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Faculty of Veterinary Medicine and Animal Science
Department of Clinical Sciences



Castration coverage and attitudes towards a castration program in Lilongwe, Malawi

Patricia Pettersson

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Castration coverage and attitudes towards a castration program in Lilongwe, Malawi

Andelen kastrerade hundar och inställning till ett kastrationsprogram i Lilongwe, Malawi

Patricia Pettersson

Handledare: Nils Fall, Department of Clinical Sciences

Examinator: Ulf Emanuelson, Department of Clinical Sciences

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SUMMARY

The aim of this study was to measure the castration coverage and the attitudes among people towards castration in an area in Lilongwe, the capital of Malawi, where a castration program has been running for a few years. Another aim was to review the literature to examine the link between castration coverage and rabies prevalence. Two areas (Area 25 and Area 23) in Lilongwe were studied through standardized household interviews. In Area 25, a non-governmental organization had been castrating dogs weekly to twice weekly for free for 3 years. In Area 23, no official organization had done castrations, and this area therefore acted as a control in the study. In each area, 200 households were interviewed. In both areas, the castration coverage was found to be quite low; 22% and 28% of the adult dogs included in the study was castrated in Area 25 and 23, respectively. There was no statistically significant difference in castration coverage between the areas ($p = 0.44$). However, attitudes towards castrations of dogs seemed to be more positive in Area 25 than in Area 23. This difference was found to be statistically significant ($p < 0.01$). Generally, attitudes towards castration of dogs were positive in both areas.

SAMMANFATTNING

Den här studien undersöker andelen kastrerade hundar samt inställning till kastration av hundar i två områden i Lilongwe, huvudstaden i Malawi. De två områdena, Area 25 och Area 23, jämfördes genom hushållsintervjuer och 200 hushåll intervjuades i varje område. I Area 25 har ett program där gratis kastration erbjudits på utvalda ställen en till två gånger i veckan pågått under några års tid. I Area 23 har inget sådant program funnits. I båda områdena var andelen kastrerade hundar relativt låg; av de vuxna hundarna som ingick i studien var 22 % kastrerade i Area 25 och 28 % i Area 23. Skillnaden i andel kastrerade hundar i de två områdena var inte statistiskt signifikant ($p = 0,44$). Däremot fanns en signifikant skillnad i inställning till kastration av hundar, där de som bodde i Area 25 i högre grad svarade att de var positivt inställda till kastration än de i Area 23 ($p = 0,001$). Generellt var de flesta tillfrågade i båda områdena positivt inställda till kastration av hundar. Studien går också igenom en del av litteraturen på området för att undersöka om det verkar finnas bevis för att kastrationer kan påverka prevalensen av rabies.

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INTRODUCTION

Rabies is a zoonotic, fatal disease that causes a lot of fear and concern and costs a lot of money in most sub-Saharan countries, including Malawi. Domestic dog populations act as reservoirs of the disease and bites from domestic dogs are the main route of infection for humans (Coatsee & Nel, 2007; WHO, 2013a). It is possible to prevent rabies outbreaks in both domestic animals and humans by vaccination of the dog population combined with dog population management. One of the most important components in dog population management is reproductive control. The most common way of achieving this is through surgical sterilization. A non-governmental organization, Lilongwe Society for Protection and Care of Animals (LSPCA), has been castrating and vaccinating dogs against rabies in Area 25 in Lilongwe, Malawi, for 3 years. Their aim is to control the dog population in a humane way, increase animal welfare and ultimately reduce and/or eliminate the spreading of rabies.

The main objectives of this study were;

- To review the literature to examine the link between rabies incidence and dog population management, with extra focus on reproductive control (castrations).
- To estimate and compare the proportion of the dog population that has been castrated in an area where a castration program has been running (Area 25), to an area where no such program has been run (Area 23).
- To evaluate the attitudes in the community towards castrations of dogs in the two areas.

LITERATURE REVIEW

Rabies: description of the disease

Rabies is a zoonotic disease that can affect most mammals including humans. Once symptoms occur, death is almost always certain. It is caused by a single stranded RNA virus of the Rhabdoviridae family within the genus *Lyssavirus* (Nielson & Mayer, 2010). The virus is transmitted through contaminated saliva that comes in contact with penetrated skin or mucus membranes (Nielson & Mayer 2010). The most common route of infection to humans are bites from rabid dogs (>99%) (WHO, 2013a). Once the virus is inoculated in the tissue, it replicates on

site. After replication, it migrates to nerves. Along the nerves it slowly transports to the brain. Once virus reaches the brain it replicates within neurons and causes encephalitis, which give rise to the typical symptoms. Symptoms are variable but can include fever, headache, weakness, disorientation and anxiety; and in the later stages: hydrophobia, hyper salivation, hyperthermia, reduced conscious level, paralysis and loss of sensation (Nielson & Mayer, 2010; Depani et al., 2007). In dogs, virus has been shown to be present in saliva from up to 1-2 weeks before symptoms can be seen, which means it is possible to get infected by a dog that does not yet show any symptoms (Fekadu et al., 1982). The incubation period vary a lot depending on the site of infection and the amount of virus particles transmitted into the tissue (Nielson and Mayer 2010). In humans, the incubation time is on average one to three months but it can in rare cases be several years (Rupprecht et al., 2002; Nielson and Mayer, 2010).

Rabies is estimated to affect and consequently kill about 55 000 - 60 000 people worldwide annually, but since cases of rabies are often not reported, the true number could be even greater (WHO, 2013a). The vast majority of cases occur in Sub-Saharan Africa and Asia (Knobel et al., 2005, WHO, 2013a).

Rabies is preventable through vaccination. This applies both to humans and several domestic animals, including dogs and cats. Vaccines can be given both before any exposure as a preventative measure, and after exposure to contact with any animal that are suspected to have rabies (post exposure-prophylaxis). The modern vaccines available today have been proven safe and efficient (WHO, 2001). However, access to vaccines is limited in many developing countries (Knobel et al., 2005).

The rabies situation in Malawi

There are only a few studies looking at rabies in Malawi specifically, but there are no indications that Malawi, being one of the least developed countries in Africa (Landguiden, 2013), would be an exception to the situation in Africa as a whole.

In a review article, Knobel et al. (2005) concluded that rabies is still an important but neglected disease in Africa. He also stated that those living in poor, rural communities often have the least access and means to afford post-exposure vaccines, while at the same time being those with the highest risk of exposure to rabid dogs. This means that most of the disease burden falls on those people, and in particular children, who have further increased risk of exposure due to closer contact with dogs. This view is shared by the WHO Expert Committee on Rabies (WHO, 2013a).

In a study from 2011, Depani et al. investigated the number of human rabies cases in a hospital situated in southern Malawi. An increase in the number of cases was seen that year compared to

previous years and the authors feared that the rabies burden is increasing rather than decreasing. In the same study the authors also concluded that there is likely a significant underreporting of human rabies cases in Malawi, as has been shown to be the case in many other African countries with similar systems for reporting rabies (Depani et al., 2007; Cleaveland et al., 2002).

The study by Depani et al. (2011) brought up several examples of cases of human rabies where the patients had not received adequate post-exposure prophylaxis after dog bites, even though they were seeking medical aid, due to the of lack of access to vaccine in the hospitals.

According to an official at the Lilongwe District of Agriculture (Mr. P. Saini, pers. comm., September 2013), the rural and peri-urban areas are those suffering the most from rabies. In the view of Mr. P. Saini, rabies is currently increasing rather than decreasing, in the Lilongwe District.

A report from the World Health Organization (WHO) in 2001 stated that many high ranked and decision making public health officers considers rabies as a rare disease and consequently neglect addressing the disease.

The WHO predicts that, if not enough efforts are made to control the disease, the problem with rabies will escalate in many countries where it is endemic, due to growing dog- and human populations, and ranks Malawi as a high risk country for contracting rabies for travelers and residents (WHO, 2013a).

The control of rabies and the link to dog population management

A close correlation between the number of rabies cases in dogs, with those in humans and livestock have been reported (Coatzee & Nel, 2007; Lembo et al., 2012). According to Coatzee and Nel (2007), the control of rabies in dogs is the most important factor in minimizing the public and veterinary health consequences of rabies in most of the parts of the developing world where rabies is endemic. To control rabies in dogs, a strategy is needed, such as a dog population management program.

Dog population management in countries where rabies is endemic should first and foremost address the stray dog populations (ICAM Coalition, 2007). There are several terms used interchangeably, such as *stray dog*, *roaming dog* and *free-ranging dog*. Stray dogs can be either ownerless (abandoned, lost or feral) or owned (but allowed to roam freely). Some dogs are only stray some proportions of the day (if allowed to roam only some parts of the day) (ICAM Coalition, 2007).

Guidelines on dog population management

The aim of a dog population management program should be to improve and maintain vaccination coverage and reduce dog behavior that increases the risk for rabies transmission (WHO, 2013a). In addition it can also improve the welfare of stray dogs and minimize other negative impacts free-roaming dogs may have on the community (WHO, 2013a).

There are guidelines on dog population management written by the International Companion Animal Management Coalition (ICAM Coalition) in 2007. These are partly based on the guidelines published in 1990 by the WHO/WSPA. The World Organization for Animal Health (OIE) has also written guidelines published in 2009. In addition, the reports from the WHO Expert Committee on Rabies also include some information about dog population management (WHO, 2005; WHO, 2013a).

Dog population management programs usually consist of several concurrent interventions, and there is not a single solution that works for every kind of area. Instead, the program needs to be tailored specifically to the area in question (ICAM Coalition, 2007). Keeping that in mind, the following things are examples of what is discussed in the guidelines and the reports from WHO: Collecting relevant background information for the population (e.g. estimation of the size of the dog population and the proportion of stray dogs), implementing a registration system for dogs, promoting a responsible ownership of dogs, vaccinating dogs against endemic diseases (e.g. rabies) and limiting the reproduction of dogs (e.g. castration) so that a stable population in which diseases can be controlled is established. In both the ICAM Coalition's and OIE's guidelines, contribution to a rabies-free dog population is mentioned as one of the primary goals to strive for when implementing a dog population management program (WHO, 2008; ICAM Coalition, 2007).

Dog population management is often presented as the preferable alternative to mass killing of dogs, which was commonly practiced in the past (Edelsten, 1995; WHO, 2005). Often, the word *humane* dog population management is used (WHO, 2013a; ICAM coalition, 2007), to distinguish it from managing the population by simply killing as many stray dogs as possible. Mass killing can, for example, be achieved through administering of poison or shooting of stray dogs in the streets. Those methods are often inhumane, and have also proven to be ineffective (Edelsten, 1995; Windiyaningsig et al., 2004). The WHO Expert Committee on Rabies states that capture and destruction of dogs is not considered to be effective anymore (WHO, 2005). In the report from WHO in 2005, they further declare that there is no evidence that the removal of dogs alone has ever had a significant impact on dog population densities or the spread of rabies, since the population turnover rate of dogs typically is so high so that the dogs removed are quickly replaced by new dogs. Mass killing of dogs have even been suggested to be counter-productive if

done indiscriminately, as vaccinated and sterilized dogs may be destroyed, giving room for new dogs that are not vaccinated and/or sterilized (WHO, 2005). In addition it might upset the community, as many stray dogs are considered being owned (Reece, 2005; WHO, 2005; ICAM coalition, 2007).

Vaccination of the dog population

A study by Zinsstag et al. (2011) found indications that rabies control in the dog populations, achieved by adequate vaccination coverage, appears to be the most cost-effective means of preventing human rabies. For many years the recommendation from WHO has been to aim for at least a 70% vaccination coverage of the dog population annually. Therefore, 70% coverage as a minimum is usually set as the goal when implementing vaccination campaigns. Coverage of 70% is still what is recommended today (WHO, 2013a). One study has found significantly lower coverage than 70% to be likely to be sufficient in certain areas (Fitzpatrick et al., 2012). WHO has made the recommendation of a 70% coverage because it should be sufficient even for those areas with a high transmission rate of rabies (Fitzpatrick et al., 2012; WHO, 2013a).

Castration of dogs as part of a dog population management program

Castration of dogs is often part of a dog population management program (ICAM Coalition, 2007; OIE, 2009; WHO, 2013a). A castrated stray dog takes up a space in the dog population, preventing new dogs from appearing by using up resources, while still not being able to breed itself and give birth to new puppies. A population with a high percentage of castrated dogs contributes to a lower turnover rate in the population, which can help maintain vaccination coverage. (WHO, 2009; WHO, 2013a). Programs that aim both to castrate and vaccinate stray dogs are often called Animal Birth Control programs (ABC programs) (Totton et al., 2010).

In a study from Jaipur, India, where a program of castrating and vaccinating neighborhood dogs had been running for 12 years, 65 % of the stray female dogs were estimated to be castrated, and a reduction of the dog population by 28 % was reported. An elimination of human rabies cases was seen after two years of running the program, and there were no new cases during the following ten years (Reece & Chawla, 2006).

In another study from Jodhpur, India, population size and demographics of stray dogs were measured before and after implementation of an ABC program. The authors reported a reduction in population size in three of five areas. In one of the other two areas they saw a trend towards a decrease in population size and in the second of those areas the population remained stable. The authors estimated that castration coverage of 40% would maintain the dog population at current levels (Totton et al., 2010).

A recent study demonstrated that dogs in a city in Rajasthan, India, where an ABC program had been running, had higher body condition scores and lower prevalence of flea infestations, less infectious diseases and fewer open wounds likely caused by fighting, compared to dogs in cities without an ABC-program (Yoak et al., 2014). The results from this study support the theory that

dog population management programs, with castration of dogs, can contribute to the overall health and welfare of dog population.

One major drawback of surgical sterilization (castrations) is that it is rather expensive (WHO, 2013a). There has been done a lot of research aiming to find an effective method for non-surgical sterilization. In 2006, Kutzler and Wood published a review on the alternatives available, and list several methods, for example GnRH-agonists and testicular injections. However, there are different concerns when it comes to all of these methods, and WHO does not yet regard any of these methods as plausible alternatives to surgical castration (WHO, 2013a). Instead, the main method of reproductive control so far is surgical sterilization (Kustritz, 2012). In some countries the act of castration of an animal is seen as unethical or a violation of the rights of that animal, while in others it is seen as perfectly acceptable (Kustritz, 2012), something which have to be taken in account for when implementing a dog population management program.

The ICAM Coalition guide on humane dog population management suggested that efforts should be concentrated towards castration of female dogs, as they are the limiting factor to the reproductive capacity of the population; castrating male dogs does not make as much of a difference if the goal is to reduce the size of the population, since there are not that many male dogs required to keep the receptive female dogs in the population pregnant (ICAM Coalition, 2007).

There is not yet enough evidence that castration can reduce the contact rate, roaming range and aggressiveness of (especially male) dogs, all of which could influence the transmission rate of rabies, but the WHO expert committee on rabies wants further research to assess if this might be the case (WHO, 2013a). Even though a local elimination or marked decrease in human rabies has been seen after some of the recent castration and vaccination programs conducted, it is hard to know how much the castration part contributed, and what was the effects of the vaccination alone (WHO, 2013).

A review article by Davlin and VonVille (2012) emphasized the importance of trying to find methods on reducing dog population turnover rate, and further concludes that programs which encourage good dog management and promote responsible pet ownership are essential to elimination of both canine and human rabies.

BACKGROUND INFORMATION FOR THE STUDY

Malawi and Lilongwe

Malawi is a sub-Saharan country regarded as one of the least developed countries in the world (Landguiden, 2013). Lilongwe is the capital of Malawi and according to the Lilongwe City Council, about 724 000 people lived in Lilongwe year 2010 (Mr. J. Kantokoma, pers. comm., September 2013). Lilongwe is divided into 58 different areas, and size, population density and socioeconomic status varies a lot between these areas (Lilongwe City Council, 2008). Some of the areas are further divided into smaller zones. For each of these smaller zones, there is usually a person in charge called “the Chief”. The Chief officially only have administrative functions (Lilongwe city council, 2008), but based on personal experience and experience of local people (Mr. E. Chiweta & E. Mitembo, pers. comm., September 2013) they are often the ones who gives directions on a lot of things regarding the community. For instance, if someone wants to do an intervention, for example sterilize dogs in the area, they are expected to speak to the Chief about this first (Mr. E. Chiweta, pers. comm., October 2013).



Figure 1. Map situating Malawi and Lilongwe. Wikimedia Commons 2013.

The dog population and dog population management in Lilongwe

There is very limited data on the dog population in Lilongwe (Mr. R. Ssuna, pers. comm., September 2013). A study that started in September 2013 carried out by the Humane Society International (HSI) is aiming to approximate the number of dogs in Lilongwe, and hopefully this will provide more information when this data is available.

According to the author’s own observations, the way dogs are being kept seem to vary a lot between different areas in the city. Some dogs seem to be confined all the time, but in certain areas it is also very common that owned dogs are allowed to roam the streets freely, either during certain times of the day/night, or all the time. Local law forbids households to keep more than two dogs (Mr. R. Ssuna, pers. comm., September 2013). However, there is currently no mandatory registration of dogs for dog owners, and the rule of maximum two dogs is usually not enforced (Mr. R. Ssuna, pers. comm., September 2013).

Campaigns of shooting stray dogs have been run by the government in the past, but those campaigns are now discontinued (Mr. R. Ssuna, pers. comm., September 2013; Mr. P. Saini, pers. comm., September 2013). A study by Edelsten in 1995 found that the campaigns that were being

run at the time was expensive and probably had little effect on rabies; already then it was recommended to emphasize vaccination of the dog population instead. In 2008 the Lilongwe City Council came to an agreement with an NGO-organization (Lilongwe Society for Protection and Care of Animals, LSPCA) to try to control the dog-population by promoting responsible ownership through education in schools, offering free surgical sterilization and running rabies-vaccination campaigns annually (Mr. R. Ssuna, pers. comm., September 2013).

The LSPCA is funded by donations and currently has two veterinarians employed. The number of dogs sterilized has steadily increased each year since they started (from 34 dogs in 2010 to 213 dogs in 2012). The LSPCA also collaborates with the police force in Lilongwe. Workshops have been held to harmonize the police's view of animal welfare violation with those of LSPCA's. The LSPCA also runs a rehoming shelter for dogs that are found to be abandoned or neglected and provides veterinary services to the community. They charge full price for veterinary services for pet owners that are able to pay, but may charge less or provide services for free for those who can not (Mr. R. Ssuna, pers. comm., September 2013; LSPCA, 2013).

There is currently no veterinary education in Malawi, which has resulted in very few authorized veterinarians active in the country (Mr. R. Ssuna, pers. comm., September 2013).

The LSPCA castration program

The LSPCA has been focusing their interventions in areas that in their opinion need most attention, based on poverty and the amount of free-roaming dogs seen in the streets, etc. They currently offer free castrations twice a week at different sites. They typically stay at the same site for a few weeks until people no longer seem to bring dogs for castration. Announcements are made in the area the day before to make the dog-owners in the community aware that they are coming. They also discuss with the Chief of the area before they begin with the castrations. About 10-20 dogs per veterinarian can typically be castrated in one day (Mr. R. Ssuna, pers. comm., September 2013).

The castrations are performed under general anesthesia. The protocol currently used is xylazine given intramuscularly followed by ketamine given intravenously. The female dogs undergo ovariohysterectomy (both the ovaries and the uterus is removed) and the male dogs a standard castration with the testicles removed. The castrations are carried out by an authorized veterinarian. At least one assistant is usually present to watch the anesthesia and prepare the dogs that are next in line. In addition to being castrated, the dogs are given one dose of ivermectin (deworming and defleecing), one dose of peri-operative antibiotics as well as NSAID and a vaccination against rabies (LSPCA records and personal experience).

All castrations done on site within the community are free of charge (as opposed to those done at the main clinic) (Mr. R. Ssuna, pers. comm., September 2013).

Population data for Area 25

In 2008, there were nearly 65 000 inhabitants in Area 25. The population density was measured to be 28.3 persons per hectare. Covering approximately 2280 hectares, Area 25 is both in terms of surface area and number of inhabitants one of the bigger urban areas in Lilongwe City (Lilongwe City Council, 2008). Using satellite maps available from google maps, one can see a large variation in population density within the borders of Area 25. The middle, southern and eastern parts are densely populated, while the houses are more spread out in the western and northern parts of the area. No official data has been found on average income and no other way to measure the economic status of the people living are known to the author.



Figure 2. Map of Area 25. Satellite map is taken from GoogleMaps (- ©2013 Google) and area borders is taken from Human Society International GIS-map, they are combined in Adobe Photoshop 7.

Population data for Area 23

Area 23 is a densely populated urban area in Lilongwe, with about 114 people per hectare. Population data from 2008, provided by the City Council in Lilongwe, reports that there are 45779 people living in the area. It borders to several other also densely populated areas, which makes the zone rather homogenous in population density (Google maps). As for Area 25, no official data has been found on average income and no other way to measure the economic status of the people living in Area 23 are known to the author.

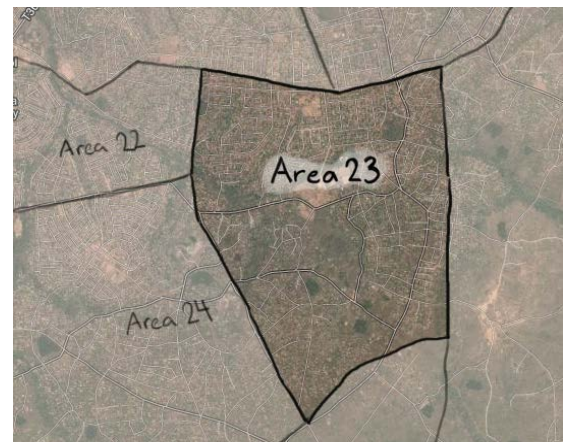


Figure 3. Map of Area 23. Satellite map is taken from GoogleMaps (- ©2013 Google) and area borders is taken from Human Society International GIS-map, they are combined in Adobe Photoshop 7.

MATERIAL AND METHODS

Information on dog ownership, castration status attitudes towards castration of dogs and the on-going castration program was collected by questionnaire based interviews of households in Area 25 and Area 23 during September and October 2013 (see appendix).

Questionnaire design

The questionnaire contained the questions relevant to this study but also to another, parallel study, investigating the rabies vaccination coverage and awareness of rabies. The questionnaire was designed with the objectives for this and the other parallel study in mind. The relevance and formulations of the questions were discussed with the staff of LSPCA, and some changes were made after that. Most questions included in the questionnaire were closed questions, with only a few available alternatives (e.g. “Is/Are your dog/dogs spayed or neutered?” (*Yes/No*)). Some questions were open-ended (e.g. “Why did you/your family chose to spay/neuter your dog/dogs?”), and the answers were then categorized before analysis.

Five trial interviews were held in Area 25 before the data collection began. The questionnaire was improved (minor changes only) after the trials based on the feedback given. One additional trial was held during the data collection before the first interview in area 23, because of a new interpreter. We did not ask for any respondents name, so all respondents could remain anonymous.

Sample selection

Areas

The households were sampled from two different areas; Area 25 and Area 23. In Area 25, LSPCA has operated since 2008, doing castrations on a larger scale since 2010. Area 23 was included to have something to compare the results from Area 25 with, because no previous study had been done before LSPCA started to do castrations in Area 25.

The choice of Area 23 as the control was based on information from the LSPCA staff that Area 23 is similar to Area 25 in population structure and socioeconomic status of the inhabitants (as we had no official data to base this on). The LSPCA has never been carrying out castrations in Area 23. Area 23 and Area 25 are not adjacent to each other, minimizing the risk that people and dogs living in the control area (Area 23) were influenced by the activities of the LSPCA in Area 25.

Households

We aimed to scatter the households selected for interviews all over the area, to make sure we sampled different kind of living standards in the area. We tried to do this with help of satellite maps of the areas (see map of Area 25 and Area 23, figures 2 and 3) and the help of our interpreters that were familiar with the areas. However, there was occasionally some confusion about which areas we had or had not been to. When arriving in a location, 5-10 households were selected by knocking the door of every third or second house (decided beforehand to avoid biased selection). If no one opened the door, we continued to the next closest house. Households were interviewed regardless if they owned dogs or not, but the questions applying only to dog-owners were left out when interviewing households that did not own a dog.

Procedures for the household interviews

The households were contacted by knocking on the door or the fence surrounding the house plot, or simply by approaching people outside the house. We then introduced ourselves and told them that we were doing a survey about dog ownership and asked if it was okay to proceed with asking questions. Most interviews were done in the local common spoken language, Chichewa, with help of interpreters. Two different interpreters were used. Interpreter A assisted in all of the interviews in Area 23 (200) and 69 of the interviews in Area 25. Interpreter B helped with the rest of the interviews in Area 25 (131). Both interpreters were staff from the LSPCA. The interpreters asked the questions guided by the questionnaires and then translated what the respondent said to English so that the answers could be written down by a Swedish veterinary student. A handful interviews in each area were done in English instead of Chichewa. Each interview typically lasted for 5-10 minutes.

Interviews with key persons

To get a better understanding of how the system works when it comes to rabies prevention and dog population management in Lilongwe, interviews were also conducted with a few key-persons: Dr. Richard Ssuna, Project Director of LSPCA; Mr. Patric Saini, Veterinary Officer at Lilongwe District of Animal Health and Livestock Department; Mr. Gilson Njunga, Officer in charge at Lilongwe's Central Reference Laboratory; Mr. M. Mwale, Assistant District Health Officer at the Lilongwe City Council.

Registers from LSPCA and Lilongwe District of Agriculture

Records from LSCPA on the number of castrated dogs in Area 25 were looked into. Records on the number of dog bites from the Lilongwe District of Agriculture office were also studied and basic population data for Lilongwe and Area 23 and 25 specifically was provided by the City Council of Lilongwe.

Analysis of data

Analysis of data collected from the household interviews was performed with Microsoft Excel 2010. Data was entered into an Excel spreadsheet, from which calculations could be made. Relevant data from the two areas were compared using either a student's T-test or a Pearson χ^2 -test. Results were regarded as significant at $p < 0.05$.

RESULTS

In total, 200 households were interviewed in Area 25 and 23, respectively. In Area 25, 66 of the interviewed households had at least one dog. In Area 23, 44 households had at least one dog. We did not record the number of households that were skipped when no one opened the door or the gate, but all the households in which someone was home and responded, choose to participate in

the study. See table 1 for some basic information on the human population and information on dog ownership obtained from the study in Area 25 and 23.

Table 1. *Descriptive statistics on the human population and dog ownership in the two areas in Lilongwe, Malawi.*

	Area 25	Area 23
Number of people living in the area (2008)*	64650	45779
Population Density (people/hectare) (2008)*	28.4	114.2
Number of households interviewed	200	200
Number of dog owning households interviewed	66	44
Number of females:males interviewed	140:60	151:49
Human:dog ratio in interviewed households	1:0.104	1:0.062
Average number of dogs per interviewed household	0.57	0.38
Average number of dogs per interviewed dog-owning household	1.72	1.70
Total number of people in interviewed households	1101	1197
Total number of dogs in interviewed households	114	75
Percentage of dogs in interviewed households that were younger than 6 months	26%	23%

*Data provided by the City Council, Lilongwe.

General findings

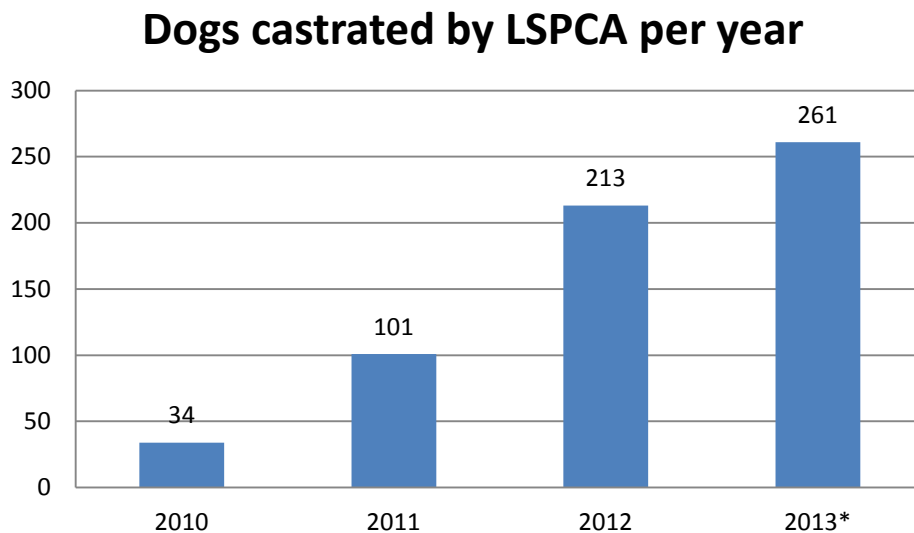
In Area 25, the average number of dogs per households was higher than in Area 23 (0.58 dogs

per household in Area 25 and 0.37 dogs per household in Area 23). Using a Student's T-test this difference was found to be significant ($p=0.042$). The average number of persons per household was similar in the two areas (5.97 and 5.50 persons per household in Area 25 and 23, respectively).

In both areas male dogs seemed more common than female dogs. In the studied households in Area 25, 66 % of the dogs were male. In the households in Area 23, 64 % of the dogs were males.

There were in total 17 castrated dogs in the study from Area 25. Three of the castrated dogs were female, six were male, and for the rest eight dogs the question about what gender the dog was were not asked. In Area 23 there were 16 castrated dogs in the interviewed households. Fourteen of these dogs were male, only two were female.

According to the records from LSPCA, 609 dogs were castrated in Area 25 from January 2010 to September 2013. See chart below (Figure 3) for more detailed information about how many dogs that have been castrated each year.



*Figure 3: Amount of dogs castrated by LSPCA in Area 25 in Lilongwe from 2010 to 2013, according to the LSPCA records. *For 2013, only dogs castrated between the beginning of January and the end of September have been recorded.*

According to Mr. R. Ssuna, the Project Director of the LSPCA, 1108 dogs have been castrated by the LSPCA in Area 25 since they started operating there, which is more dogs than we managed to

find listed in the records. He bases his information on data files stored in a computer, and it is possible that that information was more complete than the information from the handwritten records we had access to.

Castration coverage

Only counting adult dogs (dogs 6 months or older), 21% of the dogs in the study households were castrated in Area 25. Counting all dogs regardless of age, 17% of the dogs in Area 25 were castrated.

In Area 23, 26% of the dogs in the study households (only counting dogs 6 months or older) were castrated. Counting all dogs regardless of age, 21% was castrated in Area 23.

There was no statistically significant difference in castration coverage between Area 25 and Area 23, using a Pearson χ^2 -test ($p=0.44$).

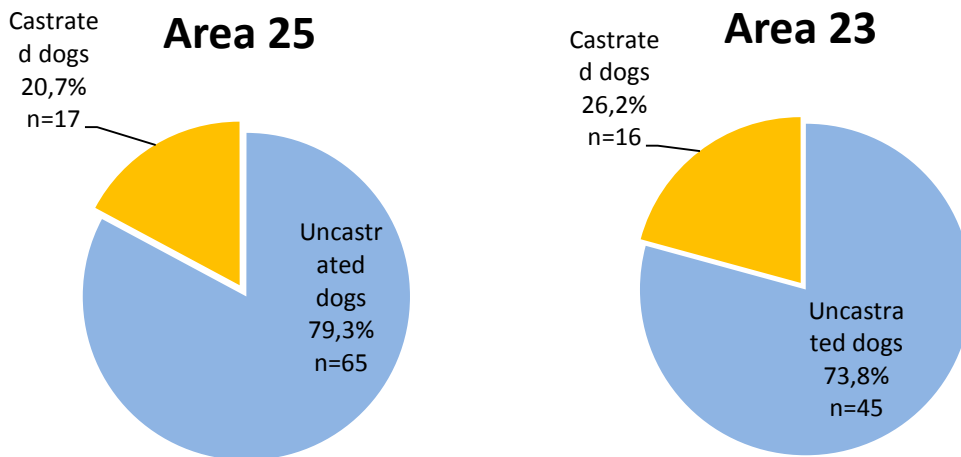


Figure 4. Percentage of dogs that were castrated in two different areas in Lilongwe, Malawi, not counting any of the dogs that were yet too young to be castrated (>6 months).

Attitudes towards castrations of dogs

Do you think its important/a good idea to spay/neuter dogs?

In Area 25, 75 % of the respondents answered that they think it is important to castrate dogs (“yes”), whereas 7% did not regard it as important (“no”). 17% stated that they did not know whether or not it is important (“don’t know”), and 2% said that it was only a good thing to do in male dogs.

In Area 23, 61% of the respondents answered that they think it is important to castrate dogs

(“yes”), whereas 18% did not regard it as important (“no”). 21% stated that they did not know whether or not it is important (“don’t know”), 1% said that it was only a good thing to do in male dogs.

The answers were categorized with those answering “yes” as one group, and those answering “no” and “don’t know” in one group, based on the assumption that those answering “yes” are likely to castrate their dog if they have the opportunity, while those answering “no” and “don’t know” probably will not castrate their dog. The small group of households that answered that castration is only a good thing to do in male dogs was discarded from the calculation. Using a Pearson chi²-test the difference between the areas was found to be significant (p=0.001).

What is the reason your dog/dogs is not spayed/neutered?

Dog-owning households with at least one intact dog were asked to state the main reason to why they had not castrated their dog/dogs. The results were quite similar in both areas, se figure 5.

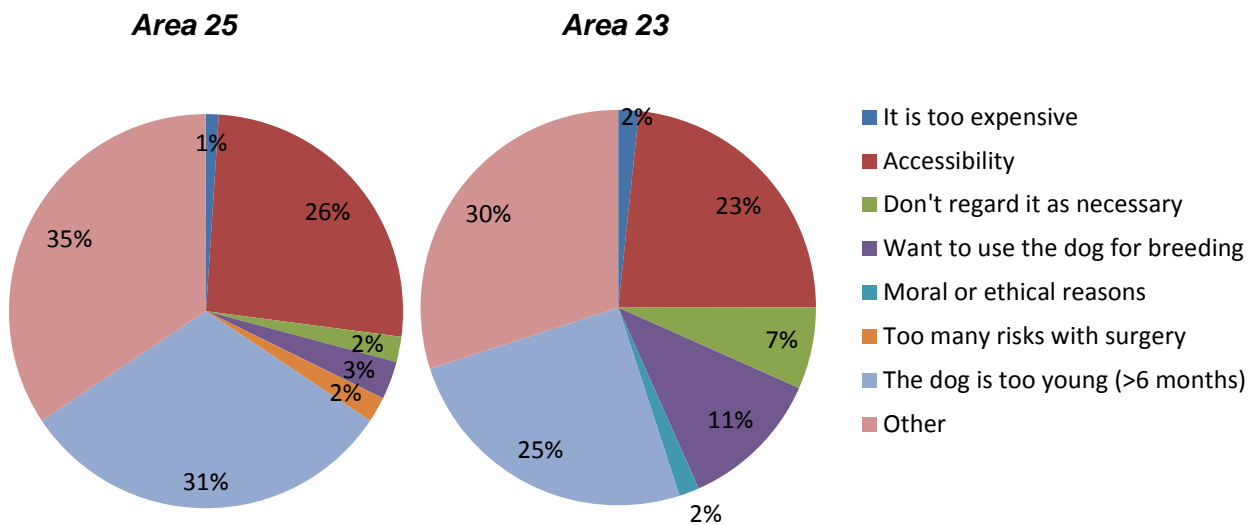


Figure 5: Reasons stated by households owning uncastrated dogs to why their dogs were not castrated in two different areas in Lilongwe, Malawi.

Why did you/your family decide to spay/neuter your dog/dogs?

The dog-owning households with at least one castrated dog were asked to pick a main reason out of six alternatives to why they had chosen to get it castrated. One alternative could be picked for each dog, meaning that a household with two dogs got to answer some questions two times, and a household with three dogs could answer the same question three times, etc. The reason for this is that there can be different reasons for each dog to why the owner has chosen to castrate them. The results are displayed in Figure 6.

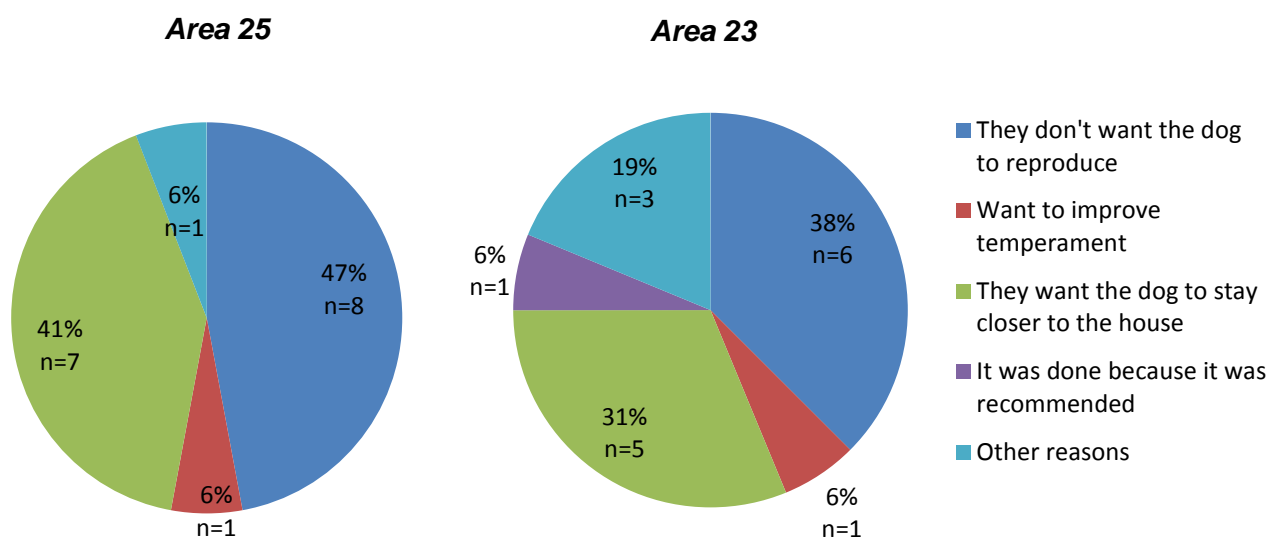


Figure 6: Reasons for castration of dogs stated by dog-owning households with at least one castrated dog, in two areas in Lilongwe, Malawi.

Have you noticed any change in behavior in your dog after the castration?

Households with at least one castrated dog were also asked (once per dog) if they had noticed any change in behavior after the castration, and if so, what kind of change and if they would classify the change as positive or negative. In Area 25, 11 out of 14 dogs were reported to have changed their behavior in a positive way. Examples of these changes included that the dog stayed closer to the house, that the dog was healthier and that the dog had put on more weight. One owner to two dogs said that her dogs had become more aggressive, and another owner to one dog could not tell if there was any difference or not.

In Area 23, 11 out of 15 dogs was said to have changed in a positive way after the castration. The examples of how they had changed were similar to those in Area 25. In four dogs, owners could not tell if there was a difference or not since they had been castrated at a very young age.

Attitudes towards the program

It was slightly more common that the respondents had heard about the LSPCA before in Area 25 than in Area 23, even though in both areas most respondents had never heard of them. In Area 25,

12% of the respondents had heard about LSPCA, in Area 23 the corresponding number was 5%. The difference between the areas was found to be statistically significant using a Pearson chi²-test ($p < 0.01$).

All of the respondents that knew about the LSPCA in Area 25 had a positive view towards them. In Area 23 all but one said they had a positive opinion about the LSPCA. The one that did not claim to have a positive opinion said he did not have enough information to make a stand and therefore claimed to be neutral.

Free-roaming dogs

One question included in the questionnaire asked to the dog-owning households was if and when their dog/dogs were allowed to roam the streets freely. In both areas, most respondents stated that their dog was never allowed to roam freely. It was also quite common that they were allowed to roam free all the time, or only at nighttime. See Figure 3 below for more details and closer comparison between the areas.

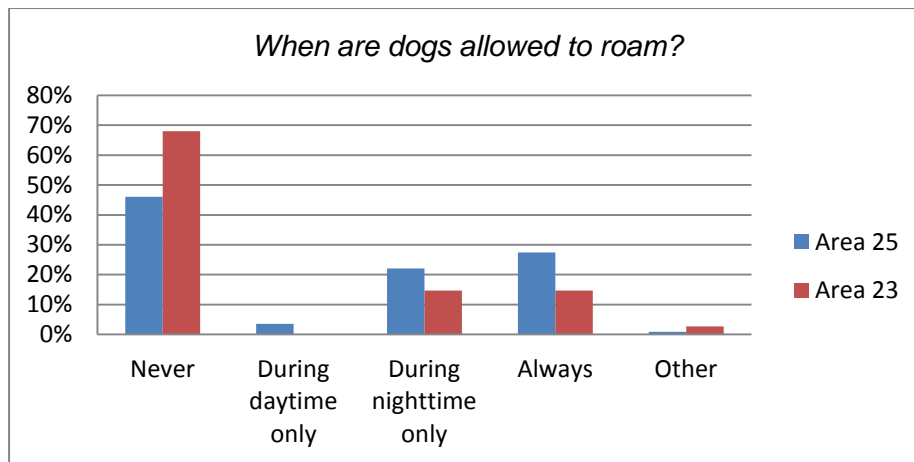


Figure 3. Dog roaming patterns as shown as a percentage of the total amount of dogs in the study in two areas in Lilongwe, Malawi.

DISCUSSION

Is there a link between castration of dogs and rabies prevalence?

Several studies have documented success in reduction of the number of rabies cases after implementation of combined vaccination- and castration programs (Reece & Chawla, 2006; WHO 2013a). However, it is hard to know if and how much the castration part contributed – it is possible that the reduction in the number of rabies cases was solely due to the vaccinations. There does not seem to be any evidence that castrations alone can reduce rabies prevalence.

Dog population management programs, of which castrations are a part, are an effective way of reducing the population turnover rate (WHO, 2013a). With a lower turnover rate, it will take longer time for vaccinated dogs to be replaced by new, unvaccinated dogs. That way, castration of dogs can help to maintain the proportion of vaccinated dogs, but it is possible that it is more cost-effective to simply vaccinate more often instead of adding castrations. There is not yet enough evidence that castration of dogs can reduce dog behavior that increases the risk for transmission of rabies (long roaming distances, aggressiveness, etc.), but hopefully this will be more evaluated in the future. An interesting finding in this study was that several owners to castrated dogs said that their dog stayed closer to the house after the castration, but the number of households with castrated dogs in this study was too small to be able to draw any certain conclusions from that.

Of course, castration of dogs may have other beneficial effects on the dog populations, which doesn't regard rabies prevalence.

Estimation of the proportion of castrated dogs

The castration coverage of 21% in Area 25, with an active castration program, must be considered quite low. There are no exact numbers of the total amount of dogs in Area 25, but based on the human:dog ratio calculated from the household interviews and human population data from the City Council, a rough estimation would be that there are around 6000 dogs in Area 25.

Since there are a lot of free roaming dogs and few castrated dogs in Area 25, the dog population turn-over rate is probably quite high. More than a fourth of the dogs in this study in Area 25 were younger than 6 months, which also points towards a high turn-over rate. Given that one can assume quite a high turn-over rate in an area like Area 25, many of the dogs castrated in 2010 and 2011 have probably been replaced by new dogs. Even disregarding that, assuming the total number of dogs to be around 6000, about 10-18% of the dog population would have been

castrated by the LSPCA (using either the information we found in the records from the LSCPA or the information from Mr. R. Ssuna). However, with only one vet doing castrations one to two times a week, it would not be realistic to expect to find a higher proportion of castrated dogs than what was estimated from the questionnaires.

In Area 23, 26% of the dogs included in the study were castrated. It is a bit surprising that no difference in castration coverage was found between Area 23 and Area 25, as Area 25 has an active castration program, while Area 23 has not. As LSPCA has not been doing castrations in Area 23, someone else must have castrated dogs there, perhaps lay persons. It is also important to keep in mind that the number of dog owning households in this study was quite small, which means that the true proportion of castrated dogs in both areas might be different from the proportion of castrated dogs in the study.

Impact of the program

It is very hard to say anything about the impact that the castrations have had so far, especially when it comes to impact on rabies prevalence, as there has not, to the author's knowledge, been done any studies on the direct effect of castrations in a dog population on rabies prevalence. A study like this would be very interesting, but probably hard to design and carry out.

On the bright side, the number of dogs castrated by the LSPCA has steadily increased each year so far. Hopefully more castrations can be carried out in the future which potentially can yield a higher coverage. Several recent studies in India have shown impact of ABC-programs on dog population density, a dog population health and a reduction in the number of rabies cases (Reece & Chawla, 2006; Totton et al., 2010; Yoak et al., 2014). Hence, it is possible that an impact on population health and the number of rabies cases might be measurable in the future when castration coverage is higher, though it will be hard to distinguish the effects of the castrations from the vaccinations.

Community attitudes towards the program and castrations

The attitude towards castration of dogs was slightly more positive in Area 25 than in Area 23. It is hard to determine with certainty if it is an effect of LSPCA doing castrations in Area 25 or not. However, castrations done by authorized veterinarians mean a safer procedure and better results compared to those done by non-authorized people. Therefore, it is possible that people have a more positive view towards castrations in Area 25 because they have seen that the dogs are still healthy after the castration, compared to those done by lay persons in Area 23. Castrations done by lay persons are most likely done without anesthesia, which makes the procedure both look and indeed be inhumane. This might negatively impact people's opinion about castrations. One

indication that the castrations in Area 23 are done by lay persons are that there seemed to be more common that male dogs were castrated in Area 23 than female dogs. Since castration of a female dog requires surgery in the abdomen, it is almost impossible to do this without anesthesia, but it is possible (although not advisable because it is not humane) to castrate males without anesthesia.

If people start seeing the benefits of castration of dogs, they might start valuing it more in the future. Combined with education in schools and trying to communicate the importance of responsible ownership, it might create a higher demand for castrations. There are rumors about Malawi being in the process of starting up a veterinary education, and with more active veterinarians in the country hopefully this can lead to that the private sector can start contributing more to castration of dogs.

In both Area 25 and Area 23, there were indications that male dogs were more common than female dogs. During our data collection, we got indications that dogs are seen as useful for guarding rather than being kept as pets. This could mean that males are regarded as more valuable because of their tendency towards more aggressive behavior compared to that of female dogs.

Study design

The ideal setup for a study like this would be to compare an area before and after an intervention. Since there was no study done in Area 25 before the castration program started, that was not possible in this case. Instead, it was decided to compare Area 25 with an area where no castration program had been running. The aim was to identify two areas that were as similar as possible, apart from the exposure (the castration program). The selection of an appropriate control was, however, difficult due to lack of valid population data and quality maps. It is possible that any differences found in the areas are an effect of the areas being inherently different, rather than an effect of the castration program. The reason why LSPCA choose to operate in Area 25 was based on their judgment that it was the area most in need of an intervention. Hence it is possible that before the intervention in Area 25, there would have been a measurable difference between the castration coverage of the two areas, with a higher proportion of castrated dogs in Area 23.

Because of limited time, two interpreters had to be used instead of one (which was the plan from the beginning). As we were in the process of finishing the data collection for one of the areas when we realized we were going to have to use an additional interpreter, one of the interpreters ended up doing the majority of the interviews in Area 25 and the other interpreter all of the interviews in Area 23. This is of course not ideal, as different persons have different ways to

express themselves, and thus may influence the answers we get when asking questions from the questionnaires. This might have tilted the results in either direction.

The way the study was designed, we got a quite small sample of dog-owning households from each area. The reason for the small sample was the limited time for the study, and that we wanted to sample households randomly (as opposed to selecting dog-owning households) so that we could also try to calculate a human:dog ratio for the both areas, to try to estimate the size of the dog population. The small sample of dog-owning households means that the results are not as reliable as they would be if there were larger samples, and are probably one of the reasons to why no statistically significant difference in castration coverage could be found between the areas.

For more trustworthy results, a new study could be done in Area 23 after an intervention there. Our results from this study could then be used as a control, and Area 23 could be compared before and after an intervention, instead of comparing two different areas.

Another thing to take note of is that the majority of the respondents from the households in the study were female. The interviews were conducted during day-time and it seemed more common that women were the ones at home at that time. It is possible that there are gender differences especially when it comes to opinions about castration of dogs. This might have affected our results, but it probably has nothing to do with the differences in views about castrations in the two areas, since there was no big difference in how many more women than men that was interviewed between the two areas.

There were not very many households included in our study that owned at least one castrated dog (eleven households in Area 25 and twelve households in Area 23), which makes it impossible to draw any certain conclusions about the community as a whole from the questions that were asked only to the people in the study that had at least one castrated dog. It is however encouraging that a majority of the few people who were asked about the result of the castration had seen positive changes in the dog's behavior or condition. Several people spontaneously said that their dog stayed closer to the house after castration.

Future considerations with regard to rabies control in Malawi

It could be argued that it would be a good idea to try to influence the community towards keeping their dogs confined instead of letting them roam freely. This way, dogs would have less contact with other dogs, and thus reduce the risk for contracting and spreading rabies and other diseases to other dogs. It would also reduce the uncontrolled reproduction of dogs. On the other hand, it is

not clear that this would benefit the welfare of the dog population as a whole. Many households in less developed areas in Lilongwe (such as Area 23 and Area 25) have only one or a few rooms and keeping their dogs indoors a substantial part of the day might not be possible. The plot area belonging to the household might be, but is more often not, surrounded by a fence. The tradition of walking dogs is not the norm, as in many western countries. This means that the option to letting the dogs roam freely would be to keep them chained to a tree or some other fixed object all the time, which cannot be viewed as good animal welfare.

The LSPCA has castrated more male dogs than female dogs, which might simply be because male dogs are more common in the communities. As the ICAM Coalition suggests, it might be advisable to concentrate on castrating the female dogs, as they are the ones limiting the reproductive capacity of the population. On the other hand, it is often behavior more typically seen in uncastrated male dogs that is thought to negatively impact the welfare of the dog population, and perhaps increase the risk of spreading rabies (fighting, roaming long distances, etc.).

A registration and identification system for dogs would probably be of great aid. It would help the authorities to keep track of the size of the dog-population and it would be easier to enforce regulations about rabies vaccination and to track dogs in suspected rabies-cases (dog-bites to people). However, it might be hard to implement this in Malawi at the moment, and it would at least require the authorities to be interested in administering such a system.

In an interview in September 2013, Mr. M. Mwale, District Health Officer at the Lilongwe City Council, stated that rabies was not on his top 10-list of important diseases. In a report from the WHO (2001), it was said that many high ranked or decision making public health officers considers rabies as a rare disease and consequently neglect the addressing of the disease. This kind of reasoning is not very surprising because developing countries, like Malawi, often have big problems with other major diseases such as Malaria, HIV and human tuberculosis (WHO, 2013b; WHO, 2013c; UNICEF, 2011). The above mentioned underreporting of rabies probably also contributes to the neglecting of the disease. It is important to remember, that even if rabies does not compare with Malaria and HIV when it comes to the number of people affected, rabies is always fatal once contracted. It is also a disease which can be totally prevented through vaccination, both in humans and dogs.

Well-informed people that we spoke to (Mr. P. Saini, Veterinary Officer at Lilongwe District of Animal Health and Livestock Department, September 2013; Mr. G. Njunga, Officer in charge at Lilongwe's Central Reference Laboratory, September 2013) were of the opinion that the rabies situation is worst in the rural and peri-urban areas. The LSPCA works and operates within the

city boundaries of Lilongwe, and the rural areas fall outside their working zone. There are indeed problems with rabies within the Lilongwe City boundaries as well, and work remains to be done both within the city and in the more rural parts of Malawi.

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APPENDIX: QUESTIONNAIRE

Questions:

Answering categories:

Housenumber		
Area		
Subarea		
Date		
Gender of person answering the questions		Male/female
How many people belong to this household?		
Does the household own a dog?		
	How many dogs belong to the household?	
	Gender of the dog/dogs?	Male/female
	How many adults and how many puppies (<6 months)?	
	Is your dog/dogs spayed or neutered?	
	Why did you or your family decide to spay/neuter it?	To stop the dog from reproducing To improve the dog's temperament To get the dog to stay closer to the house It was done because it was recommended Other reasons
	Where did you get it/them spayed/neutered?	By the LSCPA In a private clinic By the government Other
	Did you have to pay for the spay/neuter?	
	How much did you pay?	
	Would you have done it if you had to pay?	
	How much would you be willing to pay?	
	Did you notice any change in the dog's behavior after the spay/neuter?	
	In what way did it change?	It is too expensive

		Was it a positive or a negative change?	<p>It is hard to find someone that does it</p> <p>It is not necessary</p> <p>Want to use the dog for breeding</p> <p>The risks are too great</p> <p>The dog is still a puppy</p> <p>Other reasons</p>
		What is the reason your dog/your dogs is not spayed/neutered?	<p>It is too expensive</p> <p>It is hard to find someone that does it</p> <p>It is not necessary</p> <p>Want to use the dog for breeding</p> <p>The risks are too great</p> <p>The dog is still a puppy</p> <p>Other reasons</p>
		Is your dog allowed to roam the streets/go outside by itself?	Yes/No
		When is your dog allowed to roam the streets/go outside by itself?	<p>All the time</p> <p>During Daytime</p> <p>During Nighttime</p> <p>Other</p>
		Do you think it is important/a good idea to spay and neuter dogs?	<p>Yes</p> <p>No</p> <p>It is only good for males</p> <p>Don't know</p>
		Have you heard about the LSPCA?	Yes/No
		What is your opinion about the LSCPA?	Positive/Negative