Preliminary Analysis of Wild Food Intake and Health Among School Children in Central and Southeast Inland/Coast Tanzania:
The Cases of Chinangali, Malolo, and Kijiweni Villages

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Introduction

While the world is aiming at eliminating global hunger as part of the SDGs, Sub-Sahara Africa is perceived to be facing difficulties in obtaining sufficient cultivated food due to various natural, political, and socio-economic obstacles. Within this context, wild foods are considered important sources of nutrition obtainable at low or no cost as a common community good.

Previous research in Kenya has shown that agrobiodiversity, including crops and wild foods, increases food diversity (Ouduor et al. 2019). However, research focusing on children and analysis of their health implications is limited.

1　Children's wild food utilization in Africa

Research in South Africa indicated that children's food intake is insufficient, and wild food intake is recommended (Mbehenyane et al. 2020). Another article on South Africa found that children consume wild fruits, insects, fish, birds, eggs, and small mammals on a daily basis (Shackleton et al. 2002). Research in Niger noted that only children ate the nutritious pit of *Sclerocarya birrea* (Glew et al. 2004). Research in southern Malawi indicated that children listed various wild foods, and intake was determined by their taste, health benefits, alternatives, hunger, and taboos (Maseko et al. 2017).

A review article on Sub-Saharan African drylands showed that children supplement their nutrition intake with wild food (Koffi et al. 2020). Research in South Africa specifically indicated that 62% of children supplemented their nutrition with wild food, 30% constituting half of the food, and wild food increased diversity by 13% (McGarry et al. 2009).

2　Utilization of wild food in Tanzania

Wild food has also been utilized and researched in Tanzania. For example, research in semi-arid regions enlists varieties of neglected and underutilized plants to enhance the resilience of communities (Masao et al. 2023). Studies on its nutritional value have also been performed for some edible plants in Dodoma, Lindi, and Morogoro regions (Sakamoto et al. 2023a; Sakamoto et al. 2022a; Stuetz et al. 2019).

Comparative research of the Hadza foragers in the bush consuming mostly wild-food diet and village consuming mostly agricultural diet revealed some differences. In terms of oral health, women living in villages exhibited more carriers due to increased consumption of maize, whereas men living in the bush had more carriers due to the heavy reliance on honey, and perhaps tobacco and marijuana (Crittenden et al. 2017). Preliminary research on Hadza children indicated that those living in villages associated with a mixed-subsistence diet had better growth in terms of weight-for-age, height-for-age, and BMI-for-age, but not weight-for-height, in comparison to those living in the bush (Pollom et al. 2021).

Research on wild food utilization in the East Usambara Mountains also indicated various intakes of wild foods by mothers and children (Powell et al. 2013). All informants had an intake of wild food, and its contribution was largely for vitamin A (31%), vitamin C (20%), and iron (19%). Mothers consumed less wild foods in the

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dry season, but children did not show any increase since children ate more wild fruits that are ripe in the dry season (Powell et al. 2013, p.466).

Research in semi-arid (Chinagali village), inland (Malolo village), and coastal (Kijiweni village) areas showed various utilizations of wild food by adults, especially in Malolo village. Relationships between wild food intake frequency and health evaluations were identified in the three villages in Tanzania: positively related to subjective health perception in inland villages (Chinangali and Malolo villages) but negatively related in coastal Kijiweni (Sakamoto et al. 2021b). A preliminary analysis of children's wild food intake, diet, and health in Dar es Salaam and Pwani prevailed the utilization of wild food by children even near urban cities (Sakamoto et al. 2022b) but needs further research.

Previous research has indicated the importance of wild food, especially for children in Tanzania, but research on its relationship with health is limited. This article confirms children's consumption of wild food, attempts to establish relationships between children's wild food intake and health, and relates it to their general diet.

I. Information, Data, and Analytical Methods

1 Research areas

The research villages are Chinangali, Malolo, and Kijiweni villages. Chinangali is in Chamwino district, Dodoma region located in central Tanzania. The climate is semi-arid and frequent food shortages are prevalent in children's malnutrition, but anemia in women is low (24%) in comparison to Lindi region (Table 1).

The locations of the research regions are indicated in Figure 1. Malolo village is in Ruangwa district, Lindi region, located in inland southeast Tanzania. Kijiweni village has become under the jurisdiction of Lindi municipal, Lindi region, but is remote from Lindi city and is in coastal southeast Tanzania. The basic characteristics of each village are indicated in Table 2. The villages were selected based on their resilience by utilizing wild foods despite their food deficits. The association between wild food intake and the health of adults has been researched in previous research in the same villages (Sakamoto et al. 2021b); therefore, it will be researched for children in this research and compared.

2 Research methods

Wild food and food group intake frequency and health were captured by questionnaires on 8, 9, and 28 Sept. 2022 with 80 to 100 school children in Malolo, Kijiweni, and Chinangali elementary schools. School children in the 5th and 6th grades were mainly targeted.

The weekly frequency of intake was asked for the above food groups in the rainy and dry seasons with reference to Japanese studies (Tsunoda et al. 2015; Mizoguchi et al. 2004). The scores for the frequency of intake content were as follows: for carbohydrates, vegetables, oil, salt, and sugar, a score of 4 was given for "more than twice a day," 3 for "once a day," 2 for "4 to 6 days a week," 1 for "3 days a week or less" (Tsunoda et al. 2015; Mizoguchi et al. 2004), and 0 for "do not eat." For meat, fish, milk, pulses, nuts, fruits, and wild foods, 4 points were given for "every day," 3 points for "4-6 days a week," 2 points for "2-3 days a week," 1 point for "less than once a week" (Tsunoda et al. 2015; Mizoguchi et al. 2004), and 0 for "never eat".

For children's health, the questionnaire was designed to fit the actual situation in Tanzania, referring to the Health Examination Manual for Children of the Japan School Health association and the Survey Manual for the Report on Dietary Information of Children and Students. For each health problem, 3 points were given for "always," 2 points for "often," 1 point for "rarely," and 0 for "never."

Relationships between wild food / food intake in general / food group intake frequency in the dry season and child health problems were analyzed through correlation (Spearman) to confirm their respective associations. Furthermore, correlations between types of wild food consumed and distinct health problems (diarrhea and constipation) were analyzed per village.

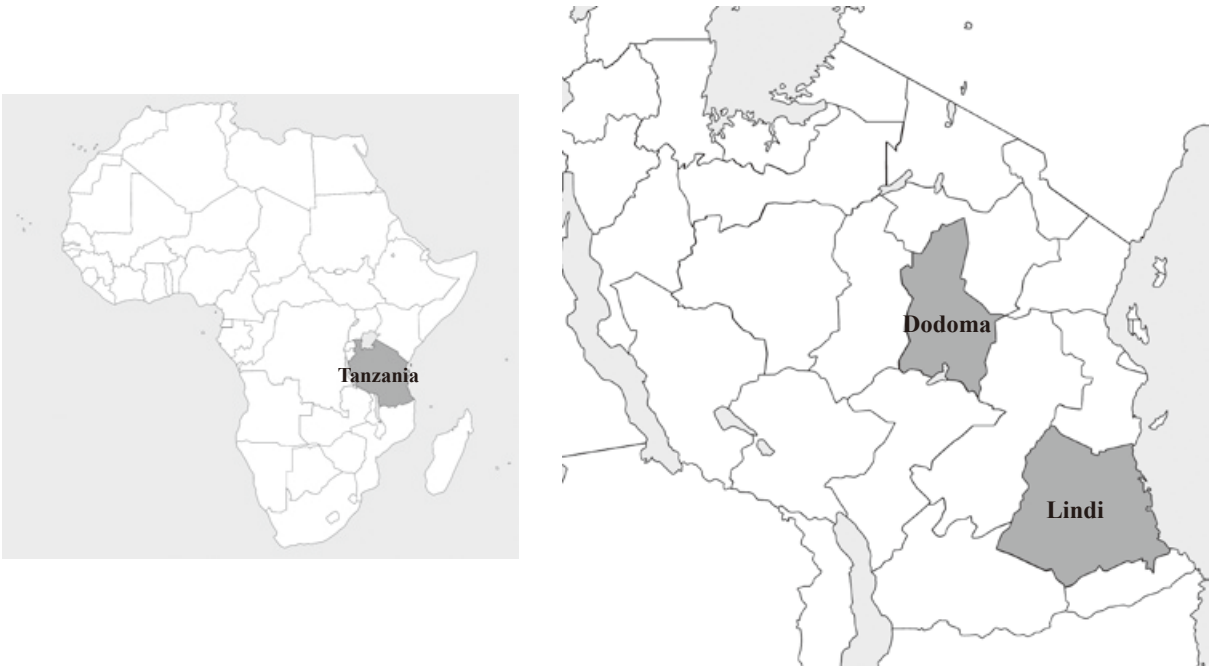
Dietary patterns including wild food intake was analyzed by factor analysis for each village to understand the food patterns and what kind of food groups were eaten in combination with wild food. The factor scores for each factor representing the food patterns of each village were correlated with health problems. All statistical analyses were performed using IBM SPSS (version 29 and 25) with reference to Tsushima (2008).

Table 1 Nutrition status of children in the research regions

Indicators	Year	Dodoma Region	Lindi Region	National average
Chronic malnutrition in children under 5 years old stunting (height by age) (%)	2018	**37**	24	31.8
Underweight of children under 5 (weight by age) (%)	2018	**18**	7	14.6
Acute malnutrition and wasting in children under 5 years of age (weight by height) (%)	2018	**3.7**	2.3	3.5
Under 5 mortality rate (per 1,000)	2015	58	65	67
Anemia in women (not pregnant) aged 15-49 (%)	2018	24	**33**	28.8

Note: **Bold** = Above the national average. Source: Created from Tanzania 2018, Tanzania 2015

Figure 1 Map of Tanzania and research regions



Source: Created by the author.

Table 2 Characteristics of the research villages

Region	Dodoma	Lindi	
Area	Semi-arid inland	Inland	Along the coast
District	Chamwino	Ruangwa	Lindi Municipal
Village	Chinangali I	Malolo	Kijiweni
Major ethnic groups	Gogo	Mwera	Machinga*
Religion	Christianity	Majority Christian, minority Muslim	Islam
Main occupation	Raising crops and livestock	Agriculture	Fishing and agriculture
Main staple foods	Maize, sorghum	Maize	Maize, sorghum
Main side dish	Vegetables, pulse	Pulse, vegetables	Fish

Note: *Hybrid between Mwera and Makonde
Source: Created based on fieldwork

II. The results

1 Research respondents

A total of 256 school children (101 boys and 119 girls) participated in the questionnaire, 80 from Chinangali, 91 from Kijiweni, and 85 from Malolo. The average age is 11.64 (standard deviation ± 1.78) for the total, 12.34 ± 1.33 for Chinangali, 11.61 ± 2.07 for Malolo, and 11.04 ± 1.61 for Kijiweni. The details are indicated in Table 3.

2 Wild food intake frequency

Children in Chinangali ate wild foods on average 1.11 ± 0.50 less frequently than children in Malolo (2.71 ± 1.24) and Kijiweni (3.55 ± 0.79) (Table 4). Children ate wild food more frequently in Kijiweni, Malolo (Sakamoto et al. 2023b), and Chinangali (Table 5).

Table 3 Age, grade, and sex of the research respondents (N = 256)

	Age			Grade			Sex		
Village	Average	±	SD	Average	±	SD	Boys	Girls	Total
Chinangali	12.34	±	1.33	4.99	±	0.67	36	44	80
Malolo	11.61	±	2.07	4.85	±	1.14	23	27	85
Kijiweni	11.04	±	1.61	4.32	±	1.40	42	48	91
Total	11.64	±	1.78	4.70	±	1.16	101	119	256

Note: SD = Standard Deviation

Table 4 Children's wild food intake frequency (N = 256)

Village	Average	±	SD
Chinangali	1.11	±	0.50
Malolo	2.71	±	1.24
Kijiweni	3.55	±	0.79
Total	2.51	±	1.35

Note: 0 = Do not eat, 1 = Less than once a week, 2 = 2-3 days a week, 3 = 4-6 days a week, and 4 = Every day

Table 5 Adult wild food intake frequency (N = 254)

Village	Average	±	SD
Chinangali	0.86	±	1.12
Malolo	1.23	±	0.95
Kijiweni	1.41	±	1.02
Total	1.25	±	0.86

Source: Calculated by the author based on the data set of Sakamoto et al. (2021b)

Table 6 Food group intake frequency in the dry season (N = 256)

Village	Chinangali			Kijiweni			Malolo			Total		
Food group	Average	±	SD	Average	±	SD	Average	±	SD	Average	±	SD
Food (general)**	2.09	±	0.28	2.77	±	0.54	2.94	±	0.39	2.61	±	0.56
Cereals*	3.04	±	0.25	2.60	±	1.17	3.15	±	1.22	2.93	±	1.02
Tubers and bananas*	2.92	±	0.31	3.10	±	0.92	2.69	±	1.11	2.91	±	0.87
Vegetables*	2.05	±	0.98	2.78	±	1.15	2.82	±	1.20	2.56	±	1.16
Meat	1.80	±	0.49	1.48	±	1.21	1.57	±	0.95	1.61	±	0.94
Fish	2.88	±	0.49	3.59	±	0.95	1.92	±	0.87	2.80	±	1.05
Milk	1.28	±	0.68	1.11	±	1.26	1.41	±	1.03	1.26	±	1.03
Eggs	1.05	±	0.32	0.83	±	0.82	1.60	±	0.83	1.15	±	0.77
Pulse	1.87	±	0.69	1.51	±	1.01	2.28	±	0.94	1.88	±	0.95
Seeds	1.65	±	0.92	2.69	±	1.42	1.91	±	1.01	2.11	±	1.23
Fruits	2.58	±	0.85	1.75	±	1.00	2.48	±	1.24	2.26	±	1.10
Oil*	2.10	±	0.49	2.15	±	1.26	2.98	±	1.28	2.41	±	1.15
Salt*	3.11	±	0.36	3.28	±	1.03	3.37	±	1.06	3.26	±	0.89
Sugar*	2.08	±	0.47	2.93	±	1.01	2.82	±	0.98	2.62	±	0.94

Note: 0 = Do not eat, 1 = Less than once a week, 2 = 2-3 days a week, 3 = 4-6 days a week, and 4 = Every day, *0 = Do not eat, 1 = Less than 3 day a week, 2 = 4-6 days a week, 3 = Once a day, 4 = More than twice a day, **Frequency eaten per day, SD = Standard Deviation

Table 7 Children's health problems

Village	Chinangali			Kijiweni			Malolo			Total		
Condition of health	Average	±	SD	Average	±	SD	Average	±	SD	Average	±	SD
No appetite	1.53	±	0.78	1.71	±	0.99	1.52	±	0.87	1.59	±	0.89
Constipation	1.56	±	0.95	1.26	±	1.04	1.44	±	0.95	1.41	±	0.99
Headache	0.96	±	0.30	1.34	±	0.80	1.44	±	0.82	1.26	±	0.72
Feeling tired	1.08	±	0.55	1.34	±	1.00	1.19	±	0.82	1.21	±	0.83
Can't see far away	1.14	±	0.44	1.00	±	1.04	1.30	±	0.95	1.14	±	0.87
Problems on waking up	0.95	±	0.45	1.11	±	0.98	1.20	±	0.84	1.09	±	0.80
Don't feel like doing anything	0.96	±	0.34	1.16	±	0.93	1.08	±	0.75	1.07	±	0.73
Stomachache	0.07	±	0.31	1.30	±	0.78	1.65	±	0.86	1.03	±	0.96
Toothache	0.94	±	0.33	0.91	±	0.90	1.11	±	0.93	0.98	±	0.78
Feel mad	0.21	±	0.44	0.94	±	0.87	1.42	±	0.92	0.87	±	0.92
Diarrhea	0.09	±	0.28	1.09	±	0.81	1.23	±	0.78	0.82	±	0.84
Dizzy	0.23	±	0.50	1.03	±	0.87	1.00	±	0.83	0.76	±	0.84

Note: 0 = Never, 1 = Rarely, 2 = Often, 3 = Always

3 Food group intake frequency

Food group intake frequencies are indicated in Table 6. Food in general (2.94 ± 0.39) and cereal (3.15 ± 1.22) were most frequently eaten in Malolo, and tuber/bananas (3.10 ± 0.92) and fish (3.59 ± 0.95) were most frequently eaten in Kijiweni.

4 Children's health problems

Children's health problems are indicated in Table 7. The most frequent problem was "No appetite[1]" (1.59 ± 0.89) in total and in Kijiweni village (1.71 ± 0.99). In Malolo, "Stomachache" (1.65 ± 0.86) was the most frequent problem, and in Chinangali, "Constipation" (1.56 ± 0.95) was the most frequent problem.

III. Analysis

1 Correlations of intake frequency

Correlations between children's wild food intake / food in general / food group intake frequency in the dry season and their health problems are indicated in Table 8. Stomachache, Diarrhea, Feeling mad, Dizzy ($p < 0.000$), and Headache ($p = 0.001$) were positively related to wild food intake frequency and strength in the given order. Constipation ($p = 0.041$) was negatively related at a statistically significant level.

Cereal intake frequency had a negative correlation with No appetite, Feeling tired, Toothache, and Do not feel like doing anything. Vegetable intake frequency had a positive correlation with Stomachache, Diarrhea, Feeling mad, and Headache but positive with No appetite. Meat intake frequency had a negative correlation with Stomachache, Diarrhea, and Feeling mad, but positive correlation with Toothache. Fish intake frequency had a negative correlation with Toothache and Stomachache. Milk intake had a positive correlation with toothache. Egg intake frequency had a positive correlation with Can't see far away. Seed intake had a positive correlation with Stomachache, Diarrhea, Feeling mad, and feeling Dizzy. Fruit intake frequency had a negative correlation with Stomachache and feeling Dizzy.

Oil and salt intake frequency had a positive correlation with Stomachache and Diarrhea, but oil intake frequency had a negative correlation with Do not feel like doing anything. Sugar intake had a positive correlation with Stomachache, Diarrhea, Feeling mad, and Dizzy.

2 Correlation of wild food species

Correlations between the species of wild food consumed and health problems (diarrhea and constipation) per village are indicated in Table 9. In Chinangali, a total of 43 species[2] within 5 types of wild food (17 fruits, 2 seeds, 17 vegetables, 6 animals, and 1 insect) were analyzed. The results indicated that children who ate wild fruit Mzabibu pori (*Cissus welwitschii*), wild vegetables Mshona nguo (*Bidens pilosa*) and Matembele pori (*Ipomoea* sp.) had a tendency not to experience constipation.

In Malolo, a total of 126 species within 9 types of wild food (29 fruits, 5 pulses, 5 nuts, 9 vegetables, 9 tubers, 37 animals, 18 insects, 1 mushroom, and 13 others) were analyzed. Children eating toxic tuber Uwanga (*Tacca leontopetaloides*) and/or baboon tended to have diarrhea. Children eating wild fruits Mng'rung'uru (*Strychnos innocua*), Usofu (*Uvaria* sp.), Mmula (*Parinari curatellifolia*), and/or tuber Kilombelombe (*Macrotyloma axillare*) tended not to experience constipation. Children eating Ming'oko (*Dioscorea hirtiflora* subsp. *orientalis*), and Vitundi (*Dioscorea* sp.) tended not to experience diarrhea.

In Kijiweni, a total of 60 species within 8 types of wild food (22 fruits, 3 pulses, 9 nuts, 10 vegetables, 4 tubers, 9 animals, 1 meat, and 2 insects) were analyzed. Children eating Mabungo (*Landolphia parvifolia*) fruit and Mlonge (*Moringa oleifera)* vegetables tended to have constipation. Children eating Mshilazi (*Mimusops fruticosa*) fruit, sufi (*Rhodognaphalon schumannianum*) and/or baobab (*Adansonia digitata*) seeds, and Nungu (porcupine) meat tended not to have diarrhea.

3 Factor analysis

Factor analysis of wild food, food groups, and food (general) intake frequency was implemented for the three villages. The pattern matrix was not able to be determined with all the variables; however, it was possible by excluding eggs. Eggs are least frequently consumed; therefore, omitting them from the analysis would be acceptable. For all the analyses, the extraction method is generalized least squares, and the rotation method is Oblimin with Kaiser Normalization.

Table 8 Correlations (Spearman) between children's wild food / food group intake frequency (dry season) and health problems

Food group intake frequency (dry season)		Stomachache	Diarrhea	Feel mad	Dizzy	Headache	Constipatioon	Can't see far away	No appetite	Problems waking up	Feel tired	Toothache	Don't feel like doing anything
Wild food	Correlation	**0.578****	**0.457****	**0.393****	**0.325****	**0.217****	**-.132***	-0.124	-0.066	-0.037	-0.035	-0.015	-0.009
	Sig. (2-tailed)	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.041**	0.052	0.298	0.559	0.577	0.812	0.888
	N	**253**	**251**	**250**	**246**	**247**	**240**	247	249	248	251	249	252
Food (general)	Correlation	**0.606****	**0.487****	**0.405****	**0.325****	**0.210****	-0.086	-0.041	-0.056	0.033	-0.031	0.066	-0.042
	Sig. (2-tailed)	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	0.184	0.524	0.377	0.602	0.624	0.304	0.511
	N	**252**	**250**	**249**	**245**	**246**	239	247	248	247	250	248	251
Cereals	Correlation	0.060	0.003	-0.014	-0.113	0.004	-0.094	-0.072	**-.127****	-0.064	**-.145***	**-.229****	**-.221****
	Sig. (3-tailed)	0.350	0.963	0.826	0.080	0.949	0.151	0.267	**0.047**	0.320	**0.023**	**0.000**	**0.000**
	N	248	247	245	242	242	237	242	**244**	243	**246**	**244**	**247**
Tubers and bananas	Correlation	0.046	0.093	0.059	0.079	-0.056	0.003	0.125	-0.021	-0.104	-0.005	-0.039	-0.025
	Sig. (4-tailed)	0.468	0.144	0.358	0.221	0.387	0.967	0.051	0.740	0.106	0.938	0.542	0.699
	N	249	248	246	242	243	236	243	245	244	247	245	248
Vegetables	Correlation	**0.220****	**0.214****	**0.163***	0.118	**0.170****	-0.115	-0.028	**-.187****	-0.093	0.049	-0.015	-0.117
	Sig. (5-tailed)	**0.000**	**0.001**	**0.011**	0.068	**0.008**	0.078	0.664	0.003	0.147	0.440	0.810	0.067
	N	**249**	**246**	**246**	241	**244**	235	242	244	244	246	245	248
Meat	Correlation	**-.157***	**-.159***	**-.170****	-0.078	-0.078	0.115	0.091	0.056	-0.117	-0.098	**0.192****	-0.006
	Sig. (6-tailed)	**0.013**	**0.013**	**0.008**	0.226	0.225	0.080	0.157	0.384	0.068	0.127	**0.003**	0.928
	N	**247**	**245**	**244**	241	241	235	243	243	243	245	**243**	246
Fish	Correlation	**-.136***	-0.077	-0.108	0.006	-0.102	-0.101	-0.127	0.055	-0.034	0.078	**-.176****	-0.018
	Sig. (7-tailed)	**0.037**	0.239	0.099	0.933	0.124	0.131	0.053	0.404	0.603	0.236	**0.007**	0.788
	N	**237**	235	234	232	231	226	233	233	233	235	**233**	237
Milk	Correlation	-0.061	-0.049	0.033	0.063	-0.068	0.054	0.086	0.071	-0.014	-0.044	**0.184****	-0.079
	Sig. (8-tailed)	0.345	0.447	0.610	0.336	0.297	0.414	0.189	0.272	0.826	0.496	**0.004**	0.218
	N	244	242	241	237	238	231	237	239	238	241	**241**	243
Eggs	Correlation	0.049	0.050	0.105	-0.008	-0.054	0.046	**0.171****	0.023	-0.054	-0.035	0.060	-0.088
	Sig. (9-tailed)	0.443	0.438	0.103	0.899	0.408	0.487	**0.008**	0.722	0.404	0.585	0.351	0.170
	N	246	245	243	240	240	234	**240**	242	241	244	242	245
Pulse	Correlation	0.046	-0.015	0.097	0.038	-0.039	0.003	0.080	0.044	0.051	0.017	0.103	0.095
	Sig. (10-tailed)	0.475	0.809	0.130	0.552	0.545	0.961	0.212	0.492	0.426	0.792	0.108	0.137
	N	248	246	245	242	242	235	243	244	243	246	244	247
Seeds	Correlation	**0.172****	**0.225****	**0.161***	**0.225****	-0.016	-0.058	0.007	-0.037	0.074	**0.161***	0.005	0.074
	Sig. (11-tailed)	**0.007**	**0.000**	**0.012**	**0.000**	0.810	0.381	0.917	0.564	0.254	**0.012**	0.933	0.247
	N	**245**	**244**	**242**	**240**	239	233	240	241	241	**243**	241	244
Fruits	Correlation	**-.149***	-0.060	-0.103	**-.128***	-0.086	0.027	0.058	0.050	0.111	0.029	0.051	-0.044
	Sig. (12-tailed)	**0.020**	0.351	0.113	**0.048**	0.186	0.681	0.375	0.437	0.087	0.648	0.433	0.498
	N	**244**	242	240	**238**	238	231	237	239	238	242	239	242
Oil	Correlation	**0.163***	**0.189****	0.090	-0.027	-0.039	-0.068	-0.096	**-.130***	-0.014	-0.114	0.025	**-.185****
	Sig. (13-tailed)	**0.010**	**0.003**	0.162	0.679	0.550	0.296	0.136	**0.042**	0.833	0.076	0.695	**0.004**
	N	**247**	**246**	245	241	241	236	241	**243**	242	245	243	**246**
Salt	Correlation	**0.216****	**0.216****	0.093	0.095	0.068	-0.090	-0.037	-0.032	0.019	-0.049	-0.054	-0.117
	Sig. (14-tailed)	**0.001**	**0.001**	0.147	0.141	0.292	0.167	0.566	0.614	0.765	0.443	0.402	0.065
	N	**249**	**248**	246	243	243	238	243	245	244	248	245	248
Sugar	Correlation	**0.311****	**0.313****	**0.222****	**0.218****	0.064	-0.125	0.026	0.086	0.078	0.034	0.006	0.030
	Sig. (15-tailed)	**0.000**	**0.000**	**0.000**	**0.001**	0.319	0.054	0.688	0.181	0.222	0.600	0.922	0.637
	N	**249**	**248**	**247**	**243**	243	238	243	245	244	247	245	248

Note: **Bold** = correlation with wild food intake; **Bold*** = Correlation is significant at the 0.05 level (2-tailed); **Bold**** = Correlation is significant at the 0.01 level (2-tailed)

Table 9 Correlation between wild food species and Diarrhea/Constipation

Table 9.1 Chinangali Village

Food group	Local name	*Scientific name* (English)	Children			Diarrhea	Constipation
			Eating	Not eating[+]			
Fruits	Mzabibu pori	*Cissus welwitschii* (wild grapes)	9	71	Correlation Coefficient	-0.110	**-.233***
					Sig. (2-tailed)	0.330	**0.048**
					N	80	**72**
Vegetable	Mshona nguo	*Bidens pilosa*	8	72	Correlation Coefficient	-0.103	**-.301***
					Sig. (2-tailed)	0.362	**0.010**
					N	80	**72**
	Matembele pori	*Ipomoea sp.*	14	66	Correlation Coefficient	-0.143	**-.252***
					Sig. (2-tailed)	0.207	**0.033**
					N	80	**72**

Table 9.2 Malolo Village

Fruits	Mng'rung'uru	*Strychnos innocua*	11	74	Correlation Coefficient	-0.080	**-.246***
					Sig. (2-tailed)	0.480	**0.025**
					N	81	**83**
	Usofu	*Uvaria sp.*	10	75	Correlation Coefficient	-0.147	**-.246***
					Sig. (2-tailed)	0.190	**0.025**
					N	81	**83**
	Mmula	*Parinari curatellifolia*	5	80	Correlation Coefficient	0.034	**-.234***
					Sig. (2-tailed)	0.765	**0.033**
					N	81	**83**
	Upunju	*unidentified*	53		Correlation Coefficient	**-.248***	-0.082
					Sig. (2-tailed)	**0.026**	0.459
					N	**81**	83
	Viaje	*unidentified*	61		Correlation Coefficient	**-.242***	-0.056
					Sig. (2-tailed)	**0.030**	0.613
					N	**81**	83
Tuber	Uwanga	*Tacca leontopetaloides*	19	66	Correlation Coefficient	**.268***	0.124
					Sig. (2-tailed)	**0.016**	0.264
					N	**81**	83
	Kilombelombe	*Macrotyloma axillare*	5	80	Correlation Coefficient	-0.162	**-.237***
					Sig. (2-tailed)	0.152	**0.032**
					N	80	**82**
	Ming'oko	*Dioscorea hirtiflora* subsp. *orientalis*	77	8	Correlation Coefficient	**-.268***	-0.125
					Sig. (2-tailed)	**0.015**	0.261
					N	**81**	83
	Vitundi	*Dioscorea sp.*	74		Correlation Coefficient	**-.256***	0.013
					Sig. (2-tailed)	**0.021**	0.910
					N	**81**	83
Animal meat	Nyani, Mnyani	(baboon)	26		Correlation Coefficient	**.294****	0.214
					Sig. (2-tailed)	**0.008**	0.052
					N	**81**	83

Table 9.3 Kijiweni Vilage

Fruits	Mabungo	*Landolphia parvifolia*	83	8	Correlation Coefficient	0.190	**.262***
					Sig. (2-tailed)	0.074	**0.016**
					N	89	**84**
	Mshilazi	*Mimusops fruticosa*	34	57	Correlation Coefficient	**-.266***	0.021
					Sig. (2-tailed)	**0.012**	0.849
					N	**89**	84
Seeds(nuts)	Mbegu za sufi	*Rhodognaphalon schumannianum*	50		Correlation Coefficient	**-.318****	-0.012
					Sig. (2-tailed)	**0.002**	0.912
					N	**89**	84
	Ndani ya mbegu za ubuyu	*Adansonia digitata* (baobab)	84	7	Correlation Coefficient	**-.210***	-0.120
					Sig. (2-tailed)	**0.049**	0.278
					N	**89**	84
Vegetable	Mlonge	*Moringa oleifera*	49		Correlation Coefficient	0.111	**.286****
					Sig. (2-tailed)	0.299	**0.008**
					N	89	**84**
Animal meat	Nungu, Nungunungu	(porcupine)	77		Correlation Coefficient	**-.245***	0.070
					Sig. (2-tailed)	**0.020**	0.528
					N	**89**	84

Note: Answers with fewer than 5 children eating are omited.
Bold* = Correlation is significant at the 0.05 level (2-tailed)
Bold** = Correlation is significant at the 0.01 level (2-tailed)
[+]Data with children "Not eating" are answers to given wild food; without is based on answers from respondents.

Factor analysis of Chinangali village excluding egg intake frequency was relevant with Kaiser-Meyer-Oikin (KMO) Measure of Sampling at 0.598 > 0.5. Bartlett's test of sphericity was statistically significant ($p < 0.001$). The factor analysis pattern matrix indicated four factors (Table 10.1). Factor 1 is the Milk pattern consuming milk frequently and, to some extent, food in general. Factor 2 is Wild food pattern consuming wild food frequently, but tubers and bananas infrequently. Factor 3 is the Meat & fruit pattern with infrequent intake of vegetables, and Factor 4 is the Sugar pattern with frequent intake of sugar and fish but infrequent intake of pulses.

Factor analysis excluding eggs of Malolo village was relevant with KMO Measure of Sampling at 0.518 > 0.5 and significant with Bartlett's Test of Sphericity ($p < 0.001$), indicating four patterns (Table 10.2). Factor 1 is the Oil pattern with frequent intake of oil and sugar. Factor 2 is the Fruit pattern with relatively frequent intake of fruits and infrequent intake of salt. Factor 3 is the Meat pattern with frequent intake of meat, milk, fish, and seeds. Factor 4 is the Pulse pattern with frequent intake of pulses. Factor 5 is Cereal pattern frequent intake of cereal and wild food. Factor 6 is the Food pattern with relatively frequent intake of food in general but infrequent intake of vegetables and tuber/bananas.

Factor analysis excluding eggs in Kijiweni village was relevant with KMO Measure of Sampling at 0.525 > 0.5 and significant with Bartlett's Test of Sphericity ($p = 0.005$). It provided five factors (Table 10.3). Factor 1 is the Fish pattern with frequent intake of fish and seeds. Factor 2 is the No milk pattern with a low intake of milk and fruits. Factor 3 is the Sugar pattern with a high intake of sugar and, to some extent, salt and tubers/bananas. Factor 4 is the Oil pattern with frequent consumption of oil and meat and, to some extent, wild food and food in general. Factor 5 is the Pulse pattern with frequent consumption of pulses but infrequent consumption of vegetables and cereals.

4 Correlation between food patterns and health problems

The correlation between the factor scores of each factor analysis of each village (Table 11) and health problems was analyzed (Table 11). In Chinangali (Table 11.1), Factor 2, Wild food intake pattern, is negatively correlated with

Table 10 Factor analysis pattern matrix of wild food and food group (excluding eggs) intake

Table 10.1 Chinagali village

Factor	1	2	3	4
Food group / Pattern	Milk	Wild food	Meat & fruits	Sugar
Milk	0.963	-0.244	-0.100	0.016
Food (general)	0.456	0.452	0.080	-0.088
Seeds	0.342	0.203	-0.294	0.190
Wild food	-0.024	**0.876**	-0.005	0.195
Tubers and bananas	-0.138	-0.785	0.191	0.184
Salt	-0.088	0.649	0.038	0.049
Cereals	-0.031	0.210	0.067	-0.047
Meat	-0.116	0.226	0.795	0.208
Fruits	0.133	0.135	0.705	-0.294
Vegetables	0.119	0.185	-0.567	-0.136
Sugar	0.441	0.013	0.295	0.634
Pulse	0.072	0.252	0.514	-0.623
Fish	-0.014	-0.121	0.061	0.475
Oil	-0.001	0.080	-0.023	0.294

Note: Rotation converged in 7 iterations.

Table 10.2 Malolo village

Factor	1	2	3	4	5	6
Food group / Pattern	Oil	Fruits	Meat	Pulse	Cereal	Food
Oil	0.999	-0.026	0.122	-0.117	0.165	0.030
Sugar	0.462	-0.042	-0.155	-0.023	-0.154	-0.143
Salt	0.172	-0.988	0.086	0.149	0.130	0.161
Fruits	0.103	0.327	0.105	0.194	0.066	0.119
Meat	-0.019	-0.115	0.754	-0.025	-0.090	-0.437
Milk	-0.009	0.047	0.670	-0.098	0.055	0.138
Fish	-0.026	0.113	0.435	0.069	-0.110	0.261
Seeds	0.052	0.060	0.377	0.337	-0.272	0.094
Pulse	-0.123	-0.033	-0.116	0.854	0.067	-0.110
Cereals	0.039	-0.072	-0.099	0.082	0.785	0.039
Wild food	-0.083	0.064	0.322	-0.084	**0.353**	-0.246
Vegetables	0.095	-0.100	0.044	0.204	-0.009	-0.536
Tubers and bananas	0.026	0.120	-0.050	0.017	0.064	-0.425
Food (general)	0.006	0.053	-0.007	0.073	0.017	0.300

Note: Rotation converged in 9 iterations.

Table 10.3 Kijiweni village

Factor	1	2	3	4	5
Food group / Pattern	Fish	No milk	Sugar	Oil	Pulse
Fish	0.979	0.011	0.213	-0.072	-0.029
Seeds	0.484	-0.021	-0.165	0.068	-0.030
Milk	-0.041	-0.953	0.074	0.236	-0.192
Fruits	0.018	-0.489	0.009	-0.048	0.073
Sugar	-0.024	-0.123	0.864	0.031	-0.111
Salt	0.420	0.061	0.478	-0.002	-0.075
Tubers and bananas	-0.027	-0.018	0.388	0.074	0.101
Oil	0.052	0.009	0.200	0.809	-0.144
Meat	0.040	-0.049	0.113	0.598	0.160
Wild food	-0.016	0.258	-0.123	**0.280**	-0.213
Food (general)	-0.038	-0.117	-0.149	0.248	-0.050
Vegetables	-0.011	0.147	0.022	0.101	-0.636
Cereals	0.210	-0.115	-0.124	0.004	-0.520
Pulse	0.314	-0.031	-0.304	0.321	0.518

Note: Rotation converged in 10 iterations.

Table 11 Correlation between health problems and factor scores without eggs (Table 8)

Table 11.1 Chinangali village

Factor			Stomachache	Diarrhea	Feel mad	Dizzy	Headache	Constipatioon	Can't see far away	No appetite	Problems waking up	Feel tired	Toothache	Don't feel like doing anything
1	Milk	Correlation	0.023	-0.176	-0.051	0.076	0.029	-0.192	-0.074	-0.114	0.076	-0.111	-0.048	-0.056
		Sig. (2-tailed)	0.842	0.132	0.661	0.515	0.807	0.117	0.527	0.354	0.519	0.346	0.683	0.630
		N	75	75	75	75	72	68	75	68	74	74	74	75
2	**Wild food**	Correlation	0.028	-0.041	0.105	0.135	0.036	-0.176	**-0.293***	**-0.275***	0.078	-0.109	-0.056	-0.045
		Sig. (2-tailed)	0.809	0.729	0.370	0.248	0.765	0.150	0.011	0.023	0.508	0.357	0.637	0.700
		N	75	75	75	75	72	68	75	68	74	74	74	75
3	Meat & fruits	Correlation	-0.109	-0.088	-0.068	0.088	0.043	0.033	-0.119	-0.070	0.095	-0.115	-0.154	0.009
		Sig. (2-tailed)	0.353	0.454	0.561	0.453	0.722	0.790	0.309	0.570	0.422	0.331	0.190	0.937
		N	75	75	75	75	72	68	75	68	74	74	74	75
4	Sugar	Correlation	-0.014	0.167	-0.127	0.026	-0.045	0.060	0.173	0.223	-0.136	-0.044	0.061	-0.175
		Sig. (2-tailed)	0.908	0.152	0.279	0.825	0.710	0.630	0.138	0.068	0.247	0.713	0.608	0.134
		N	75	75	75	75	72	68	75	68	74	74	74	75

Table 11.2 Malolo village

Factor			Stomachache	Diarrhea	Feel mad	Dizzy	Headache	Constipatioon	Can't see far away	No appetite	Problems waking up	Feel tired	Toothache	Don't feel like doing anything
1	Oil	Correlation	-0.055	0.079	-0.029	-0.011	-0.201	-0.176	-0.146	0.011	0.019	0.104	-0.145	-0.063
		Sig. (2-tailed)	0.661	0.541	0.820	0.932	0.113	0.165	0.265	0.930	0.884	0.417	0.264	0.619
		N	65	62	65	64	63	64	60	65	63	63	61	65
2	Fruits	Correlation	-0.023	0.070	0.184	0.201	-0.089	-0.081	-0.069	0.060	0.162	0.130	-0.135	0.123
		Sig. (2-tailed)	0.854	0.591	0.143	0.111	0.487	0.523	0.598	0.636	0.205	0.312	0.299	0.328
		N	65	62	65	64	63	64	60	65	63	63	61	65
3	Meat	Correlation	**0.244***	**0.290***	**0.217**	**0.272***	0.019	0.224	0.138	0.028	0.042	-0.054	**0.427****	0.187
		Sig. (2-tailed)	0.050	0.022	0.082	0.030	0.883	0.075	0.291	0.822	0.746	0.676	0.001	0.135
		N	65	62	65	64	63	64	60	65	63	63	61	65
4	Pulse	Correlation	0.029	-0.074	-0.018	0.197	-0.138	-0.132	-0.208	0.061	0.143	0.074	-0.004	0.009
		Sig. (2-tailed)	0.819	0.567	0.884	0.118	0.282	0.300	0.110	0.629	0.264	0.567	0.977	0.941
		N	65	62	65	64	63	64	60	65	63	63	61	65
5	**Cereal (wild food)**	Correlation	0.065	-0.124	-0.202	**-0.313***	-0.024	-0.010	-0.057	-0.196	**-0.318***	**-0.366****	-0.148	**-0.322****
		Sig. (2-tailed)	0.607	0.336	0.106	0.012	0.850	0.937	0.667	0.118	0.011	0.003	0.254	0.009
		N	65	62	65	64	63	64	60	65	63	63	61	65
6	Food	Correlation	-0.027	0.027	0.094	0.076	-0.068	0.087	-0.005	**0.279***	0.192	0.073	-0.018	0.172
		Sig. (2-tailed)	0.833	0.837	0.456	0.551	0.596	0.494	0.967	0.024	0.132	0.571	0.888	0.171
		N	65	62	65	64	63	64	60	65	63	63	61	65

Table 11.3 Kijiweni village

Factor			Stomachache	Diarrhea	Feel mad	Dizzy	Headache	Constipatioon	Can't see far away	No appetite	Problems waking up	Feel tired	Toothache	Don't feel like doing anything
1	Fish	Correlation	-0.063	0.105	-0.172	-0.138	-0.150	-0.226	-0.113	-0.242	-0.138	0.044	-0.110	-0.148
		Sig. (2-tailed)	0.641	0.436	0.217	0.311	0.269	0.094	0.405	0.070	0.314	0.747	0.416	0.280
		N	57	57	53	56	56	56	57	57	55	57	57	55
2	No muilk	Correlation	-0.004	-0.107	0.012	-0.082	0.111	0.059	-0.010	**-0.266***	-0.003	0.005	-0.240	0.137
		Sig. (2-tailed)	0.976	0.426	0.935	0.547	0.416	0.668	0.940	0.045	0.983	0.968	0.073	0.320
		N	57	57	53	56	56	56	57	57	55	57	57	55
3	Sugar	Correlation	-0.114	-0.017	-0.006	0.045	-0.136	0.054	0.165	0.234	0.166	0.007	-0.016	-0.040
		Sig. (2-tailed)	0.398	0.898	0.964	0.741	0.317	0.690	0.219	0.080	0.226	0.957	0.904	0.771
		N	57	57	53	56	56	56	57	57	55	57	57	55
4	**Oil (wild food)**	Correlation	-0.069	-0.099	-0.163	-0.220	-0.163	-0.185	-0.036	-0.194	**-0.308***	-0.087	0.047	**-0.288***
		Sig. (2-tailed)	0.609	0.465	0.245	0.103	0.229	0.171	0.789	0.148	0.022	0.520	0.728	0.033
		N	57	57	53	56	56	56	57	57	55	57	57	55
5	Pulse	Correlation	**0.286***	0.244	0.262	**0.459****	-0.127	0.257	0.229	**0.308***	0.223	0.089	**0.375****	**0.463****
		Sig. (2-tailed)	0.031	0.068	0.058	0.000	0.351	0.056	0.087	0.020	0.101	0.512	0.004	0.000
		N	57	57	53	56	56	56	57	57	55	57	57	55

Bold = Correlation with wild food intake; **Bold*** = Correlation is significant at the 0.05 level (2-tailed); **Bold**** = Correlation is significant at the 0.01 level (2-tailed)

Can't see far away (p = 0.011) and No appetite (p = 0.023).

In Malolo (Table 11.2), Factor 5, the Cereal pattern including relatively frequent intake of wild food, had a negative correlation with Feeling tired (p = 0.003), Don't feel like doing anything (p = 0.009), and Problems waking up (p = 0.011). Factor 3, the Meat pattern, has a positive correlation with various health problems. Factor 6, the Food pattern, has a positive correlation with No appetite.

In Kijiweni (Table 11.3), Factor 4, the Oil pattern, including relatively frequent intake of wild food, had a negative correlation with Problems waking up (p = 0.022) and Don't feel like doing anything (p = 0.033). Factor 5, the Pulse pattern, has a positive correlation with various health problems. Factor 2, the No milk pattern, has a negative correlation with No appetite.

Discussion and Conclusion

The research confirmed that children ate wild food frequently, as indicated in previous studies in other parts of Africa (Shackleton et al. 2002). However, their frequency differed among villages; the most is in Kijiweni village on the coastal Lindi region almost on a daily basis, followed by Malolo village in the inland Lindi region, and the least is in semi-arid Chinangali village. This trend between the villages was the same as that of adults in the same villages (Sakamoto et al. 2021b).

According to correlation analysis, children's wild food intake frequency and health problems such as Stomachache, Diarrhea, Feeling mad, being Dizzy, and Headache is positively related, and Constipation was negatively related. The relation was strongest in Stomachache, and children who frequently eat wild food had more Stomachaches, along with Diarrhea, Feeling mad, being Dizzy, and Headaches. On the other hand, children who had eaten wild food frequently had less Constipation. Wild food may induce stomachaches related to diarrhea but prevent constipation.

In Chinangali, wild fruits *Cissus welwitschii* and wild vegetables *Bidens pilosa* and *Ipomoea* sp. intake may prevent children from developing constipation. Children who consumed wild food frequently did not frequently consume tubers/bananas (Table 11.1). Commonly consumed wild food is edible weeds (Sakamoto et al. 2021b, p.99), which are typically taken as sticky relish (Mlenda in Swahili) with stiff porridge (Ugali in Swahili) of cereals such as sorghum, millet, or maize. Some common examples mentioned by children are Muhilili (*Cleome hirta*) by 100% in both seasons and Chipali (97.5% in the dry season) / Sagula sagula (98.8% in the dry season) (*Ipomoea mombassana, I. obscura*). The food pattern is most likely an indication that edible weeds are not utilized as relish for tubers or bananas.

Intake of wild edible weeds has been evaluated as positively influencing health in previous research on adults (Sakamoto et al. 2021b) with high iron and calcium contents (Sakamoto et al. 2022a). Correlation with the factor scores health problems in this research (Table 11.1) also implied that children with a food pattern with frequent intake of wild food can see far away and have an appetite. The appetite can be related to a healthy diet, as mentioned above. On the other hand, those who can see far away may be able to spot wild fruits and wild animals.

In Malolo, wild tuber *Tacca leontopetaloides* and baboon may be one of the reasons for children's diarrhea. Toxic tuber *T. leontopetaloides* is usually treated to detoxify the poison, but their treatment may not be sufficient. There were varieties of fruits and tubers that may prevent children from constipation (*Strychnos innocua, Uvaria* sp., *Parinari curatellifolia,* and *Macrotyloma axillare*) and diarrhea (*Dioscorea hirtiflora* subsp. *orientalis* and *Dioscorea* sp.).

In Malolo, children who consumed wild food relatively frequently consumed cereals (Table 10.2). Many children drew wild mushrooms and mentioned a variety of wild animals, insects, and vegetables in the same questionnaire as well as fruits (Sakamoto et al. 2023b). Many wild foods may be eaten as relish to *ugali*.

Correlation with factor scores and health problems indicated that fewer children who had a diet with relatively frequent intake of wild food felt tired, did not feel like doing anything, had problems waking up, or became dizzy (Table 11.2). Analysis of adults also indicated that those who frequently consume wild food have high self-evaluation of physical function (Sakamoto et al. 2021b). However, since wild food is distributed widely in the forest away from the residents in this village, the situation may be that children who are active can collect and eat wild food, as similarly mentioned in the analysis of adults.

In Kijiweni, wild fruits *Mimusops fruticosa*, wild seeds *Rhodognaphalon schumannianum* and/or *Adansonia digitata,* and meat of porcupine may prevent children from diarrhea. Children with relatively frequent wild food consumption took oil and meat frequently as well (Table 10.3). It is commonly perceived that the consumption of meat and oil is associated with wealth and wild food and *vice versa.* However, the combination of food consumption patterns indicates otherwise, and this may be related to the availability of wild fruits in residential areas (Sakamoto et al. 2023b) and that children can obtain and eat wild food regardless of their health situation.

According to the correlation with factor scores and health problems, children with the above food pattern with frequent intake of oil and relatively frequent intake of wild food have fewer problems waking up in the morning or not feeling like doing anything (Table 11.3). The association may be related to oil intake, meat intake, or wild food intake.

Limitations and Future Research

While this analysis provided possibilities of a few relationships between wild food intake and health and provided hints for areas to further investigate, it has not provided complete evidence to indicate the implications of wild food intake due to the following limitations.

Children's health situations were asked as problems; therefore, negative aspects of their health are highlighted. It may be difficult to capture the positive effects of wild food on children's health based on health problems. The analysis does not indicate causal relationships either.

The questions are based on frequency and do not take into account the amount. This has not been included in the data collection to avoid confusion.

Food intake frequency depends on children's memory; therefore, their self-evaluation of the frequency may not be precise. This is part of the reason that this analysis was done only for the dry season and not utilizing frequency data of the rainy seasons.

The analysis is limited to the food intake and health situation in the dry season; therefore, additional analysis of the rainy season is necessary to understand their situation for the whole year. Data from the rainy season were collected. Analysis is planned for the dry season and for a larger data set to understand the influence of wild food intake on children's health in the future.

Role of Authors and Acknowledgment

Sakamoto is responsible for writing the initial manuscript, editing and confirming the final manuscript, overall conceptualization, data collection, final questionnaire data input check, and supervision of data analysis. Hitomi has done the data insert for Kijiweni, data check for parts of Malolo, data analysis and its conceptualization, and edited the manuscript. Kikuchi coordinated and checked the data insert, checked the data and reference agreement of the manuscript, and confirmed the manuscript. Ohmori provided conceptualization for children's health evaluation and food intake frequency, checked the data analysis, and confirmed the manuscript. Maro coordinated and led the field work and data collection from schools in Lindi. Chimosa coordinated and collected the data from the schools in Dodoma. All authors have confirmed and agreed with the final manuscript.

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[1] The indicators for health problems and factor indicating food patterns are capitalized.

[2] The term "species" has been used but not all wild food has been identified at the species level.

References

Crittenden, Alyssa N., John Sorrentino, Sheniz A. Moonie, Mika Peterson, Audax Mabulla, & Peter S. Ungar (2017) "Oral Health in Transition: The Hadza Foragers of Tanzania," *PLoS ONE,* vol.12, no.3. https://doi.org/10.1371/journal.pone.0172197 (21 May 2023)

Glew, Robert S., Dorothy Vanderjagt, Yung-Sheng Huang, Lu-Te Chuang, Robert Bosse, & Robert Glew (2004) "Nutritional Analysis of the Edible Pit of *Sclerocarya birrea* in the Republic of Niger (Dandiya, Hausa)," *Journal of Food Composition and Analysis,* vol.17, no.1, pp.99-111. https://doi.org/10.1016/S0889-1575(03)00101-7 (21 May 2023)

Koffi, Constance K., Alissia Lourme-Ruiz, Houria Djoudi, Emilie Bouquet, Sandrine Dury, & Denis Gautier (2020) "The Contributions of Wild Tree Resources to Food and Nutrition Security in Sub-Saharan African Drylands: A review of the Pathways and Beneficiaries," *International Forestry Review*, vol.22, no.1, pp.64-82.

Masao, Catherine A., John Igoli, & Emma T. Liwenga (2023) "Relevance of Neglected and Underutilized Plants for Climate Change Adaptation & Conservation Implications in Semi-arid Regions of Tanzania," *Environmental Management*, vol.71, no.1, pp.114-130. https://doi.org/10.1007/s00267-022-01656-1 (21 May 2023)

Maseko, Heather, Charlie M. Shackleton, Joseph Nagoli, & Deepa Pullanikkati (2017) "Children and Wild Foods in the Context of Deforestation in Rural Malawi," *Hum Ecol,* vol.45, pp.795-807. https://doi.org/10.1007/s10745-017-9956-8 (21 May 2023)

Mbhenyane, Gertrude X., Bertrand A. Tambe, A. Phooko-Rabodiba, & Cebisa N. Nesamvuni (2020) "Dietary Pattern, Household Hunger, Coping Strategies, and Nutritional Status of Children in Sekhukhune District of Limpopo Province, South Africa," *African Journal of Food, Agriculture, Nutrition and Development*, vol.20, no.2, pp.15821-15836. https://doi.org/10.18697/AJFAND.91.18630 (21 May 2023)

McGarry, Dylan K. & Charlie M. Shackleton (2009) "Children Navigating Rural Poverty: Rural Children's Use of Wild Resources to Counteract Food Insecurity in the Eastern Cape, South Africa," *Journal of Children and Poverty,* vol.15, no.1, pp.19-37. https://doi.org/10.1080/10796120802677594 (21 May 2023)

Mizoguchi Keiko, Takemi Yukari, & Adachi Miyuki (2004) "Relationship Between Positive Perception toward Work and the Dietary Habits of Young Male Workers," *The Japanese Journal of Nutrition and Dietetics,* vol.62, no.5, pp.269-283. https://www.jstage.jst.go.jp/article/eiyogakuzashi1941/62/5/62_5_269/_article/-char/en (21 May 2023)

Oduor, Francis O., Julia Boedecker, Gina Kennedy, & Celine Termote (2019) "Exploring Agrobiodiversity for Nutrition: Household On-Farm Agrobiodiversity is Associated with Improved Quality of the Diet of Young Children in Vihiga, Kenya," *PLoS ONE,* vol.14, no.8. https://doi.org/10.1371/journal.pone.0219680 (21 May 2023)

Pollom, Trevor R., Chad L. Cross, N. Kristen, Ford Elle Herlosky, & Alyssa N. Crittenden, (2021) "Effects of a Mixed-Subsistence Diet on the Growth of Hadza Children," *American Journal of Human Biology,* vol.33, no.1. https://doi.org/10.1002/ajhb.23455 (21 May 2023)

Powell, Bronwen, Patrick Maundu, Harriet V. Kuhnlein, & Timothy Johns (2013) "Wild Foods from Farm and Forest in the East Usambara Mountains, Tanzania," *Ecology of Food and Nutrition,* vol.52, no.6, pp.451-478. https://doi.org/10.1080/03670244.2013.768122 (27 May 2023)

Sakamoto Kumiko, Ohmori Reiko, & Tsuda Katsunori (2021b) "Correlation Between Intake of Wild Food and Health in 3 Areas of Tanzania: Analysis from Semi-Arid Central and Inland/Coastal Southeast," *Journal of International Development Studies*, vol.30, no.2, pp. 93-112.

Sakamoto Kumiko, Kaale Lilian, & Ohmori Reiko (2022a) "Nutrient Content of Seven African Wild Leafy Vegetables in Semi-arid Tanzania," *Journal of International Development Studies, Utsunomiya University*, no.54, pp.17-28. http://hdl.handle.net/10241/00013538 (27 May 2023)

Sakamoto Kumiko, Eugenia Kafanabo, Eliud Kabelege, Ohmori Reiko, Kikuchi Yukiko, & Tsuda Katsunori

(2022b) "Is Wild Food Utilized by Primary School Children in Urban and Semi-urban Areas of Tanzania? In Relation to Their Diet and Health from a Survey in Dar es Salaam and Pwani Regions," *Journal of International Development Studies, Utsunomiya University*, no.55, pp.1-14. http://hdl.handle.net/10241/00013552 (27 May 2023)

Sakamoto Kumiko, Frank M. Mbago, & Hayashi Masayuki (2023a) *Field Guide to Edible Plants and its Nutrition in Tanzania: Focusing on Dodoma and Lindi*, Center for the Multicultural Public Sphere (CMPS).

Sakamoto Kumiko, Hitomi Toshiki, Kikuchi Yukiko, Kabuta Masahiko, Ohomori Reiko, Anna C. Maro, Tsuda Katsunori, & Frank Mbago (2023b) "Wild Food Intake and Recognition of Children in Tanzania: From Analysis of Questionnaires Comparison with Adults and Pictures of Inland and Coastal Southeast," The 60th Annual Conference (13-14 May, 2023, Makuhari International Training Center, Chiba), p.144 https://conference.african-studies.com/summary.html (27 May 2023)

Shackleton, Sheona E., Charlie M. Shackleton, Thiambi R. Netshiluvhi, B. S. Geach, A. Balance, & Dean Fairbanks (2002) "Use Patterns and Value of Savanna Resources in Three Rural Villages in South Africa," *Economic Botany,* vol.56, no.2, pp.130-146. http://www.jstor.org/stable/4256547 (27 May 2023)

Stuetz, Wolfgang, Victoria Gowele, Joyce Kinabo, Nyamizi Bundala, Hadijah Mbwana, Constance Rybak, Laila Eleraky, Christine Lambert, & Hans Konrad Biesalski (2019) "Consumption of Dark Green Leafy Vegetables Predicts Vitamin A and Iron Intake and Status among Female Small-scale Farmers in Tanzania," *Nutrient*s, vol.11, no.5, p.1025. https://doi.org/10.3390/nu11051025 (27 May 2023)

Tanzania, United Republic of (2015) *Mortality and Health.* Dar es Salaam: Ministry of Finance & Office of Chief Government Statistician, Ministry of State, President Office, State House & Good Governance. www.nbs.go.tz/nbs/takwimu/census2012/Mortality_and_Health_Monograph.pdf (27 March 2016).

Tanzania, Government of the United Republic of, University of Dodoma, development partners & UNICEF (2018) *Tanzania National Nutrition Survey using SMART Methodology (TNNS) 2018.* Dar es Salaam: MoHCDGEC, MoH, TFNC, NBS, OCGS, UNICEF. https://www.unicef.org/tanzania/reports/tanzania-national-nutrition-survey-2018 (18 Sept 2016).

Tsunoda Nobuyo, Inayama Takayo, Hata Kikuko, & Oka Jun (2015) "Vegetable Dishes, Dairy Products, and Fruits are Key Items Mediating Adequate Dietary Intake for Japanese Adults with Spinal Cord Injury," *Spinal Cord,* no.53, pp.78-790. https://www.ncbi.nlm.nih.gov/pubmed/25962372 (27 May 2023)

Tsushima Eiki (2015) *SPSS de manabu iryoukei taihenryou deta kaiseki* (Learning medical multivariate regression analysis with SPSS in Japanese)*,* Tokyo Tosho.

Preliminary Analysis of Wild Food Intake and Health Among School Children in Central and Southeast Inland/Coast Tanzania: The Cases of Chinangali, Malolo, and Kijiweni Villages

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Abstract

Wild foods are important sources of nutrition in Africa, but studies on the relationships between wild food intake and children's health are limited. The research villages, Chinangali in Dodoma region, central Tanzania, and Malolo (inland) and Kijiweni (coastal) in Lindi region, southeast Tanzania, were selected based on their resilience by utilizing wild foods despite their food deficits. Wild food and food group intake frequency and health were captured by questionnaires in September 2022 with 85 school children in Malolo, 91 in Kijiweni, and 80 in Chinangali. Relationships between children's wild food / food group intake in the dry season and health problems were analyzed through correlation (Spearman), relationships between wild food species and specific health problems (diarrhea and constipation) were analyzed through correlation (Spearman), dietary patterns including wild food intake were analyzed by factor analysis, and factor scores were correlated with health problems.

Children ate wild foods more frequently than adults. With frequency scores from 0 (do not eat) to 4 (every day), children in Chinangali ate wild foods on average 1.11 ± 0.50, less than children in Malolo (2.71 ± 1.24) and Kijiweni (3.55 ± 0.79), similar to adults. Analysis indicated that in Chinangali, children frequently eating wild foods infrequently ate tuber/bananas and/or tended to have a good appetite and can see far away. Those who ate *Cissus welwitschii* fruit, and/or *Bidens pilosa* and/or *Ipomoea* sp. vegetables tended not to have constipation. In Malolo, children who frequently ate cereals also frequently ate wild food. They tended not to have problems of feeling tired, not feeling like doing anything, or waking up. Those who ate toxic *Tacca leontopetaloides* tended to have diarrhea. Those who ate *Strychnos innocua, Uvaria* sp., and/or *Parinari curatellifolia* fruits and/or *Macrotyloma axillare* tuber tended not to have constipation. In Kijiweni, children who took oil and ate meat frequently also ate wild food relatively frequently. They tended not to have problems waking up or not feeling like doing anything. Those who ate *Rhodognaphalon schumannianum* and/or *Adansonia digitata* nuts tended not to have diarrhea. Further research and analysis are necessary to understand the causal relationship, the situation in the rainy season, and the situation in other locations.

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