



Sixty years of rabies mortality in highly urbanized cities of the Philippines from 1960 to 2019

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Abstract

Rabies, which is capable of infecting all warm-blooded organisms (including humans), is a primary global health concern. Data on the epidemiology of rabies in Southeast Asia, including the Philippines, are scarcely documented in the literature. Using archived data from the Philippine Health Statistics, this study examined rabies mortality in the Philippines from 1960 to 2019, with a particular emphasis on densely populated areas such as Metro Manila and Metro Cebu. It also explored relevant national strategies aimed at enhancing awareness and recognition of the disease. San Juan had the lowest mortality rate among Metro Manila communities, with a mere 56 fatalities, whereas Manila had the highest mortality rate.

Furthermore, it is worth noting that among the communities of Metro Cebu, Cebu City has the highest aggregate mortality rate, while Talisay Cebu exhibits the lowest mortality rate. The age group of children aged 5-9 years has the highest cumulative mortality rate, while those aged under one year have the lowest. Insufficient vaccination coverage, proliferation, and a lack of public awareness are the primary contributors to this alarming trend. Therefore, through collaboration among the government, the communities it serves, and the general public it educates about the disease, rabies can be prevented.

Keywords: Age, mortality, philippines, rabies, urban

Introduction

The zoonotic pathogen lyssavirus brings about rabies. Rabies can manifest in humans as well as other warm-blooded animals. Rabies is responsible for an estimated annual economic loss of 8.6 billion USD and 59,000 human fatalities. Dog assaults serve as the primary means of transmission in developing nations (Ntampaka *et al.*, 2019)^[17]. In order to achieve zero human fatalities globally from canine-transmitted rabies by 2030, the World Health Organization (WHO)^[25], the Food and Agriculture Organization of the United Nations, the Global Alliance for Rabies Control, and the World Organization for Animal Health established the "Zero by 30" goal in 2018 (WHO, 2023). The Philippine government enacted the Anti-Rabies Act of 2007 as a response to the problem at hand. The organization advocated for several measures, including an education campaign, a centralized database system, comprehensive vaccination policies, animal control and impoundment measures, pre-exposure prophylaxis for victims of animal attacks, and post-exposure treatment.

Additionally, it urged pet owners to assume greater responsibility in this matter. Though the "Rabies-Free Philippines by 2022" goal is more likely to be accomplished as a result of the legislation mentioned above, the initiative continues to be hampered by a number of obstacles. The challenges above encompass insufficient financial resources allocated to programs, inadequate support from local governments, limited public knowledge regarding preventive and control measures, and insufficient endorsement from other industries, including government and business (ASEAN, 2015)^[24].

A comprehension of the disease's epidemiology is imperative for the achievement of effective rabies control program planning. In the epidemiology of rabies in Southeast Asia, integrated literature is scarce. The disease's prevalence in nations such as India, Nepal, and Arab countries has been the primary focus of prior systematic reviews (Ling *et al.*, 2023)^[12]. The disparity in rabies-related fatalities between Asia and any other region globally signifies the severity of the disease's impact in that particular location. According to Hampton *et al.* (2015)^[9], the Americas contribute an insignificant 0.05% to the global human rabies mortality rate, while Asia and Africa collectively account for the vast majority of cases (59.6% and 36.4% alike). The high incidence of canine rabies exposure among minors and the impoverished, who frequently lack the financial means to undergo treatment or avoid the disease, presents an additional obstacle to human rabies prevention. Human-canine interactions primarily influence rabies transmission from dogs to humans; thus, it is imperative to conduct vaccination campaigns targeting dog populations in order to prevent human exposure. Funding from the Bill and Melinda Gates Foundation (BMGF) was allocated to the Department of Control of Neglected Tropical Diseases of the World Health Organisation (WHO) in order to evaluate the viability and advocate for an evidence-based approach to canine rabies vaccination in low-income nations (Miranda, 2014)^[15]. Because of the close proximity of domestic animals and humans to natural environments, the urban environment increases the risk of rabies transmission. Slum areas serve as primary concentration sites for risk factors associated with

human rabies. Unplanned waste disposal initially draws a considerable population of feral canines to the area.

In addition, the preponderance of unaccompanied children in communities presents a potentially lethal risk, considering that children are more vulnerable to dog attacks compared to adults. The prevention of human fatalities caused by rabies is notably impacted by the knowledge and attitudes of the general public (Herbert *et al.*, 2012) [10]. In urbanized regions, rabies research is crucial for safeguarding public health, gaining an understanding of the intricacies of disease transmission at the interface between humans and animals, and formulating precise approaches to avert and manage epidemics. The unproductive economic consequences of the rabies pandemic, including direct and indirect expenses related to disease control and monitoring, are a significant cause for national apprehension. Therefore, the current study outlined and analyzed rabies mortality rates in Metro Manila and Metro Cebu cities over sixty years in order to undertake a comprehensive assessment of primary data for disease research and control.

The research tool

Researching rabies in areas with high population density is of the utmost importance in order to formulate effective interventions, comprehend the intricate mechanisms of disease transmission in urban settings, and ensure the protection of global public health. A correlation exists between the higher population density and heightened risk in urban regions. A significant proportion of creatures and humans coexist in close proximity in urban areas. Considering that this promotes the spread of rabies from animals to humans, a preventative measure must be developed to safeguard the public. Additionally, numerous feral and domesticated animals inhabiting urban areas are susceptible to contracting rabies. Urban rabies research can provide valuable insights into preventative measures for the disease and the safeguarding of canines.

Furthermore, urban ecosystems provide shelter for a wide variety of animal species. The risk of rabies transmission to other animal species is heightened. Research into rabies aids in the prevention of emerging dangers.

Additionally, both fauna and humans engage in extensive travel between nations and cities. By analyzing urban rabies, a more comprehensive comprehension of the disease's potential for global transmission can be attained. It is essential to possess this knowledge in order to ensure the safety and security of every individual in every location. Significant expenses may also be incurred in the event of rabies epidemics. Thus, our understanding of it in urban settings will contribute to the mitigation of outbreaks.

A. Data collection

The annual publication of the Department of Health (DOH), the Philippine Health Statistics (PHS) series, was utilized to compile rabies mortality and fatality statistics for each city in Metro Manila and Metro Cebu. PHS series information is collected regarding significant health events. The document provides an exhaustive synopsis of the prevailing rates of

mortality, morbidity, and natality within the nation. The Philippine Health System (PHS) was developed through the joint efforts and cooperation of this department, local health unit allies, and the Philippine Statistics Authority.

B. Total mortality rates computation

From 1960 to 2019, the total mortality rates for Metro Manila were calculated. The region included Pateros, Caloocan, Marikina, Makati, Mandaluyong, Muntinlupa, Manila, Navotas, Malabon, Valenzuela, Pasay, Pasig, Parañaque, Quezon, San Juan, Las Piñas, and Taguig. Carcar, Cebu City, Danao, Lapu-Lapu, Mandaue, Naga, Talisay, Compostela, Consolacion, Cordova, Liloan, Minglanilla, and San Fernando had the corresponding mortality rates for Metro Cebu. In the Philippines, age-specific total mortality rates for rabies were calculated for the following age cohorts: neonates aged one and below, individuals aged 50-54, 55-59, 60-64, 65-69, and 70 years and older; individuals aged 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39; individuals aged 40-44, 45-49, 50-54, 55-59, 60-64, 65-69; and 35-39.

C. Data analysis

The formula function implemented in Microsoft Excel was utilized to compute the proportionate mortality rate attributable to rabies. The information regarding the study's outcomes between 1960 and 2019 was communicated via a scatter plot line graph for each city's data and a histogram depicting age-specific mortality.

Results and discussions

Rabies poses a substantial worldwide public health dilemma, specifically in developing nations where canines are the primary vectors of disease transmission to humans (Fooks *et al.*, 2014) [8]. Figure 1 illustrates the cumulative mortality resulting from rabies across multiple communities located in Metro Manila, Philippines. The data indicates that Manila exhibits the highest mortality rate, amounting to 56 fatalities in total. San Juan, on the other hand, has the lowest mortality rate due to a singular incident. Moreover, there was a lack of data collected pertaining to Pateros. As reported by Chaudhari *et al.* (2022) [4], the mortality rate in Quezon City was ranked second highest. The vast majority of Quezon residents own a single dog, which they primarily utilize as a companion or guardian.

Moreover, a significant proportion of the surveyed households were duly apprised of the existence of the rabies virus. This serves as a prime example of the vast potential and advantages that can be derived from running an education and awareness campaign in conjunction with the annual immunization schedule. Wildlife's impact on the epidemiology of rabies in the Philippines is minimal. Although wildlife does not appear to be a direct cause of the rabies epidemic in the Philippines, its presence can substantially escalate the financial burden associated with rabies eradication in various other countries (Miranda, 2014) [15].

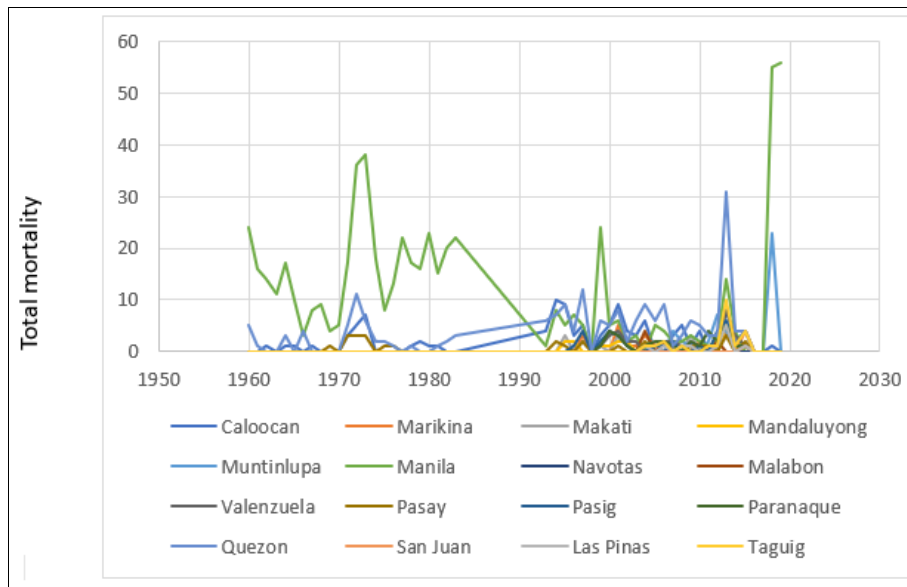


Fig 1: Metro Manila cities' total mortality from year 1960 to 2019.

Manila experienced its highest cumulative fatalities in 2019 (Figure 2), in contrast to the years 1998 and 2004, which saw no reported cases. Human rabies cases in the metropolis of Metro Manila have continued to transmit the virus to neighboring regions for the past six decades. The Philippines has identified rabies as a substantial public health issue due to the 250 documented human rabies fatalities that occurred in 2008. Akin to other regions in

Asia, the majority of rabies-related fatalities were attributed to canine infections, with at least one-third of these cases involving children younger than fifteen years of age (Dodet, 2010) [7]. The proliferation of excessive pet populations, uncontrolled free-roaming animals, and related public health issues, including the transmission of zoonotic diseases (notably rabies), can be attributed to negligent pet owners (Selby *et al.*, 1979) [21].

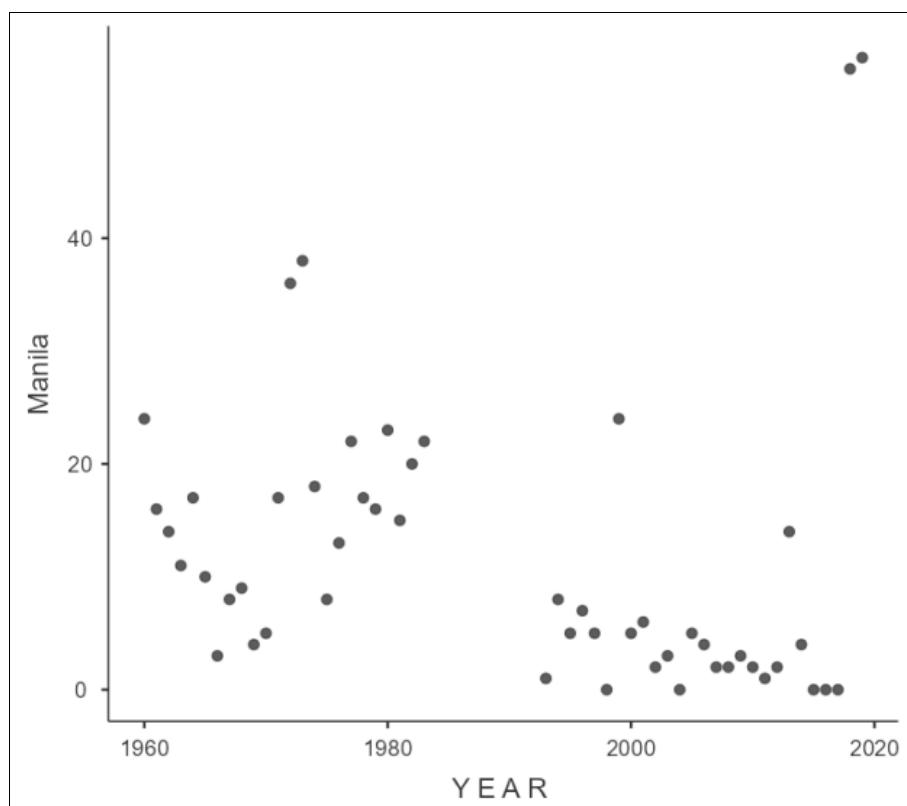


Fig 2: Manila City total mortality from year 1960 to 2019.

Figure 3 illustrates that among the communities of Metro Cebu, Cebu City has the highest aggregate mortality rate. In contrast, Talisay Cebu exhibits the lowest mortality rate. The data pertaining to Talisay, Danao, Lapu-Lapu, Cebu

City, and Mandaue is exclusive to the DOH website. In 2010, the canine vaccination rate in Carmen stood at 61%, whereas in Cebu City, it was a mere 11%. Estimates suggest that rabies could endure in dog populations where

vaccination rates fall below 70% (Miranda, 2005) [13]. The rabies eradication campaign in the Visayas has emerged relatively recently. Visayas is one of three groupings of islands in the Philippines; the other two are Mindanao and

Luzon. These three areas, boasting a population surpassing 17 million, account for over one-third of all documented instances of human rabies in the Philippines (Dodet, 2010) [7].

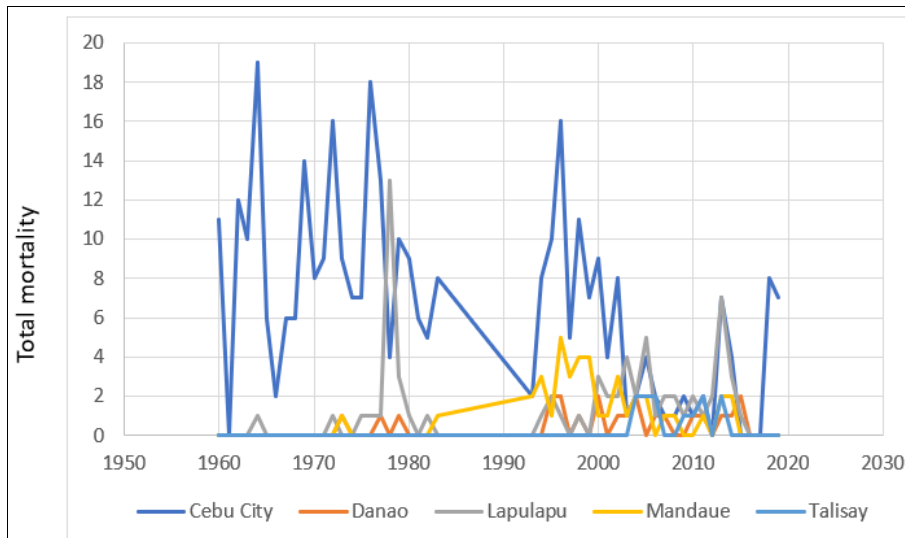


Fig 3: Metro Cebu cities' total mortality from year 1960 to 2019.

The greatest known total mortality rate was documented in Cebu City in 1964. It is critical to mention that during that time period, rabies vaccination for canines had not yet become widely available (Figure 4). From 2010 to 2012, practically all of Cebu City's canines were vaccinated as a result of extensive promotional initiatives, resulting in the lowest total mortality rate as of 2012. According to Miranda (2013) [14], cost estimates for the period of 2010-2012 in Cebu City revealed that district-level mass vaccination campaigns for dogs were more economically viable than clinic-based or fixed-site vaccination programs. The focus is

progressively transitioning to neighboring provinces in the Philippines, where rabies continues to be a substantial ailment, as certain areas near complete eradication. Leaders of similar projects in neighboring regions have been striving to establish similar endeavors with the intention of expanding the elimination area or, at the very least, strengthening its borders. The principal obstacles to eradicating rabies, according to a consensus (San Jose *et al.*, 2020) [18], are negligent behavior and a lack of awareness of conscience among dog owners.

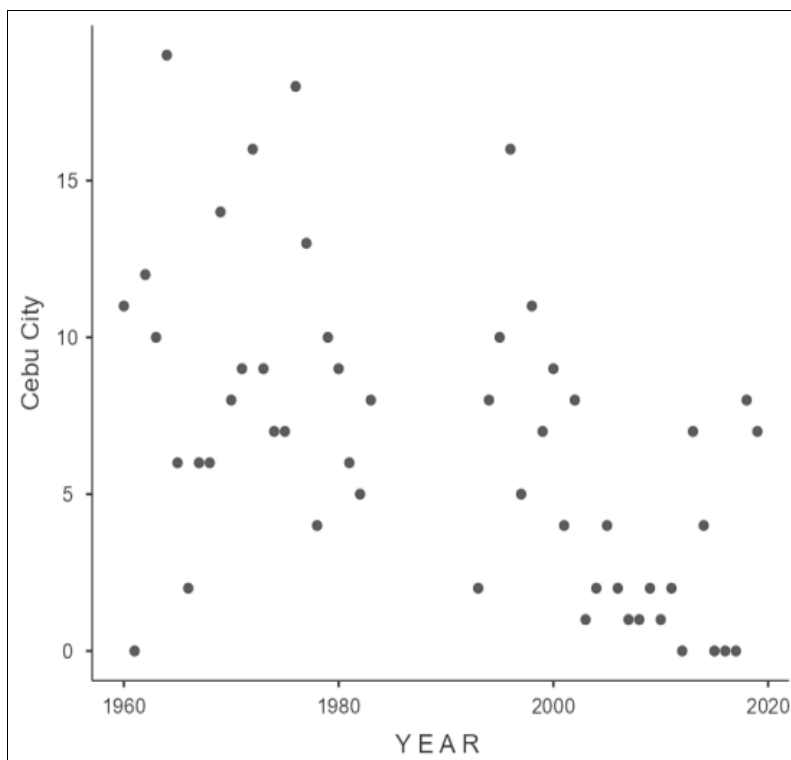


Fig 4: Cebu City's total mortality from the year 1960 to 2019

According to these findings, Manila and Cebu City had the highest incidence of rabies cases in relation to the prevalence of dog ownership and population size. Certain proprietors neglected to vaccinate their canines for a variety of reasons, including unavailability during technician visits, busy schedules, ignorance of the immunization schedule, or inadequate control over their animals. Another notable factor that contributed to the failure to vaccinate canines was the absence of knowledge concerning the vaccination schedules of canine health programs (San Jose, 2020) ^[18].

Based on age-specific data, it can be observed that the total mortality rate is most significant among infants aged five to six years, while it is least among those aged one year (Figure 5). A recent global survey indicates that the probability of childhood vaccination subsequent to a dog assault is more significant in comparison to vaccination in adults (Song, 2014) ^[22]. Hence, it is possible to forecast fluctuations in pathogenesis, immune responses, infection rates, survival periods, and mortality rates based on the age of an individual (Scott and Nel, 2016) ^[20].

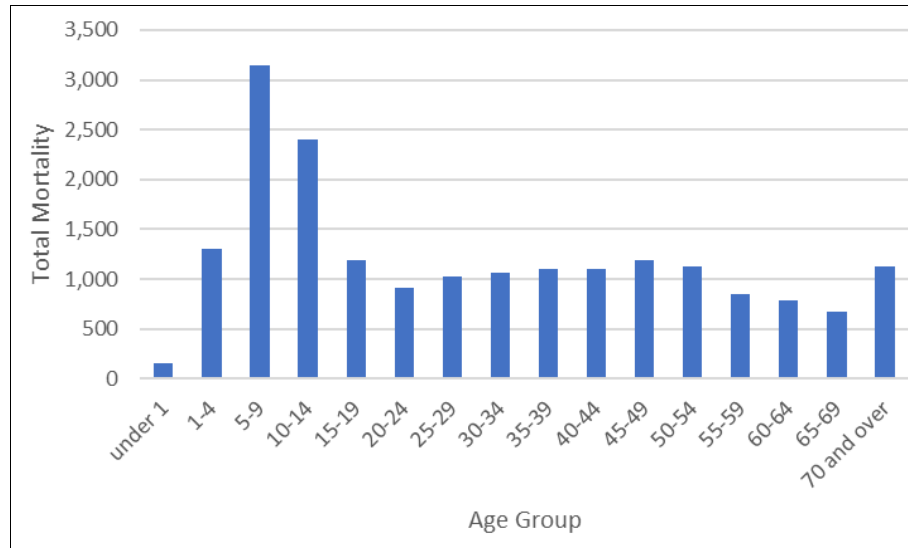


Fig 5: Mortality of rabies per age group in the Philippines from 1960 to 2019.

Variations in the prevalence of rabies occur annually and between cities due to an assortment of factors. Legislation was passed towards the end of the 1950s that mandated yearly vaccinations for canines that were three months of age or older, established penalties for failure to comply, and implemented strategies to regulate and eradicate errant canines. Due to the implementation of this initiative, the number of canines residing in Manila has reduced from 30,000 in the late 1950s to 10,000 at present. Furthermore, for the past seven years, no documented instances of rabies among canines in Manila have been established (Armbullo III *et al.*, 1972) ^[1]. According to Yuson *et al.* (2023) ^[27], determining the vaccination status of stray dogs is difficult because none of them were registered as vaccinated, despite the possibility that some of them were runaways, formerly owned canines, or have become free after the unwitting death of their owners. Schneider *et al.* (2015) ^[19] report that the urban and suburban areas of the Philippines are experiencing household congestion and accelerated population growth. The annual transmission of canine rabies may be facilitated in part by vehicular traffic (Brunker *et al.*, 2018) ^[3]. A correlation between the capacity of the virus to spread and the proximity to a road has been established (De Andrade *et al.*, 2016) ^[5]. There exists a positive correlation between the occurrence of bullying and several prognostic factors, such as the density of dogs and residents in urban areas, the width of primary and secondary roads, and more. The potential impact of congested transport systems in urban areas on the transmission of the rabies virus among

companion animals is significant (Thanapongtharm *et al.*, 2021) ^[23].

In addition, it is worth noting that a high density of dogs may lead to a substantial turnover rate among staff, consequently reducing the extent of vaccination coverage in the affected areas (Jerrard, 2004) ^[11]. It is crucial to implement comprehensive regulations that address multiple aspects of response, management, and prevention in order to address the rabies dilemma effectively. Raising community awareness is vital for the prevention and control of rabies. While immunization remains the most productive approach to rabies prevention, it was additionally recommended that canines adhere to clean enclosures, cleanse regularly, and refrain from unrestricted excursions. Although this does not directly influence the spread of the virus, it is nonetheless recommended to strengthen ethical guidelines regarding the ownership of companion animals. In addition to governmental initiatives, community members must engage in collaborative endeavors to foster rabies awareness and encourage responsible pet ownership. Rabies incidence can be decreased through collaboration with the government, the communities it serves, and the citizens it educates regarding the disease (Barroga *et al.*, 2018) ^[2]. It is mandatory for the majority of individuals who have been bitten to promptly seek medical care and administer appropriate first aid rather than persisting in seeking guidance from traditional healers or engaging in consultations (Dizon *et al.*, 2022) ^[6].

In order to mitigate the health risks associated with the disease, neighborhood rabies prevention and control strategies must be substantially enhanced, according to the

findings of the present study. Effective rabies eradication in the neighborhood would require an additional awareness-raising campaign employing a variety of methods, according to the findings of the study. In addition, effective prevention and management of rabies can be achieved through the implementation of public health initiatives and strategies, such as mass vaccination campaigns, animal population reduction, collaboration and coordination, adequate surveillance and monitoring, and similar programs (WHO, 2019). The challenges faced by various regions in the Philippines in their efforts to fully eradicate rabies can be attributed to the inadequate vaccination rate among canines. Therefore, the nation must adopt more pragmatic and effective strategies for managing rabies (Morilla *et al.*, 2023) [16].

Conclusion

The efficacy of the Philippines' national rabies control and prevention program is substantiated by the seventy-year decline in rabies-related fatalities in designated localities. Likewise, the research revealed that children are at a greater risk of acquiring rabies as a result of their restricted consciousness, understanding, and supervision. Furthermore, these results could be applied to future studies concerning canine rabies in the Philippines, allowing for a more thorough evaluation of the advantages and disadvantages of dog vaccination programs in other regions.

References

1. Armbullo III PV, Beran GW, Escudero SH. Eradication of Rabies in the Philippines. *HSMHA Health Reports*,1972;87(1):89.
2. Barroga TRM, Basitan IS, Lobete TM, Bernales RP, Gordoncillo MJN, Lopez EL, *et al.* Community Awareness on Rabies Prevention and Control in Bicol, Philippines: Pre- and Post-Project Implementation. *Tropical Medicine and Infectious Diseases*,2018;3:16. doi:10.3390/tropicalmed3010016
3. Bruncker K, Lemey P, Marston DA, Fooks AR, Lugelo A, Ngeleja C, *et al.* Landscape attributes governing local transmission of an endemic zoonosis: Rabies virus in domestic dogs. *Mol Ecol*,2018;27:773-788.
4. Chaudhari A, Kartal T, Brill G, Amano KJ, Lagayan MG, Jorca D. Dog Ecology and Demographics in Several Areas in the Philippines and Its Application to Anti-Rabies Vaccination Programs. *Animals*,2022;12:105. <https://doi.org/10.3390/ani12010105>
5. De Andrade FA, Gomes MN, Uieda W, Begot AL, Ramos ODS, Fernandes ME. Geographical analysis for detecting high-risk areas for bovine/human rabies transmitted by the common hematophagous bat in the Amazon region, Brazil. *PLoS One*,2016;11:e0157332.
6. Dizon TJR, Saito N, Inobaya M, Tan A, Reñosa MDC, Bravo TA, *et al.* Household survey on owned dog population and rabies knowledge in selected municipalities in Bulacan, Philippines: A cross-sectional study. *PLoS Negl Trop Dis*,2022;16(1):e0009948. <https://doi.org/10.1371/journal.pntd.0009948>
7. Dodet B. Report of the sixth AREB meeting, Manila, The Philippines,2009;28(19):0-3268. doi:10.1016/j.vaccine.2010.02.093
8. Fooks AR, Banyard AC, Horton DL, Johnson N, McElhinney LM, Jackson AC. Current status of rabies and prospects for elimination. *Lancet*,2014;384:1389-1399. [https://doi.org/10.1016/S0140-6736\(13\)62707-5](https://doi.org/10.1016/S0140-6736(13)62707-5) PMID: 24828901
9. Hampson K, Coudeville L, Lembo T, *et al.* Estimating the global burden of endemic canine rabies. *PLoS Negl Trop Dis*,2015;9:e0003709.
10. Herbert M, Basha SR, Thangaraj S. Community perception regarding rabies prevention and stray dog control in urban slums in India. *Journal of Infection and Public Health*,2012;5:374-380.
11. Jerrard DA. The use of rabies immune globulin by emergency physicians. *J Emerg Med*,2004;27:15-9. <https://doi.org/10.1016/j.jemermed.2004.02.005> PMID: 15219298
12. Ling MYL, Abdul Halim AFN, Ahmad D, Ramly R, Hassan MR, Abdul Rahim SSS, *et al.* Rabies in Southeast Asia: a systematic review of its incidence, risk factors and mortality. *BMJ Open*,2023;13:e066587. doi:10.1136/bmjopen-2022-066587
13. Miranda ME. Rabies Research Program. Research Institute of Tropical Medicine: Department of Health, Philippines, 2005.
14. Miranda ME. Health and economic costs and benefits of rabies elimination at the Local Government Unit level. 11th Convention and Scientific Conference of the Provincial, City and Municipal Veterinarians League of the Philippines, 2013.
15. Miranda LM, Miranda ME, Hatch B, Deray R, Shwiff S, Roces MC, *et al.* Towards Canine Rabies Elimination in Cebu, Philippines: Assessment of Health Economic Data. 5 Blackwell Verlag GmbH, Transboundary and Emerging Disease, 2014.
16. Morilla RBG, Cabanlit KL, Luga AMF, Demayo CJ, Sidic JB, Demayo CG. Assessing six decades of rabies in the Philippines. *International Journal of Public Health Science (IJPHS)*,2023;12(1):1-10.
17. Ntampaka P, Nyaga PN, Niragire F, Gathumbi JK, Tukei M. Knowledge, attitudes and practices regarding rabies and its control among dog owners in Kigali city, Rwanda, 2019. *PLOS ONE* | <https://doi.org/10.1371/journal.pone.0210044>
18. San Jose RD, Magsino PJP, Bundalian Jr RDL. Factors Affecting The Knowledge, Attitude, and Practices of Pet Owners on Responsible Pet Ownership in Magalang, Pampanga, Philippines: A Cross-Sectional Study. *Philipp. J. Vet. Med.*,2020;57(2):182-195.
19. Schneider A, Mertes CM, Tatem AJ, Tan B, Sulla-Menashe D, Graves SJ, *et al.* A new urban landscape in East-Southeast Asia, 2000-2010. *Environ Res Lett*,2015;10:034002. <https://doi.org/10.1088/1748-9326/10/3/034002>
20. Scott T, Nel. "Subversion of the Immune Response by Rabies Virus," *Viruses*,2016;8(8):231. doi: 10.3390/v8080231

21. Selby LA, Rhoades JD, Hewett JE, Irvin JA. A survey of attitudes toward responsible pet ownership. *Public Health Reports*, 1979;94(4):380–386.
22. Song M, Tang Q, Rayner S, Tao XYa, Shen Xxi, Liang GD. "Factors influencing the number of rabies cases in children in China," *Biomedical and Environmental Sciences: BES*, 2014;27(8):627–632. doi: 10.3967/bes2014.095
23. Thanapongtharm W, Suwanpakdee S, Chumkaeo A, Gilbert M, Wiratsudaku A. Current characteristics of animal rabies cases in Thailand and relevant risk factors identified by a spatial modeling approach. *PLoS Negl Trop Dis*, 2021;15(12):e0009980. <https://doi.org/10.1371/journal.pntd.0009980>
24. The ASEAN Secretariat. ASEAN rabies elimination strategy. Thailand: OIE World Organization for Animal Health, 2015.
25. World Health Organization, Food and Agriculture Organization of the United Nations and World Organisation for Animal Health. Zero by 30: the global strategic plan to end human deaths from dog-mediated rabies by 2030. Available from: <https://apps.who.int/iris/handle/10665/272756>
26. World Health Organization. WHO expert consultation on rabies: third report. World Health Organization <https://apps.who.int/iris/bitstream/handle/10665/272364/9789241210218-eng.pdf>.
27. Yuson M, Manalo DL, Miranda MEG, Hampson K, Telmo S. Rabies in the Greater Manila Area and Region IV-B of the Philippines and the Potential Impact of Age-targeted Dog Vaccination. CAB International, *One Health for Dog-mediated Rabies Elimination in Asia*, 2023, 99-114.