Used only children 0-6 months	No exclusive breast feeding = 0 Exclusive breast feeding = 1
Months of breasting	Number of months the child was breast fed	Number of months
Weight at birth	Weight of the child at birth	Measured in kilogrammes
Household Specific Features		
Mothers age	Mothers age group at the time of birth	15-34 years = 0 35-49 years = 1
Mother's education	Education level attained by the mother in household	Mother not educated = 0 Mother is educated = 1
Number of children under 5 years	Number of children under 5 years in the household	Number of children under 5 years in household
Age of mother at first birth	Age of the mother when she gave birth to her first baby	Age in years
Mothers residence	Location of the mother	Rural = 0 Urban = 1
Antenatal visits	Number of antenatal visits made by the mother	Number of antenatal visits
Community Specific Factors		
Improved sanitation	Household's sanitation measured by the type of toilet used	No toilet = 0 Improved toilet/latrine = 1
Improved water	Source of drinking water	Unimproved water=0 Improved water = 1
Aridity	Aridity levels of ASALs and Non-ASAL counties	Arid 85-100% (8 counties) = 1 and 0 otherwise Semi-arid 1 30-84% (13 counties) = 1 and 0 otherwise Semi-arid 2 10-29% (18 counties) = 1 and 0 otherwise Non ASALs (18 counties) =1 and 0 otherwise

Note: The variables were computed from Kenya Demographic and Health Survey, 2022

4.4 Descriptive Statistics

Table 2 summarizes the descriptive statistics for the various variables used in the study. These statistics are filtered into three categories. The first category ignores the aridity levels of counties and thus presents what would reflect the national level summary statistics. The second and third categories focus on ASALs and non-ASALs, respectively. The isolation of the ASALs from non-ASAL counties involved creation of ASAL dummies where 0 represents the former set of counties regardless of the levels of aridity whereas 1 represents counties in the latter category. Annex 1 is an extension of Table 4.2 to include summary statistics with detailed classification of regions. These detailed regions include arid, semi-arid (30-84%) and semi-arid 2 (10-29%) in addition to ASAL, non-ASAL and national level.

Table 4.2: Descriptive statistics

Variable			Obs.	Mean	Std. Dev.	Min	Max
Stunted (yes or no)		National	17,327	0.180	0.384	0	1
		ASALs	11,568	0.194	0.395	0	1
		Non-ASALs	5,759	0.153	0.360	0	1
Stunting (height of the child for age)		National	17,327	-0.895	1.282	-5.96	5.95
		ASALs	11,568	-0.937	1.322	-5.96	5.95
		Non-ASALs	5,759	-0.809	1.194	-5.88	5.76
Exclusive breast feeding		National	1,171	0.892	0.310	0	1
		ASALs	775	0.889	0.314	0	1
		Non-ASALs	396	0.899	0.302	0	1
Months of breast feeding		National	7,120	10.312	7.659	0	35
		ASALs	4,705	10.376	7.734	0	35
		Non-ASALs	2,415	10.186	7.510	0	35
Weight of the child at birth in kg		National	4,755	3.181	0.622	0.6	6
		ASALs	2,820	3.150	0.625	0.6	6
		Non-ASALs	1,935	3.225	0.616	0.8	6
Mothers' age at first birth		National	10,267	0.181	0.385	0	1
		ASALs	6,830	0.184	0.387	0	1
		Non-ASALs	3,437	0.176	0.381	0	1
Mothers' education	No education	National	19,530	0.226	0.418	0	1
	Primary/vocational/ informal	National	19,530	0.365	0.482	0	1
	Secondary/A-level	National	19,530	0.274	0.446	0	1
	Middle level college (certificate/ diploma)/university	National	19,530	0.135	0.341	0	1
	No education	ASALs	12,963	0.335	0.472	0	1

	Primary/vocational/ informal	ASALs	12,963	0.337	0.473	0	1
	Secondary/A-level	ASALs	12,963	0.220	0.414	0	1
	Middle level college (certificate/ diploma)/university	ASALs	12,963	0.108	0.311	0	1
	No education	Non-ASALs	6,567	0.012	0.110	0	1
	Primary/vocational/ informal	Non-ASALs	6,567	0.421	0.494	0	1
	Secondary/A-level	Non-ASALs	6,567	0.381	0.486	0	1
	Middle level college (certificate/ diploma)/university	Non-ASALs	6,567	0.186	0.389	0	1
Number of children under 5 years		National	19,530	1.684	0.896	0	7
		ASALs	12,963	1.801	0.930	0	7
		Non-ASALs	6,567	1.455	0.776	0	5
Mother's age at first birth		National	19,530	19.892	3.845	10	46
		ASALs	12,963	19.800	3.827	10	40
		Non-ASALs	6,567	20.073	3.874	11	46
Mothers' residence		National	19,530	0.342	0.475	0	1
		ASALs	12,963	0.321	0.467	0	1
		Non-ASALs	6,567	0.384	0.486	0	1
Number of antenatal visits		National	10,401	4.065	1.817	0	20
		ASALs	6,782	3.908	1.833	0	20
		Non-ASALs	3,619	4.360	1.748	0	20
Sanitation		National	18,858	0.820	0.384	0	1
		ASALs	12,518	0.735	0.441	0	1
		Non-ASALs	6,340	0.989	0.102	0	1
Improved drinking water		National	18,782	0.491	0.500	0	1
		ASALs	12,581	0.500	0.500	0	1
		Non-ASALs	6,201	0.475	0.499	0	1

Data Source: KNBS (2022) Kenya Demographic and Health Survey 2022

Table 4.2 illustrates that as of 2022, the overall proportion of children under 5 years who were stunted in the country was estimated at 18.0 per cent. Comparative proportions for those in ASALs and non-ASALs were about 19.4 per cent and 15.3 per cent, respectively. In addition, about 89 per cent of children within their first 6 months fed exclusively on breast milk. This indicates that there is still a gap in the country albeit minimal (11%) towards adhering to the WHO and UNICEF recommendations for exclusive breast feeding, save for necessary medications or supplements as recommended by healthcare professionals. Moreover, as of 2022, children breast fed for an average of 10 months. This suggests that most Kenyan mothers initiate weaning when their children are still considerably below two years as recommended by WHO.

The average weight of a child at birth in Kenya estimated at 3kg falls between the normal birth weight range of 2.5kg to 4kg. Table 4.2 also reveals that 18.1 per cent of the mothers with children under 5 years are between 35 and 49 years of age, with the rest falling within the age bracket of 15-34 years. Across the country, the lowest proportion (13.5%) of mothers with children under 5 years of age had attained at least middle level college (certificate/diploma) or university education. As of 2022, the highest education level of about two-thirds of mothers in Kenya's ASALs was primary/vocational or informal (including madras) education. Statistics also reveal that the average number of children under 5 years per household is 1.801 and 1.455 for the ASALs and non-ASALs, respectively, whereas the maximum for ASALs and non-ASALs was 7 and 5, respectively. The average ages at which women give birth for the first time are relatively equal for ASALs (19.8 years) and non-ASALs (20.1 years). It is also illustrated that about 66.4 per cent of mothers to under 5 children reside in urban areas while 33.6 per cent reside in the rural areas.

Kenya has made significant efforts both at county and national levels to enhance access to antenatal care (ANC). These efforts are geared towards improving access to maternal health and reducing mortality rates. Despite these, pregnant mothers in Kenya make an average of only 2 antenatal visits (Table 4.2), which is approximately two times less than the WHO-recommended four ANC visits (Mutai and Otieno, 2021). Only 62.4 per cent of pregnant women in Kenya meet the set recommended minimum of four visits while 1.9 per cent reported to have made zero ANC visits.

Table 4.2 reveals further that about 82 per cent of households with children under 5 have access to improved sanitation as measured by the type of toilet facilities. Improved sanitation includes use of flush toilets and improved ventilated pit latrines. Unimproved sanitation encompasses the use of pit latrines, with or without slab, bucket toilet, hanging toilet and open defecation, among others. Table 4.2 further provides that the country is struggling with low access to improved drinking water (49.1%). Improved water includes but is not limited to piped water, tap water, rainwater, and bottled water whereas unimproved water is drawn from sources such as unprotected wells and springs, rivers, dams, lakes, ponds, streams, canals, and irrigation.

5. Regression Results

This section presents the findings and discussions of the study. Tables 5.1, 5.2. 5.3 and 5.4 provide insightful results on the drivers of stunting in Kenya.

Table 5.1: Average marginal effects after probit

Independent variables	**Model 1(a)**	**Model 2(a)**	**Model 3(a)**	**Model 4(a)**
Exclusive breast feeding	-0.000 (-0.010)	-0.009 (-0.230)	-0.000 (-0.010)	-0.000 (-0.010)
Months of breasting	-0.015 (-3.180)***	-0.014 (-2.280)**	-0.013 (-2.790)***	-0.015 (-3.150)***
Weight at birth	-0.121 (-6.810)***	-0.176 (-7.450)***	-0.118 (-6.680)***	-0.121 (-6.800)***
Mothers age	-0.087 (-2.020)**	-0.076 (-1.380)	-0.090 (-2.090)**	-0.088 (-2.040)**
Number of children under 5 years	0.025 (2.000)**	0.033 (2.100)**	0.030 (2.370)**	0.025 (2.040)**
Age of the mother at first birth	-0.038 (-2.510)**	-0.045 (-2.370)**	-0.035 (-2.270)**	-0.039 (-2.530)**
Age of the mother at first birth ^2	0.001 (2.370)**	0.001 (2.280)	0.001 (2.170)**	0.001 (2.390)**
Mothers residence	-0.029 (-1.230)	-0.012 (-0.400)	-0.022 (-0.940)	-0.029 (-1.240)
Sanitation improved toilet	0.000 (0.010)	0.011 (0.340)	-0.003 (-0.120)	-0.000 (-0.010)
Household water improved	-0.005 (-0.220)	-0.039 (-1.360)	0.001 (0.070)**	-0.003 (-0.160)
Number of antenatal visits made by the mother and education	-0.007 (-1.410)	-0.015 (-2.180)**	-0.012 (-2.210)**	-0.007 (-1.480)
Aridity 85%-100%			-0.077 (-2.120)	
Aridity 30% - 84%			0.019 (0.840)	
Aridity 10% - 29%			-0.031 (-1.140)	
Non-ASALs				0.011 (0.570)
Number of Observations	848	647	848	848
Note: Dependent variable is stunting (1=stunted, 0=not stunted) p values are reported in parenthesis ***significant at 1%, **significant at 5% & *significant at 10%				

Source: Authors'

Table 5.2: Average marginal effects after probit by aridity level

	Non ASALs	Aridity Level 10-29	Aridity Level 30-84	Aridity Level 85-100
Stunted (Yes or No)	Coefficient (P-value)	Coefficient (P value)	Coefficient (P value)	Coefficient ((P-value)
Exclusive breast feeding	-0.092 (0.807)	0.821 (0.166)	0.097 0.786	0.000 (0.00)
Month of breast feeding	-0.101 (0.079)**	0.135 (0.167)	-0.119 (0.056)*	0.033 (0.767)
Weight at birth-Kg	-1.262 (0.000)***	-0.937 (0.026) ***	-0.830 (0.000) ***	0.014 (0.977)
Mothers age	-0.399 (0.407)	0.000 (0.000) ***	-0.881 (0.13)	-0.065 (0.914)
Number of children under 5 years	0.292 (0.056)**	0.726 (0.018) ***	-0.087 (0.589)	0.318 (0.19)
Mothers age at 1st birth	-0.302 (0.092)*	-0.259 (0.581)	-0.428 (0.019) **	0.366 (0.587)
Mothers age at 1st births square	0.006 (0.146)	0.007 (0.536)	0.009 (0.028) **	-0.009 (0.596)
Mothers residence	-0.232 (0.394)	1.055 (0.025) **	-0.677 (0.036) **	-0.029 0.958
Improved toilet	0.054 (0.841)	-0.627 (0.274)	0.221 (0.494)	0.351 0.563
Improved water	-0.015 (0.951)	-0.488 (0.272)	0.517 (0.071) *	-0.459 (0.361)
Education antenatal	-0.049 (0.502)	-0.23 (0.06) *	-0.100 (0.131)	-0.127 (0.33)
Constant	6.192 0.004*	3.425 0.513	6.794 0.001*	-5.626 (0.435)
R	0.261	0.332	0.203	0.121
F-statistics	58.05 (0.000)	29.90 (0.001)	34.20 (0.0003)	6.14 (0.8037)
Number of observations	347	160	211	100
Note: p values are reported in parenthesis *** p<.01, ** p<.05, * p<.1				

Source: Authors'

Table 5.3: Linear regression results

Independent variables	Model 1(b)	Model 2(b)	Model 3(b)	Model 4(b)
Exclusive breast feeding	-0.103 (-0.75)	-0.021 (-0.16)	-0.096 (-0.71)	-0.104 (-0.76)
Months of breasting	0.044 (2.11)**	0.041 (2.03)**	0.034 (1.67)*	0.044 (2.13)**
Weight at birth	0.847 (10.91)***	0.912 (12.01)***	0.85 (11.08)***	0.846 (10.90)***
Mothers age	0.258 (1.87)*	0.127 (0.93)*	0.248 (1.82)*	0.257 (1.86)*
Number of children under 5 years	-0.086 (-1.50)	-0.135 (-2.35)**	-0.113 (-1.96)*	-0.084 (-1.45)*
Age of the mother at first birth	0.141 (1.79)*	0.14 (1.83)*	0.122 (1.56)	0.14 (1.78)
$(\text{Age of the mother at first birth})^2$	-0.003 (-1.69)*	-0.003 (-1.70)*	-0.003 (-1.48)	-0.003 (-1.69)
Mothers' residence	0.221 (2.20)	0.056 (0.56)	0.157 (1.57)	0.22 (2.19)
Sanitation improved toilet	0.042 (0.41)	0.052 (0.51)	0.079 (0.78)	0.041 (0.40)
Household water improved	0.066 (0.69)	0.128 (1.29)	0.039 (0.42)	0.068 (0.72)
Number of antenatal visits made by the mother and education	0.008 (0.39)	0.048 (2.10)**	0.04 (1.75)*	0.007 (0.33)*
Aridity 85%-100%			0.536 (3.51)	
Aridity 30% - 84%			-0.199 (-1.62)	
Aridity 10% - 29%				
Non ASALs			0.37 (0.33)	0.031 (0.36)
Constant	-4.749 (-5.39)***	-4.224 (-4.55)***	-4.609 (-5.27)***	-4.609 (-5.27)***
R^2	0.152	.283	0.177	0.177
F Statistic	13.674(0.00)	5.463(0.00)	12.772(0.00)	12.532(0.00)
Number of observations	848	848	848	848

Note:
Dependent variable is stunting measured by height/age standard deviation (WHO)
p values are reported in parenthesis
***significant at 1%, **significant at 5% & *significant at 10%

Source: Authors'

Table 5.4: Linear regression results by aridity levels

	Non-ASALs	Aridity Level 10-29	Aridity Level 30-84	Aridity Level 85-100
Stunting new	Coef.& P>t	Coef. & P>t	Coef. & P>t	Coef. & P>t
Exclusive breast feeding	0.093 (0.645)	-0.08 (0.806)	-0.06 (0.833)	0.336 (0.377)
Month of breast feeding	0.059 (0.054)**	0.061 (0.194)	0.028 (0.526)	-0.007 (-0.911)
Weight at birth-kg	1.045 (0.000)***	0.967 (0.000) ***	0.763 (0.000) ***	0.173 (0.496)
Mothers age	0.154 (0.448)	0.466 (0.143)	0.279 (0.356)	0.245 (0.497)
Number of children under 5 years	-0.229 (0.011)**	-0.143 (0.295)	-0.013 (0.917)	-0.079 (0.576)
Mothers age at 1st birth	0.203 (0.060)*	0.3730 (0.1)	0.181 (0.254)	-0.455 (0.126)
Mothers age at 1st birth square	-0.004 (0.092)*	-0.008 (0.112)	-0.004 (0.22)	0.011 (0.121)
Mothers residence	0.15 (0.308)	-0.314 (0.171)	0.328 (0.14)	0.51 (0.074)*
Improved toilet	0.034 (0.817)	0.324 (0.159)	-0.005 (0.983)	0.19 (0.526)
Improved water	-0.136 (0.329)	0.275 (0.174)	-0.025 (0.903)	0.101 (0.727)
Education Antenatal	0.064 (0.091)*	0.025 (0.662)	0.032 (0.453)	0.049 (0.428)
Constant	-6.21 (0) ***	-7.72 (0.002) ***	-5.141 (0.004)***	3.517 (0.273)
R	0.254	0.228	0.134	0.14
F-statistics	10.38 (0.000)	4.40 (0.000)	2.80 (0.002)	1.51 (0.137)
Number of observations	347	176	211	114
Note: p values are reported in parenthesis *** p<.01, ** p<.05, * p<.1,				

Source: Authors'

Table 5.1 and 5.2 present the resulting marginal effects after probit estimation whereas the probit regression results are provided in Annex 1. The estimation of each of these two equations was conducted considering four different sets of regional dummies. The first model involved separately regressing the two variables measuring stunting on the independent variables. Neither the county dummies nor the aridity dummies were used in the first model. The second model is an extension of the first one by introducing the county dummies for all the 47 counties. The third model uses aridity dummies for the four aridity zones instead of county dummies. Finally, the fourth model uses a special set of aridity dummies, which lumps arid and semi-arid counties (otherwise called ASALs) into one category and the non-ASALs counties in the other category.

5.1 Child-specific Attributes

Exclusive breast feeding: Although exclusive breast feeding has a negative association and is insignificant, it decreases the probability of a child being stunted. Generally, it has a negative effect on stunting, but the effects are not statistically significant in any of the models. These results somewhat corroborate those by Sari et al. (2017), who found that there is no correlation between exclusive breast feeding and stunting.

Months of breast feeding: This variable is negative and statistically significant in all models, suggesting that longer breast feeding in months is associated with lower stunting. The months of breast feeding also imply that for each month of breast feeding, the likelihood of stunting reduces by 10.4 per cent. The analysis also implies that for each month of breast feeding, stunting reduces by 4.4 per cent. The empirical literature has extensively demonstrated the importance of breast feeding in reducing the prevalence of stunting among children.

Weight at birth: Table 5.1 and 5.3 further reveal a positive and significant effect of a child's weight at birth on the height for age. The results of marginal effects show that an increase in the birth weight of a child by 1 kilogramme reduces the probability of such a child being stunted by 12.1 per cent, holding other factors constant. The results are similar across the different model specifications. These results support those by Putri et al. (2022), who illustrated that low birth weight (LBW) increases the risk of stunting in the population of children under 60 months of age. Esfarjani et al. (2013) cites that infants with LBW do not have adequate nutrient stores for height growth hence the tendency of increasing up to three times the incidence of stunting in children under 5 years compared to children with non-low birth weight.. There is a significant relationship between weight at birth and stunting, indicating that for every unit increase in birth weight, stunting increases.. Esfarjani et al. (2013) cite that infants with LBW do not have adequate nutrient stores for height growth. There is a significant relationship between weight at birth and stunting, indicating that for every unit increase in birth weight, stunting increases.

5.2 Household-Specific Features

Mothers age: This variable shows that it is negative and statistically significant, thus implying that younger mothers may have a higher likelihood of stunting in their children. Mother's age in years at first birth shows a tendency towards significance, indicating a potential effect where an increase in mother's age at first birth correlates with a rise in stunting. The probit results indicate that mothers within the youth bracket (15-34 years) are 8.7 per cent more likely to have stunted children compared to mothers aged 35-49 years. The effect of mothers' age on stunting is significant in all the models except when county dummies are included (see model 2 in Tables 5.1). These findings contradict Esfarjani et al. (2013), who reported that children born to older mothers (greater than 34 years) are more likely to be stunted than those born to their younger (less than 35 years) counterparts.

Darteh et al. (2014) argument somewhat corroborates those of this paper because, according to Darteh ert al.(2014), children whose mothers were aged 15-24 years were more likely to be stunted than those aged 25-34. The reason cited for this is the fact that young mothers require adequate nutrition to grow fully into adults, thus compete with children over the little food eaten by the mothers.

Mothers' education: The study also constructed an interaction variable from education and the number of antenatal visits. To do so, the education variable with zero denoting no education and 1 denoting primary and above levels of education of the mother were multiplied by the number of antenatal visits. The results, which are significant after introducing county and aridity dummies but otherwise insignificant show that the combined effect of education and making antenatal visits on reduction of stunting prevalence is positive. The reduction in the likelihood of children being stunted as a result of increase in maternal education has been documented in literature (Laksono et al., 2022; Musbah and Worku, 2016). The study illustrates a reduction of the likelihood of children being stunted because of access to antenatal services, and agrees with studies such as Kuhnt and Vollmer (2017) and Abdulla et al. (2023).

Number of children under 5 years: This variable is positive and statistically significant, suggesting that having more children under 5 years may increase the likelihood of stunting. The number of children under 5 in a household has a positive relationship with stunting, implying that for every additional child under 5 years old, there is an increase in the likelihood of stunting. Overall, an addition of one child under 5 years to a household increases the likelihood of stunting of a child drawn from such a household by 2.5 per cent. This effect is significant across all the model specifications. Similar results (using the number of children as opposed to children under 5 years as in our case) were obtained by Darteh et al. (2014), who illustrated that children in households with 5-8 children had higher probability of being stunted than those with 1-4 children. Darteh et al. (2014) argued that increasing the number of siblings is likely to subject children to higher risks of malnutrition and hence impair their growth and development.

Age of mother at first birth: Evidence of the probability of a child being stunted would be reduced by about 3.8 per cent if the mother' age at first birth is increased by one year. This effect is significant across all the specifications of the probit model. When a mother's age at first birth increases by 1 year, the height for age standard deviation of her children increases by about 0.14. However, the results for the square of the mother's age at first birth suggest the likelihood of a non-linear relationship between age of the mother at first birth and child's stunting. If the results for mothers age at first birth and its square are interpreted jointly, it can be deduced that an increase in the former leads to a decrease in the likelihood of bearing stunted children. This relationship persists until an optimal mothers' age of first birth, beyond which the probability of having stunted children starts to increase.

Mother's residence: Mothers residing in urban areas are less likely to have children who are stunted compared to mothers residing in rural areas. Nevertheless, these results are not significant except in the OLS regression.

5.3 Community Factors

Improved sanitation: The coefficient represents the estimated change in the dependent variable, which is stunting for a one-unit change in the independent variable, improved toilet. In all models, the coefficients are positive, suggesting that an improvement in toilet sanitation is associated with an increase in stunting. However, the effects are not statistically significant as the p-values. Therefore, improved sanitation does not show a statistically significant association with stunting across the different models and aridity levels.

Improved water: In Table 5.1, the coefficient is negative, suggesting that an improvement in water quality is associated with a decrease in stunting, but the effects are not statistically significant ($p>0.05$). The analytical findings reveal that sources of drinking water by a household are generally not associated with stunting of children within the household. On access to water, probit results at the national level are mostly insignificant, the same to the aridity levels. The OLS also had inconsistent results, which were mostly insignificant. These findings do not agree with findings by Prayudhy and Mei Ahyant (2022), which found four factors to be associated with stunting, one being access to sanitation.

Aridity levels : The average marginal effects after probit and the linear regressions are presented per the four levels of aridity, non-ASALs, 10-29, 30-84 and 85-100. The average marginal effects analysis after probit reveals that in the non-ASALs, there is a substantial relationship with stunting, implying that for every unit increase in birth weight, the likelihood of stunting reduces by 126.2 per cent. In the aridity level 10-29, the average marginal effects after probit indicate that there is a negative relationship of the weight at birth with stunting, and suggests that for every unit increase in birth weight, the likelihood of stunting decreases by 93.7 per cent. Tables 5.1 and 5.4 further summarize the significant variables in the aridity level 30-84, with the weight at birth demonstrating a negative relationship with stunting , indicating that for every unit increase in birth weight, the likelihood of stunting decreases by 83 per cent. The linear regression indicates that the weight at birth is positively associated with stunting, implying that for every unit increase in birth weight, stunting rises by 76.3 per cent. In the aridity level 85-100, average marginal effects after probit signify a negative relationship between weight at birth and stunting, indicating that for every unit increase in birth weight, the likelihood of stunting decreases by 82.9 per cent.

6. Conclusion and Recommendations

The aim of this paper was to explore the influence of socio-demographic factors on child stunting in the ASALs. Child stunting is a critical issue, with consequences on long-term health, mortality, and societal costs to affected individuals and communities. Globally, there has been a declining trend in child stunting, but it is a significant challenge especially in low-income countries. The empirical literature has shown that there are studies that have been conducted around child stunting. This study has examined the role of socio-demographic factors, child-specific attributes, household specific features and community factors in child stunting in ASALs, focusing on the specific objective of exploring the influence of socio-demographic factors on stunting. The following are recommendations:

(i) Child-specific attributes

Duration of breast feeding: The study highlights a positive relationship between the duration of breast feeding and height for age, with an extra month of breast feeding reducing the likelihood of stunting. Encouraging and supporting mothers to continue breast feeding for longer duration contributes to better child growth and development.

Birth weight: The positive and significant effect of a child's weight at birth on height for age suggests that interventions to improve birth weight could have positive implications for reducing stunting. Programmes focusing on maternal nutrition and health care during pregnancy will reduce the level of stunting.

(ii) Household-specific features

Maternal age: The findings regarding the association between maternal age and stunting show that younger mothers are associated with higher cases of stunting. Further investigation and study into the specific factors contributing to this association, considering regional differences, could inform targeted interventions.

Number of children: The probability of a child being stunted increases with the number of children under 5 years in the household. Family planning programmes and interventions that address the nutritional needs of households with multiple young children could be effective in reducing stunting prevalence.

Mother's age at first birth: Delaying the age at which mothers have their first child could reduce the likelihood of child stunting. Understanding the cultural and socio-economic factors influencing the age at which women have their first child could inform targeted interventions.

Education and antenatal visits: The positive effect of education and antenatal visits on reducing stunting prevalence suggests the importance of maternal health and education. Strengthening maternal education and healthcare services, especially in regions with higher stunting prevalence would be beneficial.

(iii) Community factors

Improved water and sanitation: While the study does not find significant associations, ongoing efforts to improve sanitation and water quality should continue. Local context and specific challenges in different regions may influence the effectiveness of such interventions. Moreover, there is need to implement integrated health and sanitation programmes that address both water quality and sanitation issues simultaneously. By providing education programmes, targeting households and communities, this will promote proper sanitation habits and safe drinking water.

References

Abdulla, F., Rahman, A. and Hossain, M. M. (2023), "Prevalence and risk predictors of childhood stunting in Bangladesh". *Plos one*, *18*(1), e0279901.

Adam, Drewnowski (2005), "Concept of a nutritious food: Toward a nutrient density score2". *The American Journal of Clinical Nutrition*, Vol. 82, Issue 4: 721-732

Adam, Smith (1976), "The development of a system". *Scottish Journal of Political Economy*, 23 (2): 111-132.

Arthur, Odima (2021), *Effects of household environmental characteristics on child health in Kenya*. KIPPRA DP 2020. Nairobi: Kenya Institute for Public Policy research and Analysis.

Barker, D.J. and Wilson, W.D. (1990), "Height and mortality in the countries of England and Wales". *Annals of Human Biology*, 17(1).

Batool Syeda, Kingsley Agho, Leigh Wilson, Greesh Kumar Maheshwari, Muhammad Qasim Raza (2021), "Relationship between breastfeeding duration and undernutrition conditions among children aged 0-3 years in Pakistan". *International Journal of Pediatrics and Adolescent Medicine*, Vol. 8, Issue 1.

Becker, Gary S. (1975), *Human capital: A theoretical and empirical analysis, with special reference to education*, 2nd edition. New York: Columbia University Press for NBER.

Bleakley, H. (2010), "Health, human capital, and development". *Annual Review of Economics*, 2: 283.

Buisman, L.R. (2019), "What explains the fall in child stunting in Sub-Saharan Africa?" *SSM-Population Health*, 8.

Chege, P.M., Kimiywe, J.O. and Ndungu, Z.W. (2015), "Influence of culture on dietary practices of children under five years among Maasai pastoralists in Kajiado, Kenya". International Journal of Behavioural Nutrition and Physiology, 12: 131.

Darteh, E.K.M., Acquah, E. and Kumi-Kyereme, A. (2014), "Correlates of stunting among children in Ghana". BMC Public Health, 14: 1-7.

Esfarjani, Fatemeh and Roustaee, Roshanak and Mohammadi-Nasrabadi, Fatemeh and Esmaillzadeh, Ahmad. (2013), "Determinants of stunting in school-aged children of Tehran, Iran". *International Journal of Preventive Medicine*, 4. 173-9.

Elmusharaf, K., Byrne, E. and O'Donovan, D. (2015), " Strategies to increase demand for maternal health services in resource-limited settings: Challenges to be addressed". *BMC Public Health*, 15: 870.

Ferreira, HDS (2020), "Anthropometric assessment of children's nutritional status: A new approach based on an adaptation of Waterlow's classification". B*MC Pediatrics, 11;20(1):65*. doi: 10.1186/s12887-020-1940-6. PMID: 32046666; PMCID: PMC7014708.

Forh, G., Apprey, C. and Frimpomaa Agyapong, N.A. (2022), "Nutritional knowledge and practices of mothers/caregivers and its impact on the nutritional status of children 6-59 months in Sefwi Wiawso Municipality, Western-North Region, Ghana". *Heliyon*, 8 (12).

Hadi H, Fatimatasari F, Irwanti W, Kusuma C, Alfiana RD, Asshiddiqi MIN, Nugroho S, Lewis EC, Gittelsohn J. (2021), Exclusive breast feeding protects young children from stunting in a low-income population: A study from Eastern Indonesia". *Nutrients*, 13(12): 4264. doi: 10.3390/nu13124264. PMID: 34959815; PMCID: PMC8706015.

Jane, Mariaraa, Godfrey K. Ndenge and Domisiano K. Mwabu (2008), Determinants of children's nutritional status in Kenya: Evidence from Demographic and Health Surveys.

Kalinda, C., Phri, M., Qambayot, M.A., Ishimwe, M.C., Gebremariam, A., Bekele, A. and Wong, R. (2023), "Socio-demographic and environmental determinants of under-5 stunting in Rwanda: Evidence from a multisectoral study". *Frontiers in Public Health*, 11, 1107300. https://doi.org/10.3389/fpubh.2023.1107300.

Kenya National Bureau of Statistics-KNBS (2022), Demographic and Health Survey 2022. Nairobi: KNBS.

Kuhnt, J. and Vollmer, S. (2017), "Antenatal care services and its implications for vital and health outcomes of children: Evidence from 193 surveys in 69 low-income and middle-income countries". BMJ open, 7(11), e017122.

Laksono, A.D., Wulandari, R.D., Amaliah, N. and Wisnuwardani, R.W. (2022), "Stunting among children under two years in Indonesia: Does maternal education matter?" *Plos One*, 17 (7), e0271509.

Mansur, M., Afiaz, A. and Hossain, M.S.(2021), "Socio-demographic risk factors of under-five stunting in Bangladesh: Assessing the role of interactions using a machine learning method. *Plos One*, 16(8), e0256729.

Marinda, P.A.D. (2023), Statistics and bivariate associations were conducted, Chalula, F., Khayeka-Wandabwa, C., Audain, K. and Thilsted, S.H. (2023), "Dietary diversity and nutritional status of children aged 6-59 months from rural fishing and non-fishing communities in Zambia". *Scientific African*, 19, e01527.

Marther W. Ngigi and Elijah N. Muange (2023), "Effect of mothers' use of information and communication technologies on dietary quality and undernutrition in young children in Kenya". *Cogent Food and Agriculture*, 9:1, 2238398, DOI:10.1080/23311932.2023.2238398.

Musbah, E. and Worku, A. (2016), "Influence of maternal education on child stunting in SNNPR, Ethiopia". *Central African Journal of Public Health*, 2(2): 71-82.

Müller, O. and Krawinkel, M. (2005), "Malnutrition and health in developing countries". *Canadian Medical Association Journal*, 173(3): 279-286.

Mutai, K.T. and Otieno, G.O. (2021), "Utilization of focused antenatal care among expectant women in Murang'a County, Kenya". *Pan African Medical Journal*, 39(1).

Mwabu, Germano (2008), "The production of child health in Kenya: A structural model of birth weight". *Journal of African Economies*, 18: 212-260. 10.1093/jae/ejn013.

Putri, T.A., Salsabilla, D.A. and Saputra, R.K. (2022), "The effect of low birth weight on stunting in children under five: A meta analysis". *Journal of Maternal and Child Health*, 6(4): 496-506.

Offenheiser, R. and S. Holcombe (2003), "Challenges and opportunities in implementing a rights-based approach to development: An Oxfam America perspective". *Non-profit and Voluntary Sector Quarterly*, 32(2): 268 van de Linde, T. (2005). Influencing and developing good policy in Early Childhood

Opoku, M.P., Anwahi, N., Belbase, S., Shah, H., Alkateri, T. and Moustafa, A. (2023), "Accessibility of nutritional services for children with autism spectrum disorder in the United Arab Emirates: Insights from special education teachers and parents". *Research in Developmental Disabilities*, 138: 104521.

Pitt, M.M., Rosenzweig, M.R. and Hassan, M.N. (2012), "Human capital investment and the gender division of labour in a brawn-based economy". *The American Economic Review*, 102(7): 3531-3560.

Prayudhy Yushananta, Mei Ahyanti and Yetti Anggraini (2021), "Risk factors of stunting in children aged 6-59 months: A case-control study in the horticulture area". *Indian Journal of Forensic Medicine and Toxicology*, 15(4): 2164-2171.

Sahn, D.E. and D.C. Stifel (2002), "Parental preferences for nutrition of boys and girls: Evidence from Africa". *The Journal of Development Studies*, 39-1: 21-45.

Sánchez-García, S., García-Peña, C., Duque-López, M.X. et al. (2007), "Anthropometric measures and nutritional status in a healthy elderly population". BMC Public Health, 7: 2.

Sari, Anggrita, M.Kom, Mambang, Putri, Karolina, Haryono, Ika, Lestari, Yayuk and Sari, Mega (2017), Factors affecting the stunting case: A retrospective study on children in Banjarmasin. 10.2991/smichs-17.2017.3.

Sari, A., Mambang, M., Putri, K.S.C.E., Haryono, I.A., Lestari, Y.P. and Sari, M.Y. (2017), "Factors affecting the stunting case: A retrospective study on children in Banjarmasin. In 2nd Sari Mulia international conference on health and sciences 2017 (SMICHS 2017)–One health to address the problem of tropical infectious diseases in Indonesia. Atlantis Press.

Schultz, T.P. (1997), "Assessing the productive benefits of nutrition and health: An integrated human capital approach". *Journal of Econometrics*, 77(1): 141-158.

Schultz, T.W. (1961), "Investment in human capital". *The American Economic Review*, 51(1): 1-17.

Tebeje, D.B., Agitew, G., Mengistu, N.W. and Aychiluhm, S.B. (2022), "Undernutrition and its determinants among school-aged children in northwest Ethiopia". *Heliyon*, 8 (11): e11235.

Thomas O. Davenport (1999), Human capital: What it is and why people invest in it.

UNICEF, WHO, World Bank Group (2021), Levels and trends in child malnutrition: Towards a future without malnutrition for every child. Report No. 9240025251. UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates.

World Health Organization - WHO, United Nations Children's Fund - UNICEF (2019), Recommendations for data collection, analysis and reporting on anthropometric indicators in children under 5 years old. Geneva: WHO; UNICEF.

Wuttaphan, Naphat (2017), Human capital theory: The theory of human resource development, implications, and future. 240-253.

Yushananta, P, Ahyanti M, Anggraini Y. (2022), Risk factors of stunting in children aged 6-59 months: A case-control study in horticulture area. Open Access Macedonia Journal of Medical Science, 10(E):1-5.

Annex

Annex 1: Descriptive statistics

Variable	Region	Obs	Mean	Std. Dev.	Min	Max
Stunted (Yes or No)	National	17,327	0.180	0.384	0	1
	Arid	4,395	0.182	0.386	0	1
	Semiarid1 (30-84%)	4,233	0.226	0.418	0	1
	Semiarid2 (10-29%)	2,940	0.166	0.372	0	1
	ASAL	11,568	0.194	0.395	0	1
	Non-ASAL	5,759	0.153	0.360	0	1
Stunting (Height for age)	National	17,327	-0.895	1.282	-5.96	5.95
	Arid	4,395	-0.816	1.394	-5.84	5.21
	Semiarid1 (30-84%)	4,233	-1.068	1.324	-5.96	5.85
	Semiarid2 (10-29%)	2,940	-0.931	1.185	-5.9	5.95
	ASAL	11,568	-0.937	1.322	-5.96	5.95
	Non-ASAL	5,759	-0.809	1.194	-5.88	5.76
Exclusive breast feeding	National	1,171	0.892	0.310	0	1
	Arid	298	0.883	0.322	0	1
	Semiarid1 (30-84%)	264	0.879	0.327	0	1
	Semiarid2 (10-29%)	213	0.911	0.286	0	1
	ASAL	775	0.889	0.314	0	1
	Non-ASAL	396	0.899	0.302	0	1
Months of breast feeding	National	7,120	10.312	7.659	0	35
	Arid	1,738	10.171	7.765	0	34
	Semiarid1 (30-84%)	1,772	10.949	7.963	0	35
	Semiarid2 (10-29%)	1,195	9.825	7.280	0	35
	ASAL	4,705	10.376	7.734	0	35
	Non-ASAL	2,415	10.186	7.510	0	35
Weight at birth	National	4,755	3.181	0.622	0.6	6
	Arid	692	3.051	0.598	1	6
	Semiarid1 (30-84%)	1,212	3.163	0.620	0.6	6
	Semiarid2 (10-29%)	916	3.210	0.643	0.7	5.9
	ASAL	2,820	3.150	0.625	0.6	6
	Non-ASAL	1,935	3.225	0.616	0.8	6
Mothers' age	National	10,267	0.181	0.385	0	1
	Arid	2,683	0.205	0.404	0	1
	Semiarid1 (30-84%)	2,426	0.173	0.378	0	1
	Semiarid2 (10-29%)	1,721	0.166	0.372	0	1
	ASAL	6,830	0.184	0.387	0	1
	Non-ASAL	3,437	0.176	0.381	0	1

Number of children under 5 years	National	19,530	1.684	0.896	0	7
	Arid	4,935	2.123	0.966	0	7
	Semiarid1 (30-84%)	4,723	1.636	0.876	0	6
	Semiarid2 (10-29%)	3,305	1.554	0.805	0	5
	ASAL	12,963	1.801	0.930	0	7
	Non-ASAL	6,567	1.455	0.776	0	5
Mother's age at first birth	National	19,530	19.892	3.845	10	46
	Arid	4,935	19.633	3.766	11	39
	Semiarid1 (30-84%)	4,723	20.062	3.899	10	40
	Semiarid2 (10-29%)	3,305	19.674	3.793	11	39
	ASAL	12,963	19.800	3.827	10	40
	Non-ASAL	6,567	20.073	3.874	11	46
Mothers' residence	National	19,530	0.342	0.475	0	1
	Arid	4,935	0.354	0.478	0	1
	Semiarid1 (30-84%)	4,723	0.281	0.450	0	1
	Semiarid2 (10-29%)	3,305	0.330	0.470	0	1
	ASAL	12,963	0.321	0.467	0	1
	Non-ASAL	6,567	0.384	0.486	0	1
Number of antenatal visits	National	10,401	4.065	1.817	0	20
	Arid	2,404	3.407	1.925	0	10
	Semiarid1 (30-84%)	2,579	4.130	1.751	0	20
	Semiarid2 (10-29%)	1,799	4.258	1.672	0	14
	ASAL	6,782	3.908	1.833	0	20
	Non-ASAL	3,619	4.360	1.748	0	20
Sanitation	National	18,992	0.256	0.436	0	1
	Arid	4,834	0.139	0.346	0	1
	Semiarid1 (30-84%)	4,624	0.260	0.438	0	1
	Semiarid2 (10-29%)	3,190	0.281	0.449	0	1
	ASAL	12,648	0.219	0.413	0	1
	Non-ASAL	6,344	0.329	0.470	0	1
Improved drinking water	National	18,782	0.491	0.500	0	1
	Arid	4,803	0.456	0.498	0	1
	Semiarid1 (30-84%)	4,602	0.498	0.500	0	1
	Semiarid2 (10-29%)	3,176	0.567	0.496	0	1
	ASAL	12,581	0.500	0.500	0	1
	Non-ASAL	6,201	0.475	0.499	0	1

Mothers' education	No education	National	19,530	0.226	0.418	0	1
	Primary/vocational/informal		19,530	0.365	0.482	0	1
	Secondary/A-level		19,530	0.274	0.446	0	1
	Middle level college (certificate/diploma)/university		19,530	0.135	0.341	0	1
	No education	Arid	4,935	0.712	0.453	0	1
	Primary/vocational/informal		4,935	0.184	0.387	0	1
	Secondary/A-level		4,935	0.074	0.261	0	1
	Middle level college (certificate/diploma)/university		4,935	0.030	0.172	0	1
	No education	Semiarid1 (30-84%)	4,723	0.135	0.342	0	1
	Primary/vocational/informal		4,723	0.416	0.493	0	1
	Secondary/A-level		4,723	0.295	0.456	0	1
	Middle level college (certificate/diploma)/university		4,723	0.154	0.361	0	1
	No education	Semiarid2 (10-29%)	3,305	0.057	0.232	0	1
	Primary/vocational/informal		3,305	0.453	0.498	0	1
	Secondary/A-level		3,305	0.330	0.470	0	1
	Middle level college (certificate/diploma)/university		3,305	0.159	0.366	0	1
	No education	ASAL	12,963	0.335	0.472	0	1
	Primary/vocational/informal		12,963	0.337	0.473	0	1
	Secondary/A-level		12,963	0.220	0.414	0	1
	Middle level college (certificate/diploma)/university		12,963	0.108	0.311	0	1
	No education	Non-ASAL	6,567	0.012	0.110	0	1
	Primary/vocational/informal		6,567	0.421	0.494	0	1
	Secondary/A-level		6,567	0.381	0.486	0	1
	Middle level college (certificate/diploma)/university		6,567	0.186	0.389	0	1
Aridity		Arid	19,530	0.253	0.435	0	1
		Semiarid1 (30-84%)	19,530	0.242	0.428	0	1
		Semiarid2 (10-29%)	19,530	0.169	0.375	0	1
		Non-ASAL	19,530	0.336	0.472	0	1

ISBN 978 9914 738 44 5

Kenya Institute for Public Policy Research and Analysis
Bishops Garden Towers, Bishops Road
PO Box 56445, Nairobi, Kenya
tel: +254 20 2719933/4, 2714714/5, 2721654, 2721110
fax: +254 20 2719951
email: admin@kippra.or.ke
website: http://www.kippra.org