RESEARCH

Dietary diversity and associated factors among preschool children in selected kindergarten school of Horo Guduru Wollega Zone, Oromia Region, Ethiopia

Ebisa Olika Keyata1*, Abebe Daselegn2 and Alemayehu Oljira3

Abstract

Background: Preschool children are the most vulnerable group because of their high nutritional needs for growth and development. The study assessed dietary diversity scores and associated factors among preschool children in selected kindergarten schools of Horo Guduru Wollega Zone, Western Ethiopia.

Methods: The institutional-based cross-sectional study design was conducted on a total 440 of preschool children. A semi-structured questionnaire was used to collect information on the dietary diversity score of preschool children using a 24 h dietary recall method. Binary logistic regression was used to identify variables associated with dietary diversity scores of preschool children.

Results: The result showed that the majority (87.3%) of preschool children in the selected kindergarten school practiced a low dietary diversity score (less than four food groups). The result obtained from multivariate logistic regression analysis indicated that the age of preschool children [AOR 9.58(2.26–40.60)], sex of child [AOR 3.21(1.71–5.99)], and work of mother [AOR 7.49(2.33–24.07)] were significantly (p < 0.05 associated) with dietary diversity of children.

Conclusions: The findings indicated that many preschool children in the study area did not get a minimum dietary diversity score. Therefore, health extension workers must organize community-based behavior change nutritional education for mothers or caregivers to create awareness of preschool child dietary diversity practices.

Keywords: Associated factors, Dietary diversity, Kindergarten school, Preschool children

Introduction

Dietary diversity is described as the consumption of various food types such as vegetables, fruits, grains, tuber, meat, and dairy product during a given time. It reflects the idea that diversifying one’s diet by including a wider range of foods and food groups helps ensure optimal nutritional intake [1]. Institutional-based diet can be defined as entities that provide meals at institutions, including schools, colleges and universities, hospitals, correctional facilities, public and private cafeterias, nursing homes, and day-care and senior centres [2]. Among the indicated institution, nutrition for school-aged children is important for vulnerable groups, particularly preschool children, because it substantially impacts their health, cognition development, and educational achievement [3].

Appropriate and adequate feeding practice of various food groups for children and infants was fundamental for optimal child growth and development [4]. However, low

*Correspondence: ebisaolika20@gmail.com
1 Department of Food Science and Nutrition, Faculty of Agriculture, Wollega University, P.O. Box 38, Shambu, Ethiopia
Full list of author information is available at the end of the article

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dietary diversity may be the major cause of malnutrition [5]; mainly, it is a crucial problem that leads to chronic and non-communicable diseases in the future life [6] and is boldly perceived among the rural community and poor populations [7].

In the world, 10.9 million (60%) death occurred in under 5 years. Of those, 66% of deaths were due to poor feeding practices during the first 2 years of life [8, 9]. In developing countries, inappropriate dietary diversity is the major reason for childhood malnutrition which is strongly associated with morbidity and mortality [10, 11].

In Ethiopia, dietary diversity is a major challenge because preschool children consume a less diversified diet from the family dish, which is mainly cereal-based [12]. This poor dietary diversity feeding practice of preschool children resulted in a decline in education quality due to the student falling out of the classroom and discontinuing school [13].

Starchy-based staple diet with inadequate animal products, fresh fruits, and vegetables is highly practiced for infants and young children in Horo Guduru Wollega zone, Oromia, Ethiopia [14]. Ekesa et al. [15] showed that the main causes of poor dietary diversity could be resource limitation, information inadequacy, and lack of access to dietary diversity. Consequently, chronic undernutrition is very high among children who eat monotonous diets [16]. Different scholars indicated that numerous household socioeconomic status and cultural factors affect dietary diversity scores and feeding practices of children [17, 18, 19].

Families with greater incomes tend to have more diverse diets, and their children grow better for several reasons [20]. However, lower intakes of food sources have also been observed among children in low-income households. Additionally, culture, religion, and traditional knowledge affect food and nutrition security by shaping communities’ diets and intra-household food distribution patterns, affecting dietary diversity scores and intake of nutrient-rich foods in children [21].

Appropriate and adequate feeding practices are a prerequisite for good nutritional status in any given time of human life [22]. However, a lack of dietary diversity can have negative consequences (impact on the age at any time) at any age, but is particularly critical for infants and young children, especially on their health, well-being, and development, mainly by reducing physical capacities as well as resistance to infectious diseases [8]. This might be due to inadequate consumption of fruit and vegetable, which is rich in essential micronutrients such as vitamin A, iron, and zinc. These deficiencies affect the survival, health, development, and well-being of those afflicted.

Studies in Ethiopia identified dietary diversity scores and their associated factors among children aged between 6 to 23 months [14, 23, 9, 24]. The authors mentioned above indicated that there was poor dietary diversity and their diets were mainly cereal and pulse-based diets. However, there is limited information regarding dietary diversity and its associated factors among preschool children aged between 4 and 7 years in Ethiopia and study areas in particular. Hence, the present study was designed to fill this gap by addressing dietary diversity scores and associated factors among preschool children aged between 4 and 7 years in the selected kindergarten school of Horo Guduru Wollega Zone, Oromia, Ethiopia.

**Methods**

**Description of the study area**

The study was conducted in Horo Guduru Wollega Zone, Oromia, Western Ethiopia. The capital town of the zone, Shambu, is located 314 km from Addis Ababa in the Western part of Ethiopia. The zone comprises eleven rural districts. According to the report (CSA, 2011), the Horro Guduru Wollega zone covers a total land area of 8,097 km²; a total population of 641,575, of which 50.09% are male, and 49.91% are female. This study was conducted in Shambu town (Abishe Gerba, Catholic & Mati Boru Kindergarten School) and Fincha town (Fayissa & Horo Guduru College Kindergarten School), located to the west of the capital city of Ethiopia (Addis Ababa). Five kindergarten schools were selected based on the high number of preschool children in the Horo Guduru Wollega zone.

**Study design**

An institution-based cross-sectional survey design was conducted to investigate the dietary diversity and its associated factors of preschool children.

**Study population**

All preschool children aged 4 to 7 years with their mothers/ caregivers who are randomly selected from the selected kindergarten and who met the inclusion criteria were the study population. Children aged 4 to 7 years who did not come to school and were sick during data collection were excluded from the study.

**Sample size determination**

A single population proportions formula was used to determine the sample size of the study population using the assumption that 46% of the preschool children were low dietary diversity category in Matungu, Butere-Mumias region of western Kenya [25]. A Zα/2 had a 95% confidence level of 1.96, a margin of error of 0.05, a non-response of 10%, and a design effect of 1.5 to correct the sampling error. Accordingly, the calculated sample...
was 440 using the Stat CALC application of EpiinfoTM 7.0.8.3.

**Sampling procedure**

In this study, two sampling techniques were used to select study participants. In the first stage, the purposive sampling technique was used to select a kindergarten school in the Horo Guduru Wollega zone based on different preschool children in the town. Accordingly, three kindergarten schools were selected in Shambu town (Abishe Gerba, Catholic & Mati Boru) and two kindergarten schools in Fincha town (Fayissa & Horo Guduru College Kindergarten School). In the second stage, a simple random sampling technique was used to select the target group from the selected kindergarten school based on the proportion allocation ratio proposed in each school.

**Data collection tool and procedures**

Data were collected using an interviewer-administered questionnaire from preschool children's mothers/ caregivers by allowing them freely to recall the type of food items they fed to their child or children within the last 24 h. The questionnaire used in this study was first prepared in the English language and translated into the Afan Oromo. The first part of the questionnaire contains items used to collect socio-demographic information adopted from the Ethiopian Demographic and Health Survey questionnaire after contextual modifications were done. Dietary diversity was assessed by asking the mothers/caregivers whether their preschool children obtained food from the seven food groups in the last 24 h. Dietary Diversity Score (DDS) ranges from zero (0) to seven (7) which is computed by summing the number of unique food groups the child received in the last 24 h.

**Data quality control**

Two preschool teachers and one preschool director in each kindergarten school were selected, and then training was given to them. Overall, data were collected by ten preschool teachers and five school directors, and the researchers. At the end of each day, the principal investigator checked the completeness of the questionnaires. Before data collection, the questionnaire was pre-tested on 5% of the sample size out of sampled using pilot interviews with mothers/caregivers of preschool children.

**Study variable**

Child dietary diversity score (DDS) was considered a dependent variable. In contrast, socio-demographic variables including age, sex, a cycle of the child, ethnicity, religion, education of father, work of father and mother, family size, and obtained food were recorded as independent variables.

**Children’s dietary diversity**

Dietary diversity was determined based on 24-h dietary recall methods. The mothers of preschool children have requested to state what their children consumed the previous day. Dietary diversity was then computed based on seven food groups as recommended by WHO [20], which comprise cereal, roots, and tubers; legumes and nuts; dairy products; flesh foods (meat, fish, poultry, and organ meats); eggs; vitamin-A rich fruits and vegetables; Fruits (mango, papaya, orange, avocado, banana, pineapple) and Vegetables (leaf, leaf of pumpkin, cabbage, lettuce) and other fruits and vegetables such as kale, Kosta, etc. Consumption of food from each food group was sufficient to count except if a food item was only used as a condiment. However, oils and fats were not considered and calculated for dietary diversity score; these foods don’t add nutritional quality to the diets.

The dietary diversity score was calculated for each preschool child during the previous 24 h to categorize the children’s dietary diversity as high DD (>4 food groups) or low DD (<4 food groups) from seven food groups. Then, the outcome variable was coded as a high DD >4 food groups as "1" and low DD <4 food groups as "0" for logistic regression analysis.

**Data processing and analysis**

Data obtained were coded, entered, and analyzed using SPSS for Windows version 20.0. Frequencies and percentages were conducted to summarize the descriptive part of preschool children's socio-demographic characteristics and consumption of food groups. A binary/multivariate logistic regression was done to identify factors associated with dietary diversity scores. The dependent variable was coded as '1' for those who had consumed four or more foods and '0' for less than four food groups during the previous 24 h. In the beginning, the association between each independent and dependent variable was examined using bivariate logistic regression; then, variables that showed significant associations based on the assumptions were considered for multivariate logistic regression. Finally, significant variables were identified in multivariate logistic regression at a p-value < 0.05.

**Results**

**Socio-demographic characteristics of preschool children**

The result showed that less than half of the preschool children aged 5 years were enrolled in kindergarten. The gender representation for the 4 to 7-year-old children was 191 (43.4%) for boys and 249 (56.6%) for girls. The majority, 234 (53.2%) of preschool children, exist in the first cycle. Most of the respondents were Oromo by ethnicity 426 (96.8%) and protestant by religion 249 (56.6%).
The parents’ education level showed that the majority of the father attended school and were employed with a diploma and above 231 (52.5%). Regarding the occupational status of caregivers, more than half of 275 (62.5%) of the father employed in the government office, while 181 (41.1%) of the mothers were government employees. The majority, 294 (66.8%) of household sizes, were up to five people per household, including children (Table 1).

### Dietary diversity score of preschool children
The mean (±SD) intake of dietary diversity score of preschool children aged four to five years old was 2.67 (±0.80). The results showed that a high proportion of 384 (87.30%) of the study participants were categorized in the lowest dietary diversity score (DDS), while 56 (12.7%) were in the high dietary diversity score. The majority of the preschool children had consumed all starchy staple foods (cereals, roots, and tubers (100%) and pulses (legumes and nuts) (70.5%) in the previous 24 h. A quarter of preschool children aged 4–7 years had consumed eggs and Vitamin A-rich fruits and vegetables. The least consumed food group was other fruits and vegetables (1.4%) (Table 2).

### Factors that associated with Dietary Diversity of preschool children
In bivariate logistic regression analysis, children’s age, sex of a child, a cycle of a child, and the work of father and mother were the candidate variables for multi-variables analysis. Whereas in multivariable logistic regression analysis, age of preschool children [AOR 9.58 (2.26–40.60)], sex of child [AOR 3.21 (1.71–5.99)], and work of mother [AOR 7.49 (2.33–24.07)] were significantly associated with dietary diversity of children as indicated in Table 3.

### Discussion
In this study, all preschool children consumed cereal-based foods made from teff, maize, wheat, oat, and barley, with relatively low nutrient density. The findings were with the Horo district’s findings, showing that 97.7% of children consumed food from cereal, roots, and tubers [14]. However, this study contradicted Ethiopia’s Demographic health survey [26], children consumed foods made from grains (66%) [27]. This might be due to the food consumption of children in the rural area being monotype, cheap and affordable.

The study also revealed that most preschool children aged 4–7 years had consumed legumes and nuts during

### Table 1 Socio-demographic characteristics of preschool children in the study area

| Variables                  | Category            | Frequency (n = 440) | Percent |
|----------------------------|---------------------|---------------------|---------|
| Age of preschool children  |                     |                     |         |
| (years):                   | 4                   | 40                  | 9.1     |
|                            | 5                   | 191                 | 43.4    |
|                            | 6                   | 152                 | 34.5    |
|                            | 7                   | 57                  | 13.0    |
| Sex of child               | Boy                 | 191                 | 43.4    |
|                            | Girl                | 249                 | 56.6    |
| Cycle of child             | First cycle         | 234                 | 53.2    |
|                            | Second cycle        | 206                 | 46.8    |
| Ethnicity                  | Oromo               | 426                 | 96.8    |
|                            | Amhara              | 14                  | 3.2     |
| Religion                   | Orthodox            | 150                 | 34.1    |
|                            | Catholic/protestant | 249                 | 56.6    |
|                            | Muslim              | 41                  | 9.3     |
| Educational status of      | Illiterate          | 33                  | 7.5     |
| Father                     | Primary School      | 97                  | 22.0    |
|                            | Secondary School    | 79                  | 18.0    |
|                            | Diploma and above   | 231                 | 52.5    |
| Occupational status father | Employed            | 275                 | 62.5    |
|                            | Farmer              | 52                  | 11.8    |
|                            | Self-business       | 113                 | 25.7    |
| Occupation status of the   | Employed            | 181                 | 41.1    |
| mother                     | Housewife           | 165                 | 37.5    |
|                            | Self-business       | 94                  | 21.4    |
| Household size             | 1 up to 5           | 294                 | 66.8    |
|                            | Greater than 5      | 146                 | 33.2    |
| Food obtained              | Buying              | 325                 | 73.9    |
|                            | Farming             | 115                 | 26.1    |

### Table 2 Consumption of food groups by preschool children in the study area

| Variables                                      | Category            | Frequency (n = 440) | Percent |
|------------------------------------------------|---------------------|---------------------|---------|
| Cereals, roots, and tubers                     | No                  | 0                   | 0       |
|                                               | Yes                 | 440                 | 100.0   |
| Legumes and nuts                               | No                  | 130                 | 29.5    |
|                                               | Yes                 | 310                 | 70.5    |
| Dairy products                                 | No                  | 398                 | 90.5    |
|                                               | Yes                 | 42                  | 9.5     |
| Flesh foods                                    | No                  | 289                 | 65.7    |
|                                               | Yes                 | 151                 | 34.3    |
| Eggs                                           | No                  | 326                 | 74.1    |
|                                               | Yes                 | 114                 | 25.9    |
| Vitamin A-rich fruits and vegetables           | No                  | 326                 | 74.1    |
|                                               | Yes                 | 114                 | 25.9    |
| Other fruits and vegetables                    | No                  | 434                 | 98.6    |
|                                               | Yes                 | 6                   | 1.4     |
| Overall dietary diversity scores               | High                | 56                  | 12.7    |
|                                               | Low                 | 384                 | 87.3    |
the past 24 h. The obtained results were lower than the study conducted in the Horo district that showed 84.6% of children had the habit of eating daily plant protein such as bean, pea, and lentils prepared stew consumed with injera staple diet for the majority of Ethiopians [14].

The findings also depicted that most preschool school children aged 4–7 didn’t consume any cheese, yoghurt, milk, or other dairy products in the past 24 h. This finding was similar to a study in the Amhara region in Finote Selam town, where 89.60% of preschool children didn’t consume milk and milk products [28].

Less than half of preschool children considered in this study had consumed fresh food (meat, fish, and poultry) in the last 24 h. The findings were more than two times higher than the study conducted in Shashemene [29] (14%). This might be due to the improvement of knowledge and perception of mothers/caregivers during preparing food for preschool children (4 to 7 years) who can digest fatty foods compared to children aged 6 to 23 months.

A quarter of preschool children aged 4–7 years had consumed eggs. This result is lower than the study conducted in both Shashemene (40.1%) [29] and Horo district (30.4%) [14] for children between 6 to 23 months but higher than the study conducted in India [30], which showed that less than 8% of all children aged 6—23 months had consumed eggs. The study revealed that a quarter of preschool children had consumed Vitamin A-rich fruits and vegetables. This result is in line with the study conducted in Shashemene woreda [29]. This finding is also comparable with other studies conducted in Kenya [31, 32].

### Table 3  Bivariate and multivariate logistic regression analysis of factors associated with minimum dietary diversity among preschool children aged 4–7 years in the study area

| Variables                  | Category                          | Dietary Diversity Score | Crude odds ratio (COR) 95% CI | Crude odds ratio (AOR) 95% CI | P-value |
|----------------------------|-----------------------------------|-------------------------|--------------------------------|--------------------------------|---------|
| Age of Preschool children (years): | 4                                 | 32(8.30)                | 8(14.30)                       | 1                              | 1       |
|                            | 5                                 | 174(45.30)              | 17(30.4)                       | 11.60(2.47,54.33)*             | 9.58(2.26,40.60) | 0.002* |
|                            | 6                                 | 130(33.9)               | 22(39.3)                       | 2.45(0.75,8.01)*               | 1.62(0.54,4.91) | 0.39   |
|                            | 7                                 | 48(12.5)                | 9(16.1)                        | 1.38(0.50,3.85)                | 0.73(0.25,2.16) | 0.57   |
| Sex of child               | Boy                               | 181(47.1)               | 10(17.9)                       | 1                              | 1       |
|                            | Girl                              | 203(52.9)               | 46(82.1)                       | 3.28(1.66,6.48)*               | 3.21(1.71,5.99) | 0.000* |
| Cycle of child             | first cycle                       | 212(55.2)               | 22(39.3)                       | 1                              | 1       |
|                            | second cycle                      | 172(44.9)               | 34(60.7)                       | 0.43(0.18,1.02)*               | 0.45(0.20,1.03) | 0.058  |
| Ethnicity                  | Oromo                             | 373(97.1)               | 53(94.6)                       | 1                              | -       |
|                            | Amhara                            | 11(2.9)                 | 3(5.4)                         | 0.00(0.00)                     | -       |
| Religion                   | Muslim                            | 30(7.8)                 | 1(32.1)                        | 1                              | -       |
|                            | Orthodox                          | 123(32)                 | 27(48.20)                      | 0.00(0.00)                     | -       |
|                            | Protestant                        | 231(60.2)               | 18(32.10)                      | 1.84(0.89,3.81)                | -       |
| Education of father        | Illiterate                        | 30(7.8)                 | 3(5.4)                         | 1                              | -       |
|                            | Primary School                    | 86(22.4)                | 11(19.6)                       | 0.97(0.23,4.04)                | -       |
|                            | secondary School                  | 70(18.2)                | 9(16.1)                        | 0.44(0.17,1.10)                | -       |
|                            | diploma and above                 | 196(51.6)               | 33(58.90)                      | 0.45(0.17,1.18)                | -       |
| Work of father             | Employed                          | 231(60.2)               | 44(78.6)                       | 1                              | 1       |
|                            | Farmer                            | 52(13.5)                | 0(0)                           | 0.38(0.16,0.88)                | 0.63(0.31,1.29) | 0.21   |
|                            | Self-business                     | 101(26.3)               | 12(21.4)                       | 0.30(0.07,0.95)                | 0.59(0.21,1.64) | 0.31   |
| Work of mother             | Employed                          | 148(38.5)               | 33(58.9)                       | 1                              | 1       |
|                            | Housewife                         | 145(37.8)               | 20(35.7)                       | 4.85(1.39,16.79)*              | 4.19(1.30,13.53) | 0.02*  |
|                            | Self-business                     | 91(23.7)                | 3(5.4)                         | 7.95(2.37,26.70)*              | 7.49(2.33,24.07) | 0.001* |
| Household size             | 1 up to 5                         | 263(68.5)               | 31(55.4)                       | 1                              | -       |
|                            | greater than 5                    | 121(31.5)               | 25(44.6)                       | 1.87(0.81,4.29)                | -       |
| Food obtained              | Buying                            | 280(72.9)               | 45(80.40)                      | 1                              | -       |
|                            | Farming                           | 104(27.1)               | 11(19.6)                       | 0.59(0.29,1.20)                | -       |

COR Crude odds ratio, AOR Adjusted odds ratio

*: indicated significant variable at p-value <0.05 in adjusted odds ratio for multivariate
The overall results regarding the dietary diversity score of preschool children showed that most preschool children didn’t achieve a minimum dietary diversity score. However, less than a quarter of preschool children met the minimum dietary diversity score requirements in the last 24 h. The result found was lower than the study conducted in the Diredawa city, Ethiopia (24.4%) [33] and Tanzania (38%) [11]. However, the obtained result was higher when compared to the Ethiopia Demographic & Health Survey [26], in which 5% of children had minimum dietary diversity [26].

Preschool children aged four and five years were more likely to initiate dietary diversity than children who were six and seven years of age. This might be because many children aged four and five years may give special consideration to eating different food groups from their mothers/caregivers.

The findings obtained in this study revealed that girl children were 4 times more likely to meet minimum dietary diversity compared to boy children. This might be because they gave more attention to feeding their girls various food items than a male child. The results contrast with the study conducted in Diredawa, Ethiopia, which reported that male children were 3 times more likely to meet minimum dietary diversity than female children because of traditional influence on male sex preference [33].

The findings also showed that mothers’ work had a statistically significant \((p < 0.05)\) association with children’s dietary diversity. Children born from mothers who had self-business and housewives were 7.49 and 4.19 times more likely to practice the recommended dietary diversity than those born from their mothers employed in governmental organizations. This might be due to a lack of time to give different food groups for their child when related to the mother housewife.

**Conclusion**

In this study, dietary diversity score and associated factors among preschool children in selected kindergarten school of Horo Guduru Wollega Zone, Oromia Region, Ethiopia was reported. The findings showed that a high percentage of preschool children aged 4–7 years old didn’t get minimum dietary diversity as recommended by World Health Organization. Besides this, the consumption of animal-source foods such as dairy products, MPF (meat, poultry, and fish), eggs, vitamin A-rich fruit & vegetables, and other fruit and vegetable was very poor among the surveyed preschool children in the study area. The result also clearly indicated that the age of the child, sex of the child, and work of the mother are significantly associated with dietary diversity practices. Therefore, health extension workers need to organize community-based behavior change nutritional education for mothers or caregivers to create awareness of preschool child feeding practices. Agricultural extension workers should also be aware and train farmers to boost the production of animal source foods, Vitamin A-rich fruits and vegetables, and other fruits and vegetables through rearing small animals and irrigation activities to meet the minimum dietary diversity of children.

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**Authors’ contributions**

Ebisu Olika, Abebe Daselegn and Alemayehu Olijira participated in data collection, analysis, drafted and finalized the manuscript for publication. All authors read and approved the final manuscript.

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**Availability of data and materials**

All data collected from the respondents are included within the manuscript.

**Declarations**

**Ethics approval and consent to participate**

The study was approved by the ethical review boards of the Faculty of Agriculture, Wollega University before data collection. Verbal informed consent was obtained from parents before enrollment of their children and it was approved by ethical review board. All methods were carried out under relevant guidelines and regulations.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare that they have no competing interests.

**Author details**

1 Department of Food Science and Nutrition, Faculty of Agriculture, Wollega University, PO. Box 38, Shambu, Ethiopia. 2 Department of Chemical Engineering, Faculty of Technology, Wollega University, Shambu, Ethiopia. 3 Department of Agricultural Economics, Jimma University College of Agriculture and Veterinary Medicine, PO. Box: 307, Jimma, Ethiopia.

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**References**

1. Mukherjee A, Paul S, Saha J, Som TK, Ghose G. Dietary diversity and its determinants: a community-based study among adult population of Durgapur, West Bengal. Medical Journal of Dr DY Patil Vidyapeeth. 2018;11(4):296.
2. Conner D, King B, Kolodinsky J, Roche E, Koliba C, Trubek A. You can know your school and feed it too: Vermont farmers’ motivations and distribution practices in direct sales to school food services. Agric Hum Values. 2012;29(3):321–32.
3. Wang D, Fawzi WW. Impacts of school feeding on educational and health outcomes of school-age children and adolescents in low-and middle-income countries: protocol for a systematic review and meta-analysis. Syst Rev. 2020;9(1):1–8.
4. Vakili M, Abedi P, Sharifi M, Hosseini M. Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. Global J Health Sci. 2013;5(2):181.
5. Nithya DJ, Bhavani RV. Dietary diversity and its relationship with nutritional status among adolescents and adults in rural India. J Biosoc Sci. 2018;50(3):397–413.

6. Grey K, Gonzales GB, Abarra M, Lelijveld N, Thompson D, Berhane M, Kerac M. Severe malnutrition or famine exposure in childhood and cardiometabolic non-communicable disease later in life: a systematic review. BMJ Glob Health. 2021;6(3):e003161.

7. Tora TT, Degaga DT, Utallo AU. Drought vulnerability perceptions and food security status of rural lowland communities: An insight from Southwest Ethiopia. Current Research in Environmental Sustainability. 2021;3(2):100073.

8. UNICEF. WHO—The World Bank Child Malnutrition Database: Estimates for 2012 and Launch of Interactive Data Dashboards. 2013.

9. Kumera G, Tesdai E, Ayana M. Dietary diversity and associated factors among children of Orthodox Christian mothers/caregivers during the fasting season in Dejen District. North West Ethiopia Nutrition & Metabolism. 2018;15(1):1–9.

10. Janatt K, Luby SP, Rahman M, Winch PJ, Stewart CP, Ram PK. Complementary feeding practices among rural Bangladesh mothers: results from WASH Benefits study. Maternal Child Nutrition. 2019;15: e12654.

11. Sema A, Belay Y, Solomon Y, Desalew A, Misganaw A, Menberu T, Tadesse D. Minimum Dietary Diversity Practice and Associated Factors among Children Aged 6 to 23 Months in Dire Dawa City, Eastern Ethiopia: A Community-Based Cross-Sectional Study. Global Pediatric Health. 2021;8:2333794X21996630.

12. Baye K, Hirsunen K, Dereje M, Remans R. Energy and nutrient production in Ethiopia, 2011–2015: Implications to supporting healthy diets and food systems. PLoS ONE. 2019;14(3): e0213182.

13. Union A. The cost of hunger in Africa: Social and economic impact of child undernutrition in Egypt, Ethiopia, Swaziland and Uganda background paper. Abuja, 2014. p. 1–15.

14. Neme K, Olika E. Knowledge and practices of complementary feeding among mothers/caregivers of children age 6 to 23 months in Horo Woreda, Horo Guduru Wollega Zone, Oromia Region, Ethiopia. Journal of Biomedical Research and Reviews. 2017;1(1):1–10.

15. Ekessa BN, Blomme G, Garning H. Dietary diversity and nutritional status of pre-school children from Musa-dependent households in Gitenga (Burundi) and Butembo (Democratic Republic of Congo). Afr J Food Agric Nutr Dev. 2011;11(4):4896–911.

16. Coll-Black S, Gilligan DO, Hodnett J, Kumar N, Taffesse AS, Wiseman W. Targeting food security interventions: The case of Ethiopia’s productive safety net programme. ESFP Res Note. 2013;26.1–2.

17. Alam MA, Hakim M, Rouf M, Haque MQ, Ali M, Zaidul I. Nutritional status of urban slum children below five years: Assessment by anthropometric measurements with special reference to socioeconomic status. J Food Agric Environ. 2011;9(2):85–90.

18. Ali D, Saha KK, Nguyen PH, Diressie MT, Ruel MT, Menon P, Rawat R. Household food insecurity is associated with higher child undernutrition in Bangladesh, Ethiopia, and Vietnam, but the effect is not mediated by child dietary diversity. J Nutr. 2013;143(12):2015–21.

19. Demissie S, Worku A. Magnitude and factors associated with malnutrition in children 6–59 months of age in the pastoral community of Dollo Ado district, Somali region. Ethiopia Science Journal of Public Health. 2013;1(4):175–83.

20. Zewdie T, Abebaw D. Determinants of child malnutrition: empirical evidence from Kombolcha District of Eastern Hareragne Zone, Ethiopia. Q J Int Agric. 2013;52(892:2016–65185)357–72.

21. Alonso EB. The impact of culture, religion, and traditional knowledge on food and nutrition security in developing countries (No. 2201–2019–1458). 2015.

22. WHO. Indicators for assessing infant and young child feeding practices part 3: country-profiles, Geneva, 2010. p. 1–51. Available at http://whqlibdoc.who.int/publications.

23. Temesgen H, Yeneabat T, Teshome M. Dietary diversity and associated factors among children aged 6–23 months in Siman Woreda, Northwest Ethiopia: a cross-sectional study. BMC Nutrition. 2018;4(1):1–8.

24. Tasac H, Akezer N, Gebreyesus SH, Attaullahjan A, Brar S, Confreda E, Bhutta ZA. Drivers of stunting reduction in Ethiopia: a country case study. Am J Clin Nutr. 2020;12(Supplement_2):875S–893S.

25. Walingo MK, Ekesa BN. Nutrient intake, morbidity, and nutritional status of preschool children are influenced by agricultural and dietary diversity in Western Kenya. 2013.

26. Ethiopia Demographic and Health Survey (EDHS). Health survey central statistical agency Addis Ababa. Calverton: Ethiopia ICF International; 2011. p. 180–6.

27. Aremo M, Mesele M, Birhanu Z, Atenafu A. Dietary diversity and meal frequency practices among infant and young children aged 6–23 months in Ethiopia: a secondary analysis of Ethiopian demographic and health survey 2011. J Nutr Metab. 2013;2013:1–8.

28. Melkura G, Wubneh Y, Tewabe T. Household dietary diversity and associated factors among residents of finote selam town, north west Ethiopia: a cross sectional study. BMC Nutr. 2017;3(1):1–6.

29. Yonas F. Infant and young child feeding practice status and associated factors among mothers of under 24-month-old children in Shashemene Woreda, Oromia region. Ethiopia Open Access Library Journal. 2015;2(07):1.

30. Sinhababu A, Mukuopadhyay DX, Panja TK, Saren AB, Mandal NK, Biswas AB. Infant-and young child-feeding practices in Bankura district, West Bengal, India. J Health Popul Nutr. 2010;28(3):294.

31. Chelimo Fl. Assessment of complementary feeding practices and nutritional status among children in Athi-river. Machakos District Kenya: Kenyatta University; 2008.

32. Joshi N, Agho KE, Dibley MJ, Senarath U, Tiwari K. Determinants of inappropriate complementary-feeding practices in young children in Nepal: secondary data analysis of Demographic and Health Survey 2006. Matern Child Nutr. 2012:845–9.

33. Victor R. Infant and young child feeding practices among children Aged 6–23 months in Tanzania. Maternal and Child Nutrition Journal. 2012;3:357–64.

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