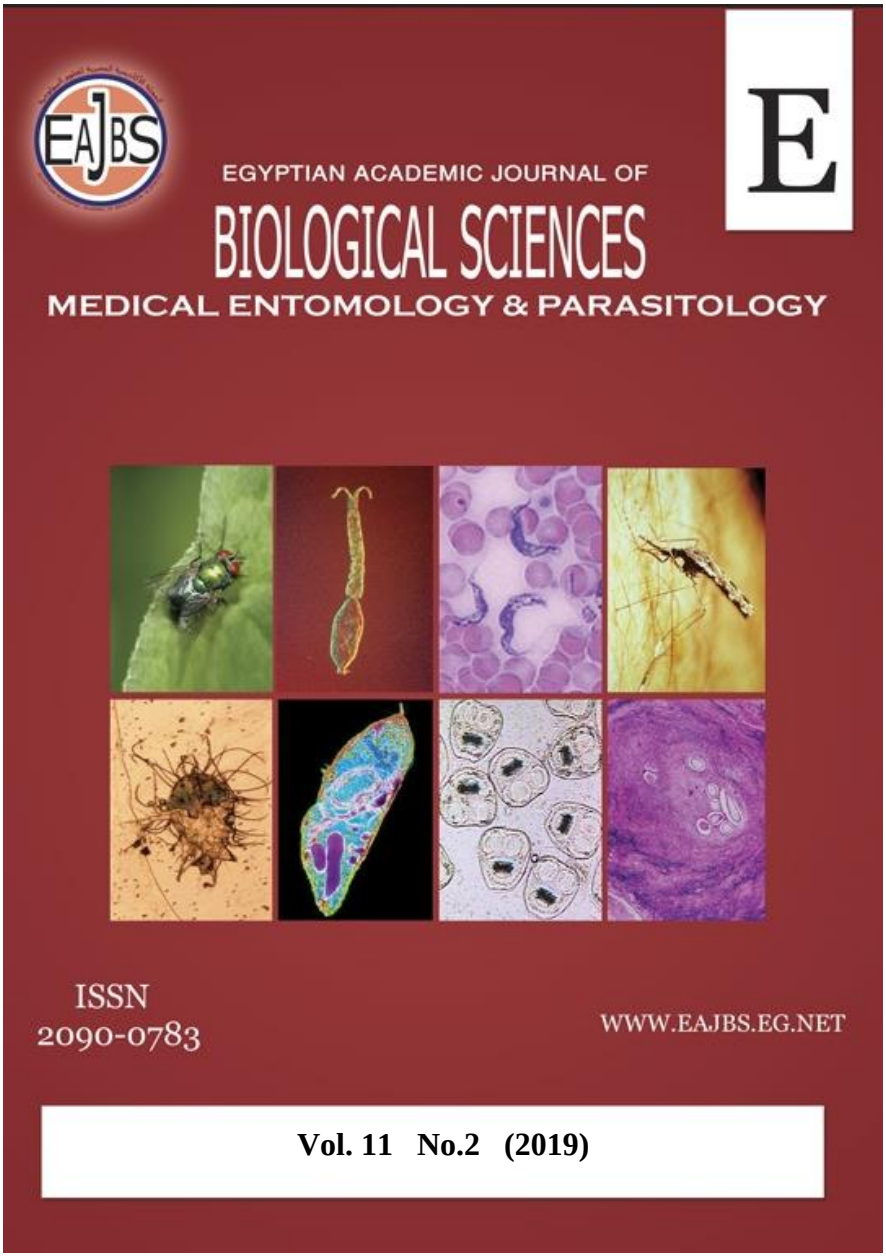

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The mechanical transmission of human parasites by cockroaches in Ismailia Governorate, Egypt.

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ABSTRACT

The role of cockroaches in the mechanical transmission of human parasites in Ismailia Governorate was studied. A total 1135 cockroaches, belonging to two families and four species, were collected from seven different sites using sticky traps. The cockroaches were examined for the presence of parasites. The total number of parasites was six, The Helminths were: *Ascaris* sp., *Trichuris* sp., *Hymenolepis* sp., *Entrobius* sp, and *Taenia* sp. The protozoa was: *Entamoeba histolitica*. The total prevalence of parasites in body surface was 12.1%, in the gut was 13.2% and in whole insect was 13.5%. The highest prevalence was recorded at the summer in whole insect with 18.8% while the lowest prevalence was at the spring on the body surface with 3.5%. On the other hand, parasites were not recorded in winter. The highest prevalence was recorded with *Periplaneta americana* occurring in the whole insect with 15.6% while the lowest prevalence was recorded with *Blattella germanica* occurring on the body surface with 12.6%. On the other hand, parasites were not recorded with *Blatta orientalis* and *Supella longipalpa*. The prevalence of parasites recorded in cockroach's sexes and stages. The highest prevalence was recorded with females occurring in the whole insect with 20%, followed with males occurring in the whole insect too with 10.3% and the lowest prevalence was recorded in nymphs with 3.2% in the gut. The present study further confirms that cockroaches play an important role as mechanical vectors of protozoan and helminth parasites. Hence, it is recommended that appropriate control measures must be taken particularly to make human dwellings as well as food preparation areas, including hospitals, hostels, schools and farms free of cockroaches.

INTRODUCTION

Cockroaches have been on earth for about 300 million years, and are the world's most common insects. Today, there are about 4,500 species of cockroaches that can be found in every part of the world. Thirty species are associated with human habitations, but only a few of these species inhabit human dwellings. The most common of these are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*) (Robinson, 2005; Uneke, 2007).

Cockroaches are termed as medically important pests because of their wide distribution in human habitation including houses, hospitals, food industries and kitchens. They may harbour multiple drug-resistant pathogenic helminths and protozoan parasites on

their external surfaces, disseminate on human food and cause serious diseases and allergies to humans. They are capable of transmitting many pathogens, including bacteria, viruses, fungi, protozoa and pathogenic helminths that threaten human health. They act as potential transmitters of agents of bacterial diarrhea and nosocomial infections in hospitals (Lee, 1997).

These insects are worldwide distributed where they are good survivors, they can survive for long periods without food or water. They are nocturnal insects; they prefer protected areas such as cracks and crevices to rest and hide. They aggregate in dark places that have high humidity and containing porous surfaces and this is referring to marking the surfaces with an aggregation pheromone found in their feces; this pheromone is very attractive to the immature stages (Cornwell, 1976).

The most favorable humidity levels are found in kitchens and bathrooms and if food, water and shelter are available; the cockroach population can multiply rapidly. When any of these resources are eliminated; the population cannot grow and may even decline (Ogg and Gold, 1993).

Unfortunately, little attention has been given for the mechanical transmission of the parasitic diseases by insect vectors and for the mechanisms that may be implicated in this type of transmission. (Thyssen *et al.*, 2004 and Graczyk *et al.*, 2005). This work aimed to study the role of cockroaches in the mechanical transmission of human parasites in Ismailia Governorate.

MATERIALS AND METHODS

This study was carried out in Ismailia Governorate. Field and laboratory work took place during one year (from July 2010 to June 2011). Seven different sites were chosen in Ismailia Governorate representing areas of health and human activities that could be affected with the presence of insect vectors that assess their potential role in the mechanical transmission of helminths and protozoa parasites of man:

1-Suez Canal University hospitals, in this site 4 localities were selected: a) outside a hospital near the garbage and the incinerator rooms. b) Hospital wards. c) Hospital bathrooms. d) Hospital kitchen

2- Male student hostel restaurant of Suez Canal University, in this site 2 localities were selected: a) outside restaurant. b) Food court.

3- Female student hostel restaurant of Suez Canal University, in this site 2 localities are selected: a) outside restaurant. b) Food court.

4- El-Salam Primary school, in this site 2 localities were selected: a) outside school. b) Inside school.

5- El-Salam disabled school, in this site 2 localities were selected: a) outside school. b) Inside school.

6- Suez road farm, in this site 2 localities were selected: a) outside barn. b) Inside barn.

7- Port- Said road farm, in this site 2 localities were selected: a) outside barn. b) Inside barn.

A collection of cockroaches was achieved by using a special type of traps named “sticky traps” which can be easily constructed and are most convenient to use (Moore and Granovsky, 1983). Trapped cockroaches from all localities were placed in labeled jars and transported to the laboratory for identification and isolation of parasites.

Isolation of parasites from external surfaces: 2 ml of sterile normal saline (0 85 %) was added to the tube and the insect was thoroughly shaken for 2 min. For parasitic ova/cyst, about 1 ml of washing was centrifuged at 2000 for 5 min and the deposit examined after staining with 2 ml freshly prepared 1% merthiolate-iodine-formaldehyde (MIF) solution (Ritchie, 1948). Smears were prepared from the stained precipitate and examined under a light microscope (Model ASZ45E), with magnification power from 10X to 40X (Bauch and Lomb USA) and identified

(Kinfu and Erko, 2008 and Getachew et al., 2007).

Isolation of parasites from gut content: After examining the cuticle, the insect was fixed in 70% alcohol for 5 min and dried in air at room temperature. The fixed insect was then placed in saline solution for 3 min. the whole gut of each washed insect was dissected out on sterile microscope slides under a stereoscopic microscope using entomological needles and macerated to liberate the lumen contents. To further minimize cross-contamination among insects, the entomological needles and forceps were dipped in ethanol between dissections (Getachew et al., 2007). The digestive tract was grounded in 2 ml saline solution. This preparation was centrifuged at 2000 rpm for 5 min and stained with 2 ml MIF solution (Merthiol-Iodine-Formaldahyde solution). Smears were prepared from the stained precipitate and examined under a microscope (Chatterjee, 1976 and Tatfeng, et. al., 2005).

Identification of helminths and protozoa parasites: Ova and cysts were counted and prevalence was calculated.

RESULTS

In total, 1135 cockroaches, belonging to two families and four species, were collected from seven different sites, Cockroaches species identified were: *Perplaneta americana* (582), *Blatella germanica* (494), *Blatta .orientalis* (36), and *Supella. longipalpa* (23). The total number of parasites was six, The Helminths were: Ascaris sp., Trichuris sp., Hymenolepis sp., Entrobius sp, and Taenia sp. The protozoa was: Entamoeba histolitica.

The prevalence of Helminths and protozoa were close in percentage to each other. The total parasites in body surface were 12.1%, in the gut was 13.2% and in whole insect was 13.5%.

As shown in Table (1) which represents the prevalence of Helminths recorded in cockroaches in different sites and localities (taking whole insect in consideration), the highest prevalence was at Suez Canal University "SCU' hospital (bathrooms) with 16.2% followed by Suez road farm (inside barn) with 15.2% and then came the Port Said road farm (inside barn) with 12.7%. On the other hand, the lowest prevalence was at Suez Canal University "SCU' hospital (hospital wards) with 4.6% followed by El-Salam disabled school (inside school) with 5 and then came Suez road farm (outside barn) with 6.2%. Based on the statistical output results of ANOVA test, one can conclude that there was **no** significant difference between the sites according to the number of Helminths (F= 1.590, DF=6, P-value =0.147). From the result of the prevalence of each Helminth species recorded in all cockroaches in different sites and localities it was clear that the most common species (taking totals in consideration) was *Ascaris* sp. with 7% followed by *Taenia* sp. with 2.3%, *Trichuris* sp. with 1.9%, *Entrobius* sp. with 1.4% and finally came *Hymenolipis* sp. With 0.4%.

Table 1: Number of insects and prevalence of occurrence of Helminths recorded in all cockroaches in different sites and localities.

Sites	Localities	Helminths			
		No. of insects	Body surface	Gut	Whole insect
SCU Hospital	Kitchen	192	9.8	9.9	10.9
	Bathroom	105	13.3	15.2	16.2
	Hospital wards	87	4.6	4.6	4.6
	Total	384	9.6	10.2	10.9
Suze road Farm	Inside barn	77	1.3	15.2	15.2
	Outside barn	32	6.2	6.2	6.2
	Total	109	11.9	14.7	14.8
Port Said road farm	Inside barn	55	10.9	12.7	12.7
	Outside barn	13	0	0	0
	Total	68	10.9	12.7	12.7
Male student hostel Restaurant of SCU	food court	141	7.1	10.6	11.3
	Outside hostel	0	0	0	0
	Total	141	7.1	10.6	11.3
Female student hostel Restaurant of SCU	food court	169	7.1	9.5	10.1
	Outside hostel	0	0	0	0
	Total	169	7.1	9.5	10.1
El- Salam primary School	Inside school	144	6.2	9	9
	Outside school	0	0	0	0
	Total	144	6.2	9	9
El-Salam disabled School	Inside school	120	2.5	5.8	5.8
	Outside school	0	0	0	0
	Total	120	2.5	5.8	5.8
Total all		1135	7.8	10	10.3

As shown in Table (2) which represents the prevalence of Protozoa recorded in cockroaches in different sites and localities. The highest prevalence was in the male student hostel restaurant of "SCU" (food court) with 14.9%. Occurring in the whole insect, followed by "SCU" hospital, (kitchen) with 13.5% and then came (bathrooms) with 13.3%. On the other hand, the lowest prevalence was in Suez road farm (outside barn) with only 6.2% occurring in the whole insect, followed by the "SCU" hospital (wards) with 6.9% and then came El-Salam primary school (inside school) with 9%. Based on the statistical output results of ANOVA test, one can conclude that there was no significant difference between the selected sites according to the number of Protozoa (F= 0.632, DF=6, P-value = 0.705). The only protozoa species recorded which is transmitted by cockroaches was *Entamoeba* sp. The highest prevalence of *Entamoeba* sp. was 14.9% at male student hostel restaurant of "SCU, the lowest one was 6.3 % in Suez road farm (outside barn). While *Entamoeba* sp. was not recorded in Port Said road farm (outside barn).

Table 2: Prevalence of occurrence of Protozoa recorded in all cockroaches in different sites and localities.

Sites	Localities	No. of insects	Protozoa		
			Body surface	Gut	Whole insect
SCU Hospital	Kitchen	192	11.5	12.5	13.5
	Bathroom	105	13.3	12.4	13.3
	Hospital wards	87	3.4	6.9	6.9
	Total	384	10.2	11.2	12
Suze road Farm	Inside barn	77	10.4	13	13
	Outside barn	32	6.2	6.2	6.2
	Total	109	9.2	11	11
Port Said road farm	Inside barn	55	7.3	10.9	10.9
	Outside barn	13	0	0	0
	Total	68	7.3	10.9	10.9
Male student hostel Restaurant of SCU	food court	141	13.5	14.9	14.9
	Outside hostel	0	0	0	0
	Total	141	13.5	14.9	14.9
Female student hostel Restaurant of SCU	food court	169	10.7	11.8	11.8
	Outside hostel	0	0	0	0
	Total	169	10.7	11.8	11.8
El- Salam primary School	Inside school	144	9	9	9
	Outside school	0	0	0	0
	Total	144	9	9	9
El-Salam disabled School	Inside school	120	10	12.5	12.5
	Outside school	0	0	0	0
	Total	120	10	12.5	12.5
Total all		1135	10	11.5	11.7

Table (3) represents the prevalence of parasites recorded in each season in all cockroaches. From the Tab. it was clear that the highest prevalence was at the summer occurring in whole insect with 18.8% while the lowest prevalence was at the spring occurring on the body surface with 3.5%. On the other hand, parasites were not recorded in winter.

Table 3: Prevalence of parasites recorded in each season in all cockroaches

Seasons	No. of insects	Total		
		Body surface	Gut	Whole insect
Summer	499	17.8	18.2	18.8
Autumn	376	10.9	12.8	12.8
Winter	59	0	0	0
Spring	201	3.5	5.5	5.5

As shown in Table (4) which represents the prevalence of Helminths recorded in cockroaches in different seasons, the highest prevalence was in summer with 15% occurring in the whole insect, while the lowest prevalence was in spring occurring on body surface with 2%. On the other hand, helminths were not recorded in winter. Based on the statistical output results of ANOVA test, one can conclude that there was a significant difference between the seasons according to the number of Helminths (F= 8.332, DF=3, P-value < 0.01). The prevalence of each Helminths species recorded in all cockroaches in different seasons shows that the most common species (taking totals in consideration) was *Ascaris* sp. with 15.6% followed by *Trichuris* sp. with 12.7%, *Taenia* sp. with 0.7%, *Hymenolipis* sp. with 0.2% and finally *came Entrobius* sp. with 0.1%.

Table 4: Prevalence of occurrence of Helminths recorded in all cockroaches in different seasons

Seasons	No. of insects	Helminths		
		Body surface	Gut	Whole insect
Summer	499	12.8	14.0	15.0
Autumn	376	5.9	9.3	9.3
Winter	59	0	0	0
Spring	201	2	4	4

As shown in Table (5) which represents the prevalence of Protozoa recorded in cockroaches in different seasons. The highest prevalence was in summer with 16.8% occurring in the whole insect. On the other hand, the lowest prevalence was in spring with 2% occurring on the body surface and the protozoa were not recorded in winter. The one-way ANOVA test showed a significant difference between the seasons of study according to the number of Protozoa (F= 10.631, DF= 3, P-value < 0.01). The only protozoa species recorded with cockroaches was the *Entamoeba* sp. The prevalence of occurrence of *E.* recorded in all cockroaches in different seasons shows that the highest prevalence of *Entamoeba* sp. was 17% in summer occurring in the whole insect and the lowest one was 2 % in spring occurring on the body surface. While *E.* was not recorded in winter.

Table 5: Number of insects and prevalence of Protozoa recorded in all cockroaches in different seasons.

Seasons	No. of insects	protozoa		
		Body surface	Gut	Whole insect
Summer	499	14.8	16.2	16.8
Autumn	376	9.6	11.4	11.4
Winter	59	0	0	0
Spring	201	2	3	3

Table (6-i) represents the prevalence of parasites recorded in different cockroach's species. From the Table, it was clear that the highest prevalence was recorded with *P. americana* occurring in the whole insect with 15.6% while the lowest prevalence was recorded with *B. germanica* occurring on the body surface with 12.6%. On the other hand, parasites were not recorded with *B. orientalis* and *S. longipalpa.*

Table (6-ii) represents the prevalence of Helminths recorded in different cockroaches species, the highest prevalence was in *P .americana* with 13.9 % occurring in the whole insect, while the lowest prevalence was in *B. germanica* occurring on body surface with 4.5%. On the other hand, Helminths were not recorded with *B. orientalis* and *S. longipalpa.* The prevalence of each Helminths species recorded in different cockroache species shows that the most common species (taking totals in consideration) was *Ascaris* sp. with 15.6% followed by *Trichuris* sp. with 12.7%, *Taenia* sp... With 0.7%, *Hymenolipis* sp. With 0.2% and finally came *Toxocara* sp. with 0.1%.

As shown in table (6-iii) which represents the prevalence of Protozoa recorded in different cockroaches species, the highest prevalence was in *P .americana* with 13.1% occurring in the whole insect. On the other hand, the lowest prevalence was in *B. germanica* with 10.7% occurring in the whole insect. Protozoa did not exist in *B. orientalis* and *S. longipalpa*. The prevalence of Protozoa species recorded in different cockroaches species shows that only *Entamoeba* sp. was recorded. The highest prevalence of *Entamoeba* sp. was 13.2% in *P. Americana* occurring in the whole insect while the lowest one was 11.5% in *B. germanica* occurring in the whole insect too. On the other hand, *Entamoeba* sp. did not exist totally in *B. orientalis* and *S. longipalpa.*

Table 6: Prevalence of different cockroaches species and their relation to recorded parasites transmitted by these vectors.

Species	No. of insects	i- Total			ii-Helminths			iii-protozoa		
		Body surface	Gut	Whole insect	Body surface	Gut	Whole insect	Body surface	Gut	Whole insect
P. americana	582	14.4	15.1	15.6	11.7	13.4	13.9	11.3	12.5	13.1
B. germanica	494	12.7	12.7	12.6	4..5	7.1	9.7	11.5	11.5	10.7
B. orientalis	36	0	0	0	0	0	0	0	0	0
S. longipalpa	23	0	0	0	0	0	0	0	0	0

Table (7-i) represents the prevalence of parasites recorded in cockroaches sexes and stages. From the Table, it was clear that the highest prevalence was recorded with females occurring in the whole insect with 20%, followed with males occurring in the whole insect too with 10.3% and the lowest prevalence was recorded in nymphs with 3.2% in the gut.

As shown in table (7-ii) which represents the prevalence of Helminths recorded in cockroaches sexes and stages, the highest prevalence was in female cockroaches with 14 % occurring in both the whole insect and in gut, while the lowest prevalence was in nymph cockroaches. Occurring in the gut with 2.1%. Based on the statistical output results of ANOVA test, one can conclude that there was a significant difference between the sites according to the number of Helminths ($F= 12.671$, $DF=2$, $P\text{-value} < 0.01$). The prevalence of occurrence of each Helminths sexes and stages recorded in different cockroaches sexes and stages shows that the most common sexes and stages (taking totals in consideration) was *Ascaris* sp. with 15.6% followed by *Trichuris* sp. with 12.7%, *Taenia* sp. With

0.7%, *Hymenolipis* sp. With 0.2% and finally came *Toxocara sp.*with 0.1%.

Table (7-iii) represents the prevalence of Protozoa recorded in cockroaches sexes and stages, the highest prevalence was in female cockroaches with 17.8% occurring in the whole insect and gut. On the other hand, the lowest prevalence was in nymph cockroaches with 2.6% occurring in the gut. The one way ANOVA test showed a significant difference between the insects sexes according to the number of Protozoa (F= 18.861, DF= 2, P-value < 0.01). The prevalence of each Protozoa species recorded in cockroaches sexes and stages shows that the only recorded protozoa was *Entamoeba* sp. The highest prevalence of *Entamoeba* sp. was 26.9% in female cockroaches occurring in the whole insect while the lowest one was 11.9% in male cockroaches occurring on the body surface.

Table 7: Prevalence of cockroaches sexes and stages and their relation to recorded parasites transmitted by these vectors.

Sex	No. of insects	i-Total			ii-Helminths			iii-protozoa		
		Body surface	Gut	Whole insect	Body surface	Gut	Whole insect	Body surface	Gut	Whole insect
Male	440	8	9.8	10	5.9	8.6	8.9	6.6	8.0	8.0
Female	506	18.6	20	20	11.5	14	14	15.4	17.8	17.8
Nymph	189	4.2	3.2	4.8	3.2	2.1	3.7	3.7	2.6	4.2

DISCUSSION

The filthy breeding habits, feeding mechanisms and indiscriminate travel between filth and food make cockroaches and other insect's efficient vectors of human parasites (Graczyk *et al.*, 2005). Cockroaches frequently feed on human faeces (Fotedar *et al.*, 1991; Graczyk *et.al.*, 2005; Pai *et.al.*, 2003) and hence can disseminate cysts, ova and larvae of gastrointestinal parasites mechanically in the environment. They are also able to transport many pathogens including bacteria, viruses, fungi, protozoa and pathogenic helminths, which threaten human health (Tawatsin *et. al.*, 2007; Mlso *et. al.*, 2005; Pai *et. al.*, 2004; Ghosh & Gayen, 2006). Some of the diseases caused by these pathogenic helminths and protozoans are amoebiasis, giardiasis, ascariasis which may also be responsible for chronic diarrhea, liver failure, intestinal disturbances and stunted growth in the affected individuals (Mbanugo & Abazie, 2002; Montressor *et.al.*, 2002; Graczyk*et.al.*, 2005; Salehzadeh *et.al.*, 2007; Sam-Wobo, 2008 and Adeleke *et.al.*, 2012).

Also, El-Sherbini & El-Sherbini (2011) revealed in their study that almost all cockroaches collected from toilets were contaminated with different parasites which were significantly higher in comparison to the control group. This shows the importance of cockroaches as a carrier of parasitic worm, cysts, or eggs.

However, still no enough researches, comparatively to those done on flies, have been completed to clarify the role of cockroaches as carriers of human parasites.

In the present study, the prevalence of helminths and protozoa recorded in all cockroaches studied were semi-convergent to each other, however the protozoa still higher than helminths, even on body surface or in gut (Chamavit *et.al.* 2011 and Alzain 2013,) however, this study is not compatible with Oguz *et.al.* (2017) who found that the protozoa were higher than parasitic worms, which recorded with 96.6% and 3.4% respectively. Bala & Sule (2012) reported that the high occurrence of *E. histolytica* might probably be because of the resistance conferred by the cyst wall, which helps the cysts to survive days to weeks in the external

environment and probably is vectored by cockroaches and other synanthropic insects.

The prevalence of helminths and protozoa recorded in body parts were close to each other where the total prevalence of parasites on the body surface was 12.1% and inside gut was 13.2%. This finding could be due to the relatively large size of the chewing mouthparts of cockroaches compared to that of flies, so they can swallow the immense ova of helminths. This conclusion agrees with the finding of Kinfu & Erko (2008) which stated that the percentage of contamination of both the external body washes and the gut contents by parasites of cockroaches trapped in the two localities did not differ significantly.

The current study showed a significant difference between the selected localities according to the number of helminths and Protozoa. The highest prevalence of helminths (Whole insect) was recorded in bathrooms of SCU hospital with 16.2% while the lowest record was in SCU hospital wards with 4.6%. On the other hand, the highest prevalence of protozoa (Whole insect) was recorded in food court (beside kitchen) of the male student hostel restaurant of SCU with 14.9% while the lowest record was outside Suez road farm with 6.2%.

Memona & Manzoor (2016) stated that the cockroaches from hospital environment harbored more parasites than houses, this insures the high infestation with helminths in SCU hospital bathroom. Ojianwuna (2014) also observed that the cockroaches collected from the toilets had more parasites, probably, because they were easily exposed to and contaminated by fecal matter. As a result of the high mobility of cockroaches, they easily deposit parasites carried on their bodies or within them on food. Etim *et al.,* (2013). Cockroaches feed on garbage and sewage and so have abundant opportunities to spread human pathogen (Cotton *et. al.,* 2000; Pai *et. al.,* 2004).

According to the capture sites, most cockroaches were caught in the toilets, followed by those caught in kitchens and in the houses. Because of the constant moisture, *B. germanica* and *B. orientalis* were not present in toilets while *P. Americana* was present in all sites. This can be explained by its great adaptation in diverse habitats (Tatang *et.al.,* 2017).

Regarding the prevalence of parasites transmitted by cockroaches in different seasons, it was clear that the highest prevalence was in summer followed by autumn then came the spring and parasites were not recorded in the winter. Temperature and humidity are key factors for the survival and development of parasite stages (Stromberg, 1997; Bush *et al*., 2001; Roepstorff *et.al.,* 2001; Bethony *et al*., 2006). Stromberg (1997) confirmed that the cockroaches prefer temperatures between 21°C and 30°C and will not survive at very low temperatures. Indoor populations tend to forage outdoors during warm weather. Likewise, during the winter months, populations established outdoors will venture inside seeking moisture and warmth. In her study, Abou Hashish stated that the prevalence of cockroaches that carried parasites as vector during the studied seasons was high during summer and was low duringSpring. Moreover, examined insects those acting as vectors in all studied seasons were acting as mechanical vectors.

In the present study there was a significant difference between the seasons according to the number of helminths and protozoa. The most parasitic species recorded transmitted were *Ascaris lumbricoids* (helminths) and *Entamoeba histolotica* (protozoa) with percentage 10.4% and 17% respectively during summer. These findings were supported by Tatang *et.al.* (2017).

Many protozoa are able to form cysts, which are relatively protective capsules around their bodies. This enables them to survive in unfavorable environmental conditions such as desiccation, unfavorable temperatures, injurious chemicals, or lack of oxygen, and aids in dispersal of the species. (Parker & Martel, 2002). This fact

supports the previous findings that insured the rare recording of protozoa during winter.

Furthermore, the present study found that the prevalence of different parasites in all studied cockroaches was higher in females more than males which were 20% and 10.3%, respectively. This conclusion agrees with (Ojianwuna, 2014). It was also observed that the female individuals of the four cockroach species encountered in this study had more parasites than their male counterparts. This may also be attributed to the fact that they roam more than the males in search of both food and sites to lay their eggs, therefore, come in contact with the contaminated materials making them more vulnerable to the pathogens. Similar findings on the number of females harbouring parasites more than the male cockroaches have been reported by Bale & Sule (2012).

Parasite infection rate (62.2%) of cockroaches recorded in this study is higher than the 54.1% reported by Chamivat et al. (2011) but lower than those of Ajero et al. (2011) , Al-Mayali and Al-yaqoobi(2010) and Bala &Sule (2012) who reported infection rates of 67%, 83.33% and 77.52% respectively . The differences in hygiene conditions in these various areas may account for the variation in the parasite carriage rate among different settings. The high cockroach densities recorded in Abraka area of Delta State may be due to the low socio-economic status of the people coupled with unsanitary conditions and lack of good hygiene practices. Many of the areas had garbage and dump sites around vicinities of the homes. This might have caused the high rate of contaminated cockroaches observed in this study. (Ojianwuna, 2014)

Female cockroaches were significantly more vectorial than males. This may probably be due to their behavior which allows them to move more than the males in search of both food and sites to lay their eggs (Bala & Sule, 2012). By this behavior, they come in contact with contaminated materials as they roam, making them more exposed to contact with pathogens. From present results of the prevalence of helminths species, it was clear that the most common species was *A. lumbricoides* with 15.6% followed by *T. trichiura* with 12.7%, *T. saginata.* With 0.7%, *H. nana* with 0.2% and finally came *T. canis* with 0.1%. On the other side, according to the prevalence of protozoa species, only *E. histolitica* was recorded.

Kinfu & Erko (2008) stated that microscopic examination of the external body washes of pooled cockroaches and individual gut contents revealed that cockroaches are carriers of *Entamoeba histolytica* cysts as well as *Ascaris lumbricoides, Enterobius vermicularis, Trichuris trichiura* and *Taenia sp*. ova. Besides their role as a nuisance, the present study further confirms that cockroaches serve as carriers of human intestinal parasites. This finding totally agree with our obtained results.

The recordings partially agree with Adeleke *et.al.*(2012) who registered cysts and ova of six gastro-intestinal parasites namely cyst of *Entamoeba hystolitica*, cysts of *Balantidium coli*, cyst of *E. coli* ova of *Ascaris lumbricoides*, , ova of *Enterobius vermicularis* and ova of Hookworms were encountered in the body surface and faecal samples of the cockroaches during their study.

The highest transport rate of *Ascaris* sp. eggs observed in the present study can be explained by the fact that *Ascaris* eggs have an inner shell layer of lipoprotein nature which makes them more resistant to harsh environmental conditions compared to the eggs of other helminths and nematodes (Smyth, 1996). Another reason is that Ascaris eggs can survive in adverse environmental conditions. It might also be due to the overdispersion of *Ascaris* eggs in the environment as a single female Ascaris lays a relatively large number of eggs (200,000 eggs/day) (Soulsby, 1982).

Cockroaches may harbor the *E. histolytica* cysts and play a role as potential mechanical disseminators.Pai *et.al.* (2003)

Finally, the present study further confirms that cockroaches play an important role as mechanical vectors of protozoan and

helminth parasites. Hence, it is recommended that appropriate control measures must be taken particularly to make human dwellings as well as food preparation areas, including hospitals, hostels, schools and farms free of cockroaches.

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ARABIC SUMMERY

النقل الميكانيكي للطفيليات بواسطة الصراصير بمحافظة الإسماعيلية ، مصر.

غادة محمد عبد الغنى، أحمد حسن أبوغالية، شيرين محمد البنا، مها فريد سليمان.
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تمت دراسة دور الصراصير في النقل الميكانيكي للطفيليات البشرية بمحافظة الإسماعيلية. تم جمع ما مجموعه 1135 صرصور ، تنتمي إلى عائلتين وأربعة أنواع ، من سبعة مواقع مختلفة باستخدام الفخاخ لزجة. تم فحص الصراصير لوجود الطفيليات. كان العدد الإجمالي للطفيليات ستة ، والديدان الحلزونية هي: أسكاريس س. ، وتريكوريس س. ، وهيمينوليبيس س. وكان البروتوزوا .Entamoeba histolitica :كان مجموع انتشار الطفيليات في سطح الجسم 12.1 ٪ ، في القناة الهضمية كان 13.2 ٪ وفي الحشرة بأكملها كان 13.5 ٪. تم تسجيل أعلى معدل انتشار في الصيف في الحشرة كاملة بنسبة 18.8 ٪ في حين كان أدنى معدل انتشار في الربيع على سطح الجسم بنسبة 3.5 ٪. من ناحية أخرى ، لم يتم تسجيل الطفيليات في فصل الشتاء. تم تسجيل أعلى معدل انتشار مع Periplaneta americana التي تحدث في الحشرة بأكملها بنسبة 15.6 ٪ في حين سجلت أدنى نسبة انتشار مع Blattella germanica التي تحدث على سطح الجسم بنسبة 12.6 ٪. من ناحية أخرى ، لم يتم تسجيل الطفيليات مع Blatta orientalis و .Supella longipalpa انتشار الطفيليات المسجلة في الصراصير بين الجنسين والمراحل. تم تسجيل أعلى معدل انتشار مع الإناث التي تحدث في الحشرة بأكملها بنسبة 20 ٪ ، تليها الذكور التي تحدث في الحشرة بأكملها أيضا مع 10.3 ٪ وسجلت أدنى نسبة انتشار في الحوريات بنسبة 3.2 ٪ في الأمعاء. تؤكد الدراسة الحالية أيضًا أن الصراصير تلعب دورًا مهمًا كمتجهات ميكانيكية للطفيليات الأولية والطفيليات.