Studies on mite species cause demodectic mange in dogs

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Abstract
This study was undertaken to investigate the prevalence of monthly and seasonal variation of Demodex species among 944 dogs of different breed, sex, age in Cairo and Giza provinces during a period from January till the end of December 2010 and revealed that, 134 dogs were infected with Demodex spp. in which the percentage of infection reached to 14.2%. 31 dogs out of 134 were carrying adult Demodex mites (3.3%). the highest prevalence was in April and May which reached 45.9% and 24.6% respectively. In regard to sex 528 males and 416 females dog were examined and recorded nearly the same percentage of infection to be 14% and 14.4% respectively. The highest percentage of Demodex infection was observed in dogs >2years old (22.6%) followed by dogs 1-2years (18.6%) then dogs 6months -1 year (13.7%) and finally dogs <6months (8.3%).Morphological description of three species of Demodex mite (D. canis, D. injai, D. cornei and unidentified species). Experimtntal trials and serological test with Demodex spp. among dogs and laboratory animals was difficult. Moreover, there were differences between Sarcoptes and Demodex mites in dog histopathologically.

Keywords: Demodex species, prevalence, Morphology, Experimental infection, Histopathology, Serology.
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Introduction
Pharooh's sculpture and encarvements shown in the temples indicates that the
dog was the best man's companion as servant and guardian. Dogs were the first
carnivore to be domesticated and have been utilized the different breeds for
serve various purposes such as hunting, patrolling in police, services, dogs for
work, guard dogs for protection, assistant dogs to aid the blind and physically
challenged, detective dogs to aid in criminal investigations and in wars. The
most importantly dogs for man's companion although pet has got the inherent
psychological instinct for companion ship like human urge and the emotional
bandage of woman to its dog is often more closer than mother to her child
because of their sophisticated social behaviors (ANwoha., 2011).

As well as dogs are the most common pet animals worldwide so they sometimes
harbor wide range of parasitic diseases with zoonotic potentials and
predisposing humans to health risk such as *Toxocara canis*, *Echinococcous
granulosis*, *leishmania* species and mange (Jay and Marion ., 1992).

Moreover, the largest body organ and the mirror of dog's body to some extended
problems was skin in which protected animals from external injuries and gives
charming look to the animals. Although, one of the most important skin disease
of canine cutaneous ectoparasitoses was mange which it's terrible word to
veterinarians and owner's because they heard it as catch –all them and also
canine scabies could be infect all species of animals including man (Mullen
and Durden ., 2009). The world wide losses from mange mites on live stock
production have been estimated to amount of US$14.4 million (Drummond et
al.1981). Generally, two types of mange are encountered with Sarcoptic mange
caused by *Sarcoptes scabei var. canis* and demodectic mange caused by
*Demodex canis*. Sarcoptic mange is an extremely pruritic and contagious
disease of dogs. This condition in dog is of great public health importance as 50
% of human cases may result due to handling of the infected dogs.
Introduction

The *Demodecidae* comprise more than 150 species of parasitic mites in seven genera from hosts in 11 mammalian orders. Simon in 1842 firstly described *Acarus folliculorum* and was reevaluated from *Acarus* to *Demodex* later by Leydig 1859. *Demodex* is the only genus of importance for domestic hosts, and it contains at least 67 named species plus many more that are unnamed and undescribed (Desch and Hillier, 2003).

Canine demodicosis also known as demodectic mange, red mange or follicular mange usually found in young dogs, especially the short haired breeds. Natural infestation is apparently acquired neonatally through contact with the nursing bitch when the adult and motile mites invade the hair follicles of dog. The mites move onto the face and front feet when the pups are nursing and treading with their front feet on the mother’s mammary (milk) glands (Dadhich and Khanna 2003).

Moreover, demodecosis was not contagious but not sever in man as in dogs which has three form of demodecosis (localized, generalized and pododemodecosis). Dogs with localized form of demodecosis develop alopecic areas around the eyelids, lips, mouth and front limb giving the animal a characteristic moth-eaten appearance while, in case of generalized demodecosis which take months and year to has persistent prurites due to intense itching from *Demodex canis*.

On other hand, the infection can only be seen in immunodeficient animals, old dogs and young puppies of about 3 months to a year. *Demodex canis* burrow deep into the skin, feeds and secrete substance that reduces the innate resistance of infected dogs. The disease is thought to be hereditary often seen in oily skinned, short haired, pubescent dogs and rare in puppies raised by hand and young adults. Both sexes have the same ability to transmit genetic predisposition to demodecosis. The higher prevalence of the disease was reported in long haired dogs (Mondal, 1990).
Introduction

The aim of the work:

1- Monthly and seasonal prevalence of *Demodex spp.* among different breeds of dogs.

2- Morphological studies for identification of *Demodex spp.*

3- Experimental infection of *Demodex spp.* in dogs and other laboratory animals such as mice and Guinea pigs.

4- Histopathological changes in skin infected by *Demodex spp.* and comparative studies with changes of sarcoptic mange.

5- Diagnosis using serological tests.
Review of Literature
2. Review of literature

2.1 *Demodex* recorded in Egypt

Mahmoud and El-Gindy (1953) mentioned that they used Benzene hexachloride and Benzil benzoate as well as gention violet emulsion in the treatment of canine mange (including *D. canis*).

Abdel-Gawad *et al.* (1988) examined 250 dogs of different breeds, ages and sexes for demodectic mange. 8% of those dogs were found infested with *D. canis*. The lesion appeared either in localized or generalized form. Morphologically, the female was longer than male and measured $268.3 \pm 10.6/\mu m$, while the male was $213.6 \pm 20.4$. The ova, larvae, protonymphs and nymphs were also described, they measured $63.7 \times 20.2$, $89.3 \times 24.6$, $132.5 \times 30.8$ and $182.2 \times 35.8 \mu m$ respectively. The population structure revealed that the male to female's ratio was 1:3.7.

Abdel-Halim *et al.* (1990) examined skin scrapings from 230 dogs with skin lesions between 1985 -1989 and revealed *D. canis* in 35 dogs (15.22%) and *S. scabiei var canis* in 33 dogs (14.34%). They added also that, during examination of 96 normal skin dogs; 37 dogs out of them were harboring *Demodex spp.* (34.33%). The infection was greater in males than females. 95% of demodectic cases were observed in young short-haired breed such as *Doberman* (4-8months). Abd El-Nagy (1990) examined 67 dogs found 5 cases suffering from demodecosis with 7.5%.

Morsy *et al.* (1995) identified *D. folliculorum* from a 6-year-old boy and his pet dog. Both showed symptoms of skin disease due to this mite.

Kelany and Galal (2011) examined 44 dogs for dermatological lesion. 8 cases (out of 44) were demodetic mange (18.2%) mostly in dogs kept in captivity while sarcoptic mange was recorded in 3 cases (6.8%).
2.2. Prevalence, incidence and factors affecting canine demodeciosis

Kirk (1949) in Western Australia examined hundreds of dogs suffering from demodectic mange. The disease was high prevalence and majority of the parasites were definitely alive and moving when transferred from the skin to the slide. They demonstrated the parasite to the owner of the dog might be a better understanding of the disease.

French (1962) observed *D. canis* in mandibular, parotid, medial retropharyngeal, iliac, prescapular, axillary, superficial inguinal and popliteal lymph nodes from dogs with severe demodectic mange but not in lymph nodes of 10 dogs with small populations of *D. canis* and few or no visible skin lesions. Thrombosis was noted in lymph vessels accompanying 9 of the lymph nodes. *D. canis* was observed in lymph vessels accompanying mandibular and parotid salivary glands but not in the secretory portions. One mite was observed in a sinus between the capsule and a thyroid follicle. Another was in the capsular connective tissue. Lungs of 3 dogs contained *D. canis*. Some mites were free in alveoli while others were closely associated with aggregates of the macrophages.

Nutting et al. (1975) in New Zealand reported of demodicids with skin scrapings from 516 individual mammals of 21 species were examined for *Demodex spp.* thirteen species were recovered from 10 host species; 8 are demodicids not previously reported from New Zealand. Six domestic mammal species examined had an incidence of demodicidosis from 4% to 60%. Demodectic infections are of some economic concern in New Zealand and are more common and important than had been supposed. They examined eyelids of 25 dogs found only one dog infected (4%).

Nolte and Ammelounx (1986) in German diagnosed *D.canis* infection in 206 dogs out of a total of 30 272 dogs. 15.5% of the dogs were 3 or more years of age (older dogs) and in 1984 the proportion increased to 45.5%. Squamous and
localized infections were more common than the pyodermic and generalized forms in these older dogs. Prevalence differed significantly between breeds, but no predisposition according to skin type or hair length could be ascertained. In many instances demodicosis occurred in older dogs of breeds with lymphopenic, neoplasms or had been treated with steroids when young.

Vargas Martinez (1986) in Spanish examined 400 dogs at clinic in Mexico City between February and November 1980, 13 had D. canis in skin scrapings. The frequency was 5.5% in the 200 dogs less than one year old and 1% in the 200 over one year.

Gothe (1989) Demodex canis is a normal resident of the skin in most healthy dogs. Such dogs are usually only carriers of the mite and do not develop clinical symptoms. Thus demodectic mange has to be considered a factorial disease. The way in which a benign infestation develops into clinical mange appears to be linked to either primary or secondary immunodepression in the host.

Mondal (1990) mentioned the factor which may increase susceptibility to demodicid include faulty nutrition, irritation of the skin with urine or saliva, intercurrent systemic illness and skin affections. There is a strong evidence of a hereditary predisposition for generalized demodectic mange in dogs, The disease is most common in certain pure breeds of dogs and within certain lines of these breeds. Sebarrhea and the presence of bacteria may generate a favourable medium for the multiplication of D. canis in dogs. Found that a suppression in cellular immune response (T-cells defect) is responsible for server generalized demodectic mange mange in dogs.

Ackerman (1991) studied demodectic mange in dogs. The various dog breeds predisposed to demodicosis are listed and the clinical picture of demodectic mange is described.
Guaguere (1991) observed that hyperadrenocorticism, iatrogenic causes and hypothyroidism are considered underlying disorder accompanied with generalized demodectic mange.

Rautenbach et al. (1991) in a rural town in Southern Africa stated that, examined animals were Mongrels (dog breed) with a mean condition score of 1.93 with high prevalence of *D. canis* among elder dogs (8 years).

Sisodia and Ghoshal (1991) briefly discussed the aetiology, transmission, pathogenesis and clinical symptoms of demodicosis in dogs caused by *Demodex canis*.

Burns (1992) concluded in the author's opinion, there is no conclusive evidence that Demodex mites play a significant role in the pathogenesis of rosacea.

Cayatte et al. (1992) recorded that 123 cases out of 1182 were observed with follicular or perifollicular inflammation and denoted that, generalized demodicosis accounted in 48% accompanied by perifollicular melanosis.

Miller et al. (1992) In Chinese Shar Peis within retrospective study on the skin diseases, they found that, 60 dogs out of 118 were suffering due to secondary allergic dermatitis, demodicosis, IgA deficiency or hypothyroidism. Approximately 20% of the dogs had more than one of these disorders.

Reddy and Rao (1992 a& b) In India, 26 dogs were studied with localized demodicosis caused by *D.canis* and they cleared that, the male short haired pure dog breed aging 2 months to one year were most commonly affected. Many predisposing factors can be contributed to the severity of the clinical manifestation of *Demodex* infection such as age, breed, sex, hair length, health status and endoparasitism in association with stress.

Kassai and Bekesi (1993) studied the prevalence of animal parasitoses by a questionnaire method in Hungary during the 1980 and reported that, *Demodex* and *Scabies* were the most generally parasitoses occurred in dogs.
Krol and Cierpisz (1994) in Polish studied the pathogenesis, breed predisposition, clinical symptoms and diagnosis of *D. canis* infections in dogs.

Principato (1994) studied a distinct seasonality occurred with a peak of diffusion of the parasites in late summer. Some correlations between the presence of mites and the increase of seborrhea in the scalp were made.

Varghese et al. (1994) in an animal hospital in Bombay examined 83 dogs with skin lesions. The overall incidence of dermatitis was 12.83%, ectoparasitoses were the most common causes of dermatitis; *S. scabiei var. canis* was 19.28% and *D. canis* was 15.66%.

Neog et al. (1995) in Guwahati, Assam, India conducted over a year (March to February) the overall incidence of mange in 303 dogs to be 14.85%. *D. canis* and *S. scabiei* were the predominant species. The highest incidence was recorded in autumn and winter seasons.

Raczynski (1996) in Poland recorded *D. canis* in 45% and *S. scabiei var. canis* 15% of purebred dogs. Two dogs had mixed infections. Demodecosis was diagnosed in animals aged 2.5 to 5 months and sarcoptic mange in 2.5- to 9-month-old dogs.

Kim SangKi (1997) in Chonnam, Korea between 1987 and 1996 applied a retrospective study on 72 dogs with *Demodex* infection. He reported that 18% of other examined dogs showed skin disease had demodicosis. About 75% of dogs with demodicosis were purebred dogs. The short-haired breeds had a much higher incidence than long-haired breeds. The age of dogs ranged from 1 month to 3 years, and about 63% of the patients were less than one year of age. He mentioned also that, sex and season had no effect on the development of demodicosis. A hereditary predisposition of generalized demodicosis was observed in one affected litter.
Nayak et al. (1997) in Orissa during examination of the records of 12 hospitals showed that 50,987 dogs were presented during the period of 5 years. *D. canis* was detected in 1697 (3%). There was no difference in the occurrence of the disease in male (51%) and female (49%) dogs. The study revealed that dogs up to 1 year of age are more frequently affected (60%) than dogs of 1-2 years (23%) and above 2 years of age (17%). Breed prevalence was high in Tibetan apso (41%) as compared to Doberman (26%), Alsatian (16%) and Mongrels (17%).

Sabolic (1997) in Veterinary Surgery Varazdin, Croatia, between 1994 and 1996 examined 831 dogs with skin diseases. The eczema was the commonest disease in 464 dogs followed by otitis externa (188), dermatitis (124), scabies caused by *S. scabiei* (24) and allergies (20). Other diseases included demodicosis, seborrhoea and microspora infections was remained.

Kleiter et al. (1998) in Vienna, Austria recorded a 5-year-old male Newfoundland dog with chronic pruritus. A generalized adult-onset demodicosis and secondary pyoderma was diagnosed. The demodicosis responsible for immune suppression and predisposing to developed other disease such as cutaneous lymphoma.

Colombo and Vercelli (1999) in Italy reported two cases of Dachshunds infected by *D. canis* and bacterial folliculitis or furunculosis associated with drug-induced immunosuppression.

Chesney (1999) in UK at a dermatology clinic examined 6 cases of canine demodicosis and reported that a form of *Demodex spp.* shorter in length than *D. canis* was found. The disease became apparent at 10 years of age, that it was common and was acquired in puppyhood, although it may be carried unnoticed for many years.
Ghiani (1999) in Italy observed a 9-year-old Shi-Tzu dog with pruritus, scabs and erythema of its paws and inguinal region. The generalized pustular demodicetic mange was caused by *D. canis* with iatrogenic Cushing's syndrome and probably an underlying allergy.

Mojzisova *et al.* (1999) concluded that the dysfunction of both lymphocytes and neutrophils could predispose to the development of secondary pyoderma and a common sequela to generalized demodicosis. The immunosuppression was developed with the duration of clinical disease.

Wang XiangSheng *et al.* (1999) in China during the examination of the pathogenic causes and skin diseases in 856 dogs recorded that, *Sarcoptes* infection was 45.49% and *Demodex* infection was 9.22%.

Aujla *et al.* (2000) recorded the prevalence of *S. scabiei* and *D. canis* mange to be 29.53 and 6.04%, respectively. Young male dogs <1 year were more prominent to mange infestation with highest prevalence in March and lowest in December and January. Among the pure breeds 90% were most susceptible to canine demodicosis. The infection was common in Spitz and Cocker-Spaniel (33.33%). Male dogs (70%) were more susceptible than the bitch (30%). 6–12 months of age dogs were most susceptible (50%) for occurrence of demodicosis, in other age groups, the prevalence ranged from 0-10%.

Barboza *et al.* (2000) observed that clinical and immunological evaluation of 10 dogs affected with generalized demodicosis showed similar lesion patterns described for the disease such as alopecia, pruritus, diffuse erythema, lesser degree of crust lesions, excoriations, folliculitis and ulcers. The age of the dogs ranged 5 to 24 months. The disease was classified as juvenile demodicosis. The most affected breeds were *German shepherd, Mongrel and Chow-Chow* and 60% of the dogs were males.
Review of literature

Choi WonPil et al. (2000) in Tae-gu, Korea Republic between 1997 and 1998 examined specimens of skin lesions obtained from 70 dogs with dermatitis. *D. canis* was diagnosed in 18.6% and *S. scabiei* in 8.6%. *D. canis* and *S. scabiei* were common in short haired breeds and in the summer and winter. Infection with a single pathogen was diagnosed in 38 dogs and mixed infections were diagnosed in 19 dogs.

**Neeraj Gupta (2000)** in Himachal Pradesh, India examined 79 dogs with dermatoses with 23.94% of the examined dogs in Palam had dermatoses. The most prevalence was in December (56.67%) followed by August (47.32%) and November (40.0%). *Sarcoptic* mange was observed in 10.13% of the cases. Dogs below 1 year of age were the most affected by pyoderma (58.3%), *Demodex* (79%) and *Sarcoptic* mange (55%). Females were more susceptible to *Demodex* (64.29%). However, males were more susceptible to sarcoptic mange.

**Pratibha Sachan et al. (2000)** examined 40 dogs of different breeds suffering from various clinical skin disorders. Skin samples were collected for bacteriological, fungal and mite examinations. 17.5% and 5% of the cases were due to fungal dermatitis and bacterial infection, respectively and they mentioned that fungal isolates associated with *D. canis* and *Sarcoptes spp.*

**Tamura et al. (2000)** in Japanese examined for *Demodex* infection among 103 dogs. In a 3-year-old *Yorkshire terrier* and found to have mixed infection with a short-bodied *Demodex* mite and *D. canis*. The skin lesions took the form of scaly dermatitis with patches of pustules around the ears, eyes, lips, chin and legs.

**Watson and Hood (2000)** recorded 3 *Demodex spp.* of from dogs and considered *Demodex spp.* as normal commensals on canine skin but are capable of producing generalised disease if mite numbers proliferate. *D. canis* was the most common species present. Then the short-bodied mite, *D. cornei* and an unnamed long bodied mite have been described. They mentioned that, the
disease arised through an inability of the host to regulate mite numbers rather than an increase in the virulence of the mite itself, the affected animals might be an inherited, specific T cell deficiency which, by itself or in conjunction with other immunosuppressive conditions. They added also that, two distinct age groups have been identified with the development of generalised demodicosis (juvenile-onset disease occurs in animals up to 18 months of age and adult-onset disease is in animals generally older than 4 years of age with no previous history of disease).

Galuppi et al. (2001) in Italy examined skin scrapings from lesions of 1138 dogs, and denoted that, *D. canis* was the most frequent ectoparasite in dogs (14.3%) followed by *S. scabiei*, *Cheyletiella spp.* and *Neotrombicula autumnalis*.

Jha et al. (2001) in Ranchi town of Jharkhand state, India examined 313 skin scrapings collected from dogs. The incidence of *S. scabiei* and *D. canis* were recorded for different breeds, age, sex, season and management system. The incidence was highest in Mongrel dogs followed by Doberman, German shepherd, Spitz, Great dane, Labrador and Dachshund. 6- to 12-month old dogs were mostly affected. Male dogs were more susceptible to mite infestation than females although the difference was not significant. The incidence was highest during the winter season followed by summer and spring seasons although the difference was insignificant.

Tamura et al. (2001) in Japan Between 1997 and 1999 determined the prevalence of *D. canis* in 150 dogs. In two dogs were found two different species of mites (*D. canis* and unidentified *Demodex spp.*). The unidentified *Demodex spp.* had several different morphological features.

Radbea et al. (2002) in Romanian studied the prevalence of canine demodicosis among 1800 dogs and found that 23.67% were positive for canine demodicosis. The most affected breeds were Crossbreed (16 cases), Rottweiler (14 cases),
Pekingese (9 cases) and German Shepherd (9 cases). Sex does not seem to be a receptivity factor. Age is an important epidemiological factor where dogs less than one year (70 of 80 cases) were affected. Only one case was found in the group older than 7 years. Canine demodicosis had no clinical manifestation in suckling dogs younger than one month.

Bellato et al. (2003) in Lages municipality, Santa Catarina, Brazil (August 1997-July 2000) examined 20 dogs monthly. They reported that 52.80% of them carrying ectoparasites. Out of them 7.70% with infected with mange. Among the manged cases 48.28% diagnosed with *D. canis* and only one dog had infected with *D. canis* and *S. scabiei var. canis* (3.44%).

Rodriguez-Vivas (2003) in Mérida capital city of Yucatán, Mexico reported the infestations in 200 stray dogs. The overall prevalence of mange was 34%, the most frequent mite was *D.canis* (23.0%) and followed by *S. scabei var. canis* (7.0%).

Jani et al. (2004) in Gujarat, India examined 1873 dogs from the different parts with a history of skin disorders. 9.88% found as clinical case of parasitic in origin. No specific age and sex predilection for dermatitis was observed. The aetiological study of dermatitis revealed a high prevalence of *Sarcoptes spp.* (56.22%). This was followed by *Demodex spp*, which was found in 43.78%. A higher incidence of dermatitis was found during the winter season.

Deepa Lahkar et al. (2005) in Guwahati, Assam, India studied the incidence of demodectic mange in 732 dogs was 11.89%. The incidence of the disease was highest (46.67%) in dogs 0-1 years old. Male dogs (61.11%) were more susceptible than female dogs (35.56%). German spitz dogs (53.33%) were more susceptible to demodicosis. Higher incidence of *D. canis* was recorded during the autumn season (18.35%), particularly in the month of November (20.69%).