

Assessment of the Community Awareness on Transmission and Control Practices towards Gastrointestinal Parasites in Fruits and Vegetables in Zanzibar

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Abstract Community can be at risk of being infected with gastrointestinal parasites due to lack of awareness. The semi-structured questionnaires were administered randomly to 400 respondents (vendors and consumers of fruits and vegetables) at the five purposively selected public markets in Zanzibar. The markets were Mwanakwerekwe, Mombasa, Darajani, Chakechake and Wete. The data that were collected included demographic characteristics of the study respondents and their awareness on the knowledge of aetiology, clinical signs, transmission and control practices with regard to gastrointestinal parasites contamination on fruits and vegetables marketed in Zanzibar. The results showed that, 75.5% of the respondents were aware on gastrointestinal parasites. The respondents were found to have good knowledge of control practices (85.3%), followed by transmission (80.5%), clinical signs (69.5%) and knowledge of aetiology (56.4%) on gastrointestinal parasites. The findings of this study indicated that community in Zanzibar were aware on transmission and control practices for fruits and vegetables contamination with gastrointestinal parasites.

Keywords: awareness, community, gastrointestinal parasites, fruits and vegetables, Zanzibar.

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1. Introduction

Fruits and vegetables have significant role in contributing nutrients such as minerals, vitamins, nutritional fibers and phytochemicals especially antioxidants that defend the human body against various infectious and non-infectious diseases [1]. Despite their nutritional values, fruits and vegetables have been reported as media for transmitting infectious agents such as gastrointestinal parasites that cause various diseases to the people [2]. In this case, strong awareness of the communities related to transmission and control of gastrointestinal parasites is highly needed. However, different studies indicated that, some communities are not aware of gastrointestinal parasites and how these parasites can be transmitted and controlled [3]. Different studies have been conducted to assess awareness of the communities on gastrointestinal parasites, for example, a study conducted in Nigeria to assess the awareness of retailers and consumers of fruits

and vegetables towards gastrointestinal parasites, the findings indicated that, the retailers and consumers had poor awareness regarding gastrointestinal parasites [4]. Similarly, a study conducted in Saudi Arabia indicated poor awareness of the community with regard to gastrointestinal parasites [5]. Therefore, poor health education awareness of the communities is the risk factor for acquiring gastrointestinal parasites infections [6]. In Zanzibar, gastrointestinal parasites have been reported as public health problem after clinical evaluation in school-aged children. The reported gastrointestinal parasites were *Trichuris trichiura*, *Ascaris lumbricoides*, hookworms and *Strongyloides stercoralis* [7]. These parasites could be probably transmitted through consumption of improperly washed or unwashed fruits and poorly cooked and consumption of raw vegetables. However, in Zanzibar there was scarce information on community awareness on the knowledge of aetiology, clinical signs, transmission and control practices related to gastrointestinal parasites contamination on fruits and vegetables. Thus, this study was designed to address that gap in knowledge.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Zanzibar and specifically at five selected public markets. Zanzibar has two major islands of Unguja and Pemba. Unguja is larger than Pemba with a total area of 1,554km² compared to 990km² for Pemba [8]. Zanzibar has a population of approximately 1.3 million with an annual growth rate of 2.8% [9]. The major economic activities in Zanzibar are agriculture, tourism and fishing. Agriculture is the first backbone to Zanzibar economy and it accounts for 31% GDP [8].

2.2. Study Design

A cross-sectional study design was adopted in this study.

2.3. Sample Size Determination

The population size of people residing in four selected districts of urban, west "B", Chakechake and Wete in Zanzibar where five central public markets are found is 536,147 [9]. Therefore, the sample size of respondents to be interviewed was determined by using Slovin's equation with 95% confidence level. $n=N/(1+Ne^2)$ [10]. Where; n = estimated sample size, N= the size of population and e = the acceptable error that was 5 % (0.05). Therefore the estimated sample size was 399.7 which was approximated to 400 respondents.

2.4. Sampling Procedures and Data Collection

The target study population was vendors and consumers of fruits and vegetables at five purposively selected public markets that included Mwanakwerekwe, Mombasa, Darajani, Chakechake and Wete. A random selection was adopted for the selection of vendors and consumers to assess their awareness on fruits and vegetables gastrointestinal parasites contamination. Each respondent was provided with a consent form to ask for his/her willingness to participate in the study. The Swahili translated semi-structured questionnaire after being piloted to check its accuracy, was administered to the respondents to collect information that included: demographic information (sex, age, educational level, occupation and location), awareness on the knowledge of aetiology, transmission, clinical signs, prevention and control practices with regard to gastrointestinal parasites.

2.5. Data Analysis

The data were entered, coded, validated and stored into the spread sheet of Microsoft Excel Window 2007 and analysed using Statistical Package for Social Sciences (SPSS) version 16.0. Chi-square test was used to determine if there were statistically significant differences between respondents' awareness and their demographic characteristics, where p-value of ≤ 0.05 was used as a cut-off point of significance. Descriptive data analysis

such as means, frequencies and proportions were performed.

2.6. Ethical Consideration

The research clearance and ethical protocols of this study were approved by Sokoine University of Agriculture (Ref. No. SUA/ADM/R.1/8/733) and (Ref. No. DPRTC/SUA/R/186/F.9) respectively. Also a permission to conduct this study in Zanzibar was granted by the Office of the Second Vice President of Zanzibar (Ref. No. OMPR/M.95/C.6/2/VOL.XII/12) and the consent forms were also used to seek for willingness of the respondents to participate in the study prior to the start of data collection.

3. Results

3.1. Demographic Characteristics of the Study Respondents

A total of 400 respondents were interviewed in this study of which 60% and 40% were from Unguja and Pemba respectively. The higher proportions of the respondents were females (56.23%). Consumers constituted 85% and vendors of fruits and vegetables comprised the remaining 15%. The mean age of the respondents was 32.9 years and higher proportions of them were aged 18-25 years (33%). In terms of education, higher proportion of the respondents had secondary education (69.25%) as shown in Table 1.

Table 1. Demographic characteristics of study respondents

Characteristics	N	(%)
Sex		
Male	175	43.75
Female	225	56.23
Location		
Unguja	240	60.0
Pemba	160	40.0
Occupation		
Vendors	60	15.0
Consumers	340	85.0
Age		
18-25	132	33.0
26-33	106	26.5
34-41	72	18.0
42-49	53	13.25
50-57	24	6.0
58+	13	3.25
Education		
Primary	90	22.5
Secondary	277	69.25
Diploma	13	3.25
Degree	5	1.25
Informal	15	3.75
Education Level	Vendors	Consumers
Primary	22(36.7)	68 (20)
Secondary	27 (45)	250 (73.5)
Diploma	-	13 (3.8)
Degree	-	5 (1.5)
Informal	11(18.3)	4 (1.2)

3.2. Awareness on Gastrointestinal Parasites

The awareness level of the community towards gastrointestinal parasites was high (75.5%). Considering the categories of awareness, the respondents had higher knowledge on control practices (85.3%) followed by transmission (80.5%), clinical signs (69.5%) and aetiology (56.4%) as summarized in Table 2.

3.3. Awareness on Gastrointestinal Parasites According to Locations

Generally, a high proportion of respondents from

Unguja (77%) were aware on gastrointestinal parasites compared to those from Pemba where the proportion was 73.44%. Specifically, respondents from Unguja were more aware with regard to the questions concerning clinical signs and washing/should wash the fruits and vegetables before selling compared to the respondents from Pemba. On the other hand, respondents from Pemba were more aware on the question about the awareness on the knowledge of control practices concerning the cooking of vegetables properly compared to those respondents from Unguja. The difference in awareness between these two locations was statistically significant (p-value < 0.05) (Table 3).

Table 2. General knowledge on aetiology, clinical signs, transmission and control practices of gastrointestinal parasites of respondents

Awareness regarding gastrointestinal parasites	Correct answers	
	N = 400	(%)
Knowledge on aetiology		
People heard of gastrointestinal parasites.	396	99.00
Those were able to mention the types of GIT parasites.	55	13.75
Knowledge on clinical signs		
Symptoms of having GIT parasites infections.	278	69.5
Knowledge on transmission		
How can a person be infected with gastrointestinal parasites?	322	80.5
Knowledge on control practices		
Wash/should wash the food stuffs before selling.	347	86.75
Washing of fruits with running water before eating.	353	88.25
Washing of hands with water and soap after toilet.	363	90.75
Cooking of vegetables properly.	301	75.25

Table 3. Awareness on gastrointestinal parasites according to locations

Awareness regarding gastrointestinal parasites	Correct answers		P- value
	Unguja n=240 (%)	Pemba n=160 (%)	
Knowledge on aetiology			
People heard of gastrointestinal parasites.	240 (100)	156 (97.5)	0.140
Those were able to mention the types of GIT parasites.	28 (11.7)	27 (16.9)	0.274
Knowledge on clinical signs			
Symptoms of having GIT parasites infections.	191(79.58)	87 (54.4)	0.000
Knowledge on transmission			
How can a person be infected with gastrointestinal parasites?	198 (82.5)	124.(77.5)	0.216
Knowledge on control practices			
Wash/should wash the food stuffs before selling.	215 (89.6)	132 (82.5)	0.041
Washing of fruits with running water before eating.	218 (90.83)	135 (84.4)	0.146
Washing of hands with water and soap after toilet.	218 (90.8)	145 (90.6)	0.944
Cooking of vegetables properly.	167 (69.6)	134 (83.8)	0.001

Significant p-values (<0.05) are in bold based on Chi-square test.

Table 4. Awareness on gastrointestinal parasites according to occupation of the respondents

Awareness regarding gastrointestinal parasites	Correct answers		P-value
	Vendors n=60 (%)	Consumers n=340 (%)	
Knowledge on aetiology			
People heard of gastrointestinal parasites.	60 (100)	336 (98.8)	0.398
Those were able to mention the types of GIT parasites.	9 (15)	46 (13.5)	0.319
Knowledge on clinical signs			
Symptoms of having GIT parasites infections.	33 (55)	245 (72.1)	0.008
Knowledge on transmission			
How can a person be infected with gastrointestinal parasites?	46 (76.7)	276 (81.2)	0.416
Knowledge on control practices			
Wash/should wash the food stuffs before selling.	31(51.7%)	316 (92.9)	0.000
Washing of fruits with running water before eating.	45 (75)	308 (90.59)	0.001
Washing of hands with water and soap after toilet.	43 (71.7)	320 (94.1)	0.000
Cooking of vegetables properly	44 (73.33)	257 (75.59)	0.307

Significant p-values (<0.05) are in bold based on Chi-square test.

3.4. Awareness on Gastrointestinal Parasites According to Occupation

Results show that consumers (77.35%) were more aware of gastrointestinal parasites compared to vendors (64.74%). Consumers were more aware on clinical signs, washing of fruits and vegetables before selling, washing of fruits with running water before eating and washing of hands with water and soap after toilets compared to vendors at statistically significant difference of p-values < 0.05 (Table 4).

3.5. Awareness on Gastrointestinal Parasites According to Sex

Results show that females (76.67%) were more aware on gastrointestinal parasites compared to males (73.93%). Females were more aware on the knowledge of washing/should wash the food stuffs (fruits and vegetables) before selling and washing of hands with water and soap after toilet compared to males. The difference was statistically significant (p-value < 0.05) (Table 5).

3.6. Awareness on Gastrointestinal Parasites According to Age Groups

The age group of 18-25 years (77.75%) had good knowledge of gastrointestinal parasites compared to 26-33

(75.94%) and 42-49 years (75.94%), 34-41 years (75%), 50-57 years (67.71%) and 58+ years (63.5%). Therefore the age groups under 50 years were more aware on the knowledge of washing/should wash the food stuffs before selling, washing of fruits with running water before eating and washing of hands with water and soap after toilets compared to the age groups over 50 years at significant difference p-values of < 0.05 (Table 6).

3.7. Awareness of Gastrointestinal Parasites According to Educational Level

The results indicated that, those respondents with degree level of education (82.5%) were highly knowledgeable on gastrointestinal parasites compared to diploma level (77.9%), secondary level (77.7%), primary level (70.97%) and informal education (57.5%). Respondents with high educational levels (degree, diploma and secondary) were more aware on the knowledge of clinical signs, washing/should wash the food stuffs before selling, washing of fruits with running water before eating and washing of hands with water and soap after toilets compared to those with low educational levels (primary and informal) at significant difference p-values of < 0.05 (Table 7).

Table 5. Awareness on gastrointestinal parasites according to sex

Awareness regarding gastrointestinal parasites	Correct answers		P-value
	Male n=175 (%)	Female n=225 (%)	
Knowledge on aetiology			
People heard of gastrointestinal parasites.	174 (99.4)	222(98.6)	0.447
Those were able to mention the types of GIT parasites.	24 (13.7)	31(13.78)	0.25
Knowledge on clinical signs			
Symptoms of having GIT parasites infections.	128 (73.14)	150(66.67)	0.163
Knowledge on transmission			
How can a person be infected with gastrointestinal parasites?	141 (80.57)	181 (80.44)	0.975
Knowledge on control practices			
Wash/should wash the food stuffs before selling.	134 (76.57)	213(94.67)	0.000
Washing of fruits with running water before eating.	151 (86.3)	202(89.8)	0.216
Washing of hands with water and soap after toilet.	147 (84)	216(96)	0.000
Cooking of vegetables properly.	136 (77.71)	165(73.33)	0.314

Significant p-values (<0.05) are in bold based on Chi-square test.

Table 6. Awareness of gastrointestinal parasites according to the age groups of respondents

Awareness regarding gastrointestinal parasites	Correct answers (frequency and %)						P-value
	18-25 n=132	26-33 n=106	34-41 n=72	42-49 n=53	50-57 n=24	58+ n=13	
Knowledge on aetiology							
People heard of gastrointestinal parasites.	130 (98.5)	104 (98.1)	72 (100)	53 (100)	24 (100)	13 (100)	0.726
Those were able to mention the types of gastrointestinal parasites	19 (14.4)	16 (15.1)	12 (1.7)	3 (5.7)	4 (16.7)	1 (7.7)	0.335
Knowledge on clinical signs							
Symptoms of having GIT parasites infections.	90 (68.2)	75 (70.8)	51 (70.8)	42(79.2)	14(58.3)	6(46.2)	0.194
Knowledge on transmission							
How can a person be infected with gastrointestinal parasites?	107(81.1)	80(75.5)	61 (84.7)	45 (84.9)	17 (70.8)	12(92.3)	0.327
Knowledge on control practices							
Wash/should wash the food stuffs before selling.	121 (91.67)	96 (90.6)	60(83.3)	47 (88.7)	17 (70.8)	6 (46.2)	0.000
Washing of fruits with running water before Eating	120 (91)	96(90.6)	63 (87.5)	48(90.6)	15 (62.5)	11(84.6)	0.000
Washing of hands with water and soap after toilet.	125(94.7)	99(93.4)	65(90.3)	47(88.7)	19(79.2)	8 (61.5)	0.001
Cooking of vegetables properly	109(82.6)	78(73.6)	48(66.7)	37(69.8)	20(83.3)	9 (69.2)	0.12

Significant p-values (<0.05) are in bold based on Chi-square test.

Table 7. Awareness of gastrointestinal parasites according to educational levels

Awareness regarding gastrointestinal parasites	Correct answers (frequency and %)					P-value
	Primary n=90	Secondary n=277	Diploma n=13	Degree n=5	Informal n=15	
Knowledge on aetiology						
People heard of gastrointestinal parasites	89 (98.9)	274 (98.9)	13 (100)	5 (100)	15 (100)	0.985
Those were able to mention the types of gastrointestinal parasites	8 (8.9)	40 (14.4)	1 (7.7)	2 (40)	4 (26.7)	0.167
Knowledge on clinical signs						
Symptoms of having GIT parasites infections	60 (66.7)	201 (72.6)	9 (69.2)	4(80)	4 (26.7)	0.005
Knowledge on transmission						
How can a person be infected with gastrointestinal parasites?	69(76.7)	229 (82.7)	11 (84.6)	4 (80)	9 (60)	0.212
Knowledge on control practices						
Wash/should wash the food stuffs before selling	74(82.2)	248 (89.5)	13 (100)	5 (100)	7 (46.7)	0.000
Washing of fruits with running water before Eating	70(77.8)	255 (92.1)	13 (100)	5 (100)	10 (66.7)	0.002
Washing of hands with water and soap after toilet	79(87.8)	258 (93.1)	13 (100)	4 (80)	9 (60)	0.000
Cooking of vegetables properly	62(68.88)	216 (77.98)	8 (61.54)	4 (80)	11 (73.33)	0.347

Significant p-value (<0.05) are in bold based on Chi-square test.

4. Discussion

This is the first study carried out to assess the community awareness on the knowledge of aetiology, clinical signs, transmission and control practices in relation to gastrointestinal parasites in Zanzibar.

The findings showed that, the level of awareness of the respondents (75.5%) on gastrointestinal parasites was high. This was in agreement with the findings from similar study in Nigeria whereby more than half of the respondents were aware on gastrointestinal parasites [11]. Similarly, in a study conducted in South Africa and Zimbabwe 91% and 81% respectively indicated the highest awareness on the two communities studied on gastrointestinal and urinary parasites [12]. The high level of awareness found in this study and other reported studies suggest that the community members had good health education on gastrointestinal parasites since these parasites are endemic in their communities [13].

Apart from general awareness, this study also indicated the respondents' awareness on gastrointestinal parasites in relation to the specific variables that assessed the categories of awareness. The results showed that, about 99% of the respondents in this study had already heard of gastrointestinal parasites. This was in contrast to findings reported in Malaysia (61.4%) and Nigeria (35%) according to [14] and [11] respectively. The disparity on response to whether heard or not heard of gastrointestinal parasites might be due to the difference in activeness of the health education strategies taking place in the studied communities to sensitize the communities that gastrointestinal parasites are existing in this world as living organisms [15].

This study observed that community awareness (knowledge) on type of gastrointestinal parasites was low as only 13.75% of the respondents were aware. However, the only mentioned type of gastrointestinal parasites in this study was *Ascaris lumbricoides*. This might be due to the fact that, according to the respondents, the most frequently adult gastrointestinal parasites come out either through the mouth, nose or during defecation is *Ascaris lumbricoides*. But in reality, gastrointestinal parasites range from helminths including *Ascaris lumbricoides* to protozoan parasites [6]. Similar findings have been

reported in Malaysia where only one-tenth of the respondents were aware on the types of gastrointestinal parasites [14]. However, different findings have been reported in Nepal where high proportion of respondents were more aware on the types of gastrointestinal parasites [15]. The difference in the knowledge of knowing various types of gastrointestinal parasites might be due to existing differences in efforts to build awareness through public health education campaigns [15].

Furthermore, about 69.5% of the respondents were aware of signs and symptoms of a person having gastrointestinal parasitic infections. This was in agreement with the studies conducted in Cote d'Ivoire, Brazil and Nigeria reported high awareness on clinical signs concerning gastrointestinal parasitic infections among the respondents [11,16,17] respectively. In contrast findings from Malaysia showed poor knowledge on clinical signs [14]. The discrepancy in awareness on clinical signs towards gastrointestinal parasites might be contributed to the fact that, gastrointestinal parasites differ in terms of infestations where some of the parasites seemed to be symptomatic and others are non-symptomatic [18].

Likewise, knowledge on transmissions was high (80.5%) in this study. This level of awareness was in contrast to report from Bangladesh [19] and Malaysia [14] where only quarter of their respondents were able to mention the ways that lead to the transmissions of gastrointestinal parasitic infections to human. Having high level of knowledge on how gastrointestinal parasites can be transmitted in the communities is advantageous weapon in controlling gastrointestinal parasites in the communities while low level of knowledge on how these parasites can be transmitted substantiate that, the communities are at risk of acquiring gastrointestinal parasitic infections [6].

Additionally, in the present study a high proportion of respondents (86.75%) recognized the importance of washing fruits and vegetables before selling/eating. This was in contrast to studies by [20] and [21] which reported 53.3% and 26.9% of the vendors were washing the fruits and vegetables before selling respectively. Having knowledgeable vendors with regard to control practices is the significant factor for reducing fruits and vegetables contamination at market level [22].

Large proportion of respondents (88.25%) understood the need of washing fruits particularly with running water before eating. This concurs with findings of similar studies in various countries [11,23,24]. However, these findings did not emphasize on washing the fruits with running water style like our study. Washing of fruits and vegetables is very significant in minimizing the chances of parasitic transmission to consumers, since gastrointestinal parasites have been observed to contaminate the fruits and vegetables [25]. Habit of eating fruits and vegetables that are not properly washed and cooked respectively, can trigger the spread of parasitic diseases to human [26].

The present study found that a very high proportion of respondents (90.75%) were aware that hand washing with water and soap after visiting toilets is the means of reducing or avoiding parasitic contamination of fruits and vegetables. This was in agreement with similar studies reported by [5,24,27,28,29,30]. However, this knowledge level was higher than 45% of respondents who acknowledged the same aspect of knowledge as reported by [31]. Habits of proper hand washing with water and soap may assist to prevent and control infectious diseases caused by microorganisms including gastrointestinal parasites [32].

Awareness on cooking style of vegetables was also observed in this study where high proportion (75.25%) of respondents confirmed that they cook the vegetables thoroughly. This is consistent with findings reported by [11] where a very high proportion of respondents (97%) substantiated that they cook their vegetables properly before eating. Proper cooking of vegetables is of paramount importance since it assists to kill infectious pathogens that are found on vegetables and making the vegetables to be fit for human consumption [33].

In accordance with locations, the findings indicated that a large proportion of respondents from Unguja (77%) were more aware in most of the aspects probed with respect to gastrointestinal parasites compared to Pemba (73.44%). This could be due to differences in terms of social and economic status of the people between communities [14].

This study reported that consumers (77.35%) were more aware of gastrointestinal parasites compared to vendors (64.74%) of fruits and vegetables. The high level of awareness shown by consumers could be attributed probably due to their high level of education compared to vendors. Therefore high level of awareness shown by consumers could help them to be free from gastrointestinal parasites infections that can be attributed by consumption of contaminated fruits and vegetables [31].

Based on the sex, females (76.67%) were more aware of gastrointestinal parasites compared to males (73.93%). The high level of awareness shown by females in this study is probably due to the fact that, females are the ones that take care of the families and prepare the food for the families. Also, more women stay indoors than men and this factor probably may prioritize the women to have enough time to listen and watching different public health education programmes through radio and television concerning personal hygiene, environmental hygiene and food hygiene as powerful tools to combat against epidemiology and transmission of parasitic diseases to the community.

The age groups of respondents under 50 years were found to be more aware of gastrointestinal parasites compared to over 50 years. This could be probably attributed due to the fact that respondents may differ in terms of educational level, ownership of radio and personal exposure to social media.

This study indicated that, awareness was increased with increased level of education and it was decreased with decreased level of education. Similar study conducted in Malaysia showed that more educated respondents were more aware of gastrointestinal parasites compared to illiterate individuals [14]. Similarly, the study carried out in Bangladesh showed the same results that respondents with high levels of education were more aware of the knowledge and practices concerning gastrointestinal parasites [34]. Furthermore, a previous study conducted in Iran confirmed that higher education of mothers was associated with reduction of infection rate to their children [35]. In addition, a study conducted in Kenya indicated that respondents with high educational levels were more aware of intestinal worms [18]. Educational level is the significant factor in understanding health protocols in the struggle for controlling gastrointestinal parasitic diseases in the community [2].

5. Conclusion

The findings of this study indicated the high level of awareness of the community on transmission and control practices with regard to gastrointestinal parasites contamination on fruits and vegetables. However, the awareness seemed to differ in terms of geographical locations (Unguja and Pemba), occupation (vendors and consumers), sex (males and females), age groups and educational level. Therefore, a good level of community awareness with regard to gastrointestinal parasites in this study has been documented to determine the success of gastrointestinal parasites control programmes worldwide, hence global development and attainment of millennium development goals.

6. Recommendations

- i. Public health education should continue to be provided in order to remind the community frequently that, washing the fruits with running water before eating, washing hands before and after meals, washing hands with water and soap after visiting toilets and cooking the vegetables properly are very important factors to avoid parasitological, bacterial and viral infectious diseases.
- ii. Personal hygiene and sanitation, washing the fruits and vegetables with clean water before selling and to avoid selling the food stuffs on the floor especially along the road sides should be considered and practiced by all vendors to avoid infectious diseases to the community.
- iii. Municipal council officers should make sure that clean water is available all the time at the markets that can be utilized by vendors and buyers for various purposes to safeguard the public health.

- iv. There should be a special public health awareness campaign to educate the school-aged children about the transmission and control of gastrointestinal parasites through consumption of fruits and raw vegetables since children are vulnerable group to GIT parasites infections in the community.

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Conflicts of Interest

There are no conflicts of interest among the authors in this study

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References

- [1] Poiroux-Gonord, F., Bidel, L P., Fanciullino, A. L., Gautier, H., Lauri-Lopez, F. and Urban, L. Health benefits of vitamins and secondary metabolites of fruits and vegetables and prospects to increase their concentrations by agronomic approaches. *Journal of Agriculture Food Chemistry*. 2010; 58(23): 12065-12082.
- [2] Agbalaka, P. I., Ejinaka, O. R., Yakubu, D. P., Obeta, U. M., Jwansa, R. I. and Dawet, A. Prevalence of parasites of public health significance in vegetables sold in Jos metropolis, Plateau State, Nigeria. *American Journal of Public Health*. 2019; 7(2): 48-57.
- [3] Al-Binali, A. M., Bello, C. S., EleShewy, K. and Abdulla, S. E. The prevalence of parasites in commonly used leafy vegetables in South Western, Saudi Arabia. *Saudi Medical Journal*. 2006; 27(5): 613-616.
- [4] Fagbenro, M. T., Mogaji, H. O., Oluwole, A. S., Adeniran, A. A., Alabi, O. M. and Ekpo, U. F. Prevalence of parasites found on vegetables and perception of retailers and consumers about contamination in Abeokuta Area of Ogun State, Nigeria. *Clinical Microbiology Case Report*. 2016; 2: 1-5.
- [5] Sara, A. I., Saad, Al-Jadidi, J., Al-Sulaiman, N., Al-Qahtani, J. and Ashour, D. Potential risk factors of intestinal parasitic infection in Al Ahssa. *Saudi Arabia*. 2018: 3521-3525.
- [6] Kiani, H., Haghghi, A., Rostami, A., Azargashb, E., Tabaei, S. J. S., Solgi, A. and Zebardast, N. (2016). Prevalence, risk factors and symptoms associated to intestinal parasite infections among patients with gastrointestinal disorders in Nahavand, Western Iran. *Tropical de São Paulo*. 2016: 1-58.
- [7] Bogoch, I. I., Speich, B., Lo, N. C., Moser, W., Croll, D., Ali, S. M. and Keiser, J. „Clinical evaluation for morbidity associated with soil-transmitted helminth infection in school-age children on Pemba Island, Tanzania. *PLoS Neglected Tropical Diseases*. 2019. 13(7): e0007581.
- [8] Mchenga, S. S. and Abubakar, Z. M. Assay on Vegetable Production and Marketing in Zanzibar Island, Tanzania. *International Journal of Environmental Agriculture*. 2016; 2(4): 53-58.
- [9] URT. *National Population and House Census of Tanzania*. National Bureau of Statistics, Dar es Salaam, Tanzania. 2012.
- [10] Tejada, J. J. and Punzalan, J. R. B On the Misuse of Slovin's Formula 61. 2012; (1): 129-136.
- [11] Abe, E. M., Ajah, L. J., Ayuba, S. O., Mogaji, H. and Ekpo, U. F. Geohelminths contamination of fruits and vegetables sold in Lafia markets. *Annual Research and Review in Biology*. 2016; 11(2): 1-8.
- [12] Mbereko, A., Chimbari, M. J., Manyangadze, T. and Mukaratirwa, S. Knowledge and perceptions of schistosomiasis, a water-borne disease, in two semi-arid rural areas of South Africa (Ndumo) and Zimbabwe (Ntalale). *Food and Waterborne Parasitology*. 2020; 21: 1-9.
- [13] Magaisa, K., Taylor, M., Kjetland, E. F. and Naidoo, P. J. A review of the control of schistosomiasis in South Africa. *South Africa Journal of Science*. 2015; 111: 1-6.
- [14] Nasr, N. A., Al-Mekhlafi, H. M., Ahmed, A., Roslan, M. A. and Bulgiba, A. Towards an effective control programme of soil-transmitted helminth infections among Orang Asli in rural Malaysia. Knowledge, attitude, and practices. *Parasites and Vectors*. 2013; 6(1): 1-12.
- [15] Williams-Blangero, S., Subedi, J., Uphadhayay, R., Manral, D., Khadka, K., Jirel, S., Yenealem, D. G., Yallow, W. W. and Abdulmajid, S. Food safety practice and associated factors among meat handlers in gondar town: a cross-sectional study. *Journal of Environmental and Public Health*. 2020: 1-7.
- [16] Acka, C. A., Raso, G., N'Goran, E. K., Tschannen, A. B., Bogoch, I., Seraphin, E., Tanner, M., Obrist, B. and Utzinger, J. Parasitic worms: knowledge, attitudes, and practices in western Cote d'Ivoire with implications for integrated control. *PLoS Neglected Tropical Disease*. 2010; 4(12): 1-14.
- [17] Midzi, N., Mtapuri-Zinyowera, S., Mappingure, M. P., Paul, N. H., Sangweme, D., Hlerema, G., Mutsaka, M. J., Tongogara, F., Makware, G., Chadukura, V., Brouwer, K. C., Mutapi, F., Kumar, N. and Mduluzi, T. Knowledge, attitudes and practices of grade three primary schoolchildren in relation to schistosomiasis, soil-transmitted helminthiasis and malaria in Zimbabwe. *BioMed Central Infection Disease*. 2011; 11(1): 1-10.
- [18] Kamunvi, F. and Ferguson, A. G. Knowledge, attitudes and practices of human intestinal helminths (worms) in two rural communities in Nyanza Province, western Kenya. *East African Medicine Journal*. 1993; 70: 482-490.
- [19] Mascie-Taylor, C., Karim, R., Karim, E., Ahmed, T. and Montanari, R. The cost- effectiveness of health education in improving knowledge and awareness about intestinal parasites in rural Bangladesh. *Economic Human Biology*. 2003; 1: 321-330.
- [20] Salamandane, C., Fonseca, F., Afonso, S., Lobo, M. L., Antunes, F. and Matos, O. Handling of fresh vegetables: Knowledge, hygienic behavior of vendors, public health in Maputo markets, Mozambique. *International Journal of Environmental Research and Public Health*. 2020; 17: 1-17.
- [21] Tefera, T. and Mebrie, G. Prevalence and predictors of intestinal parasites among food handlers in Yebu Town, Southwest Ethiopia. *PLoS One*. 2014; 9(10): 1-5.
- [22] Oranusi, U. S. and Braide, W. Microbiological Safety assessment of ready-to-eat food vended on the highway; Onitsha-Owerri, South East. *Nigerian International Research journal of Microbiology*. 2012; 3(2): 66-72.
- [23] Sharif, L. and Al-Malki, T. Knowledge, attitude and practice of Taif University students on food poisoning. *Food Control*. 2010; 21(1): 55-60.
- [24] Rakshna, M., Parasuraman, G., Dutta, R. and Jain, T. A study on the knowledge, attitude and practices of food hygiene among school going children aged between 11 to 15 years in Chennai, Tamil Nadu. *Annals of Tropical Medicine and Public Health*. 2020; 23: 232-385.
- [25] Ogun State. Prevalence of parasites found on vegetables, and perception of retailers and consumers about contamination in abeokuta area of Ogun State, Nigeria". *Clinical Microbiology and Case Reports*. 2016; 2(1): 1-5.
- [26] Centers for Disease Control and Prevention (2014). About parasites. centers for disease control and prevention. [<http://www.cdc.gov/parasites/about.html#infections>] site visited on 20/7/2021.
- [27] Vivas, A., Gelaye, B., Aboset, N., Kumie, A., Berhane, Y. and Williams, M. A. Knowledge, attitudes, and practices of hygiene among school children in Angolela, Ethiopia. *Journal of Preventive Medicine and Hygiene*. 2010; 51(2): 73-79.
- [28] Nee, S. O. and Sani, N. A. Assessment of knowledge, attitudes and practices (KAP) among food handlers at residential colleges

- and canteen regarding food safety. *Sains Malaysiana*. 2011; 40(4): 403-410.
- [29] Tegegne, H. A. and Phyto, H. W. Food safety knowledge, attitude and practices of meat handler in abattoir and retail meat shops of Jigjiga Town, Ethiopia. *Journal of Preventive Medicine and Hygiene*. 2017; 58: 320-327.
- [30] Ajibo, F. E., Njoga, E. O., Azor, N., Idika, I. K. and Nwanta, J. A. Epidemiology of infections with zoonotic pig parasites in Enugu State, Nigeria. *Veterinary Parasitology: Regional Studies and Reports*. 2020; 20: 100-397.
- [31] Tosin, O. T., Ogunniyi, T. and Seun, O. J. Human Enteric Parasitic Pathogens in Fresh Fruits and Vegetables Consumed in Ile-Ife, Osun State. *Food Science and Quality Management*. 2017; 67: 34-41.
- [32] Gelaw, A. and Anagaw, B. N. Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. *BioMed Central Public Health*. 2013; 13(1): 1-7.
- [33] Okoli, C. E., Njoga, E. O., Enem, S. I., Godwin, E. E., Nwanta, J. A. and Chah, K. F. Prevalence, toxigenic potential and antimicrobial susceptibility profile of *Staphylococcus* isolated from ready-to-eat meats. *Veterinary World*. 2018; 11: 1214-1221.
- [34] Bath, J. L., Eneh, P. N., Bakken, A. J., Knox, M. E., Schiedt, M. D. and Campbell, J. M. The impact of perception and knowledge on the treatment and prevention of intestinal worms in the Manikganj district of Bangladesh. *Yale Journal of Biology Medicine*. 2010; 83: 171-184.
- [35] Nematian, J., Nematian, E., Gholamrezanezhad, A. and Asgari, A. A. Prevalence of intestinal parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students. *Acta Tropical*. 2004; 3: 179-186.



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