



Prevalence of Giardiasis among Food Handlers at Sabrin Market- Karary Locality, Khartoum State, Sudan

Ghufran Mohammed Elameen Almahi¹, Abd Elbasit Elawad Mohammed Ahmed¹,
Eltigani OM Omer², Arafat M. Goja³, Tahani Babeekir⁴, Mohammed Suleiman
Zaroog^{2,5*}, Awad-Elkareem Abass⁶

¹Department of Epidemiology, Faculty of Public and Environmental Health, University of Khartoum, Sudan.

²Department of Community Health, College of Applied Medical Sciences, Northern Border University, KSA.

³Department of Clinical Nutrition, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, P.O. Box 1982, Dammam, Saudi Arabia

⁴Department of Public Health, College of Nursing and Health Science, University of Jazan, KSA

⁵Center for Health Research, Northern Border University, Arar, Saudi Arabia

⁶Department of Medical Laboratory Technology, College of Applied Medical Sciences, Northern Border University, Arar, Saudi Arabia

Abstract

Background: Intestinal giardia, a common pathogenic protozoan with prevalence 2%-5% in developed and 10%-50% in developing countries annually.

Methods: This cross-sectional study conducted at Sabrin Market, Karary Locality, Khartoum State, Sudan, aiming to measure the prevalence of giardiasis among food handlers in all food premises, 182 participants randomly selected. Questionnaire, observation, and laboratory testing were used for data collection.

Results: Results revealed a high giardiasis prevalence of 68.1% among food handlers, with most cases (44.4%) in cafeterias, (36.3%) popular food venues and (19.3%) in restaurants. Notably, 92.7% of infected handlers were in the cyst stage. About 56.6% of handlers were aware of giardiasis, and 17.6% reported previous infection of the giardiasis. Hygiene practices varied among the study population, with 11% not washing hands at all, 87.4% not wearing gloves, 63.7% lacked head covers, and 42.4% did not wear clean aprons. (39.6%) with dirty and uncut nails, (58.8%) wear accessories. Additionally, (29.1%) were smokers and significant number (69.1%) do not have valid health card. Environmental conditions were also poor; about (96.8%) of food premises lacked latrines, and 79% were not equipped with sinks. Among those with sinks, 84.6% did not have soap. House flies were present in 85.5% of the premises, and 80.6% had other insects like cockroaches. Giardiasis prevalence revealed a significant association with factors such as sex, age, educational level, income, knowledge, and hand washing practices.

Conclusion: we concluded that poor hygiene practices, lack of latrines, insufficient sinks, inadequate knowledge, and lack of facilities contributed to the high giardiasis prevalence. Recommendations treating the infected, establishing latrines, providing sinks with detergents for utensils and hands washing. Improving facilities, enforcing hygiene regulations, and enhancing knowledge about giardiasis among food handlers.

Keywords: Giardiasis; Food handlers; Food premises; Sudan.

1. Introduction

Giardiasis a tiny parasite, it is one of the neglected diseases [1], caused by *Giardia lamblia*, which is one of the major gastrointestinal infections associated with morbidity and mortality world wide, and associated with poor hygiene and transmitted through ingestion of sufficient numbers of a pathogen to cause illness [2], [3]

Developing countries show higher infection, more than 200 million cases of giardiasis are annually diagnosed worldwide, frequently reported in association with water and food borne outbreaks affecting about 280 million people worldwide with some 500,000 (incidence) new symptomatic cases reported annually in developing countries [4]. Giardiasis prevalence rates in developing countries ranging from 10 to 50%, and from 2 to 5% in the developed countries [5].

[5] reported the waterborne outbreaks been that largest method associated with the prevalence of *Giardia* among food handlers who attending the public health laboratory in Khartoum for annual medical check – ups, that (74.8%), of outbreaks resulted from waterborne food borne, (15.7%), person to-person (2.5%), and only (1.2%) from animal contact [6], [7].

Food handlers serve as both reservoirs and sources of infection. Limited health education and lack of personal hygiene can lead to fecal contamination of food by hands during food preparation, and implicated in the transmission of many infections to their consumers in their community [8].

Recently, quality control measures, stringent supervision of production processes, and minimizing contact with food and its various categories during production have emerged as critical factors in ensuring the production of high-quality food products. Food handlers play a critical role as the final agents in the food supply chain, with their actions having the potential to compromise food safety and make products unsafe for consumption [8]

In many developing countries, *Giardia* infections have been closely linked to inadequate hygiene, poor toilet sanitation, overcrowded living conditions, and low level of socioeconomic. *Giardia* was high prevalence among

children and become a significant public health concern due to its documented long-term effects. Notably, persistent *Giardia* infections have been increasingly associated with impaired growth and development in children, highlighting the severity of its impact [9].

While waterborne transmission remains the most common route of *Giardia* infection, other mechanisms of transmission are also significant. These include transmission through contaminated food, direct fecal-oral contact among family members, person-to-person interactions, and sexual contact [10]. Once a person or an animal has been infected with *Giardia*, the parasite lives in the intestines and is passed in stool [11].

Surveillance data indicate that giardiasis exhibits a bimodal age distribution, with incidence rates peaking among individuals aged 0–9 years and 45–49 years, and no significant differences in prevalence between genders. In endemic regions, giardiasis often follows a seasonal pattern, with most cases occurring during summer. This seasonality is frequently associated with behaviors such as consuming untreated surface water and engaging in recreational activities like swimming in lakes, ponds, or other natural freshwater bodies. Additional risk factors in endemic areas include residing in regions reliant on high-risk water sources, such as surface water whether filtered or unfiltered, unfiltered shallow well water, or living in rural settings [9].

Risk factors:

Food handlers, personal hygiene, hand hygiene, food hygiene, food safety and environmental sanitation are the main important risk factors contaminating and causing food borne giardiasis.

According to [12] and [13], food handlers can harbor various microorganisms capable of contaminating food during preparation, processing, packaging, and transport. Their role is therefore critical in minimizing the risk of product contamination. Potential sources of infection include staff-related factors such as breathing, saliva, and wounds, as well as external factors like hands, clothing, hair, facial hair, and accessories.

At a personal level, Food handlers must maintain optimal personal health, ensuring they are free from respiratory issues, gastrointestinal illnesses, wounds, or infections [14]. A food handler should maintain proper hygiene by keeping nails trimmed and clean, shaving facial hair (for males), and ensuring hair is washed and secured under a cap or scarf [5].

One of the most important promotion measures to avoid the transmission of harmful germs including giardia is hand hygiene that, prevent health care-associate defections [15]. Everyone should wash their hands before preparing or serving food or drinks [15].

In clinical settings, using an alcohol-based hand rub after thorough handwashing can reduce residual organisms remaining on the hands following fecal soiling [15].

Good food hygiene practices mean ensuring customer satisfaction, a safe and clean workplace, and compliance with legal regulations. Conversely, poor food hygiene practices can result in food contamination and outbreaks of foodborne illnesses [16].

To implement key principles of food hygiene, it is essential to maintain high standards of cleanliness and personal hygiene, prevent cross-contamination, ensure proper storage conditions, clean and sanitize all utensils and equipment, and control pests [15].

Producing safe food is essential to protect consumer from the hazards of food borne illnesses and to increase competitiveness in the both the domestic and international markets [17].

Contamination can occur at any stage between production and consumption, including harvesting, packaging, selling, and the preparation of food into a final meal. Additionally, occupational health risks arise from farmers' exposure during harvesting and the subsequent handling and transportation of vegetables from production sites to markets. [18].

Maintaining a clean work environment is essential for preventing foodborne illnesses. Bacteria can proliferate on unsanitary surfaces, leading to the contamination of food [16]. Sanitation practices in restaurants are crucial for reducing direct and cross-contamination of food and also for enhancing worker morale and proficiency, as well as improving customer satisfaction from an aesthetic perspective [19].

All equipment must be regularly cleaned and inspected, as older equipment may have crevices where dirt and bacteria can accumulate, making effective cleaning challenging. Proper cleaning procedures should be established, followed consistently, and periodically reviewed to ensure their effectiveness. Rodents transmit diseases through their feces or urine, which can contaminate food, utensils, equipment, and food contact surfaces. To prevent rodent infestations, it is essential to maintain a clean facility and eliminate potential food and water sources. Cockroaches contaminate food and surfaces by crawling over unsanitary areas, such as garbage. To prevent cockroach infestations, it is important to maintain cleanliness, remove food sources, and seal any gaps, cracks, or crevices that may provide shelter [17].

The employer's responsibilities start in the staff recruitment process. The staff should be sure that they are free from infections. Regular inspections by health authorities are necessary, and personnel who are ill should be prohibited from working. Health assessments should include x-rays, blood tests, parasite screenings, and tuberculin tests [16].

Restaurant inspections should promote awareness of food sanitation and safety among both patrons and food handlers. Factors affecting the consistency and reliability of routine inspections by health inspectors should be addressed through policies and regulations that mandate periodic training, regular inspections, and standardized evaluation procedures [12].

A study conducted by [20] in Turkey found the most common protozoan was *G.intestinal* with prevalence of (22.53%) , It was observed that factors such as the education level of food handlers, poor economic conditions, households with seven or more members, failure to wash hands after using the toilet, improper handwashing techniques, a family history of parasitic infections, and food handlers aged over 40 were most consistently associated with an increased risk of intestinal parasitic infections (P value < 0.05). The intestinal parasitic infections were significantly associated with education level of food handlers. Additionally, food handlers from overcrowded families were found to have a higher incidence of intestinal parasite infections compared to those from households with five or fewer members.

A study carried in Iran by [21] among food handlers and childcare workers, with giardiasis revealed that 69 sample were infected with giardia lambila. Among (36%) were related to the food handlers and occupations which found most frequently associated with their food, (1.44%) nurse, (1.44%) managing director of the nursery, (2.89%) housekeepers and servants (1.44%). In Nigeria [22] revealed that (97%) of the food vendors were infected with one or more faecal orally transmissible parasites of the observed parasites giardia duodenal was represent (13%). In Khartoum capital of Sudan [23] reported the prevalence of Giardia lamblia/ Helicobacterpylori and co-infections. The study showed that the prevalence rate of G.lambila by using direct wet mount according to age groups (<18), (18-28),(29-39),(40-50),(50-60),and (>60) years old were (20.6%), (9.4%), (42.6%), (13.2%), (2%) and (13.1%) respectively (P 0.053), out of (14%) positive cases for G.lambila , (50%) with low level of education, while (50%) with high level of education . An another study carried by [24] at Elhassahisa town – Gezira state – Sudan, showed that a group of food handlers (20.7%) were infected with giardiasis, and the majority (90.7%) of the infected food handlers were found in cyst form. A group of food handlers (12%) in the age range of (32-45) years were infected with giardiasis; a group of the food handlers (30.3%) knew giardiasis. most of the food handlers (96.6%) washed their hands before eating, (96.6%) washed their hands before preparing foods and (82.2%) washed their hand after latrine. Small groups of food handles (6.7%) mentioned they previously were infected with giardiasis.

Results

This descriptive Market based study was conduct in Sabrin Market – Karary Locality to study the prevalence of giardiasis among food handlers. The study revealed the following findings as explained in the below tables and figures:

Table 1: Socio- demographic characteristics of the food handlers - Sabrin Market at Karary Locality 2021

Sex	No	%
Male	129	70.9
Female	53	29.1
Total	182	100
Marital status	No	%
Married	88	48.4
Single	81	44.5
Divorced	8	4.4
Widowed	5	2.7
Total	182	100
Nationality	No	%
Sudanese	148	81.3
Foreign	34	18.7
Total	182	100
Religion	No	%
Muslim	175	96.15
Non-Muslim	7	3.85
Total	182	100
Age / year	No	%
<18	5	2.7
18-31	111	61.0
32-45	62	34.1
>45	4	2.2
Total	182	100
Educational level	No	%
Illiterate	31	17.0
Khalwa	14	7.7
Primary /basic	89	48.9
Secondary	38	20.9
University and above	10	5.5

Total	182	100
Family size / Individual	No	%
< 6	54	29.7
6	29	15.9
> 6	99	54.4
Total	182	100
Family income /month/SDG	No	%
<15	7	3.9
15	25	13.7
>15	150	82.4
Total	182	100
Shift work / hours	No	%
< 8	10	5.5
8	45	24.7
> 8	127	69.8
Total	182	100

Table 1: show the social and demographic characteristics of the food handlers.

Table 2: Prevalence of giardiasis among food handlers by person, premises and species - Sabrin Market at Karary Locality Khartoum / Sudan 2021

Prevalence of giardiasis among food handlers -	Result	No	%
	Positive	124	68.1
	Negative	58	31.9
	Total	182	100
Prevalence of giardiasis among food handlers according to their premises	Premises	No	%
	Cafeterias	55	44.4
	Popular food	45	36.3
	Restaurants	24	19.3
	Total	124	100
Species form of giardia parasite among infected food handlers	Forms	No	%
	Trophozoite	9	7.3
	Cyst	115	92.7
	Two forms	0	0
	Total	124	100

Table 2 shows that 68.1 % of the food handlers reported that they were infected with giardiasis. The table also shows that 44.4 % of the food handlers who work at cafeterias were infected with giardiasis. Table 2 also reveals that 7.3% of the infected food handlers with Trophozoites form, 92.7% in Cysts form

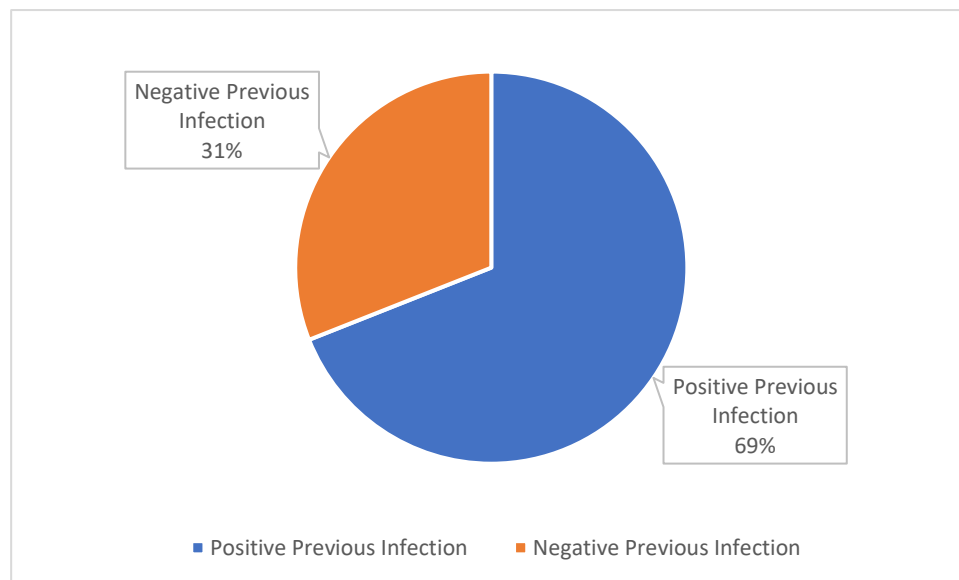


Fig. 1: Previous infection with giardiasis as mentioned by food handlers - Sabrin Market at Karary Locality

Fig. 1 showed that 31.1% of food handlers mentioned they had giardiasis before and 68.9% didn't had giardiasis before, (100%) of food handlers those had pervious infection with giardiasis taken the treatment

Table 3: Knowledge Status of the food handlers about giardiasis - Sabrin Market at Karary Locality_ Khartoum State Sudan 2021

	Know	No	%
Knowledge about giardiasis	Yes	103	56.6
	No	79	43.4
	Total	182	100
Knowledge about the system affected by giardiasis	System	No	%
	Digestive system	20	19.4
	Nervous system	40	38.9
	Respiratory system	43	41.7
	Total	103	100
Knowledge about causative agent of giardiasis	Had	NO	%
	Yes	90	87.4
	No	13	12.6
	Total	103	100
Knowledge about the type of the causative agent of giardiasis	Types	No	%
	Parasites	25	27.8
	Viruses	5	5.6
	Bacteria	50	55.5
	don't know	10	11.1
	Total	90	100
Knowledge about symptoms of giardiasis	Had symptoms	No	%
	Yes	80	77.7
	No	23	22.3
	Total	103	100
Knowledge about complication giardiasis	Had	No	%
	Yes	63	61.2
	No	40	38.8
	Total	103	100
Knowledge whether giardiasis communicable disease	Communicable	No	%
	Yes	90	87.4
	No	13	12.6
	TOTAL	103	100
Knowledge about giardiasis is preventable diseases	Prevented	No	%
	Yes	74	71.8
	No	29	28.2
	Total	103	100

	Treatment	No	%
Knowledge about treatment of giardiasis	Yes	95	92.2
	No	8	7.8
	Total	103	100

Table 3 showed that 56.6% of food handlers knew what giardiasis is and 43.4 % of food handlers lacked correct knowledge about the disease. Among the food handlers who knew giardiasis only 19.4% have knowledge and mentioned the affected system is digestive system.

While 87.4% of food handlers who knew giardiasis mentioned that giardiasis had a causative agent, but only 27.8% of them knew that giardiasis had a causative agent is parasite.

Among the food handlers who knew giardiasis about 77.7% mentioned that giardiasis had symptoms, of them only 25% mentioned diarrhea as one of symptoms, about 61.2 % of food handlers who knew giardiasis mentioned giardiasis had complications and 33.3% of the food handlers who knew giardiasis had complication mentioned dehydration as a complication

About 87.4% of food handlers mention giardiasis is a communicable disease, and 55.5% of food handlers who knew giardiasis was communicable disease mentioned contaminated food and water as mode of giardiasis transmission.

Among food handlers 71.8% mentioned giardiasis can be prevented but only 12.2 % of food handlers mentioned giardiasis can be prevented by avoids contaminated food and 40.5 % by washing their hands with water and soap. About 92.2% of food handlers mentioned that giardiasis had treatment, of them 63.2% mentioned medical treatment and 15.8% mentioned it had traditional treatment

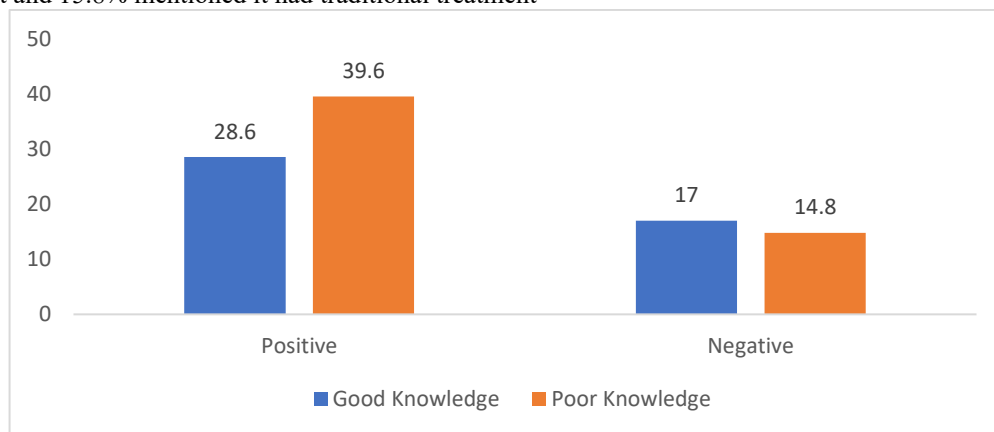


Fig. 2: The association between the prevalence of giardiasis among food handlers and their knowledge status about giardiasis - Sabrin Market at Karary Locality

Fig. 2, showed a significant association between prevalence of giardiasis among food handlers and their knowledge about giardiasis with (P value =0.00)

Table 4: The association between the prevalence of giardiasis among food handlers and some of their demographic parameters - Sabrin Market at Karary Locality 2021

	Giardia				Total	
	Positive		Negative			
	No	%	No	%	No	%
Sex						
Male	87	47.8	42	23	129	70.9
Female	37	20.3	16	8.8	53	29.1
Total	124	68.1	58	31.9	182	100
Age						
>18	4	2.2	1	0.55	5	2.7
18-31	76	41.7	35	19.23	111	61
32-45	41	22.6	21	11.5	62	34
45<	3	1.6	1	0.55	4	2.2
Total	124	68.1	58	31.9	182	100
Educational level						
Illiterate	21	11.5	10	5.5	31	17
Khalwa	10	5.5	4	2.2	14	7.7
primary /basic	60	33	29	15.9	89	48.9
Secondary	26	14.3	12	6.6	38	20.9
university and above	7	3.8	3	1.6	10	5.5

Total	124	68.1	58	31.9	182	100
Income/ SDG						
<15	2	2.7	2	1.59	7	3.9
15	19	10.4	6	3.3	25	13.7
>15	100	54.9	50	27.47	150	82.4
Total	124	68.1	58	31.9	182	100

Table 4 showed a significant association between prevalence of giardiasis among food handlers and their sex with (P value =0.02), and their age with (P value =0.01). Educational level also was significantly associated with prevalence of giardiasis among food handlers in Sabrin Market at Karary Locality. Income also showed significant association with the prevalence of giardiasis among food handlers with (P value = 0.04)

Discussion

The study showed that the prevalence of giardiasis among food handlers was (68.1%), this finding is similar but higher than the findings of study carried by [24] who found that the prevalence of giardiasis was (20.7%) among food handlers.

The study revealed that (92.7%) of the infected food handlers were in cysts form, this finding is like findings of study carried out by [24] who found (90.7%) of the infected food handlers were in cysts form.

The study showed that the distribution of infection with giardiasis among food handlers according to their age group (<18), (18-31), (32-45), (>45) years were (2.7%), (61.0%), (34.1%) and (2.2%) respectively, this finding is similar to findings of the study carried by [24] who find that the prevalence rate of giardiasis according to the age groups (<18), (18-32), (32-45), (>45) years were (16.3%), (40.4%), (37.5%) and (5.8%) respectively. The study results revealed most of the food handlers (61.0%) were in the age group (18-31) years, this finding is similar but higher than the study done by [24] who found that (40.4%) of the food handlers in the age group (18-31) years old.

Many of the food handlers (48.4%) were married, and this result showed few differing from the study that was conducted by [24] who found (57.5%) of the food handlers were single.

The study showed more than half of the food handlers (56.6%) knew giardiasis. These findings were similar but higher than what [25] presented who found that (44.4%) of the food handlers knew giardiasis.

The study revealed that (27.1%) of the food handlers washed their hands before eating, (8.0%) washed their hands before preparing food and (12.9%) washed their hands after latrines. These findings are similar but less than the study stated by [20] who found that (89.7%) of food handles washed their hands before eating and preparing food and (73.4%) washed their hands after using latrine.

The study showed that (11%) of the food handlers didn't wash their hands. this finding is not in line with [5] which approved that a food handler must thoroughly wash their hands with soap and water before handling food. This procedure should be followed by any activity that may lead to hand contamination.

The study showed that (72.8%) of the food handlers usually used water and soap to wash their hands, which is similar, but more than the findings of a study carried out by [24] who found that (4.8 %) of the food handlers used water and soap to wash their hands.

The study showed that (31.0%) of the food handlers were infected previously with giardiasis (Fig. 1). This finding is similar but higher than the study carried out by Awad E.W, 2017 [24] who found that (6.7%) of the food handlers were infected previously with giardiasis.

The study showed (30.8%) of the food handlers had valid health cards. This finding is similar to but less than the finding of a study done by [24] who found (81.7%) of the food handlers had valid health cards.

The study showed that (87.4%) of the food handlers didn't wear gloves, (63.7%) didn't wear head covers and (81.9%) of them didn't wear an apron and (51.5%) of those who wear an apron were wearing white aprons. These findings are not in line with [5] which approved that appropriate clothing for food handlers a cap that cover the hair entirely to prevent hair from falling, a light – colored jacket worn solely in the work area, an apron and gloves. The study showed that (41.2%) of the food handlers were wearing accessories. This finding is not in line with [5] which approved that jewelry could serve as a source of contamination, as it may harbor microbes and dirt accumulated during daily activities. Therefore, food handlers should refrain from wearing jewelry while working. The study showed that (39.6%) of the food handlers didn't trim their nails. This finding is not in line with [5] which approved that the food handler should keep nails trimmed and clean.

The study showed that (29.1%) of the food handlers were smokers. This finding is not in line with [5] which approved that smoking is prohibited in any area where food is received, stored, prepared, transported, or served.

The study showed there was a significant association between the prevalence of giardiasis among food handlers and their age (P value =0.01). This finding is similar to the findings of a study conduct by [24] who found that there was a significant association between the infection with giardiasis among food handlers and their age (P value 0.02).

The study showed there was a significant association between the prevalence of giardiasis among food handlers and their knowledge (P value = 0.00). This finding is opposite to study done by [24] who found that there were no associations between the infection with giardiasis among food handlers and their knowledge (P value = 0.13). The study showed that there was a significant association between the prevalence of giardiasis among food

handlers and their educational level (P value = 0.01). This finding is like study done by [24] who found that there was significant association between the infection with giardiasis among food handlers and their educational level (P value = 0.01).

The study showed there was no association between the prevalence of giardiasis among food handlers and their family size (P value = 0.88). This finding is opposite to study done by [24] who found that there was significant association between the infection with giardiasis among food handlers and their family size (P value = 0.03).

Conclusion

This is a descriptive market-based study was conducted in Sabrin Market – Karary Locality _ Sudan with an objective to study the prevalence of Giardiasis among food handlers in food premises at Sabrin Market. It concluded that the prevalence of giardiasis among food handlers was (68.1%), which is higher than the findings of previous study carried by (Awad, 2017) who found that the prevalence of giardiasis was (20.7%) among food handlers. This result indicates the increasing of this public health problem and urgent interventions recommended to be taken by the health authority in this area to cope the problem. The highest infected food handlers were reported among work at restaurants. (92%7) and followed among workers at cafeterias, (36.3%). Gender, age group, family size, family income and exposed to previous infection along with knowledge about the causes, its transmission, treatment and its preventions measures were the most common risk factors revealed significant association associated with the prevalence of giardiasis among the food handlers at Sabrin Market. Some practices and behaviors of food handlers at Sabrin Market such as washing hands before eating, after eating, after visiting latrine and before preparing food meals and washing the utensils with Soap and Water, also were associated with the disease prevalence. Wearing gloves, wearing head cover, dirty and uncut nails, food handlers wearing accessories, smoking, store drinking water in barrels, present of house flies and different insects as cockroaches, in the food premises at Sabrin Market and the practice of solid waste collection in bags and thronging them on street, also were some of the most risk behaviors and practices associated with the giardiasis prevalence among the food handler at Sabrin Market – Karary Locality

Based on its findings this study listed many recommendation such as treatment and medical care for the infected food handlers is so essential, provision of latrines, sinks with water and detergents for all food premises, Food handler should adhere to food hygiene standards and regulations as wearing gloves, head cover and apron, keeping their nails clean and trim, not allow to smoke in food premises and avoid wearing accessories.

Sabrin Market – Karary Locality authority should provide health education and hygiene education programs to increase the awareness among the food handlers about giardiasis, personal hygiene with emphasis on hand washing and also food hygiene and food contamination. The authorities must prohibit work for all food handlers who do not have health cards.

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