

Research Article

Knowledge, Attitude and Practices in Veterinarians and Pet owners for Fungal Infections in Pets and its Zoonotic Impact

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Date of Receiving: 12/02/2024
Date of Acceptance 20/05/2024
Date of Publication: 10/06/2024

ABSTRACT Fungal infections, such as dermatophytosis and systemic mycoses, pose significant health risks to both animals and humans. Fungal infections of zoonotic origin could lead animal handlers to serious life conditions in immune-compromised persons. This study determined the knowledge, attitudes, and practices (KAP) regarding fungal infections in pets and their zoonotic implications among pet owners and veterinarians. Various aspects of fungal infections such as animal handling SOPs, importance of fungal treatment completion, and transmission of fungal infections were explored in this KAP survey. Majority of the respondents had a sound knowledge of importance of hygiene and zoonotic potential of fungal infections. Overall, positive attitude was observed towards contraction of disease while respondents showed high variation of attitude in response to the importance of fungal infections. A minority of respondents were not practicing the use of hand gloves and not observing the clinical signs at all. Veterinarians obtained higher marks in both attitude and practices as compared to pet owners (p-value <0.001). On the other hand, veterinarians and pet owners showed no difference in the knowledge levels. Pearson's residual analysis showed low level of knowledge is highly correlated with the bad practices (p-value <0.001). These findings will contribute to enhancing public health efforts, veterinary education, and communication about zoonotic fungal infections. Strengthening the veterinary health system will eventually promoting better health outcomes for pets and their human companions.

KEYWORDS Fungal, KAP, Zoonotic, Pets, Survey

Introduction

Fungi are uncommon cause of disease in both healthy humans and nonhuman vertebrates even continual exposure to spores is there (Köhler *et al*, 2015). However, there has been a notable rise in fungal diseases affecting animals over the past two decades (Fisher *et al*, 2012). Fungal infections such as Dermatophytosis, Blastomycosis, Para-coccidiomycosis are being reported frequently (Gilchrist and Stokes, 1898; Bradsher and Robert, 2014) (Herrmann *et al*, 2011; Teixeira *et al*, 2014). Infectious agents of these infections include numerous pathogenic fungi such as *Microsporum canis*, *Blastomyces dermatitidis*, *Paracoccidioides* spp., *Trichophyton* spp., and *Aspergillus* spp., which can give rise to a variety of clinical manifestations from superficial cutaneous

infections to deep systemic infections that can be fatal (Bond *et al*, 2020). Such fungal infections also have zoonotic potential and can be threat to pet owners and veterinary practitioners.

Individual risks specific to pets, such as travel or participation in group settings (e.g., dog daycare, boarding, dog shows), can heighten a pet's susceptibility to infectious diseases by exposing them to local pathogens during travel or increasing contact with potentially infectious animals and contaminated objects in communal environments (Stull *et al*, 2016). Factors including pet characteristics, travel history, and regional risks for infectious disease exposure all influence and require adjustments to each pet's personalized preventive care plan (Stull *et al*, 2012). Since many pathogens affecting pets are zoonotic, pets can directly transmit infections to human household members or facilitate movement of tick and flea vectors, thereby impacting public health when preventive care

To cite this article: Akhtar, T., M. Wasif, F. Riaz, H. Faiqa, J. Nousheen, R. Malik, and K. Mohsin. (2024). *Knowledge, Attitude and Practices in Veterinarians and Pet owners for Fungal Infections in Pets and its Zoonotic Impact*. Journal of Epidemiology and Infection Biology 1(1):5-10.

for dogs and cats is not maintained (e.g., toxocariasis, borreliosis) (Bowser and Anderson, 2018). These pet-related public health risks are particularly significant for household members who are vulnerable due to age, pregnancy, or compromised immune systems (e.g., cancer or associated treatments), as zoonotic infections tend to be more frequent and severe in these populations (Stull *et al*, 2015). Consequently, the veterinary team plays a crucial role in influencing the knowledge, attitudes, and practices (KAPs) of pet owners, which directly affects the health of both pets and their owners.

Despite their prevalence, there is variability in the awareness and understanding of these infections among veterinarians and pet owners. Comprehensive knowledge about the transmission, clinical signs, diagnosis, and treatment options is essential for effective management. (Weese, 2011). The primary objective of this KAP survey is to assess the current state of knowledge, attitudes, and practices regarding fungal infections in pets among veterinarians and pet owners. This survey aims to identify gaps in knowledge and attitudes that may hinder effective management and to understand the practices currently in place that may either mitigate or exacerbate the risk of these infections. The findings from this survey will provide valuable insights for developing targeted educational programs and interventions to improve the health and safety of both pets and their human companions.

Materials and Methods

A cross-sectional KAP survey was conducted using convenience sampling. A total of 100 participants from veterinary profession and owners of pets were asked to respond to a questionnaire regarding their knowledge, attitudes, and practices concerning fungal infections in pets and their zoonotic impact. A structured questionnaire was designed using Google Forms, which allowed for efficient distribution and collection of responses through email and social media platforms. Data collection spanned over a period of three months.

KAP questionnaire

Various aspects of fungal infections were explored in this KAP survey. The aspects included in this study were related to (i) Animal handling SOPs, (ii) importance of fungal treatment completion, and (iii) transmission of fungal infections. The questionnaire included sections on demographics, knowledge of fungal infections, attitudes towards their management, and current practices in place. There were 28 questions in survey including 26 close-ended questions and 02 open-ended questions only.

To explore the relationship of demographic variables with identified sections in terms of knowledge, attitude and practices, these sections were analyzed separately. In the knowledge related questions, responses of questions related to knowledge section were categorized as "Yes" and "No". The response "Yes" was assigned with 1 mark each while the response "No" was assigned 0 mark each. Responses of attitude related questions were categorized as "Strongly Disagree", "Disagree", "Neutral", "Agree", and "Strongly Agree". Marks 1 to 5 were assigned to these responses

beginning from Strongly Disagree being the lowest marks category while the Strongly Agree with highest marks category. On the other hand, responses of questions related to practices were "Never", "Rare", "Often", and "Frequently" whereas "Never" was the lowest marks category. The sum of all the marks from each section will determine the level of understanding of that section. The individuals with obtained marks higher than 75% in knowledge, attitude, and practices will be considered as High knowledge, Positive attitude, and Good practices, respectively.

Statistical analysis

The data were exported from Google forms to R-statistical language for comprehensive statistical analysis. Descriptive statistics were used to summarize the respondents' demographics and KAP responses, while inferential statistics such as ANOVA were employed to identify significant associations within the data. Pearson Correlation was performed on obtained marks to identify the relationship among KAP responses. Pearson residual correlation was also performed on KAP related understanding of data.

Results

The KAP survey on fungal infections of pets and its zoonotic impact among pet owners and veterinarians revealed several key findings. A total of 90 individuals returned the completed questionnaires with their basic demographic information. These results highlight the critical need for targeted educational programs to improve pet owners' awareness and practices regarding fungal infections and their zoonotic potential.

Knowledge

There were 7 questions included in this section. Majority of the respondents answered these questions positively except question related to seriousness of health concern attached to fungal infections and requirement of humid environment for fungal growth (Fig. 1). Majority of the respondents agree on the need of hygiene to stop the fungal infections followed by the zoonotic potential of fungal infections. Furthermore, respondents understand the expected possible clinical signs of fungal infections.

Attitude

There were 6 questions included in this section. Majority of respondents in half of the questions strongly agreed and showed highly positive attitude while in other two questions related to contraction of disease majority respondents agreed and showed somewhat positive attitude (Fig. 2). Respondents showed division of attitude in response to the question related to importance of fungal infections when comparing with other diseases.

Practices

In this section, 7 questions were included with the responses showing frequency of practices being applied. Highest frequency of hand-washing was observed as compared to the application of pyodine scrub (Fig. 3). Around 20% of the respondents do not wear gloves at all while handling the pets

identified with fungal infection. On the other hand, there are around 10% respondents who do not look for clinical signs related to fungal infections whenever they are observing the pets.

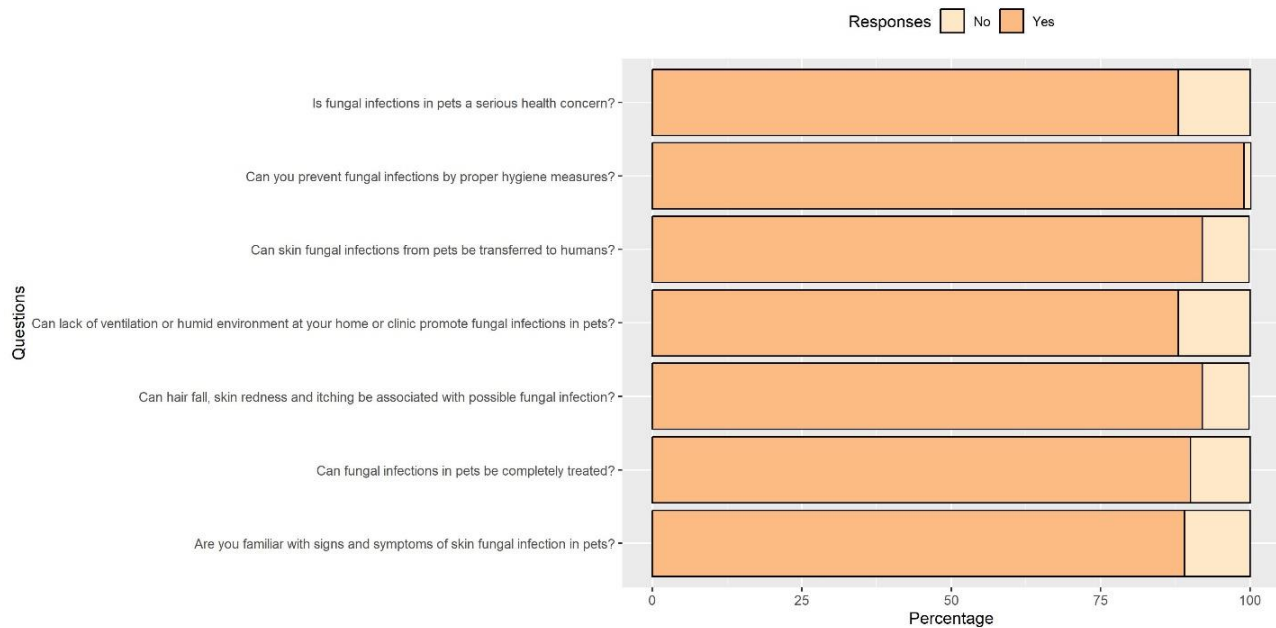


Fig. 1: Summary of the knowledge related questions and percentage of responses. Binary nominal categorical responses were used. While correct response was marked as 1 and wrong response was marked as 0.

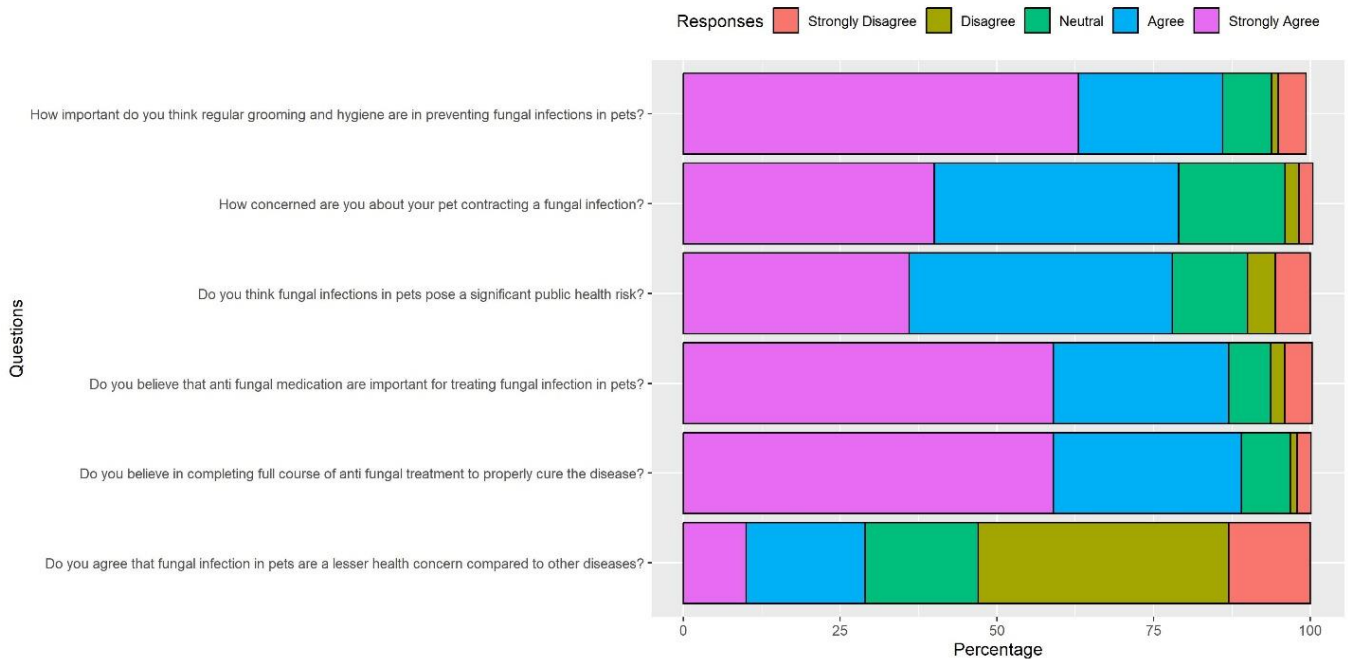


Fig. 2: Summary of the attitude related questions and percentage of responses. Ordinal categorical responses were used. While each response was marked with a numerical value ranging from 1-5. “Strongly disagree” was marked as 1 and “Strongly agree” was marked as 5.

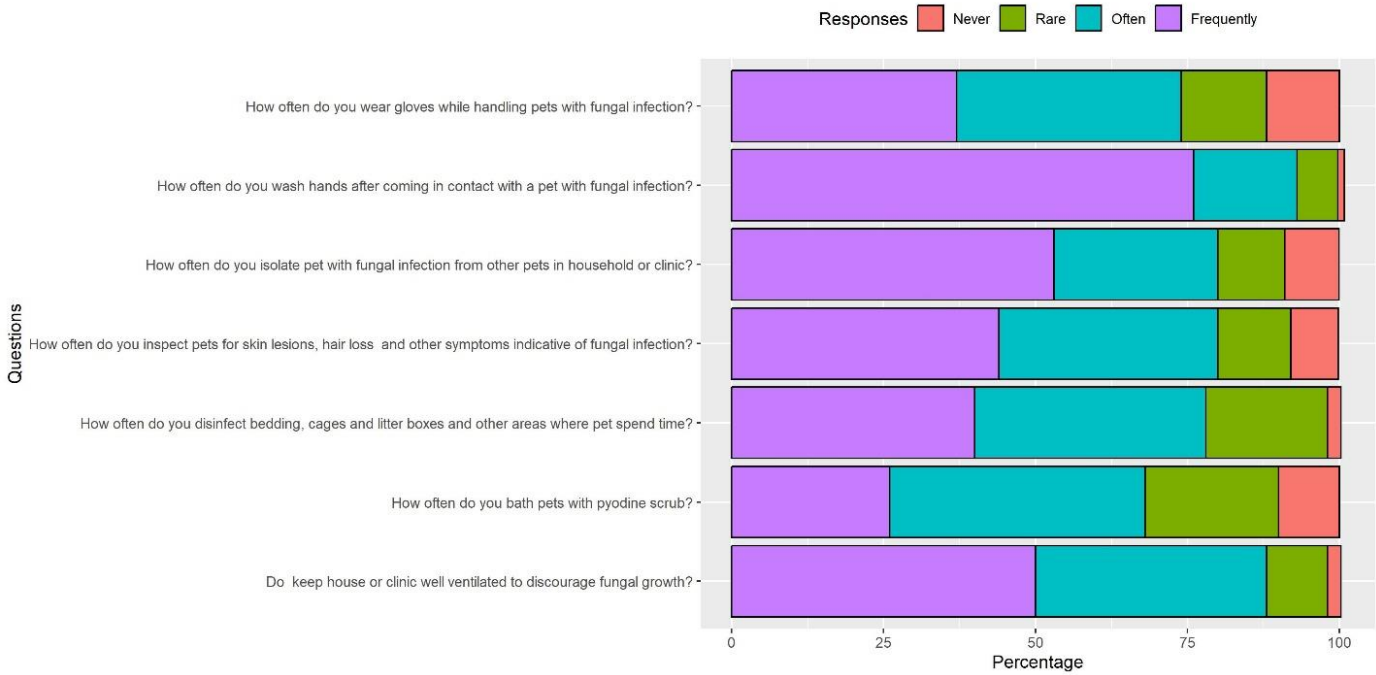


Fig. 3: Summary of the knowledge related questions and percentage of responses. Ordinal categorical responses were used. While each response was marked with a numerical value ranging from 1-4. “Never” was marked as 1 and “Frequently” was marked as 5.

Comparison with demographics

Upon comparing the marks obtained, it was revealed that attitude and practices were markedly different in both groups. Veterinarians obtained higher marks in both attitude and practices as compared to pet owners. On the other hand, veterinarians and pet owners showed no difference in the knowledge levels (Fig. 4).

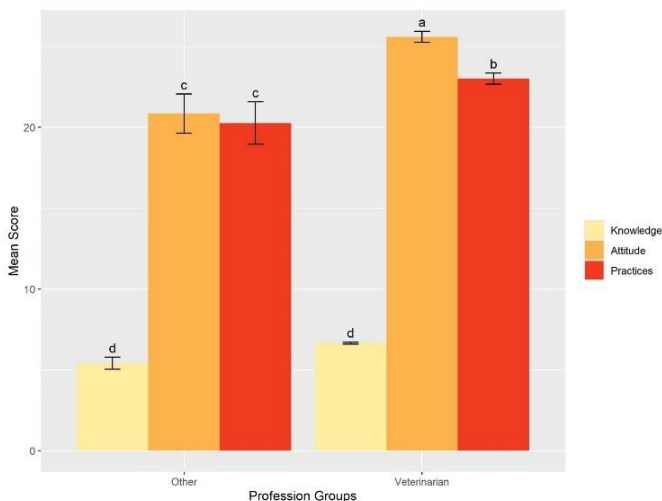


Fig. 4: Comparison of mean marks obtained by owners and veterinarians using ANOVA. Tukey HSD test was implied for post HOC tests.

Correlation among knowledge, attitude, and practices

To understand the correlation among knowledge, attitude, practices, two methodologies were utilized (Fig 6). Firstly, the Pearson’s residual correlation test was applied to compare the categories of understanding of KAP and visualized using

mosaic plot. This method shows low level of knowledge is highly correlated with the bad practices.

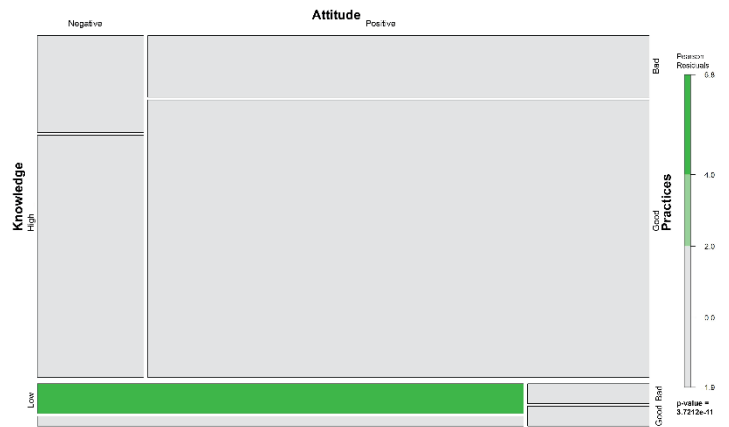


Fig. 5: Pearson’s residual correlation test was applied on the levels of categories of Knowledge (High/Low), Attitude (Positive/ Negative), and Practices (Good/Bad) and visualized using mosaic plot.

Secondly, Pearson correlation test was utilized to understand the correlation using marks obtained in these sections (Fig. 6). This test showed a significant ($p < 0.001$) and moderate correlation ($r > 0.1$) among knowledge, attitude, and practices sections. Correlation between knowledge and practices is moderate but found lower ($r = 0.35$) as compared to correlation between knowledge and attitude or between practices and attitude. ($r = 0.43$).

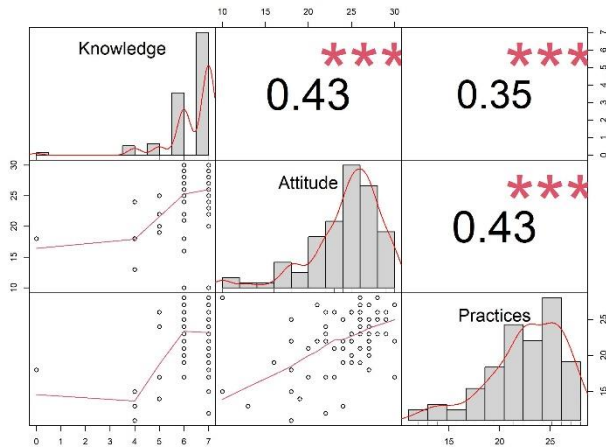


Fig. 6: Pearson's correlation test was utilized to test the correlation based on the marks obtained after analysis.

Discussion

Opportunistic fungi thrive in environments separate from their host and cause infections when they breach intact skin barriers or exploit immunological weaknesses or other debilitating conditions in the host (Casadevall and Pirofski, 2000). In contrast, pathogens are characterized by their ability to exploit and rely on the vertebrate host for completing their life cycle, obtaining nutrients, establishing a niche, and reproducing (Guarro et al, 1999; Jones et al, 2008; Seyedmousavi et al, 2015).

This study determined significant gaps in knowledge, attitudes, and practices between the two groups. Wright et al (2008) have reported that veterinarians had higher levels of awareness and compliance with preventive measures because of their professional exposure. Similarly, Mamun et al (2024) found that veterinarians had a higher skill set in evaluation and management of zoonotic diseases in comparison to pet owners. These findings are in accordance with previous studies.

The owners' and veterinarians' attitudes towards common fungal infections can clearly determine how diseases will be dealt with. Veterinarians' and pet owners' understanding can compromise the preventive measures and adherence to treatment protocols. In a previous study, Chermette et al (2008) emphasize the importance of proactive approach in dealing with fungal diseases. The regular monitoring and timely interventions can help reduce both the extent and impact of the infections.

The control measures implemented by both pet owners and veterinarians should have a direct impact on the occurrence of the fungal infections. Effective control measures include clean and appropriate living environments, proper veterinary attention, and follow up on treatments. For instance, Nagle (2006) reported that non-compliance or delays in these activities can cause outbreaks of treatable infections to occur, while increasing chances of transmission of the infections from animals to human contact. It is therefore critical that practices that cut across pet owners and veterinarians are communicated and understood.

Preventive care is widely accepted as essential for maintaining animal health and preventing disease (AAHA, 2011; Day et al, 2016). Specifically United Kingdom, it is reported that more than 30% of all veterinary appointments focus on preventive

care are more frequent than any other types (Robinson et al, 2016).

Despite the importance of these consultations, owner education has been undervalued by veterinary authorities and veterinary practitioners (Shaw et al, 2006; Shaw et al, 2008; AAHA, 2011; Robinson et al, 2016; Belshaw et al, 2018a, 2018b, 2018c; Corrigan et al, 2019; Pennelegion et al, 2020). To date, however, research directed to the quality and frequency of such interactions in the clinics has been scant (Shaw et al, 2006; Shaw et al, 2008; Belshaw et al, 2018a, 2018b, 2018c; Corrigan et al, 2019; Pennelegion et al, 2020). In a previous study, it was determined that owner education in Canada was a minor focus of wellness veterinary visits and the content of preventive care discussions vary with more emphasis on preventive care during primary vaccination appointments for juveniles than for adults (Belshaw et al, 2018b). However, it is certain that there are also differences between the two groups regarding their perception of important aspects in providing such services as mentioned in previous studies (AAHA, 2011; Belshaw et al, 2018a, 2018b, 2018c; Corrigan et al, 2019). Zanzani et al (2014) highlighted the positive impact of educational programs targeting pet owners. This study also provides the comparisons that showed the necessity for increased educational efforts aimed at pet owners to close the attitude gap and improve their practices.

In conclusion, this study shows the existence of gaps between the owners and veterinarians especially the use of gloves and regular checkups of owners. Addressing these gaps through comprehensive education and outreach programs is essential to improve pet health and reduce the risk of zoonotic transmission of fungal infections. By enhancing pet owners' understanding and practices, we can foster a more informed community that is better equipped to manage and prevent fungal infections in pets, thereby protecting both animal and human health.

Declaration of Competing Interest

The authors declare that they have no competing or conflict of interests.

Author Contributions:

Tayyaba Akhtar: Conceptualization, Methodology, formal analysis, Writing—original draft preparation. **Maryam Wasif:** Conceptualization, Methodology, formal analysis, Writing—original draft preparation. **Faiza Riaz:** Conceptualization, Methodology, Writing—original draft preparation. **Hina Faiqa:** Methodology, formal analysis, Writing—original draft preparation. **Javeria Nousheen:** Methodology, Writing—original draft preparation. **Rabia Malik:** Conceptualization, Methodology, formal analysis,

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