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Effect of enhanced nutrition services with community-based nutrition services on the diet quality of young children in Ethiopia

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Abstract

Poor diet quality related to inadequate complementary feeding is a major public health problem in low and middle-income countries including Ethiopia. Low dietary diversity has been linked to negative health outcomes in children. To provide a package of interventions to close nutritional gaps through agriculture, the Sustainable Undernutrition Reduction in Ethiopia (SURE) programme was set up as a multi-sectoral initiative and the results of combined effects of community-based and enhanced nutrition services, compared to community-based alone, on diet diversity and diet quality of complementary feeding of young children are presented. The study used pre- and post-intervention design. Baseline ($n = 4980$) data were collected from May to July 2016, and follow-up ($n = 2419$) data from December 2020 to January 2021. From 51 intervention districts having the SURE programme, 36 intervention districts were randomly selected for baseline and 31 for the follow-up survey. The primary outcome was diet quality: minimum dietary diversity (MDD), minimum meal frequency (MMF) and minimum acceptable diet (MAD). Comparing endline to baseline over the 4.5-year intervention, the use of standard community-based nutrition services of growth monitoring and promotion increased (16%–46%), as did enhanced nutrition services of infant and young child feeding counselling, and agricultural advising (62%–77%). Women involved in home gardening significantly increased (73%–93%); however, household production of food decreased yet consumption of most own-grown foods increased. Importantly, MAD and MDD increased four-fold. The SURE intervention programme was associated with improvements in complementary feeding and diet quality through enhanced nutrition services. This suggests programmes targeted at nutrition-sensitive practices can improve child feeding in young children.

KEYWORDS
community-based nutrition, diet diversity, Ethiopia, infant and young child feeding, minimum meal frequency, nutrition services

1 | INTRODUCTION

Globally, over 70% of children aged 6–23 months have low diet quality as measured by minimum dietary diversity (MDD), with significant differences across and within regions (Bégin & Aguayo, 2017). Poor diet quality related to inadequate complementary feeding practices among young children is a major public health problem in low and midline-income countries (Baye & Kennedy, 2020; Gatica-Domínguez et al., 2021; Manikam et al., 2018). Low dietary diversity as a surrogate for determining the dietary quality and suboptimal complementary feeding practices has been linked to negative health outcomes (White & Bégin, 2017; White et al., 2021). High dietary diversity is associated with improved nutritional status as measured by growth (Arimond & Ruel, 2004) and improved health of children (Disha et al., 2012; White & Mason, 2012). Improved MDD that included consumption of different types of animal-source food was associated with a reduction in the risk of stunting (Krasevec et al., 2017). A recent review of 49 low and middle-income countries showed that only four countries have achieved the requirement of MDD and minimum meal frequency (MMF). The Sub-Saharan African region had the lowest dietary diversity and diet quality compared with other regions. Interventions that improve the quality of complementary feeding, including education, on appropriate feeding practices were associated with improved nutritional status of young children (Bhutta et al., 2013; White & Bégin, 2017). Other factors that influence the quality of the diet include low awareness of the importance of diversity, and lack of availability of foods in the home due to low production diversity (Jones, et al., 2016; Arikpo et al., 2018; Muslimatun & Wiradnyani, 2016).

In Ethiopia, as in many other African countries, complementary foods for young children lack sufficient macro- and micronutrients (CSA, 2016; Dilnesaw Zerfu et al., 2016). Reaching the MDD threshold is a challenge and requires an integrated approach that combines interventions targeting agriculture as well as health, and such multi-sectoral nutritional interventions are needed to improve diet quality and feeding practices in poor rural households such as Ethiopia, where low-quality monotonous diets are common. Recognizing these gaps, Ethiopia's government designed the Sustainable Undernutrition Reduction in Ethiopia (SURE) programme, a multi-sectoral initiative that aims to combine the health and agriculture sectors' efforts to enhance complementary feeding and improve diet quality of children (Moss et al., 2018). To this end, the SURE nutrition services involved an integrated approach that included a joint visit by health extension workers (HEWs) and agricultural extension workers (AEWs) that could increase the household production diversity and knowledge of caregivers which in turn would improve the diet quality of children (Figure 1). The hypothesis was that a package of specifically designed interventions, including integrated health and agriculture behaviour change communication for nutrition, systems strengthening and multi-sectoral coordination, would result in differences in minimum acceptable diet (MAD) in children 6–23 months. The aim of this study is to provide results of an extensive examination after 4.5 years in operation, of an intervention that provided enhanced nutrition and agriculture services. The protocol for this intervention was previously published (Moss et al., 2018). A list of the community-based nutrition (CBN) services and enhanced nutrition services along with frequency of these services, who was targeted, and who delivered the services is shown in Supporting Information: Table 1. However, due to some changes in how measurements could be collected, this paper focuses primarily on services and outcomes related to improving complementary feeding in districts receiving the intervention package.

Key messages

- Improved nutrition of young children can result from interventions that combine nutrition and agriculture through joint household visits by health and agriculture extension workers.
- Use of standard nutrition services increased over time when presented with other services that include enhancements that increase men's participation.
- Improvements in complementary feeding and diet quality of infant and young child feeding are achieved through enhancement of nutrition services over and above community-based services.

2 | METHODS

2.1 | Study design

To determine the effect of CBN with enhanced services on the diet quality of children, a comprehensive government-led integrated nutrition and agriculture intervention was conducted for 4.5 years. The baseline data were collected from May to July 2016, and follow-up was conducted from December 2020 to January 2021, the latter in a different agricultural season. The protocol for the intervention was published in which a larger, quasi-experimental design was envisioned with control sites not receiving intervention initially

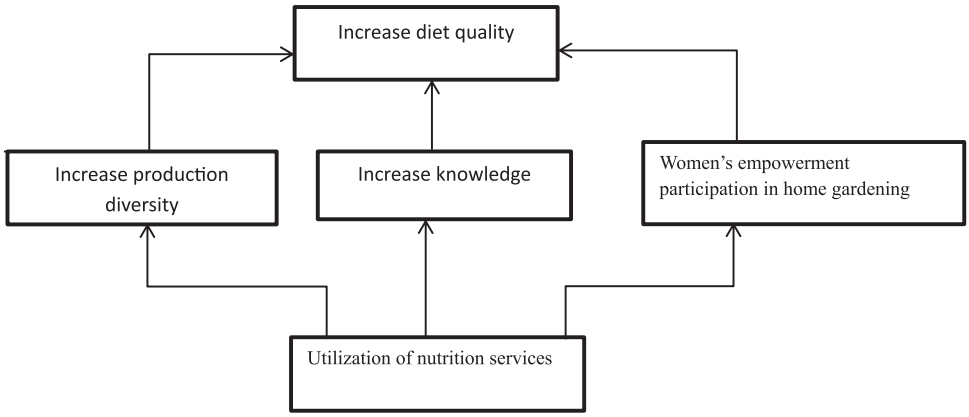

FIGURE 1 Pathways of the effect of community-based and enhanced nutrition services on diet quality of children in Ethiopia.

(Moss et al., 2018). However, due to mitigating circumstances not all components were completed. Major changes to the protocol included: dropping control sites before endline as these became compromised due to control sites accessing and using the nutrition education communication tools of the intervention. Further, ongoing problems of drought, internal conflicts in the country reduced the capacity to conduct growth (weight and height) measurements at endline which meant no possibility of the evaluation of stunting as a nutrition outcome. This paper describes how the intervention that was planned and carried out affected behavioural outcomes and programme coverages compared to outcomes that had been measured at baseline.

2.2 | Study setting and population

Administratively, Ethiopia is divided into nine regional states, which are further divided into zones, then districts or subdistricts, and finally peasant associations or kebeles. Kebeles are the smallest official administrative unit and comprise about 500–1000 or more households each (Portal, 2021). The SURE programme was initially implemented in Oromiya, Tigray, Amhara, and Southern Nations, Nationalities, and Peoples' Region (SNNPR) regions. From a total of 51 SURE intervention districts, 36 intervention districts were randomly selected for baseline, while 31 intervention districts were randomly selected for endline survey. The selection of districts was made by a statistician who was not part of the SURE programme. Figure 2 provides a flow chart showing the derivation of households. Only data from intervention sites are included in this paper.

Only households with under 2 children were eligible for inclusion in this study. During the baseline, 4980 children 0–47 months (761 children 0–5 months; 1848 children 6–23 months; 2371 children 24–47 months) were selected from 4299 households. Details about the baseline population have been published (Kuche et al., 2020). In the endline, 2438 under 2 children were included from 2406 households. Sample size calculations were based on assumption that the programme coverage of 50%, with a significance level of 5%, design effect of 2% and a 5% non-response rate. And taking into account representativeness for three age groups: 0–5 months (642 children), 6–11 months (619 children) and 12–23 months (1177 children). Additionally, the sample size determination followed multiple cluster surveys principles to estimate various nutrition indicators of public health relevance to infants and young children. The above assumptions provided a sample size of 2419 children. The sample was then distributed to the three regions following the distribution of districts included in the programme. Half (50%) of the SURE programme districts is found in the Oromia region. The remaining 22%, 17% and 11% districts are found in Amhara, SNNP and Tigray regions, respectively. Following the above distribution and excluding Tigray due to security risks for evaluators, the regional sample distribution was 56% for Oromia, 25% for Amhara and 19% for SNNP.

2.3 | Interventions description

The SURE was a multi-sectoral government-led programme that integrated health and agriculture sector service delivery for nutrition outcomes. It was a complex intervention that expanded the CBN services through integration with selected agricultural services, thus enhancing the standard CBN programme (Abebe et al., 2012). Using the socio-ecological theory of behaviour change, the SURE package included components targeted to individual, social, organizational, community/societal and policy spheres (Moss et al., 2018). SURE aimed to enhance other nutrition services by expanding CBN services to improve complementary feeding and dietary diversity.

In SURE, there were two nutrition services components that comprised the intervention. The standard CBN performed by HEWs include: (i) monthly growth monitoring and promotion for children

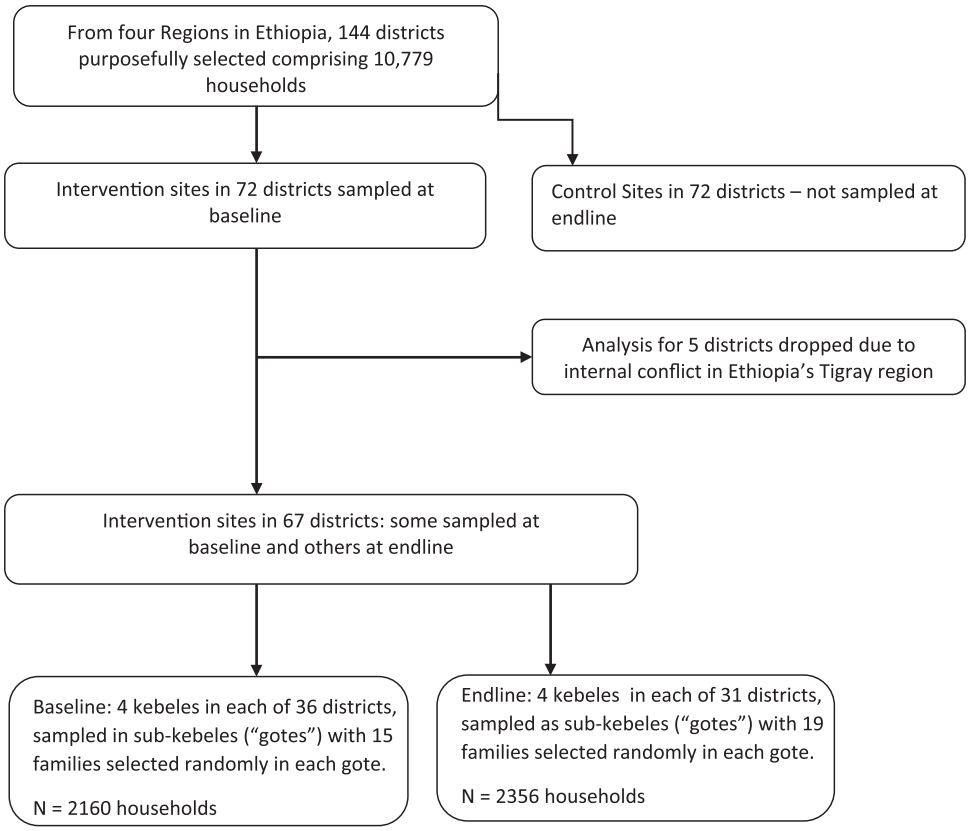

FIGURE 2 Flowchart of selection and distribution of households.

under 24 months; (ii) vitamin A supplementation and deworming and (iii) quarterly screening for acute malnutrition. The enhanced nutrition services included (a) Counselling for mother–father couples provided by teams consisting of one HEW and one AEW; (b) Women's and men's group dialogues in community networks of 30 households led by an HEW or AEW, respectively, to negotiate community actions to improve dietary diversity and child feeding; (c) demonstrations were provided by HEWs and AEWs working together; (d) AEWs grew demonstration gardens in communities with emphasis on dietary diversity and nutrition-sensitive agriculture practices; and media messages to promote infant and young child feeding (IYCF) practices and dietary diversity were broadcast. Finally, for the lowest socioeconomic decile, a one-time gift of four poultry or of seeds was provided by AEWs in the first year of the intervention. The details of those services have been described elsewhere (Moss et al., 2018).

2.4 | Sampling and data collection

In the baseline survey (2016), kebeles were selected at the study outset using probability proportional to size sampling from lists and population data provided by district officials. Gotes (subkebeles) were selected by simple random sampling (paper in hat) during data collection. On average, a gote consisted of 180 households. A complete listing of all households with children under 47 months in the gote was conducted, and 15 were selected using systematic random sampling. Resident children 0–47 months within a selected household were listed in the following age groups: 0–5.9 months, 6–23.9 months and 24–47.9 months. Where only one child for any or all age categories was present, all eligible children were selected (up to three children). Where multiple children from a single age category were present, one child was randomly selected per age group by the computer-assisted personal interview programme. This study uses data from children sampled who were between 6 and 23.9 months of age only as this is the age group for whom WHO complementary feeding indicators apply and for whom dietary data were collected

During the follow-up survey after four and one-half years, subjects were recruited following a stratified multi-stage cluster sampling strategy. From a total of 51 SURE intervention districts, 31 districts were randomly selected using the list of all SURE intervention districts as a sampling frame (Figure 2). Again, the selection of districts was made by a statistician who was not part of the SURE programme. Supervisors and district health officials randomly selected four kebeles from each of the districts, using the list of kebeles in the districts as a sampling frame. The selection of kebeles was made by supervisors and district health officials. Then, one gote per kebele was randomly selected using the list of all gotes in the kebeles as a sampling frame. The survey team visited all households in the selected gotes and prepared a sampling frame of

eligible households. A fixed number of 19 households were selected from each gote using the list of all eligible households as a sampling frame. All *de facto* under-2 children found in the selected households were the included data in this study. The primary sources of information were mothers or caregivers of the children.

2.5 | Outcomes

The primary outcome was diet quality measured using (a) MDD, defined as the consumption of foods from at least five of eight food groups in the previous 24 h by children aged 6-23.9 months; (b) MMF for breastfed infants at 6 months of age was defined as having consumed ≥2 solid, semisolid or soft meals on separate occasions in the 24-h recall period and ≥3 meals at 12 months of age. For non-breastfed infants, a minimum of four meals was required at both 6 and 12 months, including at least two animal-source milk feedings. For both breastfed and non-breastfed infants, 'meals' included both meals and snacks other than trivial amounts (<10 g) and (c) MAD defined as the achievement of the MDD and age-appropriate MMF, as defined previously, by children aged 6–23.9 months. These variables were constructed using the maternal recall of the target child from the previous day as defined by WHO in 2017 (INDEXX Project, 2018). Other measures included women's empowerment and household production. Empowerment questions were drawn from the Survey-based Women's emPow-ERment index for women's empowerment in Africa (Ewerling et al., 2017). The domains included in this module were attitude towards violence, social independence and the decision-making power of women.

2.6 | Statistical analyses

Data analysis was performed using Stata 15 (Stata Corporation). Descriptive statistics were used to describe the outcomes variables or characteristics of children and mothers. To examine the differential effects of the interventions, we derived change with 95% confidence interval (CI) and *p* values that assessed differences in changes over time (Villa, 2012). Mean differences in continuous variables and prevalence differences for categorical variables are reported.

2.7 | Ethics statement

The research protocols, baseline (protocol number: SERO-54-3-2016) and endline (protocol number: EPHI-IRB-3030-2020) received ethical clearance from Ethiopian Public Health Institute (EPHI) Institutional Committee Review Board. Informed consent was obtained by all caregivers prior to data collection. The evaluation protocol was published prior to before programme implementation (Moss et al., 2018).

3 | RESULTS

3.1 | Socio-demographic characteristics of study participants

The intervention took place in four large Ethiopian regions: Amhara, Oromia, SNNPR and Tigray. However, due to civil war and instability in the Tigray region after the baseline collection, the follow-up data collection did not include the Tigray region (Figure 2). Hence all Tigray data have been omitted. The majority of child caregivers/mothers ranged in age from 19 to 34 years old, and this held at baseline despite there being an overall difference in age distribution at follow-up. The majority of caregivers had no formal education (Table 1), and the distribution of education was different at follow-up compared to baseline, with a higher percentage having no education at endline. Overall response rates were at baseline, 99.7% and at follow-up, 99.9%.

3.2 | Utilization of enhanced and CBN services

We assessed the provision of nutrition services having a known influence on under 2 children's diet quality. Table 2 shows that in comparison to baseline (2016), there was an increase in the provision and utilization of all of the enhanced and CBN services at follow-up

TABLE 1 Socio-demographic characteristics of evaluation study participants.

Variable	Category	Baseline *n* (%)	Follow-up *n* (%)	*p* Value
Region	Amhara	470 (25.1)	618 (25.3)	0.844
	Oromia	1050 (56)	1375 (56.4)	
	SNNPR	355 (18.9)	445 (18.3)	
Age	<18	9 (0.5)	23 (0.9)	<0.001
	19–34	1510 (80.5)	1820 (74.7)	
	35–49	356 (19)	595 (24.4)	
Education	None	1102 (58.8)	1884 (77.3)	<0.001
	Primary	642 (34.3)	408 (16.7)	
	Secondary+	130 (6.9)	146 (6)	
Marital status	Married	1760 (93.9)	2297 (94.4)	0.418
		Mean ± SD	Mean ± SD	
Income	Wealth score (0–10)	1.17 ± 0.75	1.13 ± 0.79	0.156

Note: Wealth score is constructed using the following variables: house ownership, have radio, have TV, have mobile phone, have cart, number of chickens, number of goats, number of donkeys, number of horses, number of milk cows, number of oxen, main material of the wall, main material of the floor, and main material of roof.

Abbreviations: SD, standard deviation; SNNPR, Southern Nations and Nationalities Peoples Region.

TABLE 2 Utilization of enhanced and community-based nutrition services and women's participation and role in the decision-making process in the household in the years 2016 and 2020.

Component	Baseline *n* (%)	Follow-up *n* (%)	Unadjusted Difference [95% CI]	*p* Value for difference	Adjusted[a] Difference [95% CI]	*p* Value for difference
Community-based services						
Growth monitoring and promotion	121 (15.6)	829 (46.2)	30.5 [26.6, 34.4]	<0.001	29.8 [25.8, 33.8]	<0.001
Screening for acute malnutrition	233 (30.1)	614 (34.2)	4.1 [0.1, 8.0]	0.043	3.7 [−0.4, 7.8]	0.076
Vitamin A supplementation and deworming	625 (80.7)	152 (38.8)	−42.1 [−47.2, −36.8]	<0.001	−40.9 [−46.3, −35.5]	<0.001
Enhanced services						
IYCF counselling and agricultural advising	75 (62)	639 (77.1)	15.1 [6.9, 23.3]	<0.001	13.8 [5.4, 22.2]	0.001
Provision of improved seeds or poultry	423 (71.7)	719 (77.9)	6.2 [1.8, 10.6]	0.006	6.1 [1.5, 10.7]	0.009
Women's participation in household						
Women participating in the family farm	1757 (81.9)	1173 (48.1)	−33.8 [−36.4, −31.1]	<0.001	−31.7 [−34.5, −29.0]	<0.001
Home gardening	1290 (73.4)	1090 (92.9)	19.5 [16.7, 22.3]	<0.001	18.2 [15.3, 21.0]	<0.001
Fieldwork	1657 (94.3)	505 (43.1)	−51.3 [−53.9, −48.6]	<0.001	−51.4 [−54.3, −48.5]	<0.001
Raising livestock	833 (47.4)	678 (57.8)	10.4 [6.7, 14.1]	<0.001	13.4 [9.7, 17.0]	<0.001
Fishpond/aquaculture	11 (0.6)	14 (1.2)	0.6 [−0.1, 1.2]	0.102	0.6 [−0.0, 1.3]	0.064
Earned any money from the work that you did on the farm	1506 (86)	1141 (97.3)	11.3 [9.1, 13.4]	<0.001	7.9 [5.9, 9.8]	<0.001
Person who decides on how to use women's earnings (self/both)	1259 (87.7)	843 (71.2)	−16.5 [−19.5, −13.5]	<0.001	−18 [−21.2, −14.8]	<0.001
Person who decides on how to use husband's earnings (self/both)	1600 (80.4)	22 (71.0)	−9.4 [−23.5, 4.7]	0.193	−10.5 [−24.1, 3.1]	0.131
Person who decides on major household purchases (self/both)	1425 (71.5)	1598 (69.4)	−2.1 [−4.8, 0.7]	0.137	−4.5 [−7.4, −1.6]	0.002
Person who decides on minor household purchases (self/both)	1900 (95.3)	2203 (95.7)	0.4 [−0.9, 1.6]	0.558	−0.7 [−2.0, 0.5]	0.247
Person who decides about child health care (self/both)	1913 (95.9)	2212 (96.3)	0.4 [−0.8, 1.5]	0.54	−0.2 [−1.4, 1.0]	0.747
Husband helps care for the children	1824 (91.6)	1909 (83.1)	−8.5 [−10.5, −6.5]	<0.001	−7.7 [−9.9, −5.5]	<0.001
Husband helps with household chores	1156 (58.1)	590 (79.3)	21.2 [17.3, 25.2]	<0.001	23 [18.9, 27.1]	<0.001

Abbreviations: CI, confidence interval; IYCF, infant and young child feeding.

[a]Adjusted for maternal education, maternal age and income.

(2020) except vitamin A supplementation and deworming which are both done at a health clinic and showed a significant decrease.

3.3 | Women's empowerment

Overall, between 2016 and 2020, there was a considerable increase in men's participation in household chores but there was a decrease in their involvement in childcare. Participation of women in home gardening significantly increased from 73.4% to 92.9% during the intervention period while at the same time their participation in fieldwork decreased from 94.3% to 43.1%. Earning the income from the family farm, as measured using the Wealth Score, did not change (Table 2). There was no improvement in women's participation in decision-making regarding household money and purchasing.

3.4 | Women's knowledge of dietary quality

The results of the assessment of the knowledge of mothers on dietary quality and diversity, including its benefits (Table 3) show an improvement in the number of mothers appreciating that their child has to eat different food types to grow well and that children should

TABLE 3 Mother's knowledge of dietary quality and diversity.

Component	Baseline *n* (%)	Follow-up *n* (%)	Unadjusted Difference [95% CI]	Unadjusted *p* Value for difference	Adjusted[a] Difference [95% CI]	Adjusted[a] *p* Value for difference
Eat different food groups good for health/prevent illness	1793 (83.6)	2312 (96.5)	12.9 [11.3, 14.6]	<0.001	10 [8.4, 11.6]	<0.001
Eat different food groups to help children grow well	1116 (52)	2271 (94.7)	42.7 [40.5, 45.0]	<0.001	42.6 [40.3, 44.9]	<0.001
Children should begin eating soft, semi-solid or solid foods and other liquids	933 (75.7)	2118 (86.9)	11.1 [8.6, 13.7]	<0.001	13 [10.3, 15.8]	<0.001
It is good if a child over 6 months of age should eat animal products, even during fasting[b]	1108 (91)	2160 (89.4)	−1.6 [−3.7, 0.5]	0.129	−0.4 [−2.7, 1.9]	0.744
It is dangerous to give meat to a child 6–12 months of age	508 (43.2)	544 (22.8)	−20.4 [−23.5, −17.3]	<0.001	−19.5 [−22.8, −16.1]	<0.001
Food for a child over 12 months of age should be prepared separately from other food	1088 (89.2)	2097 (86.3)	−2.8 [−5.1, −0.6]	0.015	−1.3 [−3.8, 1.2]	0.305
Eating a variety of foods is not important until children are old enough to get	190 (15.6)	315 (13)	−2.6 [−5.0, −0.2]	0.032	−4 [−6.6, −1.4]	0.002

Abbreviation: CI, confidence interval.

[a]Adjusted for maternal education, maternal age and income.

[b]Ethiopian Orthodox fasting is abstaining from animal-source foods on selected days in the yearly calendar, but young children are exempt.

start eating soft, semi-solid or solid foods over the intervention period. There was a significant increase in awareness that diet diversity is helpful to health, disease avoidance and children's optimal growth by the end of the follow-up period.

3.5 | Household production and consumption of diverse foodstuffs

Most households (81%) in the intervention districts owned agricultural land. The average size of agricultural land was 1.2 hectares per household. On contrary to our expectation, there was little or no improvement in agricultural production per household. Production of a single crop remained steady at ~22% yet the production of two or more crops significantly decreased by 20%. With the intervention, households produced less animal-source foods by about 3% and did not change in consumption (Table 4). However, when examining animal foods, there was an increase by 5% in production of only one animal, and there was a similar increase (of 6% to 7%) in consumption when one animal was produced.

3.6 | Under 2 children's diet quality

There was an improvement in the consumption of vitamin A-rich fruit and vegetables as well as of egg consumption over the intervention period by under 2 children. Milk and milk products consumption went up slightly but not significantly. Some foods were eaten less, such as pulses. The diversity indices MDD, MMF and MAD showed overall increases in the quality of the diet between the baseline and follow-up surveys. During the project's implementation, diet quality indices such as MAD and MDD increased by about four-fold. The number of children who met the MMF in the follow-up (61%) was higher compared with baseline (68%). Similarly, the percentage of children who met the MDD increased from about 4% to 17% over the intervention period (Table 5).

4 | DISCUSSION

The results presented focused on changes in complementary feeding of children under 2 after implementing SURE in three regions of Ethiopia, during which time community-based and enhanced nutrition services were offered. We found utilization of most of the enhanced CBN services had increased over the 4.5-year intervention period. We report that utilization of growth monitoring and production and screening for acute malnutrition greatly improved from 2016 to 2020; however, there was a large decline in households who receive Vitamin A supplementation and deworming. The lack of improvement in Vitamin A supplementation and deworming may be related to the situation that most health facilities were closed due to the COVID-19 pandemic. The enhanced nutrition services of IYCF counselling and provision of seeds or poultry significantly increased from 2016 to 2020 (Table 2). As described, these went only to the lowest decile income, and the increase may represent an increased interest in home agriculture production, which we observed for households having only one animal (Table 4). The primary aim of improved diet diversity in under 2 children was realized with a four-fold increase in MDD.

TABLE 4 Household agricultural production and consumption.

Staples	Production			Consumption		
Crops	Baseline	Endline	*p* Value	Baseline	Endline	*p* Value
None						
One	177 (9.4)	639 (26.2)	<0.001	47 (2.8)	43 (2.4)	<0.001
Two or above	401 (21.4)	559 (22.9)		436 (25.7)	596 (33.1)	
Pulses	1297 (69.2)	1240 (50.9)		1215 (71.6)	1160 (64.5)	
None						
One	979 (52.2)	1645 (67.5)	<0.001	47 (5.2)	35 (4.4)	0.019
Two or above	570 (30.4)	546 (22.4)		556 (62.1)	544 (68.6)	
Oil crops	326 (17.4)	247 (10.1)		293 (32.7)	214 (27)	
None						
One	1455 (77.6)	2144 (87.9)	<0.001	118 (28.1)	63 (21.4)	0.013
Two or above	344 (18.3)	236 (9.7)		260 (61.9)	198 (67.3)	
Roots/tubers/vegetables	76 (4.1)	58 (2.4)		42 (10)	33 (11.2)	
None						
One	640 (34.1)	1369 (56.2)	<0.001	20 (1.6)	37 (3.5)	0.018
Two or above	529 (28.2)	469 (19.2)		545 (44.1)	466 (43.6)	
Perennial crops/fruits	706 (37.7)	600 (24.6)		670 (54.3)	566 (52.9)	
None						
One	1373 (73.2)	1906 (78.2)	0.001	53 (10.6)	43 (8.1)	0.318
Two or above	284 (15.1)	294 (12.1)		257 (51.2)	290 (54.5)	
Animal-source food	218 (11.6)	238 (9.8)		192 (38.2)	199 (37.4)	
None						
One	715 (38.1)	1003 (41.1)	<0.001	110 (9.5)	75 (5.2)	<0.001
Two or above	326 (17.4)	547 (22.4)		402 (34.7)	595 (41.3)	
Crops	834 (44.5)	888 (36.4)		648 (55.9)	772 (53.5)	

During our intervention period, the number of caregivers/mothers who received a message about IYCF counselling increased dramatically. The current intervention was aimed at behaviour change, whereby exposure to recommended IYCF messages is a first stage to adopting key behaviours which in turn improve diet quality (Salasibew et al., 2019). Exposure to recommended IYCF messaging is the initial step towards adopting critical behaviours that contribute to better diet quality. Interventions in social and behaviour change communication are critical to improving dietary quality. The results show that nutrition knowledge of diet diversity improved greatly (Table 3). This then led to improvements in IYCF practices (Table 5). Others have shown that large-scale social and behaviour change communication interventions were linked to improvements in IYCF practices in Ethiopia (Kim et al., 2016). Interventions on IYCF practices should be done along the continuum of care, from conception until a child's second birthday (Ahmed et al., 2021). Having the IYCF message also come from HEWs or AEWs may help to reinforce the positive message and promote a healthy diet to children in a rural setting of Ethiopia. Others showed that when in-person nutrition education was combined with mass media, participants generally reported greater improvements in IYCF practices in low-income settings(Graziose et al., 2017). Given the coverage of mass media is low in rural settings, combined intervention may be an effective strategy for improving the IYCF and diet quality of children in Ethiopia. If the current trend in rural Ethiopia continues, the likelihood of meeting the national IYCF target is strong.

We hypothesized that access to utilization of nutrition would increase women's empowerment which in turn improves diet quality. During the intervention period, we found the percentage of women who engage in home gardening greatly increased (Table 2). A randomized control trial from Tanzania showed that women who grown home gardening consumed more food groups and improved their diet quality (Blakstad et al., 2021). We also found that women earning money increased from the family farms, however, their financial decision-making power decreased. Nevertheless, the observed improvement in diet quality of study children may be related to the high come of women which contributed to getting diverse diets

TABLE 5 Effect of interventions on prevalence (%) of children having improved diet quality.

Component	Baseline *n* (%)	Follow-up *n* (%)	Unadjusted Difference [95% CI]	Unadjusted *p* Value for difference	Adjusted[a] Difference [95% CI]	Adjusted[a] *p* Value for difference
Breast milk	762 (92.6)	2273 (95.8)	3.2 [1.5, 5.0]	<0.001	2.2 [0.4, 4.0]	0.017
Grain, roots and tubers	600 (70)	1586 (65.1)	−5 [−8.6, −1.3]	0.008	−3.3 [−7.3, 0.7]	0.109
Legumes and nuts	320 (37.3)	820 (33.6)	−3.7 [−7.4, −0.0]	0.051	−2.8 [−6.9, 1.2]	0.165
Milk and milk products	298 (34.8)	933 (38.3)	3.5 [−0.3, 7.3]	0.069	4.9 [0.9, 8.9]	0.017
Meat and related	31 (3.6)	94 (3.9)	0.3 [−1.2, 1.7]	0.753	0.1 [−1.5, 1.7]	0.91
Egg	91 (10.6)	428 (17.6)	7 [4.1, 9.8]	<0.001	9 [5.9, 12.0]	<0.001
Vitamin A-rich fruit and vegetables	114 (13.3)	456 (18.7)	5.4 [2.5, 8.3]	<0.001	4.9 [1.7, 8.2]	0.003
Other fruit and vegetables	17 (2)	67 (2.7)	0.7 [−0.5, 2.0]	0.222	1 [−0.4, 2.3]	0.16
Minimum dietary diversity ≥5 out of eight food groups	37 (4.3)	300 (16.7)	12.4 [9.7, 15.1]	<0.001	13 [10.1, 15.9]	<0.001
Minimum meal frequency	467 (61.1)	841 (68.2)	7.1 [2.8, 11.4]	0.001	6.8 [2.2, 11.4]	0.004
Minimum acceptable diet	28 (3.7)	163 (13.2)	9.5 [6.9, 12.2]	<0.001	10.4 [7.6, 13.3]	<0.001

[a]Adjusted for maternal education, maternal age and income.

for their children. Home gardens are a source of income and food security for many rural families in Africa (Nontu, 2021). A review of several small-setting studies from Ethiopia also found a significant positive association between ownership of home/backyard gardens and home gardens and children's dietary diversity (Wordofa & Sassi, 2020). We found an increase in consumption of pulses, home-grown oils and of animal-source foods (for one animal only) in households (Table 4) and that children increased egg intake and vitamin A-rich foods (Table 5). More research is needed on different components of women empowerment in the diet quality of children in Ethiopia.

We found that the production of a single crop decreased and the production of two crops increased (Table 4). Contrary to our expectations, there was no increase in productivity for more than two groups with the exception of perennial crops/fruits, which increased both production and consumption over the intervention periods. Despite the amount of food produced by modern intensive agricultural systems, poor-quality diets, which are typically manifested as diets lacking in diversity, continue to be a concern. The observed improvement in diet quality in our study cannot be related to households' wealth score as the latter did not change. A multi-country study (Indonesia, Kenya, Ethiopia and Malawi) showed that in some cases, on-farm output diversity correlated with dietary diversity. When production diversity is high, the association becomes insignificant or even negative due to killed income benefits from specialization (Sibhatu et al., 2015). This shows that increasing on-farm diversity is not always the most effective strategy to enhance dietary diversity in smallholder households and should not be viewed as a goal in and of itself. Households with more biodiverse farms that rely less on purchased goods may also be poorer, with fewer work prospects, social connections, and market access. Our research, however, did not look into the effect of the market on production or consumption diversity. Future study is needed to learn more about how agricultural and food systems might be made more nutrition-sensitive in specific conditions.

Our evaluation of the SURE intervention found that nutrition education provided by both HEW and AEWs improved the diet quality of children or dietary diversity. Evidence suggests that nutrition education through HEWs improved caregiver knowledge (Teshome et al., 2020). The results of a recent intervention trial in Ethiopia that used different platforms to implement social and behaviour change interventions improved the dietary diversity of children (Kim et al., 2019). Similarly, a recent randomized controlled trial from Northern Ethiopia showed that complementary feeding behaviour change communication delivered using women's development army improved child diet quality or diet diversity (Abiyu & Belachew, 2020). Our results were consistent with the recent intervention on delivery of social and behaviour change interventions using multiple platforms to improve the child's diet diversity (Kim et al., 2019). The improvement in the knowledge of the caregivers' essential component to improving the diet quality of children. However, the availability of food is important to improve diet. Agriculture has a significant role to play in ensuring the availability, accessibility and utilization of a healthy diet in Africa (Waha et al., 2018). We believe that the current improvement in diet quality may also be related to enhanced nutrition services that engage both health and agriculture (Moss et al., 2018).

Our evaluation study has strengths. It examined a large-scale national-level intervention and data were collected from a representative sample of children, using the usual government system of AEWs and HEWs. However, some limitations are acknowledged. Field data collection was conducted during the COVID-19 pandemic which affected clinic and in-person visits. Seasonality was different in baseline

and follow-up collections as it was not possible to carry out measurements every month as when crops are being planted, the whole family is too busy to participate in the study for data collection such as 24-hour recall. Not controlling for seasonality may have affected results for women's empowerment where more gardening and less fieldwork was reported. For the follow-up, it was necessary to conduct when funds for the project ended. At endline, there was an increase in the percentage of caregivers having no education, with no apparent reason except chance due to gote selection. We did not measure whether there had been any constraints to joint HEW and AEW household visits and what actually happened in the gotes may have deviated over time due to local conditions. The Tigray region follow-up data could not be collected. Finally, the design of the survey does not enable us to make inferences about the programme's effectiveness, impact, or cause-effect relationships. It may indicate changes in this evaluation study, increase or decrease, between the baseline (2016) and the end-line (2020).

5 | CONCLUSION

The districts that were evaluated participating in the SURE programme intervention saw significant improvements in almost all aspects of IYCF practices, including coverage and utilization of CBN services, women empowerment and dietary quality and maternal knowledge of childcare and feeding practices, when compared to the baseline findings of indicators. The design of the study precludes assigning a causal relationship to these findings with providing enhanced services. It merits consideration to expand the SURE programme to other districts and regions of Ethiopia as well as advocating the adoption of SURE programme delivery platforms by other nutrition programmes in Ethiopia.

AUTHOR CONTRIBUTIONS

Masresha Tessema, Girmaye Ayana, and Shimelis Hussien conceived the idea and designed the study. Tadesse Kebebe, Masresha Tessema, Alem Petros, Getinet Fikresilassie and Berhanu Wodajo coordinated and supervised training and data collection. Alemayehu Hussen and Beza Teshome analysed the data. Masresha Tessema, Susan J. Whiting and Shimelis Hussien interpreted data. Masresha Tessema and Susan J. Whiting wrote the first draft of the manuscript. Susan J. Whiting, Masresha Tessema and Shimelis Hussien critically reviewed the manuscript. All authors read and approved the final version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Di-identified data will be available upon request to the authors.

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REFERENCES

Abebe, R., Fekadu, H., & Gelan, Z. (2012). Case studies: Community based nutrition. *Ethiopian Health and Research Institute: Contribution to the Mid-Term Review of the Ethiopia Nutrition Project*.

Abiyu, C., & Belachew, T. (2020). Effect of complementary feeding behavior change communication delivered through community-level actors on dietary adequacy of infants in rural communities of West Gojjam Zone, Northwest Ethiopia: A cluster-randomized controlled trial. *PloS One 15*(9), e0238355. https://doi.org/10.1371/journal.pone.0238355

Ahmed, K. Y., Agho, K. E., Page, A., Arora, A., & Ogbo, F. A. (2021). Interventions to improve infant and young child feeding practices in Ethiopia: A systematic review. *BMJ Open*, *11*(8), e048700.

Arikpo, D., Edet, E. S., Chibuzor, M. T., Odey, F., & Caldwell, D. M. (2018). Educational interventions for improving primary caregiver complementary feeding practices for children aged 24 months and under. *Cochrane Database of Systematic Reviews*, *2018*(5), Cd011768. https://doi.org/10.1002/14651858.CD011768.pub2

Arimond, M., & Ruel, M. T. (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. *The Journal of Nutrition*, *134*(10), 2579–2585. https://doi.org/10.1093/jn/134.10.2579

Baye, K., & Kennedy, G. (2020). Estimates of dietary quality in infants and young children (6-23 mo): Evidence from demographic and health surveys of 49 low- and middle-income countries. *Nutrition*, *78*, 110875. https://doi.org/10.1016/j.nut.2020.110875

Bégin, F., & Aguayo, V. M. (2017). First foods: Why improving young children's diets matter. *Maternal & Child Nutrition*, *13*(Suppl. 2), e12528. https://doi.org/10.1111/mcn.12528

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., Webb, P., Lartey, A., & Black, R. E. (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? *The Lancet*, *382*(9890), 452–477. https://doi.org/10.1016/s0140-6736(13)60996-4

Blakstad, M. M., Mosha, D., Bellows, A. L., Canavan, C. R., Chen, J. T., Mlalama, K., Noor, R. A., Kinabo, J., Masanja, H., & Fawzi, W. W. (2021). Home gardening improves dietary diversity, a cluster-randomized controlled trial among Tanzanian women. *Maternal & Child Nutrition*, *17*(2), 13096.

CSA. (2016). Central statistical agency (CSA)[Ethiopia] and ICF. Ethiopia demographic and health survey, Addis Ababa, Ethiopia and Calverton, Maryland, USA.

Dilnesaw Zerfu, A. B., W/Yohanes, M., Ayana, G., Abera, A., Tesfaye, B., Kuche, D., & Tessema, M. (2016). Ethiopian National Micronutrient Survey. http://www.ephi.gov.et/images/pictures/download2009/National_MNS_report.pdf

Disha, A., Rawat, R., Subandoro, A., & Menon, P. (2012). Infant and young child feeding (IYCF) practices in Ethiopia and Zambia and their association with child nutrition: Analysis of demographic and health survey data. *African Journal of Food, Agriculture, Nutrition and Development*, *12*(2), 5895–5914.

Ewerling, F., Lynch, J. W., Victora, C. G., van Eerdewijk, A., Tyszler, M., & Barros, A. J. D. (2017). The SWPER index for women's empowerment in Africa: Development and validation of an index based on survey data. *The Lancet. Global Health*, *5*(9), e916–e923. https://doi.org/10.1016/S2214-109X(17)30292-9

Gatica-Domínguez, G., Neves, P. A. R., Barros, A. J. D., & Victora, C. G. (2021). Complementary feeding practices in 80 low- and middle-income countries: Prevalence of and socioeconomic inequalities in dietary diversity, meal frequency, and dietary adequacy. *The Journal of Nutrition*, *151*, 1956–1964. https://doi.org/10.1093/jn/nxab088

Graziose, M. M., Downs, S. M., O'Brien, Q., & Fanzo, J. (2017). Systematic review of the design, implementation and effectiveness of mass media and nutrition education interventions for infant and young child feeding. *Public Health Nutrition*, *21*(2), 273–287. https://doi.org/10.1017/S1368980017002786

INDEXX Project. (2018). Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. https://inddex.nutrition.tufts.edu/data4diets Accessed on October 12, 2022.

Jones, A. D., Hoey, L., Blesh, J., Miller, L., Green, A., Shapiro, L. F. (2016). A systematic review of the measurement of sustainable diets. *Advances in Nutrition*, *7*(4), 641–664. https://doi.org/10.3945/an.115.011015

Kim, S. S., Nguyen, P. H., Yohannes, Y., Abebe, Y., Tharaney, M., Drummond, E., Frongillo, E. A., Ruel, M. T., & Menon, P. (2019). Behavior change interventions delivered through interpersonal communication, agricultural activities, community mobilization, and mass media increase complementary feeding practices and reduce child stunting in Ethiopia. *The Journal of Nutrition*, *149*(8), 1470–1481. https://doi.org/10.1093/jn/nxz087

Kim, S. S., Rawat, R., Mwangi, E. M., Tesfaye, R., Abebe, Y., Baker, J., Frongillo, E. A., Ruel, M. T., & Menon, P. (2016). Exposure to large-scale social and behavior change communication interventions is associated with improvements in infant and young child feeding practices in Ethiopia. *PLoS One*, *11*(10), e0164800.

Krasevec, J., An, X., Kumapley, R., Bégin, F., & Frongillo, E. A. (2017). Diet quality and risk of stunting among infants and young children in low-and middle-income countries. *Maternal & Child Nutrition*, *13*, e12430.

Kuche, D., Moss, C., Eshetu, S., Ayana, G., Salasibew, M., Dangour, A. D., & Allen, E. (2020). Factors associated with dietary diversity and length-for-age z-score in rural Ethiopian children aged 6-23 months: A novel approach to the analysis of baseline data from the sustainable undernutrition reduction in Ethiopia evaluation. *Maternal & Child Nutrition*, *16*(1), 12852. https://doi.org/10.1111/mcn.12852

Manikam, L., Prasad, A., Dharmaratnam, A., Moen, C., Robinson, A., Light, A., Ahmed, S., Lingam, R., & Lakhanpaul, M. (2018). Systematic review of infant and young child complementary feeding practices in South Asian families: The India perspective. *Public Health Nutrition*, *21*(4), 637–654. https://doi.org/10.1017/s136898001700297x

Moss, C., Bekele, T. H., Salasibew, M. M., Sturgess, J., Ayana, G., Kuche, D., Eshetu, S., Abera, A., Allen, E., & Dangour, A. D. (2018). Sustainable undernutrition reduction in Ethiopia (SURE) evaluation study: A protocol to evaluate impact, process and context of a large-scale integrated health and agriculture programme to improve complementary feeding in Ethiopia. *BMJ Open*, *8*(7), e022028.

Muslimatun, S., & Wiradnyani, L. A. (2016). Dietary diversity, animal source food consumption and linear growth among children aged 1-5 years in Bandung, Indonesia: A longitudinal observational study. *British Journal of Nutrition*, *116*(Suppl. 1), S27–S35. https://doi.org/10.1017/s0007114515005395

Nontu, Y. (2021). Determinants of home gardening participation among rural households: evidence from ingquza hill local municipality, South Africa. *Journal of Agribusiness and Rural Development*, *60*(2), 213–220.

Portal, E. G. (2021). The structure and division of power. http://www.ethiopia.gov.et/thestructure-and-division-of-power

Salasibew, M. M., Moss, C., Ayana, G., Kuche, D., Eshetu, S., & Dangour, A. D. (2019). The fidelity and dose of message delivery on infant and young child feeding practice and nutrition sensitive agriculture in Ethiopia: A qualitative study from the sustainable undernutrition reduction in Ethiopia (SURE) programme. *Journal of Health, Population, and Nutrition*, *38*(1), 29.

Sibhatu, K. T., Krishna, V. V., & Qaim, M. (2015). Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academy of Sciences*, *112*(34), 10657–10662. https://doi.org/10.1073/pnas.1510982112

Teshome, G. B., Whiting, S. J., Green, T. J., Mulualem, D., & Henry, C. J. (2020). Scaled-up nutrition education on pulse-cereal complementary food practice in Ethiopia: A cluster-randomized trial. *BMC Public Health*, *20*(1), 1437. https://doi.org/10.1186/s12889-020-09262-8

Villa, J. M. (2012). Simplifying the estimation of difference in differences treatment effects with Stata.

Waha, K., Van Wijk, M. T., Fritz, S., See, L., Thornton, P. K., Wichern, J., & Herrero, M. (2018). Agricultural diversification as an important strategy for achieving food security in Africa. *Global Change Biology*, *24*(8), 3390–3400.

White, J., & Mason, J. (2012). Assessing the impact on child nutrition of the Ethiopia Community-based Nutrition Program.

White, J. M., Beal, T., Arsenault, J. E., Okronipa, H., Hinnouho, G. M., Chimanya, K., Matji, J., & Garg, A. (2021). Micronutrient gaps during the complementary feeding period in 6 countries in Eastern and Southern Africa: Acomprehensive nutrient gap assessment. *Nutrition Reviews*, *79*(Suppl. 1), 16–25. https://doi.org/10.1093/nutrit/nuaa142

White, J. M., & Bégin, F. (2017). Complementary feeding practices: Current global and regional estimates. *Maternal & Child Nutrtion*, *13*, e12505. https://doi.org/10.1111/mcn.12505

Wordofa, M. G., & Sassi, M. (2020). Impact of agricultural interventions on food and nutrition security in Ethiopia: Uncovering pathways linking agriculture to improved nutrition. *Cogent Food & Agriculture*, *6*(1), 1724386. https://doi.org/10.1080/23311932.2020.1724386

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