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Factors associated with dog rabies immunisation status in Bamako, Mali

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ABSTRACT

We conducted a cross-sectional survey in Bamako, Mali, to determine for the first time the seroprevalence of rabies virus antibodies in the dog population and people's knowledge, attitudes and practices (KAP) towards the disease and its control. Antibody detection was done with the fluorescent antibody virus neutralisation (FAVN) test, with a positivity threshold of 0.25 IU/ml.

We visited 2956 households in 2010 and 2011 and found 379 dogs in 279 households. Data were collected on 279 dog-owning households, on 1017 non-dog-owning households and on 311 dogs. A serum or plasma sample was collected from 98 dogs. For 26 dogs we had sufficient data to describe the antibody decline over time after rabies vaccination using a quadratic regression.

Ninety percent of interviewed persons (95% CI: 85%–91%) knew about rabies. The majority of interviewees knew that rabies is transmitted from dogs to humans, and some of the characteristic clinical signs seen in rabid dogs (change of behaviour, biting, salivation) could be listed by the majority. When asked how people behave regarding a rabid dog, killing the animal was the most frequent answer (>70%). Most (65% of the non-dog-owners and 81% of the dog-owners) were aware that vaccination of dogs can prevent rabies, but only a minority of dog-owners could answer correctly at what age the dog should get a first rabies vaccination (i.e. at 3 months). There was also strong consensus among dog-owners that it is better to protect their dog from becoming rabid by vaccinating it rather than needing to treat a bitten person. Forty-five percent ($n = 306$; 95% CI 38%–52%) of dogs were reported as vaccinated against rabies at least once, but less than half of these (59/136) had a valid vaccination card. When asked for reasons for non-vaccination, cost was the most frequent reason at 31% (95% CI: 21%–43%), while general negligence was mentioned by 15% (95% CI: 10%–24%). Approximately one third of dog-owners would not pay for vaccination. To reach a threshold of 70% of vaccinated owned dogs, vaccination should not cost more than 0.2€ (100 FCFA).

The seroprevalence of rabies virus antibodies in the examined dog population was low: 24% ($n = 98$; 95% CI 15%–36%) with titres ≥0.25 IU/ml and was 46% ($n = 39$; 95% CI 29%–63%) when only including those reported as vaccinated by their owners. A seroprevalence of 59% ($n = 18$; 95% CI 33%–80%) was reached if the analysis included only dogs with a valid vaccination certificate. Interestingly 4/22 dogs showed titres ≥0.25 IU/ml despite being reported as unvaccinated. The Rabisin® vaccine showed generally higher IU titres than the Dog Vac Rabia® vaccine. All animals after booster vaccination had titres ≥0.25 IU/ml which was not the case in primo-vaccinated animals. For the Rabisin® vaccine, a Kaplan Meier estimate suggested that to maintain an antibody titre of ≥0.25 IU/ml for 75% of owned dogs, revaccination should be done after not more than 2.5 years.

This work contributes vital information towards planning an effective dog rabies control programme for the district of Bamako.

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1. Introduction

Rabies is a neglected zoonosis which, despite the availability of known effective control measures, remains a problem in the developing world (Nel, 2013). It is estimated that 59,000 people die per year due to the disease with the majority of cases in Asia (60%) and Africa (36%) (Hampson et al., 2015)., where rabies is transmitted mainly by dogs. In Bamako, the capital of Mali with 1.8 Mio inhabitants, rabid dogs were confirmed to be responsible for the majority of human cases (Dao et al., 2006). Between 1995 and 2011, 68 human rabies cases were registered in Bamako and the virus was always transmitted by dog bites (Kone personal communication, 2013). Kone (2013) calculated a human incidence of 0.37 cases per 100,000 inhabitants between 2007 and 2012 in Bamako. The mean annual rabid dog incidence for 2001 to 2013 was estimated at 2.2 rabid dogs per 1000 (Traoré, personal communication, 2014). It is important to note that there is significant under-estimation of the true human incidence (Cleaveland et al., 2002) because surveillance across the country is insufficient.

In Africa, information on knowledge, attitudes and practices towards rabies has only been recorded in a few countries, for example in Chad (Kayali et al., 2003; Mindekem et al., 2005) and Zimbabwe (Butler, 1995). Parenteral vaccination of dogs against rabies is a cost-effective control measure (Zinsstag et al., 2009), and in many African communities at least 60–75% of dogs are accessible for vaccination (WHO, 2005). This percentage corresponds also to the WHO recommendation to vaccinate at least 70% of the dog population for efficient rabies control (WHO 2013).

In Africa, data on seroprevalence surveys and studies addressing the decline of antibodies after vaccination are rare. Millán et al. (2013) found a seroprevalence of 20% in Uganda and Kitala (2001) determined 29% in Kenya. The systematic review of Davlin and Vonville (2012) summarised pre vaccination campaign seroprevalences in Zambia, Chad and Tanzania, where all were below 20%. In Nigeria 43% of dogs had antibody titres exceeding the positive threshold, but this proportion was still far below the required prevalence to stop transmission (Olugasa et al., 2011). Additionally, these studies are difficult to compare since there is heterogeneity among the diagnostic tests, the chosen titre cut-off and the investigated dog population.

This study was undertaken to identify people's knowledge, attitudes and practices with respect to rabies in dogs and its control. We also evaluated the seroprevalence of rabies virus antibodies in the sampled dog population and used these data to estimate the duration of rabies virus antibodies in vaccinated dogs in Bamako, Mali.

2. Material and methods

2.1. Study area

The cross-sectional survey was undertaken in Bamako, the capital of Mali, located in the southern part of the country. The city is divided in 6 communes with a total of 67 quarters, and the national census recorded 1.8 million inhabitants (R. G. P. H. 2009). The city has a wet and dry savannah climate with average temperature highs above 30 °C in each month. The total land area is about 267 km^2.

2.2. Data and sample collection

Questionnaire interviews, whenever possible with the head of the household, were conducted in all six communes of Bamako. We randomly selected 32 out of a total of 67 quarters with selection probability proportional to the size of the human population of the communes. During the first baseline study in 2010 and the second baseline study in 2011, households were randomly selected with slightly different procedures. The survey in 2010 was conducted between May and June, while the one in 2011 was between April and May. Full interviews were conducted in all households in 2010, but only in dog-owning households in 2011. The sampling method for households was based on a random selection approach. During the study in 2010, five field teams, each consisting of one veterinary officer and one interviewer, started in a quarter at the household of the quarter chief, then spun a bottle and walked 200 meters in the indicated direction, where they flipped a coin to select one side of the road for the inclusion of two households in two neighbouring compounds. A compound was defined as all of the houses surrounded by a wall, which could include several households. A household was defined as an individual or a group, related or not, living within the compound under the lead of the household head. It was composed of the head of household, his spouse(s), his unmarried children and possibly other related or unrelated persons. The selection procedure was repeated until at least 38 households per quarter were enrolled and interviewed. In 2011, four field teams started at five randomly selected coordinates within the same quarters. The nearest block was then chosen, where interviews were conducted in households (only one per compound) with the team moving in a clockwise direction until at least 12 households were selected. The questionnaires included questions about knowledge, attitudes and practices (KAP) regarding rabies and its control by dog- and non-dog-owners as well as basic dog characteristics (age, sex, breed and function) of dogs older than 3 months old. Some of the KAP questions included open questions to record spontaneous answers which were followed by a list of probed answers. Spontaneous answers are more useful to direct the design of future intervention programs. Prior to the first baseline survey, meetings were held with the local chiefs of each quarter. The questionnaire was tested in a non-selected quarter. The questionnaire was in French and questions were translated into Bambara when necessary. The vaccination status of each vaccinated dog was cross-checked with its vaccination card. Blood samples of each encountered owned dog over three months old were collected by the veterinary officer from the saphenous vein into 5-ml dry tubes and 2 ml EDTA tubes. Muzzles were used to prevent dog bites. Dogs were not sampled if the owner did not give consent or if a dog was uncooperative, aggressive or sick at the time of the survey. All dog-owning households were visited for follow up surveys to collect dog demography data, but these results are published elsewhere. When possible, additional blood samples to estimate the rabies virus antibody decline were collected one year later during the follow up survey for new dogs in the households.

2.3. Laboratory testing

The samples were kept in an icebox and centrifuged within 24 h of collection. Serum and plasma samples were stored at −20 °C and shipped on dry ice to the Anses-Nancy Laboratory for Rabies and Wildlife for rabies virus antibody determination. The samples were analysed using the fluorescent antibody virus neutralization (FAVN) test (Cliquet et al., 1998). The titre of the serum or plasma sample corresponded to the dilution at which 50% of the constant viral dose was neutralised by the antibodies. The titres were expressed in IU/ml by comparison with the standard serum. The threshold of positivity was established at 0.25 IU/ml (Cliquet et al., 1998).