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# PREVALENCE AND DRIVERS OF INDIVIDUAL-LEVEL DOUBLE BURDEN OF MALNUTRITION AMONG UNDER-5 CHILDREN IN KENYA

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***Abstract****: In the developing world today, nutritional and epidemiological transitions are key contributors to the continuous existence of undernutrition and overnutrition, often resulting in concurrent forms of malnutrition in a child –double burden malnutrition (DBM). The complex phenomenon occasions a unique challenge to international health organizations and governments. Many studies have focused on the household and community DBM with only a few of them examining the individual-level DBM. With data extracted from the Demographic and Health Survey (DHS) – 2015, we extend the knowledge space by systematically and empirically testing how child sex, child age, residence, maternal education, household wealth scale, and access to improved water and sanitation affect the likelihood of observing the DBM in an under-5 child. A weighted sample of 21,896 children aged 0-59 months was used in the analysis, using WHO (2006) child growth standards in which children whose height-for-age z-scores are less than -2 standard deviations are classified as stunted. Those whose weight-for-height z-scores are above +2 standard deviations are treated as overweight/obese. Bivariate and multivariate logistic regression were differently used and the findings were that (i) female children are less likely to experience DBM than their male counterparts; (ii) living in the rural settings increases the odds of occurrence of DBM in a child; (iii) children born to higher-educated mothers are less likely to experience DBM; (iv) higher-wealth households are less likely to observe DBM in a child; and (v) households with access to improved water and sanitation are less likely to observe DBM in a child. Interventions should be structured to target the specific groups of children who are simultaneously wasted and stunted because they are more exposed to the associated health risks.*

***Keywords****: Stunting, overweight/obese, double burden of malnutrition, overnutrition, undernutrition*

***Abbreviations****: DBM, Double Burden of Malnutrition; WHO, World Health Organization; DHS, Demographic and Health Survey; KDHS, Kenya Demographic and Health Survey; KNBS, Kenya National Bureau of Statistics; ICF, WASH, Water, Sanitation, and Hygiene*

## Introduction

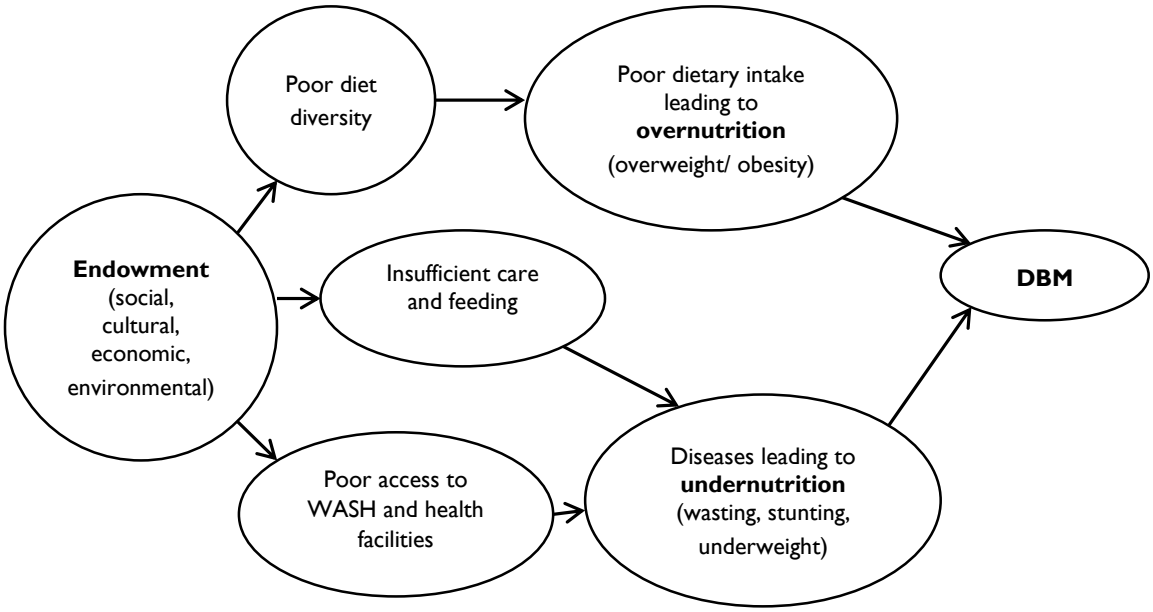
A double burden of malnutrition is the simultaneous coexistence of undernutrition and overnutrition in the same settings.[1] It can occur either at the individual level (a child is simultaneously stunted and overweight or obese), household level (household has at least a stunted child and at least an overweight or obese child), or at

the community level (where the two ends of malnutrition spectrum are simultaneously experienced among children in the same community). The dual existence of stuntedness and overweight or obesity at an individual level is a challenge because of the direct adverse implication it has on the household's health expenditure and his/her late-age morbidity to some diseases and his/her labor market productivity potential. Different studies, defining the double burden of malnutrition differently, have reported the double burden of malnutrition phenomenon in low- and middle-income countries.[2,3,4] While earlier studies pointed at low double burden rates, recent studies, focusing on exclusive subpopulations, have reported higher prevalence of individual double burden of malnutrition. In Kenya, specifically, no study was found to have been done on the individual level double burden of malnutrition with most of them focusing on the community and household double burden. [5,6,7]

The framework for this study is adopted from Masibo et al. (2020)[8] and a couple of other studies.[9,10,11] It summarizes the pathway to the individual double burden of malnutrition. In the framework, children have different socioeconomic, cultural, and environmental endowments that define the underlying cause of malnutrition at different subpopulation levels. The subpopulations can be households, administrative region, place of residence categorized as urban or rural, age group, sex, and access to water and sanitation. The endowment determines the access that a child or household has to resources (land, water, and clean air), education, support networks, social protection, infrastructure and transport, employment, income, technology, information, markets, and knowledge. The sociocultural environment includes factors such as gender, fiscal and trade policies, legislation, agriculture, food systems, urbanization, climate change, pollution, and political stability and security.

The outcome of the endowment on the child is that he/she may be subjected to three possible outcomes including (i) poor diet diversity and consumption of energy-dense and nutrient-deficient diets; and (ii) insufficient care and feeding practices; (iii) poor water, sanitation, food safety, and health services. If outcome (i) ensues, the child is further subjected to poor diet intake (quality and quantity) and becomes overweight or obese (overnutrition). If outcome (ii) ensues, the child is subjected to poor diet intake (quality and quantity) and becomes underweight, stunted, or wasted (undernutrition). Lastly, outcome (iii) subjects the child to different forms of illness and becomes underweight, stunted, or wasted (undernutrition). The sum of these three outcomes is a child that is overweight/obese and stunted.

**Figure 1: Conceptual framework for the drivers of the dual burden of over- and undernutrition in a child**




## Methods

### Anthropometric measurements and nutritional status

The measurements for child weight and height were drawn from the KDHS household survey questionnaire of 2015 for children born between January 2009 and January 2014[12]. In the survey, child height was measured using Shorr Height and Weight boards while weights were measured with SECA digital scales. Child nutritional statuses were determined using the WHO 2006 Child Growth Standards[13] in which we defined DBM as the concurrent existence of stunting and overweight/obese in an under-5 child. The number of stunted children was computed as the weighted sum of children whose height-for-age z-scores were below -2 standard deviations. The number of overweight/obese children, on the other hand, was determined as the weighted sum of children whose weight-for-height z-scores were below +2 standard deviations. Children whose height-for-age and weight-for-height z-scores were below -6 and +6 respectively were treated as invalid and excluded from the analysis. The analysis also included child age, sex, maternal education, household wealth quintile, and access to improved water and sanitation, and residence type.

### Statistical Analysis

Data analysis was done using STATA software version 14.0 anchored on Windows. Descriptive analysis of data was done in which disaggregated frequencies of the study subjects were computed and reported. We further did multivariate logistic regression of the response variable on its explanatory variables (child age, child sex, and child maternal education level). A bivariate logistic regression analysis was also done with child residence, household wealth quintile, and access to water and sanitation as the explanatory variables. The regression outputs were extracted and reported in terms of the odds ratios at a 95 percent confidence interval.

## Results

The data analyzed was drawn from a database subset of 21,986 children aged between 0 and 59 months and classified as wasted-stunted and neither wasted nor stunted. The sample comprised 15.8 percent of children age 0-11 months, 32.4 percent aged 12-23 months, and 17.0 percent aged 24-35 months and 17.8 percent and 17.0 percent respectively aged 36-47 months and 48-59 months, all with a mean age of 29.9 months. The children were 50.6 percent male and 49.6 female drawn from both urban (31.3 percent) and rural (66.7 percent) settings. About 22.4 percent and 52.3 percent of them respectively were drawn from mothers who had no education and of primary education level. On the other hand, 18.9 percent of them were drawn from mothers whose highest level of education is secondary and 6.3 percent being from mothers with tertiary education. Grouped by the wealth quintiles of the households from which they were drawn, 34.7 percent, 21.2 percent, and 16.6 percent were respectively drawn from the 1st, 2nd, and 3rd quintiles while 14.9 percent and 12.6 percent were drawn from the 4th and 5th quintiles respectively. Classified by the source of water to the household, 63.2 percent were from households with improved water sources while 36.8 percent were from the household with unimproved water sources. Lastly, 12.1 percent and 87.9 percent were drawn from households with improved and unimproved sanitation respectively.[14]

### Prevalence of individual-level double burden of malnutrition, stunting, and wasting

An individual-level double burden of malnutrition was defined as the simultaneous occurrence of undernutrition and overnutrition in an under-5 child. Overall, the estimated stunting rate is 26.7 percent which implies that 267 in 1000 children population are short for age. On the other hand, 8.9 percent are overweight or obese and 1.1 percent are both stunted and overweight or obese. While stunting is more prevalent among children living in rural settings (29.0 percent) than in urban settings (21.4 percent), overweight or obesity is more prevalent in the latter (5.6 percent) than in the former (5.1 percent). The double burden of malnutrition is more prevalent in rural settings (1.9 percent) than in urban places (1.2 percent). As for the sex of the child, 29.8 percent of the males and 23.5 percent of the females are stunted respectively. Similarly, proportionately more boys are overweight or obese (6.1 percent) than girls (5.0 percent). The double burden of malnutrition occurs in 1 percent of the male children compared to 0.9 percent of their female counterparts.

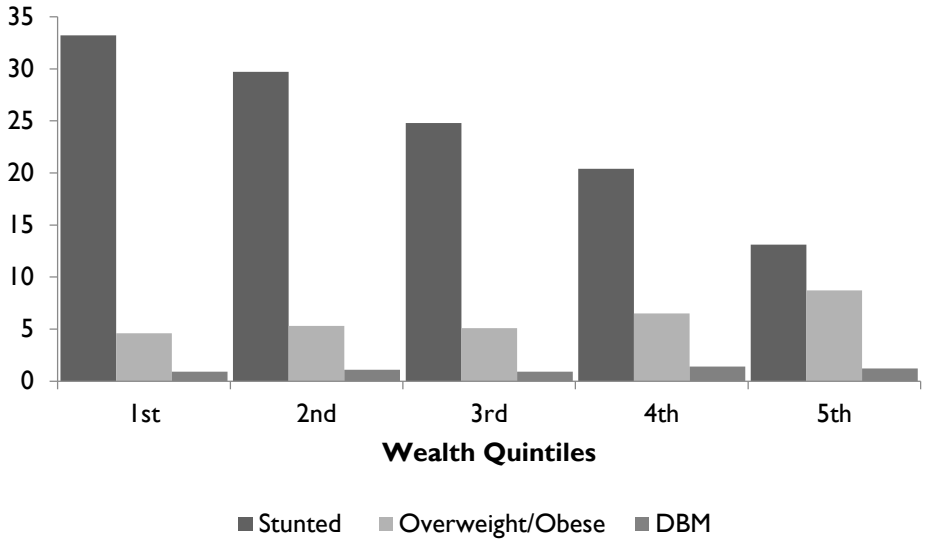
Among the children coming from households with improved water sources, stunting is less prevalent (23.9 percent) compared to those using unimproved water sources (31.0 percent). Similarly, stunting and the stunting and overweight/obesity simultaneity are more prevalent among the latter (5.9 percent and 1.0 percent respectively) than the former (5.2 percent and 1.1 percent respectively). The trend is replicated among the household based on their sanitation type with only 18.9 percent of the children from households with improved sanitation being stunted compared to the ones with unimproved sanitation's 29.0 percent. The prevalence of overweight/obesity among the children from households with improved and unimproved sanitation is 6.5 percent and 5.3 respectively while the double burden of malnutrition is 1.1 for both of the sanitation type categories.

**Table 1: Disaggregated prevalence of stunting, wasting, and the double burden of malnutrition by residence, water source, sanitation, and child sex (percent)**

| | | | **Stunted** | **Overweight /Obese** | **Double Burden of Malnutrition** |
|---|---|---|---|---|---|
| Household characteristics | Residence | Rural | 29.0 | 5.1 | 1.9 |
| | | Urban | 21.4 | 5.6 | 1.2 |
| | Water source | Improved water source | 23.9 | 5.9 | 1.0 |
| | | Unimproved water source | 31 | 5.2 | 1.1 |
| | Sanitation[15] | Improved sanitation | 18.9 | 6.5 | 1.1 |
| | | Unimproved sanitation | 29 | 5.3 | 1.1 |
| Child characteristics | Sex | Male | 29.8 | 5.6 | 1.2 |
| | | Female | 23.5 | 5.0 | 0.9 |

While the stunting rate tends to fall as we move from lower-wealth households to the upper ones, overweight/obesity is rising up the wealth scale. Stunting among the 1st wealth quintile is 33.2 percent, and 29.7 percent and 24.8 percent in the 2nd and 3rd wealth quintiles respectively. In the 4th and 5th quintiles, it is least at 20.4 percent and 13.1 percent respectively. On the other hand, overweight/obesity is 4.6 percent, 5.3 percent, and 5.1 for the 1st through 3rd quintiles and 6.5 percent and 8.7 percent for the 4th and 5th quintiles respectively. The double burden of malnutrition insignificantly and inconsistently rises down the wealth scale with the 1st wealth quintile having a prevalence of 0.9 percent, while the 2nd and 3rd have 1.1 percent and 0.9 percent each. The 4th and 5th quintiles have a 1.4 percent and 1.2 percent prevalence of the double burden.

**Figure 2: Prevalence of stunting, overweight/obesity, and the double burden of malnutrition by household wealth quintiles** (percent)




The prevalence of the three nutritional outcomes declines as we move from children whose mothers have no education at all to those whose mothers have attained higher levels of education. There, however, seems to be no consistent pattern for the nutritional outcomes across the age groups of the children but for wasting that is declining consistently up the age groups.

**Figure 3: Prevalence of stunting, overweight/obesity, and the double burden of malnutrition by maternal education (percent)**

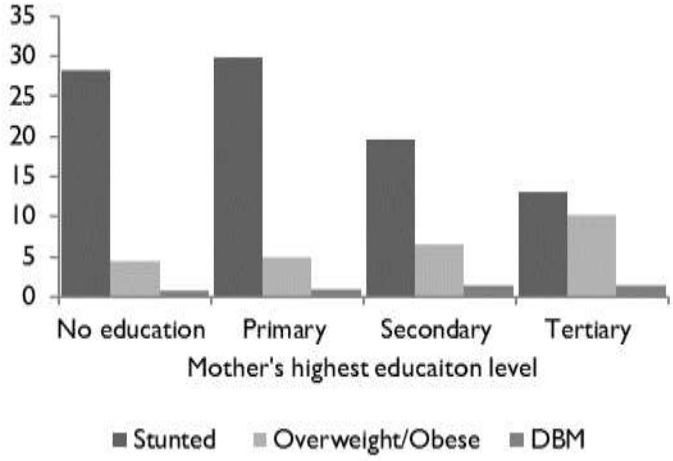
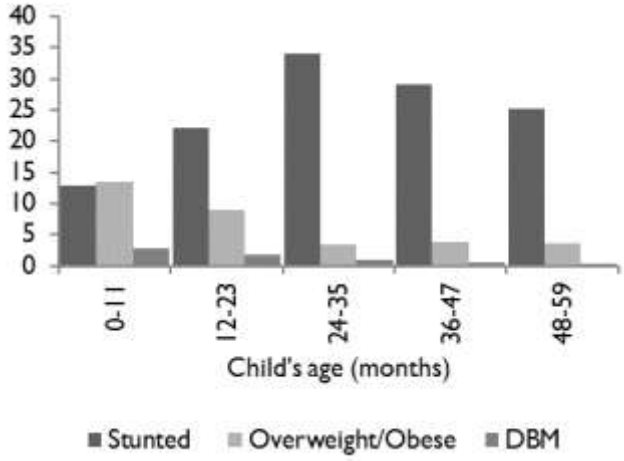



**Figure 4: Prevalence of stunting, overweight/obesity, and the double burden of malnutrition by child's age group (percent)**




**The double burden of malnutrition by maternal and child characteristics**

Holding child age and mother education at fixed values, the odds of a female under-5 child being stunted and overweight/obese is 0.06 times less likely. Similarly, the odds of children whose mothers have higher education experiencing the double burden of malnutrition in an under-5 child are lower. Specifically, the odds of an

under-5 child whose mother's highest level of education is primary being wasted and stunted is 0.44 times less likely than that of a child whose mother has no education at all holding child age and sex at fixed levels. Similarly, the odds of a child whose mother's highest level of education is secondary being wasted and overweight/obese is 0.25 times less likely than that of a child whose mother has no education at all holding child age at a fixed level. Lastly, the odds of a child whose mother's highest level of education is tertiary being wasted and stunted is less likely than that of a child whose mother has no education at all holding the child age and sex at a fixed level.

**Table 2: Multivariate logistic regression for child and maternal characteristic predictors of the individual double burden of malnutrition**

| Variable | Variable category | Odds ratio | [95% Conf. Interval] |
|---|---|---|---|
| Child age | | 1.00 | [0.99 1.01] |
| Child sex | Male (reference) | | |
| | Female | 0.06*** | [0.44 0.69] |
| Child mother education | No education (reference) | | |
| | Primary | 0.44*** | [0.35 0.55] |
| | Secondary | 0.25*** | [0.17 0.37] |
| | Tertiary | 0.07** | [0.02 0.22] |

$* p < 0.05,\ ** p < 0.01,\ *** p < 0.001$

**The double burden of malnutrition by household characteristics**

Living in rural settings increases the likelihood of the occurrence of the individual double burden of malnutrition. The odds that the double burden of malnutrition is observed in an under-5 child is about 1.6 times more likely if the child is living in the rural setting than in the urban. This implies that households living in rural settings are more likely to experience the double burden of malnutrition among the under-5 children than their counterparts living in urban settings. At the bivariate level of analysis, it is established that there is a statistically significant association between wealth and the dual occurrence of stunting and overweight/obesity in a child. The higher wealth-quintile households have lower odds of observing the simultaneous occurrence of stunting and overweight/obesity among the under-5 children. The 2$^{nd}$, 3$^{rd}$, and 4$^{th}$ wealth quintiles are 0.36, 0.40, and 0.23 respectively less likely to experience the double burden of malnutrition in children than their counterparts in the 1$^{st}$ quintile, just like is the 5$^{th}$ quintile with a lower likelihood of 0.17 times.

Under-5 children living in households with unimproved water sources and unimproved sanitation have higher odds of having the double burden of malnutrition. Lack of access to improved water sources increased the odds of concurrent wasting and overweight/obesity in an under-5 child by 71 percent. Similarly, the absence of improved sanitation in a household increased the odds that an under-5 child is concurrently stunted and wasted by 119 percent.

**Table 3: Bivariate logistic regression for child and maternal characteristic predictors of the individual double burden of malnutrition**

| Variable | Variable category | Odds ratio | S.E. | [95% Conf. Interval] |
|---|---|---|---|---|
| Residence type | Urban (reference) | | | |
| | Rural | 1.59*** | 0.21 | [1.23 2.05] |
| Wealth quintile | 1st quintile (reference) | | | |
| | 2nd quintile | 0.36*** | 0.06 | [0.26 0.49] |
| | 3rd quintile | 0.40*** | 0.40 | [0.28 0.55] |
| | 4th quintile | 0.23*** | 0.05 | [0.15 0.36] |
| | 5th quintile | 0.17*** | 0.05 | [0.10 0.29] |
| Water source | Improved (reference) | | | |
| | Unimproved | 1.71*** | 0.19 | [1.38 2.12] |
| Sanitation type | Improved (reference) | | | |
| | Unimproved | 2.19*** | 0.36 | [1.58 3.02] |

$* p < 0.05,\ ** p < 0.01,\ *** p < 0.001$

**Discussion**

It is found that 32.5 percent of under-5 children are stunted, 6.5 percent wasted, and 2.3 percent wasted and stunted. It is established that the sex of the child, education level of the mother, household wealth, place of residence, water source, and sanitation type are significant predictors of the simultaneous occurrence of stunting and wasting in under-5 children. As for the sex of the child determining the double burden of nutrition in children, we established that, holding other predictor variables in the analysis at their fixed values, the odds of a female under-5 child being simultaneously stunted and overweight/obese are lower. This sex differential in the double burden of malnutrition can be explained from biological and behavioral perspectives. The former perspective attributes the differential to chromosomal differences between males and females which predisposes males to disproportionately higher morbidity and mortality than the females.[16] Mostly, newborn girls have a lesser vulnerability to perinatal conditions (such as birth trauma, distress syndrome, and birth asphyxia among others), infectious diseases (such as intestinal infections), and congenital anomalies. This gives them a relative biological advantage compared to boys.[17,18]

On the other hand, the behavioral perspectives include cultural perceptions, selection bias, and parental preference of one sex over the other. For instance, in Kenya and selected countries in Sub-Saharan Africa, cases of comparatively more male children younger than 6 months being introduced to complementary feeding than their females are reported.[19,20,21] This early introduction to complementary feeding has got the impact of compromising the infant's immunity because they are exposed to pathogens, thus increasing their risks of infections. Further, it reduces breast milk production in the mother and may thus result in hungrier children and consequently increase the need for more complementary foods.[22] Any factor that compromises the frequency and duration of breastfeeding directly compromises the nutritional health of the infant given its

vitality to the growth and development of children.[23,24] As such, disproportionate suboptimal child feeding practices between children of different sexes can explain why concurrent stunting and overweight/obesity is more prevalent among male infants than female ones.

We found that the concurrent occurrence of stunting and overweight/obese is significantly positively influenced by maternal education. A child from a higher-educated mother is less likely to experience the double burden of malnutrition in line with the findings in many studies.[25,26,27] Because mothers are the primary caregivers of the children, it is expected that their education and knowledge have a direct effect on the child's protective caring behaviors which, in turn, have a bearing on the child's improved health. As such, we expect comparatively worse nutritional outcomes for children born to mothers with lower educational levels than their counterparts born to higher-educated mothers.

We found that children living in rural settings are more likely to be concurrently stunted and overweight/obese than their urban counterparts. This phenomenon was in agreement with frequent observation in different studies in developing countries.[28,29] This can be explained by the comparatively lower education and poorer socioeconomic status, higher prevalence of infectious diseases, higher scarcity of portable water supply, and poorer nutritional knowledge in rural settings than in the urban ones. [30] At the same time, it is found that the double burden of malnutrition is likely to be observed more among the children from higher wealth quintiles than those of lower wealth quintiles. This is in line with the findings of which attributed this relationship to a number of studies.[31,32,33] It is argued that higher-wealth households are comparatively at a better vantage economic position to access health insurance and healthcare and build social networks and knowledge and set up safer neighborhoods all of which can act as a buffer against financial hardship. As such, they are more able to guard their children against adverse nutritional threat exposure than their lower-wealth counterparts.

We found that access to improved water and sanitation is found to have a direct effect on the concurrent occurrence of stunting and overweight/obesity in infants. This coincided with the findings that attributed this association to the increased risk of mothers who are the primary handlers of children contaminating children's food or children ingesting unclean food and water if the household does not have improved water and sanitation. All these explain why children living in households without improved water and sanitation are likely to observe concurrent stunting and overweight/obesity in a child.

## Conclusion

The concurrent existence of stunting and overweight/obesity in an under-5 child is present in Kenya and is influenced by multiple factors. These include the gender of the child, the place of residence, the education level of the mother, and household wealth level, and access to improved water and sanitation. From the findings, a male child is more likely to be concurrently stunted and overweight/obese than a female one. Similarly, a child is more likely to be stunted and overweight/obese living in a rural setting than in an urban one. Further, a child born to a less educated mother is more likely to observe the double burden than if born to a mother with a higher education level. Higher household wealth decreases the odds of occurrence of the double burden in an under-5 child just as access to improved water and sanitation.

While eliminating the double burden of malnutrition and/or its component nutritional outcomes cannot only be addressed through tackling these lean-scope factors alone, what this study provides is an insight for exploring the existence and drivers of the double burden of malnutrition in Kenya. By giving empirical evidence on the existence and drivers of the double burden of malnutrition, it provides a clear policy lever through which interventions can be structured. Because Kenya's health system is devolved, an empirical county-centric analysis of the double burden of malnutrition and other linear growth failures should be done.

The DHS data on which this analysis was based was too limited to warrant a disaggregated analysis to the county level for the double burden of malnutrition except for its two components.

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