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Article

Balanced Choices: Examining the Impact of Dietary Diversity on BMI, Health Risks, and Rising Rates of Obesity in Kenya

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Abstract: The study examines the link between dietary diversity and BMI using data from Kenyan women aged 15–49. By exploring how dietary diversity affects BMI across various BMI categories, the study examines the demand for diet diversity and its impact on BMI. The results reveal a positive relationship between food diversity and BMI at all quantiles, suggesting that a more varied diet is associated with increased BMI levels among underweight, overweight, and obese individuals. This indicates that the correlation between dietary diversity and health outcomes in higher BMI categories may be ‘unfavourable’, with increased food diversity linked to a higher risk of ‘unfavourable’ BMI categories, i.e., overweight and obesity. This may be attributed to higher caloric intake and/or higher consumption of saturated fats and cholesterol from a more diverse diet, which can contribute to increased BMI. These findings highlight the need to consider moderation and balance in energy intake and the overall nutritional quality of diets when considering and evaluating diets and dietary diversity and in formulating and shaping food policies.



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Keywords: diet quality assessment; healthy food diversity score; diet diversity score; diverse diet demand; Kenya

1. Introduction

The primary cause of various forms of malnutrition, including underweight, stunting, and wasting, as well as noncommunicable diseases like overweight, obesity, and vitamin/mineral deficiencies, is attributed predominantly to poor-quality diets. (A diet high in red meat, added sugar, and salt is linked to a higher risk of certain health outcomes specifically noncommunicable diseases compared to a diet high in vegetables, legumes, whole grains, fish, and oils [1,2]. In low- and middle-income nations in particular, little is known about the behavioural and economic obstacles to dietary improvements, despite these potential advantages [3–6]). These dietary issues represent the most pressing challenges facing society today [7,8]. The simultaneous presence of both inadequate and excessive food intake and nutrient consumption among individuals, and even within households, has added complexity to the understanding of malnutrition causes in recent years [9]. There are 462 million underweight adults globally, compared to 1.9 billion who are overweight or obese [8]. Kenya is not an exception, as the country has a high prevalence of both overweight and obesity. Approximately one-third of women between the ages of 15 and 49 are overweight or obese, while 19% of children under five have stunted growth [6,10]. Obesity rates are rising, posing a more significant threat to developed and developing countries [11,12]. Kenya’s problem is that most people cannot afford a healthy diet and are

unaware of the nutritional benefits of healthy diets. As a result, most Kenyans consume a diet low in nutrients and high in calories that is deficient in essential micronutrients [10]. The growing obesity rate in Kenya raises important questions about the relationship between dietary diversity and health outcomes. While consuming a varied diet can offer benefits such as a wide range of nutrients and flavours, it does not necessarily equate to a healthy diet. This is compounded by poverty and the high cost of nutritious foods. The challenges of affordability and limited awareness of the health benefits of diets are not unique to Kenya; they face the entire world [5,13,14].

Additionally, the complexity surrounding defining a healthy diet and identifying appropriate metrics for assessing diet quality has posed significant challenges in evaluating diet quality, thus complicating the design, implementation, and oversight of food policies [5,15,16]. Dietary diversity indicators (DDIs) serve as reliable measures of nutritional adequacy, highlighting the importance of variety for nutrient intake. However, DDIs primarily assess nutrient adequacy and do not effectively capture overall diet quality, moderation, or differentiate food types [17–19]. In contrast, food-based dietary guidelines incorporate diversity, adequacy, moderation, and balance within each food-group recommendation, such as the Healthy Eating Index (HEI), which includes components reflecting beneficial types of variety [19–21].

Among these methods, the Dietary Diversity Score (DDS) [22,23] and the Food Variety Score (FVS) [24] are widely recognised indicators of diet quality and nutrient adequacy. However, they exhibit certain limitations [15,16,25]. For instance, while the DDS quantifies variety, a fundamental aspect of dietary planning, it falls short of capturing all dimensions of a high-quality diet, as it merely counts food groups consumed. In contrast, the Healthy Food Diversity (HFD) index [19,26,27] has emerged as a more promising indicator, demonstrating a specific measure of “healthy dietary diversity” that is positively associated with dietary adequacy and inversely linked to excessive nutrient intake.

The relationship between dietary diversity and its association with both dietary adequacy and various health outcomes exhibits significant heterogeneity depending on which measurement indicator is used [11,19,28–35]. For example, the relationship between dietary diversity indicators (DDIs) and any measure of dietary adequacy may suggest that higher DDIs are associated with higher dietary adequacy or, conversely, that higher DDIs correlate with lower dietary adequacy [19,20,24,25]. Similarly, concerning health outcomes, the association between DDIs and any health outcome may indicate that higher DDIs are linked to a lower risk of undernutrition or wasting or, alternatively, that higher DDIs are associated with a higher risk of obesity [28,32,34,36,37], complicating efforts to devise policies or interventions aimed at promoting healthy eating habits.

We consider two goals. The three food diversity measures, the Count Measure (CM), Healthy Food Diversity Score (HFD) and the Dietary Diversity Score (DDS), are used to assess the following two objectives: 1. the demand for a diverse diet (a proxy for a quality diet) in the household; 2. the association between diet diversity and BMI (a proxy for health). Each of these three food diversity measurements is applied differently, giving the diet a score based on a particular criterion. Although these indices seem to focus on different aspects of a healthy diet, they were designed to evaluate the nutritional value of the diet, and the outcomes are comparable. Data were utilised from the nationally representative Kenya Demographic and Health Survey 2022 (KDHS), which comprised food groups made up of 196 food items consumed at home by the surveyed.

Our results show that there is a positive correlation between food diversity and BMI for all quantiles, meaning that it increases BMI for underweight, overweight, and obese people. These results support the theory that a more diverse diet equates to a higher energy intake if moderation is not emphasised. Thus, more dietary variety may not always translate into better health because a diversified diet may lead to a higher intake of cholesterol and saturated fats, which can lead to overweight and obesity. The evaluation of diet quality is thus faced with a challenge, as are its consequences for food policy, particularly the discussion of undernutrition, obesity, and the consequent growth in noncommunicable

diseases linked to the ideal BMI (often normal BMI). Therefore, this research suggests investigating these characteristics further.

Section 2 covers the data, the underlying theory, and our empirical methodologies. In Section 3, the results are examined and presented, and then conclusions and suggestions for further study are given.

2. Materials and Methods

2.1. Data

This study uses cross-sectional data from the Kenya Demographic and Health Survey (KDHS) of 2022, a nationally representative cross-sectional household survey carried out about every five years under the World Bank Commission. In addition to a women's questionnaire for women aged 15 to 49, the study also incorporated data from the 2022 KDHS household questionnaire. The household questionnaire was primarily used to determine which women qualified for individual interviews. After 42,022 houses were chosen for the sample, 37,911 of them were able to be interviewed, resulting in a 98% response rate. Approximately 33,879 women between the ages of 15 and 49 were determined to be eligible for one-on-one interviews, with 32,156 women interviewed successfully, yielding a 95% response rate. These women had spent the previous night in the chosen households and were given the specific questionnaire for the Women's survey. This survey collected a range of personal data, such as height and weight, which was necessary for this research to ascertain the relationship between food diversity and health.

The Kenya Household Master Sample Frame (K-HMSF) served as the source of the sample for the 2022 KDHS. The framework that is currently in use in Kenya for household-based sample surveys was conducted by the Kenya National Bureau of Statistics (KNBS). As a consequence of Kenya's Population and Housing Census in 2019, 129,067 enumeration areas (EAs) were established. To generate the KHMSF, 10,000 of these EAs were chosen with a probability proportionate to their size. Four equal subsamples were randomly selected from the pool of 10,000 EAs. One of the four subsamples served as the basis for the survey sample. By georeferencing and naming households, the EAs were organised into clusters. For the majority of the survey data, the KDHS was intended to generate representative estimates at the national level, for each of the two urban and rural areas separately, at the regional level, and only for specific indicators at the county level. In order to achieve representativeness at the national, regional, and county levels, the data were correctly weighted, taking into consideration the fixed sample size per cluster and the non-proportional allocation of the sampling strata.

We limited our analysis to anthropometric and household data. In the first step, we used household data to assess the demand for a diverse diet. In the second stage, we used individual anthropometric data for women in their reproductive age range (between 15 and 49 years) to analyse the relationship between dietary diversity and BMI. One of the most important variables was the consumption data, which questioned household respondents about how many days their members had consumed different food types (vegetables, fruits, meat, dairy, oil, and condiments) in the seven days before the survey. Households were asked if there were any days during the seven-day recall period when their household did not have food or enough money to buy food. This variable was also included in the main variables. It signified a household that was "food insecure". Additional significant socioeconomic factors, including household size, location, age, gender, and educational attainment of the household head, were also analysed.

2.2. Measurement Strategy: Demand for Diet Diversity

Dietary diversity is typically measured by counting the number of distinct foods or food groups consumed over a specified period, usually between 1 and 7 days recall [16,19]. In more advanced methods, serving sizes based on dietary guidelines are used, as seen in Guthrie and Scheer's "Dietary Score" and Kant's "Serving Score", which allocate points for servings across key food groups [16]. These methods provide an understanding of dietary

patterns, helping to identify nutritional gaps and guiding public health strategies. At both individual and household levels, dietary diversity indicators reflect food quality and access, with measures like the count measure (CM) offering simple counts of food types over a reference period [16,34,38]. These indices not only represent micronutrient adequacy but also serve as a marker of household access to a variety of foods and the broader relationship between dietary patterns and food security [15,39].

Demand analysis components are related to food quality and diversity [40]. Three popular indices, Count Measure, (CM), Dietary Diversity Score (DDS), and Healthy Food Diversity (HFD) indices, are used in this study to quantify the demand for diet diversity in Kenyan Households [22,23,26].

DDS is a qualitative indicator of food intake that represents a household's access to a variety of foods and also serves as a proxy for nutrient adequacy of the diet of individuals. [39]. The number of specific foods or food types consumed over a reference period is used to generate a DDS. Based on the FAO's (2013) aggregation of food groups, the 16 food groups were reclassified into 12 food groups to quantify household dietary diversity, since a single food item can be classified into many food groups [15,16,39]. Our aggregation was based on similarities in the nutritional content and overall dietary composition.

We further combined the original 12 major food groups into five broad groups (grains, vegetables, fruit, meat/poultry/seafood, and dairy). The number of dietary groups—dairy, meat, grain, fruit, and vegetables—that are consumed each day is counted in this measure [15,16,41]. Households with greater DDS values are assumed to be consuming a more varied diet. DDS is not without weaknesses, though [5,25,28]. For instance, higher energy intake has been linked to higher DDS [28,31]. Therefore, increasing the intake of a more diverse diet may not always result in greater health because people may become overweight or obese. Moreover, increasing consumption of cholesterol and saturated fats has been connected to higher DDS, indicating that a high DDS may increase the risk of cardiovascular disease [28,42,43]. Furthermore, DDS does not distinguish between the relative healthiness of the foods consumed or account for the distribution of consumption across food items or groupings [5,26,41].

Unlike the DDS, the Healthy Food Diversity (HFD) index measures the healthiness of the food groups consumed. HFD was created by Drescher et al. (2007) as a Dietary Guide-line, which integrates nutrients, foods, and food variations to determine the recommended amount of each food group in an individual's diet and to construct a health factor (*hf*) for each food. It is now the most widely used metric for determining the quality of the diet. It assesses proportionality, quality, and diversity of diet. To determine the diet's health value (*hw*), multiply each food item's reported share in the basket by its corresponding health factor. Then, add all of the results to determine the diet's proportionality and quality [26,44,45]. In our investigation, the *hw* came from the more recently created works of Drescher et al. (2007). The *hw* of the diet multiplied by the share of the basket yielded the total HFD index. The score concurrently considered the quantity, distribution, and health value of foods—three crucial components of a diverse diet.

After calculating the indices, we examine the link between food diversity and health as measured by BMI using the empirical framework developed by [30]. This approach is based on theoretical models of household production of health [46,47], which leads to the formulation of an individual *BMI* production function wherein an individual's BMI is determined by their dietary consumption (*D*); leisure (*L*); fixed individual variables (*O*) such as age, gender, education, and socioeconomic background; and unobservable/unobserved individual traits (ϵ) such as genetic factors that influence *BMI*:

$$BMI = f(D, L, O, \epsilon) \quad (1)$$

Food consumption provides energy, vitamins, and minerals, which have an impact on utility both directly and indirectly through the development of *BMI*. Subject to financial

constraints, people select the ideal levels of D and L (and other good consumption, C) to maximise their utility.

$$\Phi^* = f_{\Phi}(P_D, P_C, W, N, O, \varepsilon_{\Phi}), \Phi = D, L \quad (2)$$

where the prices of all purchased inputs, P_D and P_C ; the wage rate, W ; non-labour income, N ; fixed (individual) factors, O ; and unobserved factors, which are assumed to have a zero anticipated mean, determine the demand for inputs into the BMI production function. The individual BMI supply function can be obtained by substituting the demand functions D and L into the BMI production function (Equation (1)). In an agricultural household model, this is comparable to deriving the supply function for farm output [48].

$$BMI^* = f_S(P_D, P_C, W, N, O, \varepsilon_{\Phi}) \quad (3)$$

Equation (3) denotes the exogenous factors—wages, prices, and features of the BMI production (and utility) function—that are used to solve the first-order (Kuhn–Tucker) conditions for the structural endogenous variables (D, L). While the individual’s BMI production function (Equation (1)) is a technological relationship, the BMI supply function (Equation (3)) is a reduced-form, behavioural relationship based on the individual’s optimal decisions. This is the most popular way to move from a theoretical framework to an empirical one [30].

Two steps can be taken to adopt an alternative “structural” approach to the shift to an empirical framework: first, estimating the demand functions for inputs (D^*, L^*), and then, using the technology (Equation (1)), substituting the predicted values. In this work, we take a (modified) structural approach, focusing on the determinants linked to Kenya’s double burden of malnutrition. We first perform an empirical investigation to evaluate the ideal demand for diet diversity. Using the exogenous (pre-determined) individual attributes specified in vector O as a regressor, the anticipated value of a measure of dietary diversity is employed in the second stage of our approach to estimate the BMI supply function (we refer to our empirical method as “modified” since we solely employ the food diversity measure and a predicted value from the first stage; the individual (pre-determined) traits and additional geographical controls, which capture wage variance, serve as proxies for the demand for leisure, or L'):

$$BMI^* = f_S^*(D^*, L', O, \varepsilon_B') \quad (4)$$

Our empirical investigation of the relationship between food diversity, BMI, and health centres on Equation (4). The two-stage process that was used has the benefit of effectively handling the potential endogeneity of food diversity, the primary explanatory variable of interest that is used in the BMI supply equation. To be more precise, we employ the first stage’s anticipated value in the second stage, and we add the necessary exogenous variables to the instruments by consulting the pertinent literature. Moreover, it makes sense to believe that equilibrium elements influencing BMI are predetermined; in other words, an individual’s traits (as well as additional behavioural and environmental factors) define BMI, even though BMI influences other characteristics of the individual. In this relationship, the impacts’ lag times are significant. Here, we contend that the impacts of BMI on other individual characteristics, such as diet diversity, have a longer (smaller) temporal lag than the effects of individual characteristics on obesity. In essence, this debate centres on the demand theory’s well-established assumption of preference stability.

2.3. Empirical Implementation

Following a two-stage structural approach, this study estimates the endogenous variables of diet diversity impacting BMI production and supply. Utilising predicted values sequentially in the second stage, the BMI supply function is evaluated. The diet diversity specification employed is derived from demand extensions by [49,50]. Household diet

diversity demand is empirically implemented following [50,51], utilising an equation encompassing household income quartile dummies, regional dummy variables reflecting price variations, household characteristics (e.g., education level, gender, age, household size), food insecurity status, and auto-consumption ratio. The diet diversity demand function is estimated through OLS regression. In the second stage, predicted diet diversity values inform the estimation of individual (women’s) BMI supply function via quantile regression. Explanatory variables include individual characteristics (age, education), regional dummies, and a wealth index. The analysis suggests that an individual’s health, as indicated by their BMI, is significantly influenced by the consumption of a diverse diet. To mitigate endogeneity concerns, explanatory variables are introduced stepwise, demonstrating stability in coefficients and indicating no severe endogeneity issues.

3. Results and Discussion

3.1. Summary Statistics

Table 1 presents a summary statistic for the variables used in the conditional Quantile Regression to determine the influence of diet diversity on women’s BMI and the OLS regression to determine the demand for diet diversity.

Table 1. Summary statistics of key variables used in the study.

Variable	Mean	Std. Dev.	Min	Max
Food diversity indicators				
Healthy Food Diversity Index (HFD)	0.397	0.059	0.24	0.623
Diet Diversity Score Index (DDS)	1.268	0.203	0.154	2
Count measure (CM)	10.213	2.776	2	16
Demographic characteristics				
Household (HH) size	5.099	2.488	1	22
Rural dummy	0.597	0.490	0	1
Male-headed household HH	0.608	0.488	0	1
Age (HH head)	42.479	13.433	15	98
Age (women)	29.216	9.514	15	49
Capital dummy (women)	0.007	0.081	0	1
Socioeconomic factors				
Poorest HH	0.155	0.362	0	1
Poorer HH	0.181	0.385	0	1
Middle HH	0.187	0.390	0	1
Richer HH	0.222	0.416	0	1
Richest HH	0.254	0.435	0	1
No education (in HH)	0.089	0.284	0	1
Primary education (in HH)	0.411	0.492	0	1
Secondary education (in HH)	0.277	0.447	0	1
Higher education (in HH)	0.218	0.413	0	1
Food insecure HH	0.301	0.459	0	1
Ratio of ‘auto consumption’	0.113	0.165	0	1
No-education (women)	0.056	0.229	0	1
Primary education (women)	0.365	0.481	0	1
Secondary education (women)	0.392	0.488	0	1
Higher education (women)	0.187	0.390	0	1
Wealth index (women)	3.239	1.409	1	5

HH stands for “household”. There are 17,243 observations for each of the two regression variables.

The data on food diversity indicators reveal that the Diet Diversity Score (DDS) has an average of 1.268, indicating a moderate level of dietary variety among Kenyan households. The Healthy Food Diversity Index (HFD) averages 0.397, suggesting a relatively low consumption of diverse healthy foods. The count measure, with an average of 10.213, indicates that Kenyan households typically consume about ten out of sixteen food groups. Overall, these food diversity metrics suggest a reasonable, albeit variable, consumption of a variety of foods, likely influenced by factors such as income limitations, limited

access to diverse food sources regional availability, market accessibility, and economic disparities [14,52]. The average household size is 5.099, with a wide range from 1 to 22, which highlights the demographic diversity in Kenya; 59.7% of households are rural, with a predominance of male-headed households (60.8%). The average age of household heads (42.479) and that of women (29.216) and a low proportion (0.7%) of women are categorised as living in the capital city, Nairobi.

The distribution across wealth categories shows a significant proportion of households in higher wealth brackets, 25.4%, richest, and 22.2% are in the richer quantiles; however, there is also a substantial proportion of poorer (18.1%) and poorest (15.5%) households, which highlights ongoing economic inequalities that may limit access to a variety of healthy food items [40].

The educational attainment within households reveals a higher prevalence of primary (41.1%) and secondary (27.7%) education, with a smaller proportion achieving higher education (21.8%). Educational attainment is closely linked to food security and dietary diversity, with higher education levels often correlating with better nutritional outcomes [53]; 30.1% of households are food-insecure households, reflecting a notable challenge in ensuring adequate food access.

An average of 11.3% of households with 'auto-consumption' indicates that a small proportion of food needs are met through household production. This relatively low figure suggests that many Kenyan households rely heavily on market-purchased food, which could be influenced by farm sizes being smaller and declining, decline in agricultural productivity, sluggish structural transformation process, and increased population pressures [54].

3.2. Demand for Food Diversity

We utilise three distributional indices to assess diet diversity: (i) Count Measure (CM), which calculates the number of different food products consumed by a household or individual, (ii) the Healthy Foods Dietary (HFD) Index; and (iii) the Diet Diversity Score (DDS)—that support healthy diets to evaluate the demand for diet diversity. The estimation coefficients for the demand for diverse food are displayed in Table 2, where the measures of count measure and healthy food diversity, HFD, and DDS were employed as dependent variables, respectively. The stated standard errors are robust, and every regression with different magnitudes and directions of coefficients rejects the hypothesis that each of the explanatory variables is jointly equal to zero.

Larger households exhibit increased demand for diet variety, as indicated by the CM, which could be attributed to different household members' diverse preferences and nutritional needs. However, this increase in variety is not necessarily associated with improved nutritional quality, as evidenced by the negative impact on DDS. Larger households may opt for cheaper, calorie-dense foods, compromising the overall nutritional quality of their diet [55,56]. This compromise between food variety and nutritional quality highlights the challenge of balancing diet diversity with healthfulness, particularly in larger households where resource allocation is a concern.

The rural dummy variable shows a positive association with the Count Measure (CM), indicating that rural households may consume a wider variety of foods. However, this variety does not translate into higher Healthy Food Diversity (HFD) or Dietary Diversity Scores (DDS), which suggests that while rural households have access to a broad range of foods, these are often less focused on nutrient-dense and healthful options. Rural areas in Kenya and sub-Saharan Africa frequently provide diverse, unprocessed foods through subsistence farming. Nevertheless, limited access to markets and nutritional education can result in diets that, despite their variety, lack essential nutrients [14,38,57].

Table 2. OLS estimates for the demand for diet diversity.

Variables	Count Measure (CM)	HFD	DDS
Household size	0.035 *** (0.01)	0.000 0.000	−0.003 ** (0.001)
Rural_dummy	0.180 * (0.072)	−0.006 *** (0.002)	−0.014 * (0.006)
Poorest	−1.602 *** (0.069)	−0.018 *** (0.002)	−0.032 *** (0.006)
Poorer	−0.550 *** (0.067)	−0.004 ** (0.002)	−0.025 *** (0.006)
Richer	0.838 *** (0.075)	0.010 *** (0.002)	0.035 *** (0.006)
Richest	2.017 *** (0.100)	0.020 *** (0.002)	0.086 *** (0.008)
No education (in HH)	−0.807 *** (0.072)	−0.016 *** (0.002)	−0.005 (0.007)
Secondary (in HH)	0.302 *** (0.059)	0.002 (0.001)	−0.002 (0.005)
Higher Education (in HH)	0.551 *** (0.078)	0.005 ** (0.002)	0.005 (0.006)
Male headed HH	0.104 * (0.049)	0.004 *** (0.001)	0.025 *** (0.004)
Age (HH head)	−0.003 (0.002)	0.000 *** 0.000	0.001 *** 0.000
Food insecure	−1.138 *** (0.058)	−0.017 *** (0.001)	−0.056 *** (0.005)
Ratio of 'auto consumption'	1.301 *** (0.138)	0.034 *** (0.003)	0.232 *** (0.012)
Constant	9.666 *** (0.114)	0.386 *** (0.003)	1.215 *** (0.009)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Household indicators are indicated by HH. The reference group for income level is the middle-income group, and the reference group for education level is the primary education group.

The demand for a varied diet is significantly lower among the poorest quantiles, reflecting the severe constraints poverty imposes on food choices. Lower-income restricts both the quantity and quality of food available, leading to monotonous diets with fewer nutrient-dense options [20,58]. In contrast, wealthier households benefit from increased access to a range of foods, including healthier options, underscoring the critical role of economic resources in enhancing diet diversity and quality [59].

Households with no education exhibit negative effects on both CM and HFD, highlighting that lower educational levels constrain the ability to make healthy dietary choices and limit food variety. Conversely, households with secondary or higher education levels show positive effects, emphasising that education enhances knowledge about nutrition and improves dietary quality. This supports the broader view that education equips individuals with the skills needed for healthier food choices and better management of food resources [29,60,61].

Household characteristics, such as gender and age, also play significant roles. Male-headed households show a positive effect on dietary diversity, which could reflect better access to resources and financial stability. Age of the household head is positively associated with diet diversity in some measures, suggesting that greater experience and stability contribute to improved dietary choices [34,61]. However, these findings may vary across contexts, highlighting the need for context-specific analysis.

Food insecurity negatively impacts diet variety, demonstrating that limited access to sufficient food reduces dietary diversity. Conversely, households that produce their own food show a positive effect on diet variety, supporting the idea that subsistence farming enhances access to diverse food options [54,62].

3.3. Diet Diversity and BMI

The second step of our model (Equation (4)) is reported by the empirical results shown in this Section and Tables 3 and 4. Women in their reproductive stages, or those between the ages of 15 and 49, are the focus of this second section of the study. The data are from the conditional Quantile Regression for the food variety measures HFD (for Table 3) and DDS (for Table 4), which are related to healthy diets. The conditional distribution estimates are expressed as a linear function of the explanatory factors. The three primary categories of an individual’s weight (and health) status are underweight, normal weight, and overweight/obesity, and these are captured by five quantiles of the BMI distribution ($Q = 0.05, Q = 0.20, Q = 0.50, Q = 0.80, \text{ and } Q = 0.95$).

The ideal BMI is between 18.5 and 25. A person is considered underweight (and undernourished) if their BMI is less than 18.5; overweight if their BMI is greater than 25; and obese if their BMI is greater than 30. In our sample, the distribution of BMI is as follows: 10% of persons are undernourished, 52% have an ideal BMI, 24% are overweight, and 14% are obese, the same percentages we have used for the quantile regressions in the Tables 3–5. According to [34], there is a difference in this distribution from the 2014 data. In particular, the ideal BMI has dropped by 7.2%, while the BMIs of overweight and obese people have increased by 3.7% and 5.1%, respectively. This suggests that these individuals’ “unhealthy” BMIs have been steadily rising. According to the most recent studies [63–66], this number indicates that the number of overweight and obese women has rapidly increased.

Table 3 examines the empirical distributional impact of the HFD diet diversity measure along with the effects of the other explanatory factors for women, such as wealth, education, age, and region.

Table 3. Quantile Regression estimates: The dependent variable is women’s BMI: using the Healthy Food Diversity Score Index.

	q10	q52	q24	q14
HFD fitted values	1.169 *** (0.191)	1.023 *** (0.236)	1.119 *** (0.204)	1.196 *** (0.219)
Women’s age	0.016 *** (0.001)	0.022 *** −0.001	0.018 *** −0.001	0.016 *** −0.001
Women’s age squared	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000
Women’s No education	−0.069 *** (0.007)	−0.083 *** (0.008)	−0.082 *** (0.007)	−0.071 *** (0.007)
Women’s secondary Educ	0.010 * (0.004)	0.005 (0.004)	0.010 * (0.005)	0.013 ** (0.005)
Women’s Higher Education	−0.003 (0.007)	−0.003 (0.005)	0 (0.006)	0.005 (0.006)
Rural dummy	0.022 *** (0.006)	0.018 *** (0.004)	0.018 *** (0.005)	0.025 *** (0.005)
Capital dummy	0.050 ** (0.017)	0.050 *** (0.011)	0.055 *** (0.013)	0.060 *** (0.01)
Wealth index	0.049 * (0.024)	0.064 * (0.032)	0.077 ** (0.026)	0.075 ** (0.025)
Wealth interaction HFD	−0.061 (0.06)	−0.072 (0.08)	−0.118 (0.066)	−0.121 (0.063)
Constant	2.096 *** (0.072)	2.224 *** (0.093)	2.147 *** (0.081)	2.092 *** (0.082)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Logarithmic BMI is the dependent variable. The HFD-fitted values are used to quantify diet diversity. The primary education group is the reference category for educational level.

Table 4. Quantile Regression estimates: The dependent variable is women’s BMI: using the Diet Diversity Score Index.

	q10	q52	q24	q14
DDS fitted values	0.203 ** (0.072)	0.137 * (0.064)	0.187 ** (0.065)	0.196 ** (0.070)
Women’s age	0.016 *** (0.001)	0.021 *** (0.001)	0.018 *** (0.001)	0.016 *** (0.001)
Women’s age squared	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000
Women’s No education	−0.083 *** (0.008)	−0.095 *** (0.008)	−0.092 *** (0.007)	−0.085 *** (0.006)
Women’s secondary Education	0.014 ** (0.005)	0.007 (0.004)	0.011 * (0.005)	0.015 ** (0.005)
Women’s Higher Education	−0.002 (0.006)	−0.003 (0.006)	0.000 (0.007)	0.004 (0.007)
Rural dummy	0.020 ** (0.006)	0.020 *** (0.004)	0.018 *** (0.005)	0.024 *** (0.005)
Capital dummy	0.048 ** (0.016)	0.045 *** (0.013)	0.049 *** (0.011)	0.053 *** (0.012)
Wealth index	0.051 (0.028)	0.055 * (0.028)	0.074 ** (0.027)	0.057 * (0.026)
Wealth interaction DDS	−0.015 (0.022)	−0.011 (0.021)	−0.03 (0.021)	−0.019 (0.021)
Constant	2.277 *** (0.089)	2.433 *** (0.084)	2.335 *** (0.083)	2.298 *** (0.090)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Logarithmic BMI is the dependent variable. The DDS-fitted values quantify diet diversity. The primary education group is the reference category for educational level.

Table 5. Quantile Regression estimates: The dependent variable is women’s BMI: using the Count Measure.

Variables	q10	q52	q24	q14
CM fitted values	0.022 *** (0.004)	0.017 *** (0.004)	0.019 *** (0.003)	0.019 *** (0.004)
Women’s age	0.016 *** (0.001)	0.021 *** (0.001)	0.017 *** (0.001)	0.016 *** (0.001)
Women’s age squared	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000	−0.000 *** 0.000
Women’s No education	−0.072 *** (0.007)	−0.085 *** (0.008)	−0.084 *** (0.006)	−0.073 *** (0.006)
Women’s secondary Educ	0.01 (0.005)	0.004 (0.004)	0.011 * (0.005)	0.013 ** (0.005)
Women’s higher Education	−0.003 (0.007)	−0.006 (0.006)	−0.002 (0.007)	0.003 (0.007)
Rural dummy	0.017 ** (0.005)	0.014 ** (0.005)	0.012 ** (0.004)	0.020 *** (0.005)
Capital dummy	0.050 ** (0.016)	0.048 *** (0.012)	0.054 *** (0.010)	0.054 *** (0.009)
Wealth index	0.040 *** (0.011)	0.043 *** (0.009)	0.043 *** (0.009)	0.045 *** (0.010)
Wealth interaction CM	−0.002 (0.001)	−0.001 (0.001)	−0.002 * (0.001)	−0.002 * (0.001)
Constant	2.352 *** (0.036)	2.479 *** (0.035)	2.431 *** (0.034)	2.396 *** (0.040)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Logarithmic BMI is the dependent variable. The count-fitted values are used to quantify diet diversity. The primary education group is the reference category for educational level.

The findings using HFD index, DDS, and CM fitted values are presented in Table 3, Table 4, and Table 5, respectively. These results mostly show consistent implications for BMI, with some variations in coefficient values. The findings with the Food diversity indicators (HFD, DDS, and CM) fitted values demonstrate the positive correlation between, food diversity and BMI across all quantiles. Against the expectations derived from the empirical modification and against the findings of other research (e.g., [29,34]), our data does not support a non-linear, inverted U-shaped association between diet diversity and BMI. It does support the inverse relationship similar to studies by [33,58]), particularly the finding that higher DDS is linked to higher calorie intake. Increasing dietary diversity may not always result in improved health because people may become overweight or obese, more specifically, if the more varied diet is higher in energy/caloric content, i.e., high in cholesterol and saturated fats.

The findings also demonstrate that age significantly and positively affects BMI. Although it has a negative sign, the age quadratic component is also statistically significant, indicating a non-linear relationship between age and BMI. This demonstrates that while age will have a favourable response to BMI, the effect will develop more slowly as an individual becomes older. Women with no education have a negative BMI, whereas women with some secondary education have a positive BMI, which may indicate a higher social position and lifestyle because they have a lower BMI. Having a rural background positively affects BMI.

Having a rural background positively affects BMI. The majority of women in rural areas tend to be thinner; this could be because the farming job is physically demanding and there may not be enough food available for them to eat. Furthermore, junk food is harder to come by in rural areas. Consuming a low-calorie diet and increasing physical activity levels can help reduce obesity [12,61]. For individuals living in the capital city, surprisingly comparable positive significant outcomes have been observed, where a higher BMI may result from consuming a more diversified diet. Because they are more likely to be exposed to conditions that could raise their BMI to harmful levels, women in the capital need to be more conscious of their BMI, take steps to lower it and put in the effort to do so, especially considering that at the 80% Quantile, we find that it has a greater effect on BMI. It can result from sedentary lifestyles, genetic vulnerability, increased calorie intake, and/or decreased calorie expenditure [12,61]. We might have observed a negative correlation between capital and BMI if the majority of women worked in offices and had easy access to potentially unhealthy quick foods.

Across all quantiles of our QR estimation, the Wealth Index, a proxy for income and household socioeconomic status, substantially raises BMI. According to this, having a high income in our setting may further increase BMI in the higher quantiles of the distribution. Households with higher incomes and resources often have more diverse diets, which can also grant them better access to healthcare and healthier living conditions. As a result, these families may experience lower risks of obesity and overweight, not only due to dietary diversity but also because of the broader benefits associated with their socioeconomic status [43]. In sub-Saharan Africa, including Kenya, higher income levels are linked to access to more diverse diets [57,66], but this diversity has been linked to an increase in the risk of obesity and overweight due to a shift towards processed, calorie-dense foods. Studies, i.e., refs. [11,43,57,64,66], show that urbanisation and rising incomes contribute to these unhealthy dietary changes, particularly in urban areas, leading to higher obesity rates. While dietary diversity is generally seen as beneficial, it does not always result in better nutritional outcomes if the variety includes unhealthy food options.

We also examined the interaction of the wealth index and food diversity indicators and wealth index in separate regressions. These interactions help capture variations due to diet quality. The interaction between wealth and food diversity indicators shows a negative impact on BMI at higher BMI categories with the Count Measure (CM), indicating that increased wealth and food diversity are associated with lower BMI. This suggests that wealthier households may have access to higher-quality, nutrient-rich foods, leading to

better weight management and reduced obesity risk. These findings are consistent with studies such as [14,29], which highlight that wealth, when it leads to the consumption of higher-quality, healthier foods, can positively influence BMI and help mitigate obesity.

4. Conclusions

This study investigates the causes of dietary diversity and its relationship with BMI. Employing a theoretically grounded estimation framework, the study assesses the demand for diet diversity and examines its link with BMI. The study indicates a positive relationship between diet diversity and BMI using measures like the Healthy Food Diversity (HFD) and Dietary Diversity Score (DDS). However, it emphasises that dietary diversity alone does not ensure nutritional adequacy, as it is also necessary to account for moderation dimensions. While a varied diet containing fruits, vegetables, whole grains, and lean proteins can be nutritious, one that includes more processed foods, sugary foods, and high-calorie foods that are frequently associated with lower incomes may lack nutritional quality and contribute to weight gain and associated health issues. Therefore, achieving both dietary diversity and the right moderation that reflects overall diet quality is crucial for overall health. Emphasising moderation and consumption of nutrient-dense foods alongside a variety of food choices can help reduce diet-related diseases. Additionally, there is a need to reassess metrics and indicators for healthy diets to account for dietary diversity's impact, particularly in high-calorie-dense settings. Advocating for variety without emphasising moderation and considerations of the caloric content may mislead policies, especially in developing countries. Hence, a closer examination of diet quality indicators and their link with normal/ideal BMI is necessary for informed food policy and interventions, particularly targeted Diet Diversity Indicators (DDIs) effective in reflecting overall diet quality would be beneficial.

A key strength of this study is its assessment of household dietary diversity, which, while an imperfect measure of nutritional quality, serves as an important indicator of a household's economic ability to access a variety of food nutrients. By focusing on the relationship between a diverse, quality diet and good health, the study creates a specific context for evaluating optimal dietary practices. Given the limited understanding of the link between dietary quality and health outcomes in developing countries, this research is particularly valuable for academics and policymakers aiming to address nutrition-related issues.

However, a notable limitation is that the study does not account for individual dietary intake or specific food quality, which may lead to an incomplete understanding of how dietary diversity influences health outcomes. Without detailed data on the types and quantities of foods consumed, the findings may overlook critical nuances in dietary patterns that affect nutritional adequacy and overall health.

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