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Original Research Article

SURVEY ON ALLERGIC AND ANAPHYLACTIC REACTIONS OF DOGS TO SOME COMMERCIALLY AVAILABLE INJECTABLE MULTIVITAMIN PRODUCTS IN OGUN STATE

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ABSTRACT

Adverse drug reactions (ADRs), particularly allergic and anaphylactic responses, remain significant yet underreported concerns in veterinary practice. This study assessed the prevalence and characteristics of ADRs in dogs following administration of commercially available injectable multivitamins in Ogun State, Nigeria. A cross-sectional pharmacovigilance survey was conducted using semi-structured questionnaires administered to 109 respondents, including veterinarians, dog owners, and breeders. Data were analyzed using descriptive and inferential statistics with the aid of Epi Info version 7.1.3.10 Multivitamin use was high (98.2%), and 55% of respondents had observed ADRs associated with injectable formulations, especially those given intramuscularly. Reported clinical signs included skin reactions (29.1%), restlessness (22.5%), and tachypnea (15.9%), with most symptoms occurring within 5–29 minutes post-injection. German Shepherds, Boerboels, and Caucasians were the most affected breeds, while young adult dogs (6 months–2 years) showed the highest susceptibility. Veterinary multivitamins were preferred over human vitamin B-complex due to perceived effectiveness and lower ADR risks, although cost and availability influenced final choice. Management of ADRs involves the use of antihistamines such as chlorpheniramine (29.5%) and corticosteroids including hydrocortisone (8.2%) and dexamethasone (11.5%). The study highlights a relatively high occurrence of ADRs linked to injectable multivitamins, while noting substantial underreporting due to weak pharmacovigilance practices. These findings underscore the need for standardized safety protocols in the administration of injectable multivitamin products, strengthen pharmacovigilance reporting systems and provide training on ADRs detection, management, and prevention in order to ensure animal safety and improve veterinary therapeutic outcomes.

Keywords: Adverse Drug Reactions (ADRs), Dogs, Injectable, Multivitamin, Prevalence

INTRODUCTION

Adverse drug events (ADEs) or adverse drug reactions (ADRs) refer to any type of harmful response to medication that occur in the body of an individual following a therapeutic, preventive or diagnostic intervention (Kommu *et al*., 2024). It is an unintended, undesired and unexpected response to a drug that negatively affects the patient's health, and this is of great concern to veterinarians and other health professionals (Arunvikram *et al.*, 2014). Hypersensitivity reactions are the primary examples of idiosyncratic adverse drug reactions (ADRs), and patients who had previous allergic reactions to a treatment are more likely to show drug hypersensitivity reactions (Maddison, 2003; Miguel-RodrÍguez *et al*., 2018). It is categorized into 4 types. Allergic reaction is also known as type-I hypersensitivity reaction (Bradley *et al*., 2023, Abbas & Goldin, 2025). Anaphylactic reaction (anaphylaxis) is an acute, severe, and sometimes life-threatening allergic reaction to foreign substances, particularly foreign proteins which are known as an allergens or antigens (Hunter *et al.*, 2024). Anaphylactic

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shock is an extreme clinical emergency, but it is relatively rare (Coile, 2024). Factors such as food, water, environment or drugs can lead to allergic and anaphylactic reactions; and commons signs associated with the condition include itchiness, frequent licking/chewing, inflammation/redness, hives, stomach issues, sneezing, nasal discharges, and swellings (The People's Dispensary for Sick Animals, 2020). In milder cases of anaphylaxis, localized reactions such as extreme swellings at the site of injection usually occur, while in severe cases there is further release of inflammatory contents of mast cells all over the body, resulting in a systemic anaphylactic reaction. Localized reactions are common, while systemic reactions are rare (Hunter *et al.*, 2024).

Multivitamins are dietary supplements that contain a combination of essential vitamins and minerals that are crucial for body functions and maintenance of the overall health of animals. Their requirements vary according to nutritional status, age, health and functions of animals (Rasikh, 2019). Vitamin B-Complex injection is the most frequently prescribed multivitamin, and this may be attributed to its relatively low cost, availability and its ability to stimulate appetite (Ihedioha *et al.,* 2021). Awe *et al.* (2017) reported cases of ADRs in Nigerian breed of dogs due to administration of either commercial veterinary multivitamins or human vitamin B complex, although they were not officially documented. The manifestation of ADRs have been observed and reported in dogs and cats following administration of vaccines, antimicrobial drugs, non-steroidal anti-inflammatory drugs, ectoparasiticides, anthelmintic and anaesthetic agents, commonly used for therapeutic or prophylactic purposes (Maddison, 2003). However, reports on ADRs due to administration of multivitamin in dogs and other animals, are generally very scanty. Despite the widespread use of injectable multivitamins in dogs, documented reports of associated adverse drug reactions are limited, particularly in Nigeria. This study therefore provides pharmacovigilance data on adverse reactions to injectable multivitamins in dogs.

This study is therefore designed to investigate the occurrence of ADRs due to administration of injectable multivitamin in dogs with the aid of a cross-sectional survey design, using a semi-structured questionnaire in nine (9) local government areas in Ogun state, Nigeria.

MATERIALS AND METHODS

STUDY LOCATION

The study was conducted in Ogun State, covering nine Local Government Areas across the four zones. In the Central Zone, the sampled LGAs were Abeokuta North, Abeokuta South, and Odeda. In the East Zone, the LGAs were Ijebu Ode and Ijebu North. In the West Zone, the LGAs were Ado-Odo/Ota and Yewa South. In the South Zone, the LGAs were Obafemi Owode and Sagamu. Ogun State is located in the southwest region of Nigeria, it is bounded by Oyo and Osun States to the North, the Republic of Benin to the West, Ondo State to the East, and Lagos State to the South. At the time of this research, there were twenty (20) local government areas in Ogun state and four (4) geopolitical zones (en.wikipedia.org).

STUDY DESIGN

A cross-sectional survey design was employed to investigate the prevalence and nature of adverse drug reactions in dogs following the administration of commercially available injectable multivitamin products.

STUDY POPULATION

The study population consisted of veterinarians, dog breeders and dog owners. Prior to the commencement of the survey, testing was conducted on the questionnaire design to ascertain its validity, thereby ensuring responses collected were unbiased.

SAMPLE SIZE DETERMINATION

For this questionnaire survey, the sample size was determined using the Epi Info software, a statistical software for Epidemiology developed by Centre for Disease Control and Prevention (CDC) (Epi-Info version 7.1.3.10), based on an expected prevalence (p) of 50%, Knowledge level of 50%, level of confidence of 95%, error Margin of 9.4%. This resulted in a minimum sample size of 109 respondents.

ETHICAL CONSIDERATIONS

Informed written consent was obtained from every respondent before the administration of the questionnaire. Participation was voluntary based on each individual's availability and willingness to be part of the study.

All participants were notified of their right to discontinue at any stage of the questionnaire survey (World Medical Association Declaration of Helsinki, 2013).

SAMPLING TECHNIQUE

A simple random sampling technique was used to select the respondents in the study area. Veterinarians, veterinary hospitals, clinics and dog breeders in the Local Government Areas in Ogun state were selected. The questionnaires were both administered through electronic form (Google docs) and hard copies.

SURVEY TOOLS AND QUESTIONNAIRE

Data were collected using a semi-structured questionnaire, containing both closed-ended and open-ended questions that were designed to decrease response inconsistencies, increase transparency, and improve data analysis. There were four

separate sections of the questionnaire. Section A, collected the socio-demographic information of respondent. Section B, consisted of questions on awareness of respondents on ADRs. Section C, included questions regarding the respondent's use of multivitamin products in practice and the last section of the questionnaire, Section D, included questions on respondent's experience from the use of injectable multivitamin products. The questionnaire was pre-tested and validated before use. This was done by defining the objectives of the questionnaire properly, selecting the target population (veterinarians, dog owners and dog breeders), administering questionnaires to them, collecting feedback, analyzing their responses and revising the questionnaire thus ensuring relevant questions were being asked and clarity to respondents. Administration of the questionnaire was carried out both online and physically between the months of March to April, 2025. The questionnaire was presented in English Language.

DATA ANALYSIS

The data obtained from the survey were analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0. Descriptive statistics such as frequencies and percentages were used to present the socio-demographic information of respondents and other result obtained from the survey study.

RESULTS

SOCIO-DEMOGRAPHIC INFORMATION OF RESPONDENTS

The respondents (n=109) consented to participating in the survey (100%), and were distributed across three status classifications.

Veterinarian (31.2%), Dog breeder (25.7%) and Dog owner (43.1%). Nine (9) Local Government Areas across Ogun state: Abeokuta South (21.1%), Abeokuta North (4.6%), Odeda (46.8%), Ijebu Ode (1.8%), Obafemi Owode (0.9%), Ifo (5.5%), Ado-Odo/Ota (5.5%), Yewa South (0.9%) and Sagamu (12.8%) were represented. Majority of the respondents were between 20 – 29 years old (73.4%) with 45.9% having 1 – 5 years of work experience. Majority of respondents were male (74.3%), while 25.7% were female.

The level of education of the respondents varied, 27.5% had SSCE qualifications, 2.8% OND, 4.6% HND, 0.9% BATCO, 45.9% BSc, 12.8% MSc holders and 5.5% PhD holders.

Most of the respondents worked in the private sector (73.4%), with 26.6% working in the public sector (Tables I and II).

TABLE I: SOCIO-DEMOGRAPHIC INFORMATION OF RESPONDENTS

Variables	Frequency	Percentage	95% CI
Status			
Veterinarian	34	31.2	22.66 - 40.78
Dog breeder	28	25.7	17.80 - 34.94
Dog owner	47	43.1	33.67 - 52.95
Total	109	100	
Gender			
Male	81	74.3	65.06 - 82.20
Female	28	25.7	17.80 - 34.94
Total	109	100	
Age (years old)			
20 – 29	80	73.4	64.07 - 81.40
30 – 39	15	13.8	7.91 - 21.68
40 – 49	8	7.3	3.22 - 13.95
50 – 59	4	3.7	1.01 - 9.13
Above 60	2	1.8	0.22 - 6.47
Total	109	100	
Years of experience			
Less than 1 year	14	12.8	7.20 - 20.61
1 – 5 years	50	45.9	36.29 - 55.68
6 – 10 years	20	18.3	11.58 - 26.91
Greater than 10 years	25	22.9	15.43 - 31.97
Total	109	100	
Level of education			
SSCE	30	27.5	19.40 - 36.90
OND	3	2.8	0.57 - 7.83
HND	5	4.6	1.51 -10.38
BSc	50	45.9	36.29 - 55.68
MSc	14	12.8	7.20 - 20.61
PhD	6	5.5	2.05 - 11.60
BATCO	1	0.9	0.02 - 5.01
Total	109	100	
Type of practice			
Public sector	29	26.6	18.60 - 35.93
Private sector	80	73.4	64.07 - 81.40
Total	109	100	

TABLE II: GEOGRAPHICAL LOCATION OF THE RESPONDENTS

Variables	Frequency	Percentage (%)	95% CI (mean)
Location (LGA)			
Abeokuta South	23	21.1	13.87 - 29.96
Abeokuta North	5	4.6	1.51 - 10.38
Odeda	51	46.8	37.17 - 56.59
Ijebu Ode	2	1.8	0.22 - 6.47
Obafemi Owode	1	0.9	0.02 - 5.01
Ifo	6	5.5	2.05 - 11.60
Ado-Odo/Ota	6	5.5	2.05 - 11.60
Yewa South	1	0.9	0.02 - 5.01
Sagamu	14	12.8	7.20 - 20.61
Total	109	100	

AWARENESS OF RESPONDENTS ON ADRS

Most respondents (80.7%) were aware of adverse drug reactions (ADRs), with all of them recognizing ADRs as unintended or harmful reactions to drugs at therapeutic doses.

About half (53.2%) reported having encountered ADRs in dogs. Regarding frequency, 26.6% rarely observed ADRs, 29.4% observed them occasionally, 5.5% observed them frequently, while 38.5% had never observed ADRs in dogs (Table III).

The results on the frequency of administration revealed that 20.5% of the respondents use multivitamin injections on a daily basis, 15.9% use them weekly, while 36.4% use them monthly and 27.3% rarely administer the injectable (Table IV).

TABLE III: AWARENESS OF RESPONDENTS ON ADRS

Variables	Frequency	Percentage (%)	95% Confidence Interval (mean)
Have you ever heard of adverse drug reactions (ADRs)?			
Yes	88	80.7	72.07 - 87.66
No	21	19.3	12.34 - 27.93
Total	109	100	
What do you understand by ADRs?			
An unintended or harmful reaction to a drug at normal therapeutic doses	88	80.7	72.07 - 87.66
A temporary reaction that occurs only in puppies	0	0	96.67 - 100.00
A sign of proper drug absorption in the body	4	3.7	1.01 - 9.13
A normal response to a drug that helps in recovery	2	1.8	0.22 - 6.47
I am not sure what ADR means	15	13.8	7.91 - 21.68
Total	109	100	
Have you ever encountered an episode of ADR in dogs?			
Yes	58	53.2	43.41 - 62.83
No	51	46.8	37.17 - 56.59
Total	109	100	
How often do you observe ADRs in dogs?			
Rarely (Less than once a year)	29	26.6	18.60 - 35.93
Occasionally (A few times a year)	32	29.4	21.02 - 38.85
Frequently (Monthly or more)	6	5.5	2.05 - 11.60
Never	42	38.5	29.37 - 48.34
Total	109	100	
What do you consider your general level of knowledge on ADRs?			
Very low	11	10.1	5.15 - 17.34
Low	20	18.3	11.58 - 26.91
Moderate	44	40.4	31.08 - 50.19
High	27	24.8	17.00 - 33.96
Very high	7	6.4	2.62 - 12.78
Total	109	100	

USE OF MULTIVITAMIN PRODUCTS IN PRACTICE/KENNELS

Generally, 98.2% of the respondents normally use multivitamin products in their practice or kennels as the case may be, while 1.8% does not. 37.7% of the respondents use tablet form, 46 (27.5%) use syrup and 58 (34.7%) use injectable forms of the multivitamin in their practice as veterinarian or kennels as dog breeders/owners. Of the fifty-eight respondents that use injectable forms, 24.5%administer the drug through intravenous (IV) route, 56.6% administer through intramuscular (IM) route and 18.9% use subcutaneous (SC).

RESPONDENTS EXPERIENCE WITH ADRS DUE TO MULTIVITAMIN INJECTABLE PRODUCTS

Fifty-five percent of respondents reported experiencing adverse drug reactions (ADRs) to injectable multivitamins in dogs. The ADRs occurred most often in young adult dogs (6 months–2 years), with intramuscular administration associated with the highest incidence (56.8%). Veterinary and human Vitamin B complex injections accounted for 43.9% of reported ADRs combined (Table V).

RESPONDENTS' PREFERENCE FOR DIFFERENT TYPES OFMULTIVITAMIN INJECTABLE PRODUCTS

Factors responsible for the choice of multivitamin injectable product used in veterinary practice or dog kennels are drug availability (36%), cost (24%), and fear of possible adverse reactions (20%). The results revealed that veterinary multivitamin injection is the preferred injectable multivitamin (65.9%) over human vitamin B complex (34.1%). Drug availability (31.6%) and therapeutic effects (26.3%) are the major factors that support choice of veterinary multivitamin injections, while drug availability (35.3%) and cost effectiveness (26.5%) were factors that influenced choice of human vitamin B complex injection (Tables VIA and VIB).

TABLE IV: USE OF MULTIVITAMIN PRODUCTS IN PRACTICE/KENNELS

Variables	Frequency	Percentage (%)	95% CI (mean)
Multivitamin products used			
Yes	107	98.2	93.53 - 99.78
No	2	1.8	0.22 - 6.47
Total	109	100	
Forms of Multivitamins used			
Tablet	63	38.8	94.31 - 100.00
Syrup	46	28.4	92.29 - 100.00
Injection	53	32.7	93.84 - 100.00
Total		100	
Route of administration			
Intravenous (IV)	13	24.5	75.29 - 100.00
Intramuscular (IM)	30	56.6	88.43 - 100.00
Subcutaneous (SC)	10	18.9	96.34 - 100.00
Total	53	100	
Frequency administration			
Daily	9	20.5	9.80 - 35.30
Weekly	7	15.9	6.64 - 30.07
Monthly	16	36.4	22.41 - 52.23
Rarely	12	27.3	14.96 - 42.79
Total	44	100	

INJECTABLE MULTIVITAMIN PRODUCTS INDUCED ADRS IN VARIOUS BREEDS OF DOGS

German shepherd, Boerboel and Eskimo breeds were reported to have the highest incidence of adverse drug reaction to multivitamin injectable at 30.7%, 15% and 11.8% respectively. A few other exotic breeds (Chowchow, French bulldog, etc.) were also reported to react adversely to administration of multivitamin injections. Skin reactions like hives (29.1%), Restlessness (22.5%), and Increased breathing (15.9%) were the most common clinical signs observed during episodes of ADRs to multivitamin injections. About 12.7% of respondents reported immediate adverse reactions following administration of multivitamin injections. The majority (67.6%) indicated that adverse drug reactions manifested within 5–29 minutes, while another 12.7% reported reactions occurring 30–59 minutes post-administration (Tables VIIA and B).

TABLE VIA: RESPONDENTS' PREFERENCE FOR DIFFERENT TYPES OF MULTIVITAMIN INJECTABLE PRODUCTS

Variables	Frequency	Percentage (%)	95% Confidence Interval (mean)
Multivitamin injections use in practices/kennels			
Veterinary multivitamins	13	31.7	18.08 - 48.09
Human vitamin B complex	10	24.4	12.36 - 40.30
Both	18	43.9	28.47 - 60.25
Total	41	100	
Factors that determined choice between veterinary multivitamins and human vitamin B complex injections			
Possible adverse reactions	15	20	96.15 - 100.00
Cost	18	24	96.03 - 100.00
Availability	27	36	87.23 - 100.00
Dosing	1	1.3	96.64 - 100.00
Therapeutic effect	13	17.3	96.23 - 100.00
Total	74	100	
Preferred multivitamin injections used in Practices/Kennel			
Veterinary multivitamins	27	65.9	49.41 - 79.92
Human vitamin B complex	14	34.1	20.08 - 50.59
Total	41	100	

TABLE VIB: RESPONDENTS' PREFERENCE FOR DIFFERENT TYPES OF MULTIVITAMIN INJECTABLE PRODUCTS

Variables	Frequency	Percentage (%)	95% CI (mean)
Factors that support choice of veterinary multivitamin injections			
Drug availability	24	31.6	95.75 - 100.00
Possibility of lower adverse reaction	15	19.7	96.15 - 100.00
Cost effective	15	19.7	96.15 - 100.00
Therapeutic effects	20	26	83.16 - 100.00
Total	76	100	
Factors that support choice of human vitamin B complex injections			
Drug availability	24	35.3	95.75 - 100.00
Possibility of lower adverse reaction	14	20.6	96.19 - 100.00
Cost effective	18	26.5	96.03 - 100.00
Therapeutic effects	12	17.6	96.27-100.00
Total	68	100	

TABLE VIIA: SHOWS BREEDS OF DOGS THAT MANIFESTED ADRS TO MULTIVITAMINS AND THE CLINICAL SIGNS OBSERVED

Variables	Frequency	Percentage (%)	95% CI (mean)
Breed(s) of dogs familiar to respondents			
German shepherd dog (GSD)	95	19.6	96.19 - 100.00
Rottweiler	66	13.6	94.56 - 100.00
Caucasian(Russian shepherd)	54	11.1	93.40 - 100.00
Boerboel	63	13	94.31 - 100.00
Pit-bull	48	9.9	92.60 - 100.00
Mongrel (Local dog)	54	11.1	93.40 - 100.00
Eskimo	59	12.2	93.94 - 100.00
Cross breeds	46	9.5	92.29 - 100.00
Total	485	100	
Breed(s) of dogs in which ADRs to multivitamin injections was observed			
German shepherd dog (GSD)	39	30.7	90.97 - 100.00
Lhasa Apso	8	6.3	96.41 - 100.00
Eskimo	15	11.8	96.15 - 100.00
Boerboel	19	15	82.35 - 100.00
Pit-bull	10	7.9	96.34 - 100.00
Caucasian	6	4.7	96.48 - 100.00
Rottweiler	11	8.7	96.27 - 100.00
Pug	2	1.6	96.61 - 100.00
Mongrel	7	5.5	96.45 - 100.00
Shih Tzu	1	0.8	96.64 - 100.00
Chow Chow	5	3.9	96.52 - 100.00
Cross breeds	2	1.6	96.61 - 100.00
All breeds	1	0.8	96.64 - 100.00
French Bulldog	1	0.8	96.64 - 100.00
Total	127	100	

TABLE VIIB: SHOWS BREEDS OF DOGS THAT MANIFESTED ADRS TO MULTIVITAMINS AND THE CLINICAL SIGNS OBSERVED

Variables	Frequency	Percentage (%)	95% CI(mean)
Observed clinical signs during the episode(s) of ADRs to multivitamin injections			
Restlessness,	41	22.5	94.72 - 100.00
Skin reactions (redness, urticaria, skin swellings and inflammation)	53	29.1	93.28 - 100.00
Nose and face twitching	19	10.4	95.98 - 100.00
Increased breathing (tachypnea)	29	15.9	88.06 - 100.00
Increased heart rate (tachycardia)	19	10.4	95.98 - 100.00
Sudden collapse	20	11	95.94 - 100.00
Salivation	1	0.5	96.64 - 100.00
Total	182	100	
Length of time between Administration and onset of signs of ADR			
Immediately	9	12.7	5.96 - 22.70
5 – 29 minutes	48	67.6	55.45 - 78.24
30 – 59 minutes	9	12.7	5.96 - 22.70
1 – 6 hours	3	4.2	0.88 - 11.86
7 – 12 hours	1	1.4	0.04 - 7.60
> 12 hours	1	1.4	0.04 - 7.60
Total	71	100	

MANAGEMENT AND PREVENTION OF MULTIVITAMIN INJECTION INDUCED ADRS IN DOGS

Some of the respondents' specific approaches for management and prevention of ADRs to multivitamin injections in dogs were as shown in tables VIIIA and B They include administration of anti-histaminic drugs such as chlorpheniramine as a top choice among others.

Taking relevant and complete history (23.9%); administration of the appropriate drug dosage (16.4%), and avoiding brands known for induction of ADRs in some breeds of dogs (13.4%) were the top responses on how ADRs of dogs to multivitamin injections can be prevented. (Tables VIIIA and B).

DISCUSSION

This study was aimed at investigating the prevalence and the nature of adverse drug reactions (ADRs), in dogs following the administration of some commercially injectable multivitamin products in Ogun State, Nigeria. This survey, which was conducted with the aid of semi-structured questionnaires, provided valuable insights into the depth of awareness, usage patterns, as well as the clinical experiences of Veterinarians, dog breeders, and dog owners to ADRs within the state. A total number of 109 respondents participated in this study and significant proportions (80.7%) of the respondents were not ignorant about ADRs, and they were able to correctly identify ADRs as unintended but harmful reactions to drugs at normal therapeutic doses.

This indicates that the majority of the respondents had some appreciable level of knowledge and awareness about ADRs.

TABLE VIIIA: MANAGEMENT AND PREVENTION OF MULTIVITAMIN INJECTION-INDUCED ADRS IN DOGS

Variables	Frequency	Percentage (%)	95% CI (mean)
Respondents' approach to managing ADRs to multivitamin injections in dogs			
Clorpheniramine	18	29.5	81.47 - 100.00
Hydrocortisone	5	8.2	96.52 - 100.00
Dexamethasone	7	11.5	96.45 - 100.00
Prednisolone	4	6.6	96.55 - 100.00
Atropine	10	16.4	96.34 - 100.00
Fluid therapy	6	9.8	96.48 - 100.00
Give the dog food	2	3.3	96.61 - 100.00
Give water orally	1	1.6	96.64 - 100.00
Take the dog for walk	1	1.6	96.64 - 100.00
Give salt and water solution orally	1	1.6	96.64 - 100.00
Pour water on the dog's body	1	1.6	96.64 - 100.00
Contact the Vet	3	4.9	96.58 - 100.00
Nothing. The condition resolves itself	2	3.3	96.61 - 100.00
Total	61	100	

About 46.8% of these respondents have experienced or observed ADRs while, 38.5% have never experienced it. This discrepancy may be due to differences in clinical exposure and diagnostic ability of the concerned respondents indicating the need for advanced trainings on ADRs identification and reporting.

The use of multivitamins by the respondents was widespread, with 98.2% of them in active use of different types in either their veterinary practices or dog kennels. The most frequently used form is the injectable, while intramuscular (IM) was the commonly adopted route of administration. This is an indication that multivitamins may be one of the most frequently prescribed and used supplements/supportive therapy in canine practices in the area under this study (Ihedioha *et al.*, 2021).

The result from this survey study revealed that 55% of respondents have observed ADRs following the administration of injectable multivitamins in dogs. This result agrees with the findings of Awe *et al.* (2017), who reported that 62.5% and 67.5% of respondents indicated observance of adverse responses in the Nigerian local dog breed to both veterinary and human vitamin B complex formulations, respectively. This present study revealed that veterinary multivitamin injections were preferred (65.9%) over human vitamin B complex, primarily due to factors like drug availability, therapeutic efficacy, economic considerations and a perceived lower risk of adverse reactions. This is not in agreement with Ihedioha *et al.* (2021) who reported that human vitamin B complex injection is the most prescribed multivitamins for dogs in a Veterinary hospital.

TABLE VIIIB: MANAGEMENT AND PREVENTION OF MULTIVITAMIN INJECTION-INDUCED ADRS IN DOGS

Variables	Frequency	Percentage (%)	95% CI (mean)
Respondents' opinion on how ADRs of dogs can be prevented	11	16.4	96.31 - 100.00
Administering the appropriate drug dosage	1	1.5	96.64 - 100.00
Slow intravenous injection of multivitamins	2	3	96.61 - 100.00
Post injection monitoring of patients for signs of ADR's	9	13.4	96.38 - 100.00
Avoid using brands known for causing ADRs in dogs	1	1.5	96.64 - 100.00
Avoid intravenous administration of multivitamin injections	16	23.9	96.11 - 100.00
Relevant and complete ADRs history taking	4	6	96.55 - 100.00
Use of veterinary preparations of multivitamin	1	1.5	96.64 - 100.00
Allergy testing where possible	3	4.5	96.58 - 100.00
Avoid self-medication of pets if not a licensed professional	5	7.5	96.52 - 100.00
Proper knowledge on the contraindications, possible side effects and idiosyncrasies of multivitamin injections in specific dog breeds	1	1.5	96.64 - 100.00
Prophylactic medication of dogs with antihistamines before administering multivitamin injections	5	7.5	96.52 - 100.00
Opting for safer routes of drug administration	1	1.5	96.64 - 100.00
Manufacturers should clearly state the possible side effects and contraindications on drug packages	2	3	96.61 - 100.00
Sensitization of dog owners, dog breeders and veterinarians on ADRs to multivitamin injections	5	7.5	96.52 - 100.00
Research should be carried out to find out the exact cause of ADRs in dogs to multivitamin injections	67	100	

This study revealed that the most vulnerable ages are; the young adult between 6 months to 2 years of age. This may be due to immune system responsiveness at this young stage of life in dogs. German Shepherds, Boerboels, and Caucasians were noted to be the commonly affected breeds with German Shepherds having the highest prevalence of 30.7%. The reasons for these breed-specific susceptibilities are still unclear, but it may involve age, genetic predispositions, immune hypersensitivity or previous exposure of some drugs (Bradley *et al*., 2023).

Findings from this study indicate that the intramuscular (IM) route of administration was associated with a higher incidence of adverse drug reactions (ADRs) compared to other routes, suggesting that IM administration may not represent the safest option for multivitamin delivery. This increased incidence may be attributed to several factors. IM administration bypasses the protective barriers of the skin and gastrointestinal tract, resulting in more rapid systemic exposure and a potentially higher likelihood of both local and systemic reactions (Zhao *et al*., 2024). Additionally, IM injections are frequently associated with local tissue irritation, pain, inflammation, and, in some cases, sterile abscess formation due to the deposition of relatively concentrated substances within muscle tissue (Sambandam *et al*., 2016). Variability in injection technique, including needle size, injection site, and volume administered, may further influence drug absorption and tissue response, thereby increasing the risk of adverse outcomes (Usach *et al*., 2019). Furthermore, multivitamin formulations, which often contain multiple active ingredients and excipients, may predispose recipients to hypersensitivity reactions when administered via the intramuscular route (Caballero *et al.*, 2021). In this study, the most frequently manifested clinical signs of ADRs were revealed to be skin reactions (hives, redness) (29.1%), restlessness (22.5%), and tachypnea (15.9%). A greater proportion of respondents indicated that the onset of these clinical signs occurred either immediately or within 5–29 minutes following administration. These clinical signs are characteristic of type I or immediate hypersensitivity reactions (allergic reaction), which involves fast IgE-mediated degranulation of basophils or mast cell (Bradley *et al.*, 2023; Hunter *et al.,* 2024). The management of these ADRs were largely pharmacological with Antihistamines, particularly chlorpheniramine (29.5%) as the most commonly used medications for managing reactions, followed by corticosteroids such as hydrocortisone (8.2%) and dexamethasone (11.5%) which align with standard emergency protocols for managing allergic drug reactions (Hunter *et al.,* 2024). Preventive measures against ADRs in dogs to injectable multivitamin products starts with taking relevant and complete history of each patient, use of prophylactic antihistamine in breeds with high risk of ADRs to multivitamin injections. Appropriate dosing and route of administration should also be adhered to. It was observed from this study that despite the considerably high awareness (80.7%) of ADRs among the respondents in this study, a gap in standardized preventive measures and documentation was evident. The report of this study aligns with the findings of Awe *et al.,* (2017) in which they highlighted an overall underreporting and lack of a structured pharmacovigilance for veterinary drug reactions in Nigeria.

CONCLUSION

The survey study revealed that both veterinary multivitamin and human vitamin B-complex injections can trigger hypersensitivity reactions, especially when administered intramuscularly. There is need for pharmacovigilance systems, organizing training workshop on safe drug administration practices, advocating for breed-specific caution and proper labeling by manufacturers in order to substantially mitigate the risk of multivitamin induced adverse drug reactions in dogs.

Ultimately, a collaborative effort between veterinarians, dog owners, researchers and policy-makers may be necessary to ensure animal safety and welfare concerning the use of multivitamins in dogs.

CONFLICT OF INTERESTS

The authors declare they have no conflict of interests with regards to this publication.

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