

Effect of community-based nutritional education on dietary diversity and consumption of animal-source foods among rural preschool-aged children in the Ilu Abba Bor zone of southwest Ethiopia: Quasi-experimental study

Kebebe Bidira  | Dessalegn Tamiru | Tefere Belachew

Department of Nutrition and Dietetics,
Institute of Health, Jimma University, Jimma,
Ethiopia

Correspondence

Kebebe Bidira, Department of Nutrition and
Dietetics, Institute of Health, Jimma
University, Jimma, Ethiopia.
Email: kebebe1@gmail.com

Funding information

Jimma University

Abstract

Dietary diversity (DD) is a concern for poor people in developing countries, particularly in Africa. Most people's diets consist primarily of monotonous carbohydrate staples, with little or no animal products and few fresh fruits and vegetables. The aim of this intervention was to see how nutrition education delivered by trained health professionals improved preschool-aged children's consumption of DD and animal-sourced foods. The study used a quasi-experimental design with 588 preschool-aged children. Researchers used a multistage sample technique followed by a systematic random sampling technique. A χ^2 test was used to determine the baseline differences in demographic and socioeconomic factors between the two groups, as well as the relationship between predictors and child DD and animal-source foods (ASFs). The researchers used generalized estimating equations to assess the change in the difference in outcomes between the intervention and control groups, as well as the association between predictors and child DD and ASFs. The adjusted odds ratio with the corresponding 95% confidence intervals was reported to show the strength of the association. The findings of this study revealed that there was a highly significant difference in both DD scores (DDS) and ASFs between the control and intervention groups DDS ($p < 0.003$) and ASF ($p < 0.001$). According to the findings of this study, nutrition education can significantly improve DDS and ASF consumption among preschool-aged children.

KEYWORDS

animal-source foods, dietary diversity, nutritional education, preschool children, southwest Ethiopia

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1 | INTRODUCTION

Dietary diversity (DD) is a good indicator of food consumption that shows the availability of a wide variety of foods in the home, as well as a proxy for the nutrient sufficiency of an individual's diet (FAO, 2010). DD, which is defined here as the total number of food groups consumed over a given reference period, has gained prominence as a valid and reliable indicator of dietary adequacy among children. Nutrient-rich foods from a variety of diets are important components of child feeding because they support dietary needs and adequate growth in their early years of life (Ac, 2014; FAO, 2010; Modjadji & Molokwane, 2020).

Animal-source foods (ASFs) are in high demand around the world, and their contribution to better nutritional outcomes is considerable. ASFs are rich in high-quality, bioavailable proteins as well as critical minerals such as iron, zinc and vitamins A and B12 (folate). Their consumption can help to improve the quality of one's diet, resulting in a more balanced and healthy diet. ASFs are especially important for people whose diet does not meet their nutritional needs, specifically regarding quality and protein intake (Bolton, 2019; FAO, 2011, 2020).

A healthy diet is essential for a person's nutritional status, health and well-being (Sirasa et al., 2020). Micronutrient deficiency in children, even at modest levels, has been reported to harm cognitive development and reduce disease resistance (Bandoh & Kenu, 2017). At least one out of every two people suffers from hidden hunger as a result of major dietary inadequacies that go occasionally undetected (UNICEF, 2019). According to the World Health Organization (WHO), one out of every two preschool children is hungry (Bandoh & Kenu, 2017). As malnutrition in all its forms is highly preventable, the millions of children who die each year as a result of malnutrition could be prevented if the appropriate therapies were implemented (WHO/UNICEF, 2008). Dietary assessment is one of the most effective approaches to prevent malnutrition (Bandoh & Kenu, 2017). The Sustainable Development Goals (SDGs) seek to guarantee that all children live healthy lives and are well-adjusted. The SDG 3 target 3.2 aimed to eliminate preventable deaths among infants and children under the age of 5 by 2030 (SDGs. UNDP, 2016). The United Nations has underlined that efforts to achieve the SDGs must take into account nutrition goals as all of the SDGs are linked to nutrition. Advances in human nutrition serve as both a maker and a marker of long-term growth (United Nations, 2014).

Globally, studies show that different sociodemographic and economic characteristics of mothers/caretakers and children are associated with DD for children aged less than 2 years. Some of the factors that determine minimum DD are the child's age, maternal education, birth order, wealth index and the number of children under the age of 5 in the household. DD is a serious concern among poor people in developing countries, particularly in Africa (Sciences, 2015). Most people's diets consist primarily of monotonous carbohydrate staples, with little or no animal products and few fresh fruits and vegetables (FAO & WHO, 1998). Optimal feeding is limited by a reliance on plant-based staples like maize meal, as well

Key messages

- Promoting minimum dietary diversity in feeding practices is essential to improve child health and development on a global scale.
- Community-based nutritional education, delivered by trained health professionals, improved feeding practices among caregivers.
- This nutrition education increased children's dietary diversity and consumption of animal-derived foods significantly.
- Our findings highlight the need for future research to investigate relevant aspects not covered in this study.

as low-cost fats and sugar (Du Plessis et al., 2013). To sustain appropriate child growth and development, the WHO recommends a minimum DD of at least four food groups out of seven (WHO, 2008), but many children are unable to achieve this criterion (Khamis et al., 2019).

In addition to insufficient DD, child malnutrition is caused by poor hygiene and unhealthy practices, as well as a lack of knowledge about how to optimize DD by utilizing existing complementary feeding resources (Kuchenbecker et al., 2017; Sciences, 2015). Nutrition education (NE) has been recognized as a high-impact intervention that can help to minimize stunting and its associated illness load. The goal of NE is to encourage voluntary changes in food choices and food- and nutrition-related behaviours that are beneficial to one's health and well-being. Study shows that NE focuses on the individual, as well as institutions, communities and policies. People's motivation to learn to eat well is improved by NE, which also improves their abilities and opportunities to do so (Sciences, 2015). The role of NE in enhancing feeding practices and, as a result, DD and child growth is supported by empirical studies. In Kenya, children whose caregivers took part in a NE intervention showed significant gains in DD (Waswa et al., 2015). Furthermore, in Ethiopia, NE improved child DD (CDD) as well as mean energy and chosen nutrient intake (Negash et al., 2014). In Ghana, combining NE with microcredit loans and economic instruction greatly enhanced children's height-for-age. All of these studies examined the effects of NE on actual participants compared with controls who did not receive it (Marquis et al., 2015). There are no specific educational programmes in the study area that work on DD and ASFs. However, nutrition is included as one component of the 16 Packages of Health Extension Programmes. Since its beginning, the programme has had a significant impact on rural people's attitudes and practices towards disease prevention, family health, hygiene and environmental sanitation. The statistics reveal that the initiative has had no substantial effect on child malnutrition and feeding practices (Banteyerga, 2010). The aim of the current NE intervention was to determine the effect of NE on DD and consumption of ASFs among preschool-aged children.

2 | METHODS

2.1 | Study setting

Ilu Abba Bor is a zone in the Oromia regional state, 600 km from the country's capital, Addis Ababa. There are 14 districts in the zone: one administrative town and 13 rural districts, with a total population of 934,783 people, including 153,585 children under the age of 5 and 100,209 children aged 2–5 years. The western section of the country runs from 70°27'40" N to 90°02'0" N latitude and 340°52'12" E to 410°34'55" E longitude. There are three main climate zones: temperate, humid, rainy and dry arid. The highest mean annual temperature in most highland areas of Ilu Abba Bora ranges from 10.6°C to 26°C.

2.2 | Study design

A quasi-experimental design with pretest–posttest and control groups was used to assess the effects of community-based nutritional education on DD and ASFs among preschool-aged children in 22 rural kebeles.

2.3 | Sample size and sampling technique

The sample size was calculated using a G-Power model with the following assumptions: 52.5% expected prevalence of the previous study among children aged 24–59 months, 2.07 odds ratio (OR) (Dewana et al., 2017), 80% power and a 5% margin of error. After accounting for a design effect of 2 and a 15% nonresponse rate, the total sample size was 588 participants (Figure 1). This paper is part of a PhD dissertation. The project sample size was determined after the sample size for each objective was calculated and the largest one was chosen.

A multistage sampling technique followed by a systematic random sampling technique was used to identify caregivers with preschool-aged children. In the first step, four districts were selected at random from a total of 14 districts. To avoid information contamination, two neighbouring districts from the selected districts were chosen as interventions and the other two adjacent districts as control groups due to their similarity in terms of access to health care, water and other services. The intervention group received two districts at random, whereas the control group received two districts. Each group (intervention and control) had 11 kebeles (Ethiopia's smallest administrative units) selected at random. Following the selection of kebeles, preschool-aged children (2–5 years) were identified and registered in each chosen kebele. A code was given to households with children aged 2–5 years old, which was used as a sample frame. A proportional allocation was carried out after the registration of preschool-aged children, and a sample was taken from both the intervention and control groups using a systematic random sampling procedure. If the caregivers/

households had more than one child, the lottery technique was used to choose one at random.

2.4 | NE strategy

In all intervention groups, NE was implemented for a total of 9 months after baseline data collection was completed. A NE package was developed using family dietary guidelines (Burgess & Glasauer, 2004) and other relevant nutritional education intervention modules and topics were adopted and modified as local situations from literature (Mushaphi et al., 2015; Siew et al., 2020) for community-based nutrition intervention as well as using the findings of a baseline survey. All health extension workers, trained health professionals and caregivers/mothers can use it to implement nutrition interventions for mothers of preschool-aged children. It is easy to use, interactive and user-friendly. This NE package consists of three educational modules and a number of supporting educational materials. The education modules focus on three areas: healthy diet awareness, nutrition and hygiene, with a total of 10 topics, namely, eating a variety of foods, providing preschoolers aged 2–5 years with starchy foods, consuming a variety of vegetables and fruits on a regular basis and consuming dry beans, split peas, lentils and soy regularly. It also included daily consumption of chicken, fish, meat, milk and eggs; however, salt and fat should be used sparingly, and sugar-containing foods and beverages should be consumed in moderation and not between meals to ensure food safety and cleanliness. To summarize the content of the modules, the first module was about caregiver awareness about healthy diets and feeding children aged 2–5 years. These topics were addressed in Sessions 1 and 2. The first and second sessions are more focused on mothers' or caregivers', child feeding knowledge and practice. A second module was about child nutrition (DD), which focuses on the seven food groups and related issues. In this module, Sessions 3–9 were covered. In module three, the issues of hygiene and sanitation were addressed in Session 10.

The caregivers/mothers gathered in a place that was convenient for them and comfortable for the group, such as a school, health post or health centre. Each kebele was allotted one trained health professional and one health extension worker, suggesting that health extension workers served as helpers and facilitators. Over the course of 5 months, 10 sessions were held every 2 weeks for approximately 30–45 min, with two sessions held in the seventh month as a refresher. The caregivers were introduced to the topic of the day on the day of the presentation. To assess prior knowledge and to encourage discussion, specific questions were asked about the topic. At the end of the session, caregivers were evaluated to see how well they understood the information.

The mechanism of communication is determined by context, cultural preference and how people normally receive and obtain information. The educational materials included group discussions, lectures, role-plays, active participation and demonstrations to teach mothers about child feeding. In this study, the group discussion

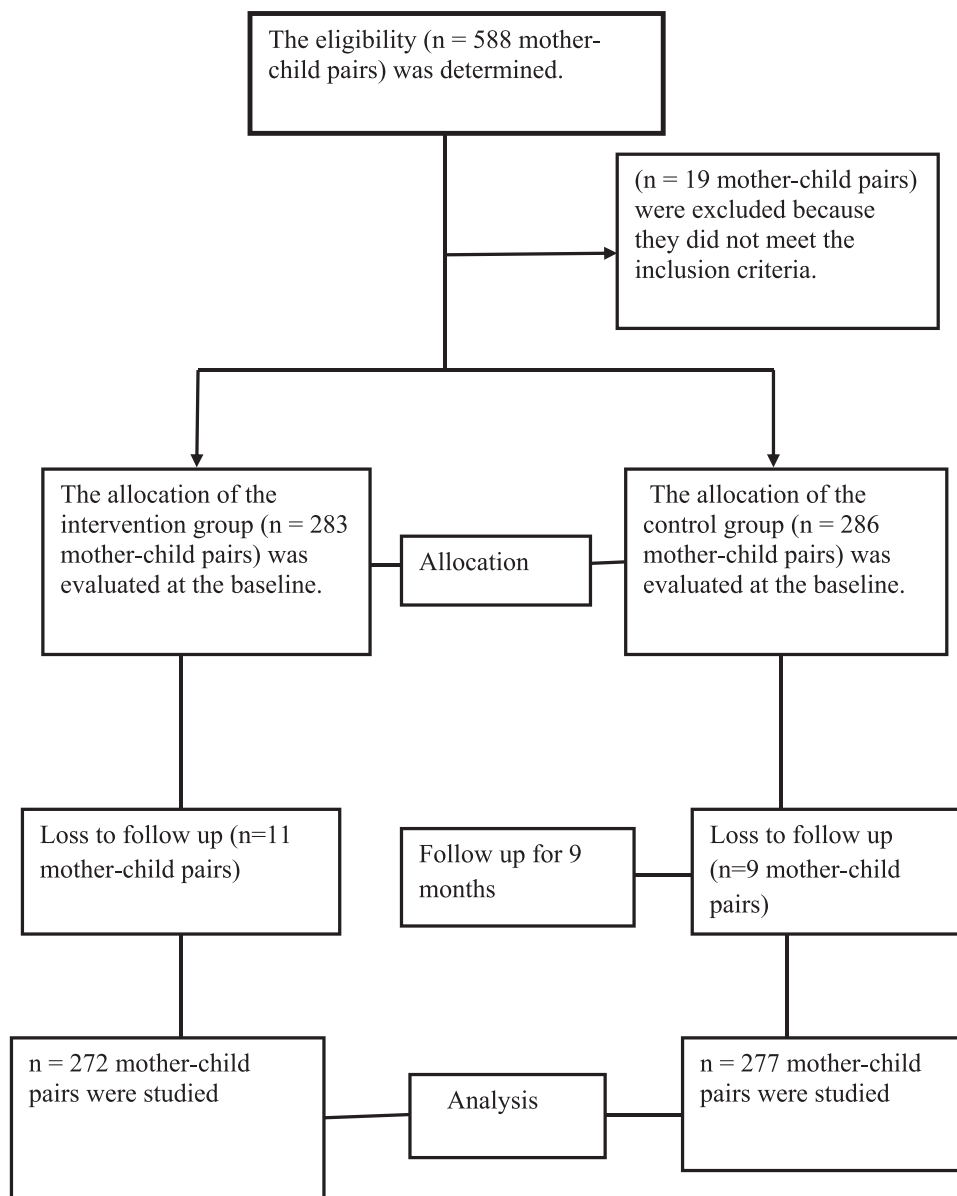


FIGURE 1 Flow diagram of the research process

method was utilized more because it is an excellent way to encourage interaction between group members and it allows for more participation.

2.5 | Process evaluation

To improve and track compliance with the intervention, monitoring activities and process evaluations were used. The principal investigator and supervisors visited each home to check on the intervention's progress and talk with the mothers and caregivers about what they were doing. Investigators and supervisors have been meeting on a regular basis to discuss the project's progress and any necessary modifications. The process evaluation's goal was to document the intervention's implementation process to see if the activities were

carried out as planned, determine the degree to which the activities reached children and mothers/caregivers and investigate contextual factors that may have impacted on target children and caregivers. The caregiver's or father's phone number, as well as the home address, was registered with the researcher, supervisors and educators in charge of that kebele as assigned by the researcher. The educators assigned to the area would call the caregivers 2 days before and on the eve of visitation day to remind them of the visitation day. The educators provided individualized counselling during follow-up. This was done on various days based on each participant's visitation day at home, and when not available at home, any convenient and available location was always used as an alternative. During visitation day, the supervisors assessed the number of training sessions including cooking demonstrations held with trained health professionals, the number of training session

role-plays and cooking demonstrations held with caregivers and also the number of lecture and group discussion sessions held with educators. It also provided information that can help in the interpretation of outcome indicators and can also be used to monitor the attendance of mothers and caregivers during nutritional education sessions. The supervisor took attendance on the number of recruited caregivers, the number of caregivers attending the education session and the number of home visits conducted by educators.

2.6 | Data collection

To ensure that the study arms were similar in terms of socio-demographic characteristics, child care practices, dietary practices and child nutrition status, a baseline analysis of 569 caregivers/mothers with preschool-aged children was undertaken at the time of recruitment. All caregivers/mothers were interviewed by trained data collectors using a structured interviewer questionnaire at the baseline and end of the study. To ensure consistency, the questionnaire was written in English first and then translated into the local language (Afan Oromo), and then back to English. Before the actual data collection, a pretest of the questionnaire was conducted on 5% of the total samples outside the study area to determine the acceptability and application of the instruments and procedures. Twelve bachelor's degree nurses were hired as data collectors, and six bachelor's degree public health officers were responsible for supervising. All data collectors and supervisors received intensive training over the course of 3 days. Investigators, qualified supervisors and data collectors took all anthropometric measurements to prevent within-examiner error. A principal investigator and professional supervisors supervised the data collection. They supervised and double-checked each questionnaire for completeness, irregularities, inconsistencies and out-of-the-ordinary answers, making immediate corrections as needed. Computer frequencies were used to check for missing variables, outliers and other errors during data entry. The original questionnaire was revised at this time to correct any identified errors.

The survey included socioeconomic and demographic characteristics, as well as water and hygiene habits, maternal and child health and child feeding habits. Trained data collectors conducted face-to-face interviews with the mothers/caregivers in their homes. The age of the child was calculated using the child's date of birth and the date of the interview. When the actual day of birth was not recorded or was unclear, the caregiver was asked to make a guess based on recent occurrences in the area. The age of the child was determined by subtracting the date of birth from the date of data collection. The DD score (DDS) was assessed using the repeated 24-h dietary recall method, which was taken three times (two weekdays and one weekend). Fasting and feasting days were included in the description of each day of the week. The children's caregivers were asked to remember everything their children ate or drank during the 24-h period of study. The individual DDS of the study respondents was calculated according to the FAO guidelines (FANTA II, 2010). The sum of scores in each of the seven food

groups, on a scale of 0–7, was used to calculate DD. At least four of the seven food groups listed below were used to compute the minimal DD (MDD) indicator: (1) grains, roots and tubers; (2) dairy products; (3) animal/flesh meals; (4) legumes and nuts; (5) vitamin A-rich fruits and vegetables; (6) eggs; and (7) other fruits and vegetables (19). The Ethiopia Demographic and Health Survey factors were used to create the Household Wealth Index, which is focused on household ownership of fixed assets, services, housing characteristics and other factors (UNICEF/WHO/WorldBankGroup, 2016).

2.7 | Data processing and analysis

Data were checked, cleaned, coded and entered into Epi-data 3.1 and then exported to SPSS 21.0 for further analysis. Recoding and transforming of some variables were performed. A χ^2 test was used to look at the baseline differences in demographic and socioeconomic characteristics between the two groups. An independent sample *t* test was used to determine the mean difference in DDS and ASFs between the intervention and control groups.

The change in the difference in outcome between the intervention and control groups, as well as the association of predictors with DDS and ASFs in children, were determined using generalized estimating equations (GEEs) with a binary logistic function and exchangeable correlation structure. GEE adjusts the standard errors by accounting for clustered observations. An independent covariance matrix was chosen for the main models by assuming two observations are equally correlated within a cluster, with no correlation between observations from different clusters. Accordingly, the bivariable GEE for sociodemographic and economic factors, water and hygiene habits, maternal and child health and child feeding habits factors for child DDS and ASFs were fitted. A multivariable GEE was used to fit all the variables in the bivariable with a *p* value of 0.25. Time and treatment interaction were used to determine the intervention's effectiveness.

The adjusted OR (AOR) with the corresponding 95% confidence intervals was reported to show the strength of the association. All analyses were carried out with the purpose of taking into account the intention-to-treat (ITT) concept. Variables having a *p* value less than 0.05 were declared statistically significant in multivariable analysis.

3 | RESULTS

Before the implementation of nutritional education, there was no statistically significant difference between the two groups observed in all variables except ANC follow-up, where there was a significant difference ($p < 0.025$) between the intervention and control groups. In all demographic variables, both groups had a similar distribution. The mean (\pm SD) age of the children in months and caregivers/mothers in years was 36.785 (\pm 9.288) and 28.415 (\pm 5.88), respectively. The majority of caregivers/mothers, 484 (85.1%), were married, and only 27 (4.7%) had a tertiary education (Table 1).

TABLE 1 Demographic and socioeconomic characteristics of mothers/caregivers and their children in the Ilu Abba Bor Zone of southwest Ethiopia

Variables	Category	Intervention, n (%)	Control, n (%)	p value
Age of mother/caregiver	<25	104 (36.7)	97 (33.9)	0.695
	25–34	130 (45.9)	133 (46.5)	
	≥35	49 (17.3)	56 (19.6)	
Marital status	Single	23 (8.1)	17 (5.9)	0.685
	Married	239 (84.5)	245 (85.7)	
	Widowed	7 (2.5)	10 (3.5)	
	Divorced	14 (4.9)	14 (4.9)	
	Divorced			
Educational status of mothers/caregiver	Cannot read and write	50 (17.7)	41 (14.3)	0.621
	Can read and write	25 (8.8)	25 (8.7)	
	Grades 1–4	50 (17.7)	41 (14.3)	
	Grades 5–8	79 (27.9)	88 (30.8)	
	Grades 9–12	68 (24.0)	75 (26.2)	
	Tertiary education	11 (3.9)	16 (5.6)	
Occupation of the mothers/caregiver	Housewife	230 (81.3)	225 (78.7)	0.631
	Merchant	33 (11.7)	32 (11.2)	
	Government employee	12 (4.2)	18 (6.3)	
	Others	8 (2.8)	11 (3.8)	
Family size	<5	220 (77.7)	212 (74.1)	0.314
	≥5	63 (22.3)	74 (25.9)	
Age of the child (in months)	24–35	128 (45.2)	122 (42.7)	0.731
	36–47	97 (34.3)	107 (37.4)	
	48–59	58 (20.5)	57 (19.9)	
Sex of the child	Male	150 (53.0)	141 (49.3)	0.377
	Female	133 (47.0)	145 (50.7)	
ANC follow-up	Yes	272 (96.1)	262 (91.6)	0.025
	No	11 (3.9)	24 (8.4)	
Place of delivery	Health facility	218 (77.0)	213 (74.5)	0.477
	At home	65 (23.0)	73 (25.5)	
Vaccination status	Incomplete	77 (27.2)	76 (26.6)	0.974
	Complete	206 (72.8)	210 (73.4)	
Knowledge score	Good	108 (38.2)	124 (43.4)	0.207
	Poor	175 (61.8)	162 (56.6)	
Household food security	Food secure	98 (34.6)	101 (35.3)	0.864
	Food insecure	185 (65.4)	185 (64.7)	
Household Wealth Index	Lowest	92 (32.5)	105 (36.7)	0.572
	Second	19 (6.7)	19 (6.6)	
	Meddle	74 (26.1)	64 (22.4)	
	Fourth	54 (19.1)	62 (21.7)	
	Highest	44 (15.5)	36 (12.0)	

Note: Other = daily labour.

Abbreviation: ANC, antenatal care.

TABLE 2 The proportion and mean difference of preschool-aged children in Illu Abba Bori, southwest Ethiopia, who consumed different types of food groups

Variables	Baseline 2019 (n = 569)				End line 2020 (n = 549)			
	Intervention, N (%)	Control, N (%)	Mean difference	p Value	Intervention	Control	Mean difference	p value
Cereals								
Yes	277 (97.9)	276 (96.5)	0.01376	0.321	268 (98.5)	271 (97.8)	0.00695	0.542
No	6 (2.1)	10 (3.5)			4 (1.5)	6 (2.2)		
Legumes								
Yes	193 (68.20)	215 (75.2)	-0.06977	0.065	198 (72.8)	218 (78.7)	-0.05906	0.106
No	90 (31.80)	71 (24.8)			74 (27.2)	59 (21.3)		
Vitamin A-rich fruits and vegetables								
Yes	146 (51.6)	170 (59.4)	-0.0785	0.06	144 (52.9)	156 (56.3)	-0.03377	0.427
No	137 (48.4)	116 (40.6)			128 (47.1)	121 (43.7)		
Other fruits and vegetables								
Yes	239 (84.5)	247 (86.4)	-0.01911	0.518	240 (88.2)	240 (86.6)	0.01593	0.574
No	44 (15.5)	39 (13.6)			32 (11.8)	37 (13.4)		
Egg								
Yes	67 (23.7)	70 (24.5)	-0.00801	0.823	95 (34.9)	68 (24.5)	0.10378	0.008
No	216 (76.3)	216 (75.5)			177 (65.1)	209 (75.5)		
Dairy product								
Yes	176 (62.2)	181 (63.3)	-0.01096	0.787	193 (71.0)	173 (62.5)	0.08501	0.035
No	107 (37.8)	105 (36.7)			79 (29.0)	104 (37.5)		
Flesh food								
Yes	61 (21.6)	61 (21.3)	-0.00226	0.948	100 (36.8)	72 (26.0)	0.10772	0.007
No	222 (78.4)	225 (78.7)			172 (63.2)	205 (74.0)		

3.1 | Food group proportions and mean differences

In terms of dietary intake of various food groups, there was no significant difference between the intervention and control groups at the beginning. At the end of the study, there was no significant difference between the intervention and control groups in food groups such as cereals ($p < 0.542$), legumes ($p < 0.106$), vitamin A-rich fruits and vegetables ($p < 0.427$) and other fruits and vegetables ($p < 0.5740$). At the end of the study, there were significant differences between the intervention and control groups in animal-source items such as eggs ($p < 0.008$), dairy products ($p < 0.035$) and flesh foods ($p < 0.007$) (Table 2).

3.2 | Mean difference in DD and food sourced from animals

At the baseline survey, no significant change in MDD or ASFs intake was found between the control and intervention

groups (DDS $p < 0.699$; ASF $p < 0.620$). However, the results revealed that there was a highly significant difference in DDS and ASF between the control and intervention groups, with the proportion of DDS in the intervention group increasing by 12.4% (DDS $p < 0.003$) while ASF consumption increased by 14.3% (ASF $p < 0.001$) (Table 3).

3.3 | Effect of the intervention on DDS

To determine independent factors related to the end-of-baseline difference in mean MDD scores, we used multivariable GEEs. Wealth status, toilet style, caregiver knowledge and nutritional education were all factors in the model. NE and caregiver knowledge were the only variables that were independent predictors of the minimum DDS. After controlling for potential confounders, preschool children in the control group were 28.7% less likely to have MDD than those in the intervention group (AOR=0.713, 95% CI: 0.509, 0.998). Caregivers who had a good knowledge of feeding practice were

TABLE 3 Differences in dietary diversity and animal source food intake between baseline and endpoint among preschool-aged children in southwest Ethiopia

Variable	Group type	N	Mean	p Value	Mean difference	SE	95% CI of the difference	
							Lower	Upper
Dietary diversity								
Baseline	Intervention	283	0.4558	0.699	-0.0162	0.04188	-0.09846	0.06607
	Control	286	0.4720					
End line	Intervention	272	0.6507	0.003	0.12366	0.04175	0.4168	0.20564
	Control	277	0.5271					
Animal source food								
Baseline	Intervention	283	0.6113	0.620	0.0204	0.04112	-0.06037	0.10116
	Control	286	0.5909					
End line	Intervention	272	0.7169	0.001	0.1429	0.4047	0.06348	0.22233
	Control	277	0.5740					

Abbreviation: CI, confidence interval.

TABLE 4 Model of generalized estimating equations for preschool-aged children in southwest Ethiopia

Predictors	Dietary diversity				95% Confidence interval	
	B	SE	p Value	AOR	Lower	Upper
Nutritional education						
Time	-0.429	0.2537	0.091	0.651	0.396	1.071
Group	-0.151	0.1724	0.382	0.86	0.614	1.206
Time × Group	-0.339	0.1720	0.049	0.713	0.509	0.998
Toilet(Ref = nonimproved)						
Improved	0.205	0.2002	0.306	1.227	0.829	1.817
Wealth index(Ref = highest)						
Lowest	-0.030	0.2616	0.910	0.971	0.581	1.621
Second	0.184	0.3337	0.582	1.201	0.625	2.311
Middle	0.221	0.2012	0.271	1.248	0.841	1.851
Fourth	-0.289	0.2624	0.270	0.749	0.448	1.252
Caregiver knowledge (Ref = poor knowledge)						
Good knowledge	0.255	0.1229	0.038	1.29	1.014	1.641

Abbreviations: AOR, adjusted odd ratio; B, beta; Ref, reference category.

1.3 times more likely to feed diversified food than those who did not (AOR = 1.29, 95% CI: 1.014, 2.641) (Table 4).

3.4 | Effect of the intervention on ASF

We used multivariable GEE to determine independent factors related to the end line – baseline difference in the mean ASF scores. Wealth

status, family size, food security, caregiver knowledge, child vaccination status and nutritional education were all variables in the model. Only nutritional education, wealth status, child immunization status and caregiver knowledge were independent predictors of ASF among the other factors. Preschool children in the control group were 40.6% less likely than those in the intervention group to have consumed ASF after controlling for possible confounders (AOR = 0.594, 95% CI: 0.498, 0.708). Preschool children from the lowest,

TABLE 5 Generalized estimating equations model for among preschool-aged children in southwest Ethiopia, 2019–2020

Predictors	Animal source food			AOR	95% Confidence interval	
	B	SE	p Value		Lower	Upper
Nutritional education						
Time	1.013	0.112	0.000	1.01	1.000	1.100
Group	-0.159	0.1832	0.385	0.853	0.596	1.221
Time × Group	-0.521	0.0899	0.000	0.594	0.498	0.708
Family size (Ref = <5)						
≥5	-0.264	0.1900	0.165	0.768	0.529	1.115
Wealth index (Ref = highest)						
Lowest	-0.706	0.2709	0.009	0.493	0.290	0.839
Second	-0.706	0.3875	0.068	0.494	0.231	1.055
Middle	-0.859	0.2901	0.003	0.423	0.240	0.748
Fourth	-1.216	0.3104	0.000	0.296	0.161	0.545
Food security(Ref = food insecurity HH)						
Food secured HH	0.232	0.1798	0.197	1.261	0.887	1.794
Vaccination status (Ref = complete)						
Incomplete	0.514	0.1999	0.010	1.672	1.130	2.474
Caregiver knowledge (Ref = poor knowledge)						
Good knowledge	0.404	0.1815	0.026	1.497	1.049	2.137

Abbreviations: AOR, adjusted odd ratio; B, beta; Ref, reference category.

middle and fourth quartile wealth status were less likely to consume ASF than children from the highest wealth status (AOR = 0.493, 95% CI: 0.290, 0.839; AOR = 0.423, 95% CI: 0.240, 0.748; and AOR = 0.296, 95% CI: 0.161, 0.545). Children who had complete vaccination status were 1.26 more likely to consume ASF compared with children who had incomplete vaccination status (AOR = 1.261, 95% CI: 0.887, 1.794). Caregivers with good knowledge of feeding practice were 1.5 times more likely to feed ASF than caregivers with poor knowledge (AOR = 1.497, 95% CI: 1.049, 2.137) (Table 5).

4 | DISCUSSION

The goal of this community-based quasi-experiment was to explore if a NE intervention administered by trained health professionals could improve preschool-aged children's DD and consumption of animal-sourced foods. The 9-month NE programme aimed to increase the nutritional diversity and ASFs consumed by preschool-aged children. The main goal of the intervention was to improve the adequacy of traditional home-cooked diets by encouraging the consumption of a diverse range of locally available and affordable nutritious foods. The intervention had a significant impact on the children's consumption of DD and ASFs. This suggests that a NE intervention can help

preschool-aged children change their eating habits without the use of dietary supplements.

The current finding is comparable with the study conducted in Hula, Ethiopia, in which the intervention group resulted in an improvement in children's DD (Negash et al., 2014). NE conducted in Hawassa Town, Southern Ethiopia indicated that NE improved the dietary practices of the mothers of the children, which is consistent with the present finding (Muluye et al., 2020). This finding is comparable with a study conducted among preschool-aged children in Makeni County, Kenya, in which the mean DDS of the control and intervention groups was found to be significantly different post-intervention (Kimiye & Nyambaka, 2020).

This current study is also similar to the study conducted in rural Limpopo Province, South Africa, in which NE significantly improves the dietary practices of the caregivers of children (Mushaphi et al., 2017). This finding is consistent with the finding of a systematic review in which the DD of the children in intervention groups was more likely to consume more diverse diets compared with their counterparts (Sunguya et al., 2013). This study is also in line with NE conducted in Kabarole district, western Uganda, in which NE significantly improved the feeding practices of children (Kabahenda et al., 2011).

A community-based NE intervention conducted in Western Kenya showed that children's DDS significantly improved in the

intervention group at the end of the line (Waswa et al., 2015), which is consistent with the present findings. A similar study conducted in Northern Ghana revealed that NE significantly improved the MDD of the children in an intervention study group, compared with the control study group (Saaka et al., 2021). This finding is also in line with the findings of the current study. Another community-based NE study conducted in Malawi in line with the present study found that NE improved caregivers' CDD (Kuchenbecker et al., 2017). The NE among preschool-aged children in China is comparable to the current study in that it has a substantial impact on reducing unhealthy diet-related behaviours in NE groups compared with controls (Hu et al., 2009). This finding is also in line with a study conducted in rural Cambodia, which found a substantial difference in CDD between comparison and intervention study groups (Reinbott et al., 2016). Other NE programmes in Indonesia's southeast Sulawesi Province support the findings of this study, indicating that NE has a considerable impact on children's DD (Effendy et al., 2020).

This NE had a beneficial, statistically significant influence on the consumption of ASFs, according to the study. The findings matched those of a study conducted in Northwest Ethiopia's west Gojjam zone, where a nutrition intervention had a significant impact on the consumption of ASFs (Abiyu & Belachew, 2020).

After controlling for possible confounders, a multivariable analysis of DD revealed that factors such as nutritional education and caregiver knowledge were statistically significant with regard to DD. In the case of ASFs, variables such as nutritional education, wealth index, vaccination status of the child and caregivers' knowledge were statistically significant with ASFs. These findings revealed that NE and caregiver knowledge were significantly associated with CDD. This finding was consistent with the study conducted in the Gorche district, southern Ethiopia, in which maternal knowledge is significantly associated with DD (Dangura & Gebremedhin, 2017). A similar study conducted in Robe Town, Bale Zone, Ethiopia is also in line with the current findings in which mothers who are knowledgeable about diet diversification increase their practice of CDD (Bedada Damtie et al., 2020). The current study is inconsistent with community-based educational intervention conducted in western Kenya that found the nutritional knowledge of the caregivers did not have a significant effect on CDD (Waswa et al., 2015). The finding of this study is also consistent with the study conducted in poor, rural and ethnic minority areas of central South China in which caregivers who had good nutritional knowledge were more likely to feed their children diversified foods compared with caregivers who had poor nutritional knowledge (Bi et al., 2019).

Regarding ASFs, the study found that preschool-aged children in the control group were 40.6% less likely to have consumed ASF compared with the intervention group. These findings also revealed that preschool-aged children from the poorest, middle and richest wealth statuses were less likely to consume ASF than children from the richest wealth status. This result was in line with the study conducted in four regions of Ethiopia (Potts et al., 2019). Moreover, children who had a complete vaccination status were more likely to

consume ASF compared with children who had an incomplete vaccination status. This could be due to integrated information provided during vaccination schedules, such that caregivers/mothers who attend vaccination schedules on a regular basis are more aware of appropriate feeding practices for their children than those who do not. This study also found that caregivers with good knowledge of feeding practices were more likely to feed ASF than caregivers with poor knowledge. The justification could be that caregivers/mothers who are knowledgeable about child nutrition and its importance for a child's growth and development are more likely to diversify their children's diets.

NE is effective in increasing the average proportion of DD and ASFs, according to the findings of this study. A number of methodological limitations hindered this study, many of which were beyond the project's control. The data of the mothers or caregivers were based on memory over a long period of time, which could lead to memory bias, particularly for child feeding practices and other retrospective data relying on the caregiver's or mother's recall of prior events. A social-desirability bias could have influenced these results, leading to an overreporting of positive behaviours. Finally, we only had two data collection sessions in our study (at baseline and end line). More follow-up visits and assessments should be included in such studies in the future to encourage behaviour change and adoption of the suggested child feeding practices.

AUTHOR CONTRIBUTIONS

All authors contributed significantly to the idea and design, data analysis, discussion, interpretation of findings, critical review and editing of the paper and final approval of the manuscript for publishing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All relevant data is available upon request from the corresponding author due to potentially identifying information.

ETHICS STATEMENT

Ethical approval was granted by the Jimma University Ethical Review Board. To obtain consent, the letter was sent to the Ilu Abba Bora Zonal Health Department, as well as each selected district and kebele. The mothers/caregivers of the children were told everything they needed to know about the study's goals and procedures. Mothers and caregivers who volunteered to take part in the study

were asked to complete an informed consent form. Mothers/caregivers who could not read or write were asked for verbal agreement, which was obtained in front of an impartial witness. To maintain confidentiality, an anonymous interview was done.

ORCID

Kebebe Bidira  <http://orcid.org/0000-0001-9017-0027>

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