



Epidemiological Profile of Human Rabies in Morocco: A National Study Over a 7-Year Period

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Abstract

Introduction: Rabies, a deadly neurotropic infection caused by the rabies virus, remains a significant public health concern globally. Despite its preventable nature through vaccination, tens of thousands of deaths occur annually, particularly affecting children under 15. Rabies is virtually 100% fatal. Morocco, despite a national strategy, continues to report cases. This study aims to describe the epidemiological profile of human rabies in Morocco over seven years (2015-2021).

Materials and methods: This is a nationwide retrospective descriptive study using epidemiological surveillance data from the Ministry of Health and Social Protection, providing information on the distribution, demographics, and characteristics of rabies cases recorded between 2015 and 2021.

Results: Over the seven-year period studied, Morocco recorded 120 cases of rabies, with 96 affecting males. The annual average was 17.1 cases, reaching its peak in 2019 with 22 cases and its lowest point in 2020 with 9 cases. Children under 9 years old accounted for 35.8% of all cases, and 72.4% of the cases originated from rural areas. The dog was the main vector (87.2%). Despite the implementation of preventive measures, unfortunately, all cases resulted in fatalities.

Conclusion: This study highlights the persistence of the rabies threat in Morocco despite national initiatives, emphasizing the importance of strengthening targeted efforts in prevention and education, especially for children, men, and individuals living in rural areas, while addressing the challenges associated with post-exposure prophylaxis.

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Introduction

The Rabies Virus (RABV), classified within the family Rhabdoviridae under the genus *Lyssavirus*, is a neurotropic infection impacting the Central Nervous System (CNS) in both humans and animals [1]. This zoonotic viral disease is preventable through vaccination. Despite its preventable nature, rabies still results in tens of thousands of deaths annually, with children under the age of 15 (5 to 14 years old) accounting for 40% of the fatalities [2].

Rabies is observed in 150 countries and on all continents except Antarctica [3], with the African continent being particularly affected, witnessing an estimated 25,000 deaths every year [4].

Dogs are the primary carriers of the rabies virus, responsible for transmission to humans in the vast majority of cases (99%) [5], who contract the virus from other dogs or wild animals [6]. The virus is typically transmitted through saliva, mainly following a bite, but it can also occur through direct contact of saliva with mucous membranes (eyes, mouth, or open wounds) [5], with a significantly higher risk of transmission following bites compared to licking (5 to 80% versus 0.1 to 1%) [7], and severity that varies depending on the location of the bite and the amount of virus present in the animal's saliva [8].

After viral transmission, the Rhabdovirus spreads from the peripheral nervous system to the central nervous system, causing encephalomyelitis [9]. Initial symptoms include fever, discomfort, headaches, progressing to anxiety and delirium [10,11]. A tingling sensation at the bite site is typical [12]. The virus targets highly innervated areas before migrating to the CNS [1]. Hypersalivation leads to hydrophobia, with spasms triggered by the sight, taste, or sound of water [13]. The infection results in immediate death due to the collapse of the nervous system [14]. Namely, once clinical symptoms appear, rabies is virtually 100% fatal [5].

The spread of rabies can be almost entirely prevented through wound care provided within the first 3 hours following exposure to the virus [15], which should be accompanied by the administration of rabies serum and rabies vaccine [16]. Meanwhile, the diagnosis is primarily clinical and based on the succession of the following three stages: prodromal, excitement, and paralysis [17].

In 2015, four international organizations – the World Health Organization (WHO), the World Organisation for Animal Health (OIE), the Food and Agriculture Organization of the United Nations (FAO), and the Global Alliance for Rabies Control (GARC) - joined forces and launched a program to achieve “zero human deaths from dog-transmitted rabies by 2030” [18].

In Morocco, despite the existence of a national strategy to combat rabies, the spread persists, with an annual average of 400 cases of animal rabies and 20 cases of human rabies recorded in the country [19]. The primary goal of this program is to eliminate dog-transmitted rabies by approximately 2025. The program is structured around key components, including epidemiological surveillance, prevention (mass vaccination of dogs, post-exposure prophylaxis, health policing), medical care for rabies cases (symptomatic treatment), and lastly, education, awareness, and training of professionals across relevant departments [19].

This study aims to describe the epidemiological profile of human rabies in Morocco over a period of 7 years (2015-2021).

Materials and methods

Study design

This is a nationwide retrospective descriptive study, utilizing data recorded by the National Directorate of Epidemiology and Disease Control (DEDC) of the Ministry of Health and Social Protection in Rabat. The focus is on rabies cases over a 7-year period, from January 1, 2015, to December 31, 2021.

In this study, we included all patients declared with rabies across the kingdom's diverse healthcare facilities, while excluding patients not officially declared and all unusable data.

Data collection

Data were collected from computerized records using the Excel software of the DEDC. An exploitation sheet was created to study parameters such as age, gender, urban or rural origin, region, hospitalization status, biting animal, vaccination status, administration of antiserum, and vital prognosis.

Statistical analysis

A descriptive analysis was conducted, describing qualitative variables using percentages and quantitative variables using mean and standard deviation.

Statistical analysis was performed using version 26 of the SPSS software.

Results

Over a seven-year period from January 2015 to December 2021, Morocco recorded a total of 120 rabies cases distributed throughout the entire kingdom, with an average of 17.1 ± 4.2 cases. The year 2020 recorded the lowest number of cases, with 9, while the year 2019 recorded the highest number with 22 cases (Figure 1 illustrates the distribution of the number of reported cases over the years).

Figure 2 illustrates the distribution of reported rabies cases in Morocco over the seven-year study period, categorized by age. Notably, children under 9 years old accounted for over one-third of the cases (35.8%), followed by those aged between 10 and 19 years, constituting 26.7% of the cases. Individuals aged over 60 years accounted for 12.5% of the cases, while those aged between 20 and 29 years were the least affected, representing only 2.5% of the cases.

Figure 3 presents the annual distribution of rabies cases in Morocco from 2015 to 2021, categorized by age groups. It is observed that, for the majority of years, the age group of 0 to 9 years is most frequently affected, occasionally replaced by the age group of 10 to 19 years. In contrast, the age groups of 20 to 29 years and 30 to 39 years were generally the least affected.

Figure 4 depicts the distribution of rabies cases in Morocco, categorized by gender and year. It is observed that, with the exception of the year 2020, where the number of cases was nearly equal between men and women, all other years consistently recorded a significantly higher number of cases in men compared to women, with a total of 96 men compared to 21 women.

According to the data in Table 1, illustrating the general characteristics of rabies cases in Morocco, it is noted that the majority of cases originated from rural areas (72.4%), with the Marrakech Safi and Rabat Salé Kenitra regions recording the highest number of cases (18.8% each), followed by the Sous Massa region (16.2%), Casablanca Settat (14.5%), and Fès Meknès

(10.2%). In contrast, the regions of Dakhla Oued Eddahab and Laayoun Sakia El Hamra reported no cases throughout the study period. Dogs emerge as the primary vectors of rabies, contributing to 87.2% of cases, followed by cats (11.1%). Regarding case management, it is noteworthy that the majority (90.3%) were hospitalized, 50% were vaccinated, and 16.4% received antiserum. Unfortunately, all cases recorded have resulted in fatalities.

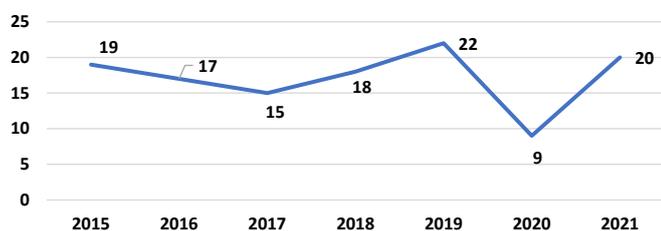


Figure 1: Number of reported rabies cases in Morocco over the years.

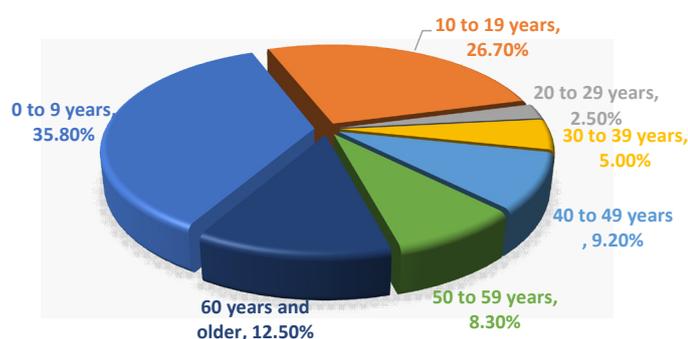


Figure 2: Distribution of reported rabies cases in Morocco based on the age of patients.

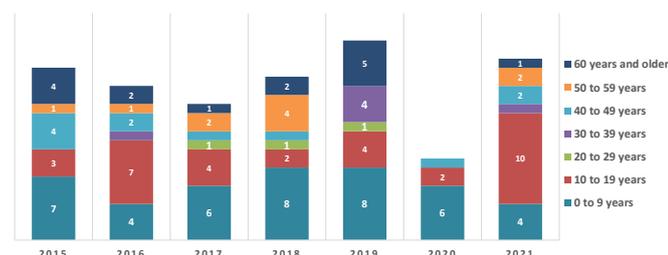


Figure 3: Annual distribution of rabies cases in Morocco from 2015 to 2021 categorized by age groups.

Discussion

The main objective of this study is to describe the epidemiological profile of human rabies in Morocco over a period of 7 years, and it was observed that during this period, Morocco recorded 120 cases of human rabies, with an average of 17.1 ± 4.2 cases. This allows us to suggest that rabies continues to decrease in Morocco, given that the latest estimates report an annual average of 20 cases of human rabies [19].

However, it is worth noting that the observed average during the period of our study is influenced by the 9 cases recorded in the year 2020, a period during which the Moroccan and international healthcare systems were impacted by the COVID-19 pandemic. Since the WHO declared globally that approximately half of essential health services have been disrupted [20].

In our study, dog bites constituted the main source of rabies, accounting for 87.2% of reported cases, most likely due to the presence of stray dogs, a problem observed not only in Morocco



Figure 4: Distribution of reported rabies cases in Morocco based on the gender of patients (N = 117).

Table 1: Geographic and Clinical Characteristics of Rabies Cases in Morocco.

		N (%)
Origin (N = 116)	Rural	84 (72.4)
	Urban	32 (27.6)
Region (N = 117)	Marrakech Safi	22 (18.8)
	Rabat Salé Kenitra	22 (18.8)
	Sous Massa	19 (16.2)
	Casablanca Settat	17 (14.5)
	Fès Meknès	12 (10.2)
	Tangier Tetouan Al Hoceima	08 (6.8)
	Beni Mellal Khenifra	07 (6.0)
	Draa Tafilaat	05 (4.3)
	Oriental Region	03 (2.7)
	Guelmim Oued Noun	02 (1.7)
	Dakhla Oued Eddahab	00 (0.0)
Laayoun Sakia El Hamra	00 (0.0)	
Biting Animal (N = 117)	Dog	102 (87.2)
	Cat	13 (11.1)
	Rat	01 (0.8)
	Donkey	01 (0.8)
Hospitalisation (N = 103)	Yes	93 (90.3)
	No	10 (9.7)
Vaccination Status (N = 80)	Vaccinated	40 (50)
	Unvaccinated	40 (50)
Administration of antiserum (N = 73)	Yes	12 (16.4)
	No	61 (83.6)
Deaths (N = 100)	Yes	100 (100)
	No	0 (0)

co [21], but in other countries on the African continent such as Tunisia, in which a study demonstrated that the increase in the incidence of rabies in dogs was attributed to the rise in the number of stray dogs [22]. Stray dogs in Asia and Africa play a significant role in human infection [23], with these continents being responsible for the majority of global human rabies cases [24,25].

Children and adolescents accounted for almost two-thirds of the recorded cases of rabies in our study. These findings align with those of a study conducted at Dhaka Hospital in Bangladesh, where children aged 14 and under represented 59.5% of all cases recorded at the hospital [26]. Additionally, an Indian study showed that rabies was statistically higher among children aged 5 to 14 [27]. These prevalence rates can be explained by the fact that the small size of children increases the risk of bites near the head and neck, raising the likelihood of developing the disease more rapidly in the absence of timely and appropriate treatment. Moreover, there is an increased expo-

sure of these age groups to stray animals, coupled with limited knowledge or awareness of how to prevent contact with these animals. This emphasizes the importance of targeted initiatives in education and vaccination against rabies, especially for children and young adults.

The gender-based disparities in rabies exposure observed in our study, where men constituted 82.05% of the cases, can be explained by cultural, occupational, and behavioral factors predisposing men to more frequent contact with potential rabies vectors. Additionally, an increase in knowledge levels among women compared to men was observed, as demonstrated in a Moroccan study conducted in El Jadida region [28]. This study assessed the knowledge, attitudes, and practices of residents regarding rabies and concluded that women had a higher level of knowledge than men. Different international studies have shown that the prevalence of rabies is higher in men than in women [26,27,29]. This underscores the need to develop prevention and education programs specifically targeting men regarding rabies.

The geographic distribution of rabies cases in Morocco highlights a predominance of cases in rural areas (72.4%). In this regard, a Moroccan review of regulatory texts on rabies published between 1913 and 2014 in the Moroccan Official Journal showed that 80% of the reports originated from rural areas, with only 20% from urban areas [30]. Similar trends have been noted in China, where human rabies cases were largely reported in eastern and southern regions, suggesting a relationship between rural zones and rabies outbreaks [31].

According to the WHO, anyone suspected of exposure to rabies must be treated immediately to prevent the onset of clinical symptoms and death. The treatment depends on the level of exposure; in case of light contact with animals (category I), no prophylaxis is necessary. For minor scratches (category II), immediate vaccination is recommended. In the case of severe exposure, such as significant bites or scratches (category III), it is advised to opt for immediate vaccination and the administration of rabies immunoglobulins to prevent rabies [32]. In our study, only 50% of cases were vaccinated, and 16.4% received administration of rabies immunoglobulins. These low rates can be explained by the delayed consultation among exposed individuals, given that in Morocco, preventive measures are mandatory for all individuals post-exposure to a suspicious animal. This includes immediate washing and local care, vaccination on days 0, 7, and 21, and serum therapy as indicated. However, for cases of human rabies that sought medical attention after the onset of symptoms, only symptomatic treatment is recommended [19]. This suggests that the majority of rabies cases diagnosed during our study consulted only after the appearance of symptoms, which contraindicates any possibility of vaccination or serum therapy.

According to the World Organisation for Animal Health, rabies causes the death of 59,000 people annually, with over 95% of these deaths occurring in Africa and Asia. It is a 100% fatal disease in both humans and animals. This aligns with the findings of our study, as all reported cases of rabies resulted in death.

Conclusion

This research highlights the persistence of the rabies threat in Morocco despite national initiatives. While the observed decrease in cases indicates progress, challenges persist, particularly among children, men, and in rural areas, necessitating a

multifaceted approach. As Morocco works towards rabies elimination, these findings offer valuable insights to optimize strategies and prioritize interventions in the ongoing battle against this preventable yet deadly disease.

Recommendations

- To enable Morocco to achieve its goal of eradicating rabies by 2025, several recommendations can be considered, including:
 - Establishing regular mechanisms for collecting data on the canine population, particularly dogs.
 - Mandating regular and independent evaluations of the national rabies control program to enhance strategies for disease prevention and control.
 - Strengthening communication campaigns on rabies through various channels, including traditional media and digital platforms.
 - Intensifying awareness campaigns focused on preventive practices, with an emphasis on at-risk populations such as children, men, and rural communities.
 - Educating pet owners about the importance of vaccination and facilitating access to vaccination services.
 - Facilitating coordination between the sectors of animal health and human health by strengthening partnerships and promoting the exchange of information.
 - Enforcing hygiene standards in slaughterhouses and public dumps through regular inspections to ensure compliance with established norms.
 - Developing strategic supply plans to ensure the constant availability of rabies vaccines and treatments.
 - Implementing continuous training programs for medical and paramedical personnel involved in post-exposure prophylaxis, as well as personnel involved in rabies management in various sectors.
 - Establishing automated monitoring systems to ensure patients' compliance with the post-exposure prophylaxis protocol.

Ethical considerations

Data collection was approved by the DEDC director (Dr. Mohammed Youbi), with respect for patient anonymity and the confidentiality of their information.

References

1. Fariyah IH, Nr ADJ, Arsiazi BAA, Nabila C, Anggrayani P. Neuro-pathogenesis of human rabies. *KESANS Int J Health Sci.* 2022; 1: 376–86.
2. Al-Mustapha AI, Bamidele FO, Abubakar AT, Ibrahim A, Oyewo M, Abdulrahim I, et al. Perception of canine rabies among pupils under 15 years in Kwara State, North Central Nigeria. *PLoS Negl Trop Dis.* 2022; 16: e0010614.
3. Kavoosian S, Behzadi R, Asouri M, Ahmadi AA, Nasirikenari M, Salehi A. Comparison of rabies cases received by the Shomal Pasteur Institute in Northern Iran: a 2-year study. *Glob Health Epidemiol Genomics.* 2023; 2023: 3492601.
4. Dodet B, Tejiokem MC, Aguemon AR, Bourhy H. Human rabies deaths in Africa: breaking the cycle of indifference. *Int Health.* 2015; 7: 4–6.

5. World Health Organization. Rabies. 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/rabies>
6. Audu SW, Mshelbwala PP, Jahun BM, Bouaddi K, Weese JS. Two fatal cases of rabies in humans who did not receive rabies post-exposure prophylaxis in Nigeria. *Clin Case Rep.* 2019; 7: 749.
7. Singh R, Singh KP, Cherian S, Saminathan M, Kapoor S, Manjunatha Reddy GB, et al. Rabies – epidemiology, pathogenesis, public health concerns and advances in diagnosis and control: a comprehensive review. *Vet Q.* 2017; 37: 212–51.
8. Setiawan KH, Probandari AN, Pamungkasari EP, Tamtomo DG. Human behaviour in keeping dogs and its relationship to rabies. *Int Res J Manag IT Soc Sci.* 2018; 5: 105–13.
9. Potratz M, Zaack LM, Weigel C, Klein A, Freuling CM, Müller T, et al. Neuroglia infection by rabies virus after anterograde virus spread in peripheral neurons. *Acta Neuropathol Commun.* 2020; 8: 199.
10. Mahadevan A, Suja MS, Mani RS, Shankar SK. Perspectives in diagnosis and treatment of rabies viral encephalitis: insights from pathogenesis. *Neurotherapeutics.* 2016; 13: 477–92.
11. Burgos-Cáceres S. Canine rabies: a looming threat to public health. *Anim Open Access J MDPI.* 2011; 1: 326–42.
12. Chacko K, Parakadavathu RT, Al-Maslamani M, Nair AP, Chekura AP, Madhavan I. Diagnostic difficulties in human rabies: a case report and review of the literature. *Qatar Med J.* 2016; 2016: 15.
13. Cárdenas-Canales EM, Gigante CM, Greenberg L, Velasco-Villa A, Ellison JA, Satheshkumar PS, et al. Clinical presentation and serologic response during a rabies epizootic in captive common vampire bats (*Desmodus rotundus*). *Trop Med Infect Dis.* 2020; 5: 34.
14. Azimzadeh Jamalkandi S, Mozhgani SH, Gholami Pourbadie H, Mirzaie M, Noorbakhsh F, Vaziri B, et al. Systems biomedicine of rabies delineates the affected signaling pathways. *Front Microbiol.* 2016; 7: 1688.
15. Liu Q, Wang X, Liu B, Gong Y, Mkandawire N, Li W, et al. Improper wound treatment and delay of rabies post-exposure prophylaxis of animal bite victims in China: prevalence and determinants. *PLoS Negl Trop Dis.* 2017; 11: e0005663.
16. Chungalucha J, Steenson R, Grieve E, Cleaveland S, Lembo T, Lushasi K, et al. The need to improve access to rabies post-exposure vaccines: lessons from Tanzania. *Vaccine.* 2019; 37: A45–53.
17. Madhusudana SN, Sukumaran SM. Antemortem diagnosis and prevention of human rabies. *Ann Indian Acad Neurol.* 2008; 11: 3–12.
18. Zero by 30: the global strategic plan to end human deaths from dog-mediated rabies by 2030. [cited 2024 Jan 18]. Available from: <https://www.who.int/publications-detail-redirect/9789241513838>
19. Programme national de lutte contre la rage 2018. Direction de l'épidémiologie et de lutte contre les maladies. Ministère de la Santé et de la Protection Sociale. 2024. Available from: <https://www.sante.gov.ma/Documents/2018/09/Rage%20JMLR%202018.pdf>
20. World Health Organization. COVID-19 continues to disrupt essential health services in 90% of countries. 2024. Available from: <https://www.who.int/news/item/23-04-2021-covid-19-continues-to-disrupt-essential-health-services-in-90-of-countries>
21. فيلخادلا ريزو ديسال باوج. ةيبارتل تاعامجال يفظوم ءاضف يفظوم ءاضف ندملاب ةلاضلا بالكل راشتنا ةروطخ لوح ةيبارتل تاعامجال. [cited 2024 Feb 29]. Available from: https://www.fctmaroc.com/2022/10/blog-post_14.html
22. Kalthoum S, Guesmi K, Gharbi R, Baccar MN, Seghaier C, Zrelli M, et al. Temporal and spatial distributions of animal and human rabies cases during 2012 and 2018 in Tunisia. *Vet Med Sci.* 2021; 7: 686–96.
23. Knobel DL, Cleaveland S, Coleman PG, Fèvre EM, Meltzer MI, Miranda MEG, et al. Re-evaluating the burden of rabies in Africa and Asia. *Bull World Health Organ.* 2005; 83: 360–8.
24. Nyasulu PS, Weyer J, Tschopp R, Mihret A, Aseffa A, Nuvor SV, et al. Rabies mortality and morbidity associated with animal bites in Africa: a case for integrated rabies disease surveillance, prevention and control – a scoping review. *BMJ Open.* 2021; 11: e048551.
25. Jane Ling MY, Halim AFNA, Ahmad D, Ramly N, Hassan MR, Syed Abdul Rahim SS, et al. Rabies in Southeast Asia: a systematic review of its incidence, risk factors and mortality. *BMJ Open.* 2023; 13: e066587.
26. Haque MS, Yeasmin T, Islam MM. Epidemiological characteristics of human rabies at Infectious Disease Hospital, Dhaka. *Bangladesh J Child Health.* 2012; 35: 102–7.
27. Singh J, Jain DC, Bhatia R, Ichhpujani RL, Harit AK, Panda RC, et al. Epidemiological characteristics of rabies in Delhi and surrounding areas, 1998. *Indian Pediatr.* 2001; 38: 1354–60.
28. Bouaddi K, Bitar A, Bouslikhane M, Ferssiwi A, Fitani A, Mshelbwala PP. Knowledge, attitudes and practices regarding rabies in El Jadida Region, Morocco. *Vet Sci.* 2020; 7: 29.
29. Rana MS, Siddiqi UR, Ghosh S, Jahan AA, Islam MK, Ali Shah MR, et al. Epidemiological study of human rabies cases in Bangladesh through verbal autopsy. *Heliyon.* 2020; 6: e05521.
30. Darkaoui S, Cliquet F, Wasniewski M, Robardet E, Aboulfidaa N, Bouslikhane M, et al. A century spent combating rabies in Morocco (1911–2015): how much longer? *Front Vet Sci.* 2017; 4: 78.
31. Zhou H, Vong S, Liu K, Li Y, Mu D, Wang L, et al. Human rabies in China, 1960–2014: a descriptive epidemiological study. *PLoS Negl Trop Dis.* 2016; 10: e0004874.
32. World Health Organization. Vaccinations and immunization. 2024. Available from: <https://www.who.int/teams/control-of-neglected-tropical-diseases/rabies/vaccinations-and-immunization>