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Adequate Dietary Intake and Consumption of Indigenous Fermented Products Are Associated with Improved Nutrition Status among Children Aged 6–23 Months in Zambia

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Abstract: Agroecological food systems and socioeconomic characteristics are known to influence household food security and food consumption patterns and consequently have an impact on child nutritional status. The present study examined food consumption patterns among children aged 6–23 months in two geographic regions of Zambia, with special focus on consumption of fermented products, and its association with illnesses and nutritional status. The cross-sectional survey enrolled a total of 213 children from Namwala and Mkushi districts of Zambia. A 24 h recall and food frequency questionnaire (FFQ) were used to determine the number of food groups consumed and consequently dietary diversity scores and food consumption patterns, respectively. Determinants of child's linear growth as measured by Height-for-Age Z-scores (HAZ) were assessed via multiple linear regression analysis. In total, 54% of the children met the minimum dietary diversity by consuming food from at least 5+ food groups. Maize meal porridge, *Mabisi* (fermented milk), *Chibwantu* and *Munkoyo* (fermented beverages based on cereals) and groundnuts were among the frequently consumed foods. A higher consumption of fermented beverages was observed in Namwala compared to Mkushi district. A significant association was observed between HAZ score (rho = 0.198, p = 0.004), Weight-for-Age Z-score (WAZ) (rho = 0.142, p = 0.039) and consumption of *mabisi*. Dietary intake had a positive association with child nutritional status. The frequent consumption of traditional non-alcoholic cereal and milk-based fermented foods underpinned their contribution to the children's dietary intake. Moreover, the trend would be viewed as an indicator to nutrition and policy actors on possible unoptimized potential of indigenous fermented foods' influence in nutritional and health status among children at regional and national levels. Although Zambia has a wide range of traditional non-alcoholic fermented food products, their prospects in provision of macro- and micronutrients along with microbiota benefits remain scanty despite global efforts increasingly advocating for the inclusion of such traditional foods in food-based recommendations.

Keywords: malnutrition; fermented food; nutritional status; dietary diversity; children; Zambia

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1. Introduction

Food insecurity, malnutrition and childhood diseases remain global challenges, especially in sub-Saharan Africa [1,2]. In all its forms, malnutrition encompasses undernutrition (wasting, stunting, underweight), inadequate vitamins or minerals, overweight, obesity, and resulting diet-related noncommunicable diseases [3,4]. As a global public health challenge, malnutrition is associated with increased morbidity and mortality along with high health care costs [5]. Globally, in 2020, 149 million children aged 5 years and below were estimated to be stunted, ~45 million wasted, ~38.9 million were overweight or obese, and an estimate of 340 million suffered from micronutrient deficiencies [4,6]. Of all the deaths that are recorded annually among children under 5 years, around 45% are linked to undernutrition [4,7], and children with multiple measures of anthropometric failure are at a high risk of morbidity and mortality [3,4,6]. Some of the factors that contribute to the high levels of malnutrition in children include but are not limited to poor infant stimulation and nurturing, inadequate dietary intake and recurrent infections [3,8]. When combined with undernutrition, diarrhoea-related illnesses are considered the second-leading causes of death among children under 5 years old in sub-Saharan Africa [9–12]. In Zambia, the 2018 demographic health survey described diarrhoea, fever and pneumonia as important contributing causes to morbidity and mortality among children under the age of 5 years in the country [13].

According to UNICEF, nutrition-related factors such as inappropriate feeding in the first year of life of a child are directly associated with deaths recorded annually among children under 5 years of age worldwide [7]. In children 6 months or older, complementary foods introduced to these children often are nutritionally inadequate and unsafe, which lead to malnutrition and related lifelong developmental consequences. In Zambia, 32.5% of households consume food from four or less food groups [14] and only 69% of the children 6–24 months receive food from at least three food groups as complementary food [15]. Agroecological food systems and socio-economic characteristics are known to influence food consumption patterns of households [16–21], and these have an effect on child nutritional status [18,22]. The influence is driven by the fact that the agroecological food system is considered as a holistic and multifaceted approach to food production that uses and creates social, cultural, economic and environmental knowledge to promote food sovereignty, social justice, economic sustainability, and healthy agricultural ecosystems [17,21,23]. For instance, fermented products such as *mabisi* which is milk based and *chibwantu* and *munkoyo* which are mainly composed of cereals are produced in Zambia and are known to deliver extended shelf life, microbiota benefits, and macro- and micronutrients [24]. Therefore, in the context of the agroecological food system, these indigenous food products can be harnessed for food sovereignty [25–28]. Consequently, of critical importance to ensuring adequate feeding are the frequency, quantity and quality of the food provided [15,29].

Based on this contextual account, this study investigated the association between dietary diversity, prevalence of illnesses and nutritional status of children aged 6–23 months in Namwala and Mkushi districts of Zambia. The core focus of concern was to examine: (1) whether there was an association between dietary diversity and nutritional status among children aged 6–23 months in the two districts, (2) whether there was a relationship between presence of illness and nutritional status in the study population, and (3) whether there was significant difference in nutritional status of the children between the two regions given differences in socio-economic characteristics, food consumption patterns, and especially the consumption of indigenous fermented products [24,25,30].

2. Methods

2.1. Study Setting, Design and Target Population

The cross-sectional survey was conducted from February to June 2018. The study sites were Namwala district of Southern province and Mkushi district of Central province in Zambia. According to the Central Statistics Office [31], the Southern and Central provinces represent 12% and 9.8% of the Zambian population, respectively. Overall, the two provinces were selected based on a common characteristic, which is the practice of a mixed agricultural system, although comparatively, the Southern province is known for its high livestock potential [32]. In addition, the two provinces were selected because they belong to different agro-ecological zones and dietary consumption of some foods such as *mabisi* (sour milk) and cereal-based non-alcoholic fermented beverages *chibwantu* and *munkoyo* [25]. The study enrolled boys and girls aged 6–23 months from rural and urban areas of the selected study sites. The period between 6 and 23 months of age is considered as one of the most critical stages for linear growth and peak stunting prevalence in most developing countries, a situation which can be attributed to high demand for nutrients for children of this age, recurrent infections and/or poor sanitation and hygiene conditions [8].

2.2. Sample Size Determination and Sampling Technique

The sample size for this study was determined following the equation, n = $[Z^2p(1 - p)]/\delta^2$, where n is the sample size, *Z* is the *Z* score value at 95% confidence level which is 1.96, p is the proportion of underweight children under the age of 5 years in Zambia (15%) [13], and δ is the margin of error which was set at ±5%. Based on the formula and factoring in attrition at 10% [33], a sample size of 213 was determined, comprising 108 and 105 children from Namwala and Mkushi districts, respectively.

Multistage sampling was used to arrive at the study sample within the respective districts in the broader provinces as follows: stage 1, Southern province has 13 districts while the Central province has 11. From each of these, one district was randomly selected, and these were Namwala and Mkushi districts in Southern and Central provinces, respectively. In stage 2, six (6) health facilities which also serve as growth monitoring and promotion centres (GMP) were randomly selected from each district based on the listing from the Ministry of Health, which categorizes facilities into urban and rural settings [34]. In Namwala, four (4) GMPs were rural, and two (2) were urban based. In Mkushi district, five (5) were categorised as rural and one (1) as urban. In stage 3, with the help of the local community health workers (CHW) attached to the respective centres, a sampling frame was developed which ensured that children aged 6–23 months who met the set criteria were captured. In stage 4, further division of the sampling frame into two strata based on gender was applied. From each stratum, simple random sampling was used to arrive at the target sample size. Only children aged 6–23 months whose legal guardians had given informed consent were included in the study. Children whose parents confirmed the presence of chronic health conditions with dietary prescription were excluded. Children with such conditions require special diets, have to adjust to the limits of foods allowed, and have decreased appetite and limited food intake [35].

2.3. Data Collection Procedures

A standard semi-structured questionnaire as earlier described and modified to the scope of the present study objectives was applied [36]. The questionnaire had sub-sections on demographic and socio-economic characteristics, food consumption patterns, anthropometry and prevalence of illness of the study participants. The age of the child and deworming status was obtained from the particular child's under five clinic card. For children who did not present with clinic cards, their age and information on whether they had taken deworming medication not more than six months before the study was obtained from their caregivers who also provided information on their socio-economic and demographic characteristics. The height and weight were measured using a height/length board (ShorrBoard) and SECA (S-876) weight scale, respectively.

A 24 h recall and food frequency questionnaire (FFQ) written in English and verbally translated into a local language (either *Tonga*, *Nyanja* or *Bemba*) were employed to assess the food intake in the last 24 h preceding the study and food consumption patterns based on a 7-day recall period for the FFQ with eight food groups, following guidelines from WHO and UNICEF [37]. Foods and beverages included in the food list for the 24 h recall followed infant and young child feeding practices (IYCF) recommended food groups, namely: 1 = breast milk, 2 = grains, roots and tubers, 3 = pulses (beans, peas and lentils) nuts and seed, 4 = dairy products, 5 = flesh foods, 6 = eggs, 7 = vitamin A-rich fruits and vegetables, 8 = other fruits and vegetables [37]. Consumption of food from a particular food group during the day or night preceding the study was considered affirmative consumption and did not take into account minimum quantity of the food consumed. The frequency of consumption of a listed food item included "not consumed", "once/day", "once/week", "2–4 times/week", "2–3 times/day"; "4–5 times/day", and "5–6 times/week". Data on whether the child had been ill were documented based on the caregivers' report of illnesses the child had two weeks prior to the data collection exercise.

Prior to data collection, enumerators with prior household survey experience were trained on how to conduct the survey, take anthropometric measurements, and collect dietary data. The data collection tools were pre-tested, and changes were made as needed.

2.4. Statistical Analysis

Anthropometric data were analysed using WHO AnthroPlus version 1.0.4. Anthropometric indicators including Height-for-Age Z scores (HAZ), Weight-for-Height Z scores (WHZ) and Weight-for-Age Z scores (WAZ) were categorized following WHO guidelines [38]. Using SPSS version 25, descriptive and inferential statistics were used to analyse the data. To establish dietary diversity score, food groups consumed by the children were counted. This was followed by classifying children into groups: those that met the recommended dietary diversity (those who had food from 5 or more food groups) and those that did not (consumed from less than 5 food groups) [37].

In this study, phi coefficient was used as a measure of strength of the association between consumption of fermented foods and presence of illness among the children in the two districts. Between the two study sites, chi-square test was used to determine the significant differences in the proportion of children with illness, their consumption of foods from the respective food groups and the consumption of fermented foods. Spearman correlation coefficient was used to determine the association between dietary diversity and socio-economic characteristics and consumption of fermented foods and nutritional status of the study participants, respectively, while *t* test was used to assess any significant differences in the mean HAZ, WAZ and/or WHZ of the children in the two study sites and by gender of the children. Multiple linear regression was used to determine the effect of the dietary diversity, health status, socio-economics and/or demographic characteristics on child nutritional status. Data collected on caregiver's level of education, household monthly food and non-food expenditure and source of drinking water were transformed into dummy variables. The model used in the estimation was: $\gamma = \alpha + \beta_n X_n + \ldots + \varepsilon$, where γ is the dependent variable HAZ scores, X_n are independent variables which include dietary diversity, health status (presence/absence of illness), socio-economic and demographic characteristics, β_n are the estimated coefficients and ε is the error term. Significance was at $p < 0.5$.

3. Results

3.1. Socio-Economic and Demographic Characteristics of the Study Population

Socio-economic and demographic attributes of the study population are presented in Table 1. A comparable proportion of boys and girls was enrolled in the study with an observed attrition rate of 1.4%. Within each district, a large proportion of the children were from rural areas compared to urban setting, while most of the caregivers were married and not more than 3% had attained tertiary education. A chi-square test established a significant difference between the two districts in the number of caregivers who were married (X^2 = 7.965, df = 3, p = 0.047) and the level of education they have attained (X^2 = 12.515, df = 3, p = 0.006). Most of the households spend less than Zambian kwacha (ZMW) 500 (approximately USD 25) per month on food, while less than 3% of the households spend more than ZMW 2500 (approximately USD 125) in both districts. In addition, the majority of the households source their drinking water from wells and boreholes. Between the two sites, there was a significant difference in the household monthly food expenditure (X^2 = 7.963, df = 3, p = 0.047) and source of their drinking water (X^2 = 31.792, df = 5, p = 0.000).

Table 1. Socio-economic and demographic characteristics of the study population.

Characteristic	**Namwala n (%)**	**Mkushi n (%)**	***p* Value**
Gender of the child			0.449
Female	56 (26.3)	49 (23.0)	
Male	52 (24.4)	56 (26.3)	
Geographic setting			0.401
Rural	79 (37.1)	82 (38.5)	
Urban	29 (13.6)	23 (10.8)	
Marital status of caregiver			0.047
Married	71 (33.3)	83 (40.0)	
Not married	37 (17.4)	22 (10.3)	
Level of education of caregiver			0.006
None	4 (1.9)	4 (1.9)	
Primary	55 (25.8)	31 (14.6)	
Secondary	48 (22.5)	64 (30)	
Tertiary	1 (0.5)	6 (2.8)	
Household monthly food expenditure (ZMW)			0.047
<500	72 (33.8)	52 (24.4)	
501–1000	28 (13.2)	35 (16.4)	
1001–2500	6 (2.8)	12 (5.6)	
>2500	2 (0.9)	6 (2.8)	
Source of drinking water			0.000
Stream	4 (1.9)	18 (8.5)	
Well	36 (16.9)	26 (12.2)	
Borehole	48 (22.5)	21 (9.9)	
Tap	19 (8.9)	35 (16.4)	
Other	1 (0.5)	1 (0.5)	

Chi-square test was used to determine the significant differences in the socio-economic and demographic characteristics between the two sites.

3.2. Food Consumption Patterns of the Study Participants

Going by the findings from the FFQ, among food items that were consumed more than once per day were foods from the grains, tubers and roots food group such as maize meal porridge (90.6%), *chibwantu* (18.3%) and *munkoyo* (4.7%); and groundnuts (21.2%) (from the legumes, pulses and nuts food group). Both chibwantu and Munkoyo are comparable cereal-based traditional fermented beverages made from maize and sometimes with the addition of millet and/or sorghum. Most of the children in the study population only had flesh foods such as chicken (51.2%), red meat (38.5%) and organ meat (27.2%) once per week. The most consumed dairy product by children was *mabisi*, followed by yoghurt and fresh milk. Only 16% of the children consumed eggs once per week. About 34.3% and 17.8% of the children consumed green leafy vegetables and fruits 2 to 4 times per week, respectively. It was observed that 19.7% and 16.4% of the children consumed sugary foods once per week and 2–4 times per week, respectively.

Table 2 presents the proportion of children consuming foods from the eight food groups in Namwala and Mkushi districts. A high proportion of children from Namwala consumed breast milk, grains, roots and tubers, dairy, eggs, vitamin A-rich vegetables and fruits compared to the children from Mkushi district. Significant differences in the proportion of children consuming other fruits and vegetables (X^2 = 5.333, df = 1, p = 0.021), dairy products (X^2 =28.137, df = 1, p = 0.000) and breast milk (X^2 =4.563, df = 1, p = 0.033) were observed between the two districts.

Table 2. Proportion of children consuming foods from the eight food groups in Namwala and Mkushi districts.

	Namwala	Mkushi	
Food Groups	**% ***	**% ***	***p* Value**
Breast milk	43.2	36.1	0.033
Grains, roots and tubers	50.7	49.3	0.161
Chibwantu	35.2	4.2	0.000
Munkoyo	1.4	29.6	0.000
Legumes and nuts	47.4	47.9	0.211
Dairy products	43.2	20.6	0.000
Mabisi	33.8	8.9	0.000
Flesh foods	44.2	45.1	0.950
Eggs	43.2	41.8	0.931
Vit. A rich fruit and vegetables	47.4	45.6	0.942
Other fruit and vegetables	36.6	42.7	0.021

* (%) calculated as a proportion of the whole sample size. Chi-square test was used to determine the significant differences in the proportion of children consuming foods from the recommended food groups.

More children in Mkushi (29.6%) consumed *munkoyo*, compared to Namwala (1.4%). On the other hand, consumption of *chibwantu* and *mabisi* was more predominant among children in Namwala district at 35.2% and 33.8% compared to Mkushi at 4.2% and 8.9%, respectively. Statistically significant differences were observed in the consumption of fermented foods: *chibwantu* (X^2 = 85.635, df = 7, p = 0.000), *munkoyo* (X^2 = 81.613, df = 6, p = 0.000) and *mabisi* (X^2 = 57.273, df = 5, p = 0.000).

The mean dietary diversity score for the study group was 2.422 $\pm$ 1.34. The mean dietary diversity score was 2.69 $\pm$ 1.42 and 2.15 $\pm$ 1.19 for Namwala and Mkushi, respectively. About 54% of the children in the two sites met the minimum dietary diversity requirements (consumed food from 5+ food groups), whereas the rest (46%) did not. Spearman correlation coefficient test showed a weak positive association between dietary diversity and level of education of caregiver (rho = 0.166, p = 0.015) and household monthly food expenditure (rho = 0.210, p = 0.002) in the study population.

3.3. Prevalence of Illnesses in the Study Population

A large proportion of the children presented with illnesses which include diarrhoea, vomiting, fever, coughs and/or malaria. It was observed that a total of 36.6% and 28.6% children had one or more illnesses in Namwala and Mkushi district, respectively. Specifically, 16.0% and 15.5% had diarrhoea, 7.5% and 3.8% were vomiting, 27.2% and 16.9% had fever, 9.4% and 13.6% had a cough or common flu while 8.9% and 4.7% had malaria in Namwala and Mkushi district in the order. Compared to Namwala (3.3%), a large proportion of the children in Mkushi (14.6%) district were dewormed not more than six months prior to the study. A chi-square test showed a significant difference in the proportion of children with fever (X^2 = 8.142, df = 1, p = 0.004) and those who had received deworming medication (X^2 = 20.625, df = 2, p = 0.000) in the two sites. Weak negative associations were observed between consumption of *mabisi* and presence/absence of diarrhoea (phi = $-$0.007, p =0.921) and *munkoyo* and vomiting (phi = $-$0.046, p = 0.501), respectively. Although insignificant associations were observed, the findings point to a stronger and significant association given a large sample size and longitudinal study, thus the need for more investigations involving a more powered sample size to support this notion.

3.4. Nutritional Status of Children in Namwala and Mkushi District

In relation to the nutritional status of the study population, most of the children (>35%) in the two districts were neither stunted, wasted, overweight nor underweight (Table 3). Generally, from the children sampled in Namwala district, 1.9% were underweight, 5.6% stunted, 2.1% wasted and 3.3% overweight. In Mkushi district, 5.2% of the children were underweight, 9.4% were stunted, 1.9% were wasted and 2.8% were overweight. Independent *t* test showed a significant difference in the mean HAZ (t = 3.245, p = 0.001) and WAZ (t = 2.556, p = 0.011) between Namwala and Mkushi and no significant difference in the mean WHZ scores. There was no significant difference in the mean HAZ, WHZ and WAZ based on gender and between children in rural and urban areas of Namwala. On the contrary, there was a significant difference (t = 2.722, p = 0.008) in the proportion of children who were wasted in rural and urban Mkushi. Spearman correlation coefficient showed a statistically significant association between HAZ score (rho = 0.198, p = 0.004), WAZ score (rho = 0.142, p = 0.039) and consumption of *mabisi.*

Table 3. Nutritional status of children aged 6–23 months in Namwala and Mkushi districts.

Category	Namwala	Mkushi	*p* Value
HAZ	n (%) *	n (%) *	0.001
Normal	96 (45.1)	85 (39.9)	
Moderately stunted	9 (4.2)	19 (8.9)	
Severely stunted	3 (1.4)	1 (0.5)	
Total	108	105	
WHZ	n (%)	n (%)	0.477
Normal	97 (45.5)	95 (44.6)	
Moderately wasted	3 (1.4)	3 (1.4)	
Severely wasted	1 (0.5)	1 (0.5)	
Overweight	7 (3.3)	6 (2.8)	
Total	108	105	
WAZ	n (%)	n (%)	0.011
Normal	104 (48.8)	94 (44.1)	
Moderately underweight	4 (1.9)	8 (3.8)	
Severely underweight	0 (0)	3 (1.4)	
Total	108	105	

HAZ is Height-for-age Z-score; WHZ is weight-for-age Z-score; WAZ is Weight-for-age Z-score and n is the number of study participants. * Percentages (%) calculated as a proportion of the whole sample size (N = 213). Independent *t* test was used to assess significant differences in the mean HAZ, WAZ and WHZ Scores.

3.5. Relationship between Dietary Intake, Health Status, Socio-Demographics and Nutritional Status

Multiple linear regression analysis was used to identify factors that significantly contributed to nutrition status of the children (Table 4). The dependent variable used in the analysis was stunting (HAZ scores). The model summary included adjusted R^2 = 0.126, R^2 = 0.225 and F = 2.266. Factors that were significantly associated with the nutritional status of the study population were caregiver level of education where B = −0.957; 95% CI (−1.853 to 0.062); p = 0.036, household non-food expenditure of ZMW < 1500 per month where B = 0.456; 95% CI (0.013–0.900); p = 0.044, household monthly non-food expenditure more than ZMW 3001–4500 (approximately USD 150–225) where adjusted B = −2.725; 95% CI (−5.145 to −0.305); p = 0.028, dietary diversity where B = 0.373; 95% CI (0.014–0.732); p = 0.042 and consumption of *mabisi* by the children where B = 0.451; 95% CI (0.041–0.861); p = 0.031.

Table 4. Factors affecting nutritional status of children aged 6–23 months in the study population.

Variable	B	95% C.I.	*p* Value
Childs's age (months)	−0.030	−0.063–(−0.003)	0.074
Sex of the child	0.187	−0.131–0.505	0.248
Geographic setting (urban/rural)	0.415	−0.023–0.854	0.063
Caregiver's age (years)	0.006	−0.017–0.029	0.607

Table 4. *Cont.*

Variable	B	95% C.I.	p Value
Number of people in the household	0.032	−0.013–0.076	0.162
Caregiver's education level (none)	−0.957	−1.853–(−0.062)	0.036
Caregiver's education level (primary)	0.059	−0.317–0.435	0.757
Caregiver's education level (secondary)—Reference	1.000	-	1.000
Caregiver's education level (tertiary)	−0.203	−1.284–0.878	0.712
Household food expenditure (<K500)—Reference	1.000	-	1.000
Household food expenditure (<K1000)	0.021	−0.385–0.426	0.918
Household food expenditure (K1001–2500)	−0.017	−0.734–0.699	0.962
Household food expenditure (>K2500)	−0.543	−1.469–0.383	0.249
Household non-food expenditure (<K500)—Reference	1.000	-	1.000
Household non-food expenditure (<K1500)	0.456	0.013–0.900	0.044
Household non-food expenditure (<K1501–3000)	0.060	−0.655–0.774	0.870
Household non-food expenditure (K3001–4500)	−2.725	−5.145–(−0.305)	0.028
Household non-food expenditure (>K4500)	1.146	−1.522–3.814	0.398
Source of drinking water (stream)	−0.067	−0.535–0.669	0.827
Source of drinking water (well)	0.109	−0.310–0.529	0.607
Source of drinking water (dam)	0.056	−1.049–1.160	0.921
Source of drinking water (borehole)—Reference	1.000	-	1.000
Source of drinking water (council supply)	0.183	−0.307–0.673	0.462
Dietary diversity	0.373	0.014–0.732	0.042
Consumption of fermented foods			
Consumption of *mabisi*	0.451	0.041–0.861	0.031
Consumption of *munkoyo*	−0.086	−0.491–0.319	0.676
Consumption of *chibwantu*	0.122	−0.295–0.538	0.565
Disease present 2 weeks prior to study	−0.316	−0.648–0.017	0.063
Constant	−1.301	−2.185–(−0.418)	0.004

Multiple linear regression analysis, where B is the adjusted beta coefficient and C.I. is the confidence interval, was used to determine factors that significantly contributed to nutrition status of the children.

4. Discussion

Going by the findings presented, about 54% of the children in the two districts combined consumed food from five and more food groups as recommended by the WHO [37] for this age group. Dietary diversity, an indicator from the WHO guidelines was adopted because it takes into account both breastfeeding and non-breastfeeding children and is considered as one of the components in combating malnutrition [39]. However, 46% of the children in both districts did not meet the minimum dietary diversity requirement. The 2013–2014 Zambia Demographic Health Survey (DHS) report shows that only 14.9% from Central province and 27.9% from Southern province of children met the minimum dietary diversity requirement [13] while 12% of children in the 2018 DHS met the minimum acceptable diet [40] during the course of the respective surveys. Similarly, findings by Marinda et al. [36] observed lower (35.6%) dietary diversity in children aged 6–23 months in Lusaka province of Zambia.

In both Namwala and Mkushi, the most consumed foods were starchy foods comprising of grains, roots and tubers, while the least consumed were dairy products, and other fruits and vegetables. However, there were some differences between the two districts in the consumption of foods from the various food groups. For instance, there was high intake of dairy products by Namwala participants as compared to those in Mkushi district. This can be attributed to the difference in agroecological food systems [17,21] and agricultural activities prominent in each region as similarly witnessed among the fishing and non-fishing communities in Zambia [18]. Namwala district of Southern province, for example, is known for livestock production compared to Mkushi district in Central province, which is known for crop production [32]. Equally, seasonality and limited availability of some fruits and vegetables in food group 8 would have contributed to the low intake observed in the study settings. Grains such as maize are a staple food countrywide [13,36] and thus a common factor contributing to the high intake of maize meal porridge in the study sites.

The outcomes point to the need to reinforce continuous medical education among health care providers at primary healthcare level with emphasis on lifestyle recommendations in a way that would promote healthy and balanced nutritional habits and culture at the community while mitigating disease development and/or progression. Equally, it is evident from the results trend presented that there is need for more strategic focus on nutritional education and awareness among antenatal and post-natal mothers and/or guardians in health facilities which also serve as growth monitoring and promotion centres at the local level in both urban and rural Zambia. In complementing social inclusion benefits derived from school feeding programs (SFP) plus other social protections [41,42], incorporating campaigns in SFP to promote balanced nutrition with information for parents in school forums, the mass media as well as the introduction of diets rich in vegetables and fruits in the SFP in schools and kindergartens to get children used to eating more vegetables and fruits, especially unprocessed fruits, would help address missed opportunities in nutritional provision.

Sub-Saharan Africa is known to have a wide variety of traditionally fermented food products prepared from cereals such as millet, maize, rice or sorghum [43–45]. Notably, in this study, maize meal porridge, fermented products such as *mabisi* (sour milk) alongside *chibwantu* and *munkoyo* (fermented cereal-based products) as well as groundnuts were among the frequently consumed foods. The frequent consumption of the traditionally non-alcoholic cereal and milk-based fermented foods underpinned their contribution in dietary intake among children aged 6–23 months in the study setting. Essentially, fermentation through the traditional methods exploit mixed cultures of diverse beneficial microorganisms widely referred to as probiotics [43,46,47]. The beneficial effects of these probiotics consumed include improvement of intestinal health by the regulation of microbiota, stimulation and development of the immune system, synthesizing and enhancing the bioavailability of nutrients, alleviation of lactose intolerance symptoms, and reducing the risk of certain childhood diseases such as diarrhoea and malnutrition [24,43,46,47]. Therefore, the consumption trend reported in our findings highlights potential and untapped benefits that could be harnessed from the traditionally fermented products in not only improving nutritional health status but also gut microbiota benefits in nutrition and health. This is so, despite the fact that there is lack of enabling policies and quality standardization framework in Zambia as the major undoing.

In consensus with observations on association between dietary diversity and infant growth in Zambia [29], in the presented findings, a positive association between dietary intake and HAZ scores was noted. An increase in dietary diversity score resulted in an increase in HAZ scores, while presence of illness was not significantly associated with HAZ scores. Similarly, findings involving 11 countries across Africa, Asia and Latin America showed that dietary diversity was significantly associated with HAZ scores of children in this age group, while strong positive associations were reported in seven of the countries [48]. On the other hand, findings in Zimbabwe pointed to evidence of acute illness to be associated with suppressed growth and nutritional wellbeing of infants while frequent infections contributed to stunting in children in developing countries even though the casual pathways are not known [49,50]. However, we note and appreciate that the non-longitudinal nature of our survey was a limitation, hence the inability to collect data on frequency of infections or health status for repeated observation at different time points of the year.

According to the Zambian DHS report stunting, underweight and wasting prevalence rates at the provincial level were found to be 33%, 11.4 and 4% for Central province while Southern province had 29%, 9.7% and 2.3% on the same indices, respectively [40]. Similarly, in this study, stunting was evidently higher in Mkushi district of Central province compared to Namwala district of Southern province. Households in Southern province had diversified livelihoods and thus engaged in different agricultural activities such as fishing, livestock and crop production [32], which could have contributed to higher dietary diversity and better economic status [31]. In Zambia, the proportion of children who are overweight has been on the rise from 1% in 2011 to 5% in 2019 [15,40]. The challenge is further advanced by the fact that our results equally point to >2.5% of children as being overweight. The phenomenon is most likely linked to the observed high intake of sugary foods, fats and oils.

There were mixed trends between diarrhoea, vomiting and consumption of the indigenous fermented products. Therefore, we note, as a limitation, that we did not assess hygiene, preparation standards, lack of quality standardization and possible variations in microbial community composition of the fermented products consumed by children [47,51–53]. Even so, the gut microbiota nutrition and health benefits that would be occasioned by consumption of the fermented food products herein discussed can also be attributed to already established results of microbiota diversity structure evidence based on Zambia context [25–28]. Moreover, there would be potential reporting bias about the child's food intake from the caregivers. As such, a longitudinal study design incorporating mixed methods with a higher sample size would be desirable to fully unravel associations and/or causality of the indigenous fermented beverages or a controlled community level study to evaluate associations between any modes of diarrhoea-lowering action or lack of the same with the frequently consumed fermented gruels, as well as the aetiological agents of diarrhoea-causing pathogens in young children.

5. Conclusions

Dietary intake had a positive association with child nutritional status. Notably, maize meal porridge, *mabisi* (fermented milk), *Chibwantu* and *Munkoyo* (fermented beverages based on cereals) and groundnuts were among the frequently consumed foods. The frequent consumption of traditionally non-alcoholic cereal and milk-based fermented foods underpinned their contribution in dietary intake among the children aged 6–23 months. Moreover, the trend would be viewed as an indicator to nutrition and policy actors on possible unoptimized potential of indigenous fermented foods influence in nutritional and health status among children at regional and national levels. Although Zambia has a wide range of traditional non-alcoholic fermented food products, their prospects in macro- and micronutrients as well as microbiota benefits remain scanty. Yet, across the world, more countries are increasingly advocating for the inclusion of such traditional foods in food-based recommendations, for regular consumption [54]. There is need for concerted efforts in mapping and promoting the uptake and utilization of traditionally fermented foods while enhancing policy framework and research within the same domain for better understanding of associated health benefits.

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Institutional Review Board Statement: The research protocol was approved by the University of Zambia Biomedical Research Ethics Committee (UNZABREC) (ref. no. 002-04-18). A written informed consent was read out to potential study participants and signed by those who agreed to participate in the study. Participants who could not read and write gave a thumbprint on the consent form. Prior to starting the data collection exercise, the study objectives were explained to the respondents by the enumerators, who then proceeded to collect data, only from those who agreed to participate in the study.

Informed Consent Statement: Informed consent was obtained from all study participants/caregiveres involved in the study.

Data Availability Statement: Data is contained within the article.

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