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Original Research Article

Evaluation of transmission capacity of houseflies and cockroaches for pathogenic human intestinal parasites

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ABSTRACT

Background: Household insects like houseflies and cockroaches are found in close proximation with human and animal habitations. These insects act as mechanical vectors for medically important pathogens and parasites. The present study aimed to identify the presence of human intestinal parasites transmitted by these insects in the present study area.
Methods: Collection of these insects were carried out for a period of six months (June to November, 2021) from areas like kitchen, college canteen, garbage piles, fish and meat shops. Microscopic examination showed presence of pathogenic human intestinal parasites and pathogens.
Results: Of the total collected flies and cockroaches, 157 (61.3%) flies and 72 (52.2%) cockroaches were found to be carriers of medically important parasites and pathogens. A total of three protozoan (*Giardia intestinalis*, *Entamoeba histolytica* and *Balantidium coli)* and three helminth parasites (*Ascaris lumbricoides*, *Enterobius vermicularis* and hookworm) were isolated from these insects. The most common protozoan and helminth parasites were *Giardia intestinalis* and *Ascaris lumbricoides.* There is significant difference between number of protozoan and helminth parasite on a single housefly and cockroach. Similarly, females of both the insect were found to be more vectorial than males. There was also correlation between the incidence of diarrhea and gastrointestinal tract infection and number of positive flies.
Conclusion: These findings imply that both insects in the current study area should be considered as possible mechanical vectors of human intestinal parasites.

Keywords: Houseflies, Cockroaches, *Ascaris lumbricoides*, *Giardia intestinalis*, Mechanical vectors, Parasites, Pathogens

INTRODUCTION

Houseflies and cockroaches among house hold pest are the most abundant pests found everywhere around the world.[1,2] They predominantly inhabit poultry and livestock farms where they constitute irritation to humans, poultry, livestock and other farm animals. Additionally, these pests have the capacity to transmit viruses and parasites that are crucial to health.[3] Houseflies belong to a group of "filth flies", very well adapted to all environment and completes its life cycle within habitations of humans and domestic animals.[4] These flies are associated with unsanitary conditions and can transmit human pathogens.[5]

Cockroaches, another major insect pest, feed on waste and decaying matter. Due to their feeding habits, they are vectors of several medically important pathogens; at night, they scavenge for food in kitchens, storehouses, empty cans, pipes, and gutters, and frequently feed on human feces, transmitting cysts of enteric protozoans and ova of intestinal helminths.[5,6] Because of their filthy feeding and breeding habits, these insects become a suitable mechanical vector for a variety of human and domestic animal illnesses and parasites.[5,7] Human intestinal parasite transmission is strongly linked to unsanitary conditions, a poor sanitary system, a lack of awareness, and poverty.[8,9]

The transmission of these parasites is caused by outdoor defecation, sewage disposal in agricultural areas, as well as poor improper disposal of fecal excrement.[5] Furthermore, pollution of food and drinking water, as well as indirect transmission via non-biting insects, contribute to the spread of the disease.[8,10] Moreover, due to poor sanitation and suitable climate conditions and moisture content, soil-transmitted helminths are prevalent in urban and rural settings, particularly in the tropics.[8,11] Amalner is a Taluka of Jalgaon District of Maharashtra with inadequate infrastructure, sanitation, and hygienic conditions. In the current study area, there are insufficient infrastructure amenities, as well as a lack of suitable toilet settings and waste disposal systems. Furthermore, individuals frequently use roadside areas for rubbish dumping and other uses. Thus, serving it as suitable breeding sites for flies and cockroaches and eventually their entrance to nearby houses.[12] The goal of this study was to determine transmission capacity of cockroaches and houseflies in the distribution of protozoan and helminth parasites in the community and to investigate presence of number protozoan and helminth parasite on a single housefly and cockroach. It was also aimed to correlate the incidence of gastrointestinal tract infection and diarrhea with number of infected insects.

METHODS

Selection of site

The research was carried out in overcrowded and unsanitary densely populated regions of Amalner city. Home kitchen, college canteen, garbage piles, fish and meat shops were selected for the collection of cockroaches and houseflies.

Insect collection

Houseflies were caught utilizing a sweep net approach for a period of six months (January to June, 2021), from their visiting places such as leftover food, dirty water, decaying fruits and vegetables, decaying meat and fish etc. A total of 256 flies were captured and placed into a well labeled specimen bottles and transported to P.G. and research Center, Department of Zoology, Pratap College, Amalner. Cockroaches were captured for up to six months with mechanical trapping devices. A total of 138 cockroaches were collected from kitchens, restaurants, cooking utensils, crevices and toilets, among other places. The specimens were preserved in well-labeled bottles and brought to the P.G. and research Center, Department of Zoology, Pratap College, Amalner.

Identification of insects

Classification and identification of cockroaches and houseflies were carried out by using standard identification keys into various genera and species.[13]

Isolation of parasites

After identification, each insect was placed in a 10 ml vial half-filled with normal saline, capped, and labelled, and left to stand for 10 minutes. To dislodge parasites adhered externally to the body surface of the insects, the tube was shaken vigorously by hand for 2 minutes. The suspension was centrifuged at 2000 rpm for 5 minutes after the insects were removed, and the supernatant was decanted. The insects were stored in 70% alcohol for future use. Samples from the sediments were placed on a clean glass plate and inspected under a microscope (10X and 40X) to look for probable human intestinal parasites adhered to the insect body externally. The helminth ova and larvae were detected using Remel Lugol's Iodine stain.[14] It was also used to better identify protozoan cysts because it stains cyst nuclei.

Data analysis

The data was analysed using SPSS software. For the examination of the proportion of insects infested with parasites descriptive statistics were used and to detect significant variations in the proportion of cockroaches and houseflies infested with parasites Chi square analysis was employed.

RESULTS

Examination of parasites on external body surface of houseflies and cockroaches

Both the insects were carefully examined and identified. Table 1 shows species distribution of the houseflies. Of the 256 houseflies, *Musca domestica* were the most abundant among all (144), followed by 36 *Musca autumnalis*, 21 were *Musca sorbens* and remaining was *Chrysomya megacephala.* Similarly of the 138 collected cockroaches, 72 were *Periplaneta americana*, 41 were *Blatella germanica* and remaining were *Blattella orientalis* (Table 2). The specimens were divided into three categories on the basis of location where they were collected (Table 1 and 2). Site-I include locations like home kitchen, restaurants, and college canteen. A total of 61 house flies and 81 cockroaches were investigated in this group. Site-II consisting of areas like garbage dumps, stagnant water near public toilet settings. A total of 121 houseflies and 41 cockroaches were collected and examined. Site-III includes areas like fish and meat shop and sweet shop and in this group 74 housefly and 16 cockroaches were examined.

Of the total 256 examined flies, 157 (61.3%) flies were found to be infested with different parasites and their cysts (Table 1). Among 157 positive flies, 89 (56.7%) were females and 68 (43.3%) were males. Of these infested male and female flies a total of three protozoan parasites and two helminth cysts were isolated (Table 3). Of the total positive females 53% were infested with *Giardia intestinalis*, followed by 48% with *Entamoeba histolytica* and 37%

Balantidium coli. Similarly, 51% positive males were infested with *Giardia intestinalis*, 44% with *Entamoeba histolytica* and 37% with *Balantidium coli*. Both male (32 %) and female (36 %) were infested with *Ascaris lumbricoides*. Also, 9% females and 10% males infested with *Enterobius vermicularis* and hookworm infestation was very low, 2% and 1.5% on female and male flies respectively. Of the total 138 roaches, more than 50% (N=72) were found to be infested with three protozoan and two helminth parasites (Table 3). Three protozoan parasites *Giardia intestinalis*, *Entamoeba histolytica* and *Balantidium coli* were isolated from male cockroaches 41.9%, 35.4% and 16% and from female 46.3%, 36.5% and 19% respectively. Among the helminth parasites *Ascaris lumbricoides* were most common 14.6% in females and 12.9% in males followed by *Enterobius vermicularis* and no hookworms were identified in both male and female cockroaches.

Table 1: Distribution of species and prevalence of infestation of houseflies collected from different locations.

Flies	Sampling site, Frequency (%)						Total
	Site-I (N=61)		Site-II (N=121)		Site-III (N=74)		
	Infested	Non-infested	Infested	Non-infested	Infested	Non-infested	
Musca domestica	18 (29.5)	13 (21.3)	44 (36.4)	24 (19.8)	26 (35.1)	19 (25.7)	144 (56.3)
Musca autumnalis	4 (6.6)	4 (6.6)	12 (9.9)	5 (4.1)	8 (10.8)	3 (4.1)	36 (14.1)
Musca sorbens	2 (3.3)	4 (6.6)	8 (6.6)	5 (4.1)	0 (0.0)	2 (2.7)	21 (8.2)
Chrysomya megacepahala	9 (14.8)	7 (11.5)	17 (14.0)	6 (5.0)	9 (12.2)	7 (9.5)	55 (21.5)
Total	33 (54.1)	28 (45.9)	81 (66.9)	40 (33.1)	43 (58.1)	31 (41.9)	256 (100)

Table 2: Distribution of species and prevalence of infestation of cockroaches collected from different locations.

Roaches	Sampling site, Frequency (%)						Total
	Site-I (N=81)		Site-II (N=41)		Site-III (N=16)		
	Infested	Non-infested	Infested	Non-infested	Infested	Non-infested	
Periplaneta americana	27 (33.3)	22 (27.2)	10 (24.4)	6 (14.6)	4 (25.0)	3 (18.7)	72 (52.2)
Blatella germanica	9 (11.1)	11 (13.6)	10 (24.4)	6 (14.6)	3 (18.8)	2 (12.5)	41 (29.7)
Blattella orientalis	6 (7.4)	6 (7.4)	5 (12.2)	4 (9.8)	2 (12.5)	2 (12.5)	25 (18.1)
Total	42 (51.9)	39 (48.1)	25 (61.0)	16 (39.0)	9 (56.3)	7 (43.7)	138 (100)

Table 3: Prevalence of infestation among male and female insects.

Parasites	Houseflies N=157, frequency (%)			Cockroaches N=72, frequency (%)		
Protozoans	**Sites of infestation**	**Male**	**Female**	**Sites of infestation**	**Male**	**Female**
	External body surface	68 (43.3)	89 (56.7)	External body surface	31 (43.1)	41 (56.9)
Giardia intestinalis	+	35 (51.5)	47 (53.0)	+	13 (41.9)	19 (46.3)
Entamoeba histolytica	+	30 (44.1)	43 (48.3)	+	11 (35.4)	15 (36.5)
Balantidium coli	+	25 (37.0)	33 (37.1)	+	5 (16.1)	8 (19.5)
Helminths						
Ascaris lumbricoides	+	22 (32.3)	32 (35.9)	+	4 (12.9)	6 (14.6)
Enterobius vermicularis	+	7 (10.3)	8 (8.9)	+	3 (9.7)	4 (9.8)
Hookworms	+	1 (1.5)	2 (2.2)	-	0	0

DISCUSSION

In the current study region, there has never been a study on the epidemiology of human parasitic diseases transmitted by houseflies and cockroaches. The most important vectors for the spread of parasites and illnesses to humans and animals, according to the current study, are houseflies and cockroaches. The current investigation discovered four protozoan parasites that were isolated from houseflies in various parts of Amalner city (Maharashtra, India). *Giardia intestinalis* was a protozoan that was frequently recorded, indicating that it is a significant human intestinal parasite. The second and third most often isolated protozoans were *Entamoeba histolytica* and *Balantidium coli* respectively. These parasites have also been found on the body surfaces of houseflies and cockroaches in early research.[15-17] House flies feed on excrement, animal manure, carrion, and other decaying organic materials and transmit parasites and cysts that stick to various areas of the body and are carried back to human habitations and animal farms.[18] Houseflies operate as mechanical vectors, moving parasites from feces or other animal waste to food and drinking water on a regular basis, placing humans and animals at risk of infection.[19-21]

The majority of the parasites found in the current study were from Site-II, which included waste dumps and stagnant water near public toilets, followed by Site-I. This is supported by studies from Egypt and Sudan.[2,22-23] Hookworms were also discovered in the current study, notably in the sanitary waste water area. This is in line with a study done in Nigeria.[24] The presence of these parasites on the body surfaces of these insects lends credence to the theory that they are key vectors of parasites to sanitary waste water sites.[25] Anatomical characteristics of houseflies and cockroaches, such as bristles and pads, enhance surface area, which aids in parasite and pathogen attachment to their legs and feet[26] and transmission to other surfaces. Furthermore, because cockroaches are larger than houseflies, they can trap more parasites and diseases, increasing their vectorial capability. It has been found in this study that the rate of transmission of medically important protozoan parasites were higher by female houseflies than males while this is opposite for helminth parasites. Female cockroaches were also more vectorial than males when it came to transporting all protozoan and helminth parasites. This could be owing to their proclivity for walking in dark regions, such as the latrine and kitchen, in search of food and to lay eggs.[27] House flies are a long-distance travelling fly that carries and transmits parasites from open defecation sites, animal farms, and garbage dumping sites to inside homes. This is in support of studies reported earlier.[28] However, the risk of parasite transmission in locations where open field defecation is common is always high, and it is the primary source of concern in those populations and areas.[29] Seasonal abundance of houseflies, the availability of excrement, the prevalence of pathogens in feces, and house flies' access to open food and utensils are all important factors in the spread of infectious agents.[30] In mechanical transmission of pathogens however there is no amplification or multiplication of pathogens but the flies carry sufficient quantity of pathogens on its body surface to cause on infection.[31] It has also been found that microorganisms present in the gut of flies are transmitted through regurgitation and excretion, suggesting that feces and vomitus may also serve as a major route of transmission of pathogens.[20]

CONCLUSION

The current investigation found that house flies and cockroaches in the study area are potential carriers of human intestinal parasites. Identification of intestinal parasites circulating in houseflies and cockroaches in the current study region, posing a risk to people, particularly youngsters. This indicates that there is an urgent need to improve the sanitary and hygienic situation. Furthermore, insect proofing devices should be used in school and college canteens, restaurants, kitchens, sweet shops, and slaughter houses to prevent contamination of food, utensils, and water. The current study also serves as an epidemiological tool for monitoring the current sanitary situation in the study area as well as the prevalence of intestinal parasites.

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REFERENCES

1. Howard J. Nuisance flies around a landfill: patterns of abundance and distribution. Waste Manag Res. 2011; 19(4):308-11.
2. Balla HJ, Usma Y, Muhammad A. The role of housefly (*Musca domestica)* in mechanical transmission of intestinal parasites in Maiduguri metropolis, North eastern, Nigeria. J Natur Sci Res. 2014;4(8):224-30.
3. Awache I, Farouk A. Bacteria and fungi associated with houseflies collected from cafeteria and food Centres in Sokoto. FUW Trends Sci Technol J. 2016; 1(1):123-5.
4. Guidelines for the control of shigellosis, including epidemics of child and adolescent health and development. Available at: https://www.who.int/publications/i/item/9241592330. Accessed on 20 November 2022.
5. Graczyk TK, Knight R, Tamang L. Mechanical transmission of human protozoan parasites by insects. Clin Microbiol Rev. 2005;18(1):128-32.
6. Graczyk TK, Knight R., Gilman RH, Cranfield M. The role of non-biting flies in the epidemiology of human infectious diseases. Microb Infect. 2001;3*(*3):231-5.
7. Pai HH, Chen WC, Peng C. Cockroaches as potential vectors of nosocomial infections. Infect. Control Hosp. Epidemiol. 2004;25(11):979-84.
8. El-Sherbini GT, El-Sherbini E. The role of cockroaches and flies in mechanical transmission of medical important parasites. J Entomol Nematol. 2011; 3(7):98-4.
9. Montressor A, Crompton DWT Hall A, Bundy DAP, Savioli L. Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level. Available at: https://www.who.int. Accessed on 20 November 2022.
10. Getachew S, Gebre-Michael T, Erko B, Balkew M, Medhin G. Non-biting cyclorrhaphan flies (Diptera) as carriers of intestinal human parasites in slum areas of Addis Ababa, Ethiopia. Acta Trop. 2007;103(3):186-94.
11. Sornmani S, Vivatanasesth P, Harinasuta C, Potha U, Thirachantra S. The control of ascariasis in a slum community of Bangkok. Tokyo: APCO publisher; 2004.
12. El-Sherbini Gneidy. Cockroaches and flies in mechanical transmission of medical important parasites in Khaldyia Village, El-Fayoum,

Governorate, Egypt. J Egypt Soc Parasitol. 2012;42(1): 165-74.
13. Service MW. A Guide to Medical Entomology. London: Macmillan Press Ltd. London. 1980.
14. Cheesbrough M. Medical Laboratory Manual for Tropical Countries. ELBS. 1998;1:23.
15. Elele, K, Gboeloh, L. Selected food-borne parasites associated with cockroaches and houseflies in Ignatius Ajuru University of Education, Port Harcourt. Niger J Parasitol. 2017;38(2):302-6.
16. Tatfeng, YM, Usuanlele, MU, Orukpe, A, Digban, AK, Okodua, M, Oviasogie, F, Turay, AA. Mechanical transmission of pathogenic organisms: the role of cockroaches. J Vector Borne Dis. 2005;42(4): 129-34.
17. Ansari MI. Evaluation of vectorial capacity of houseflies and cockroaches for transmitting human intestinal parasites. Adv Zool Bot. 2023:11(1):52-8.
18. Smallegange RC, den Otter CJ. Houseflies, annoying and dangerous. In: Emerging pests and Vector-borne diseases in Europe. Netherlands: Wageningen Academic Publishers; 2001:1;23-8.
19. Sarwar M. Insect Vectors Involving in Mechanical Transmission of Human Pathogens for Serious Diseases. Int J Bioinformatics Biomed Enginee. 2015; 1(3):300-6.
20. Pava-Ripoll M, Pearson GRE, Miller AK, Tall BD, Keys CE, Ziobro GC. Ingested Salmonella enterica, Cronobacter sakazakii, Escherichia coli O157:H7, and Listeria monocytogenes: transmission dynamics from adult house flies to their eggs and first filial (F1) generation adults. BMC Microbiol. 2015;31(15):150.
21. Fisher ML, Fowler FE, Denning SS, Watson DW. Survival of the House Fly (Diptera: Muscidae) on Truvia and Other Sweeteners. J Med Entomol. 2017; 54(4):999-5.
22. Iqbal W, Malik M, Sarwar M, Azam I, Iram N, Rashda A. Role of housefly (Musca domestica, Diptera; Muscidae) as a disease vector; A review. J Entomol Zoo Studies. 2014:2:159-63.
23. Ibrahim AMA, Ahmed, HHS, Adam, RA, Ahmed, A, Elaagip, A. Detection of Intestinal Parasites Transmitted Mechanically by Houseflies (Musca domestica, Diptera: Muscidae) Infesting Slaughterhouses in Khartoum State, Sudan. Int J Trop Dis. 2018;1(1):1-5.
24. Etim SE, Okon OE, Akpan PA, Ukpong GI, Oku EE. Prevalence of cockroaches (*Periplanata americana*) in households in Calabar: public health implications. J Public Health Epidemiol. 2013;5(3):149-52.
25. Rivault CA, Cloarec A, Le Guyader A. Bacterial load of cockroaches in relation to urban environment. Epidemiol. Infect. 1993;110(2):317-25.
26. Fasanella A, Scasciamacchia S, Garofolo G, Giangaspero A, Tarsitano E, Adone R. Evaluation of the house fly Musca domestica as a mechanical vector for an anthrax. PLoS ONE. 2010;5:e12219.
27. Bala, AY, Sule, H. Vectorial potential of cockroaches in transmitting the parasites of medical importance in Arkilla, Sokoto Nigeria. Niger J Basic Appl Sci. 2010; 20(2):111-5.
28. Mikhail MW, Soliman MI, Morsy TA. The current status of fleas according to environmental changes in some governorates in Egypt. J Egypt Soc Parasitol. 2011;41(1):199-13.
29. Fotedar R, Banerjee U, Singh S, Verma S. The housefly (Musca domestica) as a carrier of pathogenic microorganisms in a hospital environment. J Hosp Infect. 1992;20(3):209-15.
30. Oghale O, Ebube C, Oluchi U. Parasitic load on Musca domestica (Dipthera: Muscidae) from different synanthropic environments in Umuahia metropolis. J Public Health Epidemiol. 2013;5(8):309-12.
31. De Jesús AR, Bryce JR, Whiting RC. Quantitative contamination and transfer of *Escherichia coli* from foods by houseflies, *Musca domestica L*. (Diptera: Muscidae). Int J Food Microbiol. 2004; 93(2):259-62.

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