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Survey on Dermatological Disorders of Dogs during 2020-2022 in Rabat, Morocco

Abderrahmane Zahri[1]*, Mohammed Bouslikhane[2], Sara El Mazini[3,4], Meryem Lemrani[3], Ikhlass El Berbri[2], Mohammed Amine Abouelkaram[1], Thomas Balenghien[5,6], and Maria Bourquia[1]

[1]*Parasitology and Parasitic Diseases Unit, Department of Animal Pathology and Public Health, Hassan II Institute of Agronomy and Veterinary Medicine, Rabat, Morocco*
[2]*Microbiology, Immunology and Contagious Diseases Unit, Department of Animal Pathology and Public Health, Hassan II Institute of Agronomy and Veterinary Medicine, Rabat, Morocco*
[3]*Laboratory of Parasitology and Vector-Borne-Diseases, Pasteur Institute of Morocco, Casablanca 20360, Morocco*
[4]*Laboratory of Microbial Biotechnology and Bioactive Molecules, Faculty of Sciences and Technologies, Sidi Mohammed Ben Abdellah University, Fes 30000, Morocco*
[5]*CIRAD, UMR ASTRE, F-34398 Montpellier, France*
[6]*ASTRE, University of Montpellier, CIRAD, INRAE, Montpellier, France*

*Corresponding author's Email: zahriabderrahmane@iav.ac.ma

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ABSTRACT

Dermatology is an important specialty in veterinary medicine, focusing on the skin and its appendages. Therefore, the present study highlighted the percentage of skin disorders, as well as their associated risk factors, from cases received at the Parasitology-Dermatology clinic of the Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II), Rabat, Morocco for two years. A total of 1561 dogs (1450 dogs were in 28 different pure breeds and 111 dogs were mongrels, 805 males, and 756 females, with an average age of 6.5 years old) were presented at the University Veterinary Teaching Hospital (UVTH) of the IAV Hassan II from the end of October 2020 to the end of May 2022 (including vaccinations) and 125 dogs were assessed and 161 skin diseases were found (a few dogs had more than one skin disease). Dermatological examinations represented an average of 8.00% (125/1561) of all canine cases received at the University Veterinary Teaching Hospital. The most common clinical signs were pruritus, alopecia, erythema, onychogryphosis, and visible ectoparasites. Parasitic dermatoses were the most frequent, representing 44.10% of all dermatological cases, followed by allergic dermatoses (25.47%) and fungal skin infections (19.25%). Bacterial skin infections and dermatological manifestations of endocrine disorders were infrequent, representing 8.70% and 2.48%, respectively of all observed cases. Risk factors contributing to the occurrence of canine skin disorders included age and lifestyle for sarcoptic mange. An apparent predilection for the living environment was observed in the case of canine leishmaniosis, and an apparent predilection for sex regarding otodectic mange was also demonstrated. Similar results were found for the living environment and lifestyle concerning canine atopic dermatitis. Data reported herein fill gaps in knowledge of skin disorders and their associated risk factors in dogs in Morocco, demonstrating the dominance of skin diseases of zoonotic interest, including flea bite allergy dermatitis (FBAD), dermatophytosis, and canine leishmaniosis.

Keywords: Dog, Morocco, Rabat, Skin disease, Survey

INTRODUCTION

The skin, is an organ, with a crucial role in safeguarding against physical, chemical, and microbiological aggressions. Its sensory components facilitate the perception of heat, cold, pain, touch, and pressure (Hsu and Fuchs, 2022). Veterinary dermatology is gaining increasing attention, given its significant representation in routine examinations (Khoshnegah et al., 2013; Tawfik et al., 2020; Joshi, 2022; Alizadeh et al., 2024). Canine and feline skin disorders represent an important veterinary problem worldwide. A previous comprehensive study indicated that 21.40% of examinations in small animal veterinary practices in the United Kingdom (UK) were related to skin issues (Hill et al., 2006). Similarly, a study carried out at the Ferdowsi University of Mashhad in Iran reported that dermatological disorders affected 17.00% of diagnosed dogs (Khoshnegah et al., 2013). Canine skin disorders are prevalent in India, where the prevalence of infection ranges from 12.00% to 27.60% (Khurana et al., 2016; Kumar and Shekhar, 2020; Joshi, 2022). The origin of skin diseases has been evaluated in different studies to throw light on the clinical signs and cutaneous lesions in dogs. The most common sign in all dermatological examinations is pruritus (Bensignor et al., 2013; Bruet et al., 2022). Superficial pyoderma, canine leishmaniosis, flea infestation, flea bite allergy dermatitis (FBAD), and canine atopic dermatitis (CAD) were the most frequent diagnoses in Mashhad, Iran (Khoshnegah et al., 2013). In contrast, the majority of diagnoses in the UK were parasitic dermatoses and bacterial skin infections (Hill et al., 2006). Generally, the most known skin problems in dogs include sarcoptic mange, demodectic mange, allergic dermatoses, dermatophytosis, and bacterial skin infections

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(Khoshnegah et al., 2013; Khurana et al., 2016; Tawfik et al., 2020; Kumar and Shekhar, 2022). These skin disorders were diagnosed by clinical examination followed by the appropriate complementary tests required to confirm clinical suspicions (Curtis, 2012; Beco et al., 2013; Gortel, 2013; Hillier et al., 2014; Moriello et al., 2017; Mueller et al., 2020; Miller et al, 2023).

The objective of the current study was to determine the percentage of canine skin conditions assessed and the associated risk factors at the Parasitology-Dermatology clinic of the Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II), Rabat, Morocco. The usefulness of the provided information should be of great interest to veterinary students, new veterinary graduates, and practicing veterinarians in the country.

MATERIALS AND METHODS

Ethical approval

The study protocol was approved by the Hassan II Institute of Agronomy and Veterinary Medicine (IAV Hassan II), Rabat, Morocco, and the Moroccan Ministry of Agriculture. The handling of dogs has been conditioned by respect for animal welfare, which is in agreement with international ethical guidelines (European Union Directive 2010/63/EU and Animal Research, reporting of *In Vivo* experiments guidelines (ARRIVE)).

Study area

Rabat is the capital of the Kingdom of Morocco, which is located on the Atlantic side in the region of Rabat Salé - Kénitra. Situated precisely at 33° 58' 17.724" North 6° 50' 59.3268" West, within the estuarine zone of the Bouregreg River, with a Mediterranean climate, characterized by abundant rainfall in winter and a hot summer (Morocco's climate, 2023). The pet population in Morocco is estimated to be 2.65 million pets (GlobalPETS, 2023).

Case selection

From the end of October 2020 to the end of May 2022, 1561 dogs were presented to the UVTH of the IAV Hassan II in Rabat, Morocco. A total of 125 dogs (105 dogs were in 24 different pure breeds, 20 dogs were mongrels, 74 males, and 51 females, with an average age of 4.5 years old) were assessed for skin problems at the Parasitology-Dermatology Clinic of the IAV Hassan II (following the sanitary measures taken due to the pandemic of COVID-19, assessments were conducted three days a week). The diagnostic approach comprised three sequential steps, including, dermatological history, and clinical examination which aims to perform a physical examination, describe clinical signs (pruritus, alopecia, erythema, wounds, pustular eruptions, and ulcerative lesions), detect nail disorders (onychogryphosis), and identify visible ectoparasites (fleas, lice, and ticks), and complementary examinations. For this purpose, a printed dermatological form was meticulously developed and employed for each assessment (Appendix 1).

Dog's demographic information

Breed, sex, age, living environment, diet, and lifestyle of dogs with skin disorders were recorded by a vet to find statistical and/or epidemiological associations between these risk factors and the dermatoses.

Diagnostic methods

Based on the hypothesis of diagnosis following the clinical examination, the adequate and appropriate complementary examinations were chosen, which are divided into the following sections. Complementary examinations with immediate interpretation include combing, trichogram, otoscopic examination, Wood's lamp examination, ear swabbing, skin scraping, impression cytology and swab cytology of ear canal, smear of lymph node aspirates, and dermoscopy (Zanna et al., 2017).

Complementary examinations with deferred interpretation require more time to analyze their results and include, fungal culture used to diagnose dermatophytosis and Malasseziosis, blood tests to assess hematological and biochemical profiles (hypertriglyceridemia and hypercholesterolemia are related to canine hypothyroidism and Cushing's syndrome (Sieber-Ruckstuh et al., 2022) and thrombocytopenia is a common finding in canine leishmaniosis), and endocrine function tests (cortisol and thyroid hormone assays). Canine leishmaniosis was diagnosed using SNAP® *Leishmania* (Canine Leishmania Antibody test, IDEXX Laboratories, Inc. Westbrook, Maine, USA) by detecting antibodies produced against *Leishmania* (*L*) *infantum* (de Souza et al., 2019), which was also confirmed by nested PCR conditions based on the amplification of the kinetoplast DNA minicircles using two sets of primers including CSB2XF (CGAGTAGCAGAAACTCCCGTTCA), CSB1XR (ATTTTTCGCGATTTTCGCAGAACG), LiR (TCGCAGAACGCCCCT) and 13Z (ACTGGGGGTTGGTGTAAAATAG) (Noyes et al., 1998). The amplification reactions were carried out in the thermal cycler 2720 (Applied Biosystems, USA) following the thermal program, including 94°C for 5 minutes, 30 cycles (94°C for 30 seconds, 55°C for 60 seconds, and 72°C for 90 seconds), and 72°C for 5 minutes.

Statistical analysis

The descriptive statistical analysis was carried out using the statistical program Epi-Info 7.2.5.0 (CDC's National Center for Public Health Informatics, USA) and it is based on the study of the statistical and/or epidemiological associations between the dermatoses affecting dogs and the risk factors taken into consideration (breed, sex, age, living environment and lifestyle). Relative risk was quantified by estimating the odds ratio (OR) for the association between the selected risk factors and the corresponding outcome for each skin disease. Similarly, the confidence intervals for each OR were estimated with the calculation of the Chi-Square (χ^2) test. Statistical analysis was considered significant When the p-value < 0.05.

RESULTS

Demographic information

A total of 125 dogs were assessed with 161 dermatoses (dogs can be diagnosed with one or more skin disorders at the same time). Skin disorders represented 8.00% of all assessed dogs, of which 59.20% (74 cases) were males and 40.80% (51 cases) were females with an age ranging between 1 to 192 months. Most cases were of purebred dogs (84.00%) as opposed to mongrel dogs (16.00%). At the same time, the majority of dogs had a group lifestyle (76.00%) and lived outdoors (60.00%). Risk factors contributing to the occurrence of canine skin disorders included age (OR = 3.50; p = 0.02) and lifestyle (OR = 6.23; p = 0.002) for sarcoptic mange. Additionally, an apparent predilection for the living environment (OR = 6.50; p = 0.007) was observed in the case of canine leishmaniosis, and an apparent predilection for sex regarding otodectic mange (OR = 4.27; p = 0.04). Dogs who lived indoors were 5.26 times more likely to have CAD (OR = 5.26; p = 0.02) compared to dogs who lived outdoors. Additionally, dogs living alone were 10.07 times more likely to have CAD (OR = 10.07; p = 0.009) than those living in a group. Furthermore, there were epidemiological associations only in the case of different dermatoses and risk factors taken into consideration including mongrel dogs living in groups that were more exposed respectively to canine leishmaniosis (OR for mongrel dogs= 3.32; p = 0.08 - OR for lifestyle= 6.02; p = 0.08) and demodicosis (OR = 2.13; p = 0.39 - OR = 2.88; p = 0.06). Males and young dogs were more predisposed to dermatophytosis (OR = 2.14; p = 0.16, OR = 2.90; p = 0.25) and CAD was linked to young age (OR = 3.62; p = 0.36), while a solitary lifestyle without congeners favors exposure to food allergy (OR = 5.06; p = 0.21) and FBAD (OR = 2.72; p = 0.06).

Description of dermatological condition

The dermatoses diagnosed were divided according to their etiologies. Parasitic dermatoses were the most frequent conditions, occupying first place with a percentage of 44.10% (71/161), followed by allergic dermatoses (25.47%, 41/161) and fungal skin infections (19.25%, 31/161). Bacterial skin infections and dermatologic manifestations of endocrine disorders were infrequent, representing 8.70% (14/161) and 2.48% (4/161), respectively in all observed dogs (Figure 1). The ten most frequent dermatological disorders diagnosed in dogs were, FBAD (20 out of 161, 12.42%), dermatophytosis due to *Microsporum canis* (19 out of 161, 11.80%), canine leishmaniosis caused by *Leishmania infantum* (18 out of 161, 11.18%, Figure 2A), sarcoptic mange caused by *Sarcoptes scabiei* (15 out of 161, 9.32%, Figure 2B), demodicosis caused by *Demodex canis* (15 out of 161, 9.32%, Figure 2C), otodectic mange caused by *Otodectes cynotis* (13 out of 161, 8.07%, Figure 2D), CAD (12 out of 161, 7.45%), Malasseziosis caused by *Malassezia pachydermatis* (12 out of 161, 7.45%, Figure 2E), flea infestation caused by *Ctenocephalides felis* (10 out of 161, 6.21%, Figure 2F), food allergy (7 out of 161, 4.35%), and canine pyoderma (7 out of 161, 4.35%). In contrast, only one case of Cushing's syndrome, eosinophilic furunculosis and pododermatitis was diagnosed in the present study.

Breed-wise distribution

The percentage of skin disorders was the highest in common breed dogs (16.00%; 20/125), followed by German Shepherd (12.00%; 15/125); Maltese (11.20%; 14/125); French Bulldog (7.20%; 9/125); Poodle and Labrador Retriever (6.40%; 8/125; each); Rottweiler (5.60%; 7/125); Belgian shepherd (4.80%; 6/125); Chihuahua and Siberian Husky (4.00%; 5/125; each); Cane Corso, Chow Chow, Dalmatian, Jacque Russel Terrier and English Pointer (2.40%; 3/125; each); Brittany spaniel, Pekingese and Dachshund (1.60%; 2/125; each); Akita Inu, White Swiss Shepherd, Pug, Pyrenean Mountain Dog, American Pit Bull Terrier, Great Dane and American Staffordshire Terrier (0.80%; 1/125; each).

Sex-wise distribution

The percentage of skin disorders was higher in males (59.20%; 74/125) compared with females (40.80%; 51/125, Figure 3**)**.

Age-wise distribution

Dermatological disorders were most common in dogs under two years of age (50.40%; 63/125) compared to dogs between two and five years of age (26.40%; 33/125) and dogs over five years of age (23.20%; 29/125, Figure 4).

Living environment and lifestyle-wises distribution

Skin disorders were more common in dogs living outside (60.00%; 75/125) in comparison with those living indoors (40.00%; 50/125). In contrast, the majority of cases lived in groups (76.00%; 95/125) compared to those living alone (24.00%; 30/125, Figure 5).

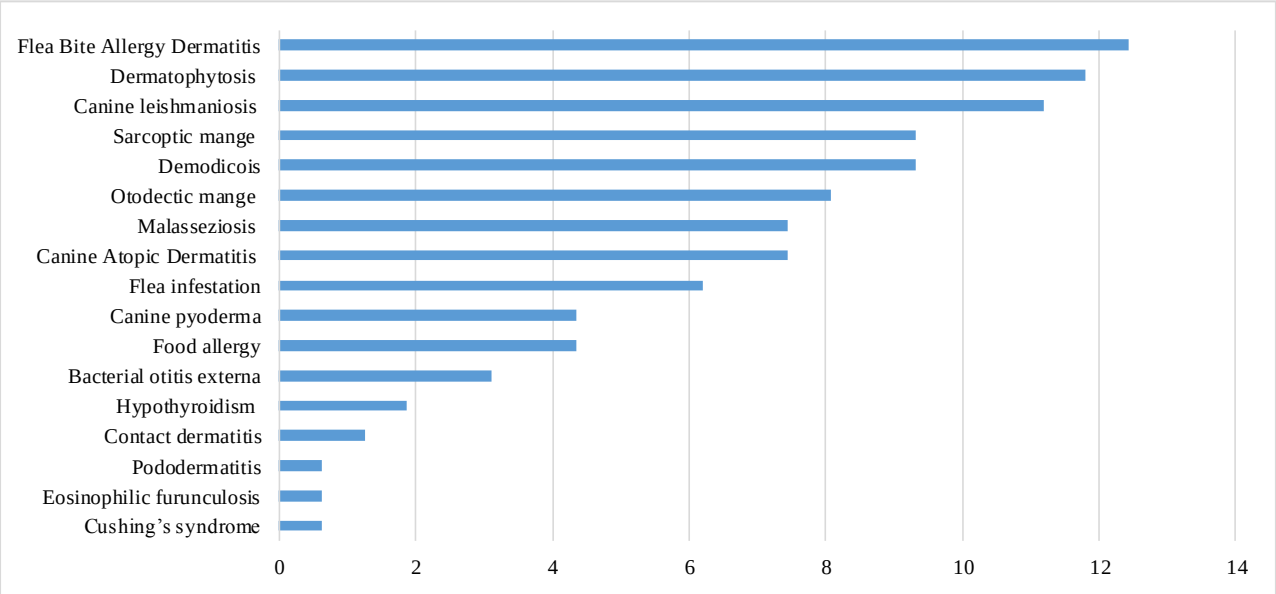

Figure 1. Percentage of dermatoses diagnosed in dogs located in Rabat, Morocco during 2020-2022

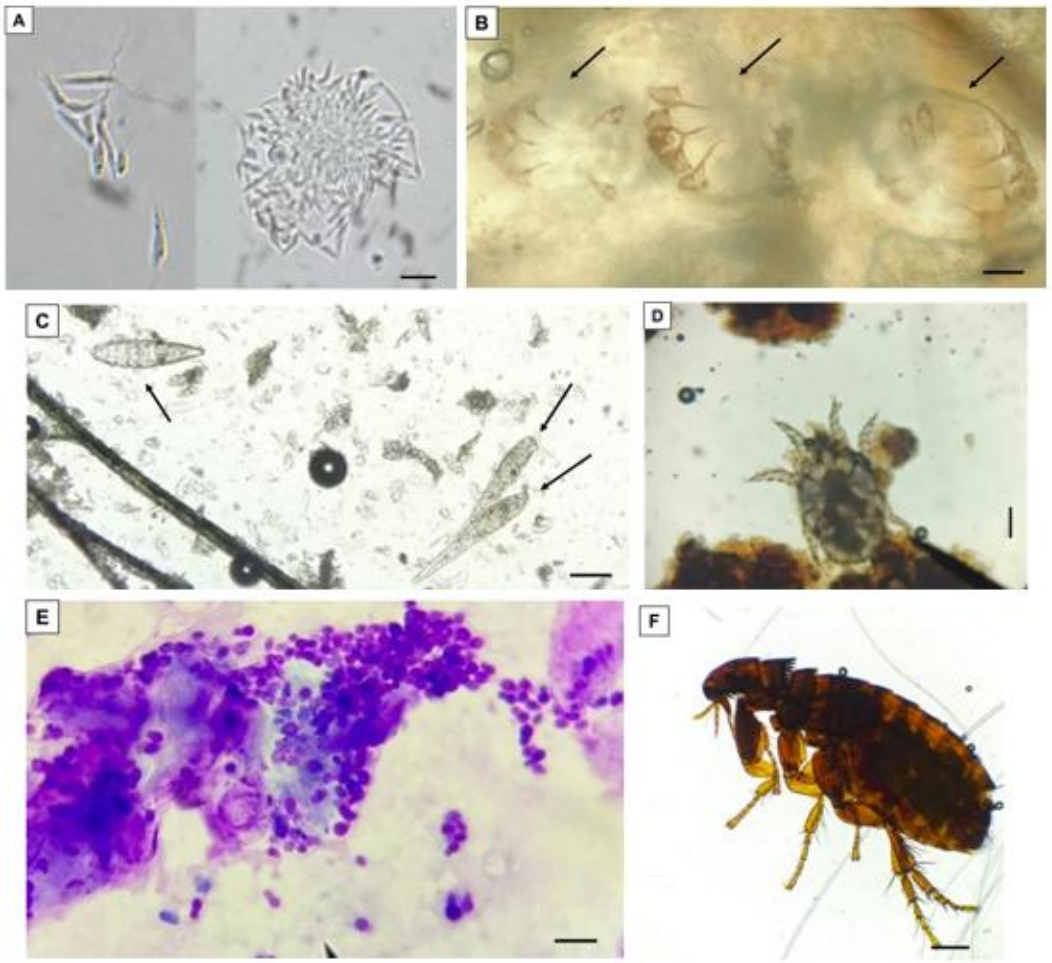

Figure 2. Etiological agents causing skin disorders in dogs located in Rabat, Morocco during 2020-2022. **A:** *Leishmania infantum* promastigotes isolated in Roswell Park Memorial Institute (RPMI) - 1640 culture medium after in vitro culture in the Novy-MacNeal-Nicolle (NNN) medium from a naturally infected English pointer and observed under an optical microscope (magnification 200x). Scale-bar: 10 µm, **B:** Adult mites of *Sarcoptes scabiei* (arrows) isolated from a common breed dog and morphologically identified under an optical microscope (magnification 400x). Scale-bar: 450 µm, **C**: Optical microscopy observation (magnification 400x) of adult mites of *Demodex canis* (arrows) in a Rottweiler puppy. Scale-bar: 150 µm, **D**: Adult mites of *Otodectes cynotis* examined in the earwax of a Chow-chow using an optical microscope (magnification 400x). Scale-bar: 250 µm, **E**: Cytological examination of the skin (by impression) in a Siberian Husky: The presence of numerous free yeasts of *Malassezia pachydermatis* (magnification 1000x) adhering to keratinocytes (rapid staining). Scale-bar: 20 µm, and **F**: Microscopic examination of *Ctenocephalides felis* collected in a German Shepherd after mounting between slide and coverslip through an optical microscope (magnification 400x). Scale-bar: 1mm

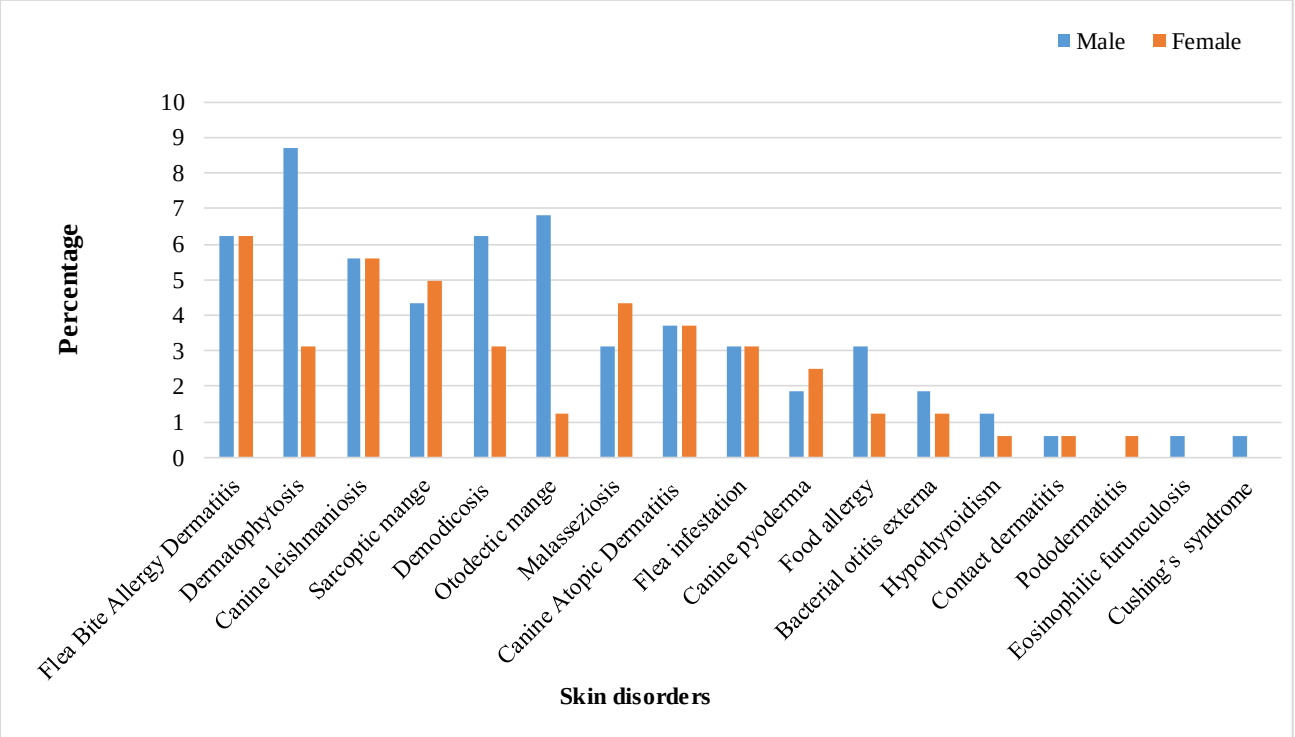

Figure 3. Sex-wise percentage of skin disorders in dogs located in Rabat, Morocco during 2020-2022

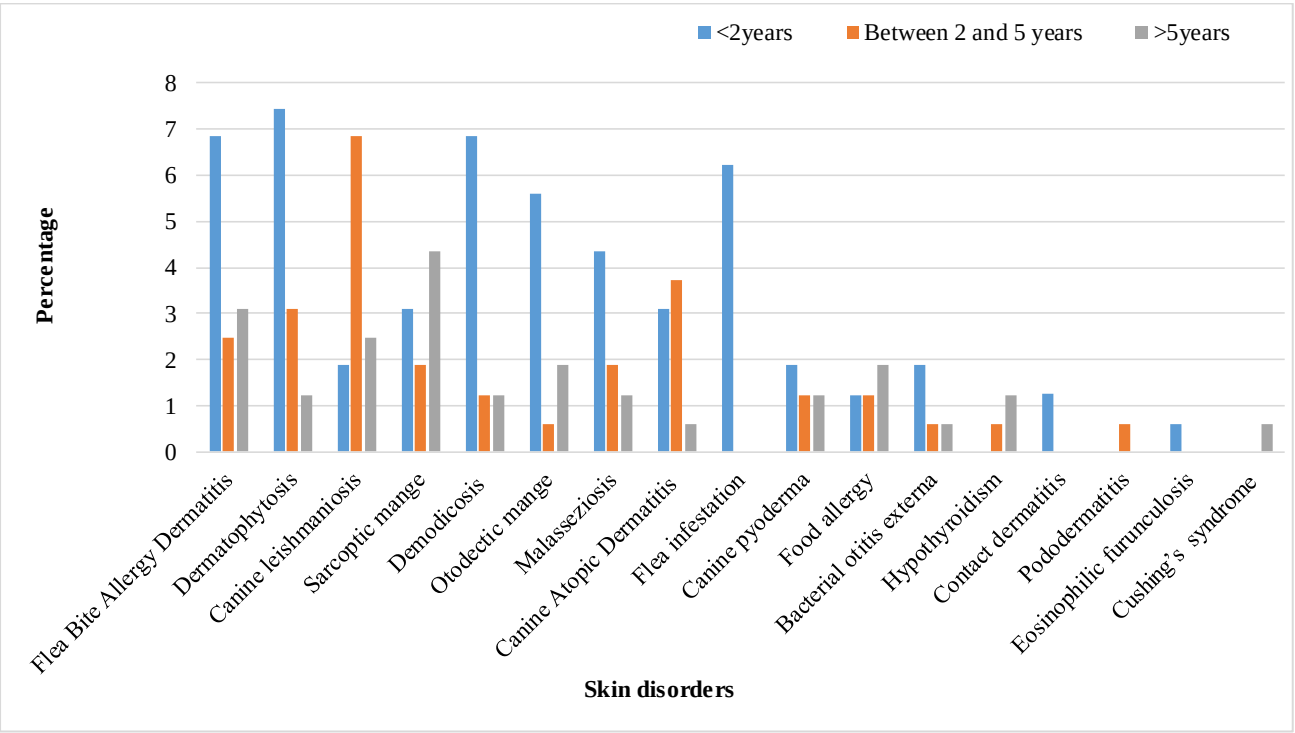

Figure 4. Age-wise percentage of dermatological disorders in dogs located in Rabat, Morocco during 2020-2022

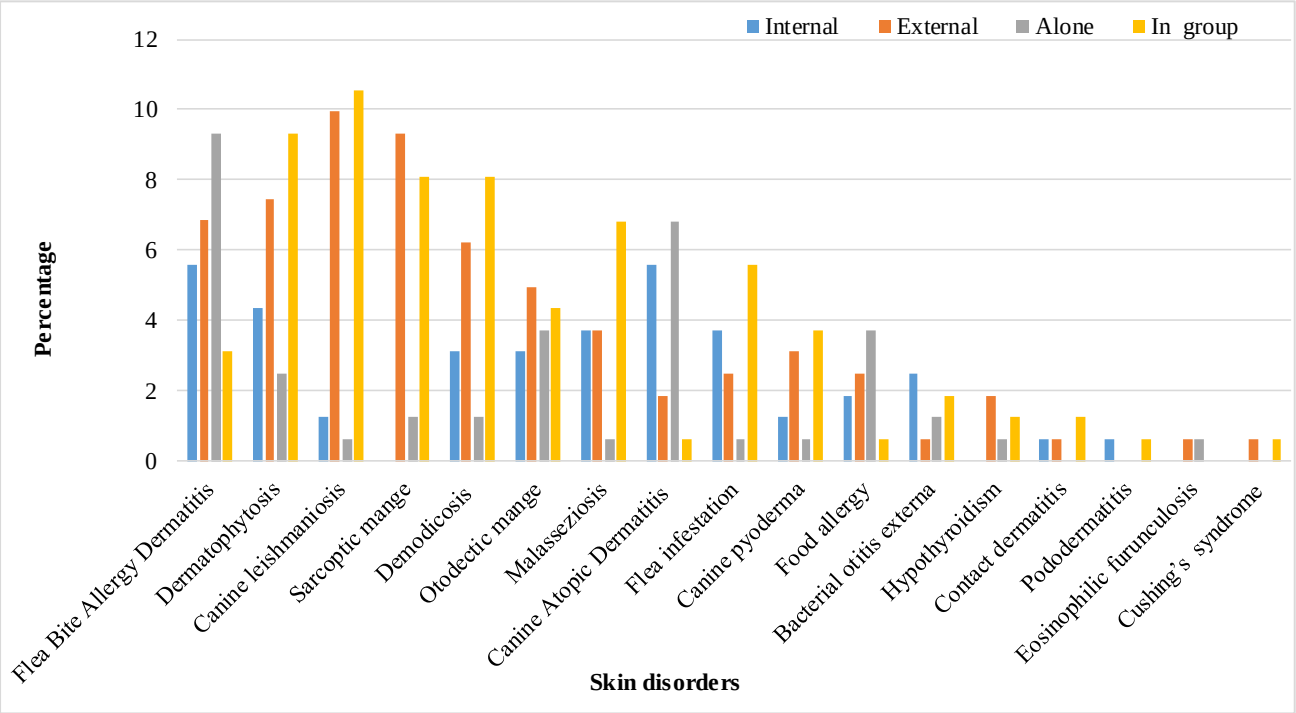

Figure 5. Living environment and lifestyle-wises percentage of dermatological disorders in dogs located in Rabat, Morocco during 2020-2022

DISCUSSION

According to the clinical study, 161 dermatoses in 125 dogs were assembled, since several dogs were affected by more than one skin disorder at the same time, this is the case for the mongrel dogs that presented simultaneously parasitic dermatoses (sarcoptic and *otodectic* mange) and fungal skin infections (dermatophytosis). Dermatology evaluations made up 8.00% of the total examinations conducted at the UVTH of the IAV Hassan II, a figure slightly below the 12.06% reported in a study by Thapa and Sarkar (2018). In other studies, the prevalence of skin disorders has been estimated between 17.00% and 27.26% (Khoshnegah et al., 2013; Khurana et al., 2016; Kumar and Shekhar, 2020). These percentage differences were due to the large number of dogs received at the UVTH of the IAV Hassan II for vaccination that were taken into account in the present study, which was not the case in previous studies.

Parasitic dermatoses represent the most frequent dermatological disorders with a percentage of 44.10%, which is in agreement with the study of Khurana et al. (2016), with a marked predominance of canine leishmaniosis, sarcoptic mange, and demodicosis. In the current study, 18 cases (11.18%) of canine leishmaniosis caused by *L. infantum* were diagnosed, and the same percentage was reported in Iran (Khoshnegah et al., 2013).

Veterinarians in Morocco struggle with the accurate diagnosis of canine leishmaniasis, primarily due to the expensive supplementary tests required to confirm the presence of the disease. Eight cases were from Rabat (the capital of Morocco and Rabat-Salé-Kénitra region) and almost all of them never left the city, four cases were from the rural commune of Sidi-Yahya-Zaër (Rabat-Salé-Kénitra region), two cases were from the city of Mehdia (Rabat-Salé-Kénitra region), and the remaining four cases were from the cities of Sala Al Jadida (Rabat-Salé-Kénitra region), Ain El-Aouda (Rabat-Salé-Kénitra region), Benslimane (Casablanca-Settat region), and Casablanca (Casablanca-Settat region). It can be assumed that there has been a change in the epidemiology profile of leishmaniosis by *L. infantum*, which is generally confined to pre-arid, semi-arid, humid, and sub-humid bioclimatic stages (Hakkour et al., 2019). Additionally, the possible urbanization of canine leishmaniosis should be seen as a wake-up call, as visceral leishmaniasis caused by *L. infantum* is a major public health problem due to its zoonotic aspect, with dogs as the main reservoir of the disease (Saridomichelakis, 2009). In light of the above results, mongrel dogs were more exposed to canine leishmaniosis than purebred dogs. Knowing that racial predisposition has been confirmed for some breeds such as German Shepherds and Rottweiler (Saridomichelakis, 2009). However, it is generally accepted that mongrel and autochthonous breeds are resistant to parasite exposure, even if they live in endemic areas (Solano-Gallego et al., 2000).

It should be noted that the age of affected animals varies from one to seven years, and based on the knowledge of Briffod (2011), it seems that dogs under three years old with those over eight years old are the most susceptible to developing the disease characterized by a long incubation period of up to four years (Müller et al., 2022). In terms of

gender, there were nine male cases and nine female cases. However, male dogs are typically favored over females for hunting and guarding, which could increase their risk of being bitten by sandflies (Rombolà et al., 2021).

Regarding the living environment and lifestyle, there were epidemiological and statistical associations between the above-mentioned risk factors and positive cases who lived outside and did not follow a regular program of prevention against external parasites, which is an important risk factor making the dogs exposed to sandflies and promoting infection (Ribeiro et al., 2018).

Regarding scabies, the reported percentage in other studies (2.82% in India and 5.06% in Iran) is lower than that found in the present study (9.32%; Khoshnegah et al., 2013; Anikar et al., 2021). In the current study, it was noticed that adult dogs are more predisposed to be affected by this dermatosis compared to young dogs although, it is observed in dogs of all ages and it is well-known in dogs under one year old (Chen et al., 2014). Only a single owner was impacted by sarcoptic mange, displaying scabies pimples on her thigh and feet. These observations are in line with Bandi and Saikumar's (2013); observations, which confirm that sarcoptic mange is a pruritic and highly contagious dermatosis in animals and humans.

For demodicosis, the results of the clinical study revealed a percentage of 9.32%, which is in agreement with Khurana et al. (2016), where it ranked second after sarcoptic mange. In addition, the study of Hill et al. (2006) identified very few cases of canine demodicosis, which presented less than 1% of dermatology examinations. Similarly, cases of demodicosis remain very limited (five cases (0.94%)) in the study of Khoshnegah et al. (2013) while the number of cases of demodicosis in the study of Shchelkanov et al. (2020) was around 409 cases (15.90%). Common breed dogs showed significant susceptibility to this skin disorder, although racial predisposition is not a risk factor to be taken into consideration (Shchelkanov et al., 2020).

Dogs living in groups were more exposed to demodectic mange than those living alone. In this regard, the overpopulation of *Demodex canis*, may be linked mainly to puppy nursing, along with other stress factors such as estrus, parturition, and endoparasites (Gortel, 2006). Juvenile demodicosis was the most common in the present study. It could be due to the immune deficiency against *D. canis* in the assessed cases, which conforms with Hugnet et al. (2001). For otodectic mange (8.07%), the most affected cases were young dogs, which is mainly due to their low immunity (Taenzler et al., 2017). Males were more exposed to infestation by *Otodectes cynotis* than females, which is capable of leaving the ear canal and spreading to other parts of the body (Sotiraki et al., 2001). However, Rodriguez-vivas et al. (2003), reported that both sexes have equal sensitivity to the mites responsible for the disease, and there is no characteristic sexual preference. It was also noted that the majority of affected dogs lived with cats who often go outdoors, which may be a factor favoring transmission. This agrees with the findings of Souza et al. (2008), which confirmed that dogs living outdoors were more exposed to *O. cynotis* infestation, and direct contact with infected animals remains the most common mode of transmission for these mites.

Finally, flea infestation accompanied or not by FBAD, is classified as the fifth dominant parasitic dermatosis in the current clinical study (6.21%), which is in agreement with Khoshnegah et al. (2013), suggesting that owners are not sufficiently aware of the need to improve hygiene conditions, particularly environmental conditions as well as the means of prevention that can reduce its frequency. It remains to be pointed out that cat fleas are the most identified under microscopy, which is reported by a previous study confirming that *Ctenocephalides felis* is the most widespread flea in dogs (Linardi and Santos, 2012). Therefore, it can be inferred that the cohabitation of dogs with cats increases the risk of flea exposure, as cats with an external lifestyle are rarely treated.

Allergic dermatoses occupied the second position (25.47%) in the current study. Flea bite allergy dermatitis (FBAD, 12.42%) and canine allergy dermatitis (CAD, 7.45%) represent the most common allergic dermatoses encountered in the present study also by several studies (Hill et al., 2006; Dávila et al., 2018; Drechsler et al., 2024). In contrast with these findings, few cases of these two dermatoses have been diagnosed by Lund et al. (1999). For flea bite allergy dermatitis (FBAD), intense pruritus was the most common clinical sign in all cases examined. This agrees with the data reported by Bruet et al. (2012), mentioning that this pruritus is essentially located in the dorso-lumbar region, accompanied by chewing, and characterized by high intensity and frequency. No breed predispositions or those linked to age, sex, or living environment have been statistically or epidemiologically proven in the case of this dermatosis. However, it was found that dogs living alone were more exposed to the risk of this skin disorder. For canine allergy dermatitis (CAD), despite the absence of an association between this dermatosis and the breeds affected in this study, the risk of exposure remains very high in West Highland white terriers (Jaeger et al., 2010). Young dogs were significantly more susceptible to this dermatosis than adults. This data agrees with the findings of previous studies (Griffin and DeBoer, 2001; Hensel et al, 2015). Similarly, predilections have been observed for the living environment and lifestyle of affected dogs in the present survey, which leads us to believe that house dust mites are incriminated in the pathogenesis of CAD in this case, especially, *Dermatophagoides farina* (Bensignor and Carlotti, 2002). Regarding food allergy, the percentage obtained in this study (4.35%) was lower than those reported in studies carried out in France (6.00%) and the UK (7.60%) by

Carlotti et al. (1990) and Chesney (2002) respectively. At the same time, it was higher compared to other studies, which estimated that food hypersensitivity accounted for 1.70% of all diagnosed canine dermatoses (Wilhelm and Favrot, 2005). In agreement with Carlotti et al. (1990), no breed, sex, age, or living environment predispositions were demonstrated for this dermatosis in the present study. On the contrary, young age seems like a risk factor for this skin disease (Rosser, 1993). Similarly, Labradors present a non-negligible risk for this dermatosis (Chesney, 2002). Furthermore, it was shown in the present study that dogs living alone were more exposed than those living in groups. Contact dermatitis remains very rare in this study (2/125; 1.25%), representing 1.89% and 0.86% of all allergic dermatoses in previous studies carried out in Iran and UK respectively (Hill et al., 2006; Khoshnegah et al., 2013). No risk factor studied could be linked to this dermatosis, due to the absence of a significant number of cases. However, Olivry et al. (1990) confirmed that Danish German Shepherd dogs are more likely to be affected than other breeds without predisposition to sex and age. The acute onset of lesions is more suggestive of an irritant contact dermatitis, which is observed in the first case (scrotal dermatitis representing an irritant reaction). On the other hand, according to Olivry et al. (1990), a chronic evolution after a long period of exposure is compatible with contact dermatitis, which is noticed in the second case.

Superficial cutaneous mycoses represented 19.25% of the dermatoses diagnosed during the current clinical survey. This finding differs from those of other studies (Hill et al., 2006; Khoshnegah et al., 2013). The percentage of dermatophytosis (11.80%) obtained in the present study was lower than that mentioned by other documented studies in Italy and Iraq (Cafarchia et al., 2004; Jarjees and Issa, 2022). It may be explained by the climate, which is a predisposing factor, and the prevalence of dermatophytes has recently seen a marked increase, especially in warmer regions (Moriello et al., 2017). Indeed, Morocco has recently experienced significant climatic changes, which could contribute to the creation of favorable conditions for the development of spores, constituting the main infectious form of dermatophytosis. It has to be emphasized that dogs and cats are the main reservoirs for zoophilic species such as *Microsporum canis*, ensuring their spread to humans (Cafarchia et al., 2004). The majority of the cases assessed showed a greenish fluorescence under the Wood's lamp, which confirms that the infections concerned are those due to *M. canis* caused by contact with an infected animal, notably cats. However, non-fluorescent lesions could be associated with either, infections related to strains of *M. canis* which do not fluoresce under the Wood's lamp and *Microsporum gypseum* that is caused by contact with contaminated soil, which can also infect humans (Tobeigei et al., 2023. In the current study, young male dogs were more predisposed to dermatophyte infection. These findings are in line with those documented by Jarjees and Issa (2022), who have reported that infection is favored by the immune deficiency associated with young age, and the particular composition of sebum in males, which increases the risk of exposure. Interestingly, Cafarchia et al. (2004) reported a high prevalence of dermatophytosis due to *M. canis*, statistically proven in Yorkshire terriers compared to other breeds, and linked to differences in skin defenses. For Malasseziosis, unlike other studies (Crespo et al., 2002; Berlanda et al., 2022), the percentage of *Malassezia* yeasts was too low (7.45%) in the present study. *Malassezia pachydermatis* is the most frequent species associated with dogs and is responsible for *Malassezia* dermatitis and otitis externa, when there is the proliferation of these commensal organisms acting as opportunistic pathogens (Guillot and Bond, 2020). As far as clinical diagnosis, it is well-recognized that it is based on the presence of pruritus accompanied by skin lesions (Bond, 2010). The results of this survey, as well as those of another similar study, confirmed the absence of any correlation between the sex, and age of animals affected by *M. pachydermatis* (Crespo et al., 2002). Although, it seems that breeds characterized by skin folds are more predisposed to *Malassezia* overgrowth (Bond et al., 2020).

Regarding bacterial skin infections, the overall percentage of these dermatoses in the present study was significantly lower (8.70%) compared to those reported in Canada, Iran, and the UK (Scott and Paradis, 1990; Hill et al., 2006; Khoshnegah et al., 2013). It is also worth noting that no association has been proven in the present study between bacterial dermatoses and risk factors likely to cause it. It may be explained by the limited number of cases received during the study period. Canine pyoderma was the most common, and the causative agent of this skin condition most frequently isolated from dogs is *Staphylococcus pseudintermedius*. Bacterial otitis externa ranked second after canine pyoderma. According to Korbelik et al. (2019) and Nuttal (2023), Otitis externa is a disease characterized by a high prevalence (up to 20.00%) and it's a recurrent affection that's harder to manage in dogs, caused by a combination of autoimmune, endocrine and parasitic disorders. Only one case of pododermatitis has been encountered in a three-year-old English pointer dog living outdoors, with a foreign body (spikelet). Breathnach et al. (2005), confirmed that the causes of pododermatitis in dogs are multiple, and are mainly due to trauma and reactions to foreign bodies. Similarly, only one case of eosinophilic furunculosis was diagnosed in the current study in a one-year-old pit bull who still frequents the outpatient setting. This is an uncommon skin disorder that affects young dogs living outdoors and develops characteristic lesions (ulcers and pustules) on the face, trunk, and legs (Curtis et al., 1995).

Finally, three cases of hypothyroidism were diagnosed, which is the most common endocrinopathy with skin manifestations in dogs (Ferguson, 1994). These dogs are aged over six years, which is accurately reported by O'Neill et

al. (2022), who confirm that hypothyroidism is an endocrine disorder of adult dogs, and the average age at diagnosis is seven years (Scott-Moncrieff, 2007). The cases concerned were two males and one spayed female who has an increased risk of developing this endocrinopathy compared to sexually intact animals according to Scott-Moncrieff (2007). In the present study, a single case of iatrogenic Cushing's syndrome was diagnosed in a six-year-old dachshund. The anamnesis revealed that this dog has atopic dermatitis, and has been treated with corticosteroid drugs for years. Indeed, long-term administration of corticosteroid drugs is one of the main causes of Cushing's syndrome according to Bennaim et al. (2019).

CONCLUSION

In summary, the overall prevalence of skin disorders was 8.00%. The results of the present study highlighted the predominance of FBAD (12.42%), followed by dermatophytosis (11.80%), and canine leishmaniosis (11.18%) in dogs examined at the Parasitology-Dermatology clinic. There was an apparent breed, sex, age, living environment, and lifestyle predilections for skin diseases diagnosed herein. The zoonotic aspect of these dermatoses requires a high level of awareness from veterinarians and owners, who are involved in control and prevention strategies. In light of these data, it is recommended to conduct further studies over a more extended period, covering various Moroccan regions, to assess the prevalence of large-scale skin disorders and identify the associated risk factors.

DECLARATIONS

Authors' contributions

Abderrahmane Zahri designed and drafted the manuscript. Mohammed Bouslikhane contributed to the design and validation of the statistical analysis. Meryem Lemrani and Sara El Mazini confirmed canine leishmaniosis by k-DNA nested PCR. Ikhlass El Berbri provided advice throughout the study. Mohammed Amin Abouelkaram helped to examine the cases received at the Parasitology-Dermatology clinic. Thomas Balenghien reviewed and edited the manuscript. Maria Bourquia supervised the study from the outset, providing valuable comments and suggestions to improve the quality of the manuscript. The final draft of the manuscript was approved by all authors before submission.

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Availability of data and materials

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Competing interests

No conflicts of interest are to be declared by the authors of this study.

Ethical considerations

The authors confirm that all authors have reviewed and submitted the manuscript to this journal for the first time.

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