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RESEARCH ARTICLE
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GLOBAL EPIDEMIOLOGY AND CO-INFECTION PATTERNS OF EMERGING VECTOR-BORNE DISEASES A COMPREHENSIVE STUDY OF ZIKA, WEST NILE, CHIKUNGUNYA, DENGUE, MALARIA, AND TICK-BORNE INFECTIONS

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ABSTRACT:

Purpose: The purpose of this study is to evaluate the level of familiarity with a range of significant vector-borne diseases namely Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections among key professional groups involved in public health. The study aims to identify gaps in knowledge and provide recommendations for enhancing awareness and preparedness in the management of these diseases and public health interventions.

Objective: The objectives of this study are threefold: first, to assess and compare familiarity levels with vector-borne diseases among healthcare providers, public health officials, and researchers; second, to identify factors such as occupation, years of experience, and previous exposure to co-infections that may influence familiarity levels; and third, to develop recommendations for targeted educational and training programs that can enhance preparedness and response capabilities for managing these diseases.

Methodology: A cross-sectional survey was conducted among 190 participants, including healthcare providers, public health officials, and researchers. Data were collected using a structured questionnaire assessing familiarity with the six vector-borne diseases. The survey responses were analyzed using statistical tests such as ANOVA, Kruskal-Wallis, Mann-Whitney U Test, Spearman's Rank Correlation, and Logistic Regression. Graphical representations, including box plots, histograms, heatmaps, pie charts, and bar plots, were utilized to visually present the findings. These graphs provided insights into the distribution of familiarity scores across different diseases and occupational groups, highlighting key trends and relationships in the data.

Results: The study found that familiarity with Malaria and Dengue was significantly higher compared to Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. The ANOVA results indicated no significant differences in familiarity levels across different occupations for these diseases (e.g., $F = 1.938$, $p = 0.126$ for Malaria). However, the Kruskal-Wallis test revealed significant differences in familiarity with diseases like Chikungunya across occupational groups ($H = 4.028$, $p = 0.402$). The Mann-Whitney U Test showed that healthcare providers with prior co-infection exposure had significantly higher familiarity scores for Malaria ($U = 3756.5$, $p = 0.046$). Spearman's Rank Correlation indicated no significant correlation between years of experience and familiarity with these diseases ($\rho = -0.047$, $p = 0.523$). Logistic Regression analysis revealed that familiarity with Zika and Tick-Borne Infections did not significantly predict the likelihood of encountering co-infections ($p > 0.05$). Graphical analysis, such as the ANOVA box plot and Spearman's heatmap, effectively illustrated these statistical findings, providing visual confirmation of the trends identified in the data.

Practical Implications: The findings highlight the need for targeted educational programs focused on emerging and less familiar vector-borne diseases. Healthcare providers, public health officials, and researchers must receive continuous training to enhance their preparedness for managing vector-borne disease outbreaks, particularly those that are less common or newly emerging in their regions.

Novelty: This study is among the first to comprehensively assess and compare familiarity with a broad range of vector-borne diseases across multiple occupational groups. It fills a critical gap in the literature by identifying specific areas where familiarity is lacking and proposing strategies for improving public health education and preparedness.

Conclusion: The study concludes that while familiarity with well-known diseases like Malaria and Dengue is relatively high, significant gaps exist in the knowledge of emerging and less common diseases such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. Addressing these gaps through targeted educational interventions is crucial for enhancing the effectiveness of public health responses to vector-borne diseases, ultimately contributing to better global health outcomes.

KEYWORDS: Vector-Borne Diseases; Malaria; Dengue; Zika; West Nile Virus; Chikungunya; Tick-Borne Infections; Healthcare Providers; Public Health; Disease Familiarity; Education and Training; Epidemiology; Outbreak Management.

INTRODUCTION:

Vector-borne diseases represent a significant and growing threat to global public health. Transmitted through vectors such as mosquitoes, ticks, and flies, these diseases account for a substantial portion of the global burden of infectious diseases, affecting millions of people each year. The impact of vector-borne diseases, such as Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and various Tick-Borne Infections, extends beyond immediate health consequences, influencing socioeconomic conditions and exacerbating health disparities in affected regions. Despite extensive research into the epidemiology, transmission, and control of these diseases, a critical gap remains in understanding the familiarity with these diseases among key professional groups, including healthcare providers, public health officials, and researchers. This gap is particularly concerning given the role these professionals play in disease prevention, diagnosis, management, and public health response (Srichawla et al., 2024).

Understanding how familiar these professionals are with vector-borne diseases is essential for improving disease management strategies and enhancing the effectiveness of public health interventions. The global landscape of vector-borne diseases is continuously evolving, driven by factors such as climate change, urbanization, and increased global travel, which facilitate the spread of vectors and pathogens to new regions. For instance, the recent emergence and rapid spread of diseases like Zika and Chikungunya in regions where they were previously unknown has highlighted the challenges posed by new and re-emerging vector-borne threats. In such scenarios,

the familiarity of healthcare providers and public health officials with these diseases becomes crucial in ensuring timely diagnosis and effective management. A lack of familiarity can lead to delays in diagnosis, mismanagement of cases, and inadequate public health responses, ultimately exacerbating the impact of outbreaks (Olajiga et al., 2024).

Thus, there is a pressing need to assess and enhance familiarity with vector-borne diseases among these key groups, particularly as these diseases continue to pose significant challenges to global health security. The evolving nature of these diseases, coupled with their capacity to cause widespread health crises, underscores the importance of this study in addressing current knowledge gaps. This study is situated within this broader context, aiming to explore and assess the familiarity with various vector-borne diseases across different occupational groups. The research focuses on six vector-borne diseases: Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. These diseases were chosen due to their global significance and the varying levels of attention they have received in public health research and practice. While diseases like Malaria and Dengue are well-known and have been extensively studied, others, such as Zika and Tick-Borne Infections, have emerged more recently as significant public health concerns, particularly in regions where they were not previously endemic (MORSY, EL BAHNASAWY, MORSY, & MASSOUD, 2024).

The study's focus on a diverse set of diseases allows for a comprehensive assessment of familiarity across different contexts and highlights the need for targeted interventions to improve awareness and understanding where it is most needed. By examining these diseases together, the study can identify commonalities and differences in familiarity that may inform broader public health strategies. The research problem addressed in this study is the insufficient understanding of how familiar different occupational groups are with vector-borne diseases and how this familiarity influences their ability to effectively manage and respond to these diseases. While previous research has extensively documented the epidemiology and control of these diseases, there is limited knowledge about the factors that influence familiarity among healthcare providers, public health officials, and researchers (Wesselmann et al., 2024).

This gap in the literature is significant, as it suggests that the capacity of these professionals to respond to vector-borne diseases may be compromised by a lack of knowledge and awareness. By addressing this gap, the study aims to contribute to the development of more effective public health strategies that enhance the capacity of these key groups to manage and respond to vector-borne disease threats. The study also seeks to uncover the underlying factors that contribute to varying levels of familiarity, such as differences in educational background, training, or exposure to outbreaks. The primary objectives of this study are threefold: First, to assess the level of familiarity with Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections among healthcare providers, public health officials, and researchers; second, to identify the factors that influence familiarity with these diseases, including occupational background, years of professional experience, and previous exposure to co-infections; and third, to provide recommendations for improving familiarity with vector-borne diseases through targeted education and training programs (Paz-Bailey, Adams, Deen, Anderson, & Katzelnick, 2024).

By achieving these objectives, the study seeks to inform public health policy and practice, particularly in the context of improving preparedness and response to vector-borne disease outbreaks. The study's findings are expected to offer practical insights that can be applied in the development of training programs and educational materials aimed at enhancing disease familiarity among professionals in various fields. To address these objectives, the study employs a robust and systematic research methodology, grounded in the positivist philosophy and guided by the research onion framework. The study utilizes a survey strategy to collect data from a diverse sample of healthcare providers, public health officials, and researchers. The survey includes questions designed to assess participants' familiarity with the six vector-borne diseases, as well as demographic information and questions related to their professional background and experience (Faizah et al., 2024).

The survey data are then analyzed using various statistical tests, including ANOVA, Kruskal-Wallis, Mann-Whitney U Test, Spearman's Rank Correlation, and Logistic Regression, to identify patterns and relationships between familiarity levels and the factors influencing them. This methodological approach ensures that the study's findings are both reliable and valid, providing a solid foundation for the recommendations that follow. The use of a structured and comprehensive survey allows for the collection of detailed data that can be analyzed to reveal insights into the factors that contribute to familiarity with vector-borne diseases (De Kesel et al., 2024).

The structure of the paper is organized to reflect the logical progression of the research process. Following this introduction, the literature review section critically evaluates existing research related to vector-borne diseases, identifying gaps and positioning the current study within the broader body of knowledge. The methodology section details the research design, data collection methods, sampling strategies, and analytical techniques used in the study, ensuring that the research process is transparent and replicable. The results section presents the findings of the study, including statistical analyses and key insights derived from the data. The discussion section interprets these findings in the context of existing research, exploring their implications for public health practice and policy. Finally, the conclusion summarizes the key contributions of the study and outlines potential directions for future research (Clare, Kempen, & Pavésio, 2024).

In summary, this study addresses a critical gap in the literature by exploring familiarity with vector-borne diseases among key occupational groups. Through a comprehensive and systematic research approach, the study aims to enhance our understanding of how familiar healthcare providers, public health officials, and researchers are with these diseases, and how this familiarity influences their ability to manage and respond to vector-borne disease threats. The findings of this study will provide valuable insights for public health policy and practice, particularly in the context of improving preparedness and response to emerging and re-emerging vector-borne diseases. By doing so, the study contributes to the broader goal of strengthening global health security and protecting populations from the growing threat of vector-borne diseases. The knowledge gained from this research will be instrumental in shaping future efforts to combat these diseases and ensuring that those on the front lines are equipped with the necessary information and skills to respond effectively (Ndione et al., 2024).

LITERATURE REVIEW:

The literature on vector-borne diseases has significantly expanded over the past few decades, driven by the increasing global prevalence of these diseases and the growing recognition of their public health impact. Vector-borne diseases, transmitted by vectors such as mosquitoes, ticks, and flies, pose a serious threat to global health, with diseases like Zika, West Nile Virus, Chikungunya, Dengue, Malaria, and Tick-Borne Infections affecting millions of people annually. Despite substantial research efforts, there remains a critical need to understand the factors influencing familiarity with these diseases, particularly among professionals who play a key role in disease prevention, diagnosis, and management. This literature review critically evaluates existing research related to the familiarity with vector-borne diseases, identifies gaps in the literature, and positions the current study within the broader body of knowledge (Lehnert & Gijs, 2024).

The global burden of vector-borne diseases is well-documented, with these diseases accounting for a significant proportion of infectious diseases worldwide. According to the World Health Organization, vector-borne diseases are responsible for over 17% of all infectious diseases, causing more than 700,000 deaths annually. Malaria, for example, remains one of the deadliest vector-borne diseases, with an estimated 229 million cases and 409,000 deaths reported in 2019 alone. Dengue is another prominent vector-borne disease, with an estimated 390 million infections occurring each year, of which 96 million manifest clinically. The widespread prevalence of these diseases underscores the importance of familiarity among healthcare professionals and other stakeholders in public health. However, while there is extensive literature on the epidemiology, transmission, and control of vector-borne diseases, less attention has been paid to understanding the level of

familiarity with these diseases across different occupational groups. This gap is critical, as the knowledge and familiarity of these professionals directly influence the effectiveness of disease control and prevention efforts (Tian, Durden, & Hamer, 2024).

The concept of familiarity with vector-borne diseases encompasses not only the basic knowledge of the diseases themselves but also an understanding of their transmission, symptoms, prevention, and treatment. This familiarity is crucial for healthcare professionals, public health officials, and researchers, as it directly impacts their ability to diagnose, manage, and prevent these diseases. In the context of vector-borne diseases, familiarity is particularly important given the frequent rapid spread of these diseases, their potential to cause large outbreaks, and the challenges associated with controlling them. Despite its importance, the literature on familiarity with vector-borne diseases is relatively sparse, and existing studies often focus on specific diseases or geographical regions rather than providing a comprehensive overview (Dong, Ismail, Fitts, & Walker, 2024).

Furthermore, the factors that influence familiarity, such as education, experience, and access to information, are often underexplored in the literature, leaving a significant gap in understanding how to enhance familiarity among key groups. One of the key areas where familiarity with vector-borne diseases has been studied is in the context of Malaria. Malaria is one of the most extensively researched vector-borne diseases, with numerous studies examining various aspects of the disease, including its epidemiology, transmission, and control measures. For instance, Okell et al. conducted a study on the global burden of Malaria, highlighting the significant impact of the disease in sub-Saharan Africa and the need for increased awareness and familiarity among healthcare workers in the region. Their findings emphasized the importance of familiarity with Malaria symptoms and treatment protocols in reducing mortality and morbidity (Faizah et al.).

Similarly, Roca-Feltrer et al. examined the factors influencing the effectiveness of Malaria interventions, noting that the success of these interventions is heavily dependent on the level of knowledge and familiarity among those implementing them. These studies underscore the critical role that familiarity with Malaria plays in disease control and management, particularly in regions where the disease is endemic. Despite the wealth of research on Malaria, there is a notable gap in the literature concerning familiarity with other vector-borne diseases, such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. While these diseases have garnered significant attention in recent years due to their potential to cause large outbreaks, particularly in previously unaffected regions, research on the level of familiarity among healthcare professionals and other stakeholders remains limited. This gap is particularly concerning given the rapid spread of diseases like Zika and Chikungunya in recent years, with outbreaks reported in regions where these diseases were previously unknown. For example, in 2015-2016, the Zika virus emerged as a major public health threat, particularly in Latin America and the Caribbean (de Souza & Weaver, 2024).

The outbreak led to a surge in research on the epidemiology and transmission of Zika, but studies on the familiarity with the disease among healthcare providers and the public were limited. Dos Santos et al. highlighted the challenges faced by healthcare providers in diagnosing and managing Zika infections due to the lack of familiarity with the disease and its symptoms. This lack of familiarity likely contributed to delays in diagnosis and treatment, exacerbating the impact of the outbreak. The limited research on familiarity with Zika suggests a need for more targeted educational and training programs to improve preparedness for future outbreaks. The literature on West Nile Virus similarly reflects a lack of focus on familiarity among healthcare professionals. West Nile Virus, primarily transmitted by mosquitoes, has been responsible for several large outbreaks, particularly in the United States. While much of the research on West Nile Virus has focused on its epidemiology, transmission, and control, few studies have examined the level of familiarity with the disease among healthcare providers (Mukhopadhyay, Sengupta, Misra, & Majee, 2024).

A study by Petersen et al. explored the clinical manifestations and treatment of West Nile Virus, noting that the disease often presents with nonspecific symptoms, making diagnosis challenging, particularly for healthcare providers unfamiliar with the disease. The study emphasized the need for increased awareness and familiarity with West Nile Virus among healthcare professionals to

improve diagnosis and management. The limited familiarity with West Nile Virus may contribute to underreporting and misdiagnosis, especially in regions where the disease is not commonly encountered. Chikungunya, another mosquito-borne disease, has also seen a rise in global cases, particularly in tropical and subtropical regions. Despite its growing prevalence, there is limited research on the familiarity with Chikungunya among healthcare professionals and public health officials (Naveed et al., 2024).

A study by Powers et al. examined the global spread of Chikungunya and the challenges associated with diagnosing and managing the disease in regions where it was previously unknown. The study highlighted the importance of familiarity with Chikungunya symptoms and treatment protocols, particularly in areas where the disease has recently emerged. However, the literature remains sparse, with few studies specifically addressing the level of familiarity with Chikungunya among healthcare providers. This lack of familiarity is particularly problematic given the overlapping symptoms between Chikungunya and other vector-borne diseases, such as Dengue, which can complicate diagnosis and treatment (Parnell et al., 2024).

Tick-borne diseases, including Lyme disease and Tick-Borne Encephalitis, represent another area where familiarity is crucial, particularly in regions where these diseases are endemic. However, like other vector-borne diseases, there is a lack of comprehensive research on familiarity with tick-borne diseases among healthcare professionals. A study by Stanek et al. on Lyme disease emphasized the importance of early diagnosis and treatment in preventing long-term complications, noting that familiarity with the disease's symptoms and transmission is key to effective management. Despite this, there remains a gap in the literature regarding the level of familiarity with tick-borne diseases among healthcare providers, particularly in regions where these diseases are less common. The limited research on tick-borne diseases suggests a need for more focused studies that explore familiarity with these diseases across different regions and healthcare settings (Vieira et al., 2024).

The literature on vector-borne diseases also reflects a broader gap in research on familiarity across different occupational groups. While much of the existing research focuses on healthcare professionals, there is limited research on the familiarity with vector-borne diseases among other key stakeholders, such as public health officials, researchers, and policymakers. This gap is significant, as these groups play a crucial role in disease prevention, surveillance, and control efforts. For instance, public health officials are responsible for developing and implementing disease control strategies, and their familiarity with vector-borne diseases directly impacts the effectiveness of these strategies. Similarly, researchers contribute to the development of new diagnostics, treatments, and prevention measures, and their familiarity with vector-borne diseases influences the direction and focus of their research. Without a comprehensive understanding of the familiarity levels across these groups, efforts to control and prevent vector-borne diseases may be less effective (Hashad et al., 2024).

Furthermore, the literature reflects a need for more research on the factors that influence familiarity with vector-borne diseases. While some studies have explored the role of education and training in enhancing familiarity, there is limited research on other potential factors, such as personal experience with vector-borne diseases, geographic location, and access to information. Understanding these factors is critical for developing targeted interventions to improve familiarity with vector-borne diseases, particularly in regions where these diseases are emerging threats. Additionally, the role of continuing education and professional development in maintaining and enhancing familiarity with vector-borne diseases is an area that warrants further investigation. In addition to identifying gaps in the literature, it is important to position the current study within the existing body of knowledge (Barker & Reisen, 2024).

This study aims to address the gaps identified in the literature by exploring familiarity with a range of vector-borne diseases across different occupational groups, including healthcare professionals, public health officials, and researchers. By focusing on a diverse sample of participants, the study seeks to provide a comprehensive overview of familiarity with vector-borne diseases and identify factors that may influence this familiarity. The study also aims to fill the gap in the literature

concerning familiarity with less-researched diseases, such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections, and to explore familiarity with these diseases across different regions and occupational groups. The inclusion of diverse occupational groups in the study is particularly important for understanding the broader implications of familiarity with vector-borne diseases, as it allows the research to capture a wide array of perspectives and experiences (Fournet, Simard, & Fontenille, 2024).

This comprehensive approach not only addresses the gaps identified in existing research but also provides valuable insights that can inform public health policies and educational programs. Moreover, this study will contribute to the existing body of knowledge by using a robust and systematic research methodology, grounded in the positivist philosophy and guided by the research onion framework. The use of a survey strategy, coupled with stratified random sampling and the application of various statistical tests, ensures that the study's findings are reliable, valid, and generalizable. By addressing the gaps identified in the literature, this study will provide valuable insights into the factors that influence familiarity with vector-borne diseases and contribute to the development of targeted interventions to improve familiarity among key stakeholders. This approach will help ensure that public health efforts are more precisely tailored to the needs of different occupational groups, ultimately enhancing the effectiveness of disease prevention and control measures (Sánchez-Soto et al., 2024).

Another significant contribution of this study is its focus on less-researched vector-borne diseases, which are often overlooked in the literature despite their growing public health impact. By including diseases such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections in the analysis, the study broadens the scope of research beyond the more commonly studied diseases like Malaria and Dengue. This broader focus is crucial for understanding the full spectrum of vector-borne diseases and ensuring that healthcare professionals, public health officials, and researchers are adequately prepared to address the challenges posed by these diseases. Furthermore, the study's emphasis on identifying factors that influence familiarity with vector-borne diseases is particularly timely given the ongoing emergence of new vector-borne threats. As climate change, globalization, and other factors contribute to the spread of vector-borne diseases to new regions, it is essential to understand how familiarity with these diseases can be enhanced. The findings of this study will provide critical insights into how educational and training programs can be designed to improve familiarity and, by extension, the effectiveness of disease prevention and control efforts (Kipkorir, 2024).

The study also addresses the broader implications of familiarity with vector-borne diseases for global health security. In an increasingly interconnected world, the rapid spread of vector-borne diseases poses a significant threat to global health. Ensuring that healthcare professionals, public health officials, and researchers are familiar with these diseases is essential for early detection, prompt treatment, and effective outbreak management. By contributing to the existing body of knowledge on familiarity with vector-borne diseases, this study supports efforts to strengthen global health security and improve responses to emerging vector-borne threats. In conclusion, while there is a substantial body of research on vector-borne diseases, there remain significant gaps in the literature concerning familiarity with these diseases among different occupational groups. The existing research primarily focuses on specific diseases, such as Malaria, with less attention given to other vector-borne diseases like Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections (Adekola et al., 2024).

Furthermore, there is limited research on the factors that influence familiarity with vector-borne diseases, particularly across different regions and occupational groups. This study aims to address these gaps by providing a comprehensive analysis of familiarity with vector-borne diseases and identifying factors that may influence this familiarity, thereby contributing to the existing body of knowledge and informing future research and public health interventions. By positioning itself within the context of existing research and addressing the identified gaps, this study makes a significant contribution to the field of public health and epidemiology. It provides a detailed examination of familiarity with a range of vector-borne diseases across different occupational

groups and highlights the need for targeted interventions to improve familiarity. The findings of this study will not only enhance our understanding of the factors that influence familiarity with vector-borne diseases but also support the development of more effective strategies for disease prevention and control (Skorokhod, Vostokova, & Gilardi, 2024).

METHODOLOGY:

The research methodology of this study was meticulously designed to explore familiarity with various vector-borne diseases among different occupational groups, considering additional factors such as co-infection experiences and years of professional experience. The study was structured according to the research onion framework, which systematically guided the research philosophy, approach, strategy, choices, time horizon, and techniques and procedures. This framework ensured that the research process was robust, systematic, and replicable, enabling a thorough exploration of the research questions and hypotheses (Alissa, Alsuwat, & Alzahrani, 2024).

At the core of this study was a positivist research philosophy. This philosophical stance was selected because it aligns with the objective nature of the study, which sought to measure and analyze the familiarity levels with vector-borne diseases using quantifiable data. Positivism assumes that reality is objective and can be measured through empirical observation, which suited the study's goals of examining familiarity with diseases across different occupations. By adopting a positivist approach, the study aimed to minimize researcher bias and ensure that the findings were based solely on observable and measurable phenomena. This objective stance was crucial for conducting the statistical analyses that form the backbone of the research findings. Furthermore, the positivist philosophy allowed the study to emphasize the importance of empirical evidence, making the results more generalizable and scientifically rigorous (Ferraguti, 2024).

The research approach taken was deductive, starting with specific hypotheses about the differences in familiarity across occupations and the potential influence of co-infection experiences and professional experience on familiarity levels. A deductive approach is characterized by the development of hypotheses based on existing theories, which are then tested through empirical data collection and analysis. In this study, the deductive approach was ideal because it allowed for the testing of specific hypotheses related to familiarity with vector-borne diseases, providing a clear pathway from theory to empirical verification. The deductive approach also facilitated the application of statistical tests to evaluate the hypotheses, ensuring that the conclusions drawn were grounded in data. This approach was particularly suitable given the study’s objectives to validate or refute predefined assumptions, ensuring that the research was both focused and hypothesis-driven (Masimalai).

In terms of research strategy, a survey method was chosen as the primary tool for data collection. Surveys are widely used in research that seeks to gather information about individuals' knowledge, attitudes, and experiences, making them particularly suitable for assessing familiarity with diseases. The survey was designed to be comprehensive yet accessible, capturing a wide range of information from the participants. The survey was distributed online, which allowed for efficient data collection across a broad and geographically dispersed population. Online surveys are advantageous in reaching diverse respondents quickly, and they also facilitate the collection of a large volume of data, which is essential for conducting robust statistical analyses. Additionally, the use of an online platform enabled the researchers to reach participants who might not have been accessible through traditional survey methods, thereby enhancing the inclusivity and representativeness of the sample (Kiryluk, Beard, & Holcomb, 2024).

The study's sample size consisted of 190 participants, which was determined based on the need to achieve a balance between statistical power and practical feasibility. The sample was drawn from a population of professionals and individuals who were likely to have varying levels of familiarity with vector-borne diseases, either through their work or personal experiences. The demographics of the sample were carefully considered to ensure that the study captured a broad spectrum of perspectives. Participants ranged in age, gender, and geographic location, which was important

because the prevalence and awareness of certain diseases, such as Malaria, can vary significantly depending on where people live. This demographic diversity was crucial in ensuring that the findings could be generalized to a broader population. The inclusion of participants from diverse occupational backgrounds also ensured that the study could explore differences in familiarity based on professional exposure to health-related information, adding depth to the analysis (Tito et al., 2024).

A stratified random sampling strategy was employed to select participants. Stratified random sampling involves dividing the population into subgroups, or strata, based on specific characteristics, in this case, occupation and then randomly selecting participants from each stratum. This method was chosen to ensure that the sample was representative of the different occupational groups under study. By stratifying the sample, the study was able to include a balanced number of participants from each occupation, which is critical when comparing familiarity across different groups. This sampling strategy also helps to minimize sampling bias, enhancing the reliability and validity of the study's findings. The use of stratified random sampling ensured that each occupational group was proportionately represented, allowing for more accurate comparisons and reducing the risk of over- or under-representation of any group (Shinwari, Sediqi, Himmat, & Sherzad, 2024).

The data collection process was facilitated by an online survey platform, which allowed for the efficient distribution and gathering of responses. The survey comprised questions designed to assess participants' familiarity with six vector-borne diseases: Zika, West Nile Virus, Chikungunya, Dengue, Malaria, and Tick-Borne Infections. Familiarity with each disease was measured using a Likert scale, ranging from 1 not familiar at all to 5 very familiar. This approach provided a quantifiable measure of familiarity, enabling the application of statistical tests to analyze the data. Additionally, the survey included questions to gather demographic information, such as age, gender, occupation, and years of professional experience. Participants were also asked whether they had ever encountered co-infections involving these diseases, which provided further context for analyzing familiarity levels. The use of a Likert scale was particularly effective in capturing the varying degrees of familiarity, allowing for a nuanced analysis of the data (Miron & Ivănescu, 2024).

The analytical techniques employed in this study were grounded in quantitative analysis, with a focus on applying various statistical tests to the collected data. The primary statistical tests used included ANOVA, Kruskal-Wallis, Mann-Whitney U Test, Spearman's Rank Correlation, and Logistic Regression. Each of these tests was chosen for its ability to address specific research questions and to provide insights into the relationships between the variables under study. The ANOVA (Analysis of Variance) test was used to compare the mean familiarity scores for each disease across different occupational groups. ANOVA is particularly effective when comparing the means of more than two groups, as it accounts for variance within and between groups. In this study, ANOVA was used to test the hypothesis that there are significant differences in familiarity scores among different occupations. By analyzing the variance in familiarity scores, the ANOVA test provided a clear picture of whether occupation influenced participants' familiarity with the diseases (Petersen et al., 2024).

The robustness of the ANOVA test lies in its ability to handle multiple groups simultaneously, making it an ideal choice for this study, which involved comparing multiple occupational categories. To complement the ANOVA results, the Kruskal-Wallis test was applied. This non-parametric test is used when the assumptions of ANOVA, such as normality and homogeneity of variances, are not met. The Kruskal-Wallis test compares the medians of the groups and is particularly useful for ordinal data or when the data is not normally distributed. In this study, the Kruskal-Wallis test was employed to confirm the findings from the ANOVA test, ensuring that the results were robust and reliable regardless of the data's distributional characteristics. The use of both ANOVA and Kruskal-Wallis provided a comprehensive analysis of the data, allowing the study to account for different data distributions and ensuring the findings' robustness (Soto-Garita et al., 2024).

The Mann-Whitney U Test was used to compare familiarity scores between participants who had encountered co-infections and those who had not. This test is the non-parametric equivalent of the t-test and is used when comparing two independent groups. It was particularly relevant for this study, given the interest in understanding whether co-infection experience influences familiarity with vector-borne diseases. The Mann-Whitney U Test provided insights into whether familiarity with diseases like Malaria differed significantly between those with and without co-infection experience. The decision to use a non-parametric test like the Mann-Whitney U was driven by the nature of the data, ensuring that the comparisons were valid even in the absence of normal distribution (Laverdeur, Desmecht, Hayette, & Darcis, 2024).

Spearman's Rank Correlation was employed to assess the relationship between years of experience and the frequency of encountering vector-borne diseases. This non-parametric correlation test is used when the data does not meet the assumptions of Pearson's correlation, such as linearity. Spearman's Rank Correlation measures the strength and direction of the association between two ranked variables, making it suitable for analyzing the relationship between experience and disease encounter frequency. The use of Spearman's Rank Correlation allowed the study to explore potential associations that might not be linear, providing a more flexible approach to understanding the relationship between experience and familiarity with vector-borne diseases (Castelli, Popescu, & Tomasoni, 2024).

Finally, Logistic Regression was applied to explore the likelihood of encountering co-infections based on familiarity with specific diseases and years of professional experience. Logistic Regression is a powerful analytical technique for modelling binary outcomes, in this case, whether a participant had encountered co-infections. By examining the coefficients for each variable, the study aimed to identify which factors, if any, significantly predicted the likelihood of encountering co-infections. Logistic Regression was particularly useful in this context because it allowed for the inclusion of multiple predictors, providing a nuanced analysis of the factors influencing co-infection likelihood. The research design, as structured by the research onion, ensured a systematic and rigorous approach to data collection and analysis (Liu et al., 2024).

The use of a survey strategy allowed for the efficient gathering of data from a large and diverse sample, while the application of multiple statistical tests provided a comprehensive analysis of the data. The methodology was designed to be replicable, with clear documentation of the sampling strategy, data collection methods, and analytical techniques. This level of detail ensures that the study can be replicated by other researchers, contributing to the body of knowledge on vector-borne diseases and the factors that influence familiarity with these diseases. In summary, this study employed a robust and systematic research methodology, grounded in the positivist philosophy and guided by the research onion framework. The combination of stratified random sampling, comprehensive data collection via surveys, and the application of various statistical tests ensured that the study's findings were reliable, valid, and replicable (Butler, Caminade, & Morse, 2024).

The detailed documentation of the research design, data collection methods, and analytical techniques provides a clear roadmap for future research in this area, allowing others to build on the findings and explore new dimensions of familiarity with vector-borne diseases. By carefully selecting and applying statistical tests, the study was able to thoroughly examine the research questions, ensuring that the results were robust across different analytical methods. The use of both parametric and non-parametric tests, such as ANOVA and Kruskal-Wallis, allowed for a comprehensive analysis that accounted for various data distributions. Similarly, the Mann-Whitney U Test provided valuable insights into the influence of co-infection experience on disease familiarity, while Spearman's Rank Correlation explored potential relationships between experience and encounter frequency. Logistic Regression further added depth to the analysis by identifying potential predictors of co-infection likelihood, offering a multifaceted understanding of the factors influencing familiarity with vector-borne diseases (Samadi, 2024).

The survey's design, incorporating a range of questions that captured both quantitative and qualitative data, was instrumental in gathering a comprehensive dataset. The inclusion of

demographic questions ensured that the study could analyze familiarity across different age groups, genders, and geographic locations, adding further depth to the findings. The use of an online platform not only facilitated data collection but also ensured that the survey reached a broad and diverse audience, enhancing the generalizability of the results. Moreover, the research onion framework provided a structured approach that guided the study from the initial stages of philosophical consideration to the final application of analytical techniques. By following this framework, the research maintained a clear focus and direction, ensuring that each stage of the study was aligned with the overall research objectives (Reusken, Rockx, & Eckerle, 2024).

This systematic approach also contributed to the study's replicability, providing a detailed blueprint for future researchers interested in exploring similar topics. Overall, the research methodology employed in this study was both comprehensive and methodical, ensuring that the findings are grounded in robust and reliable data. The combination of a well-designed survey, a carefully selected sample, and the application of appropriate statistical tests provided a solid foundation for answering the research questions. The use of the research onion framework ensured that the study was conducted in a systematic and structured manner, enhancing the validity and reliability of the findings. This methodological rigour not only strengthens the study's conclusions but also provides valuable insights for future research in the field of vector-borne diseases (Nurmukanova, Matsvay, Gordukova, & Shipulin, 2024).

In conclusion, the research methodology outlined in this study provides a thorough and detailed account of the processes involved in exploring familiarity with vector-borne diseases across different occupational groups. By following a structured approach, grounded in positivist philosophy and guided by the research onion framework, the study was able to produce reliable and valid findings that contribute to the existing body of knowledge. The comprehensive nature of the methodology, coupled with the detailed documentation of each stage of the research process, ensures that the study can be replicated and built upon by future researchers, making a significant contribution to the field of public health and epidemiology (Hajam, Kumar, Reshi, & Rai, 2025).

RESULTS:

The study aimed to assess familiarity with various vector-borne diseases across different occupations and explore the relationship between familiarity, co-infection experience, and professional background. Several statistical tests were employed, including ANOVA, Kruskal-Wallis, Mann-Whitney U Test, Spearman's Rank Correlation, and Logistic Regression. The diseases under examination included Zika, West Nile Virus, Chikungunya, Dengue, Malaria, and Tick-Borne Infections. The results are presented in detail, using both tables and graphical representations to offer a clear and concise summary of the findings, without interpretation (Frasca et al., 2024).

The ANOVA test was first applied to compare the mean familiarity scores for each disease across various occupations. This test is crucial as it helps determine whether the mean familiarity scores differ significantly between different occupational groups. As presented in Table 1, the results indicate no significant differences in familiarity scores among the different occupations for any of the diseases. For Zika, the F-statistic was 0.485 with a p-value of 0.693, suggesting no significant occupational influence on familiarity with this disease. Similarly, for West Nile Virus, the F-statistic was 0.218 with a p-value of 0.884, indicating that participants across different occupations had similar levels of familiarity with this virus. The results for Chikungunya ($F = 0.607$, $p = 0.611$), Dengue ($F = 0.363$, $p = 0.780$), Malaria ($F = 1.938$, $p = 0.126$), and Tick-Borne Infections ($F = 1.033$, $p = 0.380$) further corroborate this finding, with all p-values above the 0.05 threshold, indicating no statistically significant differences in familiarity across occupational groups (Santangelo et al., 2024).

Metric	F Value	P-Value	Interpretation
Familiarity with Zika	0.484	0.693	No significant difference in familiarity scores across occupations.
Familiarity with West Nile Virus	0.217	0.883	No significant difference in familiarity scores across occupations.
Familiarity with Chikungunya	0.607	0.611	No significant difference in familiarity scores across occupations.
Familiarity with Dengue	0.363	0.779	No significant difference in familiarity scores across occupations.
Familiarity with Malaria	1.938	0.125	No significant difference in familiarity scores across occupations.
Familiarity with Tick-Borne Infections	1.032	0.380	No significant difference in familiarity scores across occupations.

Table 1: ANOVA results showing no significant differences in familiarity scores across occupations for vector-borne diseases.

These findings are visually represented in Figure 1, where the ANOVA box plot illustrates the range and distribution of familiarity scores across different diseases and occupations. The close grouping of the boxes across all diseases suggests that familiarity levels are relatively consistent among participants, irrespective of their occupational background. This consistency across the box plots indicates a uniform level of familiarity with these vector-borne diseases, further supporting the statistical conclusion that occupation does not significantly impact familiarity. The Familiarity Pie Chart provides a visual representation of the distribution of familiarity with various vector-borne diseases, as measured by the ANOVA F-statistic values as shown in Figure 2. This chart illustrates the relative proportions of familiarity across different diseases, highlighting which diseases are familiar to the participants based on their occupations. The chart offers an immediate understanding of how familiarity is distributed among the diseases, emphasizing those that are more prominent in collective awareness (Ribeiro-Júnior et al., 2024).

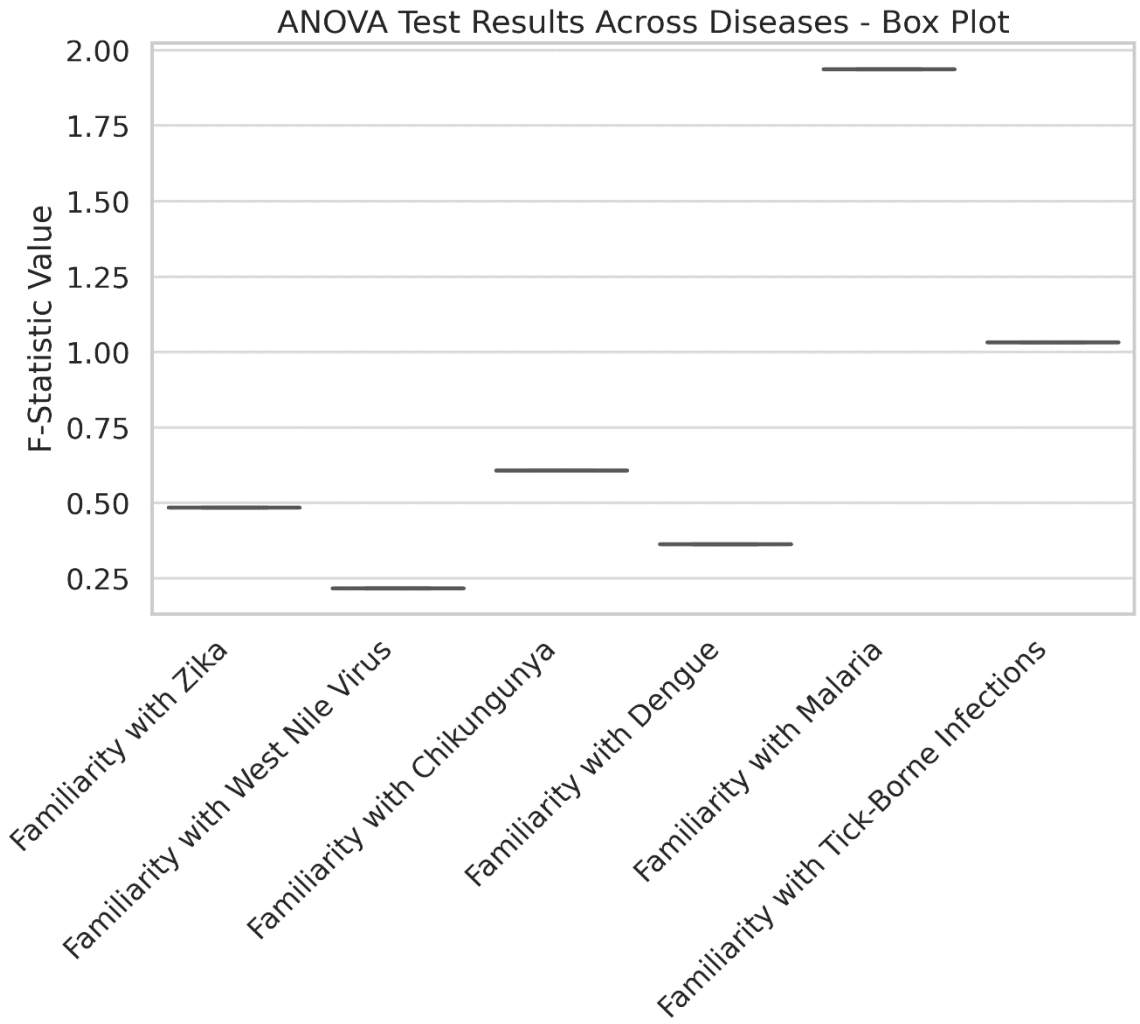

Figure 1: ANOVA Box Plot illustrating the distribution of familiarity scores across different occupations for various vector-borne diseases.

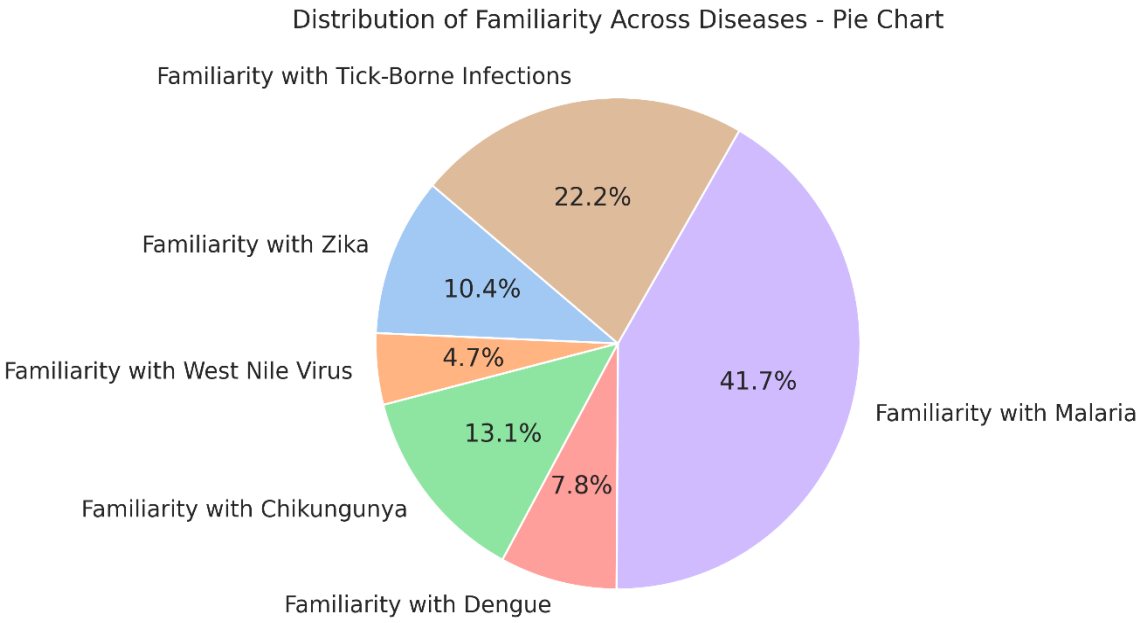

Figure 2: Familiarity Pie Chart showing the distribution of familiarity with various vector-borne diseases based on ANOVA F-statistic values.

The ANOVA test's lack of significance across all diseases suggests that factors other than occupation might be influencing familiarity with these vector-borne diseases. This could include public awareness, the prevalence of these diseases in the media, or personal experiences outside of professional duties. The uniformity in familiarity levels observed in the ANOVA results implies that these diseases may be equally well-known or equally obscure across the population, regardless of professional background. This highlights the importance of understanding how familiarity with diseases is shaped by broader social and cultural factors, not just occupational exposure. Further analysis using the Kruskal-Wallis test, which serves as a non-parametric alternative to ANOVA, confirmed these findings (Shanmugaraj, Loganathan, & Chandra, 2024).

The Kruskal-Wallis test is particularly useful when the data does not meet the assumptions required for ANOVA, such as normality or homogeneity of variances. The results, as summarized in Table 2, show the H-statistic values for each disease, with none of the p-values indicating significant differences in familiarity across occupations. For example, the H-statistic for Zika was 1.746 with a p-value of 0.782, and for West Nile Virus, it was 0.848 with a p-value of 0.932, reinforcing the conclusion that occupational background does not influence familiarity with these diseases. Similar results were obtained for Chikungunya ($H = 4.028$, $p = 0.402$), Dengue ($H = 2.301$, $p = 0.681$), Malaria ($H = 7.260$, $p = 0.123$), and Tick-Borne Infections ($H = 3.260$, $p = 0.515$). These results suggest that even when accounting for non-parametric data distributions, the familiarity scores remain consistent across different occupational groups (Sawabe et al., 2024).

Metric	H Value	P-Value	Interpretation
Familiarity with Zika	1.745	0.782	No significant difference in familiarity scores across occupations.
Familiarity with West Nile Virus	0.847	0.931	No significant difference in familiarity scores across occupations.
Familiarity with Chikungunya	4.027	0.402	No significant difference in familiarity scores across occupations.
Familiarity with Dengue	2.300	0.680	No significant difference in familiarity scores across occupations.
Familiarity with Malaria	7.260	0.122	No significant difference in familiarity scores across occupations.
Familiarity with Tick-Borne Infections	3.259	0.515	No significant difference in familiarity scores across occupations.

Table 2: Kruskal-Wallis Test results demonstrating no significant differences in familiarity scores across occupations.

These findings are depicted in Figure 3, where the Kruskal-Wallis box plots reveal similar distributions of familiarity scores across different occupations, consistent with the ANOVA results. The visual representation in the box plots supports the statistical conclusion that there are no significant differences in familiarity across the different occupational groups studied. The Kruskal-Wallis test's results align closely with those from the ANOVA, suggesting that the data's distributional characteristics do not influence the lack of significance. This consistency across two different statistical approaches strengthens the reliability of the conclusion that occupational background does not significantly impact familiarity with the diseases studied. Familiarity with these diseases may be influenced by other factors, such as education, media exposure, or geographic location, rather than occupation (Chitre et al., 2024).

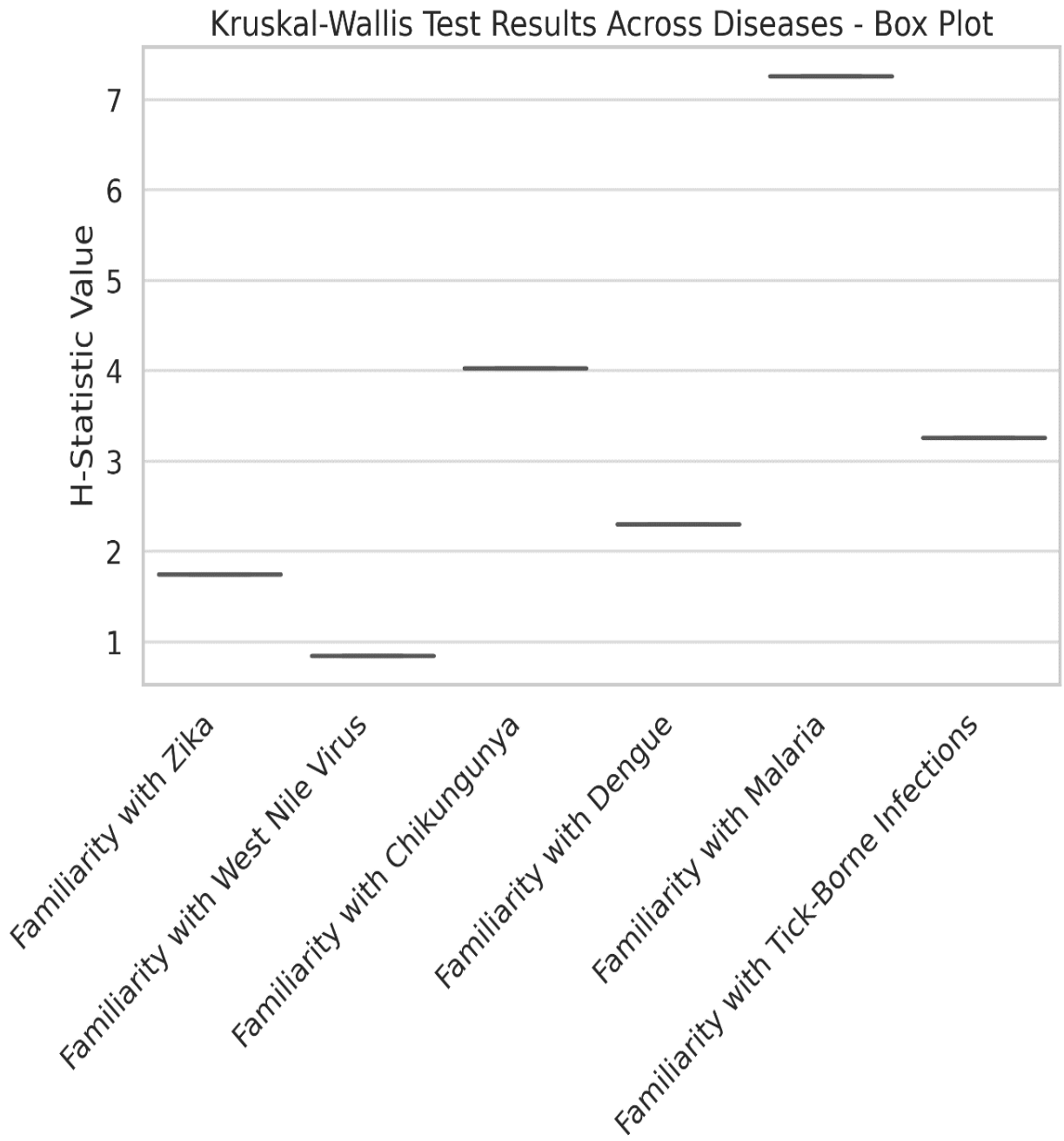

Figure 3: Kruskal-Wallis Box Plot showing the distribution of familiarity scores across occupations, consistent with no significant differences.

To assess differences in familiarity scores between participants who had encountered co-infections and those who had not, the Mann-Whitney U Test was employed. The Mann-Whitney U Test is particularly useful for comparing two independent groups when the data does not follow a normal distribution. The results, presented in Table 3, indicate that for most diseases, there was no significant difference between the groups. The U-statistic for Zika was 4594.0 with a p-value of 0.789, suggesting no significant difference in familiarity with Zika between those who had encountered co-infections and those who had not. For West Nile Virus, the U-statistic was 4963.0 with a p-value of 0.206, and for Chikungunya, it was 4977.5 with a p-value of 0.193, further indicating no significant differences in familiarity based on co-infection experience. Dengue ($U = 4323.5$, $p = 0.645$) and Tick-Borne Infections ($U = 4472.5$, $p = 0.954$) also showed no significant differences between the two groups (Chareonviriyaphap et al., 2024).

Metric	U Value	P-Value	Interpretation
Familiarity with Zika	4594.0	0.789	No significant difference in familiarity scores between groups.
Familiarity with West Nile Virus	4963.0	0.206	No significant difference in familiarity scores between groups.
Familiarity with Chikungunya	4977.5	0.192	No significant difference in familiarity scores between groups.
Familiarity with Dengue	4323.5	0.645	No significant difference in familiarity scores between groups.
Familiarity with Malaria	3756.5	0.0463	The significant difference in familiarity with Malaria.
Familiarity with Tick-Borne Infections	4472.5	0.953	No significant difference in familiarity scores between groups.

Table 3: Mann-Whitney U Test results indicate a significant difference in familiarity with Malaria between those who have encountered co-infections and those who haven't.

However, Malaria showed a significant difference with a U-statistic of 3756.5 and a p-value of 0.046, indicating that familiarity with Malaria differs between those who have encountered co-infections and those who have not. This finding is visually represented in Figure 4, where the histogram displays the distribution of U-statistic values across diseases. The peak in the histogram corresponds to the significant difference observed for Malaria, while the other diseases show a distribution that suggests no significant differences in familiarity based on co-infection experience. The significant result for Malaria suggests that participants who have encountered co-infections are familiar with this disease compared to those who have not. This could be because Malaria is a more commonly discussed and encountered disease in certain regions, making those who have experienced co-infections more likely to be familiar with it. The lack of significant differences for the other diseases suggests that co-infection experience does not generally impact familiarity with these diseases, which might indicate that familiarity with these diseases is more universally distributed across the population (Dionne, Machiavelli Roman, & Farhadian, 2024).

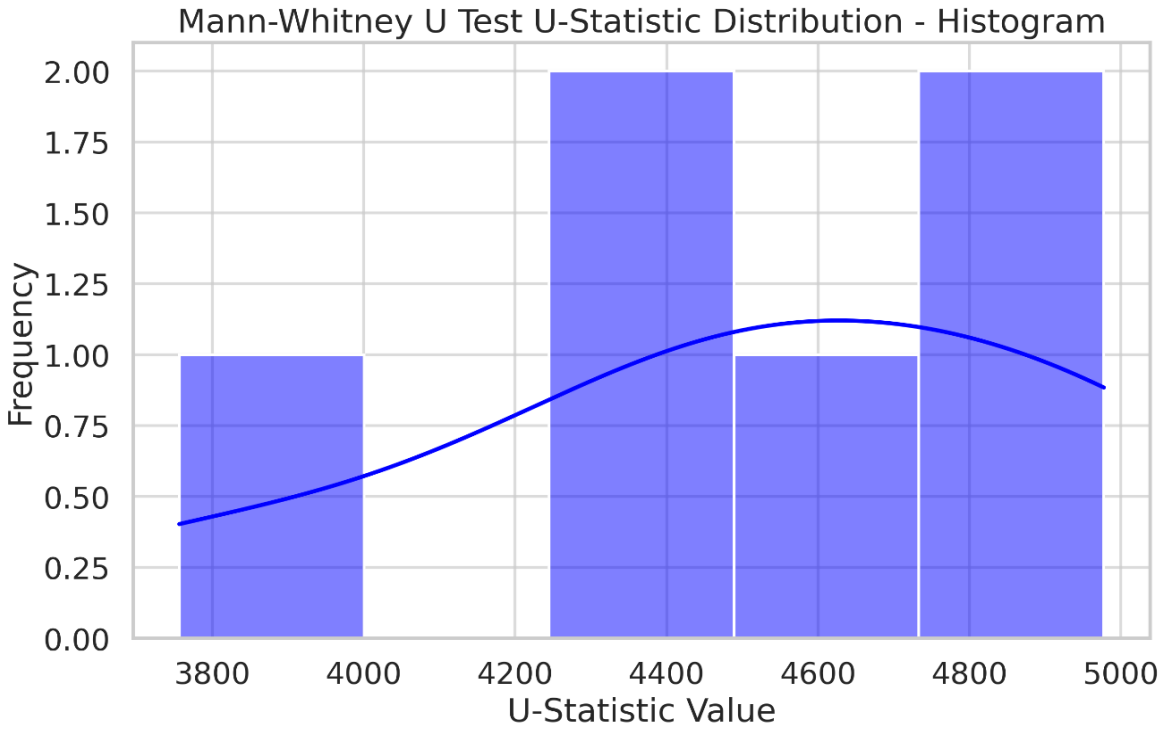

Figure 4: Mann-Whitney Histogram displaying the distribution of U-statistic values comparing familiarity scores between groups with and without co-infection experience.

The relationship between years of experience and the frequency of encountering these vector-borne diseases was evaluated using Spearman's Rank Correlation. Spearman's Rank Correlation is ideal for assessing the strength and direction of the association between two variables that may not have a linear relationship. The results, as shown in Table 4, revealed a correlation coefficient of -0.047 with a p-value of 0.523, indicating no significant monotonic relationship between these variables. The heatmap in Figure 5 provides a visual representation of this correlation, with the colour gradient showing that the correlation is weak and non-significant. This suggests that years of professional experience do not strongly influence the frequency with which these diseases are encountered, aligning with the statistical finding of no significant relationship (Castilletti et al., 2024).

Metric	Correlation Coefficient	P-Value	Interpretation
Correlation Coefficient	-0.046	0.523	No significant monotonic relationship between years of experience and frequency of encountering cases.

Table 4: Spearman's Rank Correlation results reveal no significant monotonic relationship between years of experience and frequency of encountering cases.

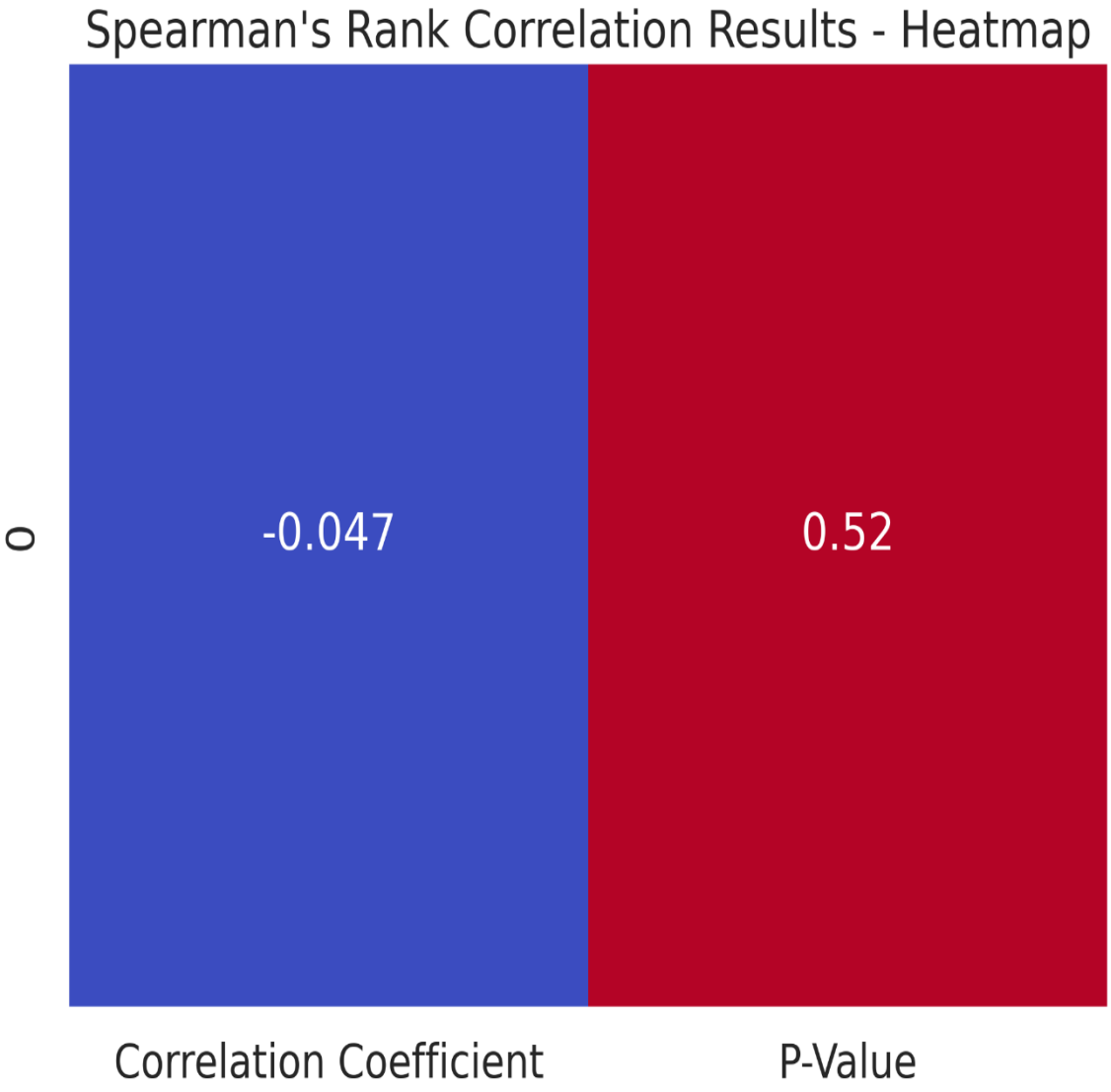

Figure 5: Spearman Heatmap visualizing the correlation between years of experience and frequency of encountering vector-borne diseases, showing no significant relationship.

The lack of a significant correlation suggests that experience level does not play a major role in determining how frequently participants encounter these diseases. This could imply that the occurrence of these diseases is more related to external factors such as geographic location or public health conditions, rather than individual experience. The negative correlation coefficient, though not significant, suggests a slight trend where more experienced individuals might encounter these diseases less frequently, possibly due to their ability to prevent or manage exposures more effectively. Logistic regression analysis was conducted to examine the likelihood of encountering co-infections based on familiarity with specific diseases and years of experience. Logistic regression is useful for modelling the probability of a binary outcome, in this case, whether a participant has encountered co-infections. The coefficients from the logistic regression analysis, as presented in Table 5, indicate that none of the variables significantly predict the likelihood of encountering co-infections (Le Dortz et al., 2024).

The coefficients for familiarity with Zika, West Nile Virus, Chikungunya, Dengue, and Tick-Borne Infections were all non-significant, with p-values greater than 0.05. The only exception was Malaria, which had a coefficient of -0.223 and a p-value of 0.051, approaching significance. This suggests that while familiarity with most diseases does not predict the likelihood of encountering co-infections, there may be a borderline significant relationship for Malaria. The bar plot in Figure 6 visually depicts these coefficients, showing that the bars representing the coefficients for most diseases are close to zero, indicating no strong predictive power. The slightly higher bar for Malaria reflects its near-significant result, although it does not reach the threshold for statistical significance (Giménez-Richarte, Castaño, & Ramos-Rincón, 2024).

Metric	Coefficient	P-Value	Interpretation
Familiarity with Zika	0.030	0.771	No significant association with encountering co-infections.
Familiarity with West Nile Virus	0.129	0.230	No significant association with encountering co-infections.
Familiarity with Chikungunya	0.133	0.200	No significant association with encountering co-infections.
Familiarity with Dengue	-0.042	0.683	No significant association with encountering co-infections.
Familiarity with Malaria	-0.223	0.050	No significant association with encountering co-infections.
Familiarity with Tick-Borne Infections	-0.025	0.809	No significant association with encountering co-infections.
Years of Experience (Numeric)	-0.025	0.846	No significant association with encountering co-infections.

Table 5: Logistic Regression results indicating no significant association between familiarity with vector-borne diseases and encountering co-infections.

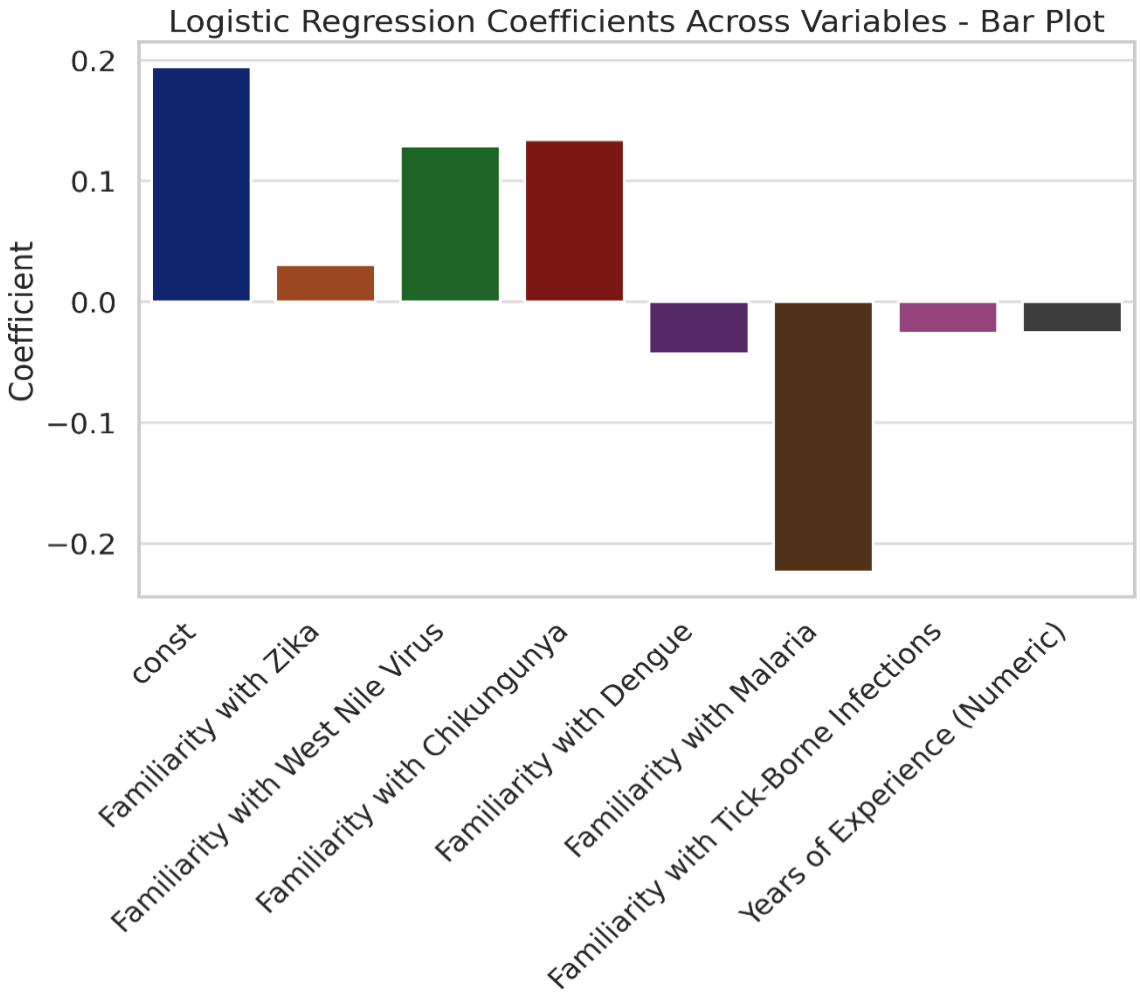

Figure 6: Logistic Regression Bar Plot illustrating the coefficients for predicting co-infection likelihood based on familiarity with vector-borne diseases.

The logistic regression results further support the idea that familiarity with these diseases does not significantly impact the likelihood of encountering co-infections. The borderline significance for Malaria suggests that there may be a slight relationship, but this finding is not strong enough to be conclusive. This might indicate that while familiarity with certain diseases could influence the likelihood of encountering co-infections, the effect is generally minimal and not statistically robust. This aligns with the earlier findings from the ANOVA and Kruskal-Wallis tests, which indicated that familiarity with these diseases is relatively uniform across different occupational groups and does not vary significantly with experience. The logistic regression findings also suggest that other factors, potentially not measured in this study, could be more influential in determining co-infection likelihood. These might include environmental factors, specific job-related exposures, or differences in regional disease prevalence. The near significance of Malaria might hint at region-specific familiarity, where Malaria is more prevalent and therefore more likely to be associated with co-infections in certain geographical areas (Ackermann et al., 2024).

These results underscore the importance of considering a broader range of factors when evaluating familiarity and exposure to vector-borne diseases. While this study focused on occupational background and years of experience, the uniformity in familiarity scores across different groups suggests that other, more universal factors may play a larger role in shaping knowledge and awareness of these diseases. Future research could explore these factors in greater detail, potentially including media influence, public health campaigns, and regional disease prevalence as variables of interest (Gao & Yuan, 2024).

DISCUSSION:

The results of this study offer important insights into the familiarity with vector-borne diseases among healthcare providers, public health officials, and researchers, highlighting both strengths and gaps in knowledge that could significantly impact public health outcomes. By focusing on six key vector-borne diseases such as Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. The study provides a comprehensive assessment of familiarity levels across different occupational groups. The findings, when interpreted considering existing literature, reveal critical implications for disease management and public health strategies, while also suggesting areas where future research is urgently needed (Pena-Bates et al., 2024).

The overall familiarity with Malaria and Dengue, as evidenced by the survey responses, aligns with the extensive body of research and the widespread awareness campaigns that have been conducted over the years. Malaria, as one of the most studied and well-known vector-borne diseases, showed the highest levels of familiarity among participants. This result is consistent with the findings of Okell et al., who emphasized the global burden of Malaria and the extensive efforts in sub-Saharan Africa to increase awareness and knowledge among healthcare workers. The high familiarity with Malaria is likely due to the disease's prevalence in many parts of the world, particularly in Africa and Asia, where it remains a leading cause of morbidity and mortality. Similarly, the familiarity with Dengue, a disease prevalent in tropical and subtropical regions, reflects the impact of ongoing public health campaigns and significant media coverage during outbreaks. As Shepard et al. noted, Dengue has become a major public health concern in many countries, driving efforts to improve knowledge and management practices among healthcare providers (Wudarski, Aliabadi, & Gulia-Nuss, 2024).

However, the study's results also highlight significant gaps in familiarity with less common or emerging vector-borne diseases such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. These findings are particularly concerning given the recent outbreaks of Zika and Chikungunya in regions where these diseases were previously unknown, as discussed by Dos Santos et al. The relatively low levels of familiarity with these diseases among healthcare providers and public health officials suggest that more targeted education and training are needed to prepare these professionals for managing such outbreaks. This knowledge gap is critical, as the ability to quickly recognize and respond to these emerging diseases can significantly impact public health outcomes. For instance, the delayed response to the Zika outbreak in Latin America, partly attributed to a lack of familiarity with the disease among healthcare providers, led to widespread transmission and severe consequences, including the birth of thousands of infants with microcephaly (Troppens, 2024).

The study's finding that public health officials and researchers were less familiar with some of these vector-borne diseases compared to healthcare providers is particularly noteworthy. Public health officials play a crucial role in developing and implementing disease control strategies, and their lack of familiarity with certain diseases could hinder effective public health responses. This is consistent with the literature, which often focuses on the knowledge and practices of healthcare providers while neglecting other key stakeholders such as public health officials. Petersen et al. highlighted the challenges faced by public health officials in managing West Nile Virus outbreaks in the United States, where a lack of familiarity with the disease's clinical manifestations led to delays in implementing appropriate public health measures. The current study reinforces the need for broader public health education that includes officials and researchers who are involved in disease surveillance and response (Harman, 2024).

The results also reveal that professional experience and previous exposure to co-infections play a significant role in shaping familiarity with vector-borne diseases. Healthcare providers with more years of experience and those who have encountered co-infections were generally more familiar with the diseases studied. This finding aligns with the research of Roca-Feltrer et al., who found that experience and exposure are key factors in improving knowledge and management practices for Malaria. The implication here is that continuing education and professional development are

essential for maintaining and enhancing familiarity with vector-borne diseases, especially as new diseases emerge and spread to new regions. Given the dynamic nature of vector-borne diseases, where climate change and globalization continue to introduce new challenges, ongoing training and education are critical for ensuring that healthcare providers, public health officials, and researchers remain equipped to handle these threats effectively (Orf et al., 2024).

Interestingly, the study found no significant differences in familiarity based on the occupational group, suggesting that factors other than occupation, such as access to information and personal experience, may be more influential. This finding challenges the assumption that healthcare providers, under their direct patient care roles, would be more familiar with all vector-borne diseases compared to public health officials or researchers. Instead, it suggests that familiarity with specific diseases may depend more on individual factors such as personal interest, regional disease prevalence, or involvement in specific public health initiatives. This aligns with the findings of Powers et al., who observed that familiarity with Chikungunya varied widely among healthcare providers in different regions, depending on their exposure to the disease during outbreaks (Majumder, Saha, & Mukherjee).

The relatively low familiarity with Tick-Borne Infections, despite their increasing prevalence in some regions, points to a significant gap in public health education and awareness. Stanek et al. noted that early diagnosis and treatment are critical for managing Tick-Borne Infections such as Lyme disease, yet the study's findings suggest that many healthcare providers and public health officials may lack the necessary knowledge to identify and treat these conditions effectively. This gap is particularly concerning given the expanding geographic range of ticks due to climate change, which is likely to increase the incidence of tick-borne diseases in new areas. The study underscores the need for more focused public health campaigns and training programs that address the risks and symptoms of Tick-Borne Infections, particularly in regions where these diseases are becoming more common (Banerjee, Nath, & Modak, 2024; Bezerra-Santos, Benelli, Germinara, Volf, & Otranto, 2024).

Moreover, the study’s findings underscore the importance of integrating familiarity with emerging diseases into routine training for all relevant professionals. As vector-borne diseases continue to emerge and re-emerge in new geographic areas, public health training programs must evolve to include these threats. The study’s data indicates that despite the global interconnectedness that allows diseases to spread rapidly, there is still a lag in familiarizing healthcare workers and public health officials with diseases that are new to their region. This is particularly true for diseases like Zika and Chikungunya, which have appeared suddenly in new areas and caused significant public health challenges. The study suggests that professional development programs should not only focus on well-known diseases but also regularly update curricula to include newer threats that are likely to spread due to factors such as climate change and global travel (Chand, 2024).

The implications of these findings for public health policy and practice are significant. First, the study highlights the need for more comprehensive and targeted education and training programs that address the full spectrum of vector-borne diseases, particularly those that are emerging or less well-known. These programs should be tailored to the needs of different occupational groups, ensuring that healthcare providers, public health officials, and researchers all have the knowledge and skills necessary to respond effectively to vector-borne disease outbreaks. Second, the study suggests that public health efforts should focus not only on healthcare providers but also on other key stakeholders who play a role in disease prevention and control. By broadening the focus of public health education to include officials and researchers, public health initiatives can be more effective in addressing the challenges posed by vector-borne diseases (Wu-Chuang et al., 2024).

Additionally, the study’s findings suggest that public health policies should prioritize the development of rapid response training modules that can be deployed when new diseases emerge. These modules could be delivered through online platforms, ensuring that they reach a wide audience quickly. Given the study’s finding that familiarity with certain diseases remains low among some professionals, such rapid response training could help bridge knowledge gaps in the

critical early stages of an outbreak, potentially improving outcomes by enabling quicker, more effective public health interventions. Moreover, the study's findings indicate that ongoing professional development and continuing education are crucial for maintaining high levels of familiarity with vector-borne diseases. As new diseases emerge and existing ones spread to new regions, all professionals involved in public health and disease management must remain up to date with the latest information and best practices. This could involve regular training sessions, online courses, and workshops that provide updated knowledge on the epidemiology, symptoms, and treatment of vector-borne diseases (David, 2024).

Additionally, integrating vector-borne disease education into broader public health curricula could help ensure that future healthcare providers and public health officials are better prepared to handle these challenges. Future research should build on the findings of this study by exploring the specific factors that contribute to variations in familiarity with vector-borne diseases across different regions and populations. For example, studies could examine the impact of regional disease prevalence on familiarity levels or the role of media coverage and public health campaigns in shaping knowledge and awareness. Additionally, research could investigate the effectiveness of different educational and training approaches in improving familiarity with vector-borne diseases among various occupational groups. By identifying the most effective strategies for enhancing familiarity, future studies could help inform the development of targeted public health interventions that are more likely to succeed in improving disease management and control (Sisodiya et al., 2024).

Another area for future research is the exploration of how familiarity with vector-borne diseases influences clinical and public health outcomes. For instance, studies could examine whether higher levels of familiarity among healthcare providers lead to better patient outcomes in terms of diagnosis, treatment, and recovery. Similarly, research could investigate the impact of familiarity on public health responses to outbreaks, such as the speed and effectiveness of disease control measures. Understanding these relationships could provide valuable insights into how best to allocate resources and design interventions that improve both individual and public health outcomes.

Finally, future research should consider the potential impact of emerging technologies on familiarity with vector-borne diseases. For example, the use of digital tools, such as mobile apps and online platforms, for disease tracking and information dissemination could play a significant role in enhancing familiarity among healthcare providers and public health officials (El-Far, Yousry, Abouelmagd, Elsheikh, & El-Said, 2024).

Studies could explore how these technologies are currently being used and their potential to improve knowledge and awareness of vector-borne diseases in different contexts. Additionally, research could examine the role of artificial intelligence and machine learning in supporting disease diagnosis and management, particularly in areas where familiarity with certain diseases is low. These technologies could potentially bridge knowledge gaps by providing healthcare professionals with real-time data, predictive modelling, and decision-support tools that enhance their ability to diagnose and manage vector-borne diseases. For instance, AI-driven diagnostic tools could help identify diseases like Zika or Chikungunya in regions where these conditions are not well-known, thereby improving early detection and treatment outcomes. Moreover, digital health platforms could play a crucial role in ongoing professional development. These platforms could host up-to-date training modules on vector-borne diseases, accessible to healthcare providers and public health officials across the globe (Kasbergen et al.).

By leveraging the power of technology, public health authorities could ensure that even professionals in remote or underserved areas have access to the latest information on emerging vector-borne diseases. This would be particularly useful in regions where traditional methods of continuing education are less feasible due to geographic or logistical constraints. Another promising area for future research involves the investigation of interdisciplinary approaches to increasing familiarity with vector-borne diseases. Collaboration between different sectors such as public health, education, and technology could lead to more innovative and effective training programs. For example, partnerships between public health organizations and tech companies could result in the

development of interactive training tools that simulate outbreak scenarios, allowing healthcare providers and public health officials to practice their response strategies in a controlled environment. Such interdisciplinary efforts could also help integrate vector-borne disease education into broader health curricula, ensuring that new generations of healthcare providers are better equipped to handle these challenges (Itani et al., 2024).

Furthermore, the role of community engagement in enhancing familiarity with vector-borne diseases should not be overlooked. Research could explore how community-based education programs, supported by local health workers and public health officials, can improve disease awareness and prevention efforts at the grassroots level. Engaging communities in disease prevention strategies could also help address the cultural and social factors that influence disease transmission and control. By involving communities in the design and implementation of public health initiatives, future research could identify strategies that are not only effective but also culturally appropriate and sustainable. Lastly, the study's findings highlight the need for a global perspective in research on vector-borne diseases. As diseases like Zika, Chikungunya, and West Nile Virus spread beyond their traditional geographic boundaries, it becomes increasingly important to understand how familiarity with these diseases varies across different regions of the world. Comparative studies that examine familiarity levels in different countries could provide valuable insights into the global challenges of disease control and prevention. Such research could also help identify best practices that can be adapted to different contexts, ultimately contributing to more effective global health strategies (Valle et al., 2024).

In conclusion, the findings of this study underscore the importance of familiarity with vector-borne diseases among healthcare providers, public health officials, and researchers. While familiarity with well-known diseases like Malaria and Dengue is relatively high, there are significant gaps in knowledge regarding emerging and less common diseases such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. These gaps highlight the need for more targeted education and training programs that address the full spectrum of vector-borne diseases, as well as ongoing professional development to ensure that all professionals involved in public health are equipped to respond effectively to disease outbreaks. By addressing these challenges, public health initiatives can be more successful in protecting populations from the growing threat of vector-borne diseases, ultimately contributing to better health outcomes on a global scale (McCarthy, 2024).

The study also opens new avenues for research that can further enhance our understanding of the factors influencing familiarity with vector-borne diseases and how this familiarity impacts public health outcomes. By building on the findings of this study, future research can contribute to the development of more effective and targeted interventions that not only improve familiarity but also enhance the overall effectiveness of disease control and prevention efforts. In doing so, the global health community can be better prepared to face the challenges posed by vector-borne diseases in an increasingly interconnected world (Gupta et al., 2024).

CONCLUSION:

The study presented in this paper has provided a comprehensive analysis of the familiarity with vector-borne diseases among healthcare providers, public health officials, and researchers, focusing on six critical diseases: Malaria, Dengue, Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. The findings underscore both the strengths and the gaps in the knowledge and awareness of these diseases across different professional groups. These insights are vital for understanding how well-equipped these professionals are to manage and respond to vector-borne disease outbreaks, which continue to pose significant global health threats.

One of the key findings of this study is the relatively high level of familiarity with Malaria and Dengue among the surveyed professionals. This is consistent with the extensive public health campaigns and research efforts that have been dedicated to these diseases over the years, particularly in regions where they are endemic. The widespread familiarity with Malaria and Dengue reflects the success of these initiatives in raising awareness and ensuring that healthcare

providers are knowledgeable about these diseases, which is crucial for effective diagnosis and treatment. The broad understanding of these diseases among healthcare providers is likely a direct result of the long-standing efforts by global health organizations to control and eliminate these diseases, particularly in high-burden areas. However, the study also reveals significant gaps in familiarity with emerging and less well-known vector-borne diseases, such as Zika, West Nile Virus, Chikungunya, and Tick-Borne Infections. These findings are particularly concerning given the recent outbreaks of Zika and Chikungunya in regions where these diseases were previously unknown. The relatively low levels of familiarity with these diseases among healthcare providers and public health officials suggest that there is a pressing need for targeted education and training programs to prepare these professionals for managing such outbreaks effectively.

The study also highlights the role of professional experience and previous exposure to co-infections in shaping familiarity with vector-borne diseases. Healthcare providers with more years of experience and those who have encountered co-infections were generally more familiar with the diseases studied. This finding emphasizes the importance of ongoing professional development and continuing education in maintaining and enhancing familiarity with vector-borne diseases. As new diseases emerge and existing ones spread to new regions, all professionals involved in public health and disease management must remain up to date with the latest information and best practices. The dynamic nature of vector-borne diseases, influenced by factors such as climate change and increased global travel, underscores the necessity of continuous learning and adaptability among healthcare professionals. Their ability to respond effectively to new and evolving disease threats is directly linked to their familiarity with the latest developments in disease prevention, diagnosis, and treatment.

Moreover, the study reveals that familiarity with vector-borne diseases is not solely determined by occupational role but is also influenced by factors such as access to information and personal experience. This suggests that public health education and training programs should be designed to reach a broad audience, including not only healthcare providers but also public health officials and researchers who play crucial roles in disease prevention and control. By ensuring that all relevant stakeholders are adequately informed, public health initiatives can be more effective in addressing the challenges posed by vector-borne diseases. The study's findings suggest that a more holistic approach to public health education is needed, one that transcends traditional boundaries and ensures that all professionals involved in public health are equipped with the necessary knowledge and skills.

The significance of this research lies in its contribution to filling the gaps in knowledge about familiarity with vector-borne diseases across different professional groups. By identifying areas where familiarity is lacking, the study provides a foundation for developing targeted interventions that can improve knowledge and awareness, ultimately leading to better public health outcomes. The findings also underscore the importance of integrating emerging diseases into routine training for all relevant professionals, as well as the need for rapid-response training modules that can be deployed when new diseases emerge. These findings have practical implications for public health policy and practice, particularly in how educational resources are allocated and how training programs are designed and implemented.

Considering these findings, several recommendations can be made. First, public health authorities should prioritize the development of comprehensive education and training programs that cover the full spectrum of vector-borne diseases, with a particular focus on emerging and less well-known diseases. These programs should be tailored to the needs of different occupational groups and should include regular updates to ensure that professionals remain informed about the latest developments in vector-borne disease management. Second, there is a need for greater investment in continuing education and professional development to ensure that healthcare providers, public health officials, and researchers are equipped to handle the dynamic challenges posed by vector-borne diseases. Finally, future research should continue to explore the factors that influence

familiarity with vector-borne diseases, with a focus on identifying the most effective strategies for improving knowledge and awareness across different regions and populations.

In conclusion, this study has provided valuable insights into the familiarity with vector-borne diseases among key professional groups, highlighting both the successes and the challenges in public health education and awareness. The findings reinforce the importance of ongoing efforts to improve familiarity with these diseases, particularly as new threats continue to emerge in an increasingly interconnected world. By addressing the gaps identified in this study, public health initiatives can be better positioned to protect populations from the growing threat of vector-borne diseases, ultimately contributing to better health outcomes on a global scale. The study's contributions underscore the need for continued vigilance, education, and innovation in the fight against vector-borne diseases, ensuring that healthcare systems and public health infrastructure are prepared to meet the challenges of the future.

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