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PREVALENCE OF BORRELIAL INFECTIONS IN TICK VECTORS AND VERTEBRATE HOSTS IN ESMAIELIYA GOVERNORATE, EGYPT.

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ABSTRACT

The seasonal dynamic of ixodid ticks and infection rate with *Borrelia sp.* in ixodid ticks, human, domestic animals (camels, goats & sheep, dogs, cattle, and buffaloes), and pet animals (dogs) were investigated in El- Tal El- kebeer, Esmaieliya governorate for 2 successive years from Mar. 2000 to Feb. 2002. The borrelial infection rate occurred in the tick population throughout the year. Spirochetes were detected in 37.28% of the 1870 ticks examined. The highest percentage ($p < 0.001$), of infection with *Borrelia sp.* in ticks were recorded in *H. dromedarii* (47.92%), followed by *R. sanguineus* (38.37%), *B. annulatus* (32.5%), and *H. excavatum* (30.42%). The prevalence of infection rate with *Borrelia sp.* in the females of each species was higher than males. The highest levels of infection with *Borrelia* in adult ticks were recorded in summer. *Borrelia* spirochete was detected in 35.79% of the blood samples (1900 samples) which were collected from man in Esmaieliya, governorate. Where, the maximum infection rates were recorded in July. The highest infection rate in blood smears which were collected from animals in Esmaieliya was recorded in camels (23.45%), followed by dogs (13.27%), goats & sheep (12.15%), cattle and buffaloes (10%). The changes in prevalence of Borrelia infection rate in the tick population were positively correlated with changes in antibody prevalence in man and animal hosts and with changes in the tick population density. Generally, the all studied events were low in winter and early spring and gradually increased to reach the highest levels in summer (maximum level in Aug.) and autumn.

Keywords: Borellia – Ixodid Ticks – seasonal prevalence – domestic animals – pet animals – Egypt.

INTRODUCTION

Borrelia are highly motile, slender, helically coiled bacteria belong to order Spirochaetales (Barbour *et al.*, 1986). About 16 species of *Borrelia* are transmitted by argasid or soft ticks, and two species, *B. theileri* and *B. burgdorferi* are transmitted by ixodid or hard ticks. *B. theileri* is the causative agent of spirochaetosis in cattle and causes abortion. *B. burgdorferi* is the causative agent of Lyme disease in animals and human. Lyme disease has received much attention due to its wide geographic distribution in different countries. In Egypt, *B. burgdorferi*, was reported in human at Fayoum (Haberberger *et al.*, 1989) and in Alexandria (Hammouda *et al.*, 1995).

Animal disease in general and tick bome diseases in particular plus the direct losses caused by tick attack are among the major factors that hamper the growth of the livestock industry in developing countries (Soneshine, 1991). Gonza-Lezacun and Guglielmone (2005) found that *R. sanguineus* may cause severe injury to their hosts, including humans. Therefore, the aim of the present study to investigate the prevalence of borrelial pathogens in both ticks as vectors and in humans, in domestic animals (camels, cattle, buffaloes, goats and sheep) and in pet animals (dogs) for study the correlation between the seasonal dynamics of the pathogens and the infected tick populations in the studied locality.

MATERIALS AND METHODS

Spirochetes detection in ticks:

The monthly collected ticks of each life stage were examined for *borrelia sp.* Hemolymph smears were obtained from both male and female by cutting the tarsus of the first leg and drawing off the exuding hemolymph on a glass slide. The smears were stained with: (a) Fontana stain (Conn *et al.*, 1960) or (b) by direct fluorescent antibody procedure (Piesman *et al.*,1986) and examined by epifluorescence microscopy.

Spirochetes detection in host:

Blood samples collected from man and animals (camels, goats & sheep, dogs cattle, and buffalo) in the studied locality were centrifuged for 20 min. at 3000 rpm. Serum was separated and kept at -40°C until examined for *Borrelia sp.* using indirect immunofluorescent antibody technique (Lane and Man weiler, 1988). Antigen slides were prepared from spirochetes obtained from ticks and cultured in modified Kelly's medium maintained in RTC laboratory (Barbour *et al.*, 1983). The spirochetes were centrifuged at 9000 xg for 20 min. at 22°C and the spirochete pellet was washed six times in sterile phosphate buffered saline (PbS), adjusted to pH 7.4 and supplemented with 5 mM magnesium chloride. The spirochete pellet was diluted in PbS saline and applied to wells in scored slides for immunofluorescence tests.

Statistical analysis:

The percentages of the different species of the tick and that of *Borrelia* infected ticks in each monthly collection were determined. In the same time, the percentages of the different blood samples in each monthly collection were detected. Data were analyzed with the chi-square test, the correlation between the rate of infection in animal, and the number of the collected ticks was examined with Pearson's correlation coefficient. Data analysis was carried out with the aid of Statistical Package for Social Science (SPSS), version 8.0 for Windows.

RESULTS

During the period of study (May 2000 –Feb. 2002), the highest mean maximum temperature was in July (36.2°C), and Aug. (36.9°C), while the lowest mean maximum temperature was in Jan. (18.8°C) and Feb. (18.2°C), respectively. The highest relative humidity (RH) was in Oct. (75.9%), while the lowest RH was in April (63.2%).

During the period of study, 9454 tick (5277 males and 4177 females), representing 4 tick species were collected from Esmaieliya governorate, and identified as *Hyalomma dromedarii*, *Hyalomma excavatum*, *Rhipicephalus sanguineus*, and *Boophilus annulatus*. The adult of *H. excavatum* was the highest abundant among species (41.5%), ($p < 0.001$), followed by *H. dromedarii* (24.76%), *B. annulatus* (22.77%), and *R. sanguineus* (10.97%). In general males (55.82%) predominated females (44.18%) in total ticks collected (Abbas *et al.*, in press).

Seasonal dynamics of *Borrelia* in ticks

As showing in (Fig. 1&2), *Borrelia* are highly motile, slender, helically coiled bacteria belong to order Spirochaetales. A total of 1870 from 9454 ticks, representing 4 species were examined for the presence of *Borrelia*, spirochete. *Borrelia sp.* was detected in 37.28% of the total examined ticks (16.1% males and 21.18% females). The highest infection rate in adults were recorded in *H. dromedarii* (47.92%), ($p < 0.001$), followed by *R. sanguineus* (38.37%), *B. annulatus* (32.5%), and *H. excavatum* (30.42%). In general the infection rate was higher in total females of all species than males.

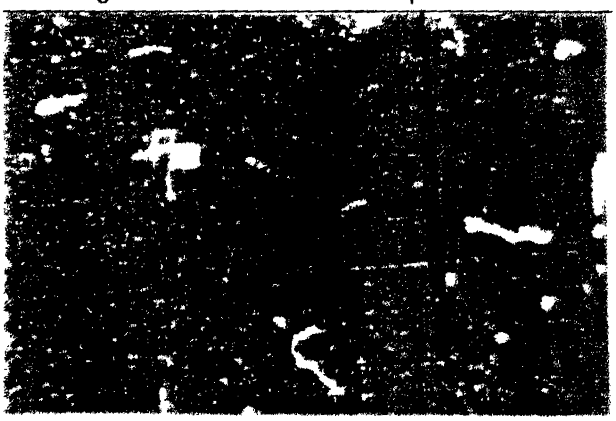


Fig.(1): *Borrelia sp.* in ticks by using Direct fluorescent antibody procedure (X=40).

Monthly collection in adults of *H. dromedarii* showed gradually increase in percentage from May (8.16%), reaching its maximum in July (19.69%), after that it decreased gradually until reach the minimum at Jan.(2.35%),and Feb (2.39%). The seasonal infection rate in adults with *Borellia sp.* (Fig. 3A), during summer (80.83%), and autumn (56.67%), was higher than other species.

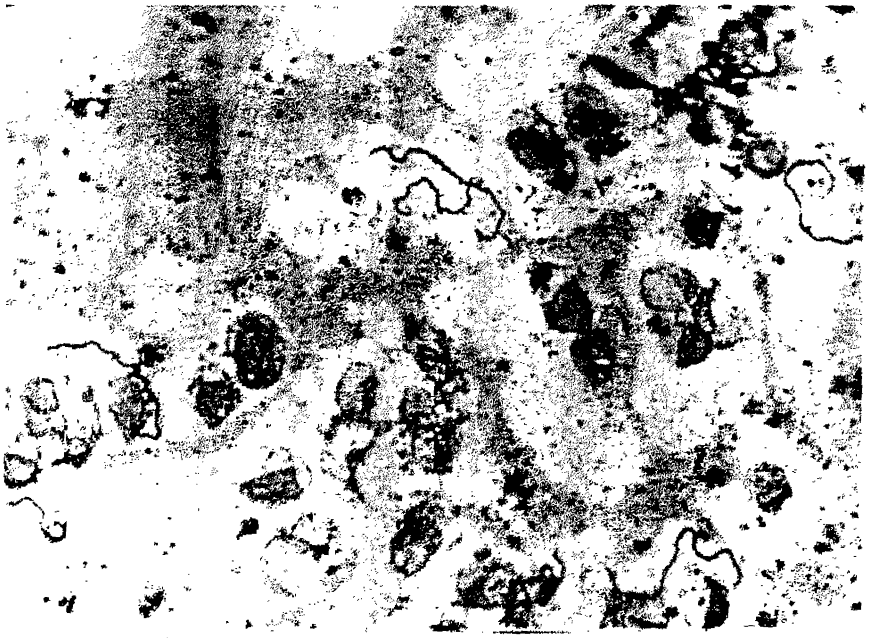


Fig.(2): *Borrelia sp.* in hosts using Fontana stain (X=100)

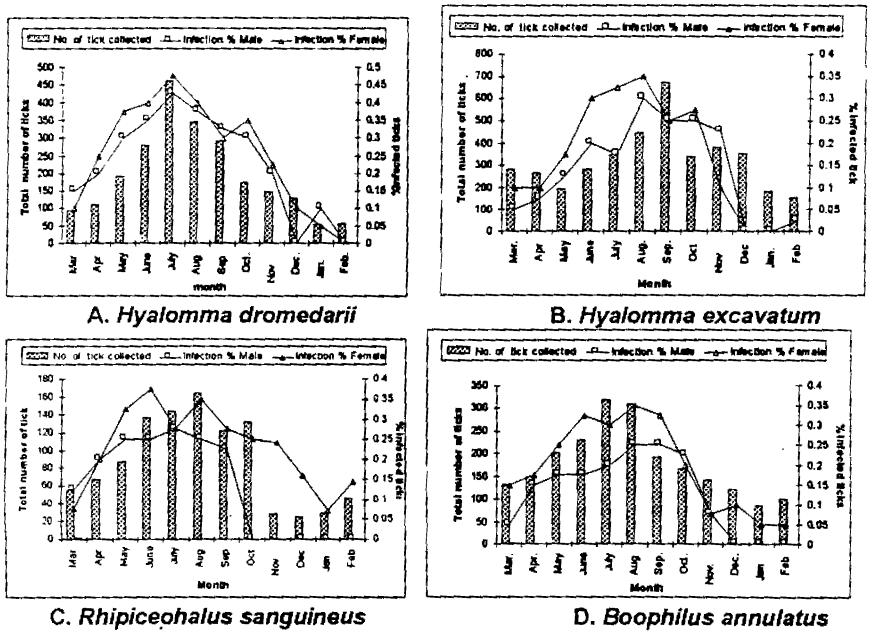


Fig. (3): Changes in the number of ixodid tick species collected and rate of infection during Mar. 2000- Feb. 2002.

However, the infection rate was very low ($p < 0.001$), in winter (8.33%). The infection in adults of *H. dromedarii* began to increase in April (45%), until reaching the maximum in July (90%), then declined gradually to reach the minimum in Feb. (0.0%). Seasonal prevalence of *Borrelia* spirochete in males of *H. dromedarii* was 38.33%, 27.5%, 21.67%, and 3.33%; in summer, autumn, spring, and winter, respectively. The percentage of infection began to increase in May (30%), until reached a maximum in July (42.5%), and decreased gradually to reach the minimum in winter (0.0%), (except in Jan. 10%), ($p < 0.001$). There was no significant difference ($p > 0.05$) not only, between the infection rates in males of *H. dromedarii* among months, but also, between the infection rate in males and females of *H. dromedarii.* However, the prevalence of infection with *Borrelia sp.* in females of *H. dromedarii* began to increase in May (37.5%) until reaching the maximum in July.(47.5%), and decreased gradually to reach the minimum in Feb.(0.0%), ($p < 0.001$). Seasonal prevalence of infection with *Borrelia* in females was high in summer (42.5%), and declined in autumn (29.17%), until reaching the lowest infection in winter (5%), and then increased again in spring (24.17%).

The percentages of *H. excavatum* adults was increased in July (8.92%), to reach a maximum in Sep. (17.33%) and then declined gradually until reached the minimum in Feb. (3.95%). The seasonal infection rate with *Borrelia sp.* in adults of *H. excavatum* (Fig. 3B) was high in summer (55%), (maximum level was Aug. 65%), ($p < 0.001$), followed by autumn (45%), and spring (20.83%). The infection rate was very low ($p < 0.001$), in winter (0. 83%), (minimum level was in Dec. and Jan. 0.0%). The prevalence of infection in males of *H. excavatum* was began in May (12.5%), and increased gradually (except in July 17.5%), to reach the maximum at Aug. (30%), and then decreased gradually to reach the minimum at Dec. and Jan. (0.0%). The highest seasonal infection rate in males of *H. excavatum* was in autumn (24.17%), followed by summer (22.5%), spring (8.33%), and winter (0.83%). In females of *H. excavatum*, the infection with *Borrelia sp.* was high in summer (32.5%), (maximum was in Aug. 35%), ($p < 0.001$), and decreased in autumn (20.83%), to reach the minimum in winter (0.0%), and then increased gradually in spring (12.5%). Infection with *Borrelia sp.* in females of *H. excavatum* did not differ among the months or between the males and females of *H. excavatum.*

Monthly collection of *R. sanguineus* revealed that, the highest percentage of the collected adults was in Aug. (15.81%), and declined gradually after that until reaching the lowest level in Dec. (2.41%). The highest seasonal infection rate ($p < 0.001$) in adults of *R. sanguineus* (Fig. 3C) was in summer (59.16%), followed by spring (39.17%), autumn (33.94%), and winter (12.35%). The maximum infection rate in adults was recorded in June (62.5%), which decreased gradually (except in July 55%), until reached a minimum in Jan (7.14%), ($p < 0.001$). The monthly prevalence of infection in males of *R. sanguineus* was relatively high in July (27.5%), ($p < 0.001$), and declined after that to a minimum (0.0%), in Oct. – Feb. and increased gradually from Mar. to June. Seasonal prevalence of infection with *Borrelia* in males of *R. sanguineus* , in order of abundance was: 25.83%, 19.17%, 8.26%, 0.0 in summer, spring, autumn, and winter, respectively. There was

no significant difference ($p > 0.05$) between the infection rates in males among months. The highest seasonal infection rate in females of *R. sanguineus* was recorded in summer (33.33%), followed by autumn (25.69%), spring (20%), and winter (12.35%). Also, there was no significant difference between the infection rates among months in females of *R. sanguineus* ($p > 0.05$). The infection in females began to rise in May (32.5%) until reached a maximum in June (37.5%), and declined after that (except in July 27.5%), until reached a minimum in Jan (7.14%).

Monthly collection of *B. annulatus* showed that, the percentage of adults began to rise in May (9.43%), until reached to a maximum in July (14.86%), and Aug. (14.4%), then declined gradually reaching a minimum in Jan. (3.99%). The highest seasonal infection rate with *Borrelia sp.* in adults of *B. annulatus,* (Fig. 3D), was in summer (53.33%), (with a maximum of 60% in Aug.), followed by autumn (38.33%), spring (31.67%), and winter (6.67%). The minimum infection rate was in Jan. and Feb. (5%), ($p < 0.001$). In males of, the seasonal prevalence of infection *B. annulatus* was relatively high in summer (20.83%), (maximum infection rate was in Aug. and Sep. 25%), and declined after that in autumn (18.33%), and continued until reached a minimum in winter (0.0%), and then began to rise again in spring (12.5%). There was no significant difference between the infection rates in males of *B. annulatus* among months ($p > 0.05$). The seasonal prevalence of infection in females of *B. annulatus,* was 32.5%, 20%, 19.17%, and 6.67%, in summer, autumn, spring, and winter, respectively. The infection rate in females of *B. annulatus,* increased in May (25%), to reach a maximum level in Aug. (35%), and declined gradually (except in Nov. 7.5%), until reached a minimum in Jan. and Feb. (5%). The infection rate in males and females were significantly different in different months ($p < 0.05$).

Seasonal dynamic of *Borrelia sp.* in hosts:

Borrelia spirochete was detected in blood samples (1900) collected from human, domestic animals (camel, goat& sheep, cattle, and buffalo) and pet animals (dogs) in Esmaieliya governorate (Fig. 1&2). Infection rate in camels (23.45%), was relatively high ($p< 0.05$), followed by dogs (13.27%), goat& sheep (12.15%), cattle and buffalo (10%).

Borrelia sp. was detected in 35% of the examined blood samples which collected from human. The highest seasonal infection rate was in summer (45%), ($p < 0.001$), in which the maximum level was in July (50%), (Fig. 4A), after that, the infection rate decreased in autumn (35%), reaching the lowest infection in winter (20%), (minimum level was in Jan. 15%), and then began to increase in spring (35%).

Seasonal prevalence of *Borrelia sp.* in camels (large animals) showed that, summer (42.87%), recorded the highest infection rate among seasons ($p < 0.001$), followed by autumn (25%), spring (23.33%), and winter (3.33%). The infection rate began to increase in Mar. (25%), and increased gradually (except in April) to reach a maximum in July (60%), and then decreased gradually (except in Aug. 28.57%) to reach the minimum in Jan. and Feb. (0.0%), (Fig. 4B). There was a high significant difference ($p < 0.001$), between the infection rate in camel and other studied animals (except

with dogs p> 0.05). There was no significant difference (p > 0.05), between the infection rate in camel among months.

The prevalence of infection rate in goats & sheep (small ruminants) began to increase in May (30%), reaching the maximum infection rate at Aug. (40%), and declined gradually to reach the minimum infection rate in late autumn (Nov.), and winter (0.0%), (p< 0.05), (Fig. 4C). The seasonal infection rate was highest in summer (30%), followed by spring (15%), and autumn (10%). There was no significant difference between the infection rate in goat & sheep among months (p > 0.05).

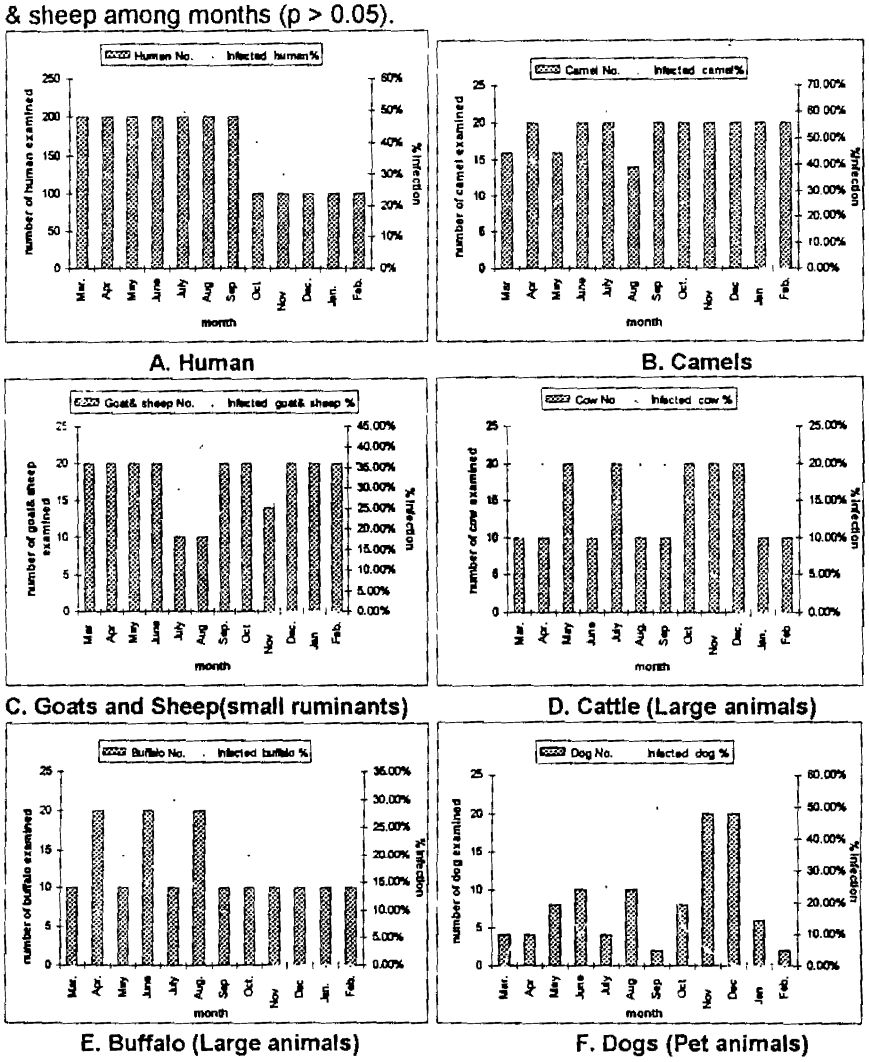


Fig. (4): Prevalence of different hosts Infection in blood samples collected from dogs in Esmaieliya Governorates during Mar.2000- Feb. 2002.

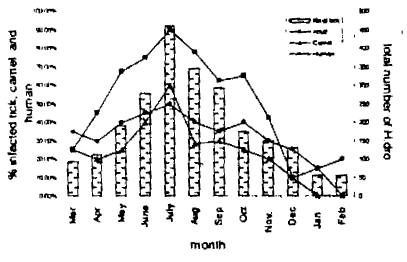
In cattle (large animals), summer (15%), recorded the highest season in infection with *Borrelia sp.* however, the infection rate was equal in spring and autumn (13.33%). The highest infection rate was in Aug., Sep. and April (20%), while, the lowest was in winter (0.0%), (Dec.- Feb.), (Fig. 4D). There was no significant difference between the infections with *Borrelia sp.* among months in cattle ($p > 0.05$).

Summer (18.33%), recorded the highest season ($p < 0.001$) in infection with *Borrelia sp.* in buffalo (Large animals), however, the infection rates were equal in spring and autumn (10%). The highest infection rate in buffalo was in July (30%), (Fig. 4E), while, the lowest (0.0%), was in late autumn (Nov.), winter and early spring (Mar.), ($p < 0.05$) There was no significant difference between the infection with *Borrelia sp.* among months in buffalo ($p > 0.05$).

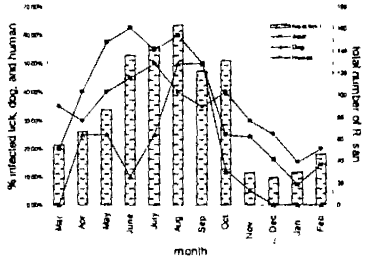
Seasonal prevalence of infection with *Borrelia* spirochete in dogs (pet animals) revealed that, the highest percentage of infection was in summer (28.33%), and autumn (22.5%), whereas, the maximum peak was in Aug. and Sep. (50%), ($p< 0.05$),(Fig. 4F). However, the minimum peak was in winter and early spring (Mar.), (0.0%), after that, the infection rate began to increase in late spring 16.67% (April and May). There was significant difference between the infections with *Borrelia sp.* among months in dogs ($p < 0.05$).

Prevalence of infection in hosts and tick population:

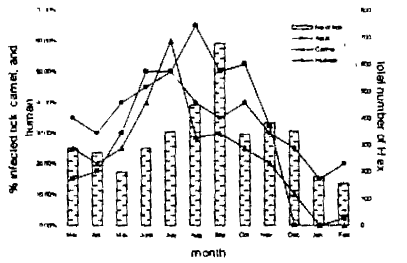
Generally, during the period of study, there was a significant positive correlation between changes in the infection rate in *H. dromedarii* and those in each of man ($r = 0.91$), camels ($r = 0.87$), and the changes in *H. dromedarii* population density ($r = 0.87$), (Fig. 5A). Also, there was a positive correlation between changes in the infection rate in *H. excavatum* and those in each of man ($r = 0.83$), camels ($r = 0.76$), sheep & goats ($r =0.77$), and the changes in *H. excavatum* population density ($r = 0.59$), (Fig. 5C&D). Positive correlation was recorded between the infection rate with *Borrelia sp.* in *R. sanguineus* and those in each of man ($r = 0.81$), dogs ($r = 0.75$), and the changes in *R. sanguineus* population density ($r = 0.80$), (Fig 5B). Also, the significant positive correlation ($p < 0.0001 - 0.005$) were recorded between the infection rate in *B. annulatus* and those in each of man ($r = 0.84$), cattle ($r = 0.86$), buffalo ($r = 0.75$), and the changes in *B. annulatus* population density ($r = 0.85$), (Fig. 5E&5F).



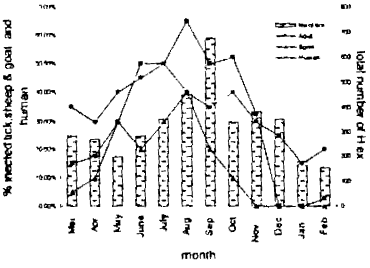
A. Adult of *H. dromedarii*, human, and camels



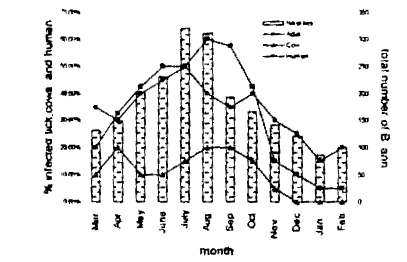
B. Adult of *R. sanguineus*, human, and dogs



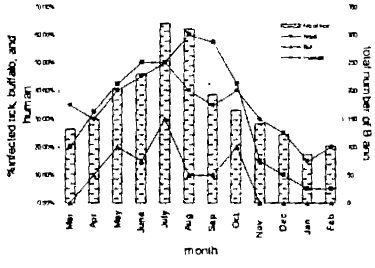
C. Adult of *H. excavatum* human, and camels



D. Adult of *H. excavatum* human, and sheep &goats



E. Adult of *B. annulatus*, human, and cattle



F. Adult of *B. annulatus*, human, and buffalo

Fig. (5): Changes in the percentage of infected ixodid tick species and its hosts and the number of ticks collected in Esmaieliya governorate during Mar.2000- Feb.2002.

DISCUSSION

Spirochetes detection in ticks:

Borrelia are highly motile, slender, helically coiled bacteria belong to order Spirochaetales (Barbour *et al.*, 1986). A total of 1870 from 9454 ticks representing 4 species (*Hyalomma dromedarii*, *Hyalomma excavatum*, *Rhipicephalus sanguineus*, and *Boophilus annulatus*) were examined for the presence of *Borrelia*, spirochete in Esmaieliya governorate during the period of study. *Borrelia sp.* was detected in 37.28% of the total examined ticks (16.1% males and 21.18% females). Borrelial infection occurred in all the collected tick species but in different rates. The infection rates in total females

examined and in each tick species were higher than in the total males examined. This might be attributed to longer time of attachment of females to the host animal (Piesman *et at.*, 1987) which might itself be infected. Also, this is agreement with findings by (Magnarelli *et al.*, 1995a & b) in Bridgeport Connecticut in south central Connecticut, Jenek & Glazaczow (1996) Wielkopolska regions, and Oliver *et al.* (1998) in Bollinger country, Missouri. Schoeler and Lane (1993) noticed that neither fertility nor fecundity in the female of *I. pacificus* was affected by spirochete restricted to the midgut, which demonstrate that this infection do not reduce the reproductive capacity. However, in some tick species the efficiency of transmission is related to duration of nymph (Piesman *et al.*, 1987), and adult of *I. dammini* attachment (Piesman *et al.*, 1991), and that 2 day of attachment appears to be crucial for transmission of *B. burgdorferi*. In Esmaieliya region, the highest infection rate with *Borrelia* was in *H. dromedarii* adult (47.92%). The second highly infected tick was in *R. sanguineus* (38.37%). This suggest that *R. sanguineus* is likely to maintenance of *borrelia* spirochete region. *B. annulatus* adult was the third highly infected tick in Esmaieliya (32.5%). *H. excavatum* adult was the fourth highly infected tick (30.42%). With exception of *B. annulatus* (Fig. from 1 to 5). Many reports confirmed the presence of *Borrelia burgdorferi* sensu lato in ixodid ticks (Rawlings, 1986; Doby *et al.*, 1990; Hubbard *et al.*, 1998 and De Michelis *et al.*, 2000). However, other reports showed that, *B. annulatus* was infected with *Borrelia theileri* (Neitz, 1956; Callow 1967; Trees 1978 and Simth *et al.*, 1985). In Esmaieliya governorate, the infection with *Borrelia sp.* in the collected ixodid ticks was relatively high in late spring (May), summer (maximum in Aug.), and autumn, but spring and winter showed the lowest infection. There was a significant relationship between the activity of *Borrelia* infected tick, temperature of the air, and relative humidity (Hubbard *et al.*, 1998, and Alekseev & Dubinina 2000). Also, in Bratislava, Slovak Republic, summer showed the highest number of spirochete per *I. ricinus* tick (Drgonova & Rehacek, 1995). Activity of tick relative to the tick pathogen system (Alekseev 1993, Alekseev *et al.*, 1996 and Alekseev *et al.*, 1998). They found a positive correlation between the presence of *Borrlia* spirochete in tick and tick activity, and that the *Borrelia* infected tick behavior under the influence of some external factors (plant and animal odors) was different from the response of uninfected ticks (Alekseev 1993, Alekseev *et al.*1996 and Staffored *et al.* 1998). The activity of tick after diapause may represent a high risk period during which the tick can attack human and infects them with spirochetes (Byelozyorov, 1985). Several interrelated factors contribute to the increase or decrease of the infection rates in the different tick species and sexes in each monthly collected sample, as well as to the success in nature of this symbiotic spirochete of the tick (Hoogstraal, 1979). The chief factor is the transovarial transmission of the agent from the parent female to the F1 generation. According to Lane and Burgdorfer (1987), *Borrelia* spirochete passed by 100% to F1 progeny and subsequently passed them to F2 by 90-97%. Transovarial transmission has been reported in *I. scapularis* (Magnarelli *et al.*, 1986), *Amblyomma americanum* (Schulze *et al.*, 1986) and *Haemapyhsalis leporispalustris* (lane & Burgdorfer, 1988). However, transovarial transmission of *B. burgdorferi* in some ixodid tick may be

inefficient because *B. burgdorferi* in the ovary of the tick destroys the microvillar process responsible for the formation of the egg cuticle (Burgdorfer *et al.*, 1989) which hence may reduce fertility and fecundity of the females and hinders the transovarial transmission of the spirochete. The second factor is the transstadial transmission from stage to stage, from larvae to nymphs and from nymphs to adults. Three to ten *I. ricinus* females passed the spirochete to 100% of the F1 larvae that passed spirochete transstadially to 100% of the resultant nymphs (Stanek *et al.*, 1986).

Spirochetes detection in host:

Borrelia sp. causes many disease in human and livestock such as different kinds of borreliosis, epidemic bovine abortion in cattle, whereas the relapsing fever and epidemic bovine abortion are mainly transmitted to man and mammals by argasid tick species (15 species) belonging to one genus (*Ornithodoros*). Lyme disease has been found to be associated with more than 15 ixodid spp. belonging to 4 genera (*Ixodes, Dermacentor, Haemaphysalis,* and *Amblyaamma*) Also, 2 ixodid tick (*Boophilus* and *Rhipicephalus*) parasites of ruminant and horses are involved with the transmission of *Borrelia theileri*, the agent of bovine borreliosis. Lyme disease has been reported from widely separated regions of the USA, Europe, Australia, and Brazil (Schmid, 1985; Yoshinari *et al.*, 1997 and 1999). In Egypt, *Borrelia burgdorferi*, the etiologic agent of Lyme disease, was reported in human at Fayoum (Haberberger *et al.*, 1989), and Alexandria (Hammouda *et al.*, 1995). Esmaieliya showed that the infection rate with *Borrelia* in human was 35.79%. However the present infection rate in Esmaieliya was higher than that previously reported in human at Dahshour, Giza (22.1%) by Helmy (2000). Also, the infection with *Borrelia sp.* in human was relatively high during March to November in Esmaieliya. The maximum infection rate with *Borrelia sp.* was during mid summer, in July and this agreed with other reports carried out by Davis *et al.* 1984, in Wisconsin, USA. Due to the fact, ticks are likely to attack large ruminant than small ruminants (Horak, 1984), camels were recorded the highest infected animal with *Borrelia sp.* in Esmaieliya (23.45%). The infection rates in camels (23.45%), were followed by dogs (13.27%), goat& sheep (12.15%), but it was the same in cattle and buffalo (10%). Similar observation was reported by Helmy (2000) in Dahshour, Giza. However, In present work, the serological results of blood samples of each animal showed that, the infection rates with *Borrelia sp.* were relatively low during winter and early spring. However, the infection rate gradually increased in late spring reaching the highest in summer and autumn (May to October). *Borrelia theileri*, is a tick-borne spirochete that infects the blood of cattle, it was first discovered in Africa at 1904 by Theiler. Since then, it has been reported in many region (countries) such and Africa (Neitz, 1956), Nigeria (Trees, 1978), Ghana (Assoku, 1979), Australia (Callow & Hoyte, 1967; Callow, 1967), Mauritius (Barre & Morel, 1983), USA (Smith *et al.*, 1935), Democrat republic of Congo (Matton & Van Melckebeke, 1990), and Sweden (Hovamark *et al.*, 1986). The infection in cattle may be accompanied by fever, lethargy, anemia and possibly hematuria followed by unremarkable recovery (Smith and Rogers, 1999). The illness has been

referred to as tick spirochetosis or bovine borreliosis (Burgdorfer, 1985, and Matton & Van Melckebeke, 1990). *Boophilus annulatus,* is known to be a vector of *Borrelia theileri* (Trees, 1978). Also, *Borrelia burgdorferi* was reported in cattle (Uilenberg *et al.,* 1988 and Rogers *et al.,* 1999). In Egypt, *Borrelia sp.* was detected from the blood samples collected from cattle and buffalo in Giza governorate (Helmy, 2000). The percentage infection with *Borrelia sp.* in buffalo (10%) in Esmaieliya agreed with other reports made in Dahshour, Giza, by Helmy 2000. *Borrelia theileri,* was isolated from calf and cattle by Smith *et al.* 1985, and Sharma *et al.* 2000, as a result of the presence of *Boophilus annulatus* on them. However, Burgess 1988 reported *B. burgdorferi,* in cattle with two peaks in May and October. In dogs, *B. burgdorferi,* was reported in blood samples by many authors: Magnarelli *et al.* 1985; Greene *et al.* 1988; Magnarelli *et al.*, (1990a)& (1990b) &(1990c) and Levy & Magnarelli, 1992. The clinical signs of dogs with borreliosis have been reported to include limb/joint disorder (Lissman *et al.*, 1984; Bosler *et al.*, 1988 and Greene 1990), and infrequently, renal failure (Magnarelli *et al.*, 1987 and Grauer *et al.*, 1988), Myocarditis (Levy and Duray 1988). The onset of this illness in dogs develops frequently during summer (Magnarelli *et al.*, 1985). Many dogs were seropositive, but had no clinical signs of borreliosis (Komblatt *et al.*, 1985; and Magnarelli *et al.*, 1985). In addition, some dogs may be susceptible to *B. burgdorferi* infection than are others, humoral and cellular immune responses may vary among dogs or some strains of *B. burgdorferi* in nature may be more pathogenic than are others (Magnarelli *et al.*, 1990).

Conclusion

It is concluded that, in this region, there was a positive significant correlation ($p < 0.0001 - 0.005$), between the changes in the infection rate with *Borrelia* in each species of ticks and those in each of man and hosts and changes in the tick population density. Human exposed to bites of different species of ticks in the studied locality had complains about suffering illness such as fever, headache, red skin lesion, and other symptoms which most probably similar to those of lyme disease. The lack of properly based surveillance methods of borrelial diseases including the probable misdiagnosis of *Borrelia* in patients blood together with a low level of health education, could contribute to a low clinical awareness of these diseases and their underestimation in our area. The present data are useful in evaluating the size of some borrelial diseases (including livestock borreliosis and lyme disease) in Egypt and understanding the role of some common animals parasitized by those tick species in the epidemiology of the diseases in Egypt.

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REFERENCES

Abbas, A. A. El.; Abd El-Baky, S. M.M.; Helmy, N.; Abd El-Mohsen, A. and Awaad, E. S. (in press): Seasonal abundance of hard ticks (Ixodidae) in two localities (Giza and Esmaieliya governorates) of Egypt.

Alekseev, A.N. (1993): Tick-borne pathogen system and its emergent qualities St Petersburg. Zool. Inst. Russ. Acard. Sci., 204 (in Russian).

Alekseev, A.N. and Dubinina, H.V. (2000): Abiotic parameters and diel and seasonal activity of Borrelia- infected and uninfected *Ixodes persulcatus*, (Acarina, Ixodidae). J. Med. Entomol., 37(1): 9-15

Alekseev, A.N. Burenkova, L.A.; Vasilyeva, I.S.; Dubinina, H.V.and chunikhin, S.P. (1996): The functioning of mixed tick-borne infection foci n Russia. Med. Parasitol., (Moscow) 4: 9-16 (in Russian).

Alekseev, A.N.; Dubinina, H.V.; Antykova, L.P.; Dzhivanyan, T.I. ;Rijpkema, S.G.; Kruif, N.V. and Cinco, M. (1998): Tick- borne borreliosis pathogen identification in Ixodes ticks (Acarina, Ixodidae) collected in St. Petersburg and Kaliningrad Blatic regions of Russia. J. Med. Entomol., 35(2):136-142.

Assoku, R.K. (1979): A study of the incidence of blood borne parasites of livestock in Southern Ghana. Bull. Anim. Helth. Prod. Africa, 27: 29-39.

Barbour, A.G.; Burgdorfer, W.; Hayes, S.F.; Peter, O. and Aeschlimann, A. (1983): Isolation of a cultivatable spirochete from *Ixodes ricinus* ticks of Switzerland. Curr. Microbiol. 8: 123-126.

Barbour, A.G.; Hayes, S.F.; Heiland, R.A.; Schrumpt, M.G. and Tessier, S.L. (1986): A borrelia-specific monoclonal antibody binds to a flagellar epitope. Infect. Immun. 52: 549-554.

Barre, N. and Morel, P.C. (1983): Ticks (Africana, Ixodoidea) of the Mascarene Islands and tick- borne disease. Revue Elevage et de Medecine Veterinare des Pays Tropicaux, 36: 371- 377.

Bosler, E.M.; Cohen, D.P. and Schulze, T.L. (1988): Host responses to *Borrelia burgdorferi* in dogs and horses. NY. Acad. Sci., 539: 221-234.

Burgdorfer, W. (1985): Borrelia. In: Lennett, E.H.; Balows, A. and Hausler, W.J., eds. Manual of clinical microbiology. 4th ed; Washington, DC: American Society for Microbiology. 479- 484.

Burgdorfer, W.; Hayes, S.F. and Corwin, D. (1989): Pathophysiology of the Lyme disease spirochete, *Borrelia burgdorferi* in ixodid ticks. Rev. Infect. Dis., 11: S1442- S1450.

Burgess, E.C. (1988): *Borrelia burgdorferi* infection in Wisconsin horses and cattle. Ann. NY. Acad. Sci., 539:235-243.

Byelozyorov, V.N. (1985): Diapause, its role in the life cycle, mechanism, pp. 214-218. In N.A. Filippova [ed.], Taiga tick *Ixodes persulcatus* Schulze (Acarina, Ixodidae). Morphology, systematic, ecology, medical importance, Nauka, Leningrad (in Russian).

Callow, L.L. (1967): Observations on tick-transmitted spirochaetes of cattle in Australia and South Africa. Br. Vet. J., 123: 492-296.

Callow, L.L. and Hoyte, H.M. (1967): Transmission experiments using *Babesia bigemina, Theileria mutans, Borrelia sp.* And cattle tick, *Boophilus microplus*. Aust. Vet. J., 37: 381-390.

Conn, H. J.; Darrow, M.A. and Emmel, V.M. (1960): Staining procedures used by the biological stain commission. 2. ed. The Williams and Wilkins Company; Baltimare. 289 pp.

Davis, J.P.; Schell, W.L.; Amundson, T.E.; Godsey, M.S.; Spielman, A.; Burgdorfer, W.; Barbour, A.G.; LaVenture, M. and Kaslow, R.A. (1984): Lyme disease in Wisconsin: epidemiologic, clinical, serologic, and entomologic findings. Yale. J. Biol. Med., 57(4):685-696.

De Michelis, S.; Sewell, H.S.; Collares-Pereira, M.; Santos-Reis, M.; Schouls, L.M.; Benes, V.; Holmes, E.C. `and Kurtenbach, K. (2000): Genetic diversity of *Borrelia burgdorferi* sensu lato in ticks from mainland Portugal. J. Clin. Microbiol., 38(6):2128-2133.

Doby, J.M.; Bigaignon, G.; Launay, H.; Costil, C.; Lambert, M.C.; Lorvellec, O. and Rolland, C. (1990): Presence de *Borrelia burgdorferi*, agent de spirochtoses a tiques, chex Ixodes (Exopalpiger) trianguluceps Biruls, Bull. de la soc. Franc. De. Parasitologie, 8: 311-322 (in France).

Drgonova, M. and Rehacek, J. (1995): Prevalence of Lyme borrelia in ticks in Bratislava, Slovak Republic. Cent. Eur. J. Public. Health, 3(3):134-137.

Gonza-Lezacun D. and Guglielmone A. A. (2005): Ticks (Acari: Ixodoidea: Argasidae, Ixodidae) of Chile. Experimental and Applied Acarology 35: 147–163.

Grauer, G.F.; Burgess, E.C. and Cooley, A.J. (1988): Renal lesions associated with *Borrelia burgdorferi* infection in a dog. J. Am. Vet. Med. Assoc., 193: 237-239

Greene, R.T. (1990): An update on the serodiagnosis of canine Lyme borreliosis. J. Vet. Intern. Med., 4: 167-171.

Greene, R.T.; Levine, J.F.; Breitschwerdt, E.B. and Berkhoff, H.A. (1988): Antibodies to *Borrelia burgdorferi* in dogs in North Carolina. Am. J. Vet. Res., 49(4):473-476.

Haberberger, R.L.; Constantine, N.T.; Schwan, T.G. and Woody, J.N. (1989): Lyme disease agent in Egypt? Trans. Roy. Soc. Trop. Med. Hyg., 83: 556.

Hammouda, N.A.; Hegazy, I.H. and el-Sawy, E.H. (1995): ELISA screening for Lyme disease in children with chronic arthritis. J. Egypt. Soc. Parasitol., 25(2): 525-533.

Helmy, N. (2000): Seasonal abundance of *Ornithodoros (O.) savignyi* and prevalence of infection with Borrelia spirochetes in Egypt. J. Egypt. Soc. Parasitol., 30(2): 607-619.

Hoogstraal, H. (1979): Ticks and spirochetes. Acta. Trop. 36: 133-136.

Horak, I.G. (1984): cattle, wild animals and parasites- epizootic or delicately balances ecosystem? In Proceeding of the 13th world Congress on Diseases of Cattle, Durban, 390-393.

Hovarnark, A.; Asbrink, E.; Schwan,O.; Henderstedt, B. and Chiristensson, D. (1986): Antibodies to *Borrelia* spirochaetes in sera from Swedish cattle and sheep. Acta. Vet. Scandinavica, 27: 479- 485.

Hubbard, M.J.; Baker, A.S. and Cann, K.J. (1998): Distribution of *Borrelia burgdorferi* sensu lato spirochaete DNA in British ticks (Argasidae and Ixodidae) since the 19th century, assessed by PCR. Med. Vet. Entomol., 12(1) :89-97.

Jenek, J. and Glazaczow, A. (1996): [The evaluation of *Borrelia burgdorferi* sensu lato spirochaetes distribution in Ixodes ricinus ticks collected in selected regions of Wielkopolska+ regions by polymerase chain reaction (PCR) method].[Article in Polish]. Przegl. Epidemiol., 50(4):383-386.

Komblatt, A.N.; Urband, P.H. and Steere, A.C. (1985): Arthritis caused by *Borrelia burgdorferi*, in dogs. J. Am. Vet. Med. Assoc., 186: 960-964.

Lane, R. S. and Man weiler, S.A.(1988): *Borrelia coriaceae* in its tick vector, *Ornithodoros coriaceus* (Acari: Argasidae), with emphasis on transstadial and transovarial infection. J. Med. Entomol., 25: 172- 177.

Lane, R.S. and Burgdorfer, W. (1987): transovarial and transstadial passage of *Borrelia burgdorferi* in the western black-legged tick *Ixodes pacificus* (Acarina, Ixodidae). Am. J. Trop. Med. Hyg., 37: 188-192.

Lane, R.S. and Burgdorfer, W. (1988): Spirochetes in mammals and ticks (Acarina, Ixodidae) from a focus of Lyme borreliosis in California. J. Wildl. Dis. 24: 1-9.

Levy, S.A. and Duray, P.H. (1988): Complete heart block in a dog seropositive for *Borrelia burgdorferi*: similarity to human Lyme carditis. J. Vet. Intern. Med., 2: 138-144.

Levy, S.A. and Magnarelli, L.A. (1992): Relationship between development of antibodies to *Borrelia burgdorferi* in dogs and the subsequent development of limb/joint borreliosis. J. Am. Vet. Med. Assoc., 1;200(3):344-347.

Lissman, B.A.; Bosler, E.M.; and Camay, H. (1984): Spirochete- associated arthritis (Lyme disease) in a dog. J. Am. Vet. Med. Assoc., 185: 219-220.

Magnarelli, L.A.; Anderson, J.F. and Johnson, R.C. (1995b): Analyses of mammalian sera in enzyme-linked immunosorbent assays with different strains of *Borrelia burgdorferi* sensu lato. J. Wildl. Dis., 31(2):159-165.

Magnarelli, L.A.; Anderson, J.F. and McAninch, J.B. (1990a): Serologic analyses of cottontail rabbits for antibodies to *Borrelia burgdorferi*. J. Clin. Microbiol., 28(5):890-893.

Magnarelli, L.A.; Anderson, J.F. and Schreier, A.B. (1990b): Persistence of antibodies to *Borrelia burgdorferi* in dogs of New York and Connecticut. J. Am. Vet. Med. Assoc., 196(7):1064-1068

Magnarelli, L.A.; Anderson, J.F.; Apperson, C.S.; Fish, D.; Johnson, R.C. and Chappell, W.A. (1986): Spirochetes in ticks and antibodies to *Borrelia burgdorferi* in white-tailed deer from Connecticut, New York State, and North Carolina. J. Wildl. Dis., 22(2):178-188.

Magnarelli, L.A.; Anderson, J.F.; Kaufmann, A.F.; Lieberman, L.L. and Whitney, G.D. (1985): Borreliosis in dogs from southern Connecticut. J. Am. Vet. Med. Assoc., 1;186(9):955-959.

Magnarelli, L.A.; Anderson, J.F.; Levine, H.R. and Levy, S.A. (1990c): Tick parasitism and antibodies to *Borrelia burgdorferi* in cats. J. Am. Vet. Med. Assoc., 1;197(1):63-66.

Magnarelli, L.A.; Anderson, J.F.; Schreier, A.B. and Ficke, C.M. (1987): Clinical and serologic studies of canine borreliosis. J. Am. Vet. Med. Assoc., 1;191(9):1089-1094.

Magnarelli, L.A.; Denicola, A.; Stafford, K.C. and Anderson, J.F. (1995a): *Borrelia burgdorferi* in an urban environment: white-tailed deer with infected ticks and antibodies. J. Clin. Microbiol., 33(3):541-544.

Matton, P. and Van Melckebeke, H. (1990): Bovine borreliosis: comparison of simple methods for detection of the spirochaete in the blood. Trop. Anim. Health. Prod., 22(3):147-152.

Neitz, W.O. (1956): A consolidation of our knowledge of the transmission of tick-borne diseases. Onderstepoort. J. Vet. Res., 27: 115-163.

Oliver, J.H.; Kollars, T.M.; Chandler, F.W.; James, A.M.; Masters, E.J.; Lane, R.S. and Huey, L.O. (1998): First isolation and cultivation of *Borrelia burgdorferi* sensu lato from Missouri. J. Clin. Microbiol., 36(1): 1-5.

Piesman, J.; Mather, T.N.; Donahue, J.G.; Levine, J.F.; Campbell, J.D.; Karakashian, S.J. and Spielman, A.(1986): Comparative prevalence of *Babesia microti* and *Borrelia burgdorferi* in four populations of *Ixodes dommini* in eastern Massachusetts. Acta Trop., 43: 263- 270.

Piesman, J.; Mather, T.N.; Sinsky, R.J. and Spielman, A. (1987): Duration of tick attachment and *Borrelia burgdorferi* transmission. J. Clin. Microbiol., 25: 557-558.

Piesman, J.; Maupin, G.O.; Campos, E.G. and Happ, C.M. (1991): Duration of adult female *Ixodes dammini* attachment and transmission of *Borrelia burgdorferi*, with description of a needle aspiration isolation method. J. Infect. Dis., 163: 895-897.

Rawlings, J.A. (1986): Lyme disease in Taxas. Zentrall für Bakteriol Hyg., (A), 263, 483-487.

Rogers, A.B.; Smith, R.D,; and Kakoma, I.(1999): Serologic cross-reactivity of antibodies against *Borrlia theileri*, *Borrelia burgdorferi*, and *Borrelia coriaceae* in cattle. Am. J. Vol. Res., 60(6): 694- 697.

Schmid, G.P. (1985): The global distribution of Lyme disease. Rev. Infect. Dis., 7: 41-50.

Schoeler, G.B. and Lane, R.S. (1993): Efficiency of transovarial transmission of the lyme disease spirochete *Borrelia burgdorferi* in the western black-legged tick *Ixodes pacificus* (Acarina, Ixodidae). J. Med. Entomol., 30: 80-86.

Schulze, T.L.; Lakat, M.F.; Parkin, W.E.; Shisler, J.K.; Charette, D.J. Bosler, E.M. (1986): Comparison of rates of infection by the Lyme disease spirochete in selected populations of *Ixodes dammini* and *Amblyomma americanum* (Acari: Ixodidae). Zentralbl. Bakteriol. Mikrobiol. Hyg. [A]. 263(1-2):72-78.

Sharma, S.P.; Amanfu, W. and Losho, T.C. (2000): Bovine borreliosis in Botswana. Onderstepoort. J. Vet. Res.,67(3): 221-223.

Smith, R.D. and Rogers, A.B. (1999): *Borrelia theileri*- a review. J. Spirochetal. Tick-borne Dis., 5: 63-68.

Smith, R.D.; Miranpuri, G.S.; Adams, J.H. and Ahrens, E.H. (1985): *Borrelia theileri*: isolation from ticks (*Boophilus microplus*) and tick-borne transmission between splenectomized calves. Am. J. Vet. Res., 46(6):1396-1398.

Sonenshine, D.E. (1991): Biology of ticks. Vol. 1, Oxford University Press, New York.

SPSS, (1998): Statistical Package for Social Science, Version 8 for windows.

Stafford, K.C.; Cartter, M.L.; Magnarelli, L.A.; Ertel, S.H. and Mshar, P.A. (1998): Temporal correlations between tick abundance and prevalence of ticks infected with *Borrelia burgdorferi* and increasing incidence of Lyme disease. J. Clin. Microbiol., 36(5):1240-1244.

Stanek, G.; Burger, I.; Hirschl, A.; Wewalka, G. and Padda, A. (1986): *Borrelia* transfer by ticks during their life cycle. Studies on laboratory animals. Zentralb. Bakteriol. Mikrobiol. Hyg. Ser., 263: 29-33.

Theiler, A. (1904): Spirillosis of cattle. J Comp Pathol Ther., 17: 47-55. Tick parasitism and antibodies to Borrelia burgdorferi in cats. J. Am. Vet. Med. Assoc., 1;197(1):63-66.

Trees, A.J. (1978): The transmission of *Borrelia theileri* by *Boophilus annulatus* (Say, 1821). Trop. Anim. Health, 10: 93-94.

Uilenberg, G.; Hinaidy, H.K.; Perie, N.M. and Feenstra, T. (1988): *Borrelia* infections of ruminants in Europe. Vet. Q., 10(1):63-67.

Yoshinari, N.H.; Barros, P.J.; Bonoldi, V.L.; Ishikawa, M.M.; Barros-Battesti, D.M.; Pirana, S.; Fonseca, A.H. and Schumaker, T.S. (1997): Perfil da borreliose de Lyme no Brasil. Rev. Hosp. Clin. Fac. Med. São. Paulo., 52: 111-117.

Yoshinari, N.H.; Bonoldi, V.L.; Barros-Battesti, D.M.; and Schumaker, T.S. (1999): Doenca de Lyme-símile no Brasil. Rev. Bras. Reumatol.,39:1-2.

إنتشار الإصابة بالبوريليا فى النواقل من القراد والعوائل من الفقاريات فى محافظة الإسماعيلية بمصر.

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تم دراسة التغيرات الموسمية للقراد إكسوديد (القراد الجامد) و الأصابة بالبوريليا فى كل من القراد الجامد والأنسان والحيوانات المستأنسه(الجمال و الماعز والغنم والكلاب والبقر والجاموس) وكذلك فى الحيوانات الأليفة (الكلاب) لمدة عامين من مارس ٢٠٠٠الى فبراير ٢٠٠٢ فى منطقة التل الكبير بمحافظة الأسماعيليه. ولقد أثبتت النتائج إصابة القراد بالبوريليا على مدار السنتين. وبفحص ١٨٧٠ من القراد كانت نسبة الإصابة بالطفيل هى : ٣٧,٢٨ ٪ . كما وجد أن أعلى نسبة إصابة بالبوريليا فى محافظة الأسماعيليه فى *هيالوما دروميدراى* (٤٧,٩٢٪)، يليها على التوالى: *ريبيسفالس سانجنيس* (٣٨,٣٧٪)، ثم *بفلس أنيولاتس*(٣٢,٥٠٪)، ثم *هيالوما إكسكفاتم* (٣٠٤٢٪). كما وجد أيضاً أن نسبة الإصابة فى الأناث فى كل نوع كانت أعلى من نسبة الإصابة فى الذكور. وعموماً فلقد سجل فصل الصيف أعلى اصابة *بالبوريليا* فى القراد. وبفحص ١٩٠٠ عينة من عينات الدم التى تم تجميعها من الأنسان وجد أن نسبة الإصابة بالطفيل *البورليا* كانت ٣٥,٧٩ ٪، حيث سجل شهر يوليه أعلى معدل بالإصابة. ولقد سجلت الجمال (٢٣,٤٥٪) أعلى معدل إصابة بين الحيوانات فى محافظة الأسماعيليه يليها على التوالى: الكلاب (١٣,٢٧٪)، الماعز والغنم (١٢,١٥٪)، ثم البقر والجاموس (١٠٪). كما وجد من الدراسة أن التغير فى نسبة الإصابة فى القراد ونسبة الإصابة فى الحيوانات والأنسان والكثافة العددية للقراد تتناسب تناسب طرديا. عموما، كلّ الأحداث المدروسة كانتْ منخفضة في الشتاء وبداية الربيع وزادتْ بشكل تدريجي لوُصُول الحدّ الأعلى في الصيف (مستوى أقصى في أغسطس) والخريف.