American Journal of Food and Nutrition, 2018, Vol. 6, No. 2, 37-45
Available online at http://pubs.sciepub.com/ajfn/6/2/2

DOI:10.12691/ajfn-6-2-2

Food Consumption Pattern and Its Impact on the Nutritional Status of 6-59 months' Children in Sana'a Governorate, Yemen

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Abstract The objective of this research is to study into what extent can food consumption pattern affects the nutritional status of children less than 5 years in Sana'a Governorate, Yemen in connection with some socio-economic factors. The investigation data was extracted from a comprehensive survey done by UNICEF, Yemen during 2016. The survey was a cross-sectional with a representative sample of children 5-59 months. The survey was conducted in the two ecological zones of Sana'a Governorate the temperate (TZ) and the dry (DZ) zones. The total number of children attained were 525 and 580 in TZ and DZ respectively. The anthropometric measures of children were taken and all the global nutrition indices (z-scores) were generated and compared with WHO Growth Standards. The food consumption pattern of household was recorded and the food consumption scores (FCS) were produced for each household. Data on some other socio-economic factors were also collected. The prevalence rates of BMIZ, MUACZ, WHZ, WAZ and HAZ are 9.1%, 19.1%, 12.9%, 40.0% and 51.3% respectively for the whole governorate. Separate nutrition indices were produced for each zone and children of DZ were found more vulnerable to malnutrition than TZ children. 92.6% of the targeted households were found on the acceptable level of the FCS classification. Using Chi-Square testing has revealed significant associations between children ages, latrine type and zones with most of the nutrition indices but not with the FCS classification. Similar results were noticed when the multivariate logistic regression particularly with children ages and latrine type but another significant association emerged between income quintiles and both HAZ and WAZ nutrition indices with little difference between zones.

Keywords: *food consumption scores, malnutrition indicators, descriptive statistics, Chi-square testing and multivariate logistic regression*

Cite This Article: Muhammed A.K. Al-Mansoob, and Muhammed S.A. Masood, "Food Consumption Pattern and Its Impact on the Nutritional Status of 6-59 months' Children in Sana'a Governorate, Yemen." *American Journal of Food and Nutrition*, vol. 6, no. 2 (2018): 37-45. doi: 10.12691/ajfn-6-2-2.

1. Introduction

Stunting of children less than 5 years of age, is a wide world problem in which 171 million children have been estimated to be affected [1,2,3]. There is no doubt that potential intellectual and technical capacity of a population depends on good nutrition, particularly for young children [4]. Food security of households can be addressed in either able to produce their own food or able to purchase it and in both cases income is the main burden. This is the reason behind considering malnutrition of early childhood as a direct consequence of poverty and lack of economic resources [5]. Good nutrition is also vital on enhancing healthy life, education and productivity of people [4].

Due to the war that is running for almost three years, poverty, household food insecurity and malnutrition have become prevalent problems in Yemen [6]. The last human development report 2016 issued by UNDP Yemen has indicated that the population live on US$1.06 per day and the country ranks 168 amongst 177 nations on the Human Development Index [7].

Nationwide, stunting, underweight and wasting are affecting 47%, 39% and 16% of less than 5 children respectively [8]. In Sana'a Governorate, it has been reported that 48%, 34.1% and 14% of children under five years old were suffered from stunting, underweight and wasting, respectively [8].

The most acceptable definition to household food insecurity stated that a household (HH) is considered food insecure if it has a limited or uncertain physical and economic access to secure sufficient quantities of nutritionally adequate and safe foods in socially acceptable ways to allow HH members to sustain active and a healthy living [3,9-14]. Yet, in Yemen no research has been performed to assess the relationship between household food security and nutritional status of under five children either nationally or on a governorate level.

The objective of the present study is to investigate the association between food consumption pattern represented by food consumption scores (FCS) and body mass index z score (BMIZ), middle upper arm circumference z score

(MUACZ), weight for height z score (WHZ), weight for age z score (WAZ) and height for age z score (HAZ) anthropometric measures in a sample of 6-59 months age in the two ecological zones of Sana'a Governorate, Yemen; namely the dry zone (DZ) and the temperate zone (TZ).

2. Materials and Methods

2.1. Study Design, Sampling and Data Collection Process

Data of the present investigation were extracted from a comprehensive survey done by UNICIF Yemen during May 21st to June 2nd, 2016 as part of other surveys planned to cover all the Yemeni governorates. The survey was a cross-sectional study with a representative sample of children 5-59 months.

The survey was conducted in the two ecological zones of Sana'a governorate, the TZ and the DZ. 11 districts were composing the TZ, Jehanah, Al Teyal, Khawlan, Bani Matar, Hamdan, Arhab, Bani Hoshaish, Nehm, Bilad Al Roos, Sanhan & Bani Bahlul and Al Hesn, while only 5 districts were composing the DZ, Bani Dhabian, Al Haymah Al Dakheliah, Sa'fan, Manakhah and Al Haymah Al Kharijiah.

All unsafe areas have been excluded from the frame before the selection of clusters. A two-staged cluster cross sectional study was conducted. The methods used, including sampling design and sample size determination were following SMART approach [15].

The sample size calculated for the TZ was higher in the anthropometry than in mortality, while for DZ, it was higher in mortality than in anthropometry. The calculated sample sizes for households in the two strata of TZ and DZ were 453 and 438 respectively. With these numbers of households, the expected numbers of under five children in the two strata were 617 and 493 respectively [15]. However, the total number of children attained were 525 and 580 in TZ and DZ respectively.

The survey has taken place in 30 clusters in each stratum. The number of households in each cluster was calculated as 15 households in both TZ and DZ.

The source of the sample frame used in this survey was taken from Sana'a Governorate Health Office. The frame contains a list of villages with a projection of population that is made based on the of the CSO 2004 Census [16].

The survey population consisted of: 1) anthropometry: children aged 6 to 59, 2) mortality: all people that have lived at the household (currently residing, left, born or died) over a set recall period; 3) IYCF (Infant and young child feeding): children 0-24 months; 4) morbidity: children 0-60 months. The data collection was completed over a 12 days period.

2.2. Anthropometric Measurement

The anthropometric data of children 6-59 months old were entered, calculated and analyzed using ENA for SMART software. The nutrition indices (z-scores) for WHZ (wasting), HAZ (stunting), WAZ (underweight), BMIZ and MUACZ were generated and compared with WHO 1995 and 2006 Growth Standards [17,18,19]. The classification of the nutritional status using the above indices as well as MUAC and BMI were made following the WHO classification [17,18,19]. Children/cases with extreme z-score values were flagged and investigated and appropriately excluded in the final analysis if deviating from the observed mean (SMART flags).

Using Z-scores in reference to the WHO Child Growth Standards, the following cut-offs were used to determine the prevalence of wasting, stunting, underweight and malnutrition. The classification used for wasting, stunting, underweight and malnutrition levels was as follows [17,18,19,20]:

WHZGAM <-2 Z-score or oedema = Global/total Acute Malnutrition

WHZGAM ≥ -2Z-scores = Normal

HAZGAM <-2 Z-score = Stunting Rates

HAZGAM ≥ -2Z-scores = Normal

WAZGAM <-2 Z-score = Underweight Prevalence Rates

WAZGAM ≥ -2Z-scores = Normal

BMIZGAM <-2 Z-score = Global Acute Malnutrition Prevalence Rates

BMIZGAM ≥ -2Z-scores = Normal

MUACZGAM <-2 Z-score = Global Acute Malnutrition Prevalence Rates

MUACZGAM ≥ -2Z-scores = Normal

The food consumption pattern variables (feeding practices) were entered and analyzed using Excel.

In SPSS, frequencies and cross-tabulations were used to give percentages, means and standard deviations in the descriptive analysis and presentation of general household and child characteristics. Significance was defined as ($P<0.05$).

2.3. Definitions [19,20,21]

1. Body Mass index:

An index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2).

2. Acute Malnutrition/Wasting:

Wasting was estimated according to the weight-for-height of each child. It is usually a result of current lack of food or illnesses that leads to acute and severe weight loss and possible onset of malnutrition. It is particularly useful to consider this variable in an emergency situation.

3. Underweight:

Weight-for-age is an indicator that reflects body weight relative to the child's age. It is used to assess whether a child is underweight or severely underweight. It takes into account both acute and chronic malnutrition.

4. Stunting:

Stunting was determined using height-for-age index. It is an indicator of linear growth of a child, and reflects prolonged or chronic lack of food and repeated infections. The effects of low height-for-age or stunting are largely irreversible by the end of 2 years of age which includes delayed motor development, impaired cognitive function and poor school performance. Stunting represents long-term effects of malnutrition and is not sensitive in assessing acute malnutrition.

5. Acute Malnutrition:

For the measures of MUAC, the standards are taken from the WHO Child Growth Standards and the identification

of severe acute malnutrition in infants and children, 2009. Moreover, MUAC is used in rapid screening of acute malnutrition for children 6-59 months at a high risk of mortality associated with malnutrition

6. FCS:

A method developed by WFP to indicate quantity and quality of food consumption [21].

FCS were calculated based on the consumption during the last 7 days from the 8 food groups following WFP guidelines [22]. The classification of FCS is not made following the global WFP one but based on the WFP Yemen way as the following:

- Below or equal to 28: Poor food consumption
- Above 28 to 42: Border line food consumption
- Above 42: Acceptable food consumption

3. Data Analysis and Results

Data analysis was done using Excel, ENA and SPSS (version 21.0). To calculate the FCS, responses were scored in accordance with the USDA Food and Nutrition Service criteria [23]. For presentation of descriptive statistics, the distribution of household and child characteristics was calculated and frequencies and percentages were reported. Binary logistic regression was used in assessing the statistical association between under-five children's nutritional status and each of the independent variables.

Data disaggregation is more likely to disclose hidden or masked information. So, the statistical analysis to the present set of data will be two folds, firstly on the whole data and secondly on each zone separately.

Table 1. The prevalence rates of some of the study variables in both zones

Variables		Zone				Both	
		DZ		TZ			
		n	%	n	%	N	%
HH size	Mean	9		11		10.1	
HH Head Gender	Female	16	2.3	9	1.4	25	1.9
	Male	687	97.7	615	98.6	1302	98.1
HH Head Marital Status	Missing	0	0.0	1	.2	1	.1
	Divorced	3	.4	0	0.0	3	.2
	Married live	692	98.4	609	97.6	1301	98.0
	Recalcitrant	1	.1	0	0.0	1	.1
	Single	4	.6	6	1.0	10	.8
	Widowed	3	.4	8	1.3	11	.8
Latrine Type	Defecation	172	24.5	22	3.5	194	14.6
	Flush/pour	376	53.5	527	84.5	903	68.0
	Open pit latrine	101	14.4	48	7.7	149	11.2
	Simple cover	41	5.8	26	4.2	67	5.0
	Other	13	1.8	1	.2	14	1.1
Sex of Children	Male	358	50.9	306	49.0	664	50.0
	Female	345	49.1	318	51.0	663	50.0
Age Child in months	6 – 11	63	10.9	49	9.3	112	10.1
	12 – 23	146	25.2	120	22.9	266	24.1
	24 – 35	129	22.2	138	26.3	267	24.2
	36 – 47	130	22.4	100	19.0	230	20.8
	48 – 59	112	19.3	118	22.5	230	20.8
Quintiles	Q1	243	38.6	86	15.8	329	28.0
	Q2	105	16.7	68	12.5	173	14.7
	Q3	120	19.0	99	18.2	219	18.7
	Q4	106	16.8	136	25.0	242	20.6
	Q5	56	8.9	155	28.5	211	18.0
BMIZ	BMIZ < -2SD	68	10.8	41	7.3	109	9.1
MUACZ	MUACZ < -2SD	160	25.4	69	12.2	229	19.1
WHZ	WHZ < -2 SD	106	16.8	48	8.5	154	12.9
WAZ	WAZ < -2 SD	320	50.7	158	28.0	478	40.0
HAZ	HAZ < -2 SD	382	60.5	232	41.1	614	51.3
FCS classification	Acceptable	644	91.6	585	93.8	1229	92.6
	Borderline	47	6.7	29	4.6	76	5.7
	Poor	12	1.7	10	1.6	22	1.7

Table 1 provides a panoramic view to the prevalence rates of the study variables. One can notice the huge household size in both zones and households are mainly headed by males. Flush/poor latrine type is the main way of sanitation followed by defecation and open pit. While the first three income quintiles in favor of DZ, the last two high income quintiles are in favor of the TZ. All the malnutrition indicators of the DZ children are significantly higher than those of the TZ. The prevalence of WAZ and HAZ have exceeded 50% and 60% thresholds in the DZ respectively. Very few percentages HHs have reached either the borderline or poor levels of the FCS classification.

In Table 2, the relationships between the nutritional status and age of children, quintiles, FCS classification and sex of child are displayed. Age of children is strongly associated with BMIZ, WHZ and HAZ. Latrine type is also strongly associated with MUACZ, WHZ, WAZ and HAZ. Income quintiles are significantly associated with both MUACZ and WAZ. No significance relationships were found between nutritional status and both FCS classification and sex of children. On the other hand, area (zones) are highly associated with the prevalence rates of malnutrition. The significant associations between all the malnutrition indicators and area (the two zones) were found. Thus, all analyses were performed for the governorate as a whole and stratified by geographical zone.

The data, then were separated according to zone and reanalyzed accordingly. As shown in Table 3 and Table 4, age of children is still significantly associated with BMIZ, WHZ and HAZ in both zones. However, only in the temperate zone a significant association between income quintiles and WAZ was detected.

Table 2. General Chi-Square analysis

Variables	Categories	BMIZ	MUACZ	WHZ	WAZ	HAZ
Age Child in months	6 - 11	21.4	24.1	21.4	42.0	35.7
	12 - 23	7.5	19.2	16.2	41.7	55.3
	24 - 35	7.5	20.0	11.7	40.0	50.9
	36 - 47	6.6	14.5	8.8	37.4	56.4
	48 - 59	8.3	17.5	9.2	39.0	49.1
Chi Square (P-value)		24.40 (0.000)	5.29 (0.259)	16.46 (0.002)	1.22 (0.876)	15.35 (0.004)
Latrine Type	Defecation	12.9	24.7	19.4	52.9	60.0
	Flush/pour	8.6	16.3	11.4	36.0	47.6
	Open pit latrine	8.5	26.6	12.7	40.8	57.0
	Simple cover	4.7	17.2	10.9	53.1	59.4
	Other	21.4	50.0	28.6	42.9	64.3
Chi Square (P-value)		7.46 (0.114)	21.55 (0.000)	11.30 (0.023)	21.98 (0.000)	13.96 (0.007)
Quintiles	Q1	9.0	19.9	12.6	45.2	57.5
	Q2	11.1	24.1	15.4	44.4	50.0
	Q3	8.2	20.4	13.3	42.3	53.6
	Q4	8.5	13.6	12.3	42.9	50.9
	Q5	7.0	14.4	9.6	26.2	43.9
Chi Square (P-value)		2.02 (0.733)	9.67 (0.046)	2.79 (0.594)	20.38 (0.000)	9.13 (0.058)
FCS classification	Acceptable	9.2	18.6	13.0	39.6	51.7
	Borderline	8.3	27.8	12.5	45.8	48.6
	Poor	9.5	19.0	9.5	38.1	42.9
Chi Square (P-value)		0.06 (0.971)	3.69 (0.158)	0.23 (0.893)	1.12 (0.572)	0.87 (0.647)
Sex of Children	Male	10.0	20.2	14.2	40.3	51.2
	Female	8.3	18.2	11.6	39.6	51.5
Chi Square (P-value)		1.10 (0.29)	0.79 (0.375)	1.92 (0.166)	0.07 (0.795)	0.01 (0.918)
Area /Zones	DZ	10.8	25.4	16.8	50.7	60.5
	TZ	7.3	12.2	8.5	28.0	41.1
Chi Square (P-value)		4.46 (0.035)	33.27 (0.000)	18.32 (0.000)	64.29 (0.000)	45.26 (0.000)

Table 3. Chi-square analysis of DZ

Variables	Categories	BMIZ	MUACZ	WHZ	WAZ	HAZ
Age Child in months	6 - 11	23.8	31.7	23.8	54.0	42.9
	12 - 23	11.6	27.4	26.0	55.5	58.9
	24 - 35	7.0	24.0	13.2	52.7	65.1
	36 - 47	7.0	19.4	10.1	43.4	65.9
	48 – 59	8.1	22.5	9.9	45.0	57.7
Chi Square (P-value)		16.52 (0.002)	4.54 (0.338)	20.67 (0.000)	5.86 (0.210)	11.30 (0.023)
Latrine Type	Defecation	14.0	27.3	21.3	54.0	58.7
	Flush/pour	10.2	23.2	15.1	50.6	61.4
	Open pit latrine	7.2	26.8	13.4	42.3	57.7
	Simple cover	7.7	25.6	17.9	64.1	66.7
	Other	23.1	46.2	30.8	38.5	61.5
Chi Square (P-value)		5.40 (0.246)	4.22 (0.378)	5.60 (0.233)	7.01 (0.136)	1.30 (0.866)
Quintiles	Q1	10.5	22.3	15.5	50.0	63.6
	Q2	13.4	32.0	20.6	53.6	52.6
	Q3	9.2	26.6	16.5	50.5	63.3
	Q4	9.8	17.4	16.3	53.3	58.7
	Q5	6.5	26.1	13.0	50.0	67.4
Chi Square (P-value)		1.91 (0.753)	6.37 (0.173)	1.77 (0.778)	0.56 (0.968)	4.77 (0.311)
FCS classification	Acceptable	10.6	24.5	16.7	50.6	60.7
	Borderline	11.4	36.4	18.2	54.5	61.4
	Poor	16.7	25.0	16.7	41.7	50.0
Chi Square (P-value)		0.47 (0.792)	3.03 (0.220)	0.07 (0.968)	0.65 (0.721)	0.58 (0.750)
Sex of Children	Male	11.1	25.1	17.5	48.6	57.5
	Female	10.4	25.6	16.1	52.8	63.6
Chi Square (P-value)		0.07 (0.787)	0.03 (0.873)	0.20 (0.657)	1.15 (0.283)	2.50 (0.114)

Table 4. Chi-square analysis of TZ

Variables	Categories	BMIZ	MUACZ	WHZ	WAZ	HAZ
Age Child in months	6 – 11	18.4	14.3	18.4	26.5	26.5
	12 - 23	2.5	9.2	4.2	25.0	50.8
	24 - 35	8.1	16.2	10.3	27.9	37.5
	36 - 47	6.1	8.2	7.1	29.6	43.9
	48 - 59	8.5	12.8	8.5	33.3	41.0
Chi Square (P-value)		13.19 (0.010)	4.79 (0.309)	9.65 (0.047)	2.22 (0.695)	9.96 (0.041)
Latrine Type	Defecation	5.0	5.0	5.0	45.0	70.0
	Flush/pour	7.4	11.4	8.9	25.7	38.0
	Open pit latrine	11.1	26.1	11.1	37.8	55.6
	Simple cover	0	4.0	0	36.0	48.0
	Other	0.0	100.0	0	100.0	100.0
Chi Square (P-value)		3.21 (0.526)	18.34 (0.001)	3.20 (0.524)	9.66 (0.048)	14.65 (0.006)
Quintiles	Q1	4.9	13.6	4.9	32.1	40.7
	Q2	7.7	12.3	7.7	30.8	46.2
	Q3	6.9	12.6	9.2	32.2	41.4
	Q4	7.5	10.7	9.2	35.0	45.0
	Q5	7.1	10.6	8.5	18.4	36.2
Chi Square (P-value)		0.63 (0.960)	0.64 (0.959)	1.46 (0.834)	10.68 (0.030)	2.85 (0.583)
FCS classification	Acceptable	7.6	12.1	8.9	27.7	41.9
	Borderline	3.6	14.3	3.6	32.1	28.6
	Poor	0.0	11.1	0.0	33.3	33.3
Chi Square (P-value)		1.35 (0.509)	0.13 (0.939)	1.82 (0.402)	0.40 (0.820)	2.17 (0.339)
Sex of Children	Male	8.7	14.5	10.5	30.9	44.0
	Female	5.9	10.0	6.6	25.2	38.3
Chi Square (P-value)		1.72 (0.189)	2.72 (0.099)	2.90 (0.089)	2.31 (0.129)	1.91 (0.167)

The binary logistic regression was applied on the whole variables of the study considering the nutritional status as dependent variables. The analysis was applied on the whole data and on each zone separately (for brevity, the analysis output was omitted here and only significant association will be displayed).

Some interesting results were obtained. For the whole data, it has been found that BMIZ is negatively associated with children age and the prevalence among children in the first age group (6-11 months) is higher than on the other age groups (Table 5). MUACZ has no significant association with children age. However, children in the age group 36-47 months are less likely affected by MUACZ than those in the first age group. Further, WHZ is negatively associated with children age with a possibility that children on the first three age groups to be less vulnerable than children on the first age group. WAZ is significantly associated with the income quintiles of HHs and poor children are more vulnerable than the rich children. HAZ is significantly associated with children age and the prevalence are 2.03, 1.88 and 2.37 more likely among children in the first age group. Finally, it was found that latrine type is significantly associated with WAZ and children living in houses using the defecate type are more vulnerable than those living in houses with flash/pour type.

On the other side, in DZ a significant association was found between BMIZ and children age group and children on the highest three age group are less vulnerable than those on the first age group (Table 6). Children on the third age group are less vulnerable MUAZ than those on the other groups. Children of HHs with second income quintile are 1.92 more likely to have MUACZ than those on the first income quintile. Further, WHZ is significantly associated with children age groups and children on the highest two group are less vulnerable than those on the first age group. Generally, no association between HAZ and children age group but there are chances of 2.16 and 2.41 to children of the third and fourth group to be more vulnerable than those of the first age group.

Table 5. Logistic regression results for the whole data

Variables	BMIZ			MUACZ			WHZ			HAZ		
Children Age	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR
6 - 11		.001			.137			.007			.011	
12 - 23	-1.2	.001	.31	-.3	.390	.77	-.3	.378	.76	.7	.005	2.03
24 - 35	-1.2	.001	.29	-.1	.879	.96	-.7	.045	.51	.6	.012	1.88
36 - 47	-1.5	.000	.22	-.7	.033	.50	-1.1	.003	.34	.9	.001	2.37
48 – 59	-1.0	.005	.36	-.3	.306	.73	-.9	.010	.39	.4	.088	1.55
	WAZ			**MUACZ**			**WHZ**					
Latrine Type	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR			
Defecate		.038			.030			.273				
Flush/pour	-.5	.009	.592	-.3	.223	.74	-.6	.032	.56			
Open pit latrine	-.5	.070	.624	.3	.416	1.28	-.5	.163	.60			
Simple cover	.1	.840	1.068	-.5	.284	.63	-.6	.195	.52			
Other	-.7	.310	.513	1.2	.069	3.29	.1	.985	1.02			
	WAZ			**HAZ**								
Quintiles	B	Sig.	OR	B	Sig.	OR						
Q1		.002			.092							
Q2	.1	.598	1.12	-.2	.315	.81						
Q3	-.1	.937	.98	-.1	.575	.89						
Q4	.1	.631	1.10	-.2	.347	.83						
Q5	-.7	.001	.48	-.6	.006	.57						

Table 6. Multivariate logistic regression of DZ

Variables	BMIZ			MUACZ			WHZ			HAZ		
Children Age	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR
6-11		.009			.138			.000			.112	
12 - 23	-.7	.103	.49	-.2	.562	.81	.3	.449	1.35	.5	.104	1.72
24 - 35	-1.3	.008	.26	-.2	.665	.85	-.6	.193	.57	.8	.025	2.16
36 - 47	-1.6	.003	.20	-.9	.026	.42	-1.1	.028	.36	.9	.010	2.41
48 – 59	-1.4	.009	.24	-.5	.245	.63	-1.3	.016	.29	.5	.126	1.72
	MUACZ											
Quintiles	B	Sig.	OR									
Q1		.057										
Q2	.7	.029	1.92									
Q3	.3	.309	1.36									
Q4	-.4	.283	.68									
Q5	.5	.258	1.59									

Table 7. Multivariate logistic regression of TZ

Variables	BMIZ			WHZ			HAZ		
Children Age	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR
6-11		.016			.047			.056	
12 - 23	-2.6	.002	.07	-2.0	.004	.14	1.1	.010	2.92
24 - 35	-1.2	.040	.31	-1.0	.080	.38	.5	.195	1.72
36 - 47	-1.5	.017	.23	-1.3	.027	.26	.9	.043	2.35
48 – 59	-.9	.099	.40	-.9	.093	.40	.5	.225	1.66
Sex child (male=0)				-.8	.041	.47			
	WAZ								
Quintiles	B	Sig.	OR						
Q1		.028							
Q2	.1	.914	1.04						
Q3	.1	.797	1.10						
Q4	.3	.318	1.40						
Q5	-.6	.064	.53						
	HAZ								
Latrine Type	B	Sig.	OR						
Defecate		.084							
Flush/pour	-1.2	.038	.31						
Open pit latrine	-.5	.451	.61						
Simple cover	-.7	.326	.50						
Other	21.1	1.000	1446812207.87						

For the TZ, a significant relationship between BMIZ and children age was found with emphasis on that children on the second, third and fourth age groups are less likely to be affected than those at the first age group (Table 7). BMIZ episodes are more vulnerable among children living in HHs using simple or other types of sanitation system than those using defecate type. WHZ is negatively associated with children age group with emphasis that children on the second, third and fourth age groups are less vulnerable than those on the first age group. WHZ is also significantly associated with sex of the child in favor of females. Furthermore, WAZ is generally associated significantly with income quintiles. No significant association between HAZ and children age groups. However, children in the second and fourth age groups are 2.92 and 2.35 more vulnerable to HAZ than those in the first age group. Finally, children living in HHs with flash/pour sanitation systems are less likely to be vulnerable to HAZ than those living with defecate system.

4. Discussion

Due to the political crises started on 2011 and so forth, lives of most Yemenis have become miserable by all means. Late 2017, WHO estimated the number of people who are food insecure in Yemen as 17 millions (60% of the total population) and over two million children under the age of five are acutely malnourished and are at a grave risk of dying [24].

Analyzing the anthropometric data of the present study has revealed high prevalence rates of malnutrition among the infants and young children of both zones of Sana'a governorate and more fiercely in the DZ. These rates have raised many queries.

The impact of food consumption pattern on nutritional status of children can be confused by other key determinants of child nutrition, such as maternal education, maternal nutritional status, access to health services and health environment like hygiene and sanitation [25,26]. The present set of data has included four potential determinants; namely children age, FCS, latrine type and HHs income quintiles. By using both Chi-square testing and the multivariate logistic regression, significant associations between BMIZ, WHZ, HAZ and children age either for the whole data or at each zone separately were detected.

For the whole data, Chi-square testing has proved that latrine type to be significantly associated with all malnutrition indicators except BMIZ. However, it has been found that only MUACZ, WAZ and HAZ are significantly associated with latrine type in the TZ alone. On the other hand, the multivariate logistic regression analysis has proved the existence of a relationship between latrine type and both MUACZ and WAZ for the whole data and with only WAZ of the TZ.

In a study conducted by World Bank, it has been reported that household poverty level rather than food insecurity is predictive of malnutrition among children [25]. The present set of data does not include any poverty measure to the HHs but includes the income quintiles that are good proxy for household's socio-economic status. In support of this, it has been found that there exists a significant association between income quintiles and WAZ of the TZ by using Chi-square testing. By applying the multivariate logistic regression, a significant association between income quintiles and WAZ for the whole data

and with WAZ of the temperate zone alone. At the end, it should be noted that in some poverty-agonized areas, some children grow and develop naturally despite of inadequate household food access due to positive fancily and caregivers' behavior [4].

The insignificant association between FCS and malnutrition of the present investigation children was surprising. However, this is could be attributed to many factors. Firstly, the data collection process took place during May to June 2016 which is the rainy season. Secondly, the data was collected cross-sectional which is not sufficient to capture seasonal variations in the food consumption trends of people.

In fact, the negative result found in our study is not unique; many other studies have come to the same conclusion either with WHZ or HAZ [3]. BMIZ and WHZ were also not associated significantly with food insecurity [27].

Nevertheless, other studies have concluded a significant association between food insecurity and WAZ or HAZ, among infants and young children [3,28].

5. Conclusion

Unless prospective studies that collect data on food consumption pattern across time, it seems unrealistic to link it with nutritional status of children and instead efforts should be paid to improve the households' incomes. Improving the sanitation services is also an important factor in reducing the onset of malnutrition among children of this governorate.

Abbreviations

HH: Household
FCS: Food Consumption Score
BMIZ: Body Mass Index Z-score
MUACZ: Middle Upper Arm Circumference Z-score
WHZ: Weight for Height Z-score
WAZ: Weight for Age Z-score
HAZ: Height for Age Z-score
DZ: Dry Zone
TZ: Temperate Zone
BMIZGAM: Body Mass Index Z-score as Global Acute Malnutrition.

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