Received: 23 March 2021 | Revised: 29 April 2021 | Accepted: 6 May 2021

DOI: 10.1111/mcn.13220

ORIGINAL ARTICLE

Maternal & Child Nutrition WILEY

# Complementary feeding practices and associated factors of dietary diversity among uncomplicated severe acute malnourished children aged 6–23 months in Burkina Faso

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**Funding information**
AAH (Action Against Hunger) & Institut de France Foundation for research & innovation; European Commission's Civil Protection and Humanitarian Aid Operations Enhanced Response Capacity, Grant/Award Number: ECHO/ERC/BUD/2016/91006; Children's Investment Fund Foundation, Grant/Award Number: CIFF03; European Commission's Civil Protection and Humanitarian Aid Operations, Grant/Award Number: ECHO/-WF/BUD/2015/91065; ELRHA (Enhancing Learning and Research for Humanitarian Assistance); Humanitarian Innovation Fund (HIF); Action Against Hunger office in France

## Abstract

Nutritional treatment of children with uncomplicated severe acute malnutrition (SAM) is based on ready-to-use therapeutic foods (RUTF). With treatment provided at community level, children could have access to other foods, and a reduction in the dose of RUTF could further increase dietary diversity during treatment. We assessed the dietary diversity score (DDS), the minimum dietary diversity (MDD), the minimum meal frequency (MMF) and the minimum acceptable diet (MAD) of 459 infants and young children aged 6–23 months being treated for SAM with different doses of RUTF. We also investigated the factors associated with DDS. Dietary intake was estimated using a single 24-h multipass dietary recall, 1 month after starting treatment, from December 2016 to August 2018. The DDS was calculated on the basis of eight food groups. Differences between children receiving the reduced RUTF and the standard RUTF dose and factors associated with DDS were assessed by Poisson and logistic regression models. RUTF dose was not associated with DDS (4.07 ± 1.25 for reduced RUTF and 4.01 ± 1.26 for standard RUTF; $P = 0.77$). Food groups most consumed by children were grains, roots or tubers (96%) and legumes and nuts (72%). Eggs consumption was low (3%). DDS was positively associated with child's age, mother's education, household wealth index, urban residence and rainy season. The present findings show that children with SAM consumed a variety of foods during treatment in addition to the RUTF ration prescribed to them. Reducing the dose of RUTF during SAM treatment did not impact DDS.

KEYWORDS
associated factors, Burkina Faso, complementary feeding, ready-to-use therapeutic food, severe acute malnutrition

**Abbreviations:** 24HDR, 24-h multipass dietary recall; ACF, Action contre la Faim; DDS, dietary diversity score; FAO, Food and Agricultural Organization; HAZ, height-for-age z-score; HFIAS, household food insecurity access scale; MA, Ministère de l'Agriculture; MAD, minimum acceptable diet; MAM, moderate acute malnutrition; MDD, minimum dietary diversity; MMF, minimum meal frequency; MS, Ministère de la Santé; MUAC, mid-upper arm circumference; RUTF, ready-to-use therapeutic food; SAM, severe acute malnutrition; UNICEF, United Nations Children's Fund; WAZ, weight-for-age z-score; WHO, World Health Organization; WHZ, weight-for-height z-score.

## 1 | INTRODUCTION

Undernutrition, including wasting, stunting and micronutrient deficiencies, remains public health problems concern in lower and middle-income countries (Victora et al., 2021) resulting mainly from poor-quality monotonous diets, illness and inadequate caregiving (UNICEF, 2014). Poor nutrition, particularly in the first 2 years, is associated with increased morbidity and mortality as well as suboptimal brain development, which negatively affects cognitive development, intellectual abilities and economic productivity in adulthood (Leroy et al., 2014; Onis & Branca, 2016; UNICEF, 2014). In 2019, at every moment, 47 million children under 5 years were wasted, of whom 75% live in lower and middle-income countries (UNICEF et al., 2019).

Complementary feeding is the process of introducing liquid, semi-liquid or soft foods to an infant diet from the age of 6 months when breastmilk alone is no longer sufficient to meet the nutritional needs (WHO & UNICEF, 2008). Between the age of 6 and 23 months, breastmilk and complementary foods provide children with the essential energy and nutrients (Darapheak et al., 2013; Victora et al., 2010). Dietary diversity is a key dimension of diet quality (Kennedy et al., 2011), and inappropriate complementary feeding practices have been identified as one of the main causes of undernutrition in West Africa (Daelmans et al., 2009; Dewey & Brown, 2003; Lutter et al., 2011). Inadequate complementary feeding practices and quality of complementary foods adversely affect the health and growth of children (Mitchodigni et al., 2017). Optimal complementary feeding practices could prevent about 6% of deaths in children under 5 years of age each year (The Lancet, 2003). Various factors such as child, maternal, household and environmental characteristics have also been associated with complementary feeding practices (Issaka, Agho, Burns, et al., 2015; Mitchodigni et al., 2017; Patel et al., 2010).

In Burkina Faso, infant and young child feeding practices are inadequate in children aged 6–23 months. In 2018, approximately 56% of children were breastfed exclusively up to 6 months of age, 71% of children started complementary feeding at the age of 6–8 months, and only 54% of children achieved minimum meal frequency (MMF) (MS, 2018). Dietary diversity score (DDS) was low; on average, children consumed two food groups per day (MS, 2018).

In children 6–59 months of age, severe acute malnutrition (SAM) is defined as a mid-upper arm circumference (MUAC) < 115 mm or a weight-for-height/length z-score (WHZ) < −3 (WHO, 2013) or presence of bilateral oedema (OMS & UNICEF, 2009). Children with SAM without medical complications at admission are treated as outpatients in the community and return to health centres once a week for treatment. Ready-to-use therapeutic foods (RUTFs) are the only foods prescribed for nutritional recovery during the treatment of SAM in children (WHO, 2013; WHO et al., 2007), and the recommendation is to give no other foods than RUTF and breastmilk to these children (WHO et al., 2007). We have previously reported that children treated for SAM with RUTF supplement their diet with complementary and family foods (Nikièma et al., 2021).

This study is part of the Modelling an Alternative Nutrition Protocol Generalizable to Outpatient Care (MANGO) individually randomized trial, testing the non-inferiority of a reduced RUTF dose compared with a standard dose in the management of uncomplicated SAM in children 6–59 months. The main results from the trial show that a reduced RUTF dose is non-inferior to standard RUTF dose in terms of the weight gain velocity (g/kg/d) of children during treatment and results in similar recovery per cent (Kangas et al., 2019). In addition, similar levels of energy and nutrient intakes coming from complementary and family feeding in both RUTF groups were shown (Nikièma et al., 2021), which suggest that the two groups of children could have comparable dietary diversity. The present sub-study aims to assess the complementary feeding practices of infants with SAM, aged 6–23 months, treated with different doses of RUTF, in the health district of Fada N'Gourma, and determine the factors associated with DDS.

**Key messages**

- Children with severe acute malnutrition without complications are treated with ready-to-use therapeutic foods.
- The main sensitization message delivered is that therapeutic foods alone are sufficient for children so no need to give other foods other than breastmilk.
- Food consumption could improve dietary diversity in children with SAM and allow a transition back to complementary feeding after treatment.
- Knowledge of the factors associated with dietary diversity in SAM children would help guide awareness messages

## 2 | METHODS

### 2.1 | Study design: The MANGO original study

The MANGO study has been described in detail elsewhere (Kangas et al., 2019; Nikièma et al., 2021). In short, it was a randomized controlled non-inferiority trial conducted in the health district of Fada N'Gourma, eastern region of Burkina Faso. The MANGO trial received the approval of the Ethical Committee (Comité d'éthique pour la Recherche en Santé) in Burkina Faso in December 2015 and the clinical trials board (Direction Générale de la Pharmacie, du Médicament et des Laboratoires) in September 2016.

The study was conducted in 10 health centres. In 2018, in the eastern region, the prevalence of global acute malnutrition (GAM) defined by WHZ < −2 SD was estimated at 8.5% with 1.7% of SAM, defined as WHZ < −3 SD (MS, 2018). Coverage for SAM treatment was estimated at 48% (ACF, 2014). In the eastern region, 63% of children in general are breastfed exclusively up to 6 months (MS, 2018). Introduction of complementary feeding was not effective in all children from 6 to 8 months; only 70% of them had started to consume foods other than breastmilk, and the average of food groups consumed per day was two (MS, 2018). Less than a quarter (23%) of children had an adequate MDD; a little more than half of children (57%) met the requirement for MMF, and MAD was 18% (MS, 2018). Most of the households in the study area experienced a food surplus during the 2014/2015 crop year, and cereal production coverage was 97% (Nikièma et al., 2015) The main ethnic groups in the region are the 'Gourmatché' (66%) followed by the 'Mossi' (16%) and the 'Fulani' (13%) (Bahan, 2009).

Before enrolment to study, all parents of eligible SAM children received information on the trial objectives and processes, and the possibility to withdraw at any time and signed informed consent of the parents was obtained before starting the trial. At admission, data were collected about the socio-demographic characteristics, anthropometry and 2-week retrospective morbidity of the child, and a clinical examination was performed. The household food insecurity access scale (HFIAS) was also assessed (Coates et al., 2007). As per national SAM treatment protocol, all mothers of the two arms were recommended weekly not to share the RUTF with other members of household to give complementary food to the child if they were still hungry after eating the RUTF and to breastfeed at all times on demand.

## 2.2 | Sample for the dietary intake survey

The dietary intake study was a cross-sectional study, nested in the MANGO trial, and started 2 months after launch of the MANGO study. Data collection took place 1 month after the admission of the children to treatment, on a total of 459 children aged 6–23 months (57% of MANGO main study sample). The sample for dietary intake was previously described (Nikièma et al., 2021). Complementary foods practice data were collected during Week 4 or 5 of treatment.

## 2.3 | Dietary intake assessment

Data on children's complementary food intake was collected using a 24-h multipass dietary recall (24HDR) (Gibson & Ferguson, 2008) at Week 4 or 5 during treatment, from December 2016 to August 2018. The 24HDR was conducted as a face-to-face interview by experienced and trained investigators. First, the caregiver was asked to recall all the foods and drinks the child had eaten the previous day, including snacks. In the second pass of recall interview, the investigators repeated to the caregiver, in a chronological order, each of the foods and drinks consumed and probed for cooking methods and recipes. The caregivers were asked to describe the composition of the listed composite foods and beverages. During the third pass, the amount consumed by the child was estimated by the caregiver using calibrated local household utensils (glasses, cups, bowls and spoons). Before closing the interview, the investigators checked responses with caregivers to make sure nothing has been omitted. The average recipe method (Gibson & Ferguson, 2008) was used to convert amounts consumed from household units to grams. Food weights were measured using a TANITA KD electronic kitchen scale (model KD-400SV, Tanita Corporation, precision 1 g, maximum load: 5 kg).

## 2.4 | Definition of variables

Rainy season was defined as June to October and dry season as November to May. Morbidity was defined as the presence of fever and/or diarrhoea during the last week. Safe source of drinking water was defined as water from taps, boreholes and protected wells. Urban living environment was defined as living less than 30 min from the town of Fada on foot. Caregivers were considered to have formal education when they had at least attended formal primary school. Ethnicity was categorized as Gourma, Mossi, Fulani and others. Household wealth index was defined using principal component analysis and included variables describing income and possessions. Three categories of household wealth index were defined: low, medium or high. Complementary foods were 'any food or liquids, whether manufactured or locally prepared, consumed as a complement to breast milk or as a breast-milk substitute, fed to infants during the complementary feeding period' (WHO & UNICEF, 2008).

DDS was defined as the number of various food groups consumed by the child out of the eight recommended groups during the preceding 24HDR period. According to the United Nations Children's Fund (UNICEF) 2020 guidelines (UNICEF, 2020), the eight food groups include (i) breastmilk; (ii) grains, roots and tubers; (iii) legumes, nuts and seeds; (iv) dairy (milk, yoghurt, cheese); (v) flesh foods (meat, fish, poultry and liver or organ meats); (vi) eggs; (vii) vitamin A-rich fruits and vegetables (carrots, mangoes, dark green leafy vegetables, pumpkins, orange sweet potato); and (viii) other fruits and vegetables. Vitamin A-rich foods were defined as containing at least 60 retinol activity equivalents (RAE)/100 g (FAO, 2015; WHO, 2010).

The definition of other revised standard indicators used in this study for complementary feeding (UNICEF, 2020) were as follows:

1. Minimum dietary diversity (MDD): Percentage of children aged 6–23 months who received food from at least five out of eight defined food groups during the previous day.
2. MMF: Percentage of children aged 6–23 months who received solid, semi-solid or soft foods (including milk feeds for non-breastfed children) the minimum number of times or more during the previous day. In the present study, the consumption of RUTF was not included in the calculation of the MMF. For breastfed children, MMF were two meals a day for children aged 6–8 months and three meals a day for those aged 9–23 months (Bégin & Aguayo, 2017; WHO, 2010). For non-breastfed children aged 6–23 months, MMF was four meals a day (WHO & UNICEF, 2018).
3. Minimum acceptable diet (MAD): Proportion of children 6–23 months of age who achieved both MMF and MDD (in breastfed and non-breastfed children) during a previous day.

4. Minimum milk feeding frequency of non-breastfed children (MMFF): Proportion of children aged 6–23 months who receive at last two milk feeds during the previous day.
5. Non-dairy animal food source (NDAF) consumption: Percentage of children aged 6–23 months who consumed egg and/or flesh food during the previous day.
6. Sugar-sweetened beverage (SSB) consumption: Percentage of children who consumed a sugar beverage during the previous day. An SSB was defined as any liquid that is sweetened with added sugar, such as brown sugar, corn sweetener, corn syrup, dextrose, fructose, glucose, high-fructose corn syrup, honey, lactose, malt syrup, maltose, molasses, raw sugar and sucrose.
7. Vegetable or fruit consumption (VF): Percentage of children aged 6–23 months who consumed any vegetables or fruits during the previous day.

### 2.5 | Data management

The statistical software package Stata Version 15.0 (Stata Corp.) was used to perform the statistical analyses. Anthropometric z-scores were calculated using the 2006 WHO growth standards (WHO, 2006). Three household food security categories were created from the HFIAS scores: food secure, mildly food insecure and moderately or severely food insecure (Coates et al., 2007).

To compute food intakes, the dietary data were converted to food groups using a food composition database (FCDB) previously described (Nikièma et al., 2021). FCDB was inserted into Lucille Software (Ghent University, Belgium). The proportion of each of eight food groups consumed and their weight were also calculated.

### 2.6 | Statistical analysis

The data analysed concerned 459 children, including 219 in the reduced RUTF dose arm and 240 in the standard RUTF dose arm. Descriptive analysis was summarized as percentage and means (±SDs) in order to present the general profile of children at baseline and at time of the recall concerning their socio-demographic, maternal, and household characteristics.

Differences between intervention and control arms were assessed using standard Poisson regression model for DDS and number of meals per day, linear mixed models for each food group intake weight and mixed logistic regression models for all other binomial variables. All models used study site (health centre) as random effects and were adjusted for child's sex, age at recall, breastfeeding status, morbidity prior to recall and caregiver's education. Collinear variables (variance inflation factor > 10) were omitted from analyses.

Possible predictors of DDS at individual, household, community and environmental levels have been selected to determine factors significantly associated with DDS (Abizari et al., 2017; Arsenault et al., 2014; Dafursa & Gebremedhin, 2019; Edris et al., 2018; Iqbal, 2017; Kuche et al., 2019). Given this, we selected at individual level some potential predictor variables such as child's age (6–11 months or 12–23 months), sex (boy or girl), morbidity at last week before recall (yes or no), stunting at admission (yes or no), caregiver's age (<25 years or > = 25 years), caregiver's education (no or yes) and caregiver's ethnic group (Gourma, Mossi, Fulani, others). For household factors level, we selected food security status (food secure, mild food insecurity or moderate or severe food insecurity), household's wealth index (low, medium or high), household's water source (safe or unsafe) and household size (<5 and > = 5). Household's residence (rural or urban) constituted a community-level variable, and season of interview (dry or rainy) was considered an environmental-level variable.

To determine the factors significantly associated with DDS, multivariate standard Poisson regression analysis using a stepwise backward approach to model construction was computed (Dangura & Gebremedhin, 2017; Issaka, Agho, Page, et al., 2015b; Joshi et al., 2012; Mitchodigni et al., 2017) to estimate the coefficient and 95% confidence interval (CI). The association between each independent variable and DDS was initially assessed in unadjusted regression model; then variables with *P*-value < 0.2 were entered for adjusted model. Assumptions of the adjusted regression model (linearity, absence of multicollinearity and homoscedasticity of error term) were checked (Casson & Farmer, 2014; Marill, 2004). Model fitness was assessed using Pearson goodness-of-fit *P*-value (adjusted *R*-squared value) and was satisfying. The outputs of the analyses are presented via crude and adjusted unstandardized Poisson regression coefficients (β). Findings were considered significant at $P < 0.05$.

### 2.7 | Ethical considerations

This study has been approved by the Burkina Faso Ethics Committee of Health Research. This trial was registered on 13 May 2016 at the IRSCTN registry (http://www.isrctn.com/ISRCTN50039021).

## 3 | RESULTS

### 3.1 | Children's characteristics at enrolment and at recall

The baseline characteristics of children, caregivers and households are presented in Table 1. Among the sample of 459 children, more than half were between 6 and 11 months old, 53% were girls, and the average weight at admission was 6 kg. The majority of caregivers (76%) had not attended formal school, and less than 15% lived in an urban area. Caregivers were on average 27 years old. At the time of the 24HDR, the mean age of children was 12 months, their mean weight was 6.6 kg, and less than 20% of children were still SAM. The three majority ethnic groups of

**TABLE 1** Characteristics[a] of children with severe acute malnutrition aged 6–23 months at admission and during the 24-h dietary recall ($n = 459$)

| | Characteristics of children | | | | | |
|---|---|---|---|---|---|---|
| | At admission | | | During 24HDR (1 month after admission) | | |
| Variables | Reduced RUTF ($n = 219$) | Standard RUTF ($n = 240$) | *P*-value | Reduced RUTF ($n = 219$) | Standard RUTF ($n = 240$) | *P*-value |
| Age, *months* | 11.0 ± 4.48 | 10.8 ± 4.56 | 0.64 | 12.0 ± 4.52 | 11.8 ± 4.56 | 0.56 |
| Children age range, *% (n)* | | | | | | 0.61 |
| 6–11 months, *% (n)* | | | | 59.4 (130) | 61.7 (148) | |
| 12–23 months, *% (n)* | | | | 40.6 (89) | 38.3 (92) | |
| Girls, *% (n)* | 52.5 (104) | 53.3 (112) | 0.86 | | | |
| Morbidity, *% (n)* | 47.0 (103) | 51.7 (124) | 0.32 | 16.4 (36) | 21.7 (52) | 0.16 |
| Breastfeeding, *% (n)* | 94.5 (207) | 94.2 (226) | 0.87 | 92.7 (203) | 92.9 (223) | 0.93 |
| Weight, *kg* | 5.98 ± 0.84 | 5.90 ± 0.91 | 0.32 | 6.68 ± 0.96 | 6.64 ± 1.04 | 0.67 |
| Height, *cm* | 67.6 ± 5.07 | 67.2 ± 5.34 | 0.36 | 68.7 ± 4.96 | 68.3 ± 5.21 | 0.42 |
| MUAC, *mm* | 113 ± 6.03 | 112 ± 6.21 | 0.16 | 123 ± 6.95 | 122 ± 7.83 | 0.34 |
| Weight for height, *z-score* | −3.04 ± 0.69 | −3.05 ± 0.72 | 0.96 | −2.12 ± 0.76 | −2.06 ± 0.85 | 0.45 |
| Height for age, *z-score* | −2.26 ± 1.20 | −2.33 ± 1.28 | 0.54 | −1.81 ± 1.19 | −1.85 ± 1.27 | 0.54 |
| Weight for age, *z-score* | −3.45 ± 0.73 | −3.50 ± 0.82 | 0.45 | −2.55 ± 0.81 | −2.55 ± 0.88 | 1.00 |
| Stunted, *% (n)* | 59.4 (130) | 57.5 (138) | 0.69 | | | |
| SAM at recall, *% (n)* | | | | 18.3 (40) | 22.1 (53) | 0.31 |
| Mothers/caregiver's age, *years* | 27.9 ± 6.49 | 27.1 ± 6.87 | 0.17 | | | |
| Mothers, no formal education, *% (n)* | 77.2 (169) | 75.4 (181) | 0.66 | | | |
| Caregiver's ethnic group, *% (n)* | | | 0.22 | | | |
| Gourma | 56.6 (124) | 56.7 (136) | | | | |
| Mossi | 26.9 (59) | 20.8 (50) | | | | |
| Fulani | 14.2 (31) | 20.4 (49) | | | | |
| Others | 2.28 (5) | 2.08 (5) | | | | |
| HFIAS category, *% (n)* | | | 0.85 | | | |
| Food security, *% (n)* | 85.8 (188) | 86.7 (208) | | | | |
| Mild food insecurity, *% (n)* | 11.0 (24) | 9.58 (23) | | | | |
| Moderate and severe food insecurity, *% (n)* | 3.20 (7) | 3.75 (9) | | | | |
| Household wealth's index, *% (n)* | | | 0.83 | | | |
| Low, *% (n)* | 28.3 (62) | 27.1 (65) | | | | |
| Medium, *% (n)* | 27.4 (60) | 30.0 (72) | | | | |
| High, *% (n)* | 44.3 (97) | 42.9 (103) | | | | |
| Access to safe source of drinking water, *% (n)* | 85.8 (188) | 82.1 (197) | 0.27 | | | |
| Open defecation, *% (n)* | 74.4 (163) | 76.3 (183) | 0.65 | | | |
| Urban residence, *% (n)* | 16.0 (35) | 13.3 (32) | 0.42 | | | |
| Recall during rainy season, *% (n)* | | | | 41.6 (91) | 38.8 (93) | 0.54 |

Abbreviations: 24HDR, 24-h dietary recall; HFIAS, household food Insecurity access scale; MUAC, mid-upper arm circumference; RUTF, ready-to-use therapeutic food.
[a]Data are means ± standard deviations (SDs), unless otherwise indicated.

caregivers in the two groups of children are, respectively, the Gourma (57%), Mossi (24%) and Fulani (17%). There were no differences in anthropometric and other characteristics between children receiving the reduced and standard RUTF dose at admission and at the time of the dietary assessment.

## 3.2 | Breastfeeding status and food groups consumption

Breastfeeding was common: 93% of children between 6 and 23 months were still breastfed in the two arms. The food groups given

**TABLE 2** Food groups consumption[a] in children with severe acute malnutrition, aged 6–23 months during treatment, receiving reduced and standard RUTF dose

| Outcome | Proportion[b] of children consuming each food group, % (*n*) | | | | Quantity[c] of each food group consumed (*g*) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Adjusted[d] | | | | Adjusted[d] | |
| | Reduced RUTF (*n* = 219) | Standard RUTF (*n* = 240) | Difference (95% CI) | *P*-value | Reduced RUTF (*n* = 219) | Standard RUTF (*n* = 240) | Difference (95% CI) | *P*-value |
| Breastmilk | 92.7 (203) | 92.9 (223) | 0.09 (−3.42, 3.61) | 0.96 | NA | NA | - | - |
| Grains, roots and tubers | 98.2 (215) | 94.6 (227) | 3.82 (0.07, 7.56) | 0.05 | 104 ± 58.9 | 95.9 ± 57.8 | 6.92 (−2.59, 16.44) | 0.15 |
| Legumes and nuts | 75.8 (166) | 70.4 (169) | 5.45 (−2.31, 13.2) | 0.17 | 16.0 ± 22.3 | 12.9 ± 19.2 | 3.35 (−0.38, 7.07) | 0.08 |
| Dairy products | 13.7 (30) | 18.8 (45) | −4.51 (−11.1, 2.03) | 0.18 | 29.3 ± 103 | 50.6 ± 154 | −21.5 (−45.7, 2.60) | 0.08 |
| Flesh foods | 60.3 (132) | 59.2 (142) | 1.20 (−7.98, 10.4) | 0.80 | 8.12 ± 18.3 | 8.12 ± 17.9 | −0.09 (−3.38, 3.20) | 0.96 |
| Eggs | 3.20 (7) | 3.33 (8) | 0.04 (−3.29, 3.36) | 0.98 | 2.02 ± 12.0 | 2.23 ± 12.8 | −0.05 (−2.31, 2.20) | 0.96 |
| Vitamin A-rich fruits and vegetables | 41.1 (90) | 42.9 (103) | −1.71 (−10.9, 7.52) | 0.72 | 14.0 ± 30.3 | 12.3 ± 23.7 | 1.61 (−3.19, 6.41) | 0.51 |
| Other fruits and vegetables | 21.9 (48) | 19.2 (46) | 2.80 (−4.60, 10.2) | 0.46 | 7.33 ± 38.3 | 2.69 ± 10.2 | 4.63 (−0.40, 9.65) | 0.07 |

*Note:* Data are mean ± standard deviation (SD) or proportion (%).

Abbreviations: NA, no available; RUTF, ready-to-use therapeutic food.

[a]Ready-to-use therapeutic foods are not included in the assessment of food group intake.

[b]Analysed by using mixed logistic regression models with study site as random effects.

[c]Analysed by using linear mixed models with study site as random effects.

[d]Adjusted for sex, age, breastfeeding, morbidity and caregiver's education.

to children aged 6–23 months in the 24 h preceding the recall are summarized in Table 2. Consumption of all food groups was similar in the two arms in proportion and quantities in unadjusted and adjusted models. Grains, roots or tubers were consumed by over 96% of children. Legumes and nuts were consumed by 72% of the sample. Flesh foods were consumed by 60% of children though in small quantities (average 8 g per day). Eggs were consumed the least often, only consumed by 3% of children.

### 3.3 | Complementary feeding indicators

Complementary feeding practices are summarized in Table 3. There was no significant difference in these indicators between the groups. Children in both arms consumed an average of four food groups per day, including breastmilk. In all, slightly less than half of the children met the MDD. In the two study arms, less than half of children met the MAD. In non-breastfed children, less than 10% met the MMFF in the two arms. Almost all children consumed SSB, and less than two-thirds of children consumed fruits or vegetables in both arms. The majority of the children in both arms consumed at least three meals per day, and children in the reduced RUTF dose arm met more often the MMF per day.

### 3.4 | Determinants of DDS

The DDS increased in older and ill children with parents in the higher education, income category and living in urban area and during the rainy season. Factors positively associated with DDS included child's age, caregiver's education and household wealth index. DDS was higher in children aged 12–23 months compared with children aged 6–11 months of age ($\beta = -0.08$; 95%CI −0.14, −0.03; $P = 0.003$); in children whose caregivers had some formal education compared with those whose caregivers did not have formal education ($\beta = -0.12$; 95%CI −0.17, −0.06; $P < 0.001$); and among children living in the richest households compared with those living in poorest household ($\beta = -0.09$; 95%CI −0.15, −0.04; $P = 0.001$). DDS was also higher in children who had been ill a week earlier with fever or diarrhoea than in healthy children ($\beta = -0.10$; 95%CI −0.16, −0.04; $P = 0.002$) and in children living in urban area ($\beta = -0.09$; 95%CI −0.17, −0.02; $P = 0.02$). DDS decreased in children with Fulani caregivers compared with those with non-Fulani (Gourma, Mossi, others) caregivers ($\beta = -0.15$; 95%CI −0.25, 0.05; $P = 0.007$). Finally, DDS was 0.32 higher in the rainy season than in the dry season ($\beta = 0.07$; 95%CI 0.02, 0.13; $P = 0.01$) (Table 4). On the other hand, DDS did not vary according to the child's sex, stunting at admission, caregiver's age or household food security status.

## 4 | DISCUSSION

The primary outcome of the present analysis was the DDS of children with SAM treated with different doses of RUTF. The average DDS was four food groups consumed by each of the two groups of children. There was no significant difference between the two groups. This finding is consistent with our previous finding that indicated no difference in energy intake from complementary and family foods between the study groups (Nikièma et al., 2021).

The average DDS was similar to those found in children treated for MAM with cash transfer in Burkina Faso (Tonguet-Papucci et al., 2017) and higher than those found in children with SAM treated

**TABLE 3** Infant and young child feeding indicators in children with severe acute malnutrition, aged 6–23 months during treatment, receiving reduced or standard RUTF dose ($n = 459$)

| Outcomes | Reduced RUTF ($n = 219$) | Standard RUTF ($n = 240$) | Difference[a] (95% CI) | *P*-value |
|---|---|---|---|---|
| Dietary diversity score[b], (based on 8 food groups) | 4.07 ± 1.25 | 4.01 ± 1.26 | 0.02 (−0.04, 0.07) | 0.50 |
| Minimum dietary diversity[c] (>= 5 food groups), *% (n)* | 47.5 (104) | 45.0 (108) | 2.68 (−6.67, 12.0) | 0.57 |
| Number of meals per day[b] | 3.72 ± 1.08 | 3.53 ± 1.13 | 0.06 (0.00, 0.11) | 0.05 |
| Minimum meal frequency[c], *% (n)* | 93.6 (205) | 87.5 (210) | 6.28 (1.67, 10.9) | 0.01* |
| Minimum acceptable diet[c], *% (n)* | 47.0 (103) | 42.1 (101) | 5.20 (−4.05, 14.5) | 0.27 |
| Non-dairy animal source[c], *% (n)* | 60.7 (133) | 57.5 (138) | 2.24 (−6.85, 11.3) | 0.63 |
| Minimum milk feeding frequency[c], *% (n)* | 8.68 (19) | 10.0 (24) | −1.15 (−6.21, 3.92) | 0.66 |
| Sugar-sweetened beverage consumption[c], *% (n)* | 98.6 (216) | 95.8 (230) | 3.73 (−0.42, 7.89) | 0.08 |
| Vegetable or fruit consumption[c] (VF), *% (n)* | 63.0 (138) | 62.1 (149) | 0.88 (−8.03, 9.79) | 0.85 |

*Notes:* Data are proportion (*n*) and mean ± standard deviation (SD).Eight food groups are (1) breastmilk; (2) grains, roots and tubers; (3) legumes and nuts; (4) dairy products (milk, infant formula, yoghurt, cheese); (5) flesh foods (meat, fish, poultry, organ meats); (6) eggs; (7) vitamin A-rich fruits and vegetables; and (8) others fruits and vegetables (UNICEF, 2020).

Abbreviation: RUTF, Ready-to-use therapeutic food.

[a]Adjusted for sex, age, breastfeeding, morbidity, food insecurity, caregiver's education, urban, ethnic group and season of interview.

[b]Analysed by using Poisson regression models.

[c]Analysed by using mixed logistic regression models with study site as random effects.

*Significant difference with $P < 0.05$.

**TABLE 4** Determinants of dietary diversity score (DDS) in children with severe acute malnutrition aged 6–23 months during treatment with RUTF ($n = 459$)

| | | Unadjusted | | | Adjusted[b] | | |
|---|---|---|---|---|---|---|---|
| **Variables** | **DDS[1]** | **β** | **95% CI[a]** | ***P*-value** | **β** | **95% CI[a]** | ***P*-value** |
| Child's sex | | | | | | | |
| Male | 3.95 ± 1.27 | −0.04 | (−0.10, 0.02) | 0.17 | −0.04 | (−0.10, 0.02) | 0.19 |
| Female | 4.12 ± 1.23 | | | | | | |
| Child's age | | | | | | | |
| <12 months | 3.91 ± 1.33 | −0.08 | (−0.14, −0.03) | 0.003* | −0.08 | (−0.14, −0.03) | 0.003** |
| > = 12 months | 4.24 ± 1.09 | | | | | | |
| Child's morbidity | | | | | | | |
| No | 3.97 ± 1.27 | −0.09 | (−0.15, −0.03) | 0.005* | −0.10 | (−0.16, −0.04) | 0.002** |
| Yes | 4.34 ± 1.11 | | | | | | |
| Stunting at admission | | | | | | | |
| No | 4.16 ± 1.24 | 0.05 | (−0.00, 0.11) | 0.07 | 0.05 | (−0.01, 0.10) | 0.10 |
| Yes | 3.95 ± 1.25 | | | | | | |
| Caregiver's education | | | | | | | |
| No | 3.92 ± 1.26 | −0.12 | (−0.18, −0.06) | <0.001* | −0.12 | (−0.17, −0.06) | <0.001*** |
| Yes | 4.41 ± 1.13 | | | | | | |
| Caregiver's age | | | | | | | |
| <25 years | 4.14 ± 1.22 | 0.04 | (−0.02, 0.10) | 0.19 | 0.04 | (−0.02, 0.10) | 0.18 |
| > = 25 years | 3.98 ± 1.26 | | | | | | |
| Caregiver's ethnic group | | | | | | | |
| Gourma | 4.07 ± 1.18 | −0.05 | (−0.11, 0.02) | 0.16 | −0.05 | (−0.11, 0.02) | 0.16 |
| Mossi | 4.26 ± 1.20 | | | | | | |
| Fulani | 3.63 ± 1.40 | −0.16 | (−0.26, −0.06) | 0.002* | −0.15 | (−0.25, −0.05) | 0.002** |
| Others | 4.30 ± 1.70 | 0.01 | (−0.23, 0.25) | 0.93 | 0.01 | (−0.23, 0.24) | 0.96 |
| Household's food security | | | | | | | |
| Food secure | 4.01 ± 1.26 | −0.05 | (−0.14, 0.04) | 0.29 | −0.05 | (−0.14, 0.04) | 0.29 |
| Mild food insecurity | 4.21 ± 1.27 | | | | | | |
| Moderate and severe FI | 4.19 ± 0.98 | −0.01 | (−0.15, 0.13) | 0.93 | −0.00 | (−0.14, 0.13) | 0.95 |
| Household's wealth index | | | | | | | |
| Low | 3.81 ± 1.28 | −0.11 | (−0.18, −0.04) | 0.002* | −0.11 | (−0.18, −0.04) | 0.002** |
| Medium | 3.92 ± 1.27 | −0.08 | (−0.15, −0.01) | 0.02* | −0.08 | (−0.14, −0.01) | 0.03* |
| High | 4.26 ± 1.19 | | | | | | |
| Household's residence | | | | | | | |
| Rural | 3.98 ± 1.24 | −0.09 | (−0.17, −0.02) | 0.02* | −0.09 | (−0.17, −0.02) | 0.02* |
| Urban | 4.37 ± 1.29 | | | | | | |
| Season of interview | | | | | | | |
| Rainy season | 4.23 ± 1.22 | 0.08 | (0.02, 0.13) | 0.007* | 0.07 | (0.02, 0.13) | 0.01* |
| Dry season | 3.91 ± 1.26 | | | | | | |

*Note:* Data are mean ± standard deviation (SD).
Abbreviation: CI, confidence interval; DDS, dietary diversity score; FI, food insecurity; RUTF, ready-to-use therapeutic food, β, unstandardized regression coefficients.
[a]Analysed by using Poisson regression models.
[b]Adjusted for sex, dosage and week of recall.
*Significant difference with $P < 0.05$. **Significant difference with $P < 0.01$. ***Significant difference with $P < 0.001$.

in Niger context with RUTF (Madzorera et al., 2018) and non-malnourished children in Burkina Faso context (Cliffer et al., 2020; MS, 2018). Also, apart from MMF, the other complementary feeding practices (MDD and MAD) did not differ following the reduction in RUTF dosage, which showed that although higher than healthy children, feeding practices did not vary depending on the intervention or the type of therapeutic food received by acute malnourished children.

The difference observed in MMF between the two groups might be explained by the fact that children receiving standard RUTF consumed it more frequently per day than other complementary family foods. However, this lower frequency of consumption of complementary foods in children receiving standard RUTF did not affect the diversity of food groups consumed, hence the similar indicators observed in the two groups of children.

The majority of children consumed grains, roots or tubers followed by legumes and nuts. These results matched to the main food groups consumed in the study area by the general population of children aged 6–23 months (MS, 2018) and in Burkina Faso (Mank et al., 2020). This suggests that there are no specific complementary foods prepared for the children of this age, who are given the same foods prepared for the whole family. The most consumed flesh food was dried fish, which were almost common in sauces and prepared meals. The low consumption of fruits and vegetables by children may contribute lead to a lower bioavailability of certain micronutrients in complementary food. This could also could account the low contribution of the family food to the total intake of micronutrients previously reported (Nikièma et al., 2021).

Some factors were found significantly associated with DDS. DDS increased with child's age and caregiver's education (Dafursa & Gebremedhin, 2019; Dangura & Gebremedhin, 2017; Iqbal, 2017; Issaka, Agho, Page, et al., 2015a; Kuche et al., 2019; Mitchodigni et al., 2017). Education gives access to information, or increase income, or changes the position of the wife in the family relationship, which gives her more decision power. Thus, the educated mother could have more ability to choose foods for her child. Sick children with diarrhoea or fever had the highest dietary diversity. These results are in contraction with previous study in non-malnourished children with diarrhoea or fever (Kuche et al., 2019). This could be explained by the dual state of health of the children in the present study: SAM and sick (diarrhoea or fever) and caregivers pay more attention to his/her food, and also to stimulate the child's appetite, diverse foods are offered to him/her. DDS was lowest in children living in Fulani households than those living in other ethnic groups. This can be explained by the fact that usually, the diet of the Fulani remains poorly diversified and usually based on dairy products, nuts and fruits (Ekpo et al., 2008). DDS was low among very poor (low wealth's index) and poor (medium wealth's index) households, which would mean that the low household income would limit the accessibility to the consumption of various foods by children. In low-resource populations, especially from the lower and middle-income countries, diets are often mainly based on grains, roots or tubers with little or no animal products and few fruits and vegetables (Ruel, 2003). This finding was similar to previous studies (Dafursa & Gebremedhin, 2019; Iqbal, 2017; Kuche et al., 2019). Children in urban area had a higher DDS compared with their peers in the rural areas. In Burkina Faso, rural residents commonly subsist on a thick, cereal-based porridge eaten with a sauce made of leafy vegetables and condiments such as soumbala (i.e. fermented seeds of African locust bean, *Parkia biglobosa*) and dried fish (Lykke et al., 2002). Previous findings have shown DDS increased in urban area (Edris et al., 2018; Iqbal, 2017). Food diversity was better during rainy season than in the dry season. Many fruits and vegetables are more abundant with the onset of seasonal rains in Burkina Faso (Somé & Jones, 2018). Also during the rainy season, which corresponds to the lean period when food reserves are greatly reduced or even exhausted, populations adapt with more picking of wild fruits and green leaves (Thiombiano et al., 2012). Previous studies reported that DDS increased in the rainy season in Burkina Faso (Arsenault et al., 2014; Somé & Jones, 2018) and in Ghana (Abizari et al., 2017). However, other studies reported that there was no variation in dietary diversity depending on the season (Lachat et al., 2017).

This study was done in a context of somewhat stable food security with a research team that provided awareness messages and administered appropriate care to children. The results could be different without the awareness messages given throughout the study on appropriate child food consumption and diversification. The stable food security status of households possibly contributed to better complementary feeding practices. The study covered 2 full years taking into account both seasons (dry and rainy) in terms of food availability and variety, which allows results to account for the variability within the year. The study was done with 93% of the children still breastfed, and breastfeeding has been considered a food group according to the 2020 UNICEF recommendations (UNICEF, 2020). The complementary feeding practices were assessed only once at one precise moment, and this could limit the generalization of children's feeding practices throughout treatment. One of the limitations of the study was the large 95% CI, which is related to the low number of children within the food groups. Another limitation was the fact that IYCF indicators were assessed on the basis of a single 24HDR and not an average of the food intake for at least two 24HDR. Furthermore, the 24HDR method has a tendency to underestimate the food intake by about 10% as compared with the observed intake (de Vries et al., 2009). Nonetheless, our results contribute to improve knowledge about DDS in the context on SAM treated with standard and reduced doses of RUTF among children, which has been scarcely reported.

## 5 | CONCLUSION

The present findings show that children with SAM consumed a relatively small variety of foods during treatment apart from the RUTF ration prescribed to them. Reducing the dose of RUTF during SAM treatment did not impact DDS. A number of factors such as age 12–23 months, higher mother's education, higher household wealth index, household urban place of residence and rainy season have been associated with better DDS.

## ACKNOWLEDGMENTS

We thank children and mothers/caregivers for participating in the trial and the research teams for their everyday efforts in implementing the trial. This study was funded by Action Against Hunger office in France; the Humanitarian Innovation Fund (HIF), a programme managed by ELRHA (Enhancing Learning and Research for Humanitarian Assistance); European Commission's Civil Protection and Humanitarian Aid Operations (grant number: ECHO/-WF/BUD/2015/91065); Children's Investment Fund Foundation (grant: CIFF03: 'Reinventing community based management of malnutrition'); European Commission's Civil Protection and Humanitarian Aid Operations Enhanced Response Capacity (grant number ECHO/ERC/BUD/2016/91006); and AAH (Action Against Hunger) & Institut de France Foundation for research & innovation. Funding covered the study conception and field implementation of the study, including the salary of VN and STK for the full length of the trial, as well as data cleaning and analyses and article writing. Other authors received no specific funding for their work related to the current study. The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.


## CONFLICTS OF INTEREST

VN, NFF, CS, CL and STK declare that they have no conflict of interest.

## CONTRIBUTIONS

VN, CS and STK conceived the research project, VN and STK collected data in the field. VN performed the data cleaning and analysis, interpreted the results, wrote the first draft of the manuscript, revised subsequent drafts and coordinated the contributors. NFF, CS and STK, VN and CS and contributed to interpretation of results and revised subsequent drafts. VN and CS acquired the funding for the study.

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**How to cite this article:** Nikièma, V., Fogny, N. F., Salpéteur, C., Lachat, C., & Kangas, S. T. (2021). Complementary feeding practices and associated factors of dietary diversity among uncomplicated severe acute malnourished children aged 6–23 months in Burkina Faso. *Maternal & Child Nutrition*, e13220. https://doi.org/10.1111/mcn.13220