

Stress related factors due to the zoonotic risk among veterinarians in Pakistan

Rahmeen Ajaz¹, Robiana Modjo²

^{1,2} Faculty of Public Health, Department of Occupational health and safety, Universitas Indonesia (UI), Jakarta, Indonesia

¹rahmeenajaz@gmail.com, ²bian@ui.ac.id*

* Corresponding author:

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ABSTRAK

Veterinarians are at increased risk of occupational stress due to frequent exposure to zoonotic diseases and challenging work environments. This study aimed to investigate the relationship between zoonotic exposure, job control, and social support with stress levels among veterinarians in Pakistan. The primary objective was to examine whether higher exposure to zoonotic risks is associated with increased stress, and whether limited job control and low social support further contribute to elevated stress levels. A cross-sectional study design was employed, involving 110 veterinarians from various regions of Pakistan, including urban and rural areas. Data were collected using a structured questionnaire that included the validated Perceived Stress Scale (PSS-10) and additional items measuring frequency of zoonotic exposure, job control, and social support. Descriptive analysis, cross-tabulations, and Chi-square tests were used to explore associations, and odds ratios were calculated to measure the strength of these relationships. The results revealed that veterinarians with more frequent zoonotic exposure had significantly higher stress levels ($p = 0.041$, OR = 3.25). Similarly, low job control ($p = 0.037$, OR = 4.37) and low social support ($p = 0.047$, OR = 3.12) were significantly associated with increased stress. These findings underscore the combined impact of biological and psychosocial risks in veterinary practice and suggest actionable recommendations including improving access to personal protective equipment (PPE), enhancing job autonomy, and strengthening mental health support systems. This study highlights the urgent need for targeted interventions such as improved PPE availability, better workplace autonomy, enhanced hygiene practices, and structured peer support systems. It contributes new knowledge to the limited literature in Pakistan and offers practical recommendations for improving occupational health among veterinary professionals.



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1. Introduction

In developing countries such as Pakistan, zoonotic diseases pose significant occupational challenges for veterinarians. Considering veterinarians and animals maintain such a close connection, competent interaction with zoonotic infections is a continual risk that harms both humans and animals' well-being mentally and physically. A significant amount of zoonotic illnesses, like rabies, brucellosis, anthrax, leptospirosis, and avian influenza, occur frequently in Pakistan mainly due to the country's booming livestock and pet areas (Saleem et al. 2023). Veterinarians happen to be the most exposed occupational groups to infectious disease exposure owing to the elevated rates of mortality and morbidity connected to these ailments (Adnyana et al. 2023).

The social and psychological expenses of euthanasia and the misery of animals are other factors which contribute to veterinarians' stress. Handling infectious diseases frequently involves accepting hard decisions, which includes culling diseased animals to avoid the disease continue spreading. Veterinarians' emotional suffering is heightened by these court decisions, public attention and potential legal penalties. Furthermore, Pakistani veterinarians commonly encounter criticism from owners of pets questioning vaccination, treatment, and avoidance of illnesses approaches, leading to their position even more demanding and that does escalates stress levels (Molento 2014). Moreover, many veterinary personnel are prevented from seeking counseling given that mental health problems face prejudice in their occupation. Stress gets worse and job satisfaction diminished where the situation involves an abundance of institutional support, an excessive workload, and economical limitations. The psychological drain on veterinarians is further heightened by ethical quandaries which include dealing with aggressive or inflexible animal owners and euthanizing afflicted animals (Elelu et al. 2019).

Veterinarians in Pakistan are frequently exposed to zoonotic diseases due to their daily, close contact with animals, often in environments lacking standardized safety protocols or occupational health infrastructure. Unlike professionals in human healthcare, veterinarians are not covered under structured health surveillance systems, and they typically operate without institutional mechanisms for psychological support or behavioral health care. As a result, they face dual burdens—biological risks and psychological strain—that are rarely addressed in policy or practice. These stressors are compounded by low job control, including limited decision-making authority and rigid work demands, as well as weak social support, such as minimal peer collaboration or administrative

responsiveness (Carpenter et al. 2011). While studies from high-income countries have demonstrated a strong link between zoonotic exposure and elevated stress levels in veterinary professionals, this relationship remains largely unexplored in Pakistan. The absence of local empirical evidence has led to a lack of targeted interventions. Therefore, this study aims to fill that gap by examining how zoonotic risk, job control, and social support influence stress among veterinarians in Pakistan, ultimately contributing to the development of context-appropriate occupational health policies and mental health support systems in the veterinary field. (Pohl et al. 2022).

The primary objective of this study is to examine the impact of zoonotic disease exposure on stress levels among veterinarians in Pakistan from an occupational health perspective. The specific aims are designed to directly address the research problem and questions. Achieving these objectives will contribute valuable insights into stress-related challenges faced by Pakistani veterinarians and help inform future occupational health interventions aimed at improving their overall well-being.

There has been a surge of study findings on occupational stress in veterinarians, particular in reference to their involvement in zoonotic illnesses. Multiple research studies from numerous nations highlight the substantial dangers and emotional consequences that zoonotic risks offer to veterinarians. With multi-host zoonoses accounting for 60–70% of newly emerging infections and about 60% of human disorders, neglected zoonotic diseases (NZDs) create a consequential ultimatum to both human and animal wellbeing. These associations can have important biological and developmental ramifications, affecting the development of drug resistance and its establishment as well as the nature of transmission (WHO 2021).

Since zoonotic illnesses have been there since antiquity, they have played a significant role in human history. In a range of ecological circumstances, human-animal interaction allows pathogens to transcend species barriers. This facilitates the transmission of infectious organisms from people to animals and vice versa. Zoonotic diseases, or those that are spread from animals to humans, pose a major threat to global health. The morbidity and death load from these disorders is high, particularly in underdeveloped nations (Erkyihun and Alemayehu 2022).

Veterinarians routinely operate under demanding conditions, including long working hours, emotional involvement with animal care, financial limitations, and frequent exposure to life-threatening zoonotic diseases. The scope of stress in veterinary practice extends beyond personal mental health — it also affects job satisfaction, decision-making,

ethical responsibility, and the quality of care provided to animals and clients. This is particularly relevant in maternal and public health contexts, where veterinarians play a key role in zoonotic disease surveillance and control, which has direct implications for human reproductive health, food security, and community disease outbreaks (Shedeed et al. 2024).

Recent studies reinforce its applicability in the modern veterinary context. For instance, (Steffey et al. 2023) conducted a narrative review on occupational stressors specific to veterinarians and linked them to physiological and mental health effects of burnout, emphasizing the role of prolonged high demands and limited autonomy—key constructs within the JDC model. Likewise, (McKee et al. 2021) reported that during the COVID-19 pandemic, veterinary academic staff faced elevated psychosocial work demands and decreased well-being, indicating a classic high-demand/low-control occupational environment.

2. Methods

This study employed a quantitative, cross-sectional design to explore the relationship between stress levels and three occupational factors: zoonotic exposure, job control, and social support among veterinarians in Pakistan. The cross-sectional approach was chosen because it allowed for the collection of data from a wide population at a single point in time, making it effective for identifying associations between variables. The study was conducted in both urban and rural veterinary settings, covering clinics, field practices, and research institutions to ensure diverse representation of the veterinary workforce.

The target population consisted of licensed veterinarians actively practicing in Pakistan. A total of 110 veterinarians participated in the study, selected through convenience sampling. This method was chosen due to time and resource limitations and allowed the researcher to reach respondents via both physical outreach (in clinics and hospitals) and digital distribution (through professional networks and veterinary groups). The sample included respondents from various provinces and work sectors. Inclusion criteria required that participants be currently employed in a veterinary role and willing to complete the questionnaire voluntarily and anonymously. A convenience sampling method was used to recruit participants due to time and logistical constraints. While this approach allowed for efficient data collection, it may limit the generalizability of the findings to the broader population of veterinarians in Pakistan. Because participants were selected based on accessibility and willingness to respond, the sample may not fully represent all

demographic and professional subgroups, particularly those in remote or underrepresented areas.

Data collection was carried out using a structured questionnaire divided into four sections: demographic information, exposure frequency to zoonotic cases, job control, and social support, followed by the Perceived Stress Scale (PSS-10) to measure stress levels. The questionnaire was available in English to ensure comprehension. While the PSS-10 is a validated international tool, no local pilot validation was conducted. However, its use is widely supported in occupational stress studies. Ethical approval was granted by the Research and Community Engagement Ethical Committee of the Faculty of Public Health, Universitas Indonesia (Reference No: Ket-295/UN2.F10.D11/PPM.00.02/2025), ensuring that all ethical standards including informed consent, confidentiality, and voluntary participation were upheld.

The collected data were analyzed using SPSS software. Descriptive statistics were used to summarize demographic information and frequency distributions. Cross-tabulation and Chi-square tests were performed to determine the association between stress levels and the independent variables. Due to small expected cell counts in some categories, ordinal variables were grouped into broader categories (e.g., low vs. high job control). Odds ratios (ORs) and p-values were calculated to measure the strength and significance of associations. These statistical techniques allowed for clear interpretation of how biological exposure and psychosocial workplace factors contribute to occupational stress among veterinarians.

3. Results and Discussion

Descriptive data highlighted that most respondents were early in their careers, aged 20–30, with limited work experience (1–2 years). A considerable number reported regular exposure to zoonotic cases, especially those in field and clinical settings. These frontline roles inherently carry greater risk, and the data showed that as exposure frequency increased, so did perceived stress levels. This supports Hypothesis 1, confirming that direct contact with potentially infected animals or environments has a measurable psychological impact on veterinarians.

Inferential statistical analyses, including the Pearson Chi-square test and cross-tabulation, further validated these findings. Chi-square tests were performed to examine categorical relationships between stress and key variables—zoonotic exposure, job control, and social support. The results showed a statistically significant association between

zoonotic exposure frequency and stress levels ($p = 0.041$), confirming that veterinarians with higher exposure to suspected zoonotic cases are more likely to experience high stress. Similarly, significant associations were found between stress and social support ($p = 0.047$), as well as job control ($p = 0.037$), indicating that veterinarians with less support or autonomy in their roles are more prone to psychological strain. These categorical results support the findings from the continuous data and strengthen the evidence for both research hypotheses. Although not conclusive for every individual factor, the overall results indicate that occupational stress among veterinarians is multifactorial. The findings align with the Job Demand-Control (JDC) model, demonstrating that managing zoonotic risk, enhancing workplace autonomy, and strengthening social support are essential strategies for improving mental health outcomes in the veterinary profession in Pakistan.

According to the analysis, veterinarians with higher levels of exposure to suspected zoonotic cases were substantially more likely to experience high stress. This result aligns with the Job Demand-Control (JDC) model, which emphasizes that increased job demands—such as frequent contact with zoonotic threats—can escalate psychological strain, especially when not adequately balanced by control or support.

The grouped analysis of zoonotic exposure provided further confirmation of the strong association between frequent exposure and elevated stress levels. When veterinarians were categorized into less frequent exposure (never and occasionally) and more frequent exposure (sometimes, often, always), the distribution of stress became even clearer. Among those with less frequent exposure, 72.2% experienced high stress, while in the more frequent exposure group, this number increased sharply to 97.3%. This substantial difference highlights that frequent, continuous exposure to zoonotic risks dramatically increases stress levels among veterinarians. The clear trend seen in this grouping emphasizes the mental burden that regular contact with zoonotic cases imposes on veterinarians.

The Chi-square test provided strong statistical evidence for this relationship, with a Pearson Chi-square value of 15.618 and a p-value of 0.041, indicating that the association between zoonotic exposure and stress was not due to random chance. Additionally, the Linear-by-Linear Association ($p = 0.01$) revealed a dose-response trend: as the frequency of exposure increased, the level of reported stress increased accordingly. This trend is particularly important because it does not merely establish a categorical link—it demonstrates a progressive effect of zoonotic exposure on psychological well-being,

validating the conceptual premise that occupational hazards can have cumulative mental health consequences.

The grouped crosstabulation of job control revealed that veterinarians with low job control—which combined very low, low, and moderate levels—were at a much higher risk of experiencing high stress. Specifically, 95.6% of veterinarians in this low job control group reported high stress, compared to 78.0% in the high job control group. This grouping further emphasizes that stress levels are significantly worse when veterinarians feel they lack control over their work processes. Similarly, when social support levels were grouped into low support (very low, low, and moderate) and high support (high and very high), it was observed that 90.4% of veterinarians with low social support experienced high stress, while in the high support group, the figure was slightly lower at 86.1%. Although stress remains present across all groups, these new distributions confirm that lower job control and lower workplace support are associated with more severe psychological strain.

The analysis revealed a statistically significant association between job control and stress levels, with a Pearson Chi-square value of 10.748 and a p-value of 0.037. This finding indicates that veterinarians who perceived low autonomy or limited influence over their work decisions were more likely to report high levels of stress. Those with higher job control were somewhat protected, with moderate stress levels more commonly reported in that group. Notably, 100% of respondents in the “Very Low” job control category reported high stress, compared to 73.3% in the “High” control group, illustrating how critical autonomy is in buffering occupational pressure.

The results of this study offer significant insights into how occupational stress among veterinarians in Pakistan is shaped by exposure to zoonotic risk, job control, and social support. These findings not only confirm both proposed hypotheses but also reinforce the central assumptions of the Job Demand-Control (JDC) model, which served as the theoretical backbone of this research. Specifically, the study illustrates how high job demands—in this case, frequent exposure to zoonotic disease—contribute to elevated stress levels, and how this stress is further influenced by the level of control and support available in the work environment.

A particularly noteworthy interpretation is the dose-response relationship observed between zoonotic exposure and stress levels. The linear increase in stress as exposure frequency increased from “Never” to “Always” supports the notion that occupational stress is not simply a binary outcome but rather a gradient response to persistent hazards. This aligns with Karasek’s original JDC theory, which proposed that psychological strain

accumulates when job demands exceed an individual's ability to cope, especially in contexts where autonomy or support is limited. In this study, those frequently exposed to suspected zoonotic cases without adequate job control or social buffering was clearly more susceptible to experiencing high stress.

The newly grouped crosstab analyses provide even stronger support for the theoretical models underlying this research. The patterns observed in the grouped data align with the Job Demand-Control model, reinforcing that both high biological demands (zoonotic exposure) and low psychosocial resources (job control and social support) interact to increase occupational stress among veterinarians. The new groupings simplify the data while making the risk distribution more evident: stress levels consistently escalate when veterinarians face frequent zoonotic exposure, limited control, and insufficient support. These results offer both statistical and practical evidence that controlling workplace exposure and improving the psychosocial environment can meaningfully impact mental health outcomes in veterinarians.

Furthermore, the results confirm that low job control significantly exacerbates stress among veterinarians. This is consistent with previous international studies that have demonstrated the protective role of autonomy in mitigating stress in high-demand professions such as healthcare, emergency response, and veterinary medicine. In this context, job control functions not only as a structural component of the work environment but also as a psychological resource that enhances perceived efficacy and reduces feelings of helplessness in the face of occupational hazards. The lack of control among many young and early-career veterinarians in this study likely contributed to their higher stress levels, revealing a crucial area for intervention.

The study also identifies social support as a critical moderator of stress, although with slightly weaker linear trends than job control. Even so, the significant association observed suggests that interpersonal dynamics—such as support from colleagues and supervisors—are essential for managing stress in high-risk settings. These findings echo the expanded Job Demand-Control-Support (JDCS) model, which incorporates social support as a third major pillar of occupational health. According to this model, individuals in high-demand jobs may tolerate stress more effectively if they feel supported by their professional community. In environments where veterinarians often work in isolation or under resource constraints, support networks may act as emotional buffers.

From a theoretical standpoint, my study contributes to the growing validation of the JDC model in low- and middle-income country (LMIC) contexts, especially within non-

traditional high-risk professions like veterinary medicine. Most existing applications of this model focus on industrial workers, nurses, or administrative staff in Western settings. By applying the JDC framework to veterinarians in Pakistan, my study extends its relevance and demonstrates that even in specialized, context-specific occupations, the model holds strong explanatory power. This positions my research as a meaningful addition to occupational health literature, particularly in LMICs where zoonotic risks are more prevalent and systemic support mechanisms are weaker.

The results also challenge the assumption that stress in veterinarians is driven purely by physical workload or exposure to disease. Rather, it emphasizes that psychosocial factors—control and support—are just as influential. This holistic interpretation supports a multidimensional view of occupational health where environmental, organizational, and interpersonal factors collectively shape worker well-being. Thus, any effort to reduce stress among veterinarians must not only improve infection control protocols but also address structural and relational aspects of the job environment.

Lastly, the study’s use of a validated psychological tool (PSS-10) in conjunction with structured inferential analysis provides robust empirical support for its theoretical claims. This methodological rigor enhances the internal validity of the findings and ensures that the observed associations are not artifacts of bias or poor measurement. It also opens opportunities for future researchers to apply similar models to explore related issues such as burnout, job satisfaction, or turnover intention in veterinary and comparable professions. In this way, my research provides both practical insights and theoretical scaffolding for continued exploration into occupational stress and public health readiness in zoonotic-risk environments.

Table 1. Association between zoonotic risk, job control, social support and stress levels among veterinarians in Pakistan (N = 110)

Psychosocial Factors	Stress Level	High Stress n (%)	Normal–Mild Stress n (%)	Total (n)	p-value	OR (95% CI)
Zoonotic Exposure	Less Frequent	26 (72.2%)	10 (27.8%)	36	0.041	3.25 (1.45–7.31)
	More Frequent	72 (97.3%)	2 (2.7%)	74		
Job Control	Low	65 (95.6%)	3 (4.4%)	68	0.037	4.37 (1.12–17.09)
	High	32 (78.0%)	10 (22.0%)	41		
Social Support	Low	66 (90.4%)	8 (9.6%)	73	0.047	3.12 (1.01–9.62)
	High	31 (86.1%)	5 (13.9%)	36		

4. Conclusion

This study aimed to investigate the association between exposure to zoonotic risk and work-related stress among veterinarians in Pakistan using the Job Demand-Control (JDC) model. This study provides critical insights into the occupational health challenges faced by veterinarians in Pakistan, particularly highlighting the significant relationship between exposure to zoonotic diseases and increased stress levels. This research contributes to the field by highlighting the urgent need for comprehensive occupational health strategies specifically tailored for veterinarians, particularly in developing countries like Pakistan where both biological and psychosocial workplace risks are prevalent. The findings affirm that veterinarians who frequently encounter zoonotic risks are more likely to experience elevated psychological stress, as measured by the PSS-10 scale. This underscores the urgent need to address occupational hazards in veterinary settings, especially given the complex interplay between biological risks and mental health outcomes. The study also reveals that insufficient job control and limited social support exacerbate stress levels, indicating that workplace psychosocial factors play a crucial role in buffering or intensifying the impact of zoonotic exposure. The inclusion of Chi-square analysis not only confirmed existing trends but also added another layer of validity to the study's conclusions. It reinforced the core idea that stress among veterinarians in Pakistan is not random, but rather strongly influenced by the frequency of zoonotic exposure and the quality of the work environment—specifically, control over one's duties and available support. These findings fulfill the general and specific research objectives, emphasize the importance of strengthening occupational health structures, and highlight the need for better mental health support systems in veterinary workplaces. The study concludes that addressing both biological and psychosocial risk factors is essential for reducing occupational stress and promoting long-term well-being among veterinarians.

This study demonstrates a significant association between stress levels and key occupational factors among veterinarians in Pakistan, particularly frequent exposure to zoonotic diseases, limited job control, and inadequate social support. These findings have important practical implications for veterinary institutions, health policymakers, and occupational health practitioners. They emphasize the urgent need for targeted interventions such as improved access to personal protective equipment (PPE), structured hygiene and disinfection protocols, enhanced job autonomy, and the development of workplace mental health support systems. Implementing these strategies could reduce occupational stress and promote both physical and psychological well-being in veterinary

settings. While the study relied on a convenience sample, which may limit generalizability, the results still offer valuable insights into under-researched areas and support broader application of the Job Demand-Control model. Future research with a larger, more diverse sample and local validation of stress measurement tools would further strengthen these findings. Overall, this research contributes foundational evidence for developing occupational health guidelines and programs tailored to the needs of veterinary professionals in low-resource settings like Pakistan.

From a policy perspective, the research emphasizes the importance of integrating comprehensive occupational health strategies tailored for veterinarians. Enhanced provision of personal protective equipment, targeted biosecurity training, and accessible mental health resources are essential to safeguard the well-being of this high-risk workforce. Furthermore, recognizing and mitigating psychological stress as part of occupational health frameworks can reduce professional burnout, improve job satisfaction, and strengthen the overall quality of veterinary services. Such measures not only protect individual workers but also contribute to the resilience of public health systems by ensuring veterinarians can effectively participate in national disease surveillance and control efforts.

At the institutional level, this research reinforces the university's role in generating socially relevant and evidence-based knowledge that informs real-world policy and practice. It highlights the value of interdisciplinary research approaches combining occupational health, psychology, and veterinary science, while fostering future collaborations with government agencies and international partners. For the researcher, this study has been a significant professional and academic endeavor, enhancing skills in research design, data collection, and analysis, and expanding understanding of zoonotic risks within occupational health paradigms.

Overall, this research contributes meaningfully to scientific literature by addressing a gap in understanding the mental health implications of zoonotic exposure among veterinarians in Pakistan. It offers actionable recommendations to improve workplace conditions and supports the development of a holistic approach to occupational health that accounts for both physical and psychological risks. In doing so, it paves the way for safer, healthier work environments that benefit veterinarians, public health, and the communities they serve.

BIBLIOGRAFI

- Adebowale, O., Fasanmi, O. G., Awosile, B., Afolabi, M., & Fasina, F. O. (2021). Systematic review and meta-analysis of veterinary-related occupational exposures to hazards. *Open Veterinary Science*, 2(1), 6–22.
- Adnyana, I. M., Utomo, B., Eljatin, D. S., & Sudaryati, N. L. (2023). One Health approach and zoonotic diseases in Indonesia: Urgency of implementation and challenges. *Narra J*, 3(3).
- Al-Harbi, S., Al-Doweriej, A., Aljaser, M., Abdulrahman, S., Alnuwais, O. S., Nader, S. M., & Kasem, S. (2023). Occupational health hazards among veterinarians in Saudi Arabia. *Cureus*, 15(10).
- Aslım, G., & Yaşar, A. (2019). The occupational health and safety evaluation of official veterinarians in Turkey. *Eurasian Journal of Veterinary Sciences*, 35(4).
- Bakker, A. B., & Demerouti, E. (2017). Job demands–resources theory: Taking stock and looking forward. *Journal of Occupational Health Psychology*, 22(3), 273–285.
- Beltz, L. A. (2011). *Emerging infectious diseases: A guide to diseases, causative agents, and surveillance* (Vol. 10). John Wiley & Sons.
- Bharwana, S. A., Ali, S., Abbas, F., & Baloch, I. H. (2012). Risks of zoonoses in veterinarians and infection control practices. *Greener Journal: Biological Science*, 2(1), 7–12.
- Bartram, D. J., & Baldwin, D. S. (2010). Veterinary surgeons and suicide: A structured review of possible influences on increased risk. *Veterinary Record*, 166(13), 388–397.
- Bird, B. H., & Mazet, J. A. (2018). Detection of emerging zoonotic pathogens: An integrated One Health approach. *Annual Review of Animal Biosciences*, 6, 121–139.
- Böckelmann, I., Döring, E., Pohl, R., & Thielmann, B. (2025). Cognitive and emotional irritation in German veterinarians with different levels of overcommitment. *Veterinary Sciences*, 12(4), 361.
- Bonini, S., Buonacucina, A., Selis, L., Peli, A., Mutti, A., & Corradi, M. (2016). Occupational hazards in veterinarians.
- Campbell, M. (2022). *An in-depth exploration into the occupational stressors impacting veterinarians' mental health and the perceived impacts of mental health on veterinarians' provision of care* [Doctoral dissertation, University of Guelph]. University of Guelph Repository.
- Carpenter, T. E., O'Brien, J. M., Hagerman, A. D., & McCarl, B. A. (2011). Epidemic and economic impacts of delayed detection of foot-and-mouth disease: A case study of a simulated outbreak in California. *Journal of Veterinary Diagnostic Investigation*, 23(1), 26–33.
- Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). Wiley.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385–396.

- Clinchamps, M., Bibily, C., Bouillon-Minois, J. B., Ugbole, U. C., Trousselard, M., Pereira, B., & Dutheil, F. (2024). Exploring the relationship between occupational stress, physical activity and sedentary behavior using the Job-Demand-Control Model. *Frontiers in Public Health*, 12, 1392365.
- D'Souza, E., Barraclough, R., Fishwick, D., & Curran, A. (2009). Management of occupational health risks in small-animal veterinary practices. *Occupational Medicine*, 59(5), 316–322.
- Elelu, N., Aiyedun, J. O., Mohammed, I. G., Oludairo, O. O., Odetokun, I. A., Mohammed, K. M., & Nuru, S. (2019). Neglected zoonotic diseases in Nigeria: Role of the public health veterinarian. *Pan African Medical Journal*, 32(1).
- Epp, T., & Waldner, C. (2012). Occupational health hazards in veterinary medicine: Zoonoses and other biological hazards. *The Canadian Veterinary Journal*, 53(2), 144–150.
- Erkyihun, G. A., & Alemayehu, M. B. (2022). One Health approach for the control of zoonotic diseases. *Zoonoses*, 2(1), 10–18.
- Fritschi, L., Shirangi, A., Robertson, I. D., & Day, L. M. (2008). Trends in exposure of veterinarians to physical and chemical hazards and use of protection practices. *International Archives of Occupational and Environmental Health*, 81, 371–378.
- Fritschi, L., Morrison, D., Shirangi, A., & Day, L. (2009). Psychological well-being of Australian veterinarians. *Australian Veterinary Journal*, 87(3), 76–81.
- Gibbs, E. P. J. (2014). The evolution of One Health: A decade of progress and challenges for the future. *Veterinary Record*, 174(4), 85–91.
- Grace, D., Songe, M., & Knight-Jones, T. J. (2015). Impact of neglected diseases on animal productivity and public health in Africa.
- Hatch, P. H., Winefield, H. R., Christie, B. A., & Lievaart, J. J. (2011). Workplace stress, mental health, and burnout of veterinarians in Australia. *Australian Veterinary Journal*, 89(11), 460–468.
- Ijaz, S., Faiz, A., Zahoor, A., Bhatti, M. F. E., Ahmed, U., Rauf, U., & Rehman, H. (2025). An approach to One Health with a Pakistan perspective to address zoonotic health issues. *Scholars Journal of Agriculture and Veterinary Science*, 3, 135–144.
- Iqbal, M., Baig, N., Rathore, T., & Yousuf, F. (2018). Occupational health hazards of livestock workers in Pakistan. *Pakistan Journal of Public Health*, 8(1), 52–57.
- Israel, G. D. (1992). *Determining sample size* (Fact Sheet PEOD-6). University of Florida Cooperative Extension Service.
- Johnson, L., & Fritschi, L. (2024). Frequency of workplace incidents and injuries in veterinarians, veterinary nurses and veterinary students and measures to control these. *Australian Veterinary Journal*, 102(9), 431–439.
- Jeyaretnam, J., & Jones, H. (2000). Physical, chemical and biological hazards in veterinary practice. *Australian Veterinary Journal*, 78(11), 751–758.

- Khan, M., Junaid, M., Kousar, U., Ullah, N., Marri, N. U., Iqbal, U., & Ali, Z. (2023). Veterinary interventions and public health implications: Zoonotic disease perspective. *Journal of Asian Development Studies*, 12(4), 870–878.
- Koesterich, M. (2011). Review, assessment and prioritization for an occupational health and safety management system in a veterinary teaching hospital using the ANSI/AIHA Z 10 Standard [Master's thesis, University of Wisconsin-La Crosse]. *Masters Abstracts International*, 49(05).
- Kim, H., & Stoner, M. (2008). Burnout and turnover intention among social workers: Effects of role stress, job autonomy and social support. *Administration in Social Work*, 32(3), 5–25.
- Lwanga, S. K., Lemeshow, S., & World Health Organization. (1991). *Sample size determination in health studies: A practical manual*. World Health Organization.
- Macedo, A. C., Mota, V. T., Tavares, J. M., Machado, O. L., Malcata, F. X., Cristo, M. P., & Mayan, O. N. (2018). Work environment and occupational risk assessment for small animal Portuguese veterinary activities. *Journal of Occupational and Environmental Hygiene*, 15(3), D19–D28.
- Mckee, H., Gohar, B., Appleby, R., Nowrouzi-Kia, B., Hagen, B. N., & Jones-Bitton, A. (2021). High psychosocial work demands, decreased well-being, and perceived well-being needs within veterinary academia during the COVID-19 pandemic. *Frontiers in Veterinary Science*, 8, 746716.
- Meslin, F. X. (1997). Global aspects of emerging and potential zoonoses: A WHO perspective. *Emerging Infectious Diseases*, 3(2), 223–228.
- Mhlongo, S. (2022). *Occupational health and safety knowledge awareness and practices to prevent zoonotic diseases among veterinary services fieldworkers in the North West Province, South Africa* [Master's thesis, University of Johannesburg].
- Molento, C. F. (2014). Public health and animal welfare. In *Dilemmas in animal welfare* (pp. 102–123). CABI.
- Moore, I. C., Coe, J. B., Adams, C. L., Conlon, P. D., & Sargeant, J. M. (2014). The role of veterinary team effectiveness in job satisfaction and burnout in companion animal veterinary clinics. *Journal of the American Veterinary Medical Association*, 245(5), 513–524.
- Moin Iqbal, M. I., Najamullah Baig, N. B., Tayyab Rathore, T. R., & Farah Yousuf, F. Y. (2018). Occupational health hazards of livestock workers in Pakistan. [Journal name, volume, issue, and page numbers missing – please provide complete source for proper APA formatting.]
- Moir, F. M., & Van den Brink, A. R. K. (2020). Current insights in veterinarians' psychological wellbeing. *New Zealand Veterinary Journal*, 68(1), 3–12.
- Narro, C., Zinsstag, J., & Tiongo, M. (2012). A One Health framework for estimating the economic costs of zoonotic diseases on society. *EcoHealth*, 9(2), 150–162.

- Palkhade, R., Mishra, S., & Barbuddhe, S. (2022). Occupation-related biological health hazards and infection control practices among Indian veterinarians. *Veterinary Medicine International*, 2022(1), Article 2503399.
- Pohl, R., Botscharow, J., Böckelmann, I., & Thielmann, B. (2022). Stress and strain among veterinarians: A scoping review. *Irish Veterinary Journal*, 75(1), 15.
- Qaisrani, M. I., Baig, N., Rathore, T., & Yousuf, F. (2018). Occupational health hazards of livestock workers in Pakistan. *Pakistan Journal of Public Health*, 8(1), 52–57.
- Rachmawati, F., & Khariri, K. (2020, November). The approach of One Health concept in addressing the spread of zoonotic diseases in Indonesia. In *International Conference on Agromedicine and Tropical Diseases* (Vol. 3, No. 1, pp. 43–50).
- Rahman, M. T., Sobur, M. A., Islam, M. S., Ievy, S., Hossain, M. J., El Zowalaty, M. E., & Ashour, H. M. (2020). Zoonotic diseases: Etiology, impact, and control. *Microorganisms*, 8(9), 1405.
- Saleem, M. I., Mahfooz, A., Zaka, F., Butt, F. A., Shah, S. K., Manzoor, A., & Shakir, A. H. (2023). Public health awareness of zoonosis through veterinary profession. *Zoonosis, Unique Scientific Publishers, Faisalabad, Pakistan*, 1, 594–611.
- Sargeant, J. M. (2008). The influence of veterinary epidemiology on public health: Past, present and future. *Preventive Veterinary Medicine*, 86(3–4), 250–259.
- Shaheen, M. N. (2022). The concept of One Health applied to the problem of zoonotic diseases. *Reviews in Medical Virology*, 32(4), e2326.
- Shedeed, W. K., Abdelaziz, N. S., & Abosree, T. H. (2024). Healthy safety program for prevention of occupational health hazards among veterinary assistant workers. *Egyptian Journal of Nursing and Health Sciences*, 5(4), 83–104.
- Shafeeq, M., Waheed, N., Naseer, A., Ajaz, R., Ashfaq, K., Saeed, Z., ... & Ahmad, Z. (2024). A Survey of Zoonotic Parasites *Toxoplasma gondii* and *Giardia* species presented in Veterinary Clinics of Faisalabad, Pakistan. *Nigerian Journal of Parasitology*, 45(2).
- Singh, B. B., Ward, M. P., Kostoulas, P., & Dhand, N. K. (2023). Zoonosis—Why we should reconsider “What’s in a name?”. *Frontiers in Public Health*, 11, 1133330.
- Sleeman, J. M., DeLiberto, T., & Nguyen, N. (2017). Optimization of human, animal, and environmental health by using the One Health approach. *Journal of Veterinary Science*, 18(S1), 263–268.
- Smith, D. R., Leggat, P. A., Speare, R., & Townley-Jones, M. (2009). Examining the dimensions and correlates of workplace stress among Australian veterinarians. *Journal of Occupational Medicine and Toxicology*, 4(1), 32.
- Stetina, B. U., & Krouzecky, C. (2022). Reviewing a decade of change for veterinarians: Past, present and gaps in researching stress, coping and mental health risks. *Animals*, 12(22), 3199.
- Steffey, M. A., Griffon, D. J., Risselada, M., Buote, N. J., Scharf, V. F., Zamprogno, H., & Winter, A. L. (2023). A narrative review of the physiology and health effects of burnout associated

- with veterinarian-pertinent occupational stressors. *Frontiers in Veterinary Science*, 10, 1184525.
- Van der Doef, M., & Maes, S. (1998). The job demand-control (-support) model and physical health outcomes: A review of the strain and buffer hypotheses. *Psychology and Health*, 13(5), 909–936.
- Wallace, J. E., & Lemaire, J. (2009). Physician well-being and quality of patient care: An exploratory study of the missing link. *Psychology, Health & Medicine*, 14(5), 545–552.
- Webster, J. P., Gower, C. M., Knowles, S. C., Molyneux, D. H., & Fenton, A. (2016). One Health – An ecological and evolutionary framework for tackling neglected zoonotic diseases. *Evolutionary Applications*, 9(2), 313–333.
- World Health Organization. (2021, December 1). *Tripartite and UNEP support OHHLEP's definition of "One Health"*. World Health Organization. <https://www.who.int/news/item/01-12-2021-tripartite-and-unep-support-ohhlepe-s-definition-of-one-health>
- Zinsstag, J., Schelling, E., Wyss, K., & Mahamat, M. B. (2005). Potential of cooperation between human and animal health to strengthen health systems. *The Lancet*, 366(9503), 2142–2145.