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Impacts of Caregivers' Nutrition Knowledge and Food Market Accessibility on Preschool Children's Dietary Diversity in Remote Communities in Southeast Nigeria

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Abstract: Empirical evidence is scanty on the nexus between caregivers' nutrition knowledge, market accessibility, and preschool children's dietary diversity in remote communities of Africa's most populous country, Nigeria. To fill this gap, this study evaluated the effects of caregivers' nutrition knowledge and access to food market on dietary diversity of preschool children. We used cross-sectional data from four hundred households selected from twenty remote communities in Southeast Nigeria. The study adopted instrumental variable regression to estimate the impacts of nutrition knowledge and food market access on preschool children's dietary diversity. The findings show that in remote communities, caregivers' nutrition knowledge and households' closeness to the market improved preschool children's dietary diversity. The study demonstrates the potential of improving preschool children's nutrition outcomes through enhancing access to food market and the nutrition knowledge of the caregivers.

Keywords: nutrition knowledge; market access; preschool children; FANTA; food groups; impact; instrumental variable

1. Introduction

This millennium has witnessed a revolution in programs and projects aimed at improving the nutritional wellbeing—macro- and micronutrient intakes—of under-five or preschool children. The international community has shown keen interest in reducing the high rates of undernutrition in rural and agricultural communities in developing countries [1–5]. Improved nutrition in rural areas will enhance child development, while diminishing mortality and morbidity [6–9]. This has stimulated research regarding preschool children's intake of diverse and nutritious diets [7]. Mothers or caregivers' knowledge or understanding of appropriate foods in their right proportions given to preschool children is therefore necessary to improve the nutritional wellbeing of the children [7,10,11]. Incidentally, many caregivers do not have adequate knowledge about the nutrient composition of certain foods that should be given to preschool children [11].

Udoh and Amodu [12] and Ngwu et al. [13] noted significant knowledge gap about complementary feeding practices among caregivers in Nigeria. Sholeye et al. [14] studied a cross-section of women in southwestern Nigeria and found that foods such as beans, beef, cereals, cassava, and yam were not given to infants; rather, herbal concoctions were served to them. Similarly, Ekwochi et al. [15] found that women refused feeding their young ones with snail, grass-cutter meat, and egg because of the belief that such foods would make the children to become sluggish, lazy, and predispose them to stealing. These perceptions led to the introduction of nutrition policies, plans, and interventions with the aim of improving caregivers' knowledge of appropriate foods and feeding practices for their young children. The interventions include protecting and advancing food and nutrition security in Yobe State; efforts to positively transform nutrition in northern Nigeria; improving maternal, newborn, and child nutrition in northern Nigeria; national policies on food and nutrition in Nigeria; National Plan of Action on Food and Nutrition (NPAN) in Nigeria; National Strategic Plan of Action for Nutrition (2014–2019); UNICEF implemented nutrition intervention programs; 2017 Nigeria Nutrition in Emergency Sector Response Plan; and 2018 Zero Hunger Initiative [9,16–26]. More so, food supplementation, food fortification, and biofortification of staple crops have been employed to address nutrient deficiencies among children and mothers in Nigeria. Besides improving caregivers' nutrition knowledge, these policies and interventions are directed towards achieving the ambitions of the Nigerian dietary guidelines for preschool children. The guidelines recommend that mothers should do exclusive breastfeeding from birth to the first six months, and after six months, they should introduce complementary feed with a variety of cereals, tubers, legumes, fruits, and animal foods given with cup and spoon [27]. The guidelines further recommend that preschool children should be fed diverse foods in required amounts while consumption of sugary foods should be limited. Also, preschool children should be given fruits and vegatables that are rich in vitamin A, other fruits and vegetables, cereals, legumes, tubers, and animal products and this should continue even when they are sick [27].

Remarkable progress in nutrition and dietary diversity of preschool children, especially in urban areas, where quality road infrastructure exists and food markets are accessible, has been recorded unlike in remote rural areas [28–30]. Remoteness and poor market access could limit the effectiveness of nutrition interventions on improving caregivers' knowledge and appreciation of the benefits of quality feeding practices and diets [31]. This raises another important research issue which is access to diverse and high-quality foods for caregivers and preschool children in remote areas.

Studies have documented the contributions of nutrition interventions on the improvement of children's feeding practices and wellbeing of mothers/caregivers [11,32–40]. Incidentally, these studies largely neglected remote communities where access to diverse foods is poor due to bad roads which make transportation and the consumption of diversified foods in such areas nearly impossible. Remoteness can undermine the efforts made to improve food security, feeding practices and diets by limiting access to quality food markets [41,42]. The contribution of market access in improving smallholder farmers' nutrition is documented in literature [43–50]. However, empirical evidence on the nexus between accessibility to food market, caregivers' knowledge of appropriate diet for preschool children, and dietary diversity in Nigeria is scanty.

This study filled this gap in knowledge by using data from Southeast Nigeria to determine the impact of caregivers' knowledge and that of access to market on children's dietary diversity. The choice of Southeast Nigeria for this study is apt for many reasons. The roads in Southeast Nigeria are in deplorable conditions, marking the region as one with bad road infrastructure in the country [51,52]. This poor state of road infrastructure makes transportation very difficult and expensive, which impacts negatively on market access [53]. Although Southeast Nigeria has the lowest stunting and wasting rates among under-five children in Nigeria, Ebonyi and Imo States, where the survey was conducted, have rates comparable to other parts of the country [54] and children in these States consume less diversified diets. Therefore, this study explored the impacts of caregivers' nutrition knowledge and food market accessibility on preschool children's dietary diversity in southeast Nigeria.

Specifically, the paper first determined caregivers' nutrition knowledge of appropriate feeding practices of preschool children and documented the food groups (types and number) consumed by preschool children in southeast Nigeria. Secondly, we used the instrumental variable regression (IVR) framework to consistently estimate the impacts of caregivers' knowledge of appropriate feeding practices and food market accessibility on preschool children's dietary diversity in southeast Nigeria.

2. Methodology

2.1. Description of the Study Area

The study area is the Southeast geopolitical zone of Nigeria. Nigeria is divided into six geo-political zones—Northcentral, Northeast, Northwest, Southeast, Southsouth, and Southwest. Southeast zone is made up of five States—Abia, Anambra, Ebonyi, Enugu, and Imo. This zone is otherwise known as Igboland because it is largely dominated by the Igbo-speaking tribe of Nigeria. The zone is bounded on the north by Kogi and Benue States, on the east by Cross River State, on the south by Akwa Ibom and Rivers States and on the west by Delta and Edo States. According to the National Bureau of Statistics, the 2016 population estimate of the area is 21,955,414 persons [55]. The vegetation of the area is predominantly rainforest, which supports the cultivation of food crops such as rice, maize, yam, cassava, oil palm, cowpea, sweet potato, cocoyam, plantain, banana, melon, bambara nut, breadfruit, groundnut, and various vegetables and fruit trees. The people of the region largely engage in farming and trading activities, as well as other occupations such as civil service, corporate businesses, etc. The region has divergent beliefs, perceptions, and attitudes about food and nutritional practices, particularly for under-five children.

2.2. Sampling Technique

This study adopted purposive and random sampling techniques. The researchers visited the Headquarters of all the Local Government Areas (LGAs) in the two states and interacted with some officials of the LGAs to ascertain the state of remote communities in the respective LGAs. Following the visits, a list of LGAs with the worst road infrastructure was compiled. Five LGAs with the worst road infrastructure were identified and selected in each of the two states for further study. In each of the LGAs identified with very bad road infrastructure, communities with poor electricity supply, poor internet and mobile phone networks, and minimal development interventions (particularly on nutrition) were also compiled. Two such communities were randomly selected from each LGA, resulting to a total of twenty communities for the survey. These were rural communities in which agriculture was the inhabitants' main means of livelihood. With the aid of the list of households obtained from the leadership of each of the communities, twenty households were picked at random. In all, two hundred households were selected from each of the states, resulting in a total of four hundred households for the final survey.

2.3. Data Collection

The survey instrument was the dietary diversity questionnaire consisting of foods consumed by preschool children over the preceding 24 h. The questionnaire was developed by the authors and administered face-to-face to caregivers of preschool children in Ebonyi and Imo states. The researchers/authors read and interpreted the content of the questionnaire to the caregivers and recorded the responses. The authors first conducted two pilot surveys for twenty caregivers in Abia state to determine the effectiveness of the questionnaire in terms of format, order, wording, and reliability. The questionnaire was administered to the twenty caregivers in the pilot state (Abia state) and re-administered after twenty-one days. The test-retest reliability of the questionnaire yielded a correlation coefficient of 0.90 which was significant at 1% level. The questionnaire consisted of questions in nominal, Likert-type, discrete and continuous scales. Most of the questions were

close-ended. This was done to standardize the responses and achieve efficient data collection, entry, coding, and analysis.

The mothers/caregivers were asked to indicate the various kinds of food fed to all under-five children in their household the previous day as contained in the questionnaire and read out by the interviewers. The questionnaire also reserved a column under the foods listed, where the authors recorded other foods eaten by preschool but not listed on the questionnaire. The questionnaire also contained detailed questions on ownership of assets, household, contextual and farm characteristics, visit to health facility and visit by a health worker, mothers' knowledge and/or perception of good feeding and nutrition practices, and market access variables. To ascertain the knowledge/perception about appropriate feeding practices, the caregivers were asked to indicate on a Likert-type scale their level of agreement or disagreement on ten knowledge questions reflecting the Nigerian dietary guidelines for preschool children. The questions include whether caregivers agree or disagree that:

i. babies should be given only breast milk for the first 180 days;
ii. babies should be given colostrum;
iii. preschool children should eat egg;
iv. preschool children should eat fish;
v. preschool children should eat fruits and vegetables;
vi. preschool children should eat meat;
vii. preschool children should eat snail;
viii. preschool children should be given cereals, tubers, plantain and beans cooked with vegetables;
ix. preschool children should be given variety of foods; and
x. sick preschool children should be given more food rather than herbal concoctions.

This method is popular in the literature and many scholars have applied this approach in assessing knowledge of mothers on appropriate feeding practices [56–61].

We asked the caregivers to indicate the length of time taken to walk to the market in their communities, being a proxy for market access. This is a better proxy for market access in communities with poor road infrastructure because bad roads would generally increase the amount of time taken to reach the market but may not necessarily increase the distance to the market.

2.4. Data Analysis

The study adopted the Food and Nutrition Technical Assistance (FANTA) Project guide for measuring dietary diversity of a group to capture the dietary diversity score of infants and young children. The FANTA project categorized foods into twelve different food groups to reflect dietary quality [62,63]. The choice of FANTA project classification of food groups was informed by many reasons. Apart from being an internationally acceptable standard metric for assessing household and individual's dietary diversity and quality, it is an ideal index for evaluating impacts of nutrition interventions [62]. Also, research attention is shifting away from overt consequences of vitamin and mineral deficiencies to multiple hidden hunger burdens [64]. The usual scientific breakdown of 5 food groups lumps together all vitamin-rich foods as well as mineral-giving foods. This type of classification blurs our understanding of preschool children's consumption of foods rich in micronutrients and the resultant multiple hidden hunger burdens and other malnutrition challenges in the event of inadequate micronutrients. A more robust classification of food groups is therefore needed to capture the existence of hidden hunger and assess the consumption of other foods that are capable of contributing to the burden of chronic diseases such as diabetes, obesity, cancer, and so on [65,66]. The dietary diversity score is a good indicator for measuring nutritional quality and feeding practices of children [64,65,67–69]. The authors followed the recommendations of Swindale and Bilinsky [62] and Swindale and Bilinsky [63] with a slight addition (adding commonly consumed foods in the study communities, such as edible insects) in using a set of 12-food groups for calculating the dietary diversity of the children—cereals/grains, fish and seafood, root/tubers and plantain, seeds/pulses/nuts,

vitamin A-rich fruits and vegetables, other fruits and vegetables, milk and milk products, oil/fats, meat (organ and flesh meat) and edible insects, sugar/honey, eggs, miscellaneous (spices, condiments and beverages). The caregivers were asked to indicate all foods listed on the questionnaire and others not listed consumed by preschool children in their households the previous day. The detail of the foods consumed by preschool children is presented in Table 3. An account of the various groups of food consumed by the children yields a score ranging from zero to twelve.

Market access was measured using walking time to the market as a proxy. Furthermore, a Likert-type scale consisting of ten statements was used to capture mothers' nutrition knowledge of appropriate feeding practices of infants and children. The mothers were asked to indicate their level of agreement, disagreement, or neutrality to the statements on a 5-point rating scale of strongly agree = 5 points, agree = 4 points, undecided = 3 points, disagree = 2 points, and strongly disagree = 1 point. A mean of 3.00 was used as cut-off point to determine the nutrition knowledge level of the mothers with respect to each statement on appropriate feeding practices of preschool children. That is, adding 1, 2, 3, 4, and 5 and dividing by 5 gives 3 as the average. Furthermore, each mother/caregiver's knowledge level of appropriate feeding practices was determined by adding up all the scores of the knowledge statements and divided by 10. This value was used as an endogenous variable in our instrumental variable regression. The instrumental variable regression model is stated as follows:

$$Y = \beta X + \delta Z + \sigma V + \varepsilon \quad (1)$$

where:

Y = Dietary diversity of the children (count i.e., number of food groups consumed)
X = Nutrition knowledge (average of the ten knowledge statements)
Z = Vector of household, farm, asset, and contextual characteristics, which served as the control variables
V = Vector of dichotomous state variable (Imo = 1, Ebonyi = 0)
β, δ and σ are the respective parameter estimates.
ε is the error term.

The impact of market access (time taken to walk to the market) on dietary diversity of children is given below:

$$Y = \alpha T + \delta Z + \sigma V + \varepsilon \quad (2)$$

where:

Y = Dietary diversity of the children (count ie number of food groups consumed)
T = Time taken to walk to the market (minutes)
Z = Vector of household, farm, asset, and contextual characteristics which serve as the control variables
V = Vector of dichotomous State variable (Imo = 1, Ebonyi = 0)
α, δ and σ are the respective parameter estimates.
ε is the error term.

There may be unobserved factors that affect both dietary diversity and caregivers' nutrition knowledge simultaneously. It is also possible to have unobserved factors that affect both dietary diversity and market access simultaneously. This creates an endogeneity problem, and to avoid this problem, the researchers used two important instruments—one for nutrition knowledge and one for market access. The instruments must be correlated with nutrition knowledge/market access (relevance criterion) but uncorrelated with dietary diversity (exclusion criterion). The researchers conducted ordinary least square regressions to ascertain the instruments that fulfilled the two basic criteria—relevance and exclusion criteria—in Equations (1) and (2). The variable, visit to a health facility in the last three months, emerged as valid instrument for nutrition knowledge and dietary

diversity while ownership of car fulfilled the exclusion and relevance criteria in the market access and dietary diversity model, hence was chosen as the valid instrument. Previous researchers adopted similar instruments in their studies [11,70–72]. These instruments can affect dietary diversity only through the knowledge of appropriate feeding practices and/or market access channels.

3. Results

3.1. Characteristics of the Respondents

From the statistics shown in Table 1, the average household size in the area was approximately 7 persons (6.69) with at least 1 woman in the reproductive age category and about 2 children (2.15) in the under-five category. The households were mostly smallholders cultivating an average of 1.57 hectares of land and their most reared livestock is fowl with an average of 7.65 birds per household. Ownership of assets such as refrigerator (20%), television (25%), and mobile phones (35%) indicates that few households in the area possessed these assets. This may be connected to poor access to electricity (29%) in the communities. Few households in the communities had access to safe drinking water (15%). The level of remoteness is further expressed by the average time it takes to get to the market place, which was approximately 61 min (over an hour).

Table 1. Demographic Characteristics of the Respondents

Variable	Mean	Std. Dev.
Number of under-five children (count)	2.15	1.24
Household size (number of persons)	6.69	2.69
Number women in reproductive age in household (count)	1.23	1.11
Education of Head (years spent in school)	7.90	5.33
Education of Spouse (years spent in school)	8.36	5.58
Spouse's age (years)	36.63	8.56
Household head's age (years)	44.24	10.53
Health worker visit (yes = 1, no = 0)	12%	
Visit to health facility for the past 12 months (yes = 1, no = 0)	44%	
Ownership of television (yes = 1, no = 0)	25%	
Ownership of radio (yes = 1, no = 0)	67%	
Ownership of mobile phone (yes = 1, no = 0)	35%	
Ownership of refrigerator (yes = 1, no = 0)	20%	
Ownership of car (yes = 1, no = 0)	16%	
Access to electricity (yes = 1, no = 0)	29%	
Ownership of motorcycle (yes = 1, no = 0)	49%	
Ownership of tricycle (yes = 1, no = 0)	13%	
Ownership of bicycle (yes = 1, no = 0)	44%	
Do you have a safe drinking water source (yes = 1, no = 0)	15%	
Number of goats owned (count)	1.81	2.66
Number of fowls owned (count)	7.65	25.48
Number of sheep owned (count)	0.85	3.03
Number of cows owned (count)	0.04	0.36
Land size (in Hectares)	1.57	2.85
Time taken to walk to the market (Minutes)	60.99	55.85
Transportation cost to the market (Naira)	460.28	402.21
Have under-five children attending school (yes = 1, no = 0)	0.24	0.13
Number of under-five children in school (count)	1.81	0.97
Sample size (N)	400	

Education is very important in improving dietary diversity and it was also examined by the researchers. Our result shows that the number of years spent in school by both parents was approximately 8 years (i.e., 7.9 years for the household heads and 8.36 years for their spouses), which means they may have only completed primary school level of education. This average is below the basic education requirement of the Universal Basic Education program in Nigeria.

3.2. Caregivers' Knowledge of Appropriate Foods that Should be Fed to Under-Five Children

From Table 2, one can see that mothers understood and appreciated that babies should be given only breast milk for the first 180 days, and that preschool children should eat fish, fruits, cereals, tubers, yam, and beans cooked with vegetables. Out of the ten statements, the mothers/caregivers

show considerable knowledge levels (i.e., up to 3 points) in five statements. For instance, the fact that mothers/caregivers knew that babies should be given only breast milk for the first 180 days and that they should be given colostrum suggests clear understanding of appropriate dietary requirement necessary for the development and maintenance of healthy food habits. Developing a healthy and balanced dietary pattern is essential for the growth and development of preschool children and it will also influence their dietary and feeding habits after five years of age [73]. However, some caregivers believed that preschool children should not eat egg, meat, and snail, and variety of foods; instead, sick children (6–59 months) should be given more herbal concoctions rather than food.

Table 2. Caregivers' knowledge of appropriate foods that should be fed to under-five children

Perception/Knowledge Statements	Mean	SD
Babies should be given only breast milk for the first 180 days	3.17 *	1.57
Babies should be given colostrum	3.43 *	1.32
Young children (6–59 months) should eat egg	2.84	1.43
Young children (6–59 months) should eat fish	3.14 *	1.52
Young children (6–59 months) should eat fruits and vegetables	3.17 *	1.50
Young children (6–59 months) should eat meat	2.85	1.48
Young children (6–59 months) should eat snail	2.94	1.42
Young children (6–59 months) should be given cereals, tubers, beans and yam cooked with vegetables	3.18 *	1.43
Young children (6–59 months) should be given variety of foods	2.99	1.50
Sick children (6–59 months) should be given more food rather than herbal concoctions	2.94	1.46

Note: * have knowledge, otherwise have no knowledge

3.3. Food Groups Consumed

Table 3 presents the list of foods consumed by preschool children while Table 4 summarizes the distribution of caregivers according to reported food groups consumed by preschool children. Table 4 shows that roots, tubers, and plantain group was the most common food category consumed by preschool children (87.5%) in the area, followed by other fruits and vegetables (83.3%), seeds, nuts, and pulses (65.5%), cereals/grains (66.0%), and vitamin A rich fruits and vegetables (61.0%). The consumption of animal-based foods and products was not very common in the area because less than 50% of the caregivers did not feed their children with such foods. For instance, 49.3% of preschool children consumed fish and seafood, 29.3% consumed milk and milk products, 42.5% consumed meat and edible insects, while 25.3% consumed eggs. The table also indicates that the children consumed less sugar/honey (5.0%) and oil and fats (3.8%).

Table 3. Specific foods given to under-five children

Food Group	Examples
Cereals/grains	Corn/maize, rice, sorghum, millet or any other grains or foods made from these (e.g., bread, corn flakes, golden morn, noodles, spaghetti, pap, *agidi*, or other grain products)
Roots, tubers, and plantain	Potatoes, yam, cassava, cocoyam, plantain, or other foods made from these roots and tuber (e.g., *garri*, *tapioca*, *fufu*, *plantain chips*, *potato chips*)
Vitamin A rich vegetables and fruits	Banana, papaya, mango, carrot, palm fruit, red/yellow sweet pepper
Other fruits and vegetables	Garden egg, fresh and canned tomatoes, African pear, avocado pear, pineapple, apple, water melon, African star apple, *ube mgba*, guava, soursop, orange, cucumber, grape, cabbage, lettuce, green, spinach, pepper fruit, waterleaf, onion, garlic, ginger, scent leaf, bitter leaf, *okazi*, *oha*, coconut, pumpkin leaf, okra, garden egg leaf, date, wild fruits, and fruit juice made from these
Meats, organs, and edible insects	Beef, pork, mutton, chevon, goat, game, turkey, guinea fowl, chicken, duck, other birds, insects (termites, locust, crickets), snail, liver, kidney, intestine, heart, or other organ meats or blood-based foods.
Eggs	Eggs from chicken, duck, guinea fowl or any other egg
Fish and seafood	Fresh, frozen or dried fish, crayfish, crab, shellfish, and other sea foods
Pulses, nuts, and seeds	Beans, groundnut, melon, walnut, cowpea, tiger nut, soybean, cashew nut, bambara nut, oil bean, breadfruit, jackfruit, *akidi*, palm kernel nut, pigeon pea, or foods made from these (e.g., *moi-moi*, *akara*, peanut butter)
Milk and milk products	Milk, yoghurt
Oil and fat	Margarine, butter, vegetable oil, bleached palm oil, groundnut oil, olive oil, etc.
Sugar/honey	Sugar, sugar cane, honey, ice cream, chocolates, candies, sweet, chewing gum, cookies, and cakes
Miscellaneous	Black pepper, salt, condiments (Onga, Maggi cube, Royco cube, Knor, Ajinomoto, Vedan) hot sauce, *Uda*, *Uziza* seed and other local spices, beverages, alcohol

Table 4. Distribution of caregivers according to reported food groups consumed by preschool children

Food Category	Frequency	Percentage
Cereals/Grains	264	66.0
Root, Tubers, Plantains	350	87.5
Seeds, Nuts, Pulses	262	65.5
Egg	101	25.3
Milk and Milk Products	117	29.3
Meat and Edible Insects	170	42.5
Fish and Seafood	197	49.3
Vitamin A Fruits and Vegetables	244	61.0
Other Fruits and Vegetables	333	83.3
Sugar/Honey	20	5.0
Oil/Fats	15	3.8
Miscellaneous	19	4.8

3.4. Number of Food Groups Consumed

The number of food groups consumed is presented in Table 5. The table shows that the children consumed less diversified diets. The average number of food groups consumed by preschool children in the area was 5.05.

Table 5. Number of Food Groups Consumed

Number of Food Groups Consumed	Frequency	Percentage
None	4	1.0
One	2	0.5
Two	38	9.5
Three	58	14.5
Four	70	17.5
Five	66	16.5
Six	59	14.8
Seven	40	10.0
Eight	42	10.5
Nine	21	5.3
Total	**400**	**100.0**

3.5. Impact of Caregivers' Nutrition Knowledge on Preschool Children's Dietary Diversity

Table 6 shows the instrumental variable (IV) regression results of the effect of nutrition knowledge on dietary diversity of preschool children. The instrumental variable (IV) regression adopted has two stages—stage 1 for nutrition knowledge and stage 2 for dietary diversity. Our main interest was the stage 2 output; however, the stage 1 model yielded interesting results. Stage 1 regression isolated that part of the variation in caregivers' nutrition knowledge which is uncorrelated with the error term using the mother/caregivers' visit to the healthcare center as an instrument to provide consistent and unbiased estimate of the impact of nutrition knowledge on dietary diversity. The effect of mother/caregivers' visit to the healthcare center was positive and significant at the 1% level and this fulfils the relevance criterion of the instrument.

For the dietary diversity regression equation, the endogenous variable (nutrition knowledge) was positive and significant at 1% level. Other significant variables include number of under-five children, household size, household head's age, health worker visit, ownership of mobile phone, ownership of refrigerator, farm size, number of under-five children attending school in a household, and the square of education of the head. An increase in the number of under-five children per household reduced the dietary diversity of the children. This is expected because an increase in the number of under-five children in the household increases the burden on the income of the household to provide for diverse foods. However, the increase in the household size/number had a positive effect on the dietary diversity. An increase in the head of household age decreased the dietary diversity of preschool children. Productivity decreases with age and the aging household heads, who in most cases are the breadwinners, would be less productive in their efforts to feed household members especially for the farming business they are known for. The health worker visit had a positive and significant effect on dietary diversity as it provides an avenue for health workers to educate and properly guide the child caregivers in taking care of the children.

Ownership of mobile phone had a significant positive impact on dietary diversity. This resultant impact is not unconnected to the fact that mobile phone serves as a medium of communication and information sharing. Surprisingly, the ownership of refrigerator produced a negative effect. This may be related to the poor access to electricity and widespread poverty observed in the area. As expected, the increase in farm size had an incremental effect on the dietary diversity because it gives room for production of more variety of crops as well as serving as means to improve income earnings.

Under-five children's enrolment in school significantly increased their dietary diversity. Under-five children enrolled in school were 1.25 times more likely to consume diverse diet than their contemporaries who were not in school. This goes to show how the exposure and awareness of the parents can translate to their children's overall wellbeing.

Table 6. Instrumental variable regression results of the impact of caregivers' nutrition knowledge on preschool children's dietary diversity

Variable	Stage 1 (Nutrition Knowledge)	Stage 2 (Dietary Diversity)
Nutrition knowledge		0.56 ***
		(4.80)
Mother/caregiver visited health facility in the last 3 months	0.36 ***	
	(3.51)	
Number of under-five children	0.12 **	−0.31 ***
	(2.44)	(−2.60)
Household size	−0.10 ***	0.24 ***
	(−4.12)	(3.16)
State (Imo = 1, Ebonyi = 0)	0.88 ***	−1.03 *
	(6.03)	(−1.81)
Number of women that reached reproductive age in the household	0.26 **	−0.05
	(2.27)	(−0.17)
Education of spouse	−0.06 *	0.15 *
	(−1.87)	(1.94)
Education of head	−0.0002	−0.05
	(−0.01)	(−1.26)
Spouses age	0.07 **	0.007
	(2.03)	(0.09)
Household head's age	0.03 ***	−0.05 **
	(3.56)	(−2.11)
Health worker visit	0.32 ***	0.71 **
	(2.82)	(2.23)
Ownership of television	−0.56 ***	0.16
	(−4.28)	(0.38)
Ownership of radio	−0.08	0.02
	(−0.64)	(0.06)
Ownership of mobile phone	−0.02	0.84 ***
	(−1.48)	(2.79)
Ownership of refrigerator	−0.13	−0.72 **
	(−0.84)	(−2.30)
Access to electricity	0.23 *	−0.15 *
	(1.81)	(−1.85)
Access to safe drinking water source	0.32 ***	−0.46 *
	(2.98)	(−1.66)
Number of goats owned	0.05 **	0.09 *
	(2.23)	(1.67)
Number of sheep owned	− 0.005	0.007
	(−0.28)	(0.19)
Number of cows owned	0.07	−0.29
	(0.39)	(−0.97)
Farm size	−0.08	0.39 ***
	(−1.43)	(3.14)
Do you have under-five children in school?	−0.27	1.25 **
	(−1.08)	(2.32)
Number of under-five children in school	−0.06	−0.20
	(−0.86)	(−1.49)
Total education cost of under-five children	2.86e−06	6.42e−07
	(1.14)	(0.12)
Farm size squared	0.001	−0.008 ***
	1.28	(−3.48)
Spouse age squared	−0.001 **	0.0003
	(−2.22)	(0.34)
Education of the head squared	0.004 **	0.002 **
	(2.23)	(2.25)
Education of the spouse squared	−0.0002	0.004
	−0.24	(2.69)
Number of women that reached reproductive age in the household squared	−0.02	0.01
	(−0.77)	(0.25)
Number of observations	400	400

Note: * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Note: values in parenthesis are *t*-values.

The more education the household head (decision maker) acquires, the more it increases both the caregiver's nutrition knowledge and under-five children dietary diversity. This is because when people acquire a higher level of education, they are more likely to relate with better information/choices beyond their contemporaries who do not have similar education attainment.

The state variable shows a positive and significant impact on caregivers' nutrition knowledge but a negative effect on the dietary diversity. This indicates that while it is more likely to have improved caregivers' nutrition knowledge in Imo state than in Ebonyi state, it is however less likely to consume more diverse foods in Imo state than in Ebonyi state. This is understandable because while Imo state is

more metropolitan, Ebonyi state is better suited for farmers' settlements and production of various food crops.

Access to electricity significantly increased caregivers' nutrition knowledge but decreased preschool children's dietary diversity. This is expected because with electricity, the various media for acquiring information and raising awareness of the household would be available.

The number of women in their reproductive age exhibited a positive and significant impact on nutrition knowledge but not on dietary diversity. This may be related to the higher chances of shared experiences on child care-giving with relatively more women in the mentioned stage of life in a household.

3.6. Impact of Market Access on Preschool Children's Dietary Diversity

Table 7 shows the regression results of market access (Stage 1) and then dietary diversity (Stage 2). It is an instrumental variable regression with ownership of car as the instrument. It was used to provide a consistent and efficient estimate of the impact of market access on dietary diversity of preschool children. Distance to the market in minutes was used as the proxy for market access.

Table 7. Instrumental variable regression results of the impact of market access on dietary diversity of under-five children

Variable	Stage 1 (Market Access)	Stage 2 (Dietary Diversity)
Distance to the market		0.05 **
		(2.08)
Ownership of car	−17.35 **	
	(−2.27)	
Number of goats owned	0.29	0.04 *
	(0.26)	(1.67)
Number of sheep owned	0.17	−0.02
	(0.20)	(−0.32)
Number of cows owned	−0.10	−0.20
	(−0.01)	(−0.49)
Education of the head	−0.34	0.11 ***
	(−0.56)	(3.03)
Education of spouse	1.81 ***	−0.05
	(2.99)	(−0.90)
Number of women that reached reproductive age in the household	−29.94 ***	−1.36 *
	(−4.43)	(−1.86)
Number of women that reached reproductive age in the household squared	3.34 **	−0.17
	(3.14)	(−1.59)
State (Imo = 1, Ebonyi = 0)	13.24 **	−1.28 ***
	(2.20)	(−2.74)
Number of under-five children	−14.43 ***	−0.45 **
	(−6.54)	(−2.20)
Household size	9.50 ***	0.28 **
	(7.91)	(2.24)
Spouse age	−0.77	−0.06 *
	(−1.59)	(−1.67)
Household head's age	0.10	−0.03
	(0.26)	(−1.11)
Ownership of motorcycle	1.18	0.18
	(0.23)	(0.61)
Ownership of tricycle	−3.14	0.58
	(−0.38)	(1.12)
Access to safe drinking water source	−23.53 ***	1.00
	(−4.48)	(2.48)**
Farm size	0.46	0.06 **
	(0.53)	(2.36)
Number of observations	400	400

Note: * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Note: values in parenthesis are *t*-values.

Ownership of car had a negative and significant effect on market accessibility of households in remote areas, implying that ownership of car shortens the time taken to get to market. Other variables which demonstrated significant effects on preschool children's dietary diversity in the regression

include education of the household head, state, number of under-five children in the household, household size (number of people), as well as farm size and access to safe drinking water.

Education of the head of household increased preschool children's dietary diversity because the decision-maker is better equipped to make informed decisions about quality foods and diets. Once more, state had alternating signs in the stage 1 (positive) and stage 2 (negative) regressions just like in Table 6. This indicates that the time taken to get to the markets in Imo state was significantly greater than the time taken to get to the markets in Ebonyi state. There are more dilapidated roads and bad road infrastructure in Imo state than in Ebonyi state.

The number of under-five children in the household had negative effects on market access and dietary diversity. This may be due to increased expenditure burden of feeding under-five children.

On the other hand, household size yielded a significant and positive effect on market access and dietary diversity. This could be reasonable for market access since households with few persons may have more alternatives to reach-out to the market than their counterparts with large household size. An increase in farm size had an incremental effect on the dietary diversity because it provides for more food production, food production diversification, and income earnings [73].

Access to safe drinking water had a significant and positive effect on dietary diversity of preschool children. This could be related to the fact that good water is also an important and regular diet requirement. The number of women in their reproductive age yielded negative relationship with time taken to reach the market and dietary diversity of the children.

4. Discussion

This study determined the effect of maternal knowledge and access to market on preschool/under-five children's dietary diversity in remote communities of selected states of Nigeria. The households were mainly poorly educated smallholder farmers who have relatively large household size, poor ownership of assets and large animals, as well as poor access to electricity and potable water. These characteristics may impact negatively on the living standards of the households. This formed part of the motivation of this study, which was to analyze the nutritional outcome of households living in remote rural communities. Some studies [74,75] acknowledged the importance of focusing on the more vulnerable groups in such research.

Result of caregivers' nutrition knowledge shows that they do not have adequate knowledge of the importance of giving eggs, meat, variety of foods, snail, etc. to under-five children. They rather preferred giving herbal concoctions to children when sick. This may be due to food restrictions by some cultural practices common in Southeast Nigeria [13] and poor market access. Poor knowledge of appropriate feeding practices and diets could contribute to high level of child malnutrition; therefore, nutrition education, which creates awareness on the dangers of malnutrition and benefits of consuming healthy diets and diverse foods, is important [73,76]. Knowledge of appropriate feeding practices for under-five children reduces stunting, wasting, underweight and related diseases. It helps mothers/caregivers understand the right food, as well as the quality and quantity to be given to the young children in their households [11].

The most commonly consumed foods by preschool children include roots, tubers, plantain, fruits and vegetables, seeds, nuts and pulses, and cereals and grains, while the consumption of animal products (meat, fish, egg) was low. This is similar to the findings of Ochieng et al. [77] Alkerwi et al. [75], and Jiang et al. [78] whose studies suggest that this dietary pattern is peculiar to poorer households. Consumption of diverse diets, particularly animal source foods (ASF), such as egg, milk and milk products, fish and sea foods, is better in meeting children's nutritional requirement and protection against stunting, underweight and other forms of malnutrition [79–81]. Consumption of starchy foods (cereals, roots and tubers) with little or no ASF results in poor quality of diets and is a contributor to high prevalence of micronutrient deficiencies among children [82]. This finding supports the work of Murendo et al. [73], Kuchenbecker et al. [76], and Pauze et al. [83] where under-five children and caregivers were reported to be undernourished owing to the large consumption of carbohydrate staples

with little of animal products. Waswa [84] also found that the diets of young children in developing countries consist mainly of starchy staples with little proteins, minerals, and vitamins. Under-five children and caregivers (especially women of child bearing age) require not only energy-rich foods but also adequate intake of protein and micronutrients of animal sources for growth. The lack of knowledge of the importance of feeding animal-based foods to children could have contributed to poor consumption of meat, snail, egg, and variety of foods to under-five children. However, the distance to market and transport cost also makes it more difficult to provide essential foods not always produced in many remote communities. This result is in line with the finding of Zhang et al. [85] who opined that rural areas are mostly characterized by fewer choices in variety of foods, which translates to low dietary diversity.

An analysis of the food groups consumed indicates that the children, on average, consumed about five (5) food groups. This goes to say that while the caregivers are perceived to have a fair level of knowledge of appropriate feeding practices for preschool children, the food consumption characteristics and dietary diversification patterns of their children (under-five year olds) are still poor. This reveals some degree of conflict in knowledge and practice, the type which may have led to Jiang et al.'s conclusion that self-reported eating habits and parents' self-perception of the children's nutrition is not correlated with dietary diversity scores [78]. Similarly, Alkerwi et al. [75] have opined that the association between dietary quality and nutrition knowledge is complicated.

The use of instrumental variable regression helps to resolve the issues of endogeneity and bias. Thus, it is an ideal analytical technique for modelling the effects of the nutrition knowledge and food market access on children dietary diversity.

Nutrition knowledge increased preschool children's dietary diversity in remote areas. This is similar to previous findings [75,76,82]. In the same way, market access exhibited a positive impact on preschool children's dietary diversity. This corroborates the findings of Sibhatu and Qaim [44], Hirvonen and Hoddinott [69], Murendo et al. [73], Davidson and Kropp [86], and Bellon et al. [87].

To avoid omitted variables error, various related covariates were included in the model to facilitate the efficiency in predicting the outcome of dietary diversity. The significance, sign, and magnitude of the coefficients of the covariates yielded interesting results. For example, state had a negative coefficient with dietary diversity. This implies that preschool children in Ebonyi state consumed more diverse foods than their counterparts in Imo state. The reason is not far-fetched because of Ebonyi state has a rich agricultural background with majority of the inhabitants cultivating diverse food crops and rearing animals. This promotes better farm and food production diversity, which is important in improving dietary diversity [69,73,74,87].

Farm size increased preschool children's dietary diversity. The scale of a farm business encourages farm and production diversity [77]. It is also an important source of improved cash income, wealth, and earnings, which increases economic access to diverse foods and consumption of quality and diversified diets [44,82,88–91].

Number of under-five children decreased dietary diversity. The burden/cost of providing diverse and quality foods to children increases as the number of children to cater for increases and this depletes the capacity of the income to cater to household needs. Contrary to the findings of Ahmed et al. [90] and Powell et al. [91], household size increased the number of food groups consumed by preschool children in remote communities. However, this outcome may very well be related to the system obtainable in the remote (rural) areas where family labor forms an integral part of the total mandays needed in farm work and allied businesses. Hence, the increase in household size might contribute to the income earnings and improved production potential.

The impact of education of the head of household on children's dietary diversity was positive. This follows the findings of Ochieng et al. [77] and Alkerwi et al. [75]. Education serves to enlighten and improve livelihoods. In principle, education has other pathways through which it functions and affects the dietary diversity with nutrition knowledge and awareness as the major channels [73,76,82,92,93].

This also relates to the ability to access and understand the healthcare information campaigns and services to improve nutrition knowledge, as observed by Agize et al. [89].

Moreover, health care visits and visits of the health care worker were positively related to nutrition knowledge and dietary diversity, respectively. The extent of the influence of education is such that the education of the parents inadvertently affects the dietary behavior, knowledge, and choices of their offspring [32,94]. In a similar way, the study found that under-five children's school enrolment increased their dietary diversity.

5. Limitations and Potential Areas for Further Research

One caveat of this study is the cross-sectional data used in estimating dietary diversity of preschool children. Repeated surveys with longer recall period and recording quantity of foods consumed would reflect the pattern and frequency of foods consumed and provide a better estimate of nutrition outcome of preschool children. This is a potential research gap and may serve as an important area for further research.

The dietary diversity score is recognized by many nutritionists as a standard index for measuring dietary quality and nutrient intake by individuals and households. However, this index has been criticized by many scholars [65,95] because high dietary diversity score among preschool children may not translate to improved nutrition outcome and better anthropometric indices. Linking dietary diversity score with anthropometric indices will provide a better understanding of the impact of consuming diverse diets/foods on nutrition quality. This is a potential gap and further research is needed in this area. Mindful of these limitations, our study yielded interesting findings and conclusions.

6. Conclusions

We analyzed the impacts of caregivers' knowledge of appropriate feeding practices and access to food market on preschool children's dietary diversity in southeast Nigeria. Using cross-sectional data carefully collected from four hundred households in southeast Nigeria, we found that there is a moderate knowledge gap on appropriate feeding practices among caregivers of preschool children. This was reflected in the low dietary diversity score recorded in the area. We employed instrumental variable regression to consistently estimate the impacts of nutrition knowledge and food market on dietary diversity of preschool children. The study used "visit to health facility" and "ownership of car" as instruments of the effects of nutrition knowledge on dietary diversity and market access on dietary diversity of preschool children, respectively. These instruments satisfied all the conditions of instrumental variable regression framework, thus were regarded as perfect instruments for modelling impacts of caregivers' knowledge of appropriate feeding practices and market access on dietary diversity. Our findings indicate that knowledge of appropriate feeding practices yielded significant improvements in dietary diversity of preschool children. We also found that time taken to the market, which is an inverse proxy of market access, led to significant reduction in dietary diversity of preschool children. The mirror of this finding signifies that market access enhances dietary diversity of preschool children. Therefore, simultaneously improving food market access in remote areas and increasing caregivers' knowledge of appropriate feeding practices will yield enhanced nutrition outcomes of preschool children. Therefore, plans, policies, and programs to improve nutrition status of preschool children should not only focus on improving caregivers' knowledge, but must be followed by ensuring that caregivers have considerable access to markets where diverse and high-quality foods can be purchased. Government policies for rural development should therefore focus more attention on construction and rehabilitation of rural roads which link the inhabitants to markets where diverse foods can be purchased.

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