

Cockroaches: Transmission of Medically Important Parasites

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ABSTRACT

Cockroaches play an important role in transmitting different diseases either mechanically and occasionally biologically. The aim of the current study is to determine the possible role of cockroaches in dissemination of medically important gastrointestinal parasites in North Gaza Governorate, Palestine. A total of 200 cockroaches were collected from residential area and hospital environment were screened for the parasites between October 2012 and January 2013. Direct wet smear, 1% lugol's iodine and modified acid-fast bacilli staining were used to identify the parasites from the body surface and the faecal samples of the cockroaches. The results show that 47 (23.5 %) of the cockroaches harbored parasitic organisms. Nineteen (17.3%) of the 110 cockroaches collected from residential areas harboured gastrointestinal parasites while 28 (31.1%) of the 90 cockroaches from hospital environment harboured parasites. Of these, 27 (57.4 %) were protozoa and the remaining 20 (42.6 %) were pathogenic helminthes and non-pathogenic helminthes. Of the pathogenic helminthes, the species included ova of *Ascaris lumbricoides*, ova of *Enterobius vermicularis* and ova of hookworm. The protozoa types that were identified included cysts of *Entamoeba histolytica*/E. dispar, trophozoites of *Balantidium coli*, cysts of *Entamoeba coli* and cysts of *Endolimax nana* were encountered from internal and external surface of the cockroaches during this study. The cockroaches from hospital environment harboured more parasites (31.1%) than residential areas (17.3%) but the difference in parasite burden was not statistically significant ($p > 0.05$). Cockroaches represent an important reservoir for infectious pathogens, therefore, control of cockroaches will substantially minimize the spread of infectious diseases in our environment.

Keywords : *Cockroaches, residential area, hospital environment, parasites, health risks, Palestine*

1. INTRODUCTION

These species inhabit human dwellings. The most common of these are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*) [6,7]. Cockroaches are about 10-50 mm in length, and have an oval, flattened shape, long antennae, and are nocturnal in habit. Cockroaches are omnivores; they will eat anything organic but prefer food sources such as sweets, cheese, meat products, starches, and grease. They also feed on plants, vegetables, and fruits. Cockroaches generally like warm, moist environments with abundant food. Sewers and wet, decaying areas are their natural habitat [8]. The habits of living and eating, body structure, and mobility of cockroaches make them well adapted for mechanically transmitting diseases. Cockroaches are known vectors of human enteropathogens as there are reports of the isolation of various human pathogens from these insects [9]. Hence they can put the human's health in danger [10]. This is why the existence of the cockroach at any places is dangerous for community's health and it can be threatening to the environment. Several studies have shown that cock-roaches can carry disease causing microorganisms such as *Escherichia coli*, *Enterobacter* spp., *Klebsiella* spp., *Pseudomonas aeruginosa* [9,11-14], various fungi [9,13,15,16], and parasites and their cysts [9,12,13]. Cockroaches may disseminate these microorganisms in many ways, predominantly by depositing them along with their excrement on human food [6,7].

Soil transmitted helminths (STH) are relatively common parasites in the slum and rural area of many countries [17-19], this high prevalence is closely related to poor environmental hygiene, and impoverished health

services [20]. The main source of transmission is defecation outside latrines by heavily infected persons [21]. Many authors have indicated that the primary school children are an ideal target group for (STH) [22], as children frequently defecate indiscriminately around their houses, particularly in the courtyards, sitting room, drains, even houses have latrines [23,2]. Also their nocturnal and filthy habits make them ideal carriers of various pathogenic microorganisms [25]. Some parasites have been found in external surface or internal parts of body of cockroaches and some studies have shown that exposure to cockroach antigens may play an important role in asthma related health problems [20,21]. The study was carried out in an unsanitary community where parasitic infections and soil contamination with helminth ova were high and where cockroaches were abundant in defecation areas and household environment.

As efforts are being geared towards reducing the public health burden of the gastro-intestinal parasites in the developing countries, proper understanding of the routes of contacting the parasites would be of immense relief in planning effective control strategies. As well as the free wandering movements of cockroaches from one location to another and their possible contribution to disease transmission prompted this study. The goal of this study was to investigate the roles of cockroaches in disseminating gastrointestinal parasites in two environmental settings; residential areas and the hospital environment in North Gaza governorate, Palestine.

2. METHODS

2.1 Collection of Specimens

During the period of this study, two hundred cockroaches, including 90 from three hospitals and 110 from different residential areas were collected from various parts of north Gaza governorate, Palestine. Each cockroach was collected in a sterile test tube transported to the laboratory and anaesthetised by outing at 0°C for 5 min examined under the dissecting microscope and identified using standard taxonomic keys. The collection was done between 8.00 AM and 5.00PM from October 2012 and January 2013.

2.2 Isolation And identification Of Parasite From External Surface

After identification, 2 ml of sterile normal saline (0.9%) was added to the test tube and the cockroaches were thoroughly shaken for 2 min. Isolation of parasitic cyst was carried out by using 1 ml of the washing result which was centrifuged at 2000 rpm for 5 min. A portion of the sediment was examined using a light microscope and the remaining sediment was stained using modified acid-fast stain for characteristic features of coccidian protozoa such as *Isospora belli*, *Endolimax nana*.

2.3 Isolation And identification Of Parasites From Internal Surfaces

After external washings, cockroaches were placed in flasks rinsed with 70% alcohol for 5 min. (to decontaminate external surfaces as 70% alcohol is bactericidal. They were transferred to other flasks and allowed to dry at room temperature. Cockroaches were then washed with normal saline for 2 to 3 min to remove traces of alcohol. Only whole and live captured cockroaches were utilized for the study. After being immobilized at 0°C the gut of the cockroach was dissected out and macerated in 2 ml of normal saline. The resulting macerate was then processed in a similar way as described previously and the results recorded. For parasites ova/cysts, about 1 ml of the washing result was centrifuged at 2000 rpm for 5 min. and the resulting deposit examined after staining with 10% Lugol iodine under light microscope and identified [26].

2.4 Statistical Analysis

The parasite burden in the body and faeces of the cockroaches in the two environmental settings were subjected to statistical analysis using t-test.

3. RESULTS

Of the 200 cockroach samples collected, 110 were collected from the residential areas while 90 were collected within the hospital environment. It is show that 47 (23.5 %) of the cockroaches harbored parasitic organisms. Nineteen(17.3%) of the 110 cockroaches collected in residential area harboured gastrointestinal parasites while 28 (31.1%) of the 90 cockroaches from hospital environment harboured parasites (Table 1).

Table 1: Distribution of gastrointestinal parasites in the body surface and faecal samples of cockroaches collected in residential and hospital environments in North Gaza, Palestine.

Sampling sites	No of cockroaches Examined	No positive (%)	No of parasites identified Faeces Body surface
Residential	110	19 (17.3%)	4 6
Hospital	90	28 (31.1%)	3 8
Total	200	47 (23.5%)	7 14

Of these, 27(57.4 %) were protozoa and the remaining 20 (42.6 %) were pathogenic helminthes and non-pathogenic helminthes. Of the pathogenic helminthes, the species included ova of *Ascaris lumbricoides*, ova of *Enterobius vermicularis* and ova of hookworm. The protozoa types that were identified included cysts of *Entamoeba histolytica*/*E. dispar*, trophozoites of *Balantidium coli*, cysts of *Entamoeba coli* and cysts of *Endolimax nana* were encounter from internal and external surface of the cockroaches during this study (Table 2). The cockroaches from hospital environment harboured more parasites than residential areas but the difference in parasite burden was not statistically significant ($p>0.05$). The parasite of *Endolimax nana* was not found in the samples from hospital environment while *E. vermicularis* and Hookworms were absent in samples from residential area. The ova of *A. lumbricoides* had the highest occurrence and parasite burden in the body surface of the cockroaches' positive for gastrointestinal helminthes in both residential and hospital environments.

<http://www.ejournalofscience.org>**Table 2:** The prevalence of the parasites in cockroaches positive for gastrointestinal parasites in residential and hospital environments.

Study sites	No. of positive	Percentage of occurrence						
		A. lumbricoides	E. vermicularis	Hookworm	E. histolytica	B. coli	E.coli	E. nana
Residential	19	8(42.1%)	0(0.0%)	0(0.0%)	2(10.5%)	2(10.5%)	4 (21.1%)	3(15.9%)
Hospital	28	9(32.1%)	1(3.6%)	2(7.1%)	4(14.2%)	5(17.9%)	7 (25%)	0(0.0%)
Total	47	17(36.2%)	1(2.1%)	2(4.3%)	6(12.8%)	7(14.9%)	11(23.4%)	3(6.4%)
		Total helminthes harboured (42.6%)			20	Total protozoa harboured 27 (57.4%)		

The mean parasite load ranged between 2.0-6.7 oval/cyst per cockroaches in hospital environment while the mean parasite load was between 2.2 and 5.0 per cockroaches in the residential areas (Table 3).

Table 3: Mean of the parasite ova/ cysts in the body of cockroaches collected in residential and hospital environment North Gaza, Palestine.

Parasites	Mean of the ova/ cysts of the parasite per cockroach	
	Hospital	Residential
Ascaris lumbricoides	6.7	4.5
E. vermicularis	2.5	0
Hookworm	3.0	0
Entamoeba histolytica	2.0	2.2
Balantidium coli	3.1	5.0
Entamoeba coli	4.1	4.5
Endolimax nana	0	3.4

4. DISCUSSION

Personal hygiene has drastically reduced the prevalence of parasitic infections in our communities, but other factors that contribute immensely to transmission of such infections are neglected. Speculations have always been made on the involvement of cockroaches as possible vectors of transmission of infections in our communities, but no documented studies are available in that regard. This study revealed that cockroaches represent a store of infectious pathogens, different organisms have been identified or isolated from their body surfaces, as mentioned earlier. All the parasites recovered from their body are of medical importance and have been implicated in many gastrointestinal disorders. Entamoeba species, B. coli, E. vermicularis Hookworm and A. lumbricoides have been reported to cause chronic diarrhea, liver complications and stunted growth in the affected people [27-31]. The higher percentage of the cockroaches harbouring gastrointestinal parasites encountered in hospital environment is not a departure from the expected results as similar observations have also been reported elsewhere [13,32]. Hospitals host patients suffering from

different ailments and these cockroaches would have been contaminated during their nocturnal movements from one ward to another and to other areas including toilets [9,13,32]. This emphasizes the significant role of cockroaches in the transmission of nosocomial infections. The remarkable aspect of the results is however, the recovery of the major gastrointestinal parasites (Entamoeba species and A. lumbricoides) in cockroaches from residential areas. This observation arguably signifies the high burden of gastro-intestinal diseases and poor sanitary conditions of residential areas in North Gaza governorate metropolis despite monthly environmental sanitation in the city as these cockroaches would have been contaminated through toilet facilities. The high occurrence of A. lumbricoides over other gastrointestinal parasites has also been well documented in human populations in different parts of Gaza Strip, Palestine [33-38], and the risk of its transmission has been associated with poor sanitary conditions [39-41]. If our hypothesis of high disease burden of gastrointestinal infections in North Gaza governorate metropolis is latter accepted through further investigations, the contamination of the cockroaches as observed in this study would undoubtedly worsen the epidemiological situation. These parasites can be easily spread by body contacts of the cockroaches with food items, eating and drinking utensils in the homes. The marginal disparity in the number of the parasites encountered in the body surface in comparison with faecal samples could possibly be explained in two ways; it could be that the insects only have body contact with the parasites without ingesting them or the parasites were unable to survive in the intestines of the insects. Both reasons are valid when considering the fact that some of the ova/ cysts of the parasites encountered are sensitive to changes in environmental factors [42]. The control or eradication of cockroaches should be attempted, to stop intestinal parasite transmission in the community, in addition to drug administration. The results of the present study revealed contamination of almost all cockroaches collected from homes with different parasites which are significantly higher in comparison to control group. The importance of cockroaches as carrier of parasitic worm, cysts, or eggs, is because there are some reports about the presence of parasitic forms on or in cockroaches [43]. The finding of the present study showed the parasitic contamination in high numbers. The presence of E. vermicularis

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infestation indicates that the cockroaches had opportunity to get in touch with infested patients or contaminated clothes which emphasizes their factorial potential for parasitic diseases [44].

5. CONCLUS ON

Cockroaches constitute an important reservoir for infectious pathogens, therefore, control of cockroaches will substantially minimize the spread of infectious diseases in our environment.

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