

Original Research Article

Determinants of fortified food consumption among children aged 6-23 months in Isiolo County, Kenya

Emily C. Mkungo^{1*}, Peter Chege¹, Judith Munga²

¹Department of Food, Nutrition and Dietetics, Kenyatta University, Nairobi, Kenya

²Food and Agricultural Organization, Nairobi, Kenya

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*Correspondence:

Emily C. Mkungo,

E-mail: emilymkungo@gmail.com

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ABSTRACT

Background: Micronutrient deficiencies pose a significant public health challenge among young children in Kenya, particularly in arid regions like Isiolo County. Fortified foods are a cost-effective intervention, yet their consumption remains low. This study examines the role of socio-economic status, availability, and caregiver knowledge in fortified food consumption.

Methods: A cross-sectional survey was conducted in Oldonyiro and Ngaremarara wards, Isiolo County, from June to August 2022, with 272 caregiver-child pairs. Data were collected using semi-structured questionnaires, focus group discussions, and key informant interviews. Logistic regression analyzed associations between socio-economic status, availability, caregiver knowledge, and fortified food consumption at $p < 0.05$.

Results: Non-fortified maize flour (100%) and vegetable oil (96.3%) were consumed daily, while fortified versions were consumed twice weekly by 36% and 47% of children, respectively. Higher socio-economic status (OR=1.729, $p=0.0034$), better caregiver knowledge (OR=1.227, $p=0.0089$), and greater availability (OR=1.311, $p=0.015$) significantly increased fortified food consumption. Only 20.2% of caregivers were knowledgeable about fortification, and fortified foods were less available in rural areas.

Conclusions: Socio-economic status, caregiver knowledge, and availability are critical drivers of fortified food consumption. Public health interventions should prioritize awareness campaigns, improve market access, and address economic barriers to enhance uptake.

Keywords: Fortified foods, Micronutrient deficiencies, Socio-economic status, Caregiver knowledge, Availability, Isiolo County

INTRODUCTION

Micronutrient deficiencies, including iron, vitamin A, and zinc, affect over two billion people globally, with severe implications for child health.¹ In Kenya, 36% of children aged 6-59 months are anemic, and 61.8% are vitamin A deficient.² Isiolo County, a semi-arid region, faces heightened malnutrition due to food insecurity and limited dietary diversity.³ Kenya's mandatory food fortification program, implemented since 2012, targets staple foods to address these deficiencies.⁴ However, consumption among children aged 6-23 months remains

low, influenced by socio-economic, knowledge, and availability factors.⁵ This study investigates these determinants in Isiolo County to inform community health strategies.

METHODS

Study design and setting

A cross-sectional survey was conducted in Oldonyiro and Ngaremarara wards, Isiolo County, Kenya, from June to August 2022. These wards were selected for their high

vulnerability to malnutrition, as identified in the Isiolo county short rains assessment report.⁶ Mixed methods combined quantitative and qualitative approaches.

Study location

The study was community-based, conducted in villages within Oldonyiro and Ngaremarara wards, with no specific hospital involved. Data collection occurred in households and local markets.

Population and sampling

The study targeted children aged 6-23 months and their caregivers. Inclusion criteria included children aged 6-23 months residing in Oldonyiro or Ngaremarara wards with caregivers willing to provide consent. Exclusion criteria included children who were ill, absent during data collection, or whose caregivers did not consent. Using Cochran's formula, a sample size of 287 was calculated, adjusted to 272 after accounting for non-response. Cluster sampling selected villages, and simple random sampling identified caregiver-child pairs.

Data collection

A validated fortification assessment coverage toolkit (FACT) questionnaire, focus group discussions, and key informant interviews with shopkeepers were used. Variables included consumption patterns, socio-economic status, availability, and caregiver knowledge.

Data analysis

SPSS version 25 was used for analysis. Logistic regression assessed associations between independent variables (socio-economic status, availability, caregiver knowledge) and fortified food consumption, with significance at $p < 0.05$. Qualitative data were thematically analyzed.

Ethical considerations

Ethical clearance was obtained from Kenyatta university's ethical review committee (Approval No. KU/PKU/2464/11596, dated April 5, 2022). Informed consent was secured from all participants, and confidentiality was maintained.

RESULTS

Consumption patterns

Non-fortified maize flour (100%) and vegetable oil (96.3%) were consumed daily, while fortified maize flour and oil were consumed twice weekly by 36% and 47% of children, respectively. Only 30% consumed fortified maize flour daily. Fortified maize flour consumption increased with age: 26.1% at 6-11 months, 36.6% at 12-17 months, and 45.1% at 18-23 months. Wheat flour consumption was low, with only 16.5% consuming fortified versions (Table 1).

Socio-economic status

Most households (88.6%) were male-headed, with 52.6% classified as low socio-economic status. Livestock herding was the primary occupation (51%), and only 33.1% of caregivers had completed primary education (Table 2).

Availability

Fortified maize flour was stocked by 75% of retailers, but non-fortified versions were more prevalent. In 20 shops surveyed, non-fortified maize flour was available in 100% ($n=20$), wheat flour in 25% ($n=5$), and vegetable oil in 75% ($n=15$), while fortified versions were present in 75% ($n=15$), 25% ($n=5$), and 50% ($n=10$) of shops, respectively.

Among households, fortified maize flour was available in 37.1%, wheat flour in 22.4%, and vegetable oil in 73.5% (Table 3).

Caregiver knowledge

Only 20.2% of caregivers were knowledgeable about fortification. While 46.3% had heard of fortified foods, only 2.4% could identify micronutrient deficiencies addressed (Table 4).

Associations

Higher socio-economic status, better caregiver knowledge, and greater availability significantly increased fortified food consumption (Table 5).

Table 1: Consumption patterns by age group (n=272).

Foods	Category	6-11 months (n=88) (%)	12-17 months (n=93) (%)	18-23 months (n=91) (%)	P value
Maize flour	Non-fortified	88 (100)	93 (100)	91 (100)	0.032*
	Fortified	23 (26.1)	34 (36.6)	41 (45.1)	
Wheat flour	Non-fortified	51 (58.0)	55 (59.1)	54 (59.3)	0.254
	Fortified	5 (5.7)	11 (11.8)	29 (31.9)	
Vegetable oil	Non-fortified	81 (92.0)	90 (96.8)	91 (100)	0.064*
	Fortified	33 (37.5)	44 (47.3)	51 (56.0)	

*Significant at $p < 0.05$.

Table 2: Household characteristics and economic status (n=272).

Variables	Category	N	%	P value
Household head gender	Male	241	88.6	-
	Female	31	11.4	
Child gender (6-23 months)	Male	129	47.4	0.127
	Female	143	52.6	
Main occupation of household head	Livestock herding	138	51.0	0.032*
	Farmer/own farm labor	39	14.3	
	Employed/salaried	30	11.0	
	Daily labor/wage labor	42	15.4	
	Small business/petty trade	23	8.5	
Caregiver education	No formal education	62	23.0	0.027*
	Pre-primary	73	26.8	
	Primary	90	33.1	
	Secondary	27	9.9	
	College	18	6.6	
	Postgraduate	2	0.7	
Economic status	Low	143	52.6	0.019*
	Medium	97	35.7	
	High	32	11.8	

*Significant at p<0.05.

Table 4: Caregiver knowledge and awareness of food fortification (n=272).

Variables	Category	N	%
Heard about food fortification	Yes	126	46.3
Sources of information (n=126)	Television	33	26.2
	Radio	43	34.1
	Newspaper	10	7.9
	Health facility/clinic	82	65.1
	Community health worker	123	97.6
	Friends/family	19	15.1
Can list fortified foods (n=126)	Maize flour	126	100
	Wheat flour	126	100
	Vegetable oil	126	100
Can identify Kenyan fortification logo (n=126)	Yes	36	28.6
Knowledge of micronutrient deficiency (n=126)	Yes	3	2.4
Importance of fortified foods (n=126)	Improves disease resistance	76	60.3
	Improves appetite	35	27.8
	Enhances learning/development	35	27.8
	Promotes health/strength	57	45.2
	Prevents vitamin/mineral deficiency	35	27.8
	Don't know	10	7.9
Knowledge score	Low (<40)	146	53.7
	Moderate (41-59)	71	26.1
	High (60-80)	55	20.2

Table 3: Local market availability of flours and vegetable oil (n=20).

Description	Food	N	Percent (%)
Non-fortified foods	Maize flour	20	100
	Wheat flour	5	25
	Vegetable oil	15	75
Fortified foods	Maize flour	15	75
	Wheat flour	5	25
	Vegetable oil	10	50

*Note: Most non-fortified foods are sourced from Meru and Nanyuki. Sale of fortified foods in Oldonyiro is low.

Table 5: Factors associated with the consumption of fortified foods by children (n=272).

Variables	Category	Fortified food	Consume	Did not consume	Total	R ²	OR (95% CI)	P value
Wealth index ranking	High	Maize flour	18	14	32	0.57	1.73 (1.13-2.65)	0.012*
	Low	Maize flour	43	100	143			
	High	Wheat flour	22	10	32	0.63	1.84 (1.17-2.89)	0.009*
	Low	Wheat flour	9	134	143			
	High	Vegetable oil	27	5	32	0.51	1.49 (1.08-2.07)	0.016*
	Low	Vegetable oil	61	83	143			
Availability of fortified foods	Available	Maize flour	58	68	126	0.44	1.31 (1.05-1.64)	0.015*
	Not available	Maize flour	40	159	146			
	Available	Wheat flour	27	99	126	0.47	1.45 (1.09-1.93)	0.011*
	Not available	Wheat flour	18	128	146			
	Available	Vegetable oil	71	55	126	0.41	1.25 (1.05-1.50)	0.013*
	Not available	Vegetable oil	57	172	146			
Caregiver knowledge	High	Maize flour	34	21	55	0.52	1.23 (1.05-1.44)	0.0089*
	Low	Maize flour	28	118	146			
	High	Wheat flour	20	35	55	0.54	1.67 (1.12-2.49)	0.012*
	Low	Wheat flour	12	134	146			
	High	Vegetable oil	55	0	55	0.51	1.13 (1.02-1.25)	0.021*
	Low	Vegetable oil	60	86	146			

*Significant at $p < 0.05$. OR=Odds ratio, CI=Confidence interval, R²=Coefficient of determination.

DISCUSSION

The high consumption of non-fortified maize flour (100%) and vegetable oil (96.3%) in Isiolo County highlights a significant missed opportunity to address micronutrient deficiencies through fortification. These staples are dietary cornerstones for young children, yet only 36% and 47% consume their fortified versions twice weekly, respectively. This aligns with findings from Leyvraz et al who reported suboptimal intake of fortified foods among children aged 6-23 months in Nairobi despite high coverage.⁵ The preference for non-fortified foods, often locally milled and cheaper, reflects economic and cultural barriers, as noted by caregivers in focus group discussions who expressed distrust in fortified foods’ “chemicals.”

Economic barriers are pronounced, with 52.6% of households classified as low socio-economic status. This mirrors findings from Vilar-Compte et al who highlighted that income constraints limit access to nutrient-rich foods in low-income settings.⁷ Households with higher wealth indices were 1.73 times more likely to feed children fortified maize flour ($p=0.012$), underscoring the role of purchasing power. In Isiolo, where livestock herding dominates (51%) and drought exacerbates economic strain, affordability is a critical barrier. Hoddinott and Yohannes similarly found that higher-income households are more likely to consume fortified foods, suggesting that subsidies or cash transfers could enhance access.¹⁰

Caregiver knowledge is another critical determinant, with only 20.2% demonstrating high knowledge of

fortification. While 46.3% had heard of fortified foods, primarily through community health workers (97.6%),

only 2.4% could identify specific micronutrient deficiencies addressed. This knowledge gap aligns with Linda, Amaya Aura, et al who found low awareness in rural Kenya hinders fortified food uptake.⁸ Caregivers with high knowledge were 1.23 times more likely to feed children fortified maize flour ($p=0.0089$), consistent with Suryana et al who showed that nutrition education improves consumption patterns.¹¹ The reliance on health workers for information suggests that community-based education programs could be scaled up effectively.

Availability of fortified foods is limited, particularly in rural Oldonyiro compared to peri-urban Ngaremarara. Non-fortified maize flour was universally available in markets (100%), while fortified versions were stocked by only 75% of retailers. This reflects supply chain inefficiencies, as noted by Mkambula et al who highlighted shortages in rural areas.⁹ Households with access to fortified foods were 1.31 times more likely to feed them to children ($p=0.015$), supporting Hotz et al who found higher consumption where fortified foods are available.¹² The predominance of non-fortified foods from nearby Meru and Nanyuki suggests that local milling practices and cost considerations override fortification mandates.

Qualitative insights further enrich these findings. Shopkeepers cited cost differences and consumer preferences for locally milled flour as reasons for low fortified food stocks. Caregivers in focus groups emphasized availability and cash constraints over knowledge, with one stating, “I heard about fortified

foods from a community health worker, but our consumption is driven by what's available and affordable." This underscores the interplay of economic, logistical, and cultural factors, as noted by the international food policy research institute which highlighted socio-cultural preferences as barriers to fortified food consumption.¹³

The study's findings resonate with global evidence on fortification's potential. A 2019 systematic review reported a 34% reduction in anemia prevalence through large-scale fortification programs in low- and middle-income countries.¹⁴ In Kenya, the 2017 ministry of health report noted a 50% reduction in vitamin A deficiency and 60% in iron deficiency among children under five due to fortification.⁴ However, Isiolo's low consumption rates suggest that national successes are not uniformly realized in arid regions, necessitating targeted interventions.

Limitations

The cross-sectional design captures data at a single point in time (June-August 2022), limiting insights into seasonal variations in consumption patterns. Reliance on self-reported data from caregivers and shopkeepers may introduce recall or social desirability bias. The study focused on socio-economic status, availability, and caregiver knowledge, excluding other potential influences like cultural beliefs or health service access. The analysis did not include nutrient content or overall micronutrient intake, which could provide deeper nutritional insights. These limitations suggest caution in generalizing findings beyond the study context, though the results offer valuable localized evidence for Isiolo County.

CONCLUSION

Socio-economic status, caregiver knowledge, and availability significantly influence fortified food consumption among children aged 6-23 months in Isiolo County. The high consumption of non-fortified staples presents a critical opportunity to enhance micronutrient intake through fortification. Targeted interventions addressing economic barriers, improving market access, and increasing caregiver awareness can leverage this opportunity to improve nutritional outcomes.

Recommendations

Implement community-based nutrition education to increase caregiver awareness of fortified foods' benefits. Strengthen supply chains to enhance fortified food availability in rural markets, particularly in Oldonyiro. Introduce subsidies or cash transfers to reduce economic barriers to fortified foods. Conduct longitudinal studies to assess seasonal consumption patterns and long-term impacts of fortification.

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