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DIET QUALITY OF PRE-SCHOOL-CHILDREN AGED 2-6 YEARS IN SELECTED SUB-COUNTIES, KITUI COUNTY IN KENYA

Thuku LN[1]*, Ngala S[1], Kaindi DM[1] and W Kogi-Makau[1]

Linet Njeri Thuku

*Corresponding author email: linethuku@gmail.com

[1]University of Nairobi, Department of Food Science Nutrition and Technology, Nairobi, Kenya

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ABSRACT

Substandard diet quality is a leading, yet avoidable, cause of poor health outcomes in children and adults. Around the globe, 22.3% of children are stunted, and although the stunting levels in Kenya have reduced from 26% to 18%, more effort is required. Different counties in Kenya have varying stunting rates, with the highest rates reported in arid and semi-arid counties, such as Kitui, where the stunting rate is 25%, which is higher than the national stunting rate of 18%. These high levels could be attributed to low dietary diversity intake, poor childcare practices, and other underlying causes of malnutrition. In arid and semi-arid lands, diets are driven by starchy staples, with low intake of fruits, vegetables, and animal-source foods. Nonetheless, minimal data exist on the diet quality of preschool children, as most data collected focus on complementary feeding practices of children aged 6-23 months. The objective of this study was to establish the diet quality of children aged 2-6 in Kitui County using the 29-food group diet quality questionnaire. A simple random sampling technique was used to sample 273 households in three sub-counties: Kitui Central, Nzambani and Katulani in Kitui County. Foods made from grains were the most consumed by 95% of the respondents, while processed meats and poultry were the least consumed at 1%. Cheese, unprocessed non-ruminant meat, fish and seafood, nuts and seeds, and fast foods were not consumed by any of the study children. The study children had a food group diversity score of 4.62 ±1.92, a Non-Communicable Disease- Protect score of 2.66 ± 1.22 and a Non-Communicable Disease-Risk score of 0.67 ± 1.047. Only 26.8% of the study children met the ALL-5 dietary requirement. The household's head occupation was significantly associated with ALL-5 and Non-communicable disease-protect scores, whereas socio-economic status was significantly associated with ALL-5 indicator. Conclusively, a small percentage of the preschool children meet the diet quality requirements. There is a need for collaborative effort between the government and other institutions to educate the population on the importance of consuming a diversified diet rich in non-communicable disease-protective foods, inclusive of the ALL-5 food groups and low in non-communicable disease-risk foods, as well as promote accessibility and affordability of these foods.

Key words: Diet quality, ALL-5, Food group diversity score, non-communicable disease-protect, non-communicable disease-risk

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INTRODUCTION

In various African settings, preschool children lean towards the consumption of diets rich in energy and low in proteins, vitamins and minerals despite their critical role in the body [1]. At this stage of childhood, children start going to preschool and could end up eating foods away from home. Additionally, they are likely to consume unhealthy snacks and can be influenced by their agemates, the media and shifting trends. The early childhood period, encompassing ages 2 to 5 years, represents a vital phase for continued neurodevelopment and psychosocial growth [2]. This phase builds upon the foundational neural architecture established during the first thousand days of life, which is essential for optimal cognitive, emotional, and social functioning.

One of the key outcomes of poor diets is malnutrition in all its forms. As of 2024, globally, 22.3% of the children were stunted, while 13 million children in Eastern and Southern Africa suffer from acute malnutrition [3]. In Kenya, although the stunting rates have decreased, they remain higher than the global rate at 25%. Although cases of stunting, wasting and underweight are found in all counties in Kenya, the distribution differs. As stated in the Kenya Health Demographic Survey 2022, some counties have stunting prevalence as high as 37% and 25% in Kilifi and Kitui counties, respectively. According to the Kitui County Agri-Nutrition Implementation Strategy, high levels of malnutrition in Kitui County could be attributed to low dietary diversity intake, poor childcare practices, and other underlying causes of malnutrition.

Substandard diet quality is a leading yet avoidable cause of poor health outcomes in children and adults. It is associated with malnutrition and a variety of chronic diseases and could be the main predisposing factor to Non-communicable Disease-affiliated deaths in all countries around the globe [4]. However, there is little or no data to show the diet quality of preschool children aged 2-6 years in Kenya. The objective of this study was to establish the diet quality of children aged 2-6 years in Kitui County using the 29-food group diet quality questionnaire.

METHODS

Study Setting

This study, conducted in April 2023, targeted households with preschool children aged 2-6 years residing in Kitui County. Out of the 18 sub-counties, 3 sub-counties, Kitui Central, Nzambani, and Katulani were conveniently selected due to their proximity to Kitui Central township, where the Food and Local, Agricultural and Nutritional Diversity (FoodLAND) project Kitui hub is located. The sample size was calculated using Fisher's formula using a prevalence rate of zinc deficiency (83.3%) among preschool children in Kenya [5]. A total of 273 households from 20 rural villages where farming activities are carried out, four from Kitui Central, eight from

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Nzambani, and eight from Katulani sub-counties, were randomly selected to participate in the study. The households were randomly picked from a sampling frame provided by the village elder. In the event a household had more than one child between 2 and 6 years, the younger child was picked as the index child. The respondent was the person responsible for the child's meals.

Data Collection tools and techniques

The study used an open data kit (ODK) [6] mobile data collection platform with the server support provided by ona.io. It used a Diet Quality Questionnaire (DQ-Q) to determine the diet quality of the study population. The DQ-Q is a tool used to gather data on indicators of dietary adequacy as well as protection against non-communicable diseases (NCDs) and can be used to evaluate dietary trends and patterns in the population. The tool was customized to the Kenyan context through a consultative engagement to identify the widely available foods for each food group. Though the output gathered from the questionnaire can generate 15 indicators namely: *i)* Minimum Dietary Diversity for Women (MDD-W)/ Food Group Diversity Score (FGDS), *ii)* ALL-5, *iii)*NCD-Protect, *iv)* NCD-Risk *v)* Global Dietary Recommendations (GDR) Score, *vi)* Zero vegetable or fruit consumption, *vii)* Animal-source food consumption, *viii)* Sweet beverage consumption, *ix)* Sweet foods consumption, *x)* Salty or fried snack consumption, *xi)* Whole grain consumption, *xii)* Pulse consumption, *xiii)* Nuts/seeds consumption, *xiv)* Processed meat consumption *xv)* %consuming each food group or combinations of food groups, the study focused on the first four indicators which are relevant to the study, giving a holistic view of the children's diet quality [7]. The children's caregivers, had to respond either yes or no to whether the child had consumed any food within the specified food group during the past 24 hours, as read out to them by the enumerator. The 29 food groups are: 1) food made from grains, 2) whole grains, 3)white roots, tubers and grains, 4) pulses, 5) vitamin A-rich orange vegetables, 6) dark green leafy vegetables, 7) other vegetables, 8) Vitamin A-rich fruits, 9) citrus fruits, 10)other fruits, 11) baked/grain-based sweets, 12) other sweets, 13) eggs, 14) cheese, 15) yogurt, 16) processed meats, 17) unprocessed red meat (ruminant), 18) unprocessed red meat (non-ruminant), 19) poultry, 20) fish and seafood, 21) nuts and seeds, 22) packaged ultra-processed salty snacks, 23) instant noodles, 24) deep fried foods, 25) fluid milk, 26) sweet tea/coffee/cocoa, 27) fruit juice/fruit-flavored drinks, 28) soft drinks and 29) fast food.

Training of Enumerators

Eight (8) enumerators who were conversant with the local language and had prior experience in collecting nutrition data were recruited. They were then trained on administering the questionnaire and validated after a pre-test exercise that was conducted in Kitui township (not part of the sample population).

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Data Analysis

Data were downloaded from the server in Excel format and was later imported into the Python software (version 3.7.3). This software was used in cleaning, coding and analyzing the data collected using the DQ-Q. Statistical Package for Social Sciences (SPSS) version 20, was used in the in-depth analysis. To generate the different diet quality indicators, the food groups were regrouped as follows.

Food Group Diversity Score (FGDS)- Grains, white roots and tubers, and plantains, Pulses- beans, peas and lentils, nuts and seeds, dairy, meat, poultry and fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, other fruits. Consumption from a food group earned one (1) mark; hence the highest possible mark is 10. The cut-off point is a score of 5.

ALL-5- Starchy staples, vegetables, fruits, pulses nuts and seeds, animal-source foods. The highest possible point for each group is one (1), resulting in five (5) points as the highest possible mark. Any score less than five (5) indicated that not all the 5 recommended food groups had been consumed.

NCD-Protect Score- Whole grains, pulses, nuts and seeds, vitamin A-rich orange vegetables, Dark green leafy vegetables, other vegetables, vitamin A-rich fruits, citrus, other fruits. This score ranges from 0-9, with a higher score indicating a higher quality diet. Consumption from a particular group earns one point while non-consumption scores a zero (0). The highest possible score is nine (9).

NCD-Risk Score- Soft drinks, Baked / grain-based sweets, other sweets, processed meat, unprocessed red meat, deep fried food, fast food & instant noodles, packaged ultra-processed salty snacks. Though based on eight (8) food groups, the highest possible score is nine (9), because consumption of processed meat earns a double score of two (2) points while consumption of the other seven (7) groups earns a score of one (1) point. The four diet quality indicators were then tested for association with the household's socio-economic status, age and gender of the child, the number of meals consumed by the child, the gender, level of education and occupation of the household head at 5% significance level. The NCD-Protect scores were categorised into minimal protection (<3 food groups), medium protection (3-4 food groups), upper medium protection (>4-≤6) and high protection (>6). Likewise, the NCD-Risk scores were categorised into minimal risk (<3 food groups), medium risk (3-4 food groups), upper medium risk (>4-≤6) and high risk (>6) [8].

The wealth index of the study households, a proxy for socio-economic status, was determined using the principal component analysis method, as described by the World Food Programme, which utilized data on housing characteristics, assets owned, and access to basic utilities.

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Ethical Consideration

The University of Nairobi approved the study, and ethical clearance was obtained from the KNH-UoN Ethical Research Committee with reference number P437/05/2022. Participants were informed about the study's objectives, procedure, benefits, and risks. Written consent was obtained from those who agreed to participate. Participation was voluntary, and each participant was free to decide otherwise at any time. Code numbers identified all participants; data was kept in a secured computer and was accessible to the research team only.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the study children in Kitui

The percentage of female children (57.1%) was higher than that of male children (42.9%). The majority of the children (82.1%) were between two and four years of age while the least (4.4%) were six years old. The mean age of the children is 3.29±1.17 years, with a range of 4 years. The largest percentage of the children (74.7%) had a child-parent relationship with the household head. There was a significant difference in age among the study children based on their gender p-value=0.02. (Table 1). The study established that most children, both males and females, consumed between two and four meals a day. These results agree with a study conducted in Kilifi among preschoolers that reported more than three-quarters (83.7%) of the children consumed two to four meals a day [9].

Social-demographic characteristics of the respondents

The majority of the respondents (96%) were female. In terms of their age, the largest percentage (75.1%) of the respondents were between 20-39 years. Slightly more than a third (35.9%) of the respondents had attained secondary school level qualification whereas the lowest percentage (0.4%) was either in secondary school or had gone through adult education. The largest percentage (37%) of the respondents were farmers and the least percentage (0.7%) were students. Slightly less than two-thirds of the respondents (65.9%) were spouses to the household head and only one (0.4%) was an employee (Table 2).

Food Group Consumption by the Study Children in Kitui County

Among the 29 food groups (Table 3), foods made from grains such as maize ugali, maize porridge, rice, bread, and chapati were the most consumed by 95% of the study children. This was four times higher than the percentage of those who were reported to have consumed whole grains (23%) and white root, tubers, and plantains (13%).

Close to two-thirds (65%) of the children had consumed dark green leafy vegetables such as Sukuma wiki (kales) and spinach, with notably low consumption of pumpkin leaves, Jute mellow leaves (mrenda), and vine spinach (nderema) at 1% and Vitamin

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A rich orange vegetables at 4%. A majority (83%) of the children consumed other vegetables, which include tomatoes, cabbage, and green capsicum. Less than a fifth of the children had consumed fruits in the preceding 24 hours: vitamin A rich fruits (15%), other types of fruits (18%), and citrus fruits (2%).

Slightly more than half of the children had consumed pulses (55%) and milk (59%) in the last 24 hours preceding the day of the interview. Other sources of proteins as reported were unprocessed red meat (14%), eggs (9%), yoghurt/mala (4%), and poultry (1%).

The most consumed snack as reported by the study respondents was baked / grain-based sweets (13%), followed by soft drinks (5%), other sweets (4%), fruit juice and fruit-flavored drinks (3%), Packaged ultra-processed salty snacks (2%), instant noodles (2%) and processed meats at 1%. Notably, about a quarter of the children consumed deep-fried foods such as chips, ngumu and mandazi (local types of doughnut).

Five (5) out of the twenty-nine food groups were not consumed by any of the study respondents; these included *cheese*; *unprocessed meat-non-ruminants such as* pork, rabbit; *fish and seafood*, *nuts, and seeds*, and *fast foods* purchased from fast food vendors.

The results of this study align with those from a study conducted in Kitui County, which reported that starchy food groups were the most consumed food group among children, with a 94.6% consumption rate, and minimal consumption of animal products, ranging between 4.6% and 32.1% [10]. The high consumption of starchy staples among households with preschool children across regions could be attributed to the fact that they are less costly when compared to foods in other food groups. As a coping mechanism, less privileged households react to food price changes by prioritising the intake of starchy foods over micronutrient-rich foods. The consumption of Starchy staples by a high proportion of the study population indicates that the households have low income [11].

The results of this study on the consumption rate of pulses were higher than those of a survey conducted in Western Kenya which exhibited lower rates of 18 % to 25% [12]. On the other hand, they were lower than the results of studies in Western Kenya and Marsabit County that reported a consumption rate of 67% and 62%, respectively [13, 14]. The seemingly lower consumption rate of pulses was unexpected, as Kitui County is a significant producer of pulses, including green grams, cowpeas, pigeon peas, and beans, indicating that these pulses are readily available. An in-depth analysis should be conducted to unravel this paradox.

The consumption rate of milk in this study was higher compared to a study conducted among preschool children in Mateka Division, Bungoma County, that reported a milk

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SCHOLARLY, PEER REVIEWED
Volume 25 No. 8
September 2025
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consumption rate of 25% [12], but similar to a study conducted in Nairobi County that reported a consumption rate of 51% [15]. The milk was consumed in various forms, either in its pure form, in tea, or porridge. Milk is a vital component of the diet, particularly for children. Evidence shows that in the low- and middle-income countries, where more often than not diets are nutrient deficient, intake of animal-source foods, including milk, has spurred linear growth and weight gain in children [16].

In this study, the least consumed food groups can be divided into two categories. The first category comprises of foods that are considered healthy, such as vegetables, fruits, poultry, unprocessed non-ruminant meats (pork, rabbit, camel), eggs and yogurt/mala. These findings are similar to those reported from a study conducted in Kilifi County among preschool children that showed other vegetables (excluding dark green vegetables), fruits, meat, eggs, and fish were the least consumed food groups [9]. Similarly, a study conducted in Mwingi (Kitui County) and Makueni County reported that meat and egg consumption was on the lower side [17]. Minimal consumption of fruits and vegetables among children can lead to inadequate intake of minerals and vitamins, which are essential for growth as well as protect them from non-communicable diseases in their later life. Many children in low- and middle-income countries cannot meet the dietary recommendations set for fruit and vegetable intake [18]. Intake of animal-source foods, even in small amounts, complements diets of poor quality and goes a long way in helping in the fight against malnutrition. They are a source of high-quality and biologically valuable protein. Perceived nutritional value was reported to be a key pull factor in the consumption of more commonly purchased animal-source foods [19].

The second category of the least consumed food groups is those considered unhealthy such as salty packaged snacks, fruit juice or fruit-flavored drinks, other sweets, soft drinks and fast foods all consumed by less than 5% of the study population (Table 2). These findings differ from the Performance Monitoring and Accountability report, which shows that 16.5% of children in 11 counties (Kitui County included) consume savory snacks, 32.9% consume sweet snacks, and 24.7% consume sugar-sweetened beverages [20]. High consumption of the aforementioned food groups can lead to overweight, obesity, insulin resistance, teeth problems, and caffeine-related effects among children [21].

Food Group Diversity Score (FGDS) among Pre-School Children in Select sub-Counties in Kitui County

Only slightly less than a third (32.2%) of the children under study had achieved the minimum target of consuming five (5) out of ten food groups. The average FGDS for the study children was 4.62±1.92, showing that the dietary diversity of the study children is below what is considered desirable by the World Health Organization.

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Volume 25 No. 8
September 2025
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These findings agree with results from a study conducted in Nairobi, which reported that the children had a mean dietary diversity score of 2.83 ± 1.4, and less than a third (28.9%) of the children achieved the minimum dietary diversity score [22]. Compared to this study, a higher percentage (42%) of children aged 48-59 months had achieved the minimum dietary diversity score in a study conducted in Marsabit County by Adongo [14].Low dietary diversity is indicated by a disproportional and inadequate consumption of food groups, which often ends up resulting in nutritional deficiencies, particularly micronutrient deficiency [23]. On the other hand, diets characterized by assorted foods from diverse food groups are linked with better nutrient intake. Cognizant of the high stunting rates (25%) in the county, Kitui County attributes this to poor dietary diversity intake, among other factors such as poor child practices. Promoting the consumption of a highly diverse diet inclusive of foods rich in micronutrients such as fruits, vegetables, pulses, and flesh foods will greatly contribute to the fight against malnutrition.

ALL-5 consumed by study children in Select sub-Counties in Kitui County

Only 26.8% of the study children consumed all five food groups classically recommended for day-to-day consumption in food-based dietary guidelines globally or within 24 hours: fruits; vegetables; pulses, nuts, or seeds; animal-source foods; and starchy staples. Of the five food groups, the most commonly consumed group was starchy staples (96%), and the least consumed was fruits (27%). The consumption rates of the other food groups were pulses, nuts and seeds (55%), animal source foods (66%), and vegetables (94%) (Figure 1).

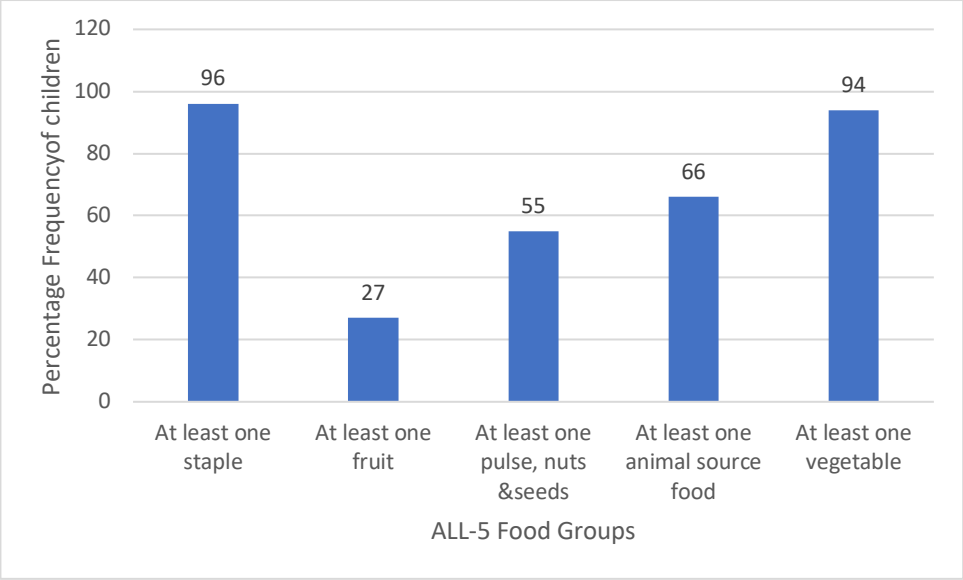

Figure 1: Proportion of those who consumed ALL- 5 groups

The results depict that among the five food groups that form the ALL-5 indicator, the consumption rate of at least one starchy staple was the highest among the study

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SCHOLARLY, PEER REVIEWED
Volume 25 No. 8
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children. These results agree with those from a study conducted in Kilifi County; cereals or foods made from cereals and grain products were the most regularly consumed, at least six times a week by preschool children in Kilifi County [24]. In Kenya, starchy staples are the primary dietary source of calories, with minimal contribution from other groups [24, 25].

The moderately high consumption of legumes among the study population aligns with the findings by Ronoh [12] where 67.8% of the children consumed legumes. In instances where households are not able to afford animal-source foods, legumes are consumed as a protein source [12]. While the study indicates a high rate of consumption of animal-source foods, this is primarily due to the elevated milk consumption levels (59%) compared to other animal-source foods that were consumed by less than 15% of the preschool-aged children in the study. Despite fish being a reserve of the riparian communities in the last few decades, the national and county governments have put in efforts to educate other citizens of the benefits of its consumption, including adding it to children's porridge flour. Per calorie, meat, fish and eggs are almost three times more expensive than dairy products [26].

The results of this study show very high consumption rates of vegetables, which differ from other studies that show vegetable consumption among preschool children is low. In Kilifi County, only 37.7% consumed vegetables at least three times a week [24]. The high consumption of vegetables could be attributed to two factors. First, the study was conducted during a wet season when cowpea leaves, a commonly consumed vegetable, were readily available. A similar occurrence was reported by Waswa *et al.* [27], where the presence of short rains led to increased availability and consumption of dark green vegetables. Secondly, though in small quantities, over 24 hours could cumulate to over 15g [28] as most families use tomatoes and onions, which are classified as vegetables, to prepare most of the children's meals.

The findings align with the report by the Kenya Health Demographic Survey, which found that 31% of children in rural areas had not consumed fruits or vegetables in the 24 hours preceding the interview day. Most children, particularly in low- and middle-income countries, are unable to meet the recommended intake of fruits. Seasonality is a significant factor influencing fruit consumption in Kenya as is price. Inadequate consumption of fruits could lead to a scarcity of micronutrients, which are vital for proper growth and development in children [18].

Results for NCD-Protect and NCD-Risk scores among pre-school children in select sub-counties in Kitui County

The NCD-Protect score for the study population was 2.66 ± 1.22, with a maximum score of 7 and a minimum score of 0. These results agree with those from a study conducted in India, which reported an NCD-Protect score of 2.3 ± 1.8 [29]. According

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to the categorisation by FoodLAND [8], the score indicates that the children have minimal dietary protection against NCDs.

A low NCD-Protect score in children, reflecting poor intake of protective foods, has long-term consequences for development and health. Such a score is associated with stunted brain and cognitive development due to a lack of critical nutrients such as vitamins and minerals. These effects can even carry over into adulthood and affect future generations, reinforcing cycles of poor health and economic disadvantage. Out of the nine (9) healthy food groups recommended by WHO as foods that protect individuals from NCDs, the most consumed were other vegetables (83%), dark green vegetables (64%), and pulses (55%). Citrus fruits (2%) and Vitamin A-rich vegetables (4%) were the least consumed. Nuts and seeds were not consumed at all (Figure 2). Whole grains, vitamin-A-rich fruits, and other fruits were consumed at moderately low rates of 23%, 15%, and 18%, respectively.

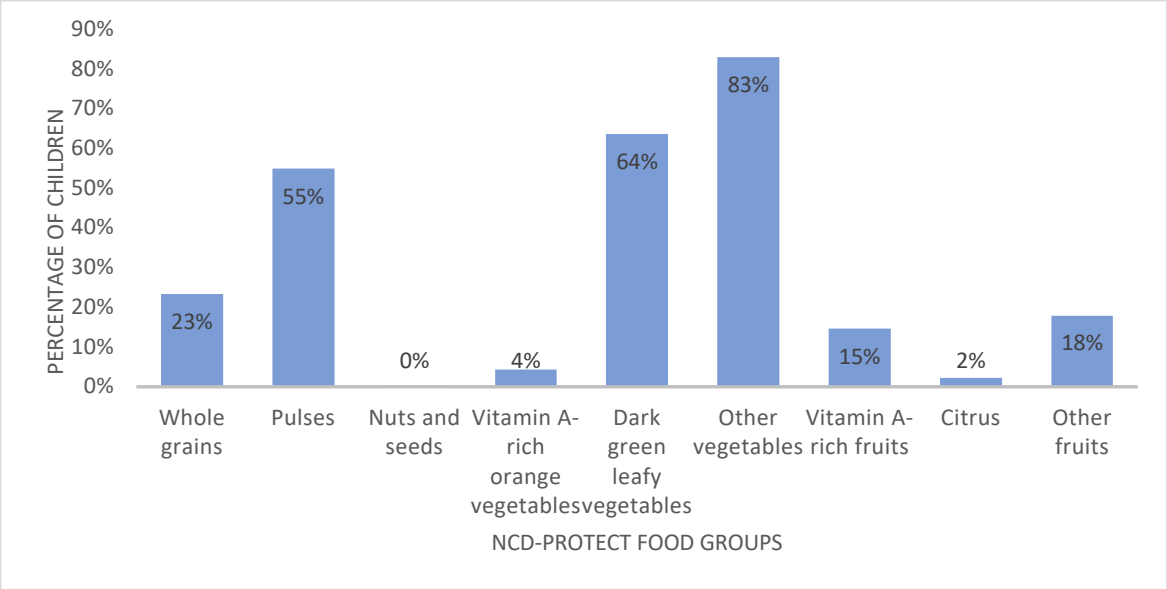

Figure 2: Consumption rates of NCD-Protect foods of the Study children who consumed in select sub-counties in Kitui county

These findings align with a study conducted in Tharaka Nithi County in Kenya, which shows that the consumption of vitamin A-rich fruits is low (at 7.2%), while dark green vegetables are a significant source of vitamin A in children's diets [30]. The findings of this study that show zero consumption of nuts and seeds are similar to those of a study conducted in Western Kenya which found that less than one percent of the children consumed nuts and seeds [31]. Although there is scarce information on the consumption rates of vitamin C-rich foods, specifically citrus fruits, there is available evidence showing elevated rates of vitamin C deficiency in parts of Kenya, indicating that the consumption rates are low.

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The NCD-Risk score for the study population was 0.67±1.047, with a maximum score of six (6) and a minimum score of zero (0) out of nine (9). The scores are similar to those reported in a study conducted in India among children, which found an NCD-Risk score of 1.0 ± 1.0 [29]. This score reflects minimal consumption of foods that increase the risk of non-communicable diseases[8].

Overall, a low NCD-Risk score indicates a protective dietary pattern that contributes to healthier development and reduces the long-term risk of non-communicable diseases (NCDs).

Of the eight (8) food groups that ought to be limited or avoided, deep-dried food such as mandazis and chips (25%), unprocessed red meat (14%), and baked/grain sweets such as cakes and biscuits (13%) were the most consumed. Soft drinks, other sweets (ice pops and chocolates), processed meats (sausages, smokies), fast foods, and ultra-processed foods were consumed by less than 5% of the study population (Figure 3).

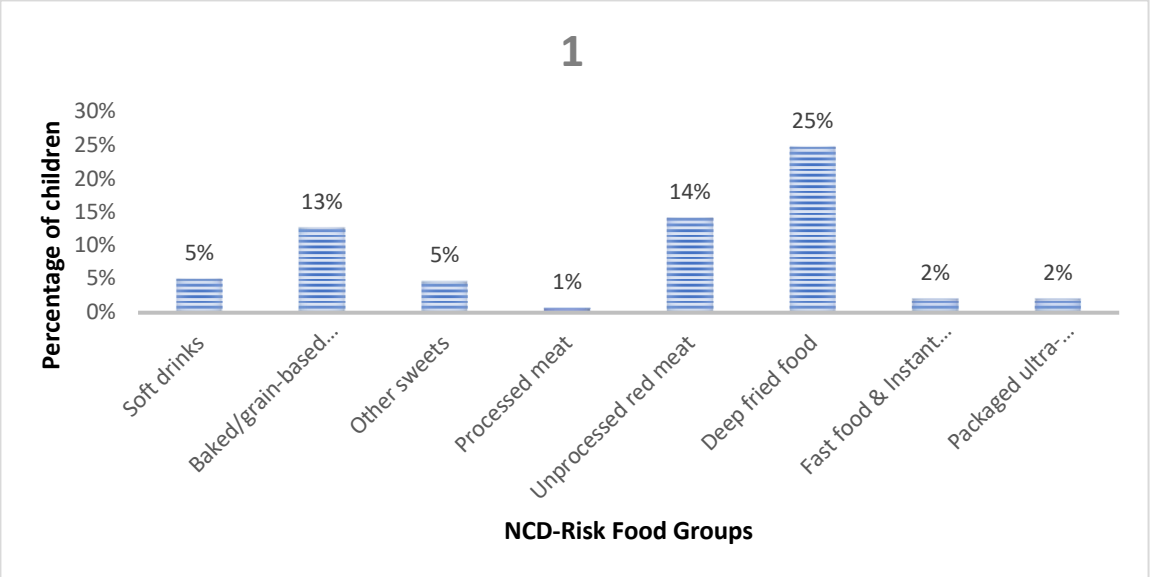

Figure 3: Consumption rates of NCD-Risk foods of the Study children who consumed in select sub-counties in Kitui county

These findings agree with a study conducted in the rural areas in India where deep-fried foods such as chips were the most consumed junk food [33]. While specific data on the consumption rates of non-communicable disease (NCD) risk foods among children in Kenya is limited, several studies and reports highlight concerning trends related to dietary habits and their potential health impacts. According to the latest Kenya Demographic Health Survey, 49% of children consumed a sweet beverage, 26% had unhealthy foods in the preceding 24 hours [34]. Nordhagen *et al*. [35] found higher rates of consumption of fast foods and sweetened beverages

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Volume 25 No. 8
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ISSN 1684 5374

among children in Nairobi County. The results of this study show lower consumption rates of NCD-Risk foods, this could be because the study site was in a rural area. In West Africa, the daily consumption rate of soft drinks among children aged 2-5 years was 20-36% in urban areas, with significantly lower consumption in rural areas [36].

Dietary habits play a key role in the deterrence, treatment or occurrence of NCD at any point of the lifecycle. Worth noting is that several non-communicable diseases originate in childhood More than NCDs' effect on health, they have a noteworthy impact on the economic status of households, societies and countries. In Kenya, it has been shown that NCDs reduce household income by 28.8%, meaning the affected families face unprecedented health expenses that push them into an unending poverty cycle. The fight against NCDs, therefore, becomes not only an ethical imperative but also a fiscal imperative [37].

Factors associated with the diet quality of study pre-school children in select sub-counties in Kitui county

This study investigated the association among the four select diet quality indicators and possible determinants, including household head characteristics (gender, education, and occupation), child characteristics (gender, age, and the number of meals consumed in a day), and household socio-economic status.

The FGDS and NCD-R scores were not significantly associated with any of the seven variables. The household head's occupation was significantly associated with two indicators: ALL-5 and NCD-P, with p-values of 0.004 and 0.01 respectively. There was a significant association between the socio-economic status and the ALL-5 diet quality indicator p-value of 0.012 (table 4). The findings of the study agree with the findings in the KDHS 2022 report that socio-economic status influences diet quality. According to the report, the percentage of children who had consumed zero vegetables or fruits declines with an increase in wealth quintile. Likewise, the study findings by Muthini *et al*. [38] partially agree with the study's findings that indicate certain livelihood sources are significantly associated with diet quality, while others exhibit inverse relationships. Research evidence show that the household head's level of education and occupation significantly influence dietary outcomes among children. Additionally, children in households with more educated or formally employed heads are more likely to meet the minimum dietary diversity requirements [39, 40].

The fact that the child's gender was not significantly associated with any of the selected diet quality indicators suggests that the study population is not affected by socio-cultural factors, for instance, gendered food allocation, which would otherwise affect the children's quality of diet.

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CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The research findings indicate that the diet quality of preschool children is far below global nutritional recommendations. They predominantly consume starchy foods as staples, with their choice leaning towards refined grains over whole grains. Food groups with higher nutrient content are still under-consumed, particularly citrus fruits, beta-carotene-containing orange-coloured vegetables, and foods with high nutrient content, such as cheese, fish and seafood, nuts, and seeds. While dark green leafy vegetable consumption is relatively adequate, overall dietary diversity remains poor, averaging less than five on the dietary diversity score, and remarkably, fewer than 26.8% of children met the comprehensive ALL-5 dietary adequacy criteria. Although the consumption of fast foods and unhealthy snacks was relatively low, the diets offer minimal protective benefits against non-communicable diseases (NCDs) and only limited exposure to dietary risk factors. These findings underscore the urgent need for targeted agri-nutrition interventions to improve diet quality and reduce long-term health risks among preschool-aged children.

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Conflict of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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Table 1: Socio-demographic characteristics of index children in study households in Kitui County

	Female n=117		Male n=156		p-value
	n	%	n	%	
Child's Age					
2 years	43	36.8	43	27.6	0.02
3 years	43	36.8	41	26.3	
4 years	15	12.8	39	25	
5 years	13	11.1	24	15.4	
6 years	3	2.6	9	5.8	
Relationship to the Household Head					
Child					
Grandchild	86	73.5	118	75.6	
Relative	28	23.9	37	23.7	
	3	2.6	1	0.6	0.508
Number of meals					
<2	3	2.6	3	1.9	
2-4	103	88	130	83	0.390
>4	11	9.4	23	14.7	

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Table 2: Social-demographic characteristics of the respondents

Variable	N	%
Respondent's Gender		
Male	11	96
Female	262	4
Respondent's Age		
<20	8	2.9
20-29	129	47.3
30-39	76	27.8
40-49	29	10.6
50-59	17	6.2
60-69	9	3.3
70-79	4	1.5
>80	1	0.4
Respondent's level of education		
Never went to school	11	4
Primary drop out	20	7.3
Completed primary	86	31.5
Secondary drop out	25	9.2
In secondary	1	0.4
Completed secondary	98	35.9
College	25	9.2
University	6	2.2
Adult education	1	0.4
Respondent's Occupation		
Student	2	0.7
Salaried employee	17	6.2
Farmer	101	37
Businessperson	36	13.2
Casual laborer	50	18.3

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September 2025
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Unemployed	58	21.2
Other	9	3.3
Relationship to household head		
Household head	49	17.9
Spouse	180	65.9
Son	1	0.4
Daughter	30	11
Grandson	1	0.4
Granddaughter	2	0.7
Relative	3	1.1
Parent	6	2.2
Employee	1	0.4

Table 3: **Food Group consumption by the Study Children (2-6yrs) in select sub-counties in Kitui County**

Food Group no	Food Group	% consumption	Food Group no	Food Group	% consumption
1	**Food made from grains**: Maize ugali, maize porridge, rice, bread, chapati, or noodles?	95%	**16**	**Processed meats**: Sausages, smokies,	1%
2	**Whole grains:** Ugali made from millet or sorghum, porridge made from millet or sorghum, green maize, githeri, or popcorn?	23%	**17**	**Unprocessed red meat (ruminant)**: Goat, beef, minced beef, mutton, liver or matumbo?	14%
3	**White roots, tubers, and plantains:** Irish potato, white sweet potato, green banana, nduma, yam, or cassava?	13%	**18**	**Unprocessed red meat (non-ruminant)**: Pork, rabbit, or camel?	0%

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Volume 25 No. 8
September 2025
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4	**Pulses**: Beans, githeri, green gram, kamande, pigeon peas, or green peas?	55%	19	**Poultry:** Chicken, duck, turkey, quail, or guinea fowl?	1%
5	**Vitamin A-rich orange vegetables**: Carrots, pumpkin, butternut, or sweet potato that is orange or yellow inside	4%	20	**Fish and seafood**: Fish, omena,	0%
6	**Dark green leafy vegetables**: Sukuma wiki, spinach, nightshade, amaranth, saget, or cowpea leaves Pumpkin leaves, mrenda, nderema, mitoo,	65%	21	**Nuts and seeds**: Groundnuts, peanut butter, cashews, pumpkin seeds, or simsim seed?	0%
7	**Other vegetables**: Tomatoes, cabbage, green capsicum, mushrooms.	83%	22	**Packaged ultra-processed salty snacks:** Crisps, Ringoz, or chevda?	2%
8	**Vitamin A-rich fruits**: Pawpaw, mango, passion fruit, or matunda ya damu?	15%	23	**Instant noodles**: Indomie?	2%
9	**Citrus**: Orange or tangerine?	2%	24	**Deep fried foods**: Chips, ngumu, mandaazi, samosa, viazi karai or bhajia, or fried chicken?	25%
10	**Other fruits**: Ripe banana, pineapple, avocado, watermelon, or thorn melon, apples, grapes, pear or guava	18%	25	**Fluid milk:** Milk, tea with milk, or powdered milk?	59%
11	**Baked / grain-based sweets:** Cakes,	13%	26	**Sweet tea / coffee /**	66%

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Volume 25 No. 8
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	queencakes, biscuits, or kaimati?			**cocoa**: Tea with sugar, coffee with sugar, Milo, or drinking chocolate?	
12	**Other sweets**: Sweets, chocolates, ice cream, or ice lollies?	5%	**27**	**Fruit juice and fruit-flavored drinks**: Fruit juice or fruit drinks?	3%
13	**Eggs?**	9%	**28**	**Soft drinks**: Soft drinks such as Coca-Cola, Fanta, or Sprite, or energy drinks such as Red Bull?	5%
14	**Cheese?**	0%	**29**	**Foods bought from Fast food joints** *such as Kenchic, KFC, Chicken Inn, Burger King, Domino's, or other places that serve pizza or burgers?*	0%
15	**Yogurt or mala**?	4%			

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Table 4: Factors associated with diet quality

	FGDS[1]	ALL-5[2]	NCD-P[3]	NCD-R[4]
Household Head Gender	0.75	0.5	0.848	1.000
Household Head Level of Education	0.911	0.6	0.1	0.287
Household Head Occupation	0.08	0.004**	0.01**	0.236
Socio-economic Status	0.122	0.012**	0.819	0.316
Gender of the index child	0.3	0.2	0.477	0.546
Child's Age	0.327	0.538	0.803	0.152
Number of meals consumed by the child	0.108	0.224	0.964	0.617

** Significant association at a 5% level of significance
Notes:
[1]Food Group Diversity Score (FGDS),
[2] ALL-5
[3]Non-communicable Disease-Protect (NCD-P),
[4]Non-communicable Disease-Risk (NCD-R)

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