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ONE-YEAR RETROSPECTIVE STUDY OF WILDLIFE MORBIDITY AND MORTALITY AT A VETERINARY CLINIC IN MINAS GERAIS, BRAZIL

(ESTUDO RETROSPECTIVO DE UM ANO DA MORBIDADE E MORTALIDADE DE ANIMAIS SELVAGENS EM UMA CLÍNICA VETERINÁRIA EM MINAS GERAIS, BRASIL)

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ABSTRACT

Epidemiological data from a morbidity and mortality profile allows decision-making, a tool that can be applied in conservation medicine practices. Our objective was to trace an epidemiological profile of wildlife animals hospitalized in a veterinary clinic in Belo Horizonte, Minas Gerais, Brazil. Hospitalization and medical care data were collected from the animals from July 2015 to July 2016, as a convenience sampling during academic reseach. A total of 639 animals were recorded, which 66.5% (425) were birds, 28.17% (180) were mammals, and 5,32% (34) were reptiles. Neonatal and pediatric care were the main comorbidity for birds and mammals, while for reptiles, the primary reason was changes in organic systems. Overall, mortality in the period was 33.6 per 100 animals, with higher rates (46% of deaths) from September to November. Neonatal care, pediatric care and non-vehicular trauma were the most common reason for mammals' hospitalization. For birds, there was a direct relationship between receiving some species and neonatal and pediatric care. Our findings were similar to other studies carried out in occasionally distinct scenarios, but that focused on wildlife mortality and morbidity. We observed in this descriptive study thatbirds were the most received group, followed by mammals, mainly associated with pediatric care, and then reptiles, associated with specific system affections. There was also an important under-reporting of diseases at the time of animals' admission, which refers to the hypothesis of difficulty in obtaining information of the animals and consequently conclude the diagnosis, compromising decision-making approach of environmental and public health managers. It is suggested to standardize the data collection of wildlife admission in the primary care settings, allowing decision-making strategies for conservation medicine.

Keywords*:* birds, conservation medicine, mammals, reptiles, wildlife management.

INTRODUCTION

Economic development processes without concern for sustainable models contribute to the harmful effects on wildlife health and welfare (GIBSON and JACKSON, 2017). Thus, modern society habits in front of economic factors possess a potent influence on the relationship between human beings and environmental health (MARIANO et al., 2011). This also contributes to the harmful effects that occur to wildlife, as part of environmental health, which may suffer due to trafficking, pouching, habitat fragmentation, deforestation, among others (CORONEL-ARELLANO et al., 2020). The current importance of this topic can be demonstrated from the hypotheses of some researchers about the origin of the current COVID-19 pandemic scenario and the present firm evidence that SARS-CoV-2 virus has a zoonotic origin from wildlife pouching and market (LAM, 2020). Due to this constant anthropogenic conflict, a considerable amount of wildlife could be harmed (FREITAS et al., 2015).

In Brazil, wildlife rehabilitation centers (CETAS) are branches of the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) and they handle the management and receiving of wildlife coming from voluntary handover, rescue, and apprehension (IBAMA, 2020). These centers have high demand for receiving wildlife, as showed by Freitas et al. (2015) which 7,426 wildlife were received in a year-based survey, mainly from apprehension (82.7%) and voluntary handover (17.3%). A large part was destined for releasing (60%) and the rest for zoos and rescue centers (10%), or they did not survive (20%). Given the amount of animals received, most of them are normally found in critical situations due to trauma, accidents or sensible periods of life (FREITAS et al., 2015).

According to Lanetzki et al. (2012), epidemiological data knowledge from morbidity and mortality profiles allows decision-making strategies that aims at improving the quality of medical care, the acquisition of new technologies and the adequate training of human resources and in the reassessment of the processes currently used. It could be a relatively sensitive indicator of living conditions and health-disease process (MANDIL et al., 2013), since it allows preventive approaches to be improved and disease determinants could work as can a subsidy to veterinary clinicians (ALVES et al. 1995). In addition, it would update investigations into the occurrence of new zoonoses from wildlife or animals under human care (MARVULO and CARVALHO, 2014, JI et al., 2020) and they could be an important tool in conservation medicine (CLEAVELAND et al., 2007).

Conservation medicine is closely linked to the term one health (CLEAVELAND et al., 2014, DEEM, 2015), a concept introduced by Schwabe (1984) and which is widely used in comparative medicine linking the relation among human, animal and environmental health for achieve balance and prevention of diseases. However, despite the importance of this concept for practices in veterinary medicine, few places in Brazil provide primary care to affected native wildlife.

Our objective was to outline a wildlife epidemiological profile of the animals received in a veterinary clinic before the destination to environmental and fauna agencies in a one-year retrospective study (2015-2016).

MATERIALS AND METHODS

Local and animals

The research was developed based on a weekly register of the reception of species of mammals, birds and reptiles, mostly from the state of Minas Gerais, Brazil. A reference veterinary clinic received all the animals during a year of investigation (Figure 1). These animals were admitted for a variety of reasons, which includes referral from environmental agency, delivering by environmental police, as well as voluntary handover by civilians. All of them were registered at CETAS, located at the headquarters of the Brazilian Institute of the Environment and Renewable Natural Resources (Ibama), in Belo Horizonte, Minas Gerais, due to Brazilian environmental legal reasons.

Records from voluntary handover and environmental police receiving were collected at a weekly frequency at the veterinary clinic. For the reliability of the animal's origins, all original records were rechecked monthly on CETAS.

Data organization was based on the information obtained at the animal's delivery and receiving, as well as information from the medical records. During the follow-up, which occurred between July 2015 and July 2016, the data were recorded in a spreadsheet composed in Microsoft Excel 2013 tool adapted from previous works (CUNHA et al. 2015; RABELO and CUNHA, 2013). Futhermore, data was collected as a convenience sampling during academic reseach.

Figure 1. Some species monitored during the one-year based research: a) Striped owl (*Asio clamator*); b) Scarlet macaw (*Ara macao*); c) Brazilian slider (*Trachemys dorbigni*); d) Black vulture (*Coragyps atratus*); e) Nine-banded armadillo (*Dasypus novemcinctus*); f) Black-and-gold howler monkey (*Alouatta caraya*)

Factors involved in wildlife admission

The following information, for each animal, were collected: order number of receipt; species; conservation status according to the International Union for Conservation of Nature (IUCN) red list and by classification according to the Chico Mendes Institute for Biodiversity Conservation (ICMBio) red list from 2018 (ICMBIO, 2018) or other research groups in Brazil (VOGT et al., 2010), categorized in a Threatened category (Critically Endangered – CR; Endangered – EN; and, Vulnerable - VU), and sub-minor categories: Near Threatened – N; Least Concern – LC; Data Deficient – DD; and, Not Evaluated – NE; physical characteristics;animal origin; health monitoring; diet; medications; procedures performed; entrance date; departure date; sex; situation on entrance (dead or alive); reason for departure.

Due to the casuistry and aspects of willdife disesases and physical questions, hospitalization causes were classified into six categories: a) primary orthopedic conditions (POC): dislocation and fracture not for vehicular trauma; b) short-term maintenance (STM): animals maintained for short term and then delivered for non-environmental agencies; c) pediatric care (PC): neonates and young animals for palliative care; d) specific systems diseases (SSD): neurological, gastrointestinal, systemic and reproductive pathologies, among others; e) Non-vehicular traumas (NVT): attack by domestic animals, injuries by contusion, electrocution, among others; f) vehicular trauma (VT): accident involving trauma with human transport vehicles, and, g) parasitic diseases (PD): diseases such as trichomoniases, candidiasis, coccidiosis, among others.

Statistical methods

Data were analyzed using descriptive methods of central tendency methods, through the description on the concentration point of most of the results of the responses; and dispersion, to assess the degree of variability of values around the mean. Proportionate mortality rate was calculated as described by the Bonita, Beaglehole and Kjellstrom (2006), as general indicator for all three classes complied data, as well as, for each single animal class. For this analysis, euthanasia was not considered as a factor included in the mortality rate.

In addition, response variables (mammals, birds and reptile's general profiles and the specific profiles of vehicular, non-vehicular traumas, most neonatal and affected species) were analyzed using GLM (Generalized Linear Models) through the statistical program R (R CORE TEAM, 2019). The explanatory variables used in the GLM were month of entry, animal species, status by IUCN, categorized in a Threatened category (Critically Endangered – CR; Endangered – EN; and, Vulnerable - VU), diet, hospitalization causes, situation on entrance (dead or alive) and reason for departure, such as, getting discharged from the clinic, death, referral or euthanasia. GLM procedure is used in order to construct statistical model determining the relationship between a sef ot explanatory variables on dependent variables (DOBSON, BARNETT, 2008).

Ethics approval

This project was approved by the Ethics Committee on the Use of Animals (CEUA), number 028/2015, from the Pontifical Catholic University of Minas Gerais, and by the State Forestry Institute (IEF), number 013 / 2015.

RESULTS

We registered and followed 639 animals, which 66.5% (425) were birds (**Table 1**), 28.17% (180) were mammals (**Table 2**), and 5.32% (34) were reptiles (**Table 3**). Regarding the origin of the animals, 84.2% came from CETAS, 12.2% from voluntary handouts at the veterinary clinic, 1.9% from rescue centers and 1.7% from private companies.

Concerning to the 425 birds, 67 species were hospitalized, six neonatal passerines were not identified, due to their period of life (nestling), as well as 16 individuals of Thrush species (*Turdus* spp.), one *Falco* spp., and one Seedeater species (*Sporophila* spp.), due to their clinical condition at entrance. Of these hospitalized birds, classified in a Threatened category, 0.94% were considered Endangered according to the IUCN red list, which includes two *Amazona vinacea* (BIRDLIFE INTERNATIONAL, 2017) and two *Crax blumenbachii* (BIRDLIFE INTERNATIONAL, 2016a), and 0.47% Vulnerable, which includes one *Anodorhynchus hyacinthinus* (BIRDLIFE INTERNATIONAL, 2016b) and one *Ramphastos tucanus* (BIRDLIFE INTERNATIONAL, 2016c). In the subgroup categorie of Threatened species, 10.6% were considered Near Threatened, which includes one *Aratinga auricapillus* (BIRDLIFE INTERNATIONAL, 2016d), one *Alipiopsitta xanthops* (BIRDLIFE INTERNATIONAL, 2016e) and 43 *Amazona aestiva*. About the departure reasons, 63.29% were discharged, 34.12% died, 1.9% were referred, and 0.7% were euthanized. Regarding the determinants of hospitalization or health issues, 65.4% of birds were hospitalized because of the need for PC, 11.3% for POC, 11.8% due to SSD, 6.6% due to NVT, 2.8% for STM, 1.4% for PD and 0.7% for VT (Figure 2, Figure 3). The main SSD observed were related to gastrointestinal and neurological systems. On the other hand, NVT were associated mainly to wings and limbs lesions due to kite string injuries, firearm, and domestic cat attack. As for cases of POC, a high number of pelvic limb fractures were reported, followed by wing fractures, limb amputation, spine fractures and phalanges fractures

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Table 1. Species of birds received at the Veterinary Clinic during the one-year retrospective study

Scientific name	English common name	Brazilian common name	Hospitalization rate (%)	Total in numbers of individuals	IUCN red list	ICMBIO red list
Psittacara leucophthalmus	White-eyed Parakeet	Periquitão-maracanã	10,6	45	LC	LC
Amazona aestiva	Turquoise-fronted Amazon	Papagaio-verdadeiro	10,1	43	NT	NT
Glaucidium brasilianum	Ferruginous Pygmy-owl	Caburé	7,8	33	LC	LC
Megascops choliba	Tropical Screech-owl	Corujinha-do-mato	7,5	32	LC	LC
Ramphastos toco	Toco Toucan	Tucanuçu	6,1	26	LC	LC
Tyto furcata	American Barn Owl	Suindara	4,2	18	NE	LC
Turdus spp.	Thrush species	Sabiá (generic name)	3,8	16	Non identified	Non identified
Cariama cristata	Red-legged Seriema	Seriema	3,5	15	LC	LC
Pionus maximiliani	Scaly-headed Parrot	Maitaca-verde	3,1	13	LC	LC
Pitangus sulphuratus	Great Kiskadee	Bem-te-vi	2,8	12	LC	LC
Columba livia	Rock dove	Pombo	2,8	12	LC	LC
Tangara sayaca	Sayaca Tanager	Sanhaçu-cinzento	2,6	11	LC	LC
Streptopelia decaocto	Eurasian Collared-dove	Rolinha	2,1	9	LC	Exotic
Rupornis magnirostris	Roadside Hawk	Gavião-carijó	1,9	8	LC	LC
Piaya cayana	Common Squirrel-cuckoo	Alma-de-gato	1,6	7	LC	LC
Nyctidromus albicollis	Pauraque	Bacurau	1,6	7	LC	LC
Eupetomena macroura	Swallow-tailed Hummingbird	Beija-flor-tesoura	1,6	7	LC	LC
Falco sparverius	American Kestrel	Quiriquiri	1,6	7	LC	LC
Ara ararauna	Blue-and-yellow Macaw	Arara-canindé	1,4	6	LC	LC
Passeriforme non identified	Non identified	Non identified passeriforme species	1,4	6	Non identified	Non identified
Athene cunicularia	Burrowing Owl	Coruja-buraqueira	1,2	5	LC	LC
Asio clamator	Striped Owl	Coruja-orelhuda	1,2	5	LC	LC
Brotogeris chiriri	Yellow-chevroned Parakeet	Periquito-do-encontro-amarelo	1,2	5	LC	LC

Eupsittula aurea	Peach-fronted Parakeet	Periquito-rei	0,9	4	LC	LC
Turdus rufiventris	Rufous-bellied Thrush	Sabiá-laranjeira	0,9	4	LC	LC
Tyrannus melancholicus	Tropical Kingbird	Suiriri	0,9	4	LC	LC
Coragyps atratus	American Black Vulture	Urubu-da-cabeça-preta	0,9	4	LC	LC
Guira guira	Guira cuckoo	Anu-branco	0,7	3	LC	LC
Caracara plancus	Southern Caracara	Carcara	0,7	3	LC	LC
Penelope obscura	Dusky-legged Guan	Jacu	0,7	3	LC	LC
Colaptes campestris	Campo Flicker	Pica-pau-do-campo	0,7	3	LC	LC
Colaptes melanochloros	Green-barred Woodpecker	Pica-pau-verde-barrado	0,7	3	LC	LC
Crotophaga ani	Smooth-billed Ani	Anu-preto	0,5	2	LC	LC
Sicalis flaveola	Saffron Finch	Canário-da-terra-verdadeiro	0,5	2	LC	LC
Cyanocorax cristatellus	Curl-crested Jay	Gralha-do-campo	0,5	2	LC	LC
Crax blumenbachii	Red-billed Curassow	Mutum-de-bico-vermelho	0,5	2	EN	CR
Amazona vinacea	Vinaceous-breasted Amazon	Papagaio-de-peito-roxo	0,5	2	EN	VU
Turdus leucomelas	Pale-breasted Thrush	Sabiá-barranco	0,5	2	LC	LC
Aramides cajaneus	Grey-cowled Wood-rail	Saracura	0,5	2	LC	LC
Geranoaetus melanoleucus	Black-chested Buzzard-eagle	Águia-serrana / Gavião-pé-de-serra / Ágia-chilena	0,2	1	LC	LC
Anodorhynchus hyacinthinus	Hyacinth Macaw	Arara-azul-grande	0,2	1	VU	NT
Ara macao	Scarlet Macaw	Arara-piranga	0,2	1	LC	LC
Ara chloropterus	Red-and-Green Macaw	Arara-vermelha	0,2	1	LC	NT
Hydropsalis torquata	Scissor-tailed Nightjar	Bacurau-tesoura	0,2	1	LC	LC
Myiozetetes similis	Social Flycatcher	Bentevizinho-de-penacho-vermelho	0,2	1	LC	LC
Saltatricula atricollis	Black-throated saltator	Bico-de-pimenta	0,2	1	NE	LC
Sicalis flaveola valida	Saffron Finch	Canário-Peruano	0,2	1	NE	Exotic
Cygnus atratus	Black Swan	Cisne-negro	0,2	1	LC	Exotic
Egretta thula	Snowy Egret	Garça-branca-pequena	0,2	1	LC	LC
Falco spp.	Non identified	Gavião (generic name)	0,2	1	Non identified	Non identified

Milvago chimachima	Yellow-headed Caracara	Gavião-carrapateiro	0,2	1	LC	LC
Buteo brachyurus	Short-tailed Hawk	Gavião-da-cauda-curta	0,2	1	LC	LC
Falco femoralis	Aplomado Falcon	Gavião-de-coleira	0,2	1	LC	LC
Buteo albicaudatus	White-tailed Hawk	Gavião-de-rabo-branco	0,2	1	LC	LC
Bubo virginianus	Great Horned Owl	Jacurutu	0,2	1	LC	LC
Aratinga auricapillus	Golden-capped Parakeet	Jandaia-da-testa-vermelha	0,2	1	NT	LC
Psarocolius decumanus	Crested Oropendola	Japu-preto	0,2	1	LC	LC
Asio stygius	Stygian Owl	Mocho-diabo	0,2	1	LC	LC
Coccyzus melacoryphus	Dark-billed Cuckoo	Papa-lagarto-acanelado	0,2	1	LC	LC
Alipiopsitta xanthops	Yellow-faced Amazon	Papagaio-galego	0,2	1	NT	NT
Gnorimopsar chopi	Chopi Blackbird	Pássaro-preto / Graúna	0,2	1	LC	LC
Sporophila plumbea	Plumbeous Seedeater	Patativa	0,2	1	LC	LC
Amazonetta brasiliensis	Brazilian Teal	Pato-pé-vermelho	0,2	1	LC	LC
Patagioenas picazuro	Picazuro Pigeon	Pombão/Asa-branca	0,2	1	LC	LC
Vanellus chilensis	Southern Lapwing	Quero-quero	0,2	1	LC	LC
Turdus amaurochalinus	Creamy-bellied Thrush	Sabiá-Poca	0,2	1	LC	LC
Tigrisoma lineatum	Rufescent Tiger-heron	Socó-boi	0,2	1	LC	LC
Sporophila sp.	Seedeater species	Sporophila (generic name)	0,2	1	Non identified	Non identified
Saltator maximus	Buff-throated Saltator	Trinca-ferro	0,2	1	LC	LC
Ramphastos tucanus	Red-billed Toucan	Tucano-grande-de-papo-branco	0,2	1	VU	LC
Ramphastos dicolorus	Red-breasted Toucan	Tucano-de-bico-verde	0,2	1	LC	LC

Table 2. Species of mammals received at the Veterinary Clinic during the one-year retrospective study

Scientific name	English common name	Brazilian common name	Hospitalization rate (%)	Total in numbers of individuals	IUCN red list	ICMBIO red list
Didelphis albiventris	White-eared Opossum	Gambá-de-orelha-branca	48,3	87	LC	LC
Callithrix penicillata	Black-pencilled Marmoset	Sagui-de-tufos-pretos	19,4	35	LC	LC
Coendou spinosus	Porcupine	Ouriço-cacheiro	4,4	8	LC	LC
Mazama gouazoubira	Gray Brocket	Veado-catingueiro	4,4	8	LC	LC
Alouatta caraya	Black-and-gold Howler Monkey	Bugio-preto	2,8	5	NT	NT
Nasua nasua	South American Coati	Quati	2,8	5	LC	LC
Myrmecophaga tridactyla	Giant Anteater	Tamandua-bandeira	2,8	5	VU	VU
Galictis cuja	Lesser Grison	Furão-pequeno	1,7	3	LC	LC
Eira barbara	Tayra	Irara	1,7	3	LC	LC
Callicebus personatus	Atlantic Titi	Sauá-de-cara-preta	1,7	3	VU	VU
Alouatta guariba clamitans	Southern brown howler	Bugio-ruivo	1,1	2	VU	VU
Cerdocyon thous	Crab-eating Fox	Cachorro-do-mato	1,1	2	LC	LC
Chrysocyon brachyurus	Maned Wolf	Lobo-guará	1,1	2	NT	VU
Sapajus nigritus	Black-horned Capuchin	Macaco-prego	1,1	2	NT	NT
Tamandua tetradactyla	Southern Tamandua	Tamandua mirim	1,1	2	LC	LC
Sciurus aestuans	Brazilian squirrel	Caxinguelê/Esquilo	0,6	1	LC	LC
Leopardus tigrinus	Northern Tiger Cat	Gato-do-mato	0,6	1	VU	EN
Puma yagouaroundi	Jaguarundi	Gato-mourisco	0,6	1	LC	VU
Puma concolor	Puma	Onça-parda	0,6	1	LC	VU
Coendou prehensilis	Brazilian Porcupine	Ouriço-grande	0,6	1	LC	LC
Lycalopex vetulus	Hoary fox	Raposa-do-campo	0,6	1	NT	VU
Dasypus novemcinctus	Nine-banded Armadillo	Tatu-galinha	0,6	1	LC	LC
Euphractus sexcinctus	Yellow Armadillo	Tatupeba	0,6	1	LC	LC

Table 3. Species of reptiles received at the Veterinary Clinic during the one-year retrospective study

Scientific name	English common name	Brazilian common name	Hospitalization rate (%)	Total in numbers of individuals	IUCN red list	ICMBIO red list
Phrynops geoffroanus	Geoffroy's Toadhead Turtle / Geoffroy's Side-necked Turtle	Cágado-de-barbicha	23,5	8	NE	LC
Boa constrictor	Red-Tailed Boa	Jibóia	23,5	8	LC	LC
Chelonoidis carbonaria	Red-footed Tortoise	Jabuti-piranga	20,6	7	NE	LC
Trachemys dorbigni	Black-bellied slider	Tigre-d'agua	20,6	7	NE	NT
Trachemys scripta elegans	Yellow-bellied Slider Turtle	Tartaruga-de-orelha-vermelha	5,9	2	LC	Exotic in Brazil
Oxyrhopus guibei	Non availablle	Cobra-falsa-coral	2,9	1	LC	LC
Caiman latirostris	Broad-snouted Caiman	Jacaré-do-papo-amarelo	2,9	1	LC	LC

Regarding the 180 mammals, 23 species were hospitalized, which 6.1% of the animals were considered Vulnerable by the IUCN red list, which included one *Leopardus tigrinus* (PAYAN and OLIVEIRA, 2016), two *Alouatta guariba clamitans* (JERUSALINSKY et al., 2021), three *Callicebus personatus* (MELO et al., 2021), and five *Myrmecophaga tridactyla* (MIRANDA et al., 2014). As Near Threatened species, it was identified 5.6% of the animals, which included one *Lycalopex vetulus* (LEMOS et al., 2020), two *Chrysocyon brachyurus* (PAULA et al., 2016), two *Sapajus nigritus* (LUDWIG et al., 2021), and five *Alouatta caraya* (BICCA-MARQUES et al., 2021). About the departure reasons, 56.1% of the animals were discharged, 35.6% died, 5.6% were referred, and 2.8% were euthanized. Regarding the determinants of hospitalization or health issues, 57.2% were hospitalized for the need for PC, 13.3% for NVT, 11.1% for SSD, 10% for VT, 6.1% for POC and 2.2% for STM (Figure 2, Figure 3). The main SSD observed were related to neurological, gastrointestinal, and reproductive disorders (vaginal prolapse). On the other hand, NVT were related to a high frequency of traumas and injuries absent from a specific history, but, with clinical features associated to a falling or attack by co-specifics, followed by electrocution only in primates, with the highest occurrence in *Callithrix penicillata*, followed by *Alouatta guariba*, and *Callicebus personatus*; and domestic dog attack. In relation to VT, a high number of limb fractures, polytrauma and spine fracture were registered mostly in marsupials (*Didelphis albiventris*) and canids (*Chrysocyon brachyurus* and *Cerdocyon thous*).

Regarding the 34 reptiles, seven species were hospitalized, which 20.6% were considered near threatened according to ICMBio (VOGT et al., 2010; ICMBIO, 2018), which includes seven *Trachemys dorbigni*. About the departure reasons, 79.4% were discharged and 20.6% died. Regarding the determinants of hospitalization or health issues, 44.1% were hospitalized due to SSD, 20.6% for VT, 20.6% for STM, 8.9% for NVT, 2.9 % for PC and 2.9% for POC (Figure 2, Figure 3). The main SSD was respiratory (pneumonia), reproductive (prolapse in testudines, mainly in *Trachemys* and *Chelonoidis*) and systemic (sepsis in groups of *Boa constrictor* from illegal trade). In the other hand, NVT were more frequently due to attack by domestic dogs and injuries by fish hook (in *Phrynops geoffroanus* and *Trachemys scripta elegans*, respectively). As for the case of POC, a mandible fracture in a *Caiman latirostris* was registered for management error prior to referral. In relation to VT, a high number of carapace and plastron fractures and soft tissue exposure (prolapse) were received, affecting mainly *Phrynops geoffroanus* and *Boa constrictor*.

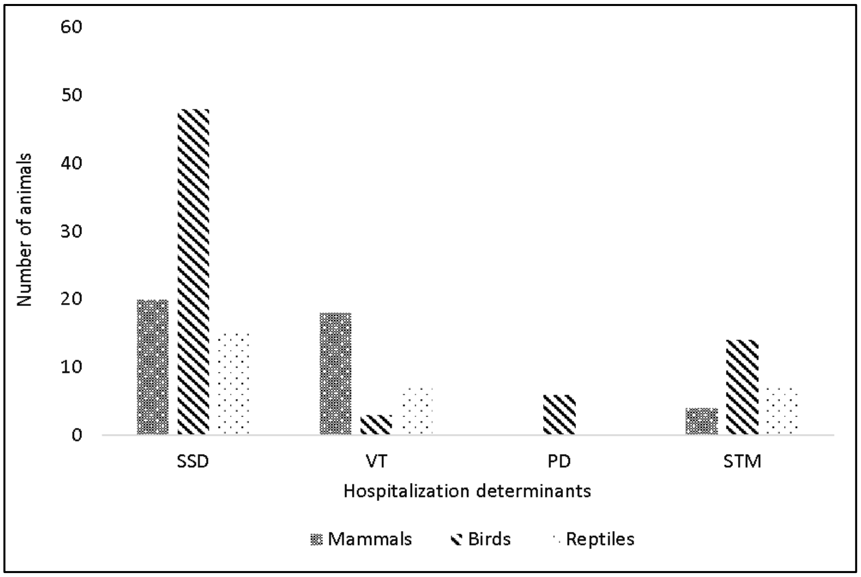

Figure 2. Mammals, birds and reptiles' hospitalization determinants through the one year-based survey, including Specific Systems Diseases (SSD), Vehicular Trauma (VT), Parasitic Diseases (PD) and Short-Term Maintenance (STM).

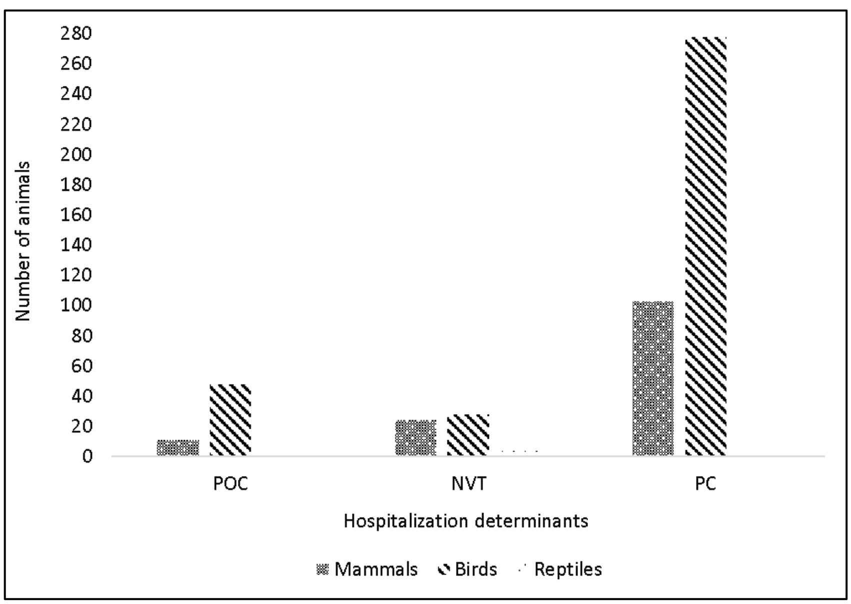

Figure 3. Mammals, birds and reptile's hospitalization determinants through the one year-based survey, including Primary Orthopedic Conditions (POC), Non-Vehicular Traumas (NVT) and Pediatric Care (PC).

The one-year period proportionate mortality rate was 33.6 per 100 animals, considering all three classes, with the highest rates occurring from September to November, with 46% of deaths. In relation to this indicator for birds, mammals and reptiles, the proportionate mortality rate was 33.9%, 35.6% and 20.6%, respectively. In relation to the total number of animals treated, 11.7% underwent some anesthetic or sedation procedure, while 8.7% underwent surgical procedures.

Regarding the analysis by GLM, the most hospitalized mammals were *Didelphis albiventris* and *Callithrix penicillate*, due to PC and NVT, respectively (p <0.05). As for the profile of PC, there was a greater number of hospitalizations of *Didelphis albiventris* in the months of December and January (p <0.05) (table 1).

For birds, there was a direct relationship between the species *Glaucidium brasilianum*, *Megascops choliba*, *Pionus maximiliani*, *Psittacara leucophthalmus*, *Amazona aestiva*, *Columba livia*, *Turdus* spp., *Tangara sayaca*, *Tyto furcata* and *Ramphastos toco*, to the hospitalization determinant PC (p <0.05) (Table 4).

Table 4- GLM-reduced models for the effects of the explanatory variables: month (M), hospitalization determinant (HD) and species (S) on the response variable: most frequent mammal, mammal pediatric care and bird hospitalization determinant*

Main question	Variables	Estimate ± SE	z	P
Most frequent mammal	*Intercept*	2.35938 ± 0.09468	24.920	< 2e-16
	HD	-0.10292 ± 0.02963	-3.473	0.000514
Mammal pediatric care	*Intercept*	3.084634 ± 0.109941	10.497	< 2e-16
	M	0.008096 ± -2.535	5.207	0.0112
Bird hospitalization determinant	*Intercept*	1.267560 ± 0.058188	21.784	<2e-16
	S	-0.003119 ± 0.001383	-2.254	0.242

*Nonsignificant effects are not displayed since they were removed from the models.

DISCUSSION

In this study, we evaluated the epidemiological profile of wildlife animals received in a veterinary clinic in Belo Horizonte, Minas Gerais, the sixth largest city in Brazil (IBGE, 2019). Since the clinic received an important number of animals, it could represent a considerable percent of wildlife affection as in other areas of Minas Gerais. We found birds as the most received group, followed by mammals and reptiles, due to PC and SSD. Regarding the most hospitalized mammals, PC were the main hospitalization determinants, and, for birds, there was a direct relationship between receiving some species and PC.

As previously described, despite the existence of research on the occurrence of wildlife from environmental agencies (FREITAS et al., 2015), information related to veterinary medical occurrences, epidemiological profiles, and their association with other variables, were not found. According to data obtained by this research, highlighting the incidence of endangered species hospitalized, the number of animals in a year comprised 8.6% of those received by Freitas et al. (2015).

The frequency of received animals by order / group was corroborated by Freitas et al. (2015) and Romero et al. (2019) regarding the main entrance of birds. However, only data from Romero et al. (2019), workin at Wildlife Rescue and Rehabilitation Centers in Chile, found mammals and then reptiles, as the most frequent, respectively. Due to the purpose of their research, Freitas et al. (2015) found, also researching at the same CETAS described at this paper, this higher occurrence of birds as a direct relationship with the preference of this group related to the illegal wildlife trade. In the case of the current research, this correlation was not possible since the animal's source data did not follow a pattern. However, birds are the most affected group in relation to illegal trade due to the species diversity, species richness and the frequent description of new species of Brazilian neotropical avifauna (MYERS et al., 2000; PIACENTINI et al., 2015) and the range of habitats within the urban and peri-urban environment, which could facilitate a greater contact with human beings (MOURA et al., 2015) and domestic animals (LOSS et al., 2013), predisposing harmful effects.

As for the higher number of mammals received when compared to reptiles, despite the diversity of herpetofauna being considered greater in the national territory (ICMBIO, 2018), possibly, the perception of pain in animals phylogenically distant from humans may be lower according to the relationship of the person and their knowledge, facilitating the recognition of feelings in mammals and less in reptiles (RUCINQUE et al., 2017; VALROS and HANNINEN, 2018). In addition, there is a bias in relation to animals considered more splendid when compared to others, such as reptiles and amphibians, including fish and invertebrates (DONALDSON et al., 2016), which could justify the low referral of these animals to clinics. Another reason could be based on the neglect in relation to the preservation of reptiles, since most people, in general, does not know how to differentiate venomous from non-venomous animals and so, for ignorance, fear or even cultural beliefs, despise reptiles (MARTINS and MOLINA, 2008; ARAÚJO and LUNA, 2017).

In the present study, GLM was used to determine the form of the relationship of mammals, birds and reptile's general profiles, the specific profiles of vehicular, non-vehicular traumas, most neonatal and affected species, with the distinct explanatory variables (month of entry, animal species, status by IUCN, diet, hospitalization causes, situation on entrance and reason for departure). Considering our casuistry, both for birds and mammals, pediatric care was the main causes of hospitalization, which differs from another research, which found trauma as the main entrance reason, including associated to reptiles (ROMERO et al., 2019). Andery et al. (2013) found primary orthopedic conditions, mainly fractures, as the most frequent affection to birds of prey. It is important to consider in our research that primary orthopedic conditions could not be associated with their original cause, due to the lack of a confident history of all animals received, which could be associated with vehicular or non-vehicular traumas, thus increasing the frequency of direct occurrence due to these casualties.

There was a low occurrence of vehicular trauma, in mammals, birds, and more frequently in reptiles. However, in the absence of the history of animals from wildlife, it is believed that the values found for vehicular traumas or other traumatic interactions, such as incidents with domestic animals, especially dogs and cats, are underdiagnosed, as already stated. Vehicular traumas are a worldwide cause of wildlife morbidity, what is associated to an increase in vehicle traffic, but also direct relations with seasonality, territorial and reproductive behavior (BÍL et al., 2019). We could not establish a relationship between vehicular and non-vehicular trauma with certain species or seasons of the year. However, it is important to highlight that the non-vehicular trauma injuries were directly related to the higher occurrence of primates and marsupials in the clinic. In addition, the seasonality of morbidity and mortality can be explained by the nesting season of birds in Minas Gerais (MARINI et al., 2007) and the condition of road flooding in the summer, for reptiles (SANTANA, 2012).

Seasonality pattern was found between the number of *Didelphis albiventris* hospitalized and the time of year, with greater occurrence in December and January, which is found as the peak reproduction with the increase in the proportion of males in relation to females in this marsupial species distribution (OLIVEIRA et al., 2010).

Pediatric care was found by Romero et al (2019) as the third main cause of bird's admission and the sixth cause for mammals, reaching 4.6% and 3.5%, respectively and not being this recurrent disease in reptiles. Recent publications on wildlife pediatric medicine for birds (WORELL, 2012), mammals (LOPATE, 2012) and reptiles (JOHNSON, 2012) could facilitate the main approach for this casualty.

In the case of reptiles, our main cause of entrance (specific systems diseases) differed from the found by Romero et al. (2019), which trauma were the primary affection. Endothermics, territorial behavior and neonatal dependency are aspects discussed by Santana (2012), demonstrating the differences in relation to birds and reptiles, relevant aspects to deal with preventive measures related to wildlife trauma.

In view of the number of admitted species and individuals in only one place over the course of one year and the estimated wildlife populations decreasing globally (MARTON-LÈFEVRE, 2010), the importance of drawing long-term epidemiological profiles with spatial extension is emphasized, in order to achieve adequate tools to drive wildlife conservation methods.

Although GLM could be considered an analysis increasing the accurancy of the sampling, our data outline the epidemiological profile of one unique facility in Minas Gerais, with an expansion of relevance mainly for the city of Belo Horizonte and the metropolitan region, since it was not possible to record the origin of all animals at the time of delivery. In order to correlate admission and casuistries, future studies should address the origin of all animals, allowing the design of local map strategies. Also, it would be important to combine data from vehicular trauma hotspots with our results, tracing a profile associated with traumas, providing knowledge of the most frequent areas of occurence, which could serve as a pilot for the development of strategies.

CONCLUSION

Our findings were similar to other studies carried out in occasionally distinct scenarios, but that focused on wildlife mortality and morbidity. We observed, in this descriptive study performed in a veterinary clinic located in Belo Horizonte, that birds (Class Aves) were the main animals received, followed by mammals (Class Mammalia), both for pediatric care, and then, for reptiles (Class Reptilia), due to specific system disorders. The most received mammals were *Didelphis albiventris* and *Callithrix penicillata* and an important seasonal association was observed for the marsupial species. For birds, there was a direct correlation between pediatric care and the admission for specific bird species, which includes *Glaucidium brasilianum*, *Megascops choliba*, *Pionus maximiliani*, *Psittacara leucophthalmus*, *Amazona aestiva*, *Columba livia*, *Turdus* spp., *Tangara sayaca*, *Tyto furcata* and *Ramphastos toco*. It is important to consider that the lack of information on the cause of most orthopedic disorders probably had an impact on the diagnosis of vehicular and non-vehicular trauma. Also, a considerable under-reporting of diseases at the time of animals' admission occured, which refers to the hypothesis of the difficulty in obtaining information of the animals and consequently conclude the diagnosis, compromising decision-making approach of environmental and public health managers. It is suggested that organizations working with wildlife admission for health care should be trained for data collection and analysis, prioritizing standardization of methods, as well as the medical aspects of the most frequent wildlife demands, such as pediatric care, head injury and orthopedic trauma, allowing decision-making strategies for conservation medicine.

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