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Cross-sectional study and Building a Geographical Information System for Brucellosis in Monufiya

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ABSTRACT

Background/ Aim: Brucellosis is a communicable disease with highly significance in human and veterinary practices as well as responsible forsubstantial economic losses in cattle. This study aimed to detect the incidence of brucellosis for three successive years from 2016–2018 in Monufiya governorate using Rose Bengal test. In addition to apply the Geographic Information System (GIS) 10.1 to investigate the patterns of the disease and to identify high-risk areas of the disease.

Methods: A total of 75,697 animals (43,274 cattle, 19,974 buffaloes, 8,684 sheep, and 3,765 goats) were tested by RBPT and the obtained data were subjected to the Geographic Information System (GIS) 10.1 to investigate the patterns of the disease over the period from 2016-2018 and to identify high-risk areas of the disease.

Results: The reported results indicated that the highest incidence rate of brucellosis in Ashmoun center 3% other than in other cities in cattle and buffaloes. In the other side, the incidence rates in both sheep and goats varied widely between cities and even in the same city within the three years.

Conclusion: The animal's movement represent a major source of infection dissemination in Monufiya governorate. Strict measures and preventive strategies must be regulating to prevent the dissemination of brucellosis in Monufiya, especially in moveable flocks.

Keywords: *Brucella*, GIS, Monufiya, Rose Bengal test and Prevalence.

INTRODUCTION

Brucellosis remainsone of the significantserious and zoonotic infections worldwide (Pappas et al., 2006). Gram-negative coccobacilli of the genus *Brucella* was the etiological agent of brucellosis which affects cattle, sheep, goats, and other livestock (Solera et al., 1997). David Bruce in 1887 discover the *Brucella melitensis* , although other several species have been identified such as *B. abortus* (which infects cattle), *B. melitensis* (which infects sheep and goats), *B. suis*, *B. neotomae*, *B, ovis*, and *B. canis* (Corbel, 1997; Garin-Bastuji et al., 1998). Although most industrialized countries have eliminated brucellosis, it remains a main disease in the Mediterranean counties, Africa, western Asia, and Latin America (Pappas et al., 2006). Because of repeated abortions, drop in milk production, infertility disorders, veterinary cost, high culling rates and treatment expenses it can cause noteworthy financial losses in the dairy industry as well as small-scale holders (Franc et al., 2018). The main relative important modes of infection transmission are ingestion, inhalation, and direct contact and the etiological agent's gateways vary depending on the animal reservoirs, epidemiological area, occupational related groups, and those exposed to the risk (Guerrier et al., 2011). Brucellosis was first recorded in Egypt in 1939 (Refai, 2002). Egypt's brucellosis control programmes have used two approaches: vaccination to susceptible animals and slaughter of the positive serologic cases. The test-and-slaughter strategy, as well as mass vaccination of animals, continue the most applied methods for controlling brucellosis in endemic countries (Vatankhah et al., 2019; El-Diasty et al., 2022). As a result, ongoing research is critical to preventing transmission and identifying new reservoir areas (Zameer Durrani et al., 2020). Several countries have reported effective programmes for managing *Brucella* infection through strong immunization programmes based on the use of smooth live vaccines, steady diagnostic technologies, mass vaccination of large populations, and culling of *Brucella*-positive animals (Moreno, 2014).

Egypt has a diverse livestock population that includes sheep, goats, cattle, and buffaloes. Egypt has more buffaloes than any other country in the Middle East region (Refai, 2002). In Egypt, *B. melitensis* infections in cattle and buffaloes have increased in addition to high prevalence rates in sheep and goats (Refai, 2002). Recently, advanced techniques such as molecular classification of *Brucella* circulating strains have been critical for eradicating repeated outbreaks, limiting infection spread, and selecting anti-brucellosis strategies (Mick et al., 2014). Other recent modern techniques such as existing MLVA and Multilocus sequence typing (MLST) databases for genotyping of bacteria have facilitated global epidemiologic studies, and allow to limit the disease dissemination (Kattar et al., 2008). Geographic information system (GIS) can provide a full description of the epidemiology of the disease for planning control measures (Moore & Carpenter, 1999). Our study aimed to determine the distribution of brucellosis in Monufiya governorate from the period 2016-2018 using Rose Bengal Plate test and GIS.

MATERIALS AND METHODS

Animals and samples:

In this study, 75,697 animals (43,274 cattle, 19,974 buffaloes, 8,684 sheep, and 3,765 goats) from herd and individual animals in Monufiya governorate, Egypt during 2016, 2017 and 2018; the case history revealed no previous infection with brucellosis.

Screening of samples by RBPT:

We used one of the serologic tests that recommended by the National Brucella Committee, which represents the general organization of veterinary services, veterinary laboratories, and Universities in Egypt (Refai, 2002). The Rose Bengal plate test was performed according to Alton et al. (1975) and Samaha et al. (2008).

Geographic Information System:

A PC-computer is used for data entry, editing, analysis, and producing output. A SUMMAGRAPHICS digitizer A0 size is also used for digitizing maps. Software packages are used for processing namely: ARC/INFO and Arc View. ARC/INFO and Arc View as powerful GIS software for spatial data manipulation.

Statistical analysis:

Data was stored in Microsoft (MS) Excel Spread Sheet program and analysis was carried out using Fishers exact test to determine the incidence of brucellosis, statistical significance was set at $P < 0.05$ (Ilstrup, 1990).

RESULTS

Results attained form different animal groups are shown in table (1). The highest incidence of brucellosis in cattle was in Ashmoun 3% and 3.92% during 2016 and 2017 respectively and Birket elsab 2.5% during 2018. The lowest incidence of brucellosis in cattle was in Sadat City 0% during 2016, 2017 and 2018 (Fig. 1).

The incidence of cattle brucellosis was increasing significantly during 2016-2018 in Birket elsab and decreasing significantly during the same period in Shibin el Kom (Table 1).

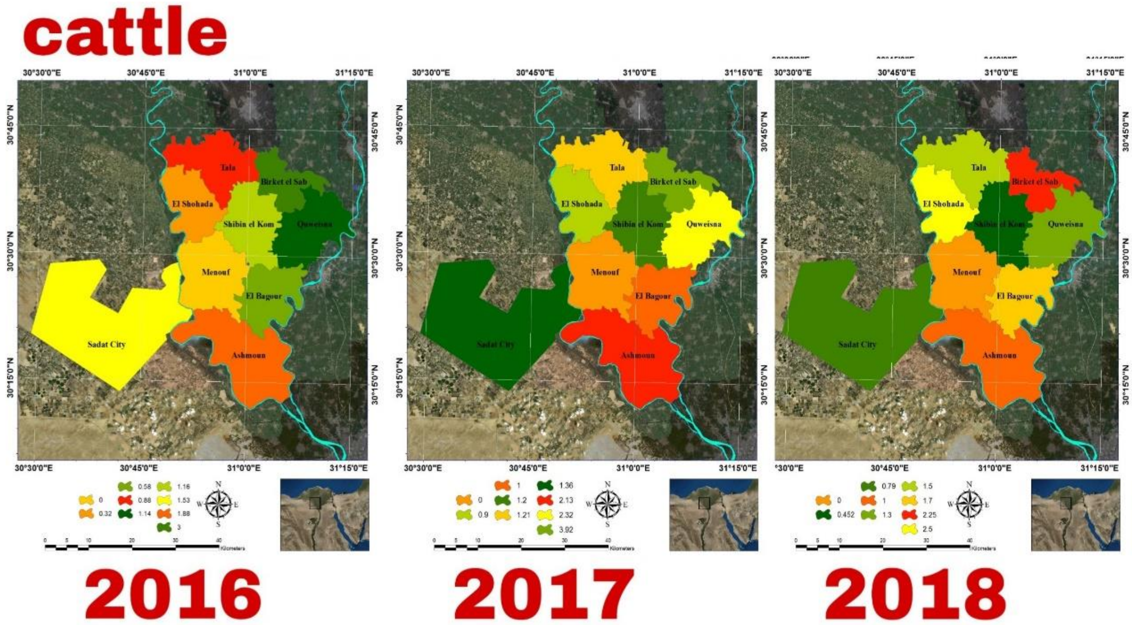

Figure (1): Distribution of cattle brucellosis prevalence during 2016–2018.

The highest incidence of brucellosis in buffaloes was in Ashmoun 2.42%, 1.7% and 2.38% during 2016, 2017 and 2018 respectively. The lowest incidence of brucellosis in buffaloes was 0% in Sadat City during 2016, 2017 and 2018 and Quweisna 2018 (Fig. 2).

The incidence of buffalo brucellosis was increasing significantly during 2016-2018 in Birket elsab and decreasing significantly during the same period in Shibin el Kom, El Bagour and Quweisna (Table 1).

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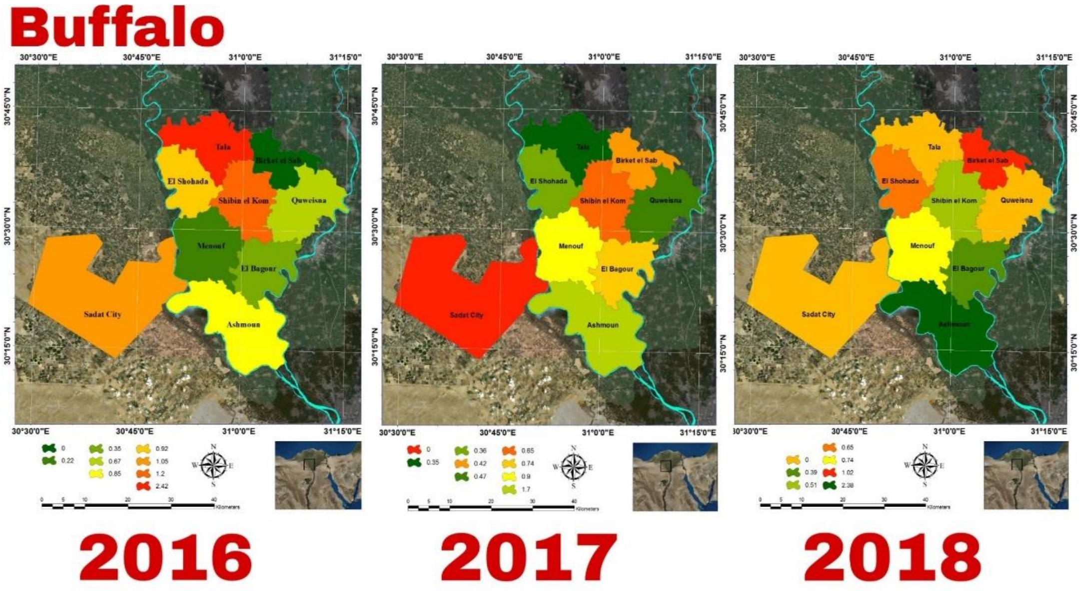

Figure (2): Distribution of buffalo brucellosis prevalence during 2016–2018.

The higher incidence of brucellosis in sheep was recorded in Ashmoun 6.96% during 2016, Sadat City 12.15% during 2017 and Shibin el Kom 16% during 2018. The lowest incidence of brucellosis in sheep was in Quweisna 0.43% and 0.33% during 2016 and 2017 respectively and Ashmoun 1.587% during 2018 (Fig. 3).

The incidence of sheep brucellosis was increasing significantly during 2016-2018 in Shibin el Kom, and Quweisna and decreasing significantly during the same period in Sadat City (Table 1).

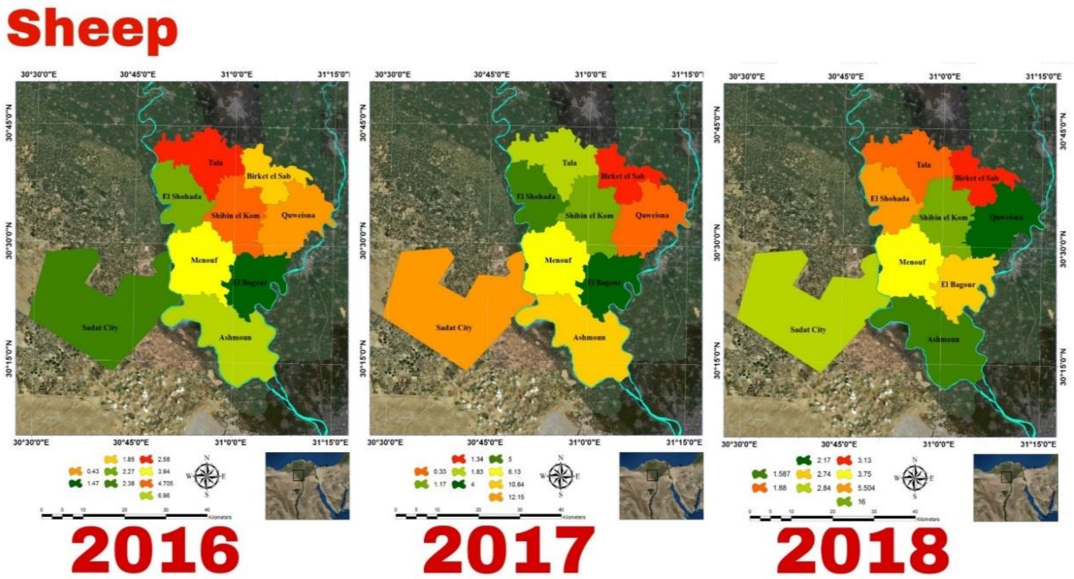

Figure (3): Distribution of sheep brucellosis prevalence during 2016–2018.

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The highest incidence of brucellosis in goats was in Menouf 12% and 7.75% during 2016 and 2017 respectively and El Shohada 7.69% during 2018. The lowest incidence of brucellosis in goats was 0% in Sadat City and Tala during 2016, 2017 and 2018 and Quweisna 2018 (Fig. 4).

The change of incidence pattern of goat brucellosis was insignificant in all cities during 2016-2018 except for Menouf and Quweisna was decreasing significantly during the same period (Table 1).

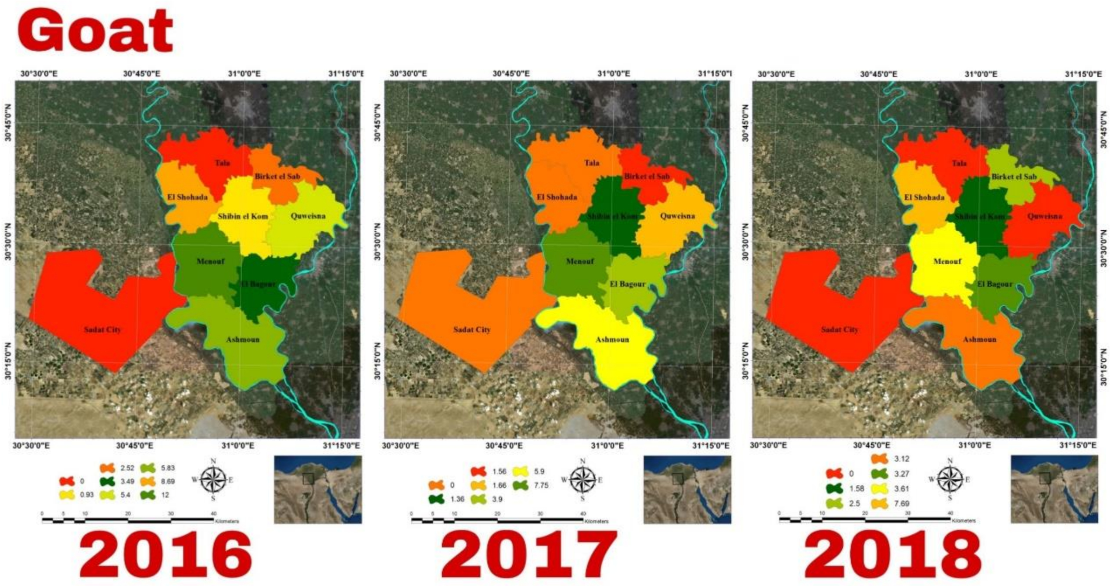

Figure (4): Distribution of goat brucellosis prevalence during 2016–2018.

The incidence of brucellosis among sheep and goats is significantly higher than other species. The incidence of brucellosis in Ashmoun is significantly higher than other cities in Monufiya (Table 1).

Table (1): Rose Bengal test results for brucellosis in animals in Monufiya during 2016-2018

		Serologic test, no. positive (%) RBP		
Serum source	**Location**	**2016**	**2017**	**2018**
Cattle	El Bagour	1.88% (13/689)	2.13% (18/843)	1% (19/895)**
	Ashmoun	3% (35/1149)	3.92% (47/1198)	2.25% (31/1207)
	El Shohada	0.58% (8/1371)**	1% (18/1787)**	1.7% (271563)
	Birket el Sab	0.32% (4/1234)**	0.9% (10/1045)**	2.5% (18/703)
	Sadat City	0% (0/6724)**	0% (0/4704)**	0% (0/4751)**
	Menouf	1.14% (11/960)	2.32% (19/816)	1.3% (10/742)

Serum source	Location	Serologic test, no. positive (%) RBP 2016	2017	2018
	Quweisna	1.53% (18/1169)	1.36% (13/953)**	.79% (6/753)**
	Shibin el Kom	1.16% (7/601)	1.2% (7/548)**	0.452% (3/663)**
	Tala	0.88% (2/1362)	1.21% (12/985)**	1.5% (58/3859s
Buffaloes	El Bagour	1.2% (14/1122)	0.74% (8/1073)*	0.39% (3/751)**
	Ashmoun	2.42% (27/1114)	1.7% (15/845)	2.38% (16/672)
	El Shohada	0.85% (6/703)	0.36% (3/819)**	0.65% (4/611)**
	Birket el Sab	0.35% (3/848)***	0.42%(3/711)**	1.02%(5/487)
	Sadat City	0% (0/53)***	0% (0/138)**	0% (0/134)**
	Menouf	1.05% (10/949)	0.90% (8/886)	0.74% (7/935)**
	Quweisna	0.92% (7/757)	0.47% (3/638)**	0% (0/611)**
	Shibin el Kom	0.22% (2/879)**	0.65% (6/915)*	0.51% (7/1366)**
	Tala	0.67% (7/1033)**	0.35%(2/570)**	0% (0/354)**
Sheep	El Bagour	1.47% (5/338)	4% (8/200) **	2.74% (7/255)
	Ashmoun	6.96% (53/71) **	10.64% (30/282) **	1.587% (4/252)
	El Shohada	2.27% (10/440) **	5% (9/180) **	5.504% (17/659) **
	Birket el Sab	1.85% (12/648)	1.34% (4/297)	3.13% (15/479)
	Sadat City	2.38% (3/126)	12.15% (13/107) **	2.84% (4/161)
	Menouf	3.94% (9/228) **	6.13% (10/163) **	3.75% (5/133)
	Quweisna	0.43% (1/698)	0.33% (1/302)	2.17% (9/413)
	Shibin el Kom	4.705% (20/425) **	1.17% (5/424)	16% (24/150) **
	Tala	2.58% (17/659) **	1.83% (7/382)	1.88% (4/212)
Goats	El Bagour	3.49% (5/143)	3.9% (5/128) **	3.27% (8/244)
	Ashmoun	5.83% (22/377) **	5.9% (12/203) **	3.12% (6/192)
	El Shohada	8.69% (2/23) **	-	7.69% (1/13) **

Serum source	Location	Serologic test, no. positive (%) RBP		
		2016	2017	2018
	Birket el Sab	2.52% (7/277)	1.56% (6/385)	2.5% (6/240)
	Sadat City	0% (0/10)	0% (0/77)	0% (0/1)
	Menouf	12% (22/183) **	7.75%(10/129) **	3.61% (3/83)
	Quweisna	5.4% (4/76) **	1.66%(4/240)	0% (0/170)
	Shibin el Kom	0.93% (2/214)	1.36% (3/220)	1.58% (1/63)
	Tala	0% (0/16)	0% (0/38)	0% (0/20)

*Significance at $p < 0.05$.

DISCUSSION

Brucellosis is a highly contagious and public health concern disease that affects humans and a varied range of domestic animals, including ruminants (Radostits et al., 2006). It can pose an occupational risk to humans who handle products from infected animals, such as laboratory technians, veterinarians, slaughter workers, and farmers who come contact with animals (D'Anastasio et al., 2011). Brucellosis is still an endemic or re-emerging neglected zoonotic disease in many parts of the world, particularly in Africa and Asia (Seleem et al., 2010).). Brucellosis is a significant issue in intensive, peri-urban, and small-holder dairy livestock (Njeru et al., 2015). In several developed countries, brucellosis has been successfully controlled through the use of host species-specific vaccines or a test and slaughter policy in free areas (McDermott & Arimi, 2002). Till now there are ten Brucella species are known, with five isolated from human cases (Sohn et al., 2003). Over 500,000 new human cases of brucellosis are diagnosed globally each year by the World Health Organization (WHO) (Corbel, 1997); however, this figure is likely to be underestimated due to underreporting and misdiagnosis (Jennings et al., 2007).Because the vast majority of human cases are acquired through the ingestion of contaminated dairy products or direct contact with an infected animals, particularly dairy cattle; brucellosis control is critical to the prevention of human infection (Corbel, 2006). So apart from its impact on human health, ruminant brucellosis causes substantial economic losses due to abortion in pregnant cows, reduce in milk production, and infertility in adult males (OIE, 2009). The main cause of brucellosis in animals and humans in Egypt and other countries is *B. melitensis biovar 3*. (Refai, 2002; Samaha et al., 2008). In high-risk populations, the incidence of human brucellosis has been reported to be as high as 8% (Samaha et al., 2009).In our study, the serologically reactive animals for *Brucella* spp. in Monufiya in cattle, buffaloes, sheep, and goats was addressed in the last three years, 2016, 2017, and 2018 (Table 1). The overall prevalence rates in cattle and buffaloes were generally higher in the Ashmoun area than in other cities, which can be explained by the fact that this location area shares borders with three governorates in addition to

Menouf and Sadat City, making Ashmoun an open market for animals trading from various localities. Sadat City had a 0% prevalence, which may be attributed to the use of testing and slaughter policies in large farming systems. During 2016-2018, the prevalence of cow and buffalo brucellosis increased significantly in Birket-elsab. Variations in infection in different cities may be attributed to environmental and stress factors, which may modulate susceptibility to infection.Regarding to brucellosis in sheep and goats; it was clear that a wide variation was noticed between cities and even in the same city within the three years.which can be attributed to mobile movement of most sheep or goat flocks in Monufiya governorate. The continuous movement of infected sheep or goats can led to more contamination of the pastures and spread brucellosis to other animals (e.g., cattle or buffaloes) in other herds or areas. This movement is constitute a major risk factor for failure of brucellosis eradication programs in Egypt and several countries. Elimination or control of infection in sheep and goat flocks can allow more reduction in the disease spreading and dissemination in cattle and buffalo(Samaha et al., 2008).

CONCLUSION

Our findings emphasize the need for continuous national surveillance programs for control and prevention of brucellosis in Monufiya and other governorates. Measures should be established to control spread of brucellosis, especially in mobile flocks. These measures should include identification of infected animals by periodic examination of flocks or newly purchased animals, application of testing and slaughter policies, adoption of vaccination programs, and strict quarantine measures. Sheep farmers should also be notified about transmission of brucellosis from sheep to cattle and buffaloes. Educational programs about brucellosis are important for livestock owners and consumers.

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