

AKADÉMIAI KIADÓ

Acta Microbiologica
et Immunologica
Hungarica

67 (2020) 3, 156–160

DOI:


[10.1556/030.2020.01067](https://doi.org/10.1556/030.2020.01067)

© 2020 Akadémiai Kiadó, Budapest

ORIGINAL ARTICLE



Prevalence and risk factors to *Demodex folliculorum* infection in eyelash follicles from a university population of Mexico

JAIME VARGAS-ARZOLA¹, ARISTEO SEGURA-SALVADOR¹,
HONORIO TORRES-AGUILAR¹, MARIO URBINA-MATA¹,
SERGIO AGUILAR-RUIZ¹, D. LUCÍA DÍAZ-CHIGUER²,
ADRIÁN MÁRQUEZ-NAVARRO³, LÁZARO
MORALES-REYES³, NOÉ ALVARADO-VÁSQUEZ⁴ and
BENJAMÍN NOGUEDA-TORRES^{5*} 

¹ Faculty of Chemical Sciences, Autonomous University Benito Juárez of Oaxaca, City of Oaxaca, Oax, Mexico

² Institute of Security and Social Services of State Workers, Mexico City, Mexico

³ Federal Commission for the Protection of Health Risks, Mexico City, Mexico

⁴ Department of Biochemistry, National Institute of Respiratory Diseases, Mexico City, Mexico

⁵ Departamento de Parasitología, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Ciudad de México, México

Received: October 24, 2019 • Accepted: November 18, 2019

Published online: March 30, 2020

ABSTRACT

Demodex folliculorum shows a high occurrence in the general population, however, its pathologic relevance is still controversial. In this prospective study, we evaluated the prevalence of *D. folliculorum* on eyelashes from 8,033 subjects of a university population (including 7,782 students, and 251 academics). Additional information on some risk factors to infection by the mites was evaluated, as well. A prevalence of 1.47% was found, where 118 individuals were positive for *D. folliculorum*; and, among them, 63 (53.4%) were women and 55 (46.6%) were men. Results showed a negative correlation with the age ($r = -0.45$), the highest prevalence was found in individuals between 19 and 22 years of age (2.1%, 84 patients). The number of *D. folliculorum* mites did not differ between the right and left eye; however, the use of cosmetics or facial cream, contact lens, hair removers, were factors present in patients infected with *D. folliculorum*. Although Demodex prevalence did not increase in line with weight, we found significantly higher prevalence in the 51–60 kg and 71–80 kg weight groups, and a particularly high prevalence in the over 81 kg weight group (2.6%). In conclusion, it was observed that the main population positive to infection consisted of young adults; this is in contrast with the international evidence reporting a high rate of infection in older adults. Besides, our results suggest that items of daily use such as cosmetics, facial cream, eyeliner, glasses, or contact lenses may be some of the main culprits of the infection by *D. folliculorum*.

KEYWORDS

Demodex folliculorum, eyelashes, mites, prevalence, demodicosis

INTRODUCTION

Demodex folliculorum and *Demodex brevis*, called “follicle mites”, are ectoparasites found in humans who are their specific host. *Demodex* mites belong to the order Prostigmata family Demodicidae, and subclass Acari. *D. brevis* resides in glands of Zeis (unilobular sebaceous glands located on the margin of the eyelid), whereas *D. folliculorum* occurs in the space

*Corresponding author. Tel.: +52
(55) 57296000Ext62399. E-mail:
bnogueta@hotmail.com

between the follicle wall and the eyelash, where they usually cause anterior blepharitis and posterior blepharitis, respectively. These species have been associated as causal agents of demodicosis, cutaneous colonization with nonspecific facial signs and symptoms [1–3]. Both species of *Demodex* represent etiological agents of chronic blepharitis, conjunctival inflammation, and Meibomian gland dysfunction [4]. However, their pathogenic role in healthy people is still controversial. Recent studies have reviewed their importance as etiological agents of ocular disease and eyelash disorders in healthy people [5–6], as well as in immunocompromised [7] or diabetic patients [8]. Areas with high or low production of sebum have been associated with *Demodex* colonization [9, 10]; other variables like the use of make-up, pet ownership, face-wash per day, shared items, income level, cleanliness, or living in close contact with older adults have been linked to the infection by *Demodex* [9]. *Demodex* mites can be found in Europe, Asia, and America. Although, in Mexico, a prevalence of 27.3% has been reported in Monterrey, Nuevo León [11], data about the prevalence of these mites in other regions of the country, such as Oaxaca, are scarce [12]. In addition to the aforementioned, its pathologic relevance, as well as the pathogenic mechanisms and risk factors relevant for infection by *Demodex* are still unknown or controversial. In this work, a population of 8,033 individuals from a university population was studied and some variables associated with the infection by *Demodex* mites and with the development of blepharitis were analyzed.

SUBJECTS AND METHODS

Subjects

This study was carried out from April 2016 until April 2017, and included 8,033 subjects; 7,782 (96.9%) students, and 251 (3.1%) academic staff from a university of Oaxaca, Mexico. All subjects participated voluntarily in this study, which was approved by the Ethics Committee of the *Facultad de Ciencias Químicas, Universidad Autónoma Benito Juárez de Oaxaca*, Oaxaca, and complied with the guidelines of the Declaration of Helsinki. None of the evaluated individuals had been previously diagnosed with demodicosis. In addition, information about age, weight, pet ownership, sanitary ware (cosmetics, facial cream, eyeliner, and hair removers), use of glasses or contact lenses, antimicrobial or moisturizing ophthalmic products, facial cream, and ocular annoyance, was acquired through a questionnaire.

Samples

Sampling was performed as published by Vargas-Arzola et al. [12]. Briefly, 16 eyelashes (eight per each eye) were randomly collected using a pair of sterile tweezers and placed in labeled plastic bags, and immediately taken to the laboratory for evaluation. During the analysis, the eyelashes were placed on a slide, two drops of 0.5% Evans blue was added, and covered with a coverslip. The eyelashes were

carefully examined at 40× and 100× magnifications for the proper identification of *Demodex* mites. A sample was considered positive if at least one adult mite was detected in the study material.

Statistical analysis

Results were analyzed with Pearson Chi-square and Fisher tests and a Pearson correlation analysis was also made. The SPSS statistics software (version 19) was used. $P \leq 0.05$ was considered statistically significant.

RESULTS

After analyzing eyelashes of the 8,033 subjects of this study, we found 118 individuals positive for *D. folliculorum*, with an overall prevalence of 1.47% (95% CI: 1.22–1.76). The mite was identified according to their structural characteristics (Fig. 1). Our results showed that of these 118 *Demodex* positive subjects, 63 (53.4%) were women and 6.7% of them had conjunctivitis; whereas 55 (46.6%) were men, with a prevalence of conjunctivitis similar to that observed in women (6.7%). From the study population, 2,240 individuals were administrative workers, and of these 1,254 (56%) were men and 986 (44%) were women. *Demodex* positivity was found in 33 individuals of this population, *Demodex* prevalence rate was the same as in the students' group (1.47%). The age ranges of this group are between 18 and 30 years (1,400 individuals), 515 between 30 and 40 years, 302 between 40 and 50 years, and finally 23 individuals were >50



Figure 1. Example of an adult *Demodex folliculorum* found in samples of evaluated eyelashes

Table 1. Prevalence by age group (%) in 118 subjects positive to infection by *D. folliculorum*

Age (yr)	Positive to <i>D. folliculorum</i> (n)	Negative to <i>D. folliculorum</i> (n)	Prevalence by age group
15–18	19	2271	0.8
19–22	84	3902	2.1*
23–older	15	1742	0.8
Total	118	7915	

* $P < 0.05$.

years. Demodex prevalence in men and women did not differ significantly. However, an additional analysis that evaluated the age revealed a significant association in the subjects aged between 19 and 22 years (84 patients) with the presence of *D. folliculorum* ($P \leq 0.05$; Table 1). Although we analyzed thoroughly the samples to determine the presence of *D. brevis*, we did not find this mite species.

We evaluated also the probable association between the weight of the subjects and *D. folliculorum* infection (Table 2). The statistical analysis showed an association between weight and prevalence of *D. folliculorum* ($P < 0.05$), observing the highest prevalence in the category of over 81 kg of weight. Analysis showed that Demodex prevalence increased with body weight: individuals with body weight between 51 and 60 kg had 1.7% positivity rate ($P < 0.05$) and between 71 and 80 kg 1.8% ($P < 0.05$). Prevalence of Demodex was highest among individuals weighing more than 81 kg (2.6%; $P < 0.05$) (Table 2).

In people positive for *D. folliculorum* infection, mites were localized in similar numbers in both the right and left eyes. In the right eye between 1.2 and 1.6 mites were reported, whereas in the left eye between 1.0 and 1.1 mites were reported. The statistical analysis did not find significant differences ($P > 0.05$). Prevalence of risk factors in Demodex positive individuals is shown in Table 3. Among the variables associated with the presence of *D. folliculorum*, we found that pet ownership corresponded to the highest percentage of infection (55.9%), although it was not statistically significant compared with individuals without a pet, followed by the use of cosmetics (47.4%) ($P > 0.05$) and the use of glasses or contact lenses (40.6%) ($P < 0.05$). The use of facial cream (36.4%) and hair removers (33.8%) were also relevant factors ($P < 0.05$). The lowest percentage was

Table 2. Prevalence according to body weight (%) in subjects of a university population positive to infection by *D. folliculorum*

Weight (kg)	Positive to <i>D. folliculorum</i> (n)	Negative to <i>D. folliculorum</i> (n)	Prevalence by weight group
40–50	12	1291	0.9
51–60	46	2674	1.7*
61–70	26	2374	1.1
71–80	16	883	1.8*
81–higher	18	693	2.6*
Total	118	7915	

* $P < 0.05$.Table 3. Analysis of factors presents in the population infected by *D. folliculorum* (n = 118)

	Number of Demodex positive patients with risk factors	Prevalence (%)
Animals	66	55.9
Cosmetics	56	47.4
Glasses or contact lens	48	40.6*
Facial cream	43	36.4*
Eyeliner	31	26.2
Antimicrobial or moisturizing ophthalmic products	20	16.9
Hair removers	40	33.9*

* $P < 0.05$.

observed in patients using antimicrobial or ophthalmic products (16.9%) ($P > 0.05$). Prevalence of eye irritation was high in Demodex positive individuals (56.6%), which may enhance the spread of the infection. Additional information recorded in the questionnaires was that 92.3% of the people positive for *D. folliculorum* underwent daily personal grooming, 80.5% used public transport, and 76.2% live in houses made of concrete. Our results showed that use of contact lens, facial cream and hair removers were strongly associated with the presence of infection; whereas, the use of antimicrobial or ophthalmic products was less related to the presence of *D. folliculorum*.

DISCUSSION

Demodex mites have recently attracted interest as a source of ophthalmologic and dermatologic pathologies. The infection by these mites is common, and according to some authors, the prevalence can reach 100% of the population studied [13]. However, the pathological importance of this mite in diseases like blepharitis or rosacea is still being evaluated [14, 15]. Additionally, the roles of age, obesity, income level, cleanliness, etc., as risk factors for infestation by *D. folliculorum* are still controversial. Our results did not show significant differences regarding gender in the infected patients. These data contrast with those described by Ru-Juan et al. [16], who reported a higher prevalence in Chinese female medical students (16.4%), as compared to male students (3.7%). Although these variations can be explained by the total number of evaluated individuals (Ru-Juan et al., 316 patients; vs. our 8,033 patients), the number of Demodex positive individuals was similar in both studies. In the study by Ru-Juan, prevalence of demodicosis 51.2%, whereas, in our work it was much lower 1.47%. Our results agree with those of Sedzikowska et al. [14] and Aycan et al. [17], who did not find that gender had an impact on Demodex infection.

Previous studies have assessed the importance of age as a risk factor for infection by *D. folliculorum* [9,16,18]. However, data are contradictory. Some authors reported that infection is more common in elderly people (76–105 years)

[12]. However, it has also been reported that infection is higher in young people [17, 18]. In our study, the overall prevalence was of 1.47% in students and academic staff, however, it was higher in people aged 19–22 years (prevalence of 2.1%). In comparison, Horvath et al. [9] showed that the prevalence of *D. folliculorum* or *D. brevis* was of 17.7% and was more frequent in men (21.9%) and in older adults (20%). This prevalence contrasts with that shown in other works, where it varies from 17.2% to 67.6% [9,17,18]. Likewise, although both *D. folliculorum* and *D. brevis* can be found in humans, *D. folliculorum* was the only species found in all the positive cases of our work; this was confirmed through the analysis of its morphologic structures, such as the gnathosoma, podosome, and opisthosoma.

High body weight or obesity may lead to a number of dermatological manifestations that can favor the infection by *Demodex* mites, among them are production of sebum by the sebaceous glands and alterations of the sudoriferous glands [19]. In addition, factors such as oily or mixed skin could contribute too and be a predisposing factor for the establishment of *Demodex* species that colonize humans. Currently, studies that revise the association between body weight and the presence of *Demodex* mites are scarce. [20]. In our study, we found a high prevalence of infection by *D. folliculorum* in individuals with a weight of 51–60, 71–80, and in persons with weight >81 kg. Interestingly, patients with a weight between 40 and 50 and 61 and 70 kg had a low prevalence of infection. Our results contrast with those shown by other authors, who reported that positivity to infection by *D. folliculorum* was significantly higher principally in the patients with higher weight [20]. These differences indicate that more studies, evaluating the role of obesity as a risk factor to infection by the mites, are necessary. The link between overweight/obesity and demodicosis is still not clearly established.

Factors like gender, residence, sharing sanitary ware, the frequency of face-wash per day, and use of facial cleansing cream, skin type, and skin disease have been associated with *Demodex* infestation [18, 21]. In this work, we studied individuals from a university population, which can be considered an urban population, middle class, with middle incomes, which can be considered as having good cleanliness habits. In addition, we consider that the number of individuals evaluated is adequate to reflect the prevalence of *Demodex* mites in this type of population. Our results showed that prevalence was low (1.47%), this contrasts with that reported by Vargas-Arzola et al. [12], who made a similar study in this zone of Mexico, but in a rural population. In their work, the authors reported a greater number of infected individuals, mainly elderly, and, additionally, they observed that men were more affected than women. In comparison, Biernat et al. [24] reported that gender was not important, but that age was linked with a higher prevalence of *Demodex* infection.

In conclusion, our results suggest that gender is not an important factor for the infection by *Demodex* mite. It is interesting that the main infected population is in the 19–22 years of age range, as this could be linked with the results shown in Table 2, and could be associated with the type of

population (a university population) studied, that is a young population, which is very prone to exchange personal hygiene items, such as cosmetics or eye liners. We consider that these could be a contagion source of the mite that had not been considered important so far. Also, it is important to mention that many patients mentioned the presence of ocular annoyance, which can be a factor that enhances the spread of the infection. This possibility should be evaluated in subsequent studies. In addition, the presence of pets is common among young people, which can be another important source of infection to consider, although in this work the association was not statistically significant. *Demodex* infection rate may vary according to population type or ethnic group, as well [16, 17, 22]. In our study, *Demodex* prevalence rate seem to depend on the socioeconomic level and the cleaning habits of the individuals. Finally, our results indicate that the importance of the *Demodex* mite as a parasite is still controversial, thus, further studies are required to evaluate the association between *Demodex* mites and the presence of blepharitis or rosacea, with attention to the ethnic group and socioeconomic level of the population evaluated [12, 14, 15, 18, 23].

Conflict of interest: The authors declare that they have no conflict of interest.

REFERENCES

- [1] Lacey N, Kavanagh K, Tseng SC. Under the lash: *Demodex* mites in human diseases. *Biochem (Lond)* 2009; 31: 2–6.
- [2] Karıncaoglu Y, Bayram N, Aycan O, Esrefoglu M. The clinical importance of *Demodex folliculorum* presenting with nonspecific facial signs and symptoms. *J Dermatol* 2004; 31: 618–26.
- [3] Ruffi T, Mumcuoglu Y. The hair follicle mites *Demodex folliculorum* and *Demodex brevis*: biology and medical importance. A review. *Dermatologica* 1981; 162: 1–11.
- [4] Pahuja S, Puranik C, Jelliti B, Khairallah M, Sangwan VS. Parasitic infections of the external eye. *Ocul Immunol Inflamm* 2013; 21: 292–9.
- [5] Efron N. Eyelash disorders. In: *Contact lens complications*. 3rd ed. Elsevier Saunders (W.B.) Co Ltd.; 2012. p. 67–75.
- [6] Elston DM. *Demodex* mites: facts and controversies. *Clin Dermatol* 2010; 28: 502–4.
- [7] Kosik-Bogacka DI, Lanocha N, Lanocha A, Czepita D, Grobelny A, Zdziarska B, et al. *Demodex folliculorum* and *Demodex brevis* in healthy and immunocompromised patients. *Ophthalmic Epidemiol* 2013; 20: 159–63.
- [8] Yamashita LS, Cariello AJ, Geha NM, Yu MC, Hofling-Lima AL. *Demodex folliculorum* on the eyelash follicle of diabetic patients. *Arq Bras Oftalmol* 2011; 74: 422–4.
- [9] Horvath A, Neubrandt DM, Ghidan A, Nagy K. Risk factors and prevalence of *Demodex* mites in young adults. *Acta Microbiol Immunol Hung* 2011; 58: 145–55.
- [10] Turan N, Kapıcıoğlu Y, Saraç G. The effect of skin sebum, pH, and moisture on demodex infestation in acne vulgaris and rosacea patients. *Turkiye Parazit Derg* 2017; 41: 143–7.

- [11] Godínez-Hana A, Medina de la Garza C, Velázquez-Arenas L, García-Guerrero CJ, González-González SE. Prevalence of *Demodex folliculorum* and *Demodex brevis* in a Mexican population [Spanish]. *Med Universitaria* 2004; 6: 96–100.
- [12] Vargas-Arzola J, Reyes-Velasco L, Segura-Salvador A, Márquez-Navarro A, Díaz-Chiguer DL, Noguera-Torres B. Prevalence of *Demodex* mites in eyelashes among people of Oaxaca, Mexico. *Acta Microbiol Immunol Hung* 2012; 59: 257–62.
- [13] Liu J, Sheha H, Tseng SC. Pathogenic role of *Demodex* mites in blepharitis. *Curr Opin Allergy Clin Immunol* 2010; 10: 505–10.
- [14] Sędzikowska A, Oseka M, Skopiński P. The impact of age, sex, blepharitis, rosacea and rheumatoid arthritis on *Demodex* mite infection. *Arch Med Sci* 2018; 14: 353–6.
- [15] Wesolowska M, Knysz B, Reich A, Blazejewska D, Czarnecki M, Gladysz A, et al. Prevalence of *Demodex* spp. in eyelash follicles in different populations. *Arch Med Sci* 2014; 10: 319–24.
- [16] Ru-Juan Z, Xue-Rong Y, Ying Z, Yi-Ning P, Wen-Ting X, Ting-Ting H, et al. Investigation on *Demodex* infection status and influencing factors in medical students in Wuhu City. *Zhongguo Xue Xi Chong Bing Fang Zhi Za Zhi* 2017; 29: 358–62.
- [17] Aycan OM, Otlü GH, Karaman U, Daldal N, Atambay M. Frequency of the appearance of *Demodex* sp. in various patient and age groups. *Turkiye Parazitolo Derg* 2007; 31: 115–8.
- [18] Zhao YE, Guo N, Xun M, Wang M, Wang DL. Sociodemographic characteristics and risk factor analysis of *Demodex* infestation (Acari: Demodicidae). *J Zhejiang Univ Sci B* 2011; 12: 998–1007.
- [19] Yosipovitch G, DeVore A, Dawn A. Obesity and the skin: skin physiology and skin manifestations of obesity. *J Am Acad Dermatol* 2007; 56: 901–16.
- [20] Dokuyucu R, Kaya OA, Yula E, Ustun I, Bayram F, Gokce C. The presence of *Demodex Folliculorum* in various obese groups according to BMI levels. *Arch Iran Med* 2016; 19: 210–4.
- [21] Wang GY, Zhang YS. Investigation of *Demodex* infection among medical students. *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi* 2006; 24: 156–7.
- [22] Isa NH, Loong LW, Fang GH, Mohamad AM, Razali N, Rani NI, et al. Demodicosis among university medical students in Malaysia and the effects of facial cleanser and moisturizer usage. *Southeast Asian J Trop Med Public Health* 2011; 42: 1375–80.
- [23] Cui JH, Wang C. Facial *Demodex* infestation among urban and rural residents in Shangqiu City of Henan Province. *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi* 2012; 30: 283–5.
- [24] Biernat MM, Rusiecka-Ziółkowska J, Piątkowska E, Helemejko I, Biernat P, Gościński G. Occurrence of *Demodex* species in patients with blepharitis and in healthy individuals: a 10-year observational study. *Jpn J Ophthalmol* 2018; 62: 628–33.