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Research Article

Factors Associated with Puppy Morbidity and Mortality among the Breeding Kennels in Nairobi and its Environs in Kenya

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Abstract

Aim

Dogs are extensively employed in security and protection of property both in urban and rural areas. Besides, many other dogs are also kept as pets for companionship in urban families providing a unique, intimate, emotional bond and relationship that people share with their pets giving important meaning to their lives. Majority of puppies, however, never survive puppyhood and die within 6 months after birth. Majority of them die because of worm infestation, viral or bacterial infections, trauma, abnormalities or poor mother/puppy bond. The objective of this study was to determine the factors associated with puppy morbidity and mortality in breeding kennels in Nairobi and its environs in Kenya. The study was done for a period of 6 months.

Materials and Methods

A total of 35 kennels with 556 puppies were purposely selected and a questionnaire was administered. The study was carried out between 1st October 2013 and 31st March 2014. In addition, faecal samples were collected from 513 of the puppies to determine the level of helminth infestation.

Results

There was a significant association between the number of litters per bitch and puppy morbidity ($p < 0.016$) and a marginal significant association between housing and puppy mortality ($p = 0.092$). There was also a significant association between the use of veterinary services and puppy mortality ($p < 0.001$), and a marginal significant association between deworming adult dogs and puppy mortality ($p = 0.074$). There were significant associations between worms isolated in faecal samples and puppy mortality ($p = 0.018$) and between worms isolated and puppy morbidity ($p < 0.001$).

Conclusion

The study showed that the provision of proper housing and management of kennels in Nairobi and its environs were important factors associated with puppy morbidity and mortality. The study further showed that the control of ectoparasites and endoparasites is done inadequately. The kennels need to ensure that the bitches do not have more than one litter in a year and that they incorporate veterinarians fully when it comes to healthcare management.

Keywords: Kennels; Puppies; Morbidity; Mortality; Kenya

Introduction

Dogs are extensively employed in security and protection of property both in urban and rural areas. Besides, many other dogs are also kept as pets for companionship in urban families providing a unique, intimate, emotional bond and relationship that people share with their pets giving important meaning to their lives [1] and [2]. Dogs have many roles to play and perform many roles for people. The roles include hunting, herding, pulling loads, protection, assisting police and military, companionship, and, more recently, aiding individuals with disability. This impact on human society has given them the nickname "man's best friend". In some cultures, however, dogs are also a source of meat [3].

Nairobi has an urban population of about 3,138,369 people and the highest per cent of the 3,000,000 dogs in Kenya [4]. This has arisen because of insecurity and the cultural change in the society with most of the middle class population embracing modern lifestyles, hence the large numbers of dogs in Nairobi [5].

When a breeder or a pet owner loses an animal, they undergo a disenfranchised grief and the loss is similar to suicide, as they may not mourn publicly or openly acknowledge such a loss or even receive social support [6-8].

The breeder, most often, breeds dogs to supplement his income or sometimes as a sole source of income for his household. For the security company, having puppies born within its premises is a sure way of reducing expenses of buying puppies at exorbitant prices from the breeder therefore saves money and increases his profits. The loss of a puppy or puppies to any of the above parties is consequently a prelude to a lot of financial loss to the breeder, a work and monetary disruptions for the security company, and an emotional and financial inconvenience for the family [5] and [9].

Neonatal morbidity and mortality in puppies range from 5% to 35% in both breeding kennels and breeding colonies. Various maternal, litter and environmental factors affect morbidity and mortality in neonates and the incidence increases as the bitch ages increase. The causes may further be divided into three groups: environmental, genetic, and infectious [10,11].

No studies on causes of puppy morbidity and mortality have been done in Kenya to ascertain the different causes of morbidity and mortality in canine neonates and puppies except for one study that was done on adult dog mortality [10]. A large number of studies have however been conducted in other countries especially in the United States of America and Europe [12-17]. The objective of this study was therefore to determine the factors associated with puppy morbidity and mortality in Nairobi and its environs.

Materials and Methods

Study Area

The study was conducted within the Nairobi County and its environs. The locations that were selected for the study were Embakasi, Hurlingham, Karen, Kikuyu, Kilimani, Kinoo, Langa-ta, Lavington, Limuru, Mbagathi Way, Nairobi Industrial Area, Ngara, Parklands, Thika, Upper Hill, Uthiru and Westlands. All the above locations were part of the larger Nairobi County of the immediate peri-urban zones of Nairobi.

Study Design

A cross-sectional study was used to collect data from a group of puppies. Most of the kennels had an average number of about 50 dogs with an average number of breeding bitches of about three to six.

The study was carried out between 1st October 2013 and 31st March 2014 on 35 major kennels in Nairobi and its environs. The kennels were purposely selected and provided an adequate number needed for the study as they formed entire population of kennels in Nairobi and its environ. For puppies to be eligible they had to be between 1 day and 1 ½ years (18 months) old and they were identified using the breeder's records.

Data collection

Data were collected by the use of a structured close-ended questionnaire. The questionnaires were pre-tested with some dog owners before they were administered to the kennels. In some instances, the questions were rephrased to clearly capture the information provided by the breeders. Kennel level data included date, name of breeder and the location of the kennel, breed identification, total number of dogs (male and female) and purpose of breeding (guard, pets). Questions were asked on management of the kennels, such as the type of housing (concrete, metal, wooden), bedding (blankets, mattresses, gunny sacks), the type of biosecurity measures applied (quarantine, disinfection) and the type of breeding done (natural or artificial insemination). The questions also included vaccination program, general management and hygiene. The type and the frequency of disease control measures employed such as vaccination protocol (age at first vaccination, diseases vaccinated against), deworming protocol (age of deworming), ectoparasites control (dipping, spraying, spot on) and the role of the veterinarian in the application of these measures were recorded for each kennel. Records of all the puppy morbidity and mortality cases in the kennels within a period of 3 years (2010-2013) (infections, accidental, euthanasia, and post-caesarean-section) and treatments carried out were collected.

Stool samples from a random number of puppies (20% of total puppies present) were collected per kennel to estimate the

eggs per grams of faeces in order to identify the type of worm infestation. The stool sample was obtained per rectally using a gloved hand and put in a stool sample bottle.

Data storage and analysis

Data collected in questionnaires were first cross-checked and cleaned manually. The data were then entered and stored into a computer using Microsoft Excel® 2010 (Microsoft Corporation, USA), coded or restructured where applicable. The digital data files were cleaned for any errors that might have occurred during data entry and cross-checked against the original data questionnaires where applicable.

The data file was exported to SPSS version 16.0.0 [18] statistical package for analysis from Microsoft Excel® 2010.

zones within the Nairobi County and its environs. About 17.1% of the kennels were within Karen area, 11.4% in Industrial area, 8.6% in Lavington and another 8.6% in Westlands. Hurlingham, Kinoo, Ngara, Parklands and Thika each had a 5.7% of the kennels under study while Embakasi, Kikuyu, Kilimani, Langata, Limuru, Mbagathi Way, Upper Hill and Uthiru each had a 2.7% of the kennels (Table 1).

The dog population among the 35 kennels is shown below in Table 2 with 23% having a population of between 1 and 30 dogs, 37% having a dog population within a range of 31 to 60 dogs and 20% having a dog population with a range of between 61 and 90 dogs. About 6% had a dog population of between 91 and 120 dogs and only 3% of the kennels had a population of between 121 and 150 dogs. Another 6% of the kennels had a population of between 211 and 240 dogs, whereas another 6% had a population of more than 300 dogs.

Location	Kennel	%
Embakasi	1	2.9%
Hurlingham	2	5.7%
Karen	6	17.1%
Kikuyu	1	2.9%
Kilimani	1	2.9%
Kinoo	2	5.7%
Langata	1	2.9%
Lavington	3	8.6%
Limuru	1	2.9%
Mbagathi Way	1	2.86%
Nairobi Industrial Area	4	11.43%
Ngara	2	5.71%
Parklands	2	5.71%
Thika	2	5.71%
Upper Hill	1	2.86%
Uthiru	1	2.86%
Westlands	3	8.57%
Grand Total	35	100.00%

Table 1. Locations of breeding kennels under study within Nairobi County and its environs, 2014.

Descriptive statistics were then computed that included frequencies, means, range and standard deviation for the continuous variables while proportions were computed for any categorical variables. Morbidity and mortality were estimated by dividing the number of puppies sick (numerator) and the total number of puppies under study (denominator) for morbidity and the number of puppies dead (numerator) and the total number of puppies under study (denominator) for mortality. Management factors were investigated for association with puppy morbidity and mortality using Chi Square tests.

Results

Kennels Demographics

All the kennels selected for the study were located in 17 areas/

Dog population in the study kennels

The study kennels had a total dog population of 2772, made up of 2216 adults (80%) and 556 puppies (20%). There was an average population of 80 dogs (adults and puppies) per kennel. The puppy population was comprised of 222 females and 334 males.

Dog breeds in kennels within Nairobi County and its environs A variety of canine breeds were found in the breeding kennels in Nairobi County and its environs (Table 3). The most popular breed was the German Shepherd Dog (Alsatian) found in 74.3% of the kennels and the least common ones were Boerboels and Boxers found only in 5.7% and 8.6% of the kennels respectively. The other popular breeds included Rottweilers

(51.4%), Cross breeds (45.7%) and Golden Retrievers (28.6%). A few other breeds that were not popular were grouped under others and were 34.3%. Some breeds used for special duties like sniffing of narcotics and explosives were also found in breeding kennels. These breeds included Golden Retrievers (28.6%), Labrador Retriever (17.1%), Springer Spaniel (22.9%), Lhasa Apso (11.4%) and Boxers (8.6%).

Table 2. Canine Population distribution within the 35 Kennels under Study in Nairobi County and its Environs, 2014.

Dog Population	No. Kennels	% of Kennels
1 - 30	8	22.9%
31 - 60	13	37.1%
61 - 90	7	20.0%
91 - 120	2	5.7%
121 - 150	1	2.9%
151 - 180	0	0%
181 - 210	0	0%
211 - 240	2	5.7%
241 - 270	0	0%
271 - 300	0	0%
> 300	2	5.7%
Total Kennels	35	100%

Table 3. Dog breeds found in breeding Kennels within Nairobi County, 2014.

Dog Breed	No. of Kennels	% of Kennels
Boerboel	2	5.7%
Boxer	3	8.6%
German Shepherd Dog	26	74.3%
Golden Retriever	10	28.6%
Labrador Retriever	6	17.1%
Lhasa Apso	4	11.4%
Rottweiler	18	51.4%
Springer Spaniel	8	22.9%
Crosses	16	45.7%
Others	12	34.3%

Age at which bitches start breeding and size of litters per bitch and kennel

As shown in Table 4 below, 42.8% (15/35) of the kennels started breeding their bitches at around 6 – 10 months of age, 34.3% (12/35) start breeding their bitches at 11 – 14 months, 11.4% (4/35) starting at 15 – 24 months of age and another 11.4% (4/35) starting breeding their bitches after 24 months.

A high number of the kennels (80%; 28/35) had their bitches give one litter per year whereas 17.1% (6/35) their bitches had two litters per year. Only 2.86% (1/35) of the kennels had no breeding bitches as this kennel only bought puppies and raised them for security purposes only.

On yearly basis, 34.3% (12/35) of the kennels had 3 litters per year, while 28.6% (10/35) had more than 3 litters per year and 20% (7/35) had 2 litters annually. The remainder 11.4% (4/35) had a litter yearly while 5.7% (2/35) did not know the number of litters they got on a yearly basis.

Housing management, Biosecurity and heat provision to puppies

The housing in the kennels under study was divided into four groups; metal/steel with wood and sandy/grass floor, mixture of wood, concrete and metal house, metal/Steel with concrete and all wooden Houses. Metal/steel with wood and sandy/grass floor kennels comprised 5.7% (2/35), mixture of wood, concrete and metal houses involved 82.9% (29/35) of the kennels, metal/Steel with concrete consisted of 2.9% (1/35) and all wooden Houses made up 8.6% (3/35).

Regarding provision of beddings in the kennels, only 28.6% (10/35) provided beddings while 71.4% (25/35) did not provide any beddings (Table 5). Of those that provided beddings, 14.3% (5/35) provided wooden planks as beddings, 11.4% (4/35) provided newspapers as beddings while 2.86% (1/35) provided blankets as beddings.

Biosecurity was provided in the kennels in the form of using either a disinfectant, conducting quarantine or provision of both (Table 5). Disinfectants were used by 68.6% (24/35) of the kennels whereas 31.4% (11/35) of the kennels practised both methods.

On the provision of heat after bitches whelped to combat hypothermia, 42.8% (15/35) of the kennels provided heat while 57.1% (20/35) did not provide any form of heat to the kennels. Of the kennels that provided heat for the puppies after whelping, 93.3% (14/15) used normal electric bulbs while 6.7% (1/15) used infrared bulbs.

Use of professional veterinary services

Professional veterinary services were used by all the kennels within Nairobi County with 77.1% (27/35) using the services as need arose while 11.4% (4/35) had a programme whereby the veterinarian visited the kennels fortnightly and as need arose. Another 11.4% (4/35) of the kennels had a veterinarian visit the kennels regularly on a monthly basis but attended to cases as the need arose.

The veterinary services that were used by the kennels were deworming, vaccinations, general advice on husbandry, treatments and routine surgeries. Of the 35 kennels under the study, 37.1% (13/35) carried out deworming, vaccinations, received general advice on husbandry and treatments as the main forms of veterinary services. About 22.9% (8/35) of the kennels carried out deworming, vaccinations, received general advice on husbandry, treatments and routine surgeries were conducted too by the veterinary surgeons. About 25.7% (9/35) of the kennels mainly carried out vaccinations and received general advice on husbandry and treatments as the main services rendered by the veterinarians they engaged. The percentage of kennels that carried out vaccinations as the only veterinary service were 5.7% (2/35) while 2.9% (1/35) only carried out deworming, received general advice on husbandry and treatments. Another 2.9% (1/35) carried out deworming and vaccinations only and the last 2.9% (1/35) carried out vaccinations, received general advice on husbandry, treatments and routine surgeries as the only veterinary services they used in their kennels.

Laboratory facilities were not used by all the kennels under study to confirm diagnosis or for investigations. Only 28.6% (10/35) of the kennels used laboratory facilities while 71.4% (25/35) of the kennels did not use laboratory facilities.

Deworming of puppies and adult dogs in kennels

The kennels under study had different regimes of carrying out deworming for both puppies and adults. The majority of the kennels, 74.3% (26/35), dewormed their adult canines every 3 months, 22.9% (8/35) dewormed their adult canines every 6 months and 2.9% (1/35) never dewormed their adult dogs.

With puppies, 45.7% (16/35) of the kennels dewormed their puppies every fortnight, 2.9% (1/35) dewormed some of their puppies every 2 weeks, others monthly and others every 3 months; 14.3% (5/35) dewormed their puppies quarterly, 34.3% (12/35) dewormed their puppies monthly and another 2.9% (1/35) of the kennels never dewormed their puppies.

The faecal test results for worm positivity among the puppies revealed that 14.3% (5/35) of the kennels had 10% of their puppies positive for worms, 20% (7/35) had 11 – 20% positive, 8.6% (3/35) had 21 – 30% positive, 8.6% (3/35) had 31 – 40% positive, 8.6% (3/35) had 41 – 50% positive, 2.9% (1/35)

had 51 – 60% positive, 14.3% (5/35) had 61 – 70% positive, 2.9% (1/35) had 71 – 80% positive, 2.9% (1/35) had 81 – 90% positive and 17.1% (6/35) of the kennels under study had 91 – 100% positive s. The worms that were found in the faecal flotation test were either hookworms (36%) or ascarids (64%) with ascarids being the most predominant.

Table 4. The ranges of kennels sampled with worm positivity in puppies.

% of Puppies Positive with worms in Kennels 1 decimal point	No. of Kennels (N = 35)	% Kennels
0 - 10%	5	14.29%
11 - 20%	7	20.00%
21 - 30%	3	8.57%
31 - 40%	3	8.57%
41 - 50%	3	8.57%
51 - 60%	1	2.86%
61 - 70%	5	14.29%
71 - 80%	1	2.86%
81 - 90%	1	2.86%
91 - 100%	6	17.14%
Total No. of Kennels	35	100.00%

Table 5. A summary of the type of worms identified from puppies' faecal samples in kennels within Nairobi County and its environs.

Worms isolated	No. of puppies dead	No. of puppies alive	Mortality (%)	No. of kennels
Roundworms	21	71	22.8%	8
Ascarids	31	112	21.7%	5
Ascarids + Roundworms	48	166	22.4%	18
No worms	18	89	16.8%	4
	118	438	20.9%	35

Control of Ectoparasites

The kennels reported various ways of controlling ectoparasites that included dipping, shampooing, spraying, using Spot-On formulations, tablets or injectables. Of these methods, 22.9% (8/35) of the kennels only dipped their dogs, 65.7% (23/35) carried out both dipping and shampooing, 2.9% (1/35) were carrying out dipping, shampooing and spraying, 2.9% (1/35) carried out dipping, shampooing, spraying, applying Spot-Ons, used tablets and injections while 5.7% (2/35) only shampooed their dogs.

Puppies' vaccination and vaccination status at time of study

Commencement of vaccination in puppies among the kennels varied from 4 weeks of age to 12 weeks of age. About 8.6% (3/35) of the kennels started vaccinating their puppies at 4 weeks old, 5.7% (2/35) started at 5 weeks of age, 62.9% (22/35) started at 6 weeks of age, 20.0% (7/35) started at 8 weeks of age while 2.9 % (1/35) started their puppy vaccinations at 12 weeks of age.

The diseases puppies were vaccinated against included parvovirus, canine distemper virus, hepatitis, leptospirosis, parainfluenza and rabies. Of these diseases, 31.4% (11/35) of the

kennels under study vaccinated against rabies alone, 42.9% (15/35) of the kennels vaccinated against both parvovirus and rabies while 25.7% (9/35) of the kennels vaccinated their puppies against parvovirus, canine distemper, hepatitis, leptospirosis, parainfluenza and rabies.

There was a significant association between the use of veterinary services and puppy mortality,

Table 6. Factors affecting prevalence of morbidity and mortality in puppies.

Factor	Morbidity		Mortality	
	χ^2	P Value	χ^2	P Value
Age of kennels	6.474	0.007	0.021	0.485
Age of puppies	8.64	0.003	1.568	0.140
Biosecurity	1.019	0.178	2.165	0.070
Canine population per kennel	91.48	< 0.001	74.93	< 0.001
Deworming (Adult dogs)	0.176	0.382	2.54	0.074
Litters per bitch per year	4.92	0.016	1.269	0.159
Veterinary services rendered	1.122	0.169	96.2	< 0.001
Worms Isolated	58.85	< 0.001	4.441	0.0175

The puppies within the kennels that were of vaccination age ranged from 6 weeks to over 3 months but not more than 1 year. Within this population, 2.9% (1/35) of the kennels had puppies that were 6 weeks old but not yet vaccinated, 8.6% (3/35) had puppies that were 6 weeks old and some over 3 months but not yet vaccinated, 2.9% (1/35) had puppies that were 8 weeks old and still not vaccinated, 2.9% (1/35) had puppies that were over 3 months old and still not vaccinated, 5.7% (2/35) had puppies that were 10 weeks old and were vaccinated, 8.6% (3/35) had puppies that were 12 weeks old and were vaccinated, 5.7% (2/35) had puppies that were 12 weeks old and others over 3 months and were all vaccinated.

Puppy morbidity and mortality

The number of litters per bitch had no association with puppy mortality ($\chi^2 = 1.269$, $p < 0.159$) but there was an association between the number of litters per bitch and puppy morbidity ($\chi^2 = 4.92$, $p < 0.016$).

There was a marginal association between housing and puppy mortality ($\chi^2 = 1.755$, $p = 0.092$) but no association between housing and puppy morbidity ($\chi^2 = 0.1475$, $p = 0.391$).

Marginally there was an association between biosecurity and puppy mortality ($\chi^2 = 2.165$, $p = 0.070$) but no association between biosecurity and morbidity ($\chi^2 = 1.019$, $p = 0.178$).

$\chi^2 = 96.2$, $p < 0.001$ but no significant association between the use of veterinary services and puppy morbidity, $\chi^2 = 1.122$, $p < 0.169$.

Deworming adult dogs had a slight association with puppy mortality ($\chi^2 = 2.54$, $p = 0.074$) but no significant association between deworming adult dogs and puppy morbidity ($\chi^2 = 0.133$, $p = 0.399$).

However, there was a significant association between worms isolated in faecal samples and puppy mortality ($\chi^2 = 4.44$, $p = 0.018$) and between worms isolated and puppy morbidity ($\chi^2 = 58.85$, $p < 0.001$).

There was no significant association between the ages of puppies in the kennels and puppy mortality ($\chi^2 = 1.568$, $p = 0.140$) but there was a significant association between the ages of puppies in the kennels and puppy morbidity ($\chi^2 = 8.64$, $p = 0.003$).

Discussion

The results of this study showed that there was high puppy morbidity and mortality within breeding kennels in Nairobi County and its environs at a rate of 34.7% and 21.2% respectively.

The most popular breeds encountered were German Shepherd Dogs (Alsatian), Rottweilers, Cross breeds and Golden Retrievers and were mainly bred as guard dogs [19] and [20]. The most noted observation on the breeds was the high use of cross breeds for security. This is because mixed-breed dogs exhibit all behavioural traits believed to be important in protection duties which include attention, defensive, and trustworthy [21] and a higher median age at death [22]. There was, however, no significant association between the breeds kept in a kennel and puppy morbidity nor mortality. This result differed from other studies [23, 24] which stated that perinatal puppy mortality was explained by breed and litter size. This can further be explained by observations that even though a kennel may have been breeding dogs for years and there is no improvement in management there would be no change in the mortality and morbidities unless there is intervention in nutritional status, immune health, age of dogs within the kennel and environmental factors such as humidity, overcrowding, ventilation, and sanitation [25, 26].

Breeding within kennels was done with bitches of ages between 6 months and 2 years. Age of bitches at breeding was observed not to be significantly associated with puppy morbidity and mortality. This observation disagreed with an earlier study that age has a profound influence on the reproductive performance of a bitch and indirectly puppy mortality [27]. It has been observed that the number of puppies weaned is highest while mortality is lowest when dams are two years old or older but less than seven years old [28]. However, by nine years of age, the litter size is lowest per weaning per litter and mortality is at its highest [28,29]. In this study, since most of the breeders bred for commercial purposes, and their recording system poor, it was difficult to follow a bitch's performance for more than 3 years.

Majority of the kennels (80%) had their bitches produce one litter per year whereas 17.1% of the bitches had two litters per year even though this was not significantly associated with the number of litters per bitch and puppy mortality, but there was an association between the number of litters a bitch had and morbidity [30]. Even though the number of litters per bitch was not associated with puppy mortality, the litter size in pure-bred dogs is influenced by the size of the breed, the age of the bitch and the method of mating [29].

The housing in the kennels in this study fell into four groups; metal/steel with wood and sandy/grass floor, mixture of wood, concrete and metal house, metal/steel with concrete and all wooden houses. There was no significant association between housing and puppy morbidity and mortality. The latter differed from other studies where housing was observed to contribute a lot to the well-being of the puppy and reduce the risk of infectious diseases [31]. Non-porous surfaces that are easily disinfected and durable enough to withstand repeated clean-

ing should be used in all animal housing areas. The latter must be used in areas housing puppies or infected animals or those that are newly admitted with an unknown health history [32, 33]. There was equally no significant association between provision of beddings in the kennels and puppy mortality though other literature record otherwise [32]. This is explained by the fact that provision of beddings is just one factor that can be used in prevention of puppy mortality by preventing hypothermia, but it is low in the list compared to colostrum ingestion by the puppy which has been shown to provide more protection to the puppy from infectious organisms [26, 34].

Biosecurity was provided in the kennels in the form of using either a disinfectant, conducting quarantine or provision of both. Majority of the kennels used disinfectants for biosafety and there was statistically a marginal significant association between biosecurity and puppy mortality but no association between biosecurity and morbidity. This would mean that though the efficacy of the disinfectant or means of biosecurity used is important [35], other factors come into play to reduce morbidity and mortality. These include the vaccination status and immune stability of both the dam and the puppies.

Professional veterinary services were reported to be used by all the kennels within Nairobi County and its environs at various levels. There was an association between the use of veterinary services and puppy mortality but no association between the use of veterinary services and puppy morbidity. Some kennels used veterinary services as need arose while others the veterinarian visited the kennels on a regular basis. Most of the breeders were more concerned with cutting down the cost of veterinary services rendered than the overall good the services offered to the kennel as a whole. This means that the breeders need to be educated to understand the basic sequence of normal events, particularly those surrounding the pivotal neonatal period, which offer valuable insight and direction for treatment of individual animals. In addition, the continued constructive contact between the veterinarian and the breeder or kennel operator is important for preventive or therapeutic management directed toward the appropriate stage of development. Ultimately, this can be rewarding for both the breeder and the veterinarian. Even though the veterinarian will make good pharmacological judgement, sometimes this alone is not the best strategy when it comes to pharmacotherapeutics in kennels [26,37]. The veterinary services that were reported to be used by the kennels were deworming, vaccinations, general advice on husbandry, treatments and routine surgeries. The use of veterinary services by the kennels should be imperative for a breeder as there are temporal changes in biochemical and haematological values for puppies in the first 2 months compared to those of the adults. A veterinarian with this knowledge will know how to handle the puppies medically [38,39].

The kennels from this study reported different deworming regimes for both puppies and adults. There was a marginal significant association between deworming adult dogs and puppy mortality but no association with puppy morbidity. There was no association between puppy deworming and morbidity and mortality. This finding agrees with other studies that reported there is a higher prevalence of intestinal parasites in dogs from kennels that ranged from 35.5% to 100% and that intestinal parasitism can be asymptomatic [40]. This could be explained by the fact that irregular deworming of dogs or puppies may not be effective since this needs to be done consistently and regularly. According to the results of this study, there were many kennels that had a very irregular deworming program ranging from deworming adult dogs every three months to deworming them once every 6 months to no deworming at all. This encourages resistance to anthelmintics and increasing the risk of puppies being infested [41]. A recommended regime for adult dogs would be every three months while for puppies, depending on the age, every two weeks until they are six months old and there after monthly until they are one year of age [37]. Majority of the kennels from this study had a higher percentage of their puppies infested with worms and this was significantly associated with either the worms detected in faecal samples or with puppy morbidity or mortality. This study agrees with another one that was done in Tanzania where it was found that helminthosis in adults influenced puppy mortality [41].

There was no significant association between the ages of puppies in the kennels and puppy mortality but a significant association between the ages of puppies in the kennels and puppy morbidity. This agrees with other studies that stated the rate of neonatal diseases excluding stillbirths is highest during the first days of life. Factors like hypoxia during birth, in-breeding, genetic or teratogenic defects and malformations, maternal disturbances, vaccination status of the mother, low birth weight, environmental conditions or infectious agents predispose puppies to life-threatening conditions. Infectious diseases, essentially bacterial, are the second most important cause of mortality after losses during parturition [11]. When it came to the age at which puppies died, most of the deaths were happening within the first 2 days postpartum [13].

More than 90% of the perinatal mortality was found at both the individual litter and kennel levels. The efforts to minimize puppy mortality should therefore be targeted first at the management of the individual litter then at the kennel level rather than at the breed level [18]. Common-litter factors were more important than additive genetic factors. Mortality attributable to infection increases significantly with increases in inbreeding.

Conclusion

The study showed that there was a serious constraint in providing proper housing and management of kennels in Nairobi and its environs. Appropriate housing and segregation of new and sick animals, proper sanitation and disinfection, disease surveillance, isolation and treatment are necessary for successful kennel management. Breeding kennels do not provide beddings to prevent dogs from pressure wounds and cold surfaces, and vaccination protocols are not adhered to by most breeding kennels leading to poor control of diseases. Breeding kennels should provide good beddings to reduce puppy mortality through hypothermia, and regular preventive procedures such as vaccination, health assessment, and stringent vaccination protocols should be adhered to strictly to avert losses through puppy mortality.

Breeders do not use professional veterinary services adequately leading to losses through poor husbandry. Veterinarians do not have closer interaction with the breeders due to cost of treatment causing them to look for easy way round. Breeders need to use professional veterinary services to alleviate puppy morbidity and mortality. Veterinarians need to have closer interaction with the breeders to educate them on the importance of understanding the life stages of a puppy. Breeders are not keen in the provision of colostrum that is important to neonates before developing their own immunity.

Authors' Contributions

The present study is a part of Master degree of Andrew Matole Konde. George Karuoya Gitau designed the study. Andrew Matole Konde did the research under the guidance of George Karuoya Gitau, Japheth Chesire Kiptoon and Daniel Waweru Gakuya. All authors participated in the drafting and revision of the manuscript, read and approved the final manuscript.

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