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Article

Prevalence and clinical characteristics of *Malassezia* infection in dogs and cats in Dhaka, Bangladesh

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Abstract: *Malassezia* species are commensal yeasts inhabiting the skin and external ear canals of dogs and cats but can become opportunistic pathogens under predisposing conditions, leading to dermatitis and otitis externa. This study investigated the distribution and clinical characteristics of *Malassezia* infections, with or without concurrent bacterial involvement, in companion animals presented to the Teaching and Training Pet Hospital and Research Centre, Dhaka, Bangladesh. A total of 203 clinically suspected cases were evaluated over a two-year period (January 2022–December 2023) using cytological examination of skin and ear samples stained with Giemsa. Among the diagnosed cases, dogs accounted for 60% and cats for 40%, with male animals representing a slightly greater proportion of cases than females. Adult animals aged 3–6 years comprised the largest age group (45.81%). Local dogs represented the highest proportion of canine cases, whereas Persian cats were the most frequently affected feline breed. Lesions were most commonly observed in the ear pinnae and external ear canals (27.59%), followed by the ventral trunk (23.15%), dorsal trunk (14.78%), generalized dermatitis (14.29%), axillae (6.90%), neck (5.42%), perineal region (4.43%), and interdigital spaces (3.45%). Cytological examination demonstrated the characteristic footprint- or peanut-shaped budding yeast cells of *Malassezia*, and concurrent bacterial infection was detected in 57% of cases. The findings indicate that *Malassezia*-associated dermatitis and otitis are common clinical conditions among companion animals presented to this referral hospital, with mixed bacterial infections occurring frequently. This study provides baseline epidemiological and clinical data on *Malassezia* infections in dogs and cats in Bangladesh and highlights the diagnostic value of routine cytological examination in veterinary practice. The findings further emphasize the importance of early recognition, investigation of underlying predisposing factors, and appropriate management of concurrent bacterial infections to improve treatment outcomes. These baseline data may also support future molecular epidemiological studies, antifungal resistance surveillance, and the development of evidence-based diagnostic and therapeutic guidelines for companion animal dermatology in Bangladesh.

Keywords: opportunistic pathogens; bacteria; cytological evaluation; footprint; co-infection

1. Introduction

The lipophilic yeasts of the genus *Malassezia* are well-recognized commensal microorganisms inhabiting the skin and mucosal surfaces of warm-blooded vertebrates (Theelen *et al*., 2018; Bond *et al*., 2020; Bajwa, 2023; Jańczak *et al*., 2023). Although they normally exist as part of the cutaneous microbiota, *Malassezia* species can become opportunistic pathogens when host defense mechanisms or the skin microenvironment are altered, resulting in dermatitis and otitis externa in dogs and cats. To date, approximately 18 *Malassezia* species have been described, of which eleven have been detected in cats and nine in dogs using culture and molecular diagnostic techniques (Hobi *et al*., 2022).

Malassezia species are associated with a wide range of dermatological disorders in companion animals, including otitis externa, dermatitis, and, less frequently, paronychia and keratitis (Ledbetter and Starr, 2015; Bajwa, 2017; Oliveira *et al*., 2018; Guillot and Bond, 2020; Spatz and Richard, 2020; Daniel, 2022; Hobi *et al*., 2022). The pathogenicity of these yeasts is often enhanced by concurrent microbial infections. Besides *Malassezia*, bacteria such as *Staphylococcus* spp., *Streptococcus* spp., *Proteus* spp., *Pseudomonas* spp., and *Escherichia coli* are frequently implicated in otitis externa and dermatitis in carnivores (O'Neill *et al*., 2021; Lynch and Helbig, 2021; Rosales *et al*., 2024). Mixed yeast–bacterial infections may exacerbate inflammation, prolong disease progression, and complicate therapeutic management.

Clinically, *Malassezia* dermatitis typically presents as pruritic, erythematous, greasy, and malodorous skin lesions that initially involve the ventral abdomen and intertriginous regions before extending to the axillae, inguinal region, trunk, and other body sites (Moraru *et al*., 2019). Hyperpigmentation and lichenification are frequently observed in chronic cases. In the external ear canal, *Malassezia* may occur either alone or concurrently with bacterial pathogens, resulting in erythema, thickening of the ear canal and pinna, excessive cerumen production, scaling, and yellowish-to-brown otic discharge. These clinical manifestations can substantially compromise animal welfare and quality of life if left untreated.

The diagnosis of *Malassezia* dermatitis primarily relies on compatible clinical signs, cytological demonstration of increased numbers of yeast cells in affected tissues, and clinical response to antifungal therapy. Although antifungal susceptibility testing is not routinely performed in veterinary practice, several studies have documented the emergence of antifungal resistance in *Malassezia*, involving mechanisms such as efflux pump activation, alterations in fungal sterol metabolism, and biofilm formation (Cafarchia *et al*., 2015; Iatta *et al*., 2017; Kim *et al*., 2018; Peano *et al*., 2020; Kurniadi *et al*., 2022; Hobi *et al*., 2022; Shin and Bae, 2023). *Malassezia* organisms are readily identified on cytological preparations as characteristic footprint-, peanut-, or bottle-shaped broad-based budding yeast cells measuring approximately 3–8 μm in diameter (Bond *et al*., 2020; Bajwa, 2023). The tape-strip technique provides a convenient and reliable method for collecting superficial skin samples, whereas culture and DNA-based diagnostic techniques are generally reserved for research and epidemiological investigations (Bond *et al*., 2020).

Treatment of *Malassezia* dermatitis typically involves topical antiseptic and antifungal therapy, with systemic antifungal agents reserved for severe, generalized, or recurrent infections. Combination therapy including antifungal agents, antibiotics, and glucocorticoids is frequently required to control concurrent bacterial infection, reduce inflammation, and manage proliferative skin lesions. Systemic azole antifungals, including clotrimazole, miconazole, ketoconazole, posaconazole, nystatin, and terbinafine, are commonly used in refractory cases (Bond *et al*., 2020; Guillot and Bond, 2020; Hobi *et al*., 2022; Bajwa, 2023). Successful long-term management depends on the identification and treatment of underlying predisposing conditions, such as allergic skin disease, endocrine disorders, keratinization defects, or immunosuppressive conditions, to minimize recurrence (Bond *et al*., 2020; Hobi *et al*., 2022; Bajwa, 2023).

Although *Malassezia* species are predominantly adapted to animals, they also possess zoonotic and public health relevance. Nosocomial systemic infections caused by *Malassezia* have been reported in humans, particularly among immunocompromised patients (Rhimi, 2020). One potential route of transmission involves healthcare workers who own companion animals, thereby raising concerns regarding opportunistic transmission to susceptible neonatal patients (Suleyman and Alangaden, 2016).

Despite the increasing recognition of *Malassezia*-associated dermatitis and otitis in companion animals worldwide, published epidemiological evidence from Bangladesh remains scarce. Most available reports are limited to individual clinical observations or general dermatological conditions and do not comprehensively describe the distribution of *Malassezia* infection, demographic characteristics of affected animals, anatomical distribution of lesions, or the occurrence of concurrent bacterial infections. Consequently, veterinarians in Bangladesh have limited locally generated evidence to support accurate diagnosis, effective therapeutic decision-making, and disease surveillance. This lack of baseline epidemiological information represents an important knowledge gap that may hinder timely diagnosis and optimal management of *Malassezia* infections in

companion animals. Based on this knowledge gap, the present study was designed to address the following research questions, including, what is the distribution of *Malassezia* infection among dogs and cats presented to a veterinary teaching hospital in Dhaka, Bangladesh? What are the predominant clinical manifestations and anatomical locations of *Malassezia*-associated lesions? How are species, age, sex, breed, and lifestyle associated with the occurrence of diagnosed cases? and how frequently does concurrent bacterial infection occur in animals diagnosed with *Malassezia* dermatitis?

The study was conducted under the hypothesis that *Malassezia* infection is more frequently diagnosed in dogs than in cats, predominantly affects adult animals, exhibits characteristic clinical and cytological features, and is commonly accompanied by concurrent bacterial infection. It was further hypothesized that demographic characteristics and anatomical lesion distribution vary among affected companion animals. Accordingly, the objective of this study was to investigate the distribution and clinical characteristics of *Malassezia* infection in dogs and cats presented to the Teaching and Training Pet Hospital and Research Centre in Dhaka, Bangladesh.

The novelty of this study lies in providing one of the first comprehensive hospital-based investigations of *Malassezia* infection in both dogs and cats in Bangladesh. Unlike previous reports, the study simultaneously evaluates demographic characteristics, anatomical distribution of lesions, cytological findings, and concurrent bacterial infections using a standardized diagnostic approach over a two-year period. The findings of this study have important clinical and veterinary public health implications. The baseline data generated can improve clinicians' awareness of the epidemiological and clinical patterns of *Malassezia* infection, facilitate earlier recognition and cytological diagnosis, and support more appropriate therapeutic management, particularly in cases complicated by bacterial co-infection.

2. Materials and Methods

2.1. Ethical approval

No ethical approval was required to conduct the study.

2.2. Study area and duration of study

Clinical records of dogs and cats diagnosed with *Malassezia* infection, with or without concurrent bacterial infection, were retrospectively reviewed from cases presented to the Teaching and Training Pet Hospital and Research Centre, Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh, over a two-year period from January 2022 to December 2023 (Figure 1).

2.3. Study design and collection of samples

Dogs and cats diagnosed with *Malassezia* infection were classified according to species, breed, age, lifestyle (indoor, outdoor, or mixed), anatomical location of lesions, and the presence or absence of concurrent bacterial infection. Clinical samples were collected from affected skin lesions and external ear canals using skin scrapings or sterile cotton swabs, depending on the lesion type. Smears were then prepared on clean glass slides for subsequent cytological examination.

2.4. Cytological study

Smears prepared from skin lesions and ear canal samples were air-dried, fixed in absolute methanol, and stained with Giemsa stain following standard cytological procedures. The stained slides were examined using a compound light microscope (Leica DM500, Leica Microsystems, Wetzlar, Germany) under 10× and 100× (oil immersion) objective magnifications for the detection of *Malassezia* yeast cells and concurrent bacterial organisms, following established cytological diagnostic protocols (Guillot and Bond, 2020; Bond *et al*., 2020). The presence of characteristic broad-based budding yeast cells exhibiting a typical "footprint" or "peanut-shaped" morphology was considered diagnostic of *Malassezia* species.

2.5. Data analysis

Data obtained from the 203 dogs and cats included in the study were coded and entered into Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) for data cleaning, validation, sorting, and preliminary tabulation. Descriptive statistics, including frequencies and percentages, were used to summarize the distribution of demographic characteristics, lesion locations, and cytological findings. Graphs and pie charts were initially generated using Microsoft Excel and subsequently refined using Adobe Illustrator (Adobe Inc., San Jose, CA, USA) to produce publication-quality figures. The study area map was prepared using QGIS software (Version 3.34; QGIS Development Team, Open Source Geospatial Foundation).

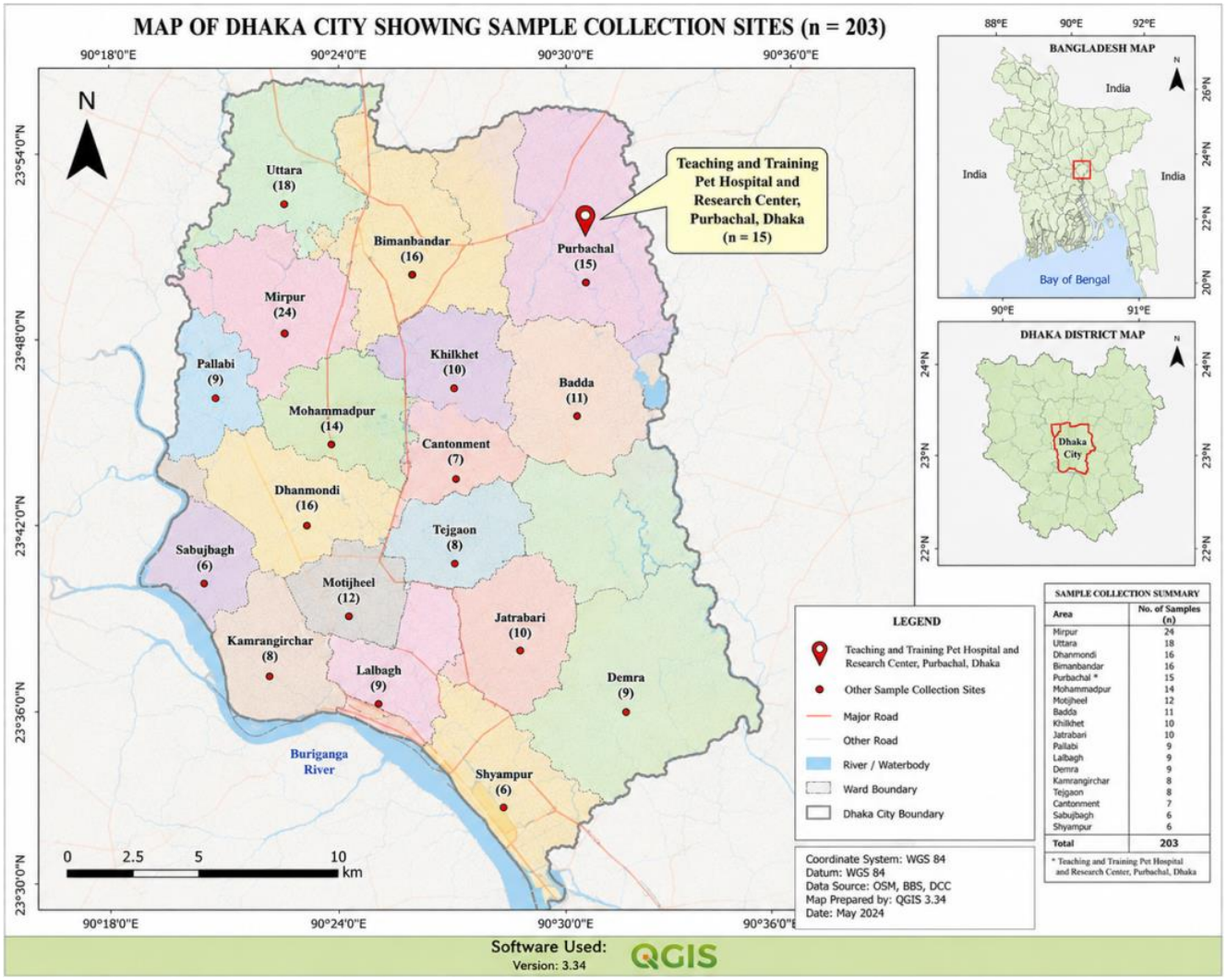

Figure 1. Map of the sample collection site.

3. Results and Discussion

3.1. Distribution of *Malassezia* infection according to animal species

Among the 203 companion animals diagnosed with *Malassezia* infection, dogs accounted for 60% (n = 121) of the cases, whereas cats represented 40% (n = 82) (Figure 2). The findings indicate that *Malassezia* infection was more frequently diagnosed in dogs than in cats among animals presented to the Teaching and Training Pet Hospital and Research Centre during the study period. The greater proportion of canine cases may be attributed to differences in skin physiology, sebaceous gland activity, hair coat characteristics, management practices, and environmental exposure, all of which may influence the growth and proliferation of *Malassezia* species. Similar observations have been reported by Brame and Cain (2021), who also found a higher frequency of *Malassezia* infection in dogs than in cats. In contrast, Nguyễn *et al*. (2023) reported that dogs and cats accounted for 91.7% and 8.3% of diagnosed cases, respectively, indicating a more pronounced species difference than observed in the present study. Such variation among studies may reflect differences in geographic location, climatic conditions, animal populations, husbandry and hygienic practices, referral patterns, diagnostic criteria, and routine ear and skin care.

3.2. Distribution of *Malassezia* infection according to gender

Among the 203 companion animals diagnosed with *Malassezia* infection, males accounted for 55% of the cases, whereas females represented 45% (Figure 3). The findings indicate that male animals comprised a slightly greater proportion of diagnosed cases than females during the study period. The higher proportion of cases observed in males may be associated with physiological, hormonal, behavioral, or management-related factors that could influence susceptibility to skin and ear infections, although the exact mechanisms remain unclear. Comparable findings were reported by Nguyễn *et al*. (2023), who observed that 54.2% of *Malassezia* infections

occurred in males and 45.8% in females. Similarly, Dhoot *et al*. (2021) documented a greater proportion of affected males (60%) than females (40%). In a study conducted in the Kurdistan region of Iraq, Jarjees and Issa (2022) reported that dermatophytosis was more frequently diagnosed in male cats (47.6%) than in female cats (41.4%), although the difference was not statistically significant, while no sex-related difference was observed among dogs. Conversely, Coelho *et al*. (2024) reported comparable frequencies of *Malassezia* infection between male and female dogs in both healthy and dermatologically affected populations. The variation among studies may reflect differences in study populations, sample size, animal management practices, geographical and climatic conditions, as well as the distribution of underlying dermatological disorders.

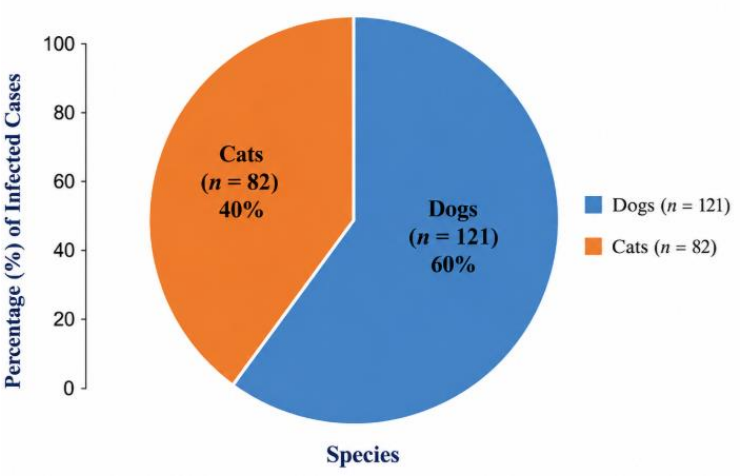

Figure 2. Occurrence of *Malassezia* infection according to animal species.

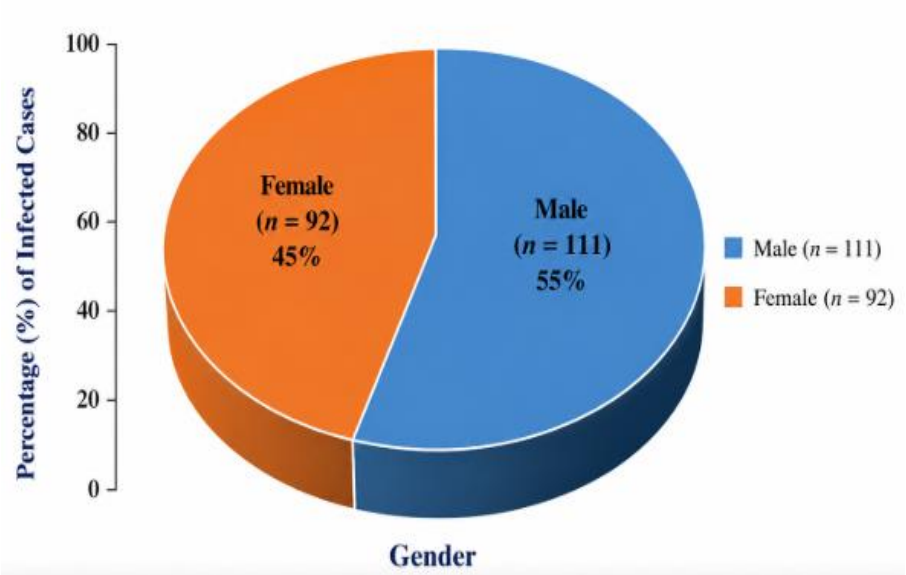

Figure 3. Occurrence of *Malassezia* infection according to gender.

3.3. Distribution of *Malassezia* infection according to age

Among the 203 companion animals diagnosed with *Malassezia* infection, adult animals aged 3–6 years accounted for the largest proportion of cases (45.81%), followed by junior animals aged 7 months–2 years (28.57%), mature animals aged 7–10 years (18.72%), senior animals aged 11–14 years (3.45%), and kittens/puppies aged 0–6 months (2.96%). Geriatric animals (≥15 years) represented the smallest proportion of diagnosed cases (0.49%) (Table 1). The predominance of adult animals may reflect prolonged environmental exposure, greater opportunities for the development of underlying dermatological disorders such as allergic skin disease, endocrine abnormalities, and seborrheic conditions, as well as cumulative alterations in the cutaneous microenvironment that favor *Malassezia* overgrowth. Comparable findings were reported by Sudipa *et al*. (2021), who documented that approximately 40% of *Malassezia* infections occurred in dogs older than three

years. Similarly, Dhoot *et al*. (2021) observed a marked increase in the proportion of diagnosed cases among animals aged 3–9 years (49.8%), whereas animals younger than one year (0.39%) and those older than 12 years (2.7%) accounted for relatively few cases. In contrast, Boone *et al*. (2021) and Seetha *et al*. (2018) reported that the majority of affected animals were between 1 and 3 years of age, representing approximately 56% of all diagnosed cases. Likewise, Nguyễn *et al*. (2023) found that animals aged 1–3 years accounted for 45.8% of *Malassezia* infections. The variation in age distribution among studies may be associated with differences in study populations, geographical and climatic conditions, husbandry practices, breed composition, underlying diseases, referral patterns, and age classification systems.

Table 1. Age wise occurrence of *Malassezia* infection in dogs and cats.

Age	Frequency	Percentage (%)
Kitten/Puppy (0 - 6 months)	6	2.96
Junior (7 months - 2 years)	58	28.57
Adult (3 years - 6 years)	93	45.81
Mature (7 years – 10 years)	38	18.72
Senior (11 years – 14 years	7	3.45
Geriatric (15 years+)	1	0.49
Total	**203**	**100**

3.4. Distribution of *Malassezia* infection according to dog breed

A total of 14 dog breeds were represented among the 121 canine cases diagnosed with *Malassezia* infection. Local (non-descriptive) dogs accounted for the largest proportion of diagnosed cases (33.06%), followed by German Shepherds (19.83%), Golden Retrievers (13.22%), Lhasa Apsos (8.26%), Spitz (6.61%), mixed-breed dogs (4.96%), Labrador Retrievers (3.31%), Beagles (3.31%), Shih Tzus (2.48%), Great Danes (1.65%), and Bulldogs, Maltese, Pomeranians, and Sorail dogs (0.83% each) (Table 2). A similar distribution was reported by Seetha *et al*. (2018), in which non-descriptive dogs represented the largest proportion of diagnosed cases (55%), followed by Labrador Retrievers and Spitz (13%), German Shepherds (11%), Chinese Pugs (4%), Dalmatians (2%), and Dobermans and Great Danes (1%). The relatively larger proportion of local dogs observed in the present study may reflect the greater population of non-descriptive dogs presented to the hospital and differences in ownership patterns, accessibility to veterinary care, and local dog demographics rather than an inherent breed predisposition. In contrast, Nguyễn *et al*. (2023) reported a substantially higher proportion of *Malassezia* infection among exotic breeds (75%) than domestic breeds (25%), indicating geographical variation in breed distribution. Previous studies have suggested that certain breeds, including West Highland White Terriers, American Cocker Spaniels, Dachshunds, Boxers, Poodles, English Setters, Australian Silky Terriers, Shih Tzus, and Basset Hounds, may be predisposed to *Malassezia* dermatitis because of inherited skin characteristics, seborrheic tendencies, or underlying allergic disorders (Bond *et al*., 2020; Guillot and Bond, 2020; Hobi *et al*., 2022; Bajwa, 2023). However, because the present investigation was based on hospital cases and did not include the underlying breed population at risk, the observed breed distribution should be interpreted cautiously.

Table 2. Breed wise occurrence of *Malassezia* infection in dogs.

Dog breed name	Frequency	Percentage (%)
Local	40	33.06
German Shepherd	24	19.83
Golden Retriever	16	13.22
Labrador	4	3.31
Lhasa Apso	10	8.26
Shitzu	3	2.48
Spitz	8	6.61
Beagle	4	3.31
Bull dog	1	0.83
Great Dane	2	1.65
Maltese	1	0.83
Pomeranian	1	0.83
Sorail	1	0.83
Mixed	6	4.96
Total	**121**	**100**

3.5. Distribution of *Malassezia* infection according to cat breed

Among the 82 feline cases diagnosed with *Malassezia* infection, Persian cats accounted for the largest proportion of cases (54.88%), followed by local breeds (20.73%), mixed breeds (9.76%), Scottish Fold (7.32%), British Shorthair (4.88%), and Russian Blue (2.44%) (Table 3). The predominance of Persian cats among the diagnosed cases may be associated with breed-specific characteristics, including their long and dense hair coat, increased skin fold formation, grooming challenges, and a greater tendency to develop seborrheic skin conditions, all of which may create a favorable microenvironment for *Malassezia* proliferation. However, because the present study was based on hospital cases and did not evaluate the underlying breed population at risk, these findings should be interpreted as the distribution of diagnosed cases rather than evidence of breed susceptibility.

Previous studies have reported that *Malassezia* dermatitis is generally less common in cats than in dogs (Bajwa, 2017; Oliveira *et al*., 2018; Daniel, 2022; Miller *et al*., 2023; Sousa *et al*., 2024). Although *Malassezia* infection has been described in a variety of feline breeds, breed-related differences in colonization and clinical disease have also been documented. Moriello *et al*. (2017) reported that Persian cats represented a substantial proportion of dermatophytosis cases in their study, highlighting the influence of breed characteristics on dermatological disorders. Furthermore, Devon Rex and Sphynx cats have been reported to harbor higher *Malassezia* colonization loads than many other breeds, predisposing them to seborrheic skin disorders and *Malassezia*-associated dermatitis (Older *et al*., 2019; Vanderwolf *et al*., 2023). Differences in breed distribution among studies are likely influenced by geographical location, breed popularity, management practices, referral patterns, environmental conditions, and variations in study populations.

Table 3. Breed wise occurrence of *Malassezia* infection in cats.

Cat breed name	Frequency	Percentage (%)
Local	17	20.73
Persian	45	54.88
Scottish fold	6	7.32
British short hair	4	4.88
Russian Blue	2	2.44
Mixed	8	9.76
Total	**82**	**100**

3.6. Distribution of *Malassezia* infection according to lifestyle

Based on their living environment prior to presentation, the animals were categorized as indoor, outdoor, or mixed (both indoor and outdoor) lifestyle. Among the diagnosed cases, indoor animals accounted for the largest proportion (43%), followed by outdoor animals (30%) and animals with mixed indoor–outdoor exposure (27%) (Figure 4). The higher proportion of diagnosed cases among indoor animals may reflect the greater number of indoor companion animals presented to the hospital, differences in pet ownership patterns, or management practices rather than an increased biological predisposition to *Malassezia* infection. Nevertheless, environmental conditions such as high humidity, inadequate hygiene, limited ventilation, and prolonged exposure to moisture may influence the proliferation of *Malassezia* in both indoor and outdoor environments. Outdoor and mixed-lifestyle animals may additionally be exposed to fluctuating environmental conditions, environmental contaminants, and increased contact with other animals, which could contribute to microbial colonization and the development of skin disorders. Comparable observations were reported by Coelho *et al*. (2024), who found that the majority of examined cats (130 of 151) were housed in catteries or had outdoor access, suggesting that increased animal-to-animal contact and shared environments may facilitate *Malassezia* colonization and transmission.

3.7. Anatomical distribution of *Malassezia* lesions

Lesions were most frequently observed in the ear pinnae and external ear canals (27.59%), followed by the ventral trunk (23.15%), dorsal trunk (14.78%), generalized dermatitis (14.29%), axillary regions (6.90%), neck (5.42%), perineal region (4.43%), and interdigital spaces (3.45%) (Table 4; Figure 5-8).

The predominance of lesions in the ear pinnae and external ear canals is consistent with the lipophilic nature of *Malassezia* species, which preferentially colonize warm, moist, and lipid-rich anatomical sites. Clinical manifestations commonly include alopecia, erythema, scaling, crust formation, greasiness, hyperpigmentation, and, in chronic cases, lichenification (Bond *et al*., 2020; Guillot and Bond, 2020; Hobi *et al*., 2022; Bajwa, 2023). The frequent involvement of the ventral and dorsal trunk observed in the present study may likewise

reflect favorable environmental conditions for yeast proliferation, particularly in areas with increased sebaceous gland activity, skin folds, friction, and moisture accumulation. The anatomical distribution observed in the present study differs from that reported by Seetha *et al*. (2018), who identified the neck as the most frequently affected site, followed by the dorsal and ventral trunk. Similarly, Martins (2022) reported the highest yeast counts in the neck region, followed by the ear canal, interdigital spaces, and groin. These differences may be attributable to variations in animal populations, breed composition, climatic conditions, management practices, diagnostic criteria, and the prevalence of underlying dermatological disorders among study populations. Previous studies have shown that lesion distribution may vary between canine and feline patients. In dogs, *Malassezia* dermatitis commonly affects the pinnae, external ear canals, muzzle, ventral neck, trunk, thighs, and paws, whereas in cats, lesions are more frequently observed on the pinnae, face, chin, neck, limbs, and ventral abdomen. Furthermore, breeds such as Sphynx and Devon Rex have been reported to exhibit greater involvement of the ventral neck, axillae, inguinal region, and paws because of their distinctive skin characteristics (Hobi *et al*., 2022; Bajwa, 2023).

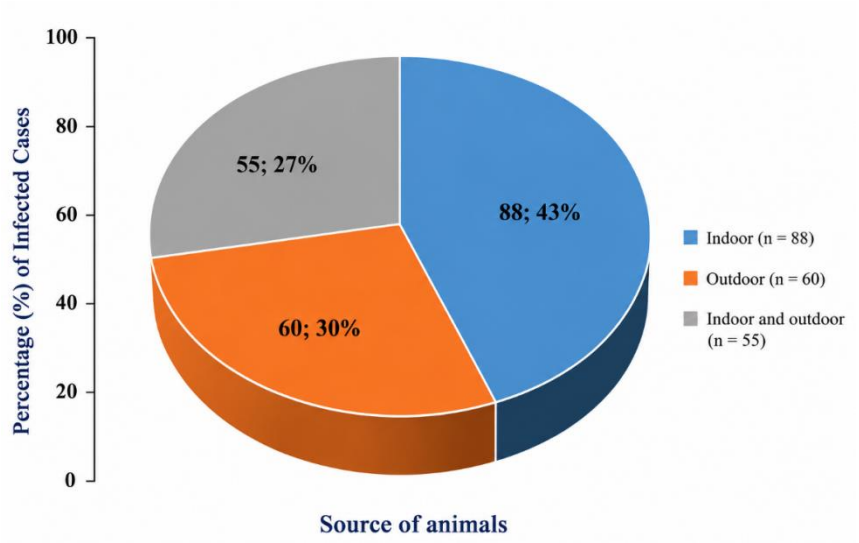

Figure 4. Occurrence of *Malassezia* infection according to patient's lifestyle.

Figure 5. Hyperpigmented lesion on the lower ventral abdomen of a dog with *Malassezia* dermatitis.

Figure 6. Ear canal infection caused by *Malassezia* in a cat.

Figure 7. Hyperpigmentation of the ear pinna associated with *Malassezia* infection in a dog.

Figure 8. Interdigital dermatitis caused by *Malassezia* infection in a dog.

Table 4. Frequency of *Malassezia* isolation from different locations of patients.

Affected locations	Frequency	Percentage (%)
Dorsal trunk	30	14.78
Ear pinnae and canals	56	27.59
Ventral trunk	47	23.15
Neck	11	5.42
Arm pits	14	6.90
Perenial region	9	4.43
Generalized dermatitis	29	14.29
Interdigital area	7	3.45
Total	**203**	**100**

3.8. Cytological examination

Cytological examination of smears prepared from affected skin lesions and ear canal samples confirmed the presence of *Malassezia* yeast cells in all clinically diagnosed cases. Following Giemsa staining, characteristic broad-based budding yeast cells with the typical "footprint," "peanut," or "babushka" morphology were readily observed under light microscopy (Figure 9). In several samples, coccoid bacteria were also detected alongside *Malassezia* yeast cells, indicating concurrent bacterial colonization or mixed infection (Figure 10). Direct microscopic examination remains a rapid, practical, and cost-effective diagnostic method for *Malassezia* dermatitis, utilizing samples obtained by tape stripping, impression smears, cotton swabs, or skin scrapings (Bond *et al*., 2020; Bajwa, 2023; Drechsler *et al*., 2024). Cytologically, *Malassezia pachydermatis* is recognized by its characteristic unipolar, broad-based budding yeast cells with the typical "footprint," "peanut," or "babushka" appearance (Bond *et al*., 2020; Drechsler *et al*., 2024; Bajwa, 2023), which was consistent with the findings of the present study. Comparable observations were reported by Karlapudi (2017), who identified *Malassezia pachydermatis* together with bacterial pathogens, including *Staphylococcus* spp. and *Pseudomonas* spp., using Diff-Quik-stained cytological preparations. Seetha *et al*. (2018) demonstrated that the diagnostic sensitivity of cytological techniques varied according to the sampling method, reporting detection rates of 26% for impression smears, 34% for adhesive tape preparations, and 40% for skin swabs. Likewise, Hobi *et al*.

(2024) described cytological findings characterized by abundant *Malassezia* yeast cells accompanied by bacterial aggregates in clinically affected animals. These findings support the value of cytological examination as a reliable first-line diagnostic tool for the rapid confirmation of *Malassezia* dermatitis and the simultaneous detection of concurrent bacterial involvement in routine veterinary practice.

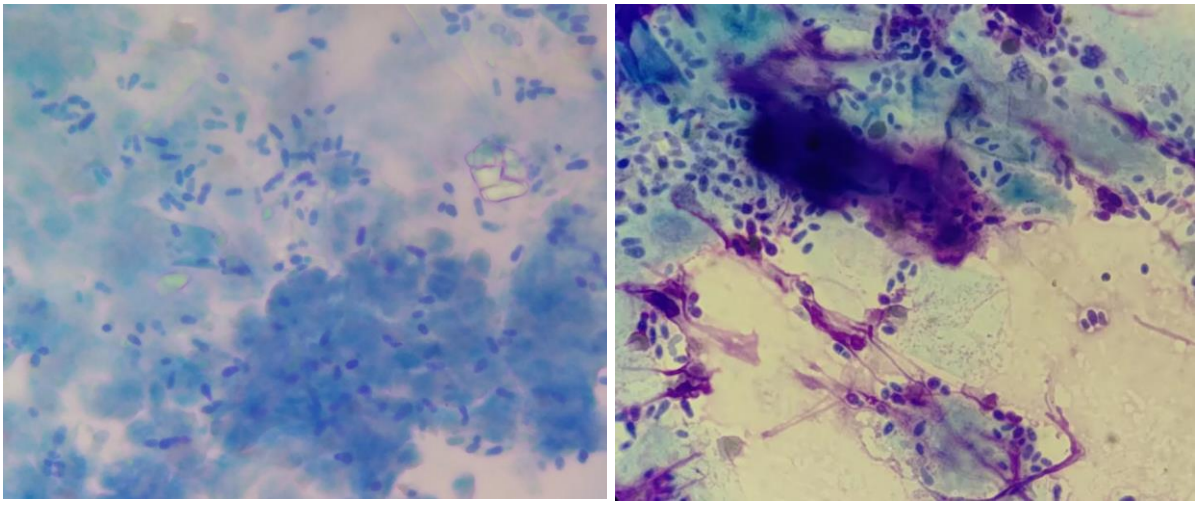

Figure 9. Giemsa-stained cytological smear showing characteristic broad-based budding *Malassezia* yeast cells with typical "footprint" (peanut-shaped) morphology under light microscopy (100× oil immersion).

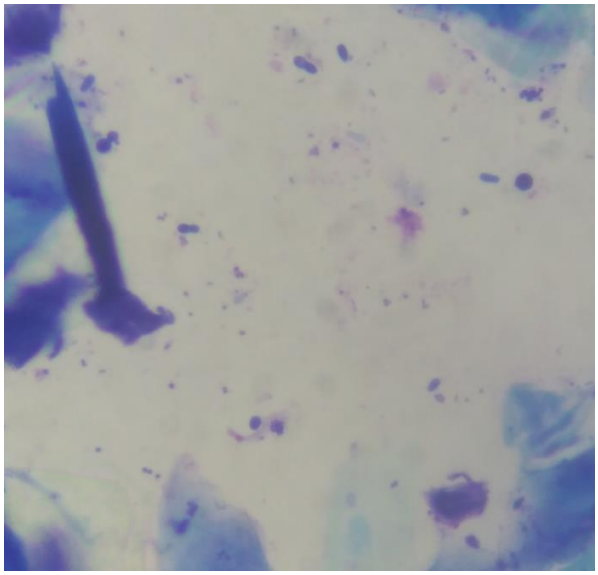

Figure 10. Giemsa-stained cytological smear showing characteristic *Malassezia* yeast cells (footprint morphology) together with coccoid bacteria, indicating concurrent bacterial infection (100× oil immersion).

3.9. Concurrent bacterial infection

Cytological examination revealed that 57% of the cases exhibited concurrent bacterial infection, whereas 43% showed *Malassezia* infection without detectable bacterial involvement. The presence of coccoid bacteria in affected skin and ear samples indicated that mixed microbial infections were common among clinically affected animals (Figure 11). The frequent occurrence of bacterial co-infection observed in the present study is consistent with the opportunistic nature of *Malassezia* dermatitis. Disruption of the cutaneous barrier, increased skin moisture, excessive sebaceous secretions, allergic skin diseases, endocrine disorders, and other predisposing factors can facilitate the simultaneous proliferation of *Malassezia* species and opportunistic bacteria, thereby exacerbating inflammation and the severity of clinical lesions. Previous studies have similarly reported that bacterial pathogens, particularly *Staphylococcus* spp., *Streptococcus* spp., *Pseudomonas* spp., *Proteus* spp., and

E. coli, are frequently isolated from cases of canine and feline otitis externa and dermatitis associated with *Malassezia* overgrowth (O'Neill *et al*., 2021; Lynch and Helbig, 2021; Rosales *et al*., 2024). The high proportion of mixed infections observed in the present study highlights the importance of comprehensive cytological evaluation to identify both yeast and bacterial organisms, thereby facilitating appropriate therapeutic decision-making.

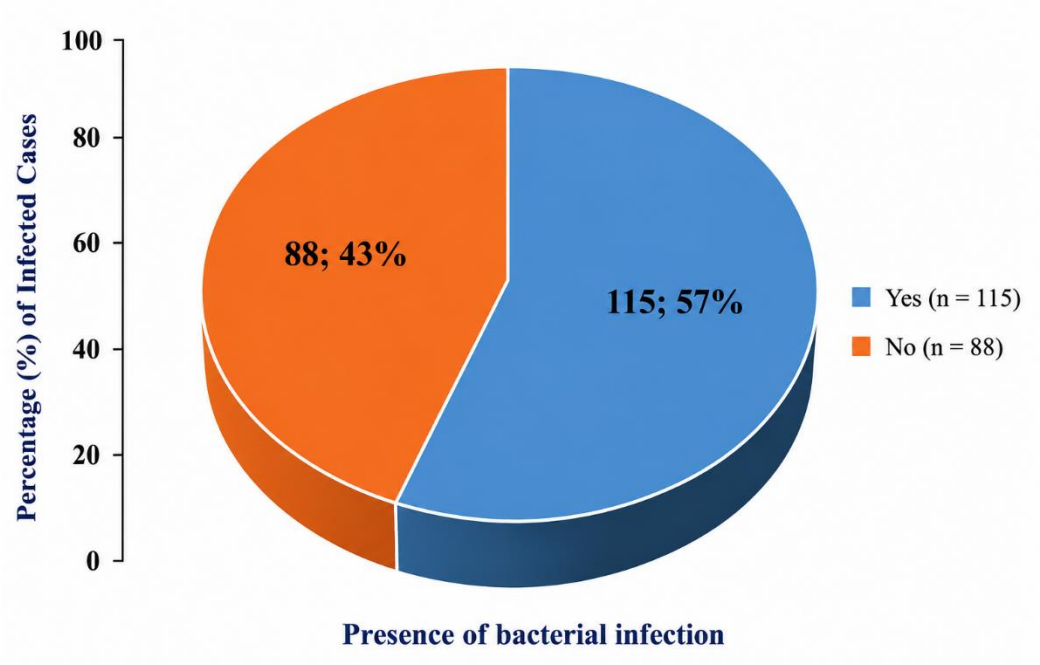

Figure 11. Occurrence of *Malassezia* dermatitis with or without bacterial infection.

4. Conclusions

This study provides baseline epidemiological and clinical information on *Malassezia* infection in dogs and cats presented to a veterinary teaching hospital in Dhaka, Bangladesh. Dogs accounted for a larger proportion of diagnosed cases than cats, with males and adult animals (3–6 years) representing the highest proportions. Local dogs and Persian cats were the most frequently affected breeds within their respective species. The ear pinnae and external ear canals were the most commonly affected sites, followed by the ventral trunk. Cytological examination using Giemsa-stained smears proved to be a rapid and practical diagnostic method, confirming the characteristic *Malassezia* yeast cells and detecting concurrent bacterial infection in more than half of the cases. The findings highlight the importance of routine cytological examination and early clinical diagnosis for effective management of *Malassezia* dermatitis. Although limited by its hospital-based design, reliance on cytological diagnosis, and lack of molecular characterization and antifungal susceptibility testing, this study provides valuable baseline data for Bangladesh. Future studies should incorporate molecular identification, fungal culture, and antifungal susceptibility testing to improve the diagnosis and management of *Malassezia* infections.

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Data availability

The data supporting the findings of the study are available within the article.

Conflict of interest

None to declare.

Authors' contribution

Mohammad Bayazid Bostami: supervision, planed the study, designed, analysis, reviewed, writing of the original draft editing and revision of the manuscript; Sayma Mahmud Moon: sample collection, organization and initially drafted the manuscript; Aparna Datta and Mizanur Rahman: data finalization, data analysis, manuscript writing, editing, and revision of the manuscript; Abdul Mannan: data organization, analysis, interpretation, editing, and revision of the manuscript; Md. Osman Khan: sample collection, organization and initially drafted the manuscript. The manuscript was read and approved by all authors prior to submission.

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