Children's Wild Edible Food Preferences and Health Influences in Semiarid Tanzania:

Preliminary Analysis with a Focus on Diarrhea and Constipation

School of International Studies, Utsunomiya University SAKAMOTO Kumiko
Research Assistant, Dodoma Region, Tanzania Michael CHIMOSA
School of International Studies, Utsunomiya University HITOMI Toshiki
Research Supporter KIKUCHI Yukiko
Botanist, Dar es Salaam, Tanzania Frank MBAGO
Professor, School of Regional Design, Utsunomiya University OHMORI Reiko

Abstract

The article investigated the wild food health influences and preferences of children in semiarid Tanzania through a questionnaire administered to 400 pupils in five schools and four focus group discussions. Correlations between the intake of specific wild food and symptoms (diarrhea/constipation) were analyzed from the questionnaire data, and symptom experiences and wild food preferences were collected through groups. Matembele pori (*Ipomoea* sp.) was negatively correlated with constipation (coefficient of -0.251, $p < 0.000$) and positively correlated with diarrhea (0.181, $p < 0.000$), and confirmed by one experience of diarrhea by a child in Manzilanzi. *Ipomoea* sp. has high contents of iron, calcium, and fiber, which is beneficial, but excessive intake of fiber may require caution. The baobab kernel, Ngwelu/Mkole (*Grewia* sp.), Mfulu (*Vitex payos*), and Mdawi (*Cordia sinensis*) intake is negatively correlated with diarrhea, but contrary diarrhea from excessive intake of Mfulu was also reported by a child in Majeleko. Mtumba (*Boscia coriacea*) intake is correlated with diarrhea, although this correlation has not been reported in children. This article highlights the potentials, but the results are not conclusive and invite further research to understand the functions of these wild foods.

Introduction

1 Importance of wild food intake by children

The reliability of cultivated crops in semiarid areas is limited, and wild foods have great potential to supplement food in these areas. Previous research has also described the contribution of wild food intake in dry lands (Koffi et al. 2020) and semiarid Tanzania (Masao et al. 2023).

Differences between children and adults have also been articulated in previous research in Tanzania. Mothers consumed less wild food in the dry season, but children did not show any decrease since they ate more wild fruits that were ripe in the dry season (Powell et al. 2013). A study in Niger indicated that only children ate the nutritious pit of *Sclerocarya birrea* (Glew et al. 2004). Children's wild food intake is important and needs to be understood differently from that of adults.

A study in Malawi indicated that children in least deforested sites listed more wild foods (Maseko et al. 2017). Furthermore, the consumption and avoidance of wild food are decided based on commonality, contribution to health, limited

alternatives, hunger, availability, and local taboos.

Children at the age of primary school children are at a transition stage from being fed by family to independently obtaining food on their own. Going to school also increases their access to a variety of food, including wild food. In addition to their pro-activeness, they also retain some vulnerability. Within the context of eliminating global hunger as part of the SDGs in the mist of changing food patterns and the potential contribution of wild food to health（Sakamoto et al. 2023a）, it is also important to understand children's wild food intake and preferences so that wild food can play a positive role in their daily lives. One objective of this article will be to clarify the preferences for wild food among children in semiarid Tanzania.

2 Contribution of wild food intake

Previous research has indicated that wild foods play a substantive role in children's nutritional status. Research in South Africa indicated that 62% of children had supplemented their nutrition with wild food, 30% had supplemented their nutrition with half of the food, and 13% had increased diversity with wild food（McGarry et al. 2009）. Research in the East Usambara Mountains of Tanzania indicated that mothers and children consume wild food, which contributes to vitamin A（31%）, vitamin C（20%）, and iron（19%）（Powell et al. 2013, p.466）.

Research in semiarid（Chinagali village）, inland（Malolo village）, and coastal（Kijiweni village）areas of Tanzania showed various utilizations of wild food by adults. Relationships between wild food intake frequency and health evaluations were identified in the three villages in Tanzania; these evaluations were positively related to subjective health perceptions in inland villages, including semiarid Chinangali（elaborated in Sakamoto et al. 2020）, but negatively related in a coastal village（Sakamoto et al. 2021; Sakamoto et al. 2023a）.

Further preliminary analysis of children in the same villages indicated mixed correlations between wild food intake and various health problems, including diarrhea and constipation（Sakamoto et al. 2023b）. Furthermore, comparisons of five primary schools in the semiarid Dodoma indicated that children who had more access to wild food in remote areas generally had better health evaluations（Sakamoto et al. in press）. The second objective of the article will be to further articulate the relationship between wild food species intake and health problems（diarrhea and consumption）with a larger dataset with a focus on semiarid Tanzania.

3 Research area and methods

The research targets are the above five primary schools in semiarid Tanzania, located in Chamwino district, Dodoma region of central Tanzania: Manzilanzi and Mbelezungu primary schools in Mbelezungu village, Majeleko primary school in Majeleko village, and Mahata and Chinangali primary schools in Chinangali II village.

To obtain general quantitative information about wild food intake among children in the area, pupils in the five schools, mainly in grades V and VI, were invited to participate in the questionnaire on 26, 27, 28, 29 September 2022, 80 to 100 pupils each. As a result, a total of 400 pupils（80 from each school）participated —166 boys（41.5%）, 230（57.5%）girls, and 4 no answer. Seven pupils（1.7%）were in Grade III, 43（10.8%）were in Grade VI, 162（40.5%）were in Grade V, and 187（46.8%）were in Grade VI.

Details of the methodology and research area, along with the preliminary results, have been compiled in Sakamoto et al.（in press）. According to the results, Manzilanzi, followed by Mbelezungu,

had the highest intake frequency of wild food in the remote areas, whereas Mahata and Chinangali had lower frequencies. As noted in the article previously, schools with a higher frequency of wild food had better health evaluations.

Among the questions in the questionnaire, this article analyses the association between specific wild food intake and apparent health symptoms, namely, diarrhea and constipation. For children's health, the *Health Examination Manual for Children of the Japan School Health Association and the Survey Manual for the Report on Dietary Information of Pupils* were referred to, and 3 points were given for "always," 2 points for "often," 1 point for "rarely," and 0 points for "never." Correlation analysis (Spearman) was implemented between specific wild food species intake and health symptoms (diarrhea and constipation). All the statistical analyses were performed using IBM SPSS (version 25).

To understand children's preferences and experiences related to wild food intake, participatory focus group discussions on wild food were held in Manzilanzi (8 children), Mbelezungu (5 children), Majeleko (7 children), and Chinangali (4 children) on 22, 23, and 24 August 2023 in the same villages in Chamwino district, Dodoma region. The participants were not limited to pupils who participated in the questionnaire, and areas with higher wild food intake were emphasized. The priorities were in the following order: Manzilanzi and Mbelezungu in Mbelezungu village, Majeleko village, and Chinangali II village. Discussions were held on their favorite wild food, wild food that they could obtain in large quantities, and wild food for hunger.

The intake of wild food species, which was significantly positively correlated with symptoms (diarrhea and constipation), was assessed if participants experienced these symptoms. Participants were not systemalically asked about negative correlations since it is difficult to self-evaluate whether intake of wild food has prevented diarrhea or constipation.

l Correlation between wild food variety and health symptoms

According to the questionnaire, the pupils ate varieties of wild food. Among the mentioned wild foods (Sakamoto et al. in press), wild food with fewer than five pupils eating it or domesticated food was omitted. As a result, a total of 44 wild foods were analyzed for their ability to prevent symptoms. As indicated in Table 1, 17 fruits, 2 seeds, 18 vegetables, 6 animals, and 1 insect were analyzed.

Table 2 shows the correlations between wild food intake variety and symptoms of diarrhea and constipation. Among the fruits, seven wild fruits, namely, Ngwelu, Mfulu, Mtundwe, Mkole, Mdawi, Msaka, and Teratera, exhibited a statistically significant negative correlation with diarrhea. Although correlation analysis does not reveal a causal relationship (as in all the following implications), it is possible that the intake of these fruits prevents diarrhea. On the other hand, three fruits (Mtumba, Mzabibu pori, and Mdachi) were significantly positively correlated with diarrhea, and two fruits (Mtumba and Mzabibu pori) were significantly negatively correlated with constipation. The intake of these two fruits may prevent constipation, but the three fruits may induce diarrhea. Among the fruits, the correlation coefficient was greatest for Mtumba and constipation (-0.212, $p < 0.000$).

Among the wild seeds, the baobab kernel and diarrhea incidence were significantly negatively correlated. Baobab kernel may have a positive effect on preventing diarrhea.

Table 1 Wild foods analyzed

Group	# Local name	*Scientific name* (English)	Dry season (n=400)	
Fruit	1 Ubuyu	*Adansonia digitata* (baobab)	375	93.8%
	2 Ngwelu	*Grewia sp. Nov.*	352	88.0%
	3 Mtafuta	*Grewia burtii, G. similis*	348	87.0%
	4 Mfulu	*Vitex payos*	335	83.8%
	5 Mperemehe	*Grewia flavescens*	342	85.5%
	6 Mtundwe	*Ximenia americana*	313	78.3%
	7 Mkole	*Grewia bicolor*	310	77.5%
	8 Mdawi	*Cordia sinensis*	319	79.8%
	9 Msaka	*Maerua edulis*	300	75.0%
	10 Teratera	*Opuntia ficus-indica*	234	58.5%
	11 Mtumba	*Boscia coriacea*	223	55.8%
	12 Mzabibu pori	*Cissus welcitschii* (wild grapes)	145	36.3%
	13 Msena	*Cordia ovalis*	129	32.3%
	14 Mpokore	*Grewia sp.*	47	11.8%
	15 Mkwambe	*Cordia goetzei*	44	11.0%
	16 Mdachi	*Commiphora ugogensis*	37	9.3%
	17 Ngangaula	*Cordyla africana*	31	7.8%
Seeds	1 Ndani ya mbegu za ubuyu	*Adansonia digitata* (baobab kernel)	239	59.8%
	2 Ifungo	*Dactyloctenium giganteum*	58	14.5%
Vegetables	1 Muhilile	*Cleome hirta*	360	90.0%
	2 Sagula sagula	*Ipomoea obscura*	346	86.5%
	3 Mzole	*Corchorus olitorius*	322	80.5%
	4 Mtulu	*Opilia celtidifolia*	300	75.0%
	5 Maweza	*Ipomoea sinensis*	291	72.8%
	6 Chapali	*Ipomoea obscura*	254	63.5%
	7 Matembele pori	*Ipomoea sp.*	235	58.8%
	8 Feune	*Amaranthus gracizans*	249	62.3%
	9 Mnafu	*Solanum nigrum*	222	55.5%
	10 **Mlenda batata**, Ilende, Mgulu	*Ceratotheca sesamoides*	219	54.8%
	11 **Mlenda wima**, Mzinze	*Sesamum augustifolim*	152	38.0%
	12 Chunga	*Launaea cornuta*	129	32.3%
	13 Mtango pori	*Cucumis dipsaceus*	136	34.0%
	14 Mshona nguo	*Bidens pilosa*	62	15.5%
	15 Kandajizi	*Waltheria indica*	54	13.5%
	16 **Mgagani**, Mzimwe	*Cleome gynandra*	50	12.5%
	17 Mtimba mwisi	*Alternathera sessils*	31	7.8%
	18 Mgomwa, Mgomwe, Ingomwe	*Commiphora* sp.	15	3.8%
Animals and insects	1 Ndege	(bird)	369	92.3%
	2 Kanga	(Guinea fowl)	363	90.8%
	3 Sungura	(rabbit)	347	86.8%
	4 Ng'onde, Dikidiki	(dik-dik)	198	49.5%
	5 Swala	(gazelle)	189	47.3%
	6 Kumbikumbi	(flying ants)	122	30.5%
	7 Mbawala	(bushbuck)	45	11.3%

Count per group

Among the wild vegetables, 10 vegetables, namely, Muhilile, Sagula sagula, Mzole, Mtulu, Maweza, Chapali, Feune, Mnafu, Mlenda batata, and Chungu was negatively significantly correlated with diarrhea. These vegetables may assist in preventing diarrhea. Among the wild vegetables, Mnafu had the highest correlation with diarrhea (-0.220, $p < 0.000$). Furthermore, Chungu and Mlenda wima had a significantly positive correlation with constipation, which may imply that they provoke constipation.

On the other hand, four wild vegetables, Matembele pori, Mtango pori, Kandijizi, and Mtimba mwisi, were significantly positively correlated with diarrhea. These vegetables may induce diarrhea.

Table 2 Correlations between wild food intake and health symptoms

Group	#	Local (or English) name	Diarrhea (n=386) Correlation Coefficient	Sig. (2-tailed)	Constipation (n=370) Correlation Coefficient	Sig. (2-tailed)	Possible implication***
Fruits	2	Ngwelu	**-.157****	**0.002**	-0.081	0.120	
	4	Mfulu	**-.153****	**0.003**	-0.061	0.244	
	6	Mtundwe	**-.121***	**0.018**	-0.062	0.231	
	7	Mkole	**-.101***	**0.047**	0.042	0.417	May prevent dirrhea
	8	Mdawi	**-.109***	**0.033**	0.024	0.644	
	9	Msaka	**-.147****	**0.004**	0.085	0.102	
	10	Teratera	**-.172****	**0.001**	0.023	0.655	
	11	Mtumba	**0.177****	**0.000**	**-.212****	**0.000**	May cause diarrhea, but may prevent constipation
	12	Mzabibu pori	**0.154****	**0.002**	**-.120***	**0.021**	
	16	Mdachi	**0.105***	**0.039**	-0.018	0.731	May cause dirrhea
	1	(baobab)	0.024	0.645	-0.016	0.761	
	3	Mtafuta	-0.096	0.059	-0.018	0.723	
	5	Mperemehe	-0.065	0.201	0.006	0.908	
	13	Msena	0.047	0.355	-0.091	0.080	
	14	Mpokore	0.020	0.689	-0.060	0.253	
	15	Mkwambe	0.081	0.112	-0.092	0.077	
	17	Ngangaula	0.039	0.448	-0.056	0.281	
Seeds	1	Ndani ya mbegu za ubuyu	**-.165****	**0.001**	0.011	0.826	May prevent dirrhea
	2	Ifungo	0.030	0.556	-0.008	0.881	
Vegetables	1	Muhilile	**-.141****	**0.005**	-0.063	0.229	
	2	Sagula sagula	**-.120***	**0.018**	-0.003	0.961	
	3	Mzole	**-.113***	**0.026**	-0.001	0.982	
	4	Mtulu	**-.197****	**0.000**	0.055	0.291	
	5	Maweza	**-.108***	**0.034**	0.068	0.191	May prevent dirrhea
	6	Chapali	**-.103***	**0.042**	0.092	0.078	
	8	Feune	**-.153****	**0.003**	0.079	0.128	
	9	Mnafu	**-.220****	**0.000**	0.054	0.296	
	10	Mlenda batata	**-.113***	**0.027**	-0.019	0.722	
	12	Chunga	**-.194****	**0.000**	**0.150****	**0.004**	May prevent dirrhea, but may cause constipation
	11	Mlenda wima	-0.082	0.107	**0.134****	**0.010**	May cause constipation
	7	Matembele pori	**0.181****	**0.000**	**-.251****	**0.000**	May cause diarrea, but prevent constipation
	13	Mtango pori	**0.106***	**0.038**	**-.117***	**0.024**	
	15	Kandajizi	**0.126***	**0.013**	-0.002	0.971	May cause dirrhea
	17	Mtimba mwisi	**0.113***	**0.026**	0.025	0.633	
	14	Mshona nguo	0.098	0.055	-0.010	0.850	
	16	Mgagani	0.099	0.052	-0.035	0.499	
Animals and insects	3	(rabbit)	**-.105***	**0.039**	**0.111***	**0.032**	May prevent dirrhea, but may cause constipation
	4	(dik-dik)	**-.223****	**0.000**	**0.107***	**0.039**	
	6	(flying ants)	**-.237****	**0.000**	**0.118***	**0.023**	
	5	(swala)	-0.063	0.217	**-.145****	**0.005**	May prevent constipation
	1	(bird)	-0.003	0.948	0.035	0.497	
	2	(Guinea fowl)	-0.045	0.380	-0.011	0.830	
	7	(bushbuck)	-0.008	0.874	-0.049	0.349	

Count in Table 1; ** Bold: Correlations is significant at 0.01 level (2-tailed); *Bold: Correlations is significant at 0.05 level (2-tailed)
*** Correlation analysis does not prove a causal relationship.

Moreover, Matembele pori and Mtango pori were negatively correlated with constipation, suggesting the possibility of preventing constipation. Matembele pori was most strongly correlated with constipation (-0.251, $p < 0.000$).

The intake of two wild animals and one insect — rabbit, dik-dik, and flying ant — was significantly negatively correlated with diarrhea and was significantly positively correlated with constipation. Eating rabbits, dik-dik, and flying ants may prevent diarrhea but may provoke constipation. Among the animals and insects, flying ants had the highest correlation coefficient (-0.237, $p < 0.00$), followed by dik-dik (-0.223, $p < 0.000$). The intake of gazelles was significantly negatively correlated with constipation.

Ⅱ Reported negative health symptoms upon eating a wild food variety

In the focus group discussions, after confirming consumption, experiences of diarrhea/constipation upon eating the wild food varieties that were positively correlated with diarrhea/constipation were asked. The results are indicated in Table 3.

The only experience among the correlated wild foods was one child in Manzilanzi who experienced diarrhea after eating Matembele pori vegetables. Although significant correlations were not detected, one child in Majeleko shared the experience of diarrhea after eating too much Mfulu fruit since it is so tasty. Another child in Chinangali reported experiencing diarrhea after eating the Mzole vegetable.

Ⅲ Preferences and evaluation of wild food varieties

Table 4 indicates the preference ranking of wild food from their focus group discussions. All the wild foods listed were fruits.

All the groups listed Mtafuta, Mfulu, and Ngwelu as their favorite wild foods, and the wild foods that can be obtained in large quantities. The most common favorite in Manzilanzi is Mtafuta, in Mbelezungu is Mfulu, and in Majeleko is Ngwelu. Mfulu and Ngwelu are the most obtainable in large quantities in the respective villages. Mtafuta is also listed as famine wild food in Manzilanzi and Majeleko, and Mfulu is listed as famine wild food in Majeleko and Chinangali.

Mperemehe and Mkole are listed as favorite

Table 3 Experiences of negative health symptoms from wild food intake (focus group discussions)

Group	#	Wild food	Correlated symptoms	Manzilanzi (n=8) Consumption	Manzilanzi (n=8) Symptoms	Mbelezungu (n=5) Consumption	Mbelezungu (n=5) Symptoms	Majeleko (n=7) Consumption	Majeleko (n=7) Symptoms	Chinangali (n=4) Consumption	Chinangali (n=4) Symptoms
Fruits	4	Mfulu	No					Yes	**1 diarrhea**		
	11	Mtumba	Diarrhea	Yes	No diarrhea	Yes	No diarrhea	Yes	No diarrhea	Yes	No diarrhea
	12	Mzabibu pori	Diarrhea	No		No		No		No	No diarrhea
	16	Mdachi	Diarrhea	No		No		No		No	
Vegetables	3	Mzole	No							Yes	**1 diarrhea**
	7	**Matembele pori**	Diarrhea	Yes	**1 diarrhea**	Yes	No diarrhea	Yes	No diarrhea	Yes	No diarrhea
	11	Mlenda wima	Constipation	No		No		No		No	
	13	Mtango pori	Diarrhea	Yes	No diarrhea	Yes	No diarrhea	Yes	No diarrhea	Yes	No diarrhea
	15	Kandajizi	Diarrhea	No		Yes	No diarrhea	No		No	
	17	Mtimba mwisi	Diarrhea	No		No		No		No	
Animals	3	(rabbit)	Constipation	Yes	No constipation	Yes	No constipation	Yes	No constipation	Yes	No constipation
	4	(dik-dik)	Constipation	Yes	No constipation	Yes	No constipation	Yes	No constipation	Yes	No constipation
Insects	1	(flying ants)	Constipation	Yes	No constipation	Yes	No constipation	Yes	No constipation	No?	

Count in Table 1 In bold are symptoms reported

Table 4 Preferences ranking for wild food (focus group discussions)

#	Local name (Enlgish name)	*Scientific name*	Favorite wild food Man	Mb	Maj	C	Obtainable in quantity Man	Mbe	Maj	C	Famine wild food Man	Mb	Maj	C
3	Mtafuta	*Grewia burtii, G. similis*	1	4	2	2	3	2	2	3	1		1*	
4	Mfulu	*Vitex payos*	4	1	4	2	5	1	3	4			1*	1
2	Ngwelu	*Grewia sp. Nov.*	2	2	1	5	2	2	1	5				
5	Mperemehe	*Grewia flavescens*	5	3	5		4		4		1	1	1*	
7	Mkole	*Grewia bicolor*	5	4	3				4			1		
8	Mdawi	*Cordia sinensis*	5			5				2				
1	Mbuyu (baobab)	*Adansonia digitata*	2				1				1		1*	
11	Mtumba	*Boscia coriacea*	5											
13	Msena	*Cordia ovalis*	5											
	Msanze	*Clerodendrum pleiosciadium*	5											
	Mhumbulu	*Flacourtia indica*	5											
	Mkwaju (tamarind)	*Tamarindus indica*	5											
	Mkuyu	*Ficus* sp.	5											
	Mgandu	*Berchemia discolor*										1		
	Mzambarau (jambolan)	*Syzygium cumini*				1				1				1
	Embe (mango)	*Mangifera indica*				2								1

Count in Table 1 Man = Manzilanzi; Mb = Mbelezungu; Maj = Majeleko; C = Chinangali * The group may not have experienced hunger

wild foods in all locations except Chinangali. Mperemehe is obtainable in quantity in Manzilanzi and Majeleko, and famine food in Manzilanzi, Mbelezungu, and Majeleko. Mkole is obtainable in quantity in Majeleko, and famine food is obtainable in Mbelezungu. Mdawi is a favorite wild food in Manzilanzi and Chinangali, and is obtainable in large quantities in Chinangali. Baobab is the most obtainable and also the 2nd most favorite wild food in Manzilanzi and famine-related food in Manzilanzi and Majeleko.

Children in Manzilanzi listed more wild foods than did those in other locations. Mtumba, Msena, Msanze, Mhumbulu, tamarind, and Mkuyu are mentioned only in Manzilanzi. Mgandu is mentioned only in Mbelezungu as a famine food.

Jambolan, which is a tree that has been planted and naturalized, is mentioned only in Chinangali as a favorite wild food, obtainable in large quantity, and as a famine food. Mango, which is a cultivated tree, is also mentioned only in Chinangali as a favorite wild food and famine food.

Although not listed, children in Manzilanzi and Chinangali mentioned that rabbits are tasty with a full smile when it has been mentioned in the discussion on symptoms.

Ⅳ Discussion and conclusion

The focus group discussions (Table 4) revealed clear differences even within neighboring areas. Children in Manzilanzi, which is in the most remote area, listed numerous favorable wild foods. On the other hand, children in Chinangali were exotic, naturalized, and cultivated fruits, unlike in other areas. These results complement the results of the questionnaire, which indicated that children of Manzilanzi primary school ate wild food most frequently and that Chinangali primary school ate the least (Sakamoto et al. 2024). These findings also agree with previous research in Malawi, where children in the least deforested sites listed more wild food (Maseko et al. 2017).

Regarding health implications, the report of a child in Manzilanzi (Table 3) were consistent with the correlation between the intake of Matembele pori and diarrhea (Table 2). However, it is also important to note that correlations indicate that it may also prevent constipation. Matembele is *Ipomoea batata* (sweet potato leaves) but Matembele pori — pori means wild/forest in Swahili in this context— refers to various indigenous species in the *Ipomoea* genus. These included Sagula sagula, Maweza, and Chipali (Table 1); however, the interpretations of Matembele pori may slightly differ since all the species are negatively correlated with diarrhea, indicating a contradiction. These leafy vegetables have high iron, calcium, and fiber contents (Sakamoto et al. 2022 analyzed samples from the same district; also refer to Msuya et al. 2009; Stuetz et al. 2019) and are expected to contribute to health; however, one interpretation may be that excess intake of fiber or minerals such as magnesium may induce diarrhea.

The intake of flying ants, dik-dik, baobab kernels, and many wild fruits and vegetables have the potential to prevent diarrhea. Matembele pori and Mtumba (*Boscia coriacea*) have the potential to prevent constipation.

Among the wild foods ranked by children, Mfulu, Ngwelu, Mkole, Mdawi, and baobab kernel have the potential to prevent diarrhea (Table 2); however, it was reported that excessive consumption of Mfulu causes diarrhea (Table 3). Mtumba had both the potential to induce diarrhea and to prevent constipation. These fruits, which are already favored or accessed by children, should be continued to be consumed, but at the same time, children should be

advised to avoid excessive eating to prevent diarrhea. Further investigations of the functions of wild foods are recommended based on the insights gained through this research.

Acknowledgments and Role of the Authors

Prof. Yamagata Tatsumi provided us with a concrete comment on our poster presentation at the 24th JASID spring conference, which enabled us to analyze direct relationships between wild food variation and clear health symptoms such as diarrhea. The authors would like to thank Mr. Sato Yuki, Mr. Polgahagedara Don Pubudu Sanjeewa, Mr. Sakuraoka Yu, and Ms. Okawa Sho for inserting the questionnaire data; Mr. Frimpong Andrew Charles, Ms. Uchida Keiko, Mr. Sakuraoka, and Ms. Okawa for routinely checking the data insert; and Mr. Charles and Ms. Uchida for the data and reference checking of the manuscript.

Sakamoto is responsible for writing the initial manuscript, editing and confirming the final manuscript, overall conceptualization, data collection, facilitating participatory group discussions, final questionnaire data input checks, and data analysis. Chimosa coordinated and collected the data from the schools in Dodoma, facilitated participatory group discussions, and confirmed the interpretation of the results. Hitomi performed a preliminary analysis of the relationship between wild food intake and health evaluation, presented the findings in a poster at JASID, and received the above comments from Prof. Yamagata. Kikuchi coordinated and checked the data insert and checked the data and reference agreement of the manuscript. Ohmori conceptualized the children's health evaluation and food intake frequency, checked the data analysis, and confirmed the interpretation of the results. All the authors have confirmed and agreed with the final manuscript.

This research was supported by Grants in aid for Scientific Research: 22H00032, 18H03438, and 18H00776.

References

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. https://www.cifor.org/knowledge/publication/7648/（27 Oct 2023）

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）

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

Msuya, J.M., P Mamiro., & K. Weinberger（2009）“Iron, Zinc and β-carotene Nutrients Potential of Non-cultivated Indigenous Vegetables in Tanzania,” *Acta Hortic*., vol.806, pp.217-222.

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（2020）“Health, Livelihoods, and Food Intake of Children and Adults in Central Tanzania: From Questionnaire Interviews in Chinangali I Village, Chamwino District, Dodoma Region,” *Journal of the School of Regional Design, Utsunomiya University,* no.7, pp.43-63. http://hdl.handle.net/10241/00012127（23 Oct 2023）

Sakamoto Kumiko, Parinya Khemmarth, Ohmori Reiko, & Anna C. Maro（2021）“Health, Livelihoods, and Food Intake in Inland Southeast Tanzania: From questionnaire interviews in Malolo Village, Lindi Region,” *Journal of the Faculty of International Studies, Utsunomiya University,* no.51, pp.15-34. http://hdl.handle.net/10241/00012762（9 Oct 2023）

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

Sakamoto, Kumiko, Lilian Daniel Kaale, Reiko Ohmori, & Tamahi Kato（Yamauchi）（2023a） *Changing Dietary Patterns, Indigenous Foods, and Wild Foods: In Relation to Wealth, Mutual Relations, and Health in Tanzania,* Springer.

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）

Sakamoto Kumiko, Hitomi Toshiki, Kikuchi Yukiko, Ohmori Reiko, Anna C. Maro, & Michael Chimosa（2023c）“Preliminary Analysis of Wild Food Intake and Health Among Children in Central and Southeast Inland/Coast Tanzania: The Cases of Chinangali, Malolo, and Kijiweni Villages,” *Journal of the School of International Studies, Utsunomiya University,* no.56, pp. 1-14. https://uuair.repo.nii.ac.jp/records/2000019（8 Oct 2023）

Sakamoto Kumiko, KIikuchi Yukiko, Michael Chimosa, Frank Mbago, Sato Yuki, & Ohmori Reiko（2024）“Children’s Food, Wild Food, and Health in Semiarid Tanzania: Differences Within Neighboring Schools in Chamwino, Dodoma,” *Journal of the School of International Studies, Utsunomiya University*, no.56, pp. 1-14.

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,” *Nutrients,* vol.11, no.5, p.1025. https://doi.org/10.3390/nu11051025（27 May 2023）