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Dog bite incidence and associated risk factors

A cross-sectional study on school children in Tamil Nadu

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Dog bite incidence and associated risk factors – a cross-sectional study on school children in Tamil Nadu

Hundbetsincidens och relaterade riskfaktorer – en tvärsnittsstudie på skolbarn i Tamil Nadu

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SUMMARY

Dog bites pose a threat to public health globally and can lead to infection, disfigurement, incapacity, post-traumatic stress syndrome and even death. In geographical areas where rabies is endemic, bites from infected dogs account for over 90% of the human rabies cases. Children have been proven to be at a greater risk of being bitten by dogs and subsequently contracting rabies than adults. In this cross-sectional study, a school survey was undertaken in association with a rabies awareness campaign in India, to investigate the dog bite incidence and various risk factors associated with dog bites as well as assessing the knowledge of safe interaction with dogs among children in the age group 10-18 years. A total of 1295 questionnaires were collected. 43.2 % (n=556) out of the respondents were boys and 56.8 % (n=731) were girls with a mean age of 14 years. Of the children asked, 73.5 % (n=945) did not own a dog, whereas 26.6 % (n=338) reported they did own a dog. Out of the respondents, 23.3% (n=279) reported having been bitten by a dog. More children were bitten by family dogs than stray dogs, and the most common location for dog bites was in a domestic environment. The gender distribution among the children who reported to have been dog bitten was 39.7% (n=110) girls and 60.3% (n=167) boys. The gender difference was found to be statistically significant ($p < 0.05$). There was a significant correlation between owning a dog and being bitten by a dog as well as displaying unsafe behaviour when engaging with dogs. Boys were more likely to display unsafe behaviour than girls. Children who had taken part of an informational lecture on rabies and dog bite prevention gave more correct answers when asked about safe interaction with dogs, but showed no difference in the risk perception compared to children who had not taken part of a lecture. It is suggested that educational efforts targeting children are implemented to raise the level of awareness of rabies, proper wound management, dog population control and safe dog behaviour to reduce the dog bite incidence as well as contributing to the eradication of rabies from India.

SAMMANFATTNING

Hundbett utgör ett globalt hot mot folkhälsan och kan, förutom att leda till döden, även orsaka infektioner, missbildningar, handikapp och även posttraumatiskt stressyndrom. I geografiska områden där rabies är endemiskt står bett från infekterade hundar för över 90 % av de humana rabiesfallen. Barn löper större risk att bli hundbitna än vuxna, och därmed även ökad risk för att smittas av rabies. I denna tvärsnittsstudie genomfördes en skolundersökning i samband

med en rabiesinformationskampanj i Indien, för att undersöka hundbetsincidensen och olika riskfaktorer relaterade till hundbett samt en uppskattning av kunskapen om säkert beteende vid interaktion med hundar bland barn i åldersgruppen 10-18 år. Totalt 1295 enkäter samlades in. Av de tillfrågade var 43,2 % (n = 556) pojkar och 56,8 % (n = 731) flickor med en medelålder på 14 år. Av de tillfrågade barnen ägde 73.5 % (n = 945) ingen hund, medan 26,6 % (n = 338) var hundägare. Andelen hundbitna bland barnen var 23.3 % (n = 279). Fler barn hade blivit bitna av familjehundar än gatuhundar och den vanligaste platsen för hundbett var i en hemmiljö. Könsfördelningen bland de hundbitna barnen 39.7 % (n = 110) flickor och 60.3 % (n = 167) pojkar. Könsskillnaden visade sig vara statistiskt signifikant ($p < 0,05$). Det fanns ett signifikant samband mellan att äga en hund och att bli biten av en hund samt att uppvisa riskbeteende vid interaktion med hundar. Pojkar var mer benägna att visa riskbeteende än flickor. Barn som fått delta i en informativ föreläsning om rabies och förebyggande åtgärder mot hundbett svarade signifikant bättre på frågor om säker interaktion med hundar, men visade ingen skillnad i riskuppfattning jämfört med barn som inte fått någon föreläsning. Det föreslås att utbildningsinsatser riktade till barn genomförs för att höja medvetenheten om rabies, korrekt sårbehandling, hundpopulationskontroll och säkert hundbeteende för att minska hundbetsincidensen och som en del i att utrota rabies i Indien .

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INTRODUCTION

Historical evidence suggests humans have kept canine companions, originally domesticated from wolves, for more than 15,000 years (Savolainen *et al.*, 2002). Over the years, the wild nature of the wolf gradually transformed into man's best friend, the dog. In spite of the long domestication process, human-canine interaction is not always without friction and dog bite related injuries are considered a public health issue. In the US alone, dog related injuries affect approximately 1.5% of the population annually (Gilchrist *et al.*, 2008). Throughout the world, it has been found that children are more at risk of getting bitten by dogs (Abubakar and Bakari, 2012; De Keuster *et al.*, 2006; Sacks *et al.*, 1996; Sudarshan *et al.*, 2006; Tenzin *et al.*, 2011). This is commonly explained by children possessing lower awareness, lesser knowledge in safe behaviour around dogs, higher vulnerability due to lower physical strength and smaller size. Apart from the pain caused by the bite itself, dog bites can result in infection, disfigurement, incapacitation and even post-traumatic stress disorder (Peters *et al.*, 2004). Animal bites might also serve as an important route of transmission for a number of diseases, most importantly rabies, which still remains endemic in large parts of the world. The World Health Organisation (WHO) states that 99% of all human rabies cases are caused by infected dog saliva (WHO, 2013). India accounts for approximately one third of all human rabies cases in the world, with an estimate of more than 20,000 human rabies fatalities reported annually, of which 96.2% have contracted infection from rabid dogs (Sudarshan *et al.*, 2006).

This study was sponsored by the Swedish International Development Cooperation Agency and carried out as a Minor Field Study in Tamil Nadu, India. The study was carried out in connection with a rabies vaccination campaign launched by Worldwide Veterinary Service (WVS).

Objective

The main objective of this study was to conduct a survey in schools in a rabies endemic area (Tamil Nadu, India) to explore the dog bite incidence among children, as well as to further investigate and identify risk factors in connection with dog bites and finally assess children's knowledge about responsible interaction with dogs.

LITERATURE REVIEW

Dog bites – associated risks and risk factors

Dog related injuries, most frequently dog bites, are considered a public health issue globally. Not only can dog bites lead to fatalities, they can result in infection, disfigurement, incapacity and thus a loss of income as well as post-traumatic stress syndrome (De Keuster *et al.*, 2006; Peters *et al.*, 2004). In a survey of five Asian countries, animal related injuries were amongst the five leading causes of death in children aged 0-17 (Linnan *et al.*, 2007). The occurrence of a dog bite is depending on an intricate causal web. Previous research has, however, focused on three main factors: characteristics of the victim, characteristics of the biting dog and environmental circumstances.

Firstly, studies on the human factors are consistent regarding two demographical characteristics of dog bite victims. Gender and age have both been shown to serve as two important risk factors for dog bites and children are more at risk than adults (Bjork *et al.*, 2013; Daniels *et al.*, 2009; Fèvre *et al.*, 2005; Gandhi *et al.*, 1999; Georges and Adesiyun, 2008; Gilyoma *et al.*, 2013; Ichhpujani *et al.*, 2008; Reisner *et al.*, 2011; Rosado *et al.*, 2009; Sacks *et al.*, 1996; Shen *et al.*, 2013; Shetty *et al.*, 2005; Sudarshan *et al.*, 2006; Tenzin *et al.*, 2011; Yalcin *et al.*, 2012). It has been suggested that children have limited experience and are more likely to have substandard knowledge of safe interaction with dogs in combination with a higher level of curiosity than adults, thus becoming more vulnerable to being bitten by dogs.

Other demographical characteristics of dog bite victims have been elucidated and proven to be conclusive from a global perspective. Coming from a low income background and rural areas is a well-known risk factor for dog bites (Mehndiratta, 2012; Rosado *et al.*, 2009; Shuler *et al.*, 2008; Sudarshan *et al.*, 2007). This is believed to depend on a higher density of dogs as well as a higher number of unsupervised free-roaming dogs, and thus increased exposure to dogs for residents in the area. A multi-centric study on children in rural China (Shen *et al.*, 2013) could not show a positive correlation between dog ownership and dog bite incidence among children, but there was a significant association between having owned a dog previously and bite incidence. The dog bite incidence also appeared to have a positive association with displaying unsafe behaviour when engaging with dogs

Secondly, attempts to characterize the biting dogs result in different conclusions. In a veterinary clinic-based retrospective cohort study it was highlighted that dogs used for companionship were more likely to cause a dog bite injury than dogs kept for guarding purposes (Messam *et al.*, 2008). Other epidemiological research supports the evidence that dog bites are more commonly caused by dogs known to the victim (Rosado *et al.*, 2009; Schalamon *et al.*, 2006). There is variation to this though. In a hospital-based study in Bhutan by Tenzin *et al.* (2011), stray dogs accounted for 71% of the recorded bites. This has also proved to be the case in a number of studies conducted in India (Ichhpujani *et al.*, 2008; Mehndiratta, 2012; Sudarshan *et al.*, 2001; Sudarshan *et al.*, 2006). Messam *et al.*, (2007) suggest that environmental risk factors for dog bites most probably differ in various cultural contexts, serving as a possible explanation to the various results in dog bite risk factors between studies carried out in high income countries and low income countries.

Some dog breeds, commonly labelled as high-risk breeds, account for significantly more dog bites than other dog breeds (Gandhi *et al.*, 1999; Gershman *et al.*, 1994; Ozanne-Smith *et al.*, 2001; Rosado *et al.*, 2009; Schalamon *et al.*, 2006). Dog bites outside non-play situations are likely to depend on aggressive behaviour displayed by the dog, sometimes specifically directed towards children. Aggressive behaviour could also be a symptom of illness in the dog (Reisner *et al.*, 2007), and in some areas in the world symptomatic of a rabies infection (Scott, 2008).

Attempts to further identify risk factors regarding gender and reproductive status of the biting dog have given inconclusive results. Intact males were reported to be responsible for a higher number of bite incidents in some studies (Messam *et al.*, 2012; Rosado *et al.*, 2009; Shuler *et al.*, 2008), whereas Guy *et al.* (2001) found female dogs to be more likely to bite. In contrast to this, neutered dog were overrepresented (93%) as biters in a study made by Reisner *et al.* (2007), and males comprised of 75% of the biting group.

Lastly, environmental factors influencing dog bite incidence have not been as extensively investigated as the human and canine aspects. Correlations to weekends rather than weekdays as well as seasonal patterns have been documented in the literature (Agarwal and Reddajah, 2004; Mehndiratta, 2012; Reece *et al.*, 2013; Rosado *et al.*, 2009). Higher dog bite incidence during holidays and on weekends could be explained by the fact that people spend more time at leisure with a higher rate of outdoor activity and thus are more exposed to dogs. Reece *et al.* (2013) suggest the seasonal variation in dog bite incidence depends mainly on the

reproductive cycle of the free-roaming dogs with an increased likeliness of being bitten during periods when mothers are protective of their young.

Rabies

Rabies, a feared disease long known to man, is a zoonosis capable of infecting all mammals. The main mode of transmission to humans is through the saliva of an infected dog. Once the virus has entered the body and established an infection, death is practically inevitable. Rabies is present on all continents and poses a serious threat to public health worldwide. Asia and Africa are particularly affected by rabies. Although preventable, rabies causes an estimated 55,000 human deaths annually (WHO, 2013). Out of these, more than 31,000 rabies fatalities occur in Asia alone (Knobel *et al.*, 2005). Even though the burden of rabies has been greatly reduced in some Asian countries, it remains endemic on the Indian subcontinent. India alone is estimated to have more than 20,000 human rabies fatalities per year (Sudarshan *et al.*, 2006).

Although lethal, rabies can effectively be prevented. As case management on individual basis, WHO recommends proper wound management, rinsing with water and soap for at least 15 minutes followed by application of iodine or ethanol solution to clear the bitten site from virus particles. This is a key procedure and significantly reduces the risk of infection (Dean *et al.*, 1963). In class 2 and 3 rabies exposure cases (WHO, 2013), WHO also recommends receiving post-exposure prophylaxis (PEP) according to adopted regimens. In a population based approach, WHO recommends mass vaccination campaigns against rabies targeting the entire dog population as well as carrying out animal birth control programs. Mass vaccination of dogs against rabies is thought to be the most cost effective way of preventing rabies (WHO, 2013).

Rabies vaccination programs in combination with efforts targeting reproductive control of the dog population has proven to significantly reduce the human rabies mortality (Cleaveland *et al.*, 2003; Reece and Chawla, 2006).

Apart from targeting dogs, it is of great importance to improve rabies awareness amongst the population, to improve public attitudes and to target and attain a higher participation in rabies vaccination and animal birth control programs. Educational efforts are also of paramount importance in order to improve proper wound management, seek medical attention if needed

and fulfill vaccination protocols. Studies in risk-populations in areas where rabies is endemic often show there is a lack of knowledge in this matter (Dodet *et al.*, 2008; Frey *et al.*, 2013; Georges and Adesiyun, 2008). A cross-sectional study in Bangalore, India, showed that only approximately half of the respondents knew about adequate wound care following a dog bite (Herbert *et al.*, 2012). A survey in Pune by Kakrani *et al.* (2013), however, found that 87.2% of the people living in an area with an abundance of street dogs were familiar with adequate wound care. It has also been showed that a high reliance on traditional healers and indigenous treatment is extensive in risk-populations thus being a considerable obstacle in rabies control since the window of opportunity to treat the infection is lost (Agarwal and Reddajah, 2004; Frey *et al.*, 2013; Ichhpujani *et al.*, 2006; Jemberu *et al.*, 2013; Rumana *et al.*, 2013; Sudarshan *et al.*, 2007). In a pilot-study in Sri Lanka, Matibag *et al.* (2009) found that an educational campaign had a positive effect on the participants' knowledge, attitude and practice regarding rabies. It was also suggested that simple information and education campaign (IEC) materials could serve as a cost-effective method in enhancing the public awareness about rabies.

In the Philippines, an intersectional program was launched in 2007 with the purpose of eradicating rabies. This was successfully carried out through mass rabies vaccination of dogs, animal birth control programs, implementing veterinary quarantine and improving veterinary diagnostics, surveillance and monitoring. This was paralleled with educational efforts among the population, by enhancing bite wound management and introducing rabies prevention in elementary schools. The number of rabies cases was dramatically decreased over three years and was found to be zero in 2010 (Lapiz *et al.*, 2012). Similar efforts have shown positive results in other rabies endemic countries in Asia such as Thailand (Kamoltham *et al.*, 2003) and Sri Lanka (Public Health Veterinary Services, 2013.). An initiative towards an intersectional rabies control program was taken in Tamil Nadu in 2011, making it the first state in India to try and implement anti rabies work on a larger multi-levelled scale (Abbas *et al.*, 2011).

Dog management in India

The approach to dogs in India differs largely from the Swedish conditions. The human-dog relationship ranges from dogs kept as pets, much like the common practice in Sweden, to feral dogs living in the streets. WHO has established five different categories to further clarify the different populations of urban dogs: 1. Restricted dogs, fully supervised by man, 2. Family dogs, semi-independent and fully restricted by man, 3. Neighbourhood dogs, semi-restricted

and semi-dependent, 4. Unrestricted dogs, semi-dependent and unrestricted, 5. Feral dogs, independent and unrestricted. Categories 3-5 would be described as street dogs from a European point of view. These dogs have an important function in Indian society as rat hunters and they help dispose of domestic waste. In doing so, they contribute to public health by helping to control the vermin. The semi- to unrestricted dogs are also commonly used as guard dogs. On the downside, free roaming dogs serve as an important reservoir with regard to the spread and transmission of rabies and other diseases, and might also be perceived as dangerous by the public (Herbert *et al.*, 2012). Indian authorities have routinely tried to manage the free roaming dog populations by simply euthanizing individuals, most commonly in a brutal and inhumane manner with poorly trained staff carrying out the task. The World Organization for Animal Health (OIE) states in their guidelines for controlling street dog populations that putting down the street dogs does not work as a sustainable technique in controlling the dog population. It will have a short-term effect, but other dogs quickly take their place (OIE, 2009). Lately, these methods are being replaced with ABC- (Animal Birth Control) programs, based on neutering of mainly female dogs, vaccinating them and releasing them back into the area where they came from to fill the ecological niche. This has proved to be an effective way of managing rabies (Coleman and Dye, 1996; Reece and Chawla, 2006).

Dog bite prevention

The guidelines for dog bite prevention include for instance, a restriction of particularly high-risk dog breeds (Clarke and Fraser, 2013; Schalamon *et al.*, 2006), education of dog-owners and adequate animal training.

Children's knowledge about dog bite prevention is often found to be poor (Dixon *et al.*, 2012; Shen *et al.*, 2013). Dixon *et al.* (2012) found that there was no statistical relationship between dog bite prevention knowledge and sociodemographic or experiential factors. Furthermore the test score for dog bite prevention knowledge was increased by 0.25 per year of age of the respondents.

Educating children about dog bite prevention appears to have a positive outcome (Meints and Keuster, 2009; Spiegel, 2000; Wilson *et al.*, 2003). In spite of this, it may be disputed whether educational interventions have an impact on the behaviour of children when presented with a dog or if they only improve children's ability to give a correct answer when asked on the matter. In 2000, Chapman *et al.* (2000) undertook a study in Australia where children were given an interactive lecture on safe dog behaviour. Seven to 10 days post-intervention,

participants were presented with an unknown dog unaware that they were being filmed by the research team. Results showed that children who had taken part of the intervention showed significantly safer behaviour compared to children in the control schools. This indicates that educational efforts could be helpful in improving and promoting safe interaction with dogs among children on a short term basis. There are no studies known to the author investigating the effects of education campaigns on dog bite incidence.

Interventions in dog populations might also have a positive effect on reducing the dog bite numbers. In a study in Jaipur a decline in dog bites was associated with a sterilisation program of female dogs. The reduction in dog bites was thought to depend on firstly less maternal protective behaviour among the dogs. Secondly, the reduced number of fertile animals in the dog population itself caused less territorial fights among the dogs, less fights over females and a total decline in the size of the dog population (Reece *et al.*, 2013).

Worldwide Veterinary Service

Founded in 2002 in the UK, the Worldwide Veterinary Service (WVS) aims to be a veterinary resource and support for animal organisations worldwide. Focusing mainly on low income countries, WVS works both for improved animal welfare and to benefit the local communities. Subjects that are commonly targeted include the prevention of zoonoses, education of the public and the local veterinarians or securing animal health in order to sustain the source of income for a family as well as carrying out scientific studies (WVS, 2013).

In 2006, the Global Alliance for Rabies Control seized the initiative with the creation of World Rabies Day with events being held on September 28th (Global Alliance for Rabies Control, 2013). Contributing to the World Rabies Day, WVS began organising a mass vaccination campaign to be put into operation in September 2013 with a stated long-term goal of eradicating rabies in India. The campaign, called Mission Rabies, aimed to vaccinate 50,000 dogs in 30 days and was based in 10 carefully selected checkpoints in India. Along with the rabies vaccination project, projects for neutering stray dogs and performing emergency medical care was managed (Mission Rabies, 2013).

MATERIALS AND METHODS

Conduct of the study

The study was conducted from August-October 2013 in 13 different schools in Tamil Nadu, India and carried out as a part of a rabies awareness program connected to an extensive rabies vaccination campaign covering 10 Indian cities. The data was collected using a questionnaire covering different aspects of knowledge about rabies, dog behaviour, risk awareness, attitudes towards rabies vaccinations and dogs, dog bite history and characteristics as well as practices in human-canine interactions and wound management. This study focuses on the dog bite incidence, dog bite characteristics in general and in connection with perceived risk and safe interaction with dogs. The remaining data is presented in a different report (Osmar-Vitalich, 2014).

Vaccination campaign

During September 2013 a broad rabies vaccination campaign was launched by WVS in 10 different checkpoints evenly distributed all over India. As well as trying to meet a target of vaccinating 50,000 dogs, the campaign collected figures to constitute the basis of India's first database for rabies and dog populations. The campaign was pursued for 14 days at each check-point and each vaccinated dog was recorded using a recently developed epidemiological tool called Epi-Collect, an application for smartphone data collection (EpiCollect, 2013). At each check-point, four teams consisting of international volunteers as well as local veterinarians and volunteers worked in two daily shifts, one in the morning and one in the afternoon, covering a different ward per shift. The dogs were caught using nets, vaccinated, marked and then released. In case of locating a dog with suspected rabies, the animal was collected in a humane way and then euthanized. To confirm diagnosis, necessary samples were obtained and sent in to accredited laboratories. To ensure vaccination coverage met the recommended target of 70%, each ward was supervised two days after the vaccination drive and all vaccinated dogs were counted. If the numbers happened to be too low, more dogs were vaccinated until the target was reached.

Parallel to the vaccination drive, an educational campaign divided into two parts was taking place at the check-points. The first part targeted both adults and children and consisted mainly of handing out leaflets on responsible dog-ownership, animal birth control, wound

management and rabies during the vaccination drives. The other part was focusing on children solely and aimed to create awareness with regards to rabies, wound management, animal birth control and responsible human-canine interactions. This was achieved through visiting schools and giving informational speeches, handing out leaflets and answering questions. Each dog that was vaccinated was recorded in Epi-Collect. Information, such as age, sex, neutered/not neutered, owned/free roaming, marked/collared as well as the GPS-coordinates for each individual dog at the time it was caught and vaccinated were logged. The data were transferred to the database at the end of each day.

Study area

The study was conducted in three selected areas in Tamil Nadu; Madurai, Ooty and Coonoor. Madurai is a large city with an abundance of free roaming dogs and annually reported human rabies fatalities (unpublished data, WVS). No previous educational measures known to the author had been undertaken in Madurai prior to our survey. The geographical area of Ooty and Coonoor had been exposed to a number of rabies vaccination campaigns as well as ABC-programs over the past decade, and subsequently they have less problems with the dog population with reported rabies cases, human or canine, for the last 10 years (Ilona Otter, WVS, personal communication 2013).

School survey

The school survey was conducted in association with the Mission Rabies educational campaign and necessary permissions were obtained by WVS. Partaking in the survey was optional and anonymous and all participants, students as well as teachers, were informed of the purpose and asked for consent previous to the distribution of the questionnaires.

Questionnaire

A structured questionnaire was designed according to the Knowledge, Attitude, Practice (KAP) model (Launiala, 2009). The steps were as follows:

- Literature review within relevant fields.
- Construction of the questionnaire in English.
- Evaluation of the questionnaire by experts in the field.
- Pilot survey in one school in Coimbatore.
- Adjustment of the questionnaire according to the results of the pilot survey.

- Translation of the questionnaire into Tamil by a native speaker. The questionnaire was later translated back to English by two native Tamil speakers in order to control the accuracy of the translation.

The questionnaire was put together in four different sections: Background data, Knowledge, Attitude and Practice (Appendix 1). In the background data section participants were asked about their age, gender, and number of dogs, people and children living in their household as well as if they had taken part in an educational program or vaccination campaign regarding rabies prior to the survey. The Knowledge section consisted of both open and closed questions such as “What is rabies?”, “Can humans get rabies?”, “How can rabies be prevented?”, “Can rabies be treated” etc., as shown in the appendix. The Attitude section of the questionnaire was made up of different statements where participants were asked to indicate on a scale ranging from 1 to 5 on the degree of agreement, with 1 representing *strongly disagree* and 5 representing *strongly agree*. In the Practice section, participants were presented with four different scenarios mirroring real life dog encounters. Participants were asked to pick one out of four different options on how they would act. They were also asked to report if they had been bitten by a dog, what type of dog it was, location of the participant on the event of the bite and what action they took following the bite. Questions on adequate wound management and open questions about dog interactions were also included.

Madurai

The questionnaire was distributed to 10 schools in urban and peri-urban Madurai. The schools were selected as convenience samples and visited in connection with a rabies awareness program that was carried out as a part of Mission Rabies. A randomized sample with a target of 100 students in each school at ages 10-18 years was given the questionnaire and asked to independently fill out the questions. Nine out of the 10 schools were English medium schools, thus the students were expected to master a higher level of English and subsequently completed the form in English. One of the schools was a Tamil speaking school and consequently the students were given the questionnaire in Tamil. Completion of the forms was supervised in six of the schools, and un-supervised in four of the schools. In eight of the schools the questionnaire was completed after an intervention was undertaken in the form of a brief speech on facts about rabies, rabies prevention, safe dog behaviour and dog population management during the morning assembly. In two of the schools the questionnaire was filled out prior to the informational talk. The talk itself was performed in Tamil in nine of the schools by either the local veterinary coordinator for Mission Rabies in Madurai or by a

Rotary club volunteer who had been given previous training on the matter. In one of the schools, the informational speech was held in English by the author of this study together with a colleague.

Ooty and Coonoor

Three schools were selected as convenience samples in the area of Ooty and Coonoor. A target of at least 100 students in the ages 10-18 years were asked to complete the form. The same questionnaire that was used in Madurai was used in Ooty and Coonoor after a number of minor adjustments, as shown in appendix B. The students in the Ooty school were given an informational speech in the morning assembly, following the same routine as in Madurai, and the students were assigned to fill in the questionnaires two days later. The two schools in Coonoor were surveyed as pre-intervention samples and the forms were completed prior to the informational talk. The lecture was carried out in English in all three schools by the author of this report together with a colleague.

Analysis

A total number of 1295 questionnaires were collected from 13 different schools. A large number of the questionnaires were not adequately completed, thus sample sizes for each question differ. The questionnaires were analysed using descriptive statistics in Microsoft Excel (Microsoft Co., Redmond, USA). The data was statistically analysed using the chi square-test with a 95% confidence interval and processed in EpiTools (Epi-Tools, 2013).

RESULTS

Demographics

The children participating in the study consisted of students aged 10-18 years with a mean age of 14 years. The age distribution among the participants is shown in Table 1. Out of the respondents 43.2% (n=556) were boys and 56.8% (n=731) were girls. The mean number of dogs per household was 0.5, the mean number of children per household was 2.8, and the mean number of people per household was 6.2. Of the children asked 26.6% (n=338), had a dog in the household, whereas 73.5% (n=945) reported they had no dogs in their household.

On the question of whether the participant ever had enrolled in a vaccination campaign or education program regarding rabies, 80.6% (n=1041) replied they had not, 11.5% (n=144) said they had participated in a vaccination campaign or education program regarding rabies, 0.7% (n=9) replied indecisive and 7.5% (n=97) did not complete the question.

Table 1. *Age and gender distribution among respondents*

Age	Girls (%)	Boys (%)	Total (%)
10	8 (1.45)	16 (2.20)	24 (1.87)
11	62 (11.21)	53 (7.28)	115 (8.98)
12	88 (15.91)	79 (10.85)	167 (13.04)
13	121 (21.88)	91 (12.50)	212 (16.55)
14	129 (23.33)	80 (10.99)	209 (16.32)
15	75 (13.56)	181 (24.86)	256 (19.98)
16	55 (9.95)	198 (27.20)	253 (19.75)
17	13 (2.35)	26 (3.57)	39 (3.04)
18	2 (0.36)	4 (0.55)	6 (0.47)
Grand Total	553 (100.00)	728 (100.00)	1281 (100.00)

Dog bite incidence

Characteristics of human factors

Out of the respondents, 23.3% (n=279) reported having been bitten by a dog. The gender distribution among the children who had been dog bitten was 39.7% (n=110) girls and 60.3% (n=167) boys as shown in Table 2. The gender difference was found to be statistically significant ($p < 0.05$). The age distribution was as shown in Figure 1 with 86.2% (237/275) being in the age group 12-16. Out of the children with dogs in their households, 36.0% had been bitten by dogs, but only 18.7% of the children who reported having no dogs in their household had been bitten (Table 3). The difference proved to be statistically significant ($p < 0.05$).

Canine and environmental factors

A majority of the children (55.9%) had been bitten by a family dog, 42.7% had been bitten by a stray dog and the remaining 1.5% reported they had been bitten by both a family dog and a stray dog. The location where the dog bite occurred differed to some extent between the bite victims, with the predominant situation being in a domestic environment (Table 4). The proportion of the respondents that had been bitten at home was 37.3%, 18.6% were at a friend’s or neighbour’s house and 1.0% at a relative’s house. The second most common setting of dog bite incidents was in the street, with 35.3% of the children reporting that this was the case. Other locations mentioned were “home and street” (1.5%) and “other place” (3.9%). The remaining 2.5% of the bite victims could not recall their whereabouts at the time they got bitten. The relative risk (RR) for being bitten by a family dog at home was 4.1 and this was significant ($p < 0.05$).

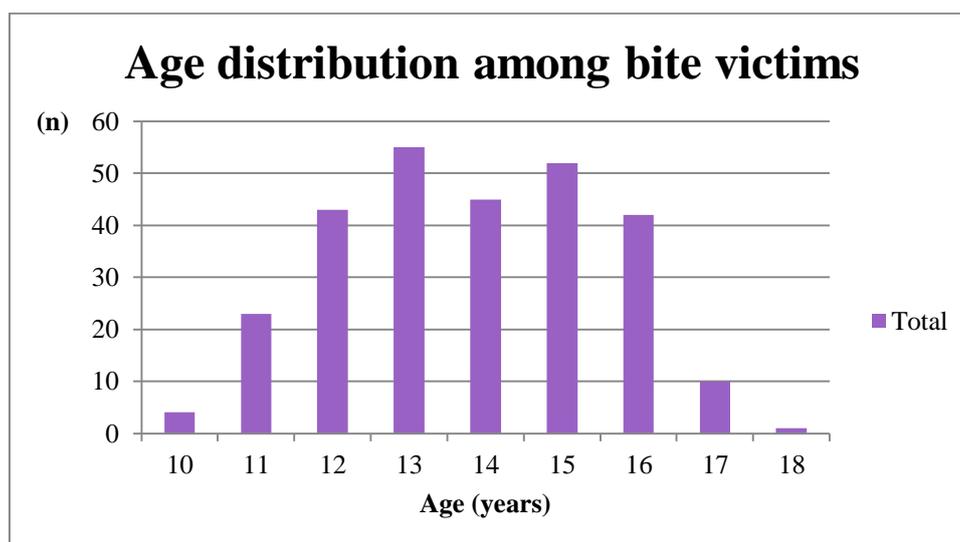


Figure 1. Age distribution among children who reported having been bitten by a dog.

Table 2. Gender distribution among bitten and non-bitten respondents. Figures in the table represent number of responses

Bitten by dog	Boys (%)	Girls (%)	Total (%)
No	357 (68.13)	555 (83.46)	912 (76.70)
Yes	167 (31.87)	110 (16.54)	277 (23.30)

Grand Total	524 (100.00)	665 (100.00)	1189 (100.00)
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Table 3. Dog ownership status related to dog bite incidence. Figures in the table represent number of responses

Bitten by dog	No dogs in household (%)	Dog-owners (%)	Total (%)
No	699 (81.28)	203 (64.04)	902 (76.64)
Yes	161 (18.72)	114 (35.96)	275 (23.36)
Grand Total	860 (100.00)	317 (100.00)	1177 (100.00)

Table 4. Dog status in relation to physical location at the time of the bite. Figures in the table represent number of responses

Location at the time of the bite	Family dog (%)	Family dog and stray dog (%)	Stray dog (%)	Total (%)
Friend's/neighbour's house	21 (18.26)		16 (18.82)	37 (18.41)
Home	63 (54.78)		11 (12.94)	74 (36.82)
Home and street	1 (0.87)	1(100.00)	1 (1.18)	3 (1.49)
I don't know	4 (3.48)		1 (1.18)	5 (2.49)
Other place	3 (2.61)		5 (5.88)	8 (3.98)
Relative's house	1 (0.87)		1 (1.18)	2 (1.00)
Street	22 (19.13)		50 (58.82)	72 (35.82)
Grand Total	115 (100.00)	1(100.00)	85 (100.00)	201 (100.00)

Behaviour in canine-child interactions

In the Practice section, the children had to select one alternative out of four in a number of given scenarios describing possible dog encounters, as mentioned previously. The correct alternative would reflect a safe mode of action in handling the situation. Subsequently, the maximum score was four points. Children who scored more than two points will be referred to as having scored more than 50%.

Baseline data

Overall, the mean score was two and the median score was three on the behaviour test. A total of 70.6% of the children scored 50%. There was an apparent gender difference in the results with girls having an average score of 76.3% and 75% of the girls scoring >50% (Figure 2), while boys had an average score of 69% and 65.3% of the boys scoring >50% (Figure 2). The difference proved to be statistically significant ($p < 0.05$). On the question “What do you do if you meet a dog in the street”, 52.4% of the respondents would display a safe behaviour, such as stand still, ignore the dog or walk away from the dog, 15.1% would display risky behaviour, for instance shout at the dog, chase the dog or throw rocks at it, 2.1% were indecisive and simply answered “I don’t know” and 2.9% would display a behaviour categorised as “Other” since the risk associated with those actions was impossible to estimate (for instance “Say hello” or “Call dog catcher”), see Table 5.

Table 5. Answers to the question "What do you do if you meet a dog in the street?". This shows the responses of all children asked, including both pre- and post-intervention schools.

avoid/ignore	618 (55.03)
be careful	13 (1.16)
call dog catcher	8 (0.71)
chase the dog	17 (1.51)
feed the dog	11 (0.98)
I don't know	25 (2.23)
I will be afraid	14 (1.25)
look at it	3 (0.27)
make friends with the dog	11 (0.98)
run away from it	112 (9.97)
stand still	146 (13.00)
take it to the hospital	7 (0.62)
throw stones at the dog	16 (1.42)
walk silently	85 (7.57)
other	26 (2.32)
pet/play with the dog	11 (0.98)
Grand Total	1123 (100.00)

Behaviour in bite victims

In general, bite victims scored lower on questions about behaviour around dogs than children who had not been bitten by dogs. Among the children who had not been bitten by dogs, 72.5% of respondents scored >50%, whereas in the group who had been bitten by dogs, 64.5% scored >50% (Figure 3). This difference proved to be statistically significant ($p < 0.05$). Both groups had a mean score of 50%. Among bite victims, 59.9% would display safe behaviour, 19.4% would display risky behaviour, 3.6% were indecisive and 3.6% would display other behaviour. Among non-bitten respondents, 72.5% would display safe behaviour and 16.8% would display risky behaviour. Statistical analysis revealed that the RR was 1.3 on the probability that bite victims would display risky behaviour, but this was not statistically significant ($p = 0.07$). Gender inclination towards risky behaviour among bite victims was that 12.9% of the boys and 6.5% of the girls would display risky behaviour. The RR for boys was 1.2 but the gender difference proved not to be statistically significant.

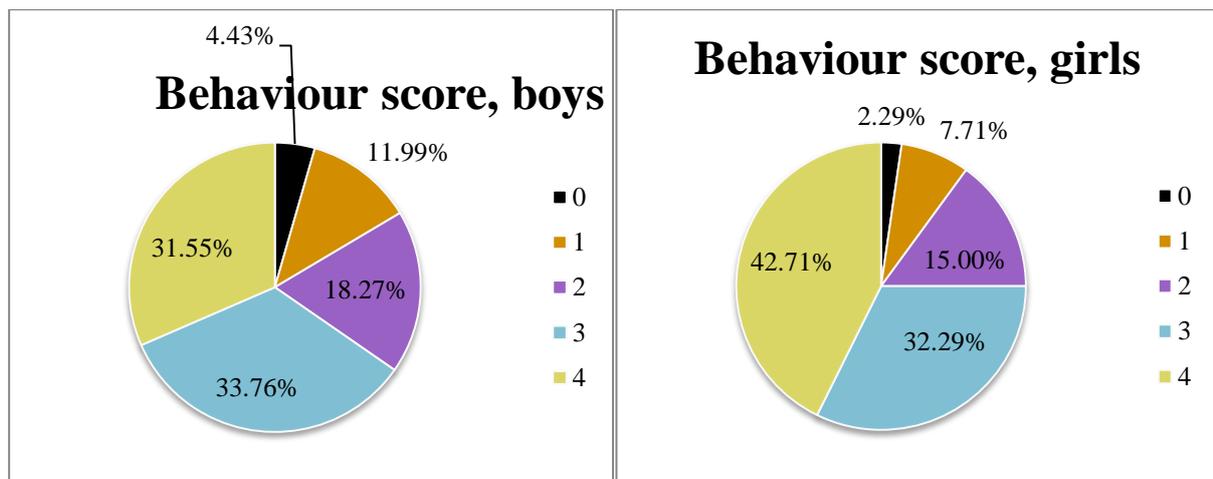


Figure 2. Behaviour score among male and female respondents.

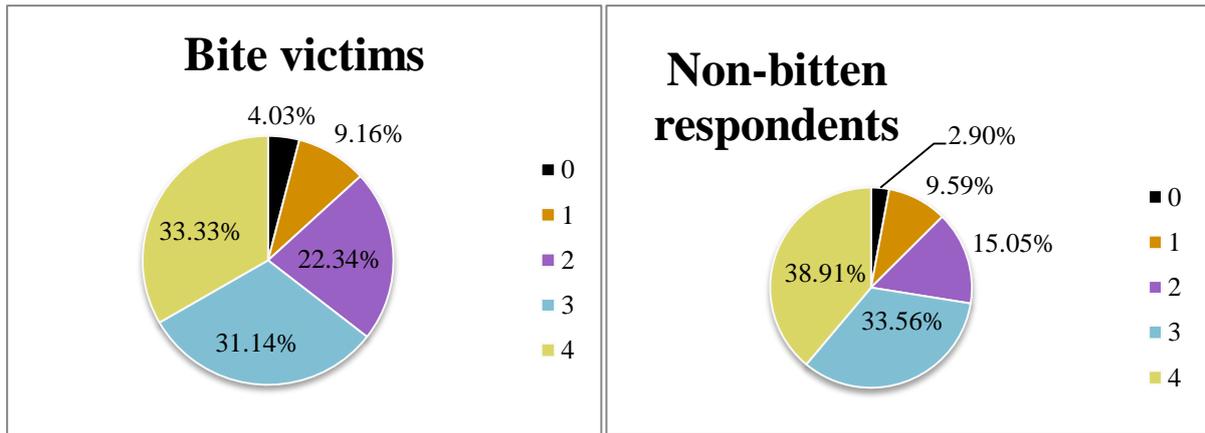


Figure 3. Behavioural score among children who reported having been bitten by dogs (left) and behavioural score among non-bitten respondents (right).

Behaviour in dog-owners

On the behaviour questions, dog-owners scored significantly ($p < 0.05$) lower than children who did not own a dog. Among non-dog-owners a total of 72.8%, scored higher than 50% on the test, compared to the dog-owners of which only 66.4% reached a score higher than 50% (Figure 4).

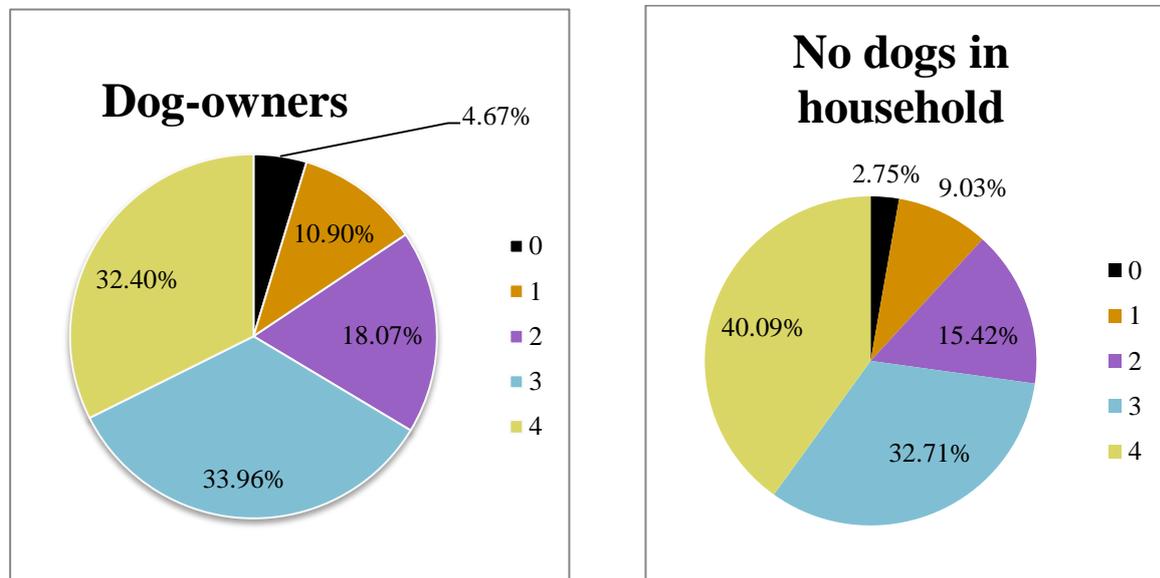


Figure 4. Behaviour score for children who reportedly owned a dog compared to the behaviour score for children with no dogs in household.

Effects of an informational speech on risk behaviour and risk estimation responses

In general, the respondents who had not taken part of an informational lecture showed a lesser degree of knowledge about responsible and safe interaction around dogs. Only 50% displayed safe behaviour when asked what to do if they meet a dog in the street, compared to the post-intervention schools where 91.7% answered correctly. Moreover, 44.3% of the children in the pre-intervention schools would display risky behaviour, as opposed to the post-intervention schools that only accounted for 4.5% of participants displaying risky behaviour ($p < 0.05$) (Table 6). Only 46.3% of respondents in the pre-intervention schools scored higher than 50% on scenarios involving interaction with dogs, compared to 84.3% in the post-intervention schools ($p < 0.05$) (Table 6).

The impact of the informational speech on the perceived risk of contracting rabies seemed to be less than the effect on dog behaviour and differences between the two intervention groups were smaller. In the pre-intervention schools, 18.5% thought their family was at risk, 69.2% did not think rabies posed a threat to their family and 12.3% answered indecisively. The result was similar in the post-intervention schools where 25.6% answered yes, 70.6% answered no and 3.8% answered indecisively on the question “Do you think your family is at risk of contracting rabies?” (Table 6).

Table 6. *Effects of a lecture on children’s responses to questions about safe interactions with dogs and rabies risk*

	Pre-intervention (%)	Post-intervention (%)	Total (%)
Score of behaviour points			
0	35 (7.76)	7 (0.88)	42 (3.37)
1	88 (19.51)	31(3.89)	119 (9.54)
2	119 (26.39)	87 (10.93)	206(16.52)
3	146 (32.37)	263(33.04)	409(32.80)
4	63 (13.97)	408 (51.26)	471(37.77)

Grand Total	451 (100.00)	796 (100.00)	1247(100.00)
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Behaviour when engaging with dogs

Risky behaviour	179 (44.31)	32 (4.45)	211(18.79)
Safe behaviour	202 (50.00)	659 (91.66)	861(76.67)
Indecisive	13 (3.22)	12 (1.67)	25 (2.23)
Other	10 (2.48)	16 (2.23)	26 (2.32)
Grand Total	404 (100.00)	719 (100.00)	1123(100.00)

Do you think your family is at risk of contracting rabies?

I don't know	54 (12.33)	28(3.79)	82 (6.97)
No	303 (69.18)	522 (70.64)	825(70.0)
Yes	81 (18.49)	189 (25.58)	270(22.94)
Grand Total	438 (100.00)	739(100.00)	1177(100.00)

Vaccination data

During the vaccination campaign in Madurai, a total number of 8,568 dogs were caught and vaccinated against rabies (Table 7) (WVS, unpublished data).

Table 7. *Number of vaccinated dogs during a vaccination campaign in Madurai.*

Dog ownership status	Number of dogs vaccinated (%)
Free roaming	4882 (56.99)
Owned	3685 (43.01)
Grand Total	8567 (100.00)

DISCUSSION

In this study, a number of factors associated with dog bites and risk behaviour were investigated in conjuncture with assessing children's knowledge about safe dog interaction. Out of the respondents, 23.3% (n=279) reported having been bitten by a dog, which can be considered a high number. A limitation in estimating the bite incidence is that there was no clear definition of a "dog bite" when the participants were instructed to fill in the questionnaires. Subsequently, some children might have reported bites that needed medical attention and others might have reported play bites that did not even break the skin.

Characteristics of human factors

Far from surprising, this study found that males were statistically more likely to have experienced dog bites than female participants. This has been presented in a number of epidemiological studies on dog bite characteristics (Rosado *et al.*, 2009; Shen *et al.*, 2013; Sudarshan *et al.*, 2006; Tenzin *et al.*, 2011; Yalcin *et al.*, 2012). This can also be related to boys being more likely to display risk behaviour, as shown in this study. Shen *et al.* (2006) suggest this could be due to boys being more willing to take risks in a supervised environment to impress peers and teachers. The question of whether boys are inherently more risk taking or if it is to a larger extent related to cultural beliefs and practices, causing environmental impact, falls outside the scope of this study.

Dog-owning

The likelihood of being bitten by a family dog among dog-owners was higher than among children who reported having no dogs in their household. Naturally, children with dogs in their household are more exposed to dogs, thus the chances of getting bitten dramatically increase. There is also evidence that dog-owners are more likely to ignore dominant behaviour from their own dog, than from unknown dogs (Moss and Wright, 1987). Moreover, children with dogs in their households were more likely to display risky behaviour when confronted with unknown dogs in the street. These findings are in accordance with previous research (Shen *et al.*, 2013) and could be explained by the assumption that children who are familiar and comfortable with dogs will not perceive them as threats to the same extent as

children with no records of owning dogs and subsequently act with less caution around dogs. Dog owners have also been found to lack substantial knowledge about safe dog-interaction (Reisner and Shofer, 2008). The majority of the bites had occurred in a domestic environment which is in agreement with the largest proportion of the biters being family dogs. This scenario is in line with previous studies (Messam *et al.*, 2012; Rosado *et al.*, 2009; Schalamon *et al.*, 2006). Nonetheless, this finding is contrary to other studies conducted in India (Ichhpujani *et al.*, 2008; Mehndiratta, 2012; Sudarshan *et al.*, 2001; Sudarshan *et al.*, 2006) where stray dogs are reportedly more commonly the cause of the majority of the bites. The reasons for the different results might be found in the way the data has been collected. In the previous studies conducted in India, data have been obtained from medical clinics or hospitals where people have come to seek treatment. A possible explanation is that people would be more likely to seek treatment when bitten by stray dogs if they are aware of the risks of disease transmission or that bites from stray dogs are more harmful than bites from family dogs and need more urgent treatment. The questionnaires in this study were self-reported and the children were not given a definition of what type of dog bite they should report, which can explain why the results differ largely. Nonetheless, it is an interesting observation that children are commonly bitten by their own dogs in their house also in some areas in India, even though these bites might not require medical attention as often as bites from stray dogs.

As mentioned earlier, dogs in India are commonly kept free-roaming unsupervised for large parts of the day. Free-roaming dogs will be more exposed to infectious diseases since they will come in contact with large number of dogs of uncontrolled background. This could serve as an important transmission route for diseases such as rabies. The fact that children are more likely to get bitten by family dogs in their own homes clearly emphasises the importance of adopting working vaccination schemes for rabies. Additionally, creating awareness among the public regarding rabies, proper wound management, safe behaviour around dogs and responsible dog ownership should be addressed since being bitten by an owned dog is no guarantee for not contracting rabies and necessary measures still need to be undertaken in the occurrence of a bite. Education and creating public awareness play a large part in securing adequate vaccination coverage within the dog population, especially in connection with vaccination drives. Dog owners would possibly be less willing to submit their dogs for vaccination if they have not been sufficiently informed about the purpose. Of the dogs vaccinated during the vaccination drive in Madurai, 43.0% were recorded as owned whereas the rest were logged as free-roaming. During vaccination drives, the more restricted dogs are

less likely to be vaccinated due to their inaccessibility to the vaccination teams if, for instance, the owners are out at the time or reluctant to participate (Suzuki *et al.*, 2008).

Limitations of the study

There are a number of limitations within this study. Firstly, the study samples were all convenience samples due to circumstances beyond our control, thus cannot be expected to be representative for the population as a whole. Moreover, a number of environmental factors can have had an impact on the collected data. For instance, it was not possible to carry out the completion of a number of the questionnaires under the supervision of the author. The absence of someone familiar with the procedure of filling out the questionnaires makes it impossible to further clarify and explain more thoroughly questions from the participants. For these reasons, the definition of “bitten by a dog” was not conveyed to the participants. Subsequently, it cannot be elucidated whether the children who reported having been bitten by a dog, might refer to anything from a play bite or a dog’s teeth touching their skin to severe injuries in need of emergency medical care. Even though children were instructed to fill in the forms truthfully as well as individually, bias was likely introduced because the children might have spoken to each other or tried to put down what they perceived was the “right” answer rather than what they actually know or think. Furthermore, in unsupervised sessions there was a possibility that teachers could have shared too much information with the participants, either out of unawareness of the study design or in order to improve the overall result for the school. Another limitation to this study is the fact that a high number of the schools surveyed were given the questionnaire post-intervention, thus the answers will be heavily influenced by the informational speech given prior to the survey and cannot be expected to reflect the actual knowledge of the children. The probability is high that children who have just been given a lecture on correct wound management, safe behaviour and other items will try to give the right answer in accordance with the information they have just taken part of, rather than a truthful answer about their knowledge/beliefs. Moreover, the executors of the intervention differed for different schools and also tended to stress different things to the students, which is clearly reflected in the answers given. These factors are, however, not very likely to bias the responses to the Background data section or the circumstances regarding dog bites. Another limitation to the study is the language barrier which might play an important role in the accessibility of the information given to the children as well as their interpretation of the questionnaire, the comprehension of given instructions as to how the form was meant to be filled out and the authors’ understanding of the given answers.

CONCLUSION

Despite these limitations, a number of interesting findings confirm results from previous studies. This study confirms results from previous studies indicating sex, age, unsafe behaviour and dog-ownership as risk factors of dog bites and subsequently a higher risk of contracting rabies in areas where rabies is endemic. It is suggested that educational efforts addressing children are implemented to raise the level of awareness of rabies, proper wound management, dog population control and safe behaviour around dogs to reduce the dog bite incidence as well as contributing to the eradication of rabies from India.

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APPENDIX 1

Questionnaire

This questionnaire aims to find out what you know about rabies and dogs, so that in the future we can provide you with all the information that you might need. Please note that this is not a test and try and answer the questions truthfully. If you do not know the answer to any question, just write that you don't know and move on to the next question. Thank you for your participation!

Background data:

1. How old are you?
2. Are you a boy or a girl?
3. How many dogs are in your household?

19. Do you think dogs make good companions?

Yes

No

I don't know

Other:.....

20. Do you think dogs are healthy animals to keep around (for guarding, hunting, companionship etc?)

Indicate where you stand regarding the following statements on a scale by *circling* the option that best fits your belief:

21. All dogs are dangerous

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

22. Stray dogs are dangerous

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

23. Rabies is a problem in India

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

24. Rabies is a problem in your area

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

25. Children are at a greater risk of contracting rabies than adults

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

26. I have been taught about rabies in school

strongly agree

moderately agree

neutral

moderately disagree

strongly disagree

27. I have been taught about rabies from my parents

strongly agree moderately agree neutral moderately disagree strongly disagree

28. Rabies can be effectively prevented by vaccinating dogs

strongly agree moderately agree neutral moderately disagree strongly disagree

29. Rabies can be effectively prevented by euthanizing (killing) stray dogs

strongly agree moderately agree neutral moderately disagree strongly disagree

30. Rabies can be prevented by educating people about the disease

strongly agree moderately agree neutral moderately disagree strongly disagree

D)

31. What do you do if you meet a dog in the street?

32.. *Have you ever been bitten by a dog?*

Yes

No

If yes, was it:

32 a) *family dog*

b) *stray dog*

33. Where were you when you got bitten?

at home

on the streets

friend or neighbour's house

other place

34. Chose the alternative that you would do in the following situations:

You are running or playing and a dog runs up to you. Should you



- *Stop playing, stand very still and don't shout or scream?*
- *Keep on playing, chase the dog away and shout at the dog?*
- *Stand still and shout at the dog or scream. Kick the dog if the dog comes close to you?*

You are riding a bicycle and a dog chases you. Should you

- *Stop riding and stand still?*
- *Carry on riding away as fast as you can and hope the dog doesn't catch you?*
- *Stop riding and try and make friends with the dog by trying to stroke the dog?*



A dog jumps at you. Should you

- *Try to turn your back to the dog and stand still?*
- *Start to run away, shouting at the dog and kicking the dog away?*
- *Stand still and push the dog off you, screaming and shouting?*



A dog barks at you. Should you

- *Look at the floor and slowly back away from the dog?*
- *Run up to the dog shouting at the dog to stop making such a noise?*
- *Start to run away screaming and shouting?*