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## Full Length Research Paper

# Prevalence of *Brucella* antibodies in horses (*Equus Caballus*) in Jalingo, Taraba State, Nigeria

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A study was conducted to determine the prevalence of *Brucella* antibodies in Jalingo using the Rose Bengal plate test (RBPT) and the serum agglutination test (SAT). A total of 90 adult horses that were on zero grazing management system were sampled. The sampling sites were selected based on the availability of horses. The objectives of the study were to determine the prevalence of *Brucella* antibodies in horses as well as the distribution of the infection according to sex. There was no association of horses seen with other animals. The samples collected comprised of 88 males and 02 female horses from four locations in Jalingo: Barade, Sarkin dawaki, Sintali and Turaki. All the sera samples were subjected to initial screening by RBPT and positive cases were then analyzed with SAT. The overall prevalence of *Brucella* antibodies was 07 (07.8%) with all positive cases recorded from male horses for RBPT, while none was positive for SAT among the male and female horses. There was no significant difference in the prevalence of horse *Brucella* antibodies between male and female ( $P>0.05$ ). Horses in Jalingo are in the four wards identified and were all sampled. Turaki ward recorded the highest prevalence of 13.3%, while Barade Ward had the lowest prevalence with 00.0%. However, there is no significant difference in the prevalence between the male and female ( $P>0.05$ ). Further studies need to be conducted to determine the involvement of other species and humans.

**Key words:** Horse, Brucellosis, Jalingo, Rose Bengal plate test (RBPT), serum agglutination test (SAT).

## INTRODUCTION

Brucellosis is an important zoonotic disease worldwide causing serious human health problems and substantial economic losses for the livestock industry (Corbel, 1997). The disease is highly contagious in domestic (camel, cattle, buffaloes, sheep and goats), wild (deer, elk, bison, zebra) and companion (horses, donkeys, mules and

dogs) animals and is one of the most important and widespread zoonosis in the world (Poester et al., 2002). The disease remains an uncontrolled problem in regions with poor animal and public health standards leading to high endemic in Africa, the Mediterranean, Middle East, parts of Asia and Latin America (Capasso, 2002; Refai,

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2002). Among domesticated species, cattle, sheep, pigs and goats are most commonly affected. Infection in horses is uncommon, while cats are resistant (Benkirane, 2006). Brucellosis is generally asymptomatic in horses (Denny, 1973). Fistulous withers and poll evil are the most common clinical manifestations in the horse, and also associated with a variety of other clinical manifestations, including vertebral osteomyelitis (Collins et al., 1971; Cohn et al., 1992), abortion, infertility (Denny, 1972) and arthritis (Carrigan et al., 1987).

Prevalence of the disease in Nigeria among various animal species is reported to be 16.5% in camels (Sadiq et al., 2013), 21.3% in bovine, 11.1% in ovine and 20% in caprine (Zubairu et al., 2014). Seroprevalence rate of 11% was detected for *B. abortus* and 0% for *B. melitensis* among animal handlers, livestock keepers, butchers and middlemen (Adamu et al., 2015), while another study of the infection rate among butchers and the general public is 31.82% (Cadmus et al., 2006).

Equine infection most frequently involves *B. abortus*, but *B. suis* was isolated from horses with septic bursitis and from the internal organs of a mare with no external signs of disease (Cvetnic et al., 2005). Because of the difficulty that may be encountered in attempts to culture *B. abortus* from horses with fistulous withers, concomitant serologic testing for detection of specific antibodies was recommended. Serological surveys have indicated that many horses may be exposed to *B. abortus* without developing clinical signs of the disease (Göz et al., 2007). For serodiagnosis of horse brucellosis, many serologic tests such as Rose Bengal plate test (RBPT), serum agglutination test (SAT), complement fixation test (CFT), mercaptoethanol agglutination, Agar gel diffusion and Coombs tests have been commonly used (Hutchins and Lephed, 1968; MacMillan, 1985).

Horses are accorded special attention due to the immense role they play in polo games, cultural festivals and security (Ehizibolo et al., 2011). *Brucella abortus* infection in horses is important not only as clinical existence but also as a source of infection to horse riders, handlers and the general public and may be significant and warrant investigation. Studies concerning brucellosis have been conducted on cattle, sheep and goats, but most have focused on cattle. However, a small number of surveys have been carried out to determine the epidemiologic role of horses and donkeys. The aim of this study was to determine the prevalence of *brucella* antibodies in horses raised in Jalingo, Taraba State, Nigeria.

## MATERIALS AND METHODS

### Study area

Jalingo is the capital city of Taraba state. It is also the headquarters of Jalingo Local Government. It lies between latitude 8.90°N and longitude 11.3° E. It has a good climatic condition and rich in agricultural produce with temperatures ranging between 20-40°C

and mean annual rainfall of 1,500 mm per annum.

### Animals

The sampling sites were selected based on the availability of horses. Therefore, virtually all the horses found within the wards were sampled. The horses were on zero grazing. The horses are primarily for ceremonial purposes and serve as a form of prestige to owners.

### Samples collection

All the horses found within the wards were sampled. The horses were on zero grazing. The horses are primarily for ceremonial purposes and serve as a form of prestige to owners. Verbal approval was sought from the District head (Galadima) of Jalingo who gave us one of his aides to assist us reach the horse owners.

Five milliliters of blood samples were collected by venipuncture via the jugular vein using syringe and needle. Information about sex, age and location of the equines sampled were recorded. All the samples collected were placed in sterile blood sample bottles and allowed to stand for 30 min before centrifuging. The sera were separated, placed in ice packs and transported to the microbiology laboratory, College of Agriculture, Jalingo and stored at -20°C till needed for analysis.

### Serological tests

#### Rose Bengal plate test (RBPT)

The procedure described by Nielsen and Dunkan (1990) was followed. The antigen used was from Veterinary Laboratories Agency (VLA, UK). The serum samples earlier stored in the refrigerator were removed and left at room temperature for 30 min. 30 µl (0.03 ml) of the serum samples were dispensed onto the plate and 30 µl (0.03 ml) of RBPT antigen were dropped alongside the sera. Using applicator stick the antigen and the sera were mixed together and examined for agglutination.

#### Serum agglutination test

1 ml of SAT antigen was diluted with 9 ml of prepared phenol saline buffer. 0.8 ml of the phenol saline solution was dispensed in the first tube and 0.5 ml was dispensed into the remaining four tubes (Morgan et al., 1978). 0.2 ml of the test serum were dispensed into the first tube, the second and up to the fifth tube and mixed properly. 0.5 ml of the mixture was transferred serially from the first to the last tube and 0.5 ml was discarded from the last tube. This resulted in dilutions of 1:5, 1:10, 1:20 and so on. 0.5 ml of the diluted SAT antigen (1:9) was added to each tube, mixed properly and gave a final dilution of 1:10, 1:20, 1:40, 1:80 and 1:160. The tubes were covered with aluminum foil and incubated at 37°C in a water bath for 24 h and the result was read.

### Sample analysis

Simple percentages and Chi square were used to analyze the data by subjecting it to SPSS-16 statistical software.

## RESULTS

In this study, 07 (07.8%) of the 90 sampled horses were



**Table 1.** Prevalence of *Brucella* antibodies in Horses in Jalingo.

Location	No. examined	RBPT		SAT		X <sup>2</sup>
		No. +ve (%)	No. -ve (%)	No. +ve (%)	No. -ve (%)	
Barade	15	00(00.0)	15(100.0)	00(00.0)	15(100.0)	3.53
S/Dawaki	18	02(11.1)	16(88.9)	00(00.0)	18(100.0)	
Sintali	27	01(03.7)	26(96.3)	00(00.0)	27(100.0)	
Turaki	30	04(13.3)	26(86.7)	00(00.0)	30(100.0)	
Total	90	07(07.8)	83(92.2)	00(00.0)	90(100.0)	

\*The figure in parenthesis is percentages (%) of the number positive or negative, No. +ve = Positive, No. -ve = negative, % +ve = percentage positive, % -ve = percentage positive, RBPT = Rose Bengal plate test. PV= 0.3260 X<sup>2</sup>= 3.53 df= 3 a=0.05.

**Table 2.** Sex and specific prevalence of *Brucella* antibodies in horses.

Sex	No. examined	RBPT		SAT		X <sup>2</sup>
		No. +ve (%)	No. -ve (%)	No. +ve (%)	No. -ve (%)	
Male	88	07(07.9)	81(92.1)	00(00.0)	88(100.0)	3.53
Female	02	00(00.0)	02(100.0)	00(00.0)	02(100.0)	
Total	90	07(07.8)	83(92.2)	00(00.0)	90(100.0)	

\*The figure in parenthesis is percentages (%) of the number positive or negative, No. +ve = Positive, No. -ve = negative, % +ve = percentage positive, % -ve = percentage positive, RBPT = Rose Bengal plate test. PV= 1,000 X<sup>2</sup>= df= 1 a=0.05.

positive by RBPT. Turaki ward recorded 04 (13.3%) prevalence and had the highest seroprevalence (Table 1). This was followed by Sarkin Dawaki with 02 (11.1%), Sintali 01 (03.7), while Barade recorded no positive case. All the RBPT positive cases that were subjected to SAT recorded no positive case. They had titers between 1/10 and 1/20 values and others showed no titers at all. There was no significant difference among the wards ( $p > 0.05$ ).

This study also indicated that male horses were the ones that were positive for *Brucella* antibodies with 07 (07.9%) of the 88 male horses' samples screened with RBPT, with no positive case observed in the 02 female horses screened (Table 2). All the RBPT positive cases showed no titer that was equal to or greater than 1:40 when tested with SAT. However, there was no significant difference in the prevalence between the male and female ones in Jalingo ( $p > 0.05$ ).

## DISCUSSION

The overall prevalence of 07.8% by RBPT and 00.0% by SAT in this study is comparable to the findings of other workers carried out in horses in Nigeria; 14.7% (Ehizibolo et al., 2011) and 4.8% (Bale and Kwanashie, 1984). It is however higher than 5.5% (Sadiq et al., 2013) in other equines (donkey) in Borno and Yobe States by both RBPT and SAT and 4.2% in lowlands of central Oromiya, Ethiopia (Jegerfa et al., 2009).

The result in this study shows that male horses, 07 (07.8%) by RBPT have higher prevalence than female

horses 00 (00.0%). Ehizibolo et al. (2011) also reported that all the mares in their study were negative when screened with RBPT. The higher prevalence of the *Brucella* antibodies in the male in this study could be as a result of the low population of female horses sampled. There are controversial reports regarding the prevalence of brucellosis in relation to the sex of animals, as some of the research workers reported significantly higher prevalence in males than females (MacMillan and Cockrem, 1986). Whereas, others report that females have higher prevalence than males (Hussein et al., 2005).

The prevalence of the disease observed in the Rose Bengal plate test (RBPT) is higher than in serum agglutination test (SAT). This is in agreement with the works of Mbuk et al. (2011), who recorded a higher seroprevalence in RBPT than SAT. Results of RBPT, which could not be confirmed by SAT, indicate the non-specific reaction in these samples and that all animals tested are considered negative for brucellosis.

## CONCLUSION AND RECOMMENDATIONS

The presence of brucellosis in horses that are on zero grazing in Jalingo metropolis is an enigmatic. It is a possibility that the horses in this study may have been exposed to *B. abortus* through the ingestion of infected pasture that was fed to them. They may also be infected at an early age or through a means that was not identified in this study.



Identification of horses with brucellosis makes it imperative that strategic planning for the control of brucellosis in Nigeria should include horses. It is recommended that horse riders be screened for the disease as a preventive measure as well as to possibly establish association.

### Conflict of Interests

The authors have not declared any conflict of interests.

### ACKNOWLEDGEMENTS

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*Full Length Research Paper*

# Trends of risk factors of completed suicide by gender and age

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The objective of this study was to identify trends of completed suicide based on gender and age groups. Population data of complete suicide in Sri Lanka during 2005 to 2014 were collected from the Sri Lanka Police Statistics Department. One-way analysis of variance (ANOVA), chi-square test and descriptive statistics were used to analyze the data. Risk factors of completed suicide is significantly depending with age (Chi-square= 15581.28,  $\chi^2_{0.05,70}=90.5$ ) and gender (Chi-square= 2109.71,  $\chi^2_{0.05,27}=40.1$ ). Risk factors of completed suicide in Sri Lanka during the last decades have not been changed significantly.

**Key words:** Suicide, mental health, risk factors, public health.

## INTRODUCTION

Suicide is an important health problem, which receives an increasing attention worldwide. The total suicidal death in 2012 was 803900 which accounting 11.4 deaths per 100,000 out of total death in the world (WHO, 2014a). The suicide rate in Sri Lanka was 47.0 suicides per 100,000 population in 1995 and since then the overall rate has fallen by more than half in 2009 to 19.6 per 100,000 (Gunnell, 2007). Although the pattern of suicide rate has decreased in 2009, in 2012 the rate of suicide has significantly increased up to 28.8 per 100,000 populations in Sri Lanka (WHO, 2014b). When compared with the global situation, the trend of suicide in Sri Lanka still to be considerable. In the annual report of WHO (2014b), Sri Lanka had been ranked in the fourth position among 172 countries in terms of most suicide prone countries in the world.

Chemical and plant poisoning, taking pills, self-immolation, hanging, narcotics, chalks, self-harm,

drowning, jump from high places, fire arms, explosive, sharp weapons, firearms, etc., have been used as method of commit suicide globally (Meyer-Rochow et al., 2015). Considering high income country, 50% of the suicides are due to hanging and second most common method is firearms accounting for 18% of total suicide (WHO, 2014b). However, it was revealed base on world suicide data during 1990 to 2007 that most common method of suicide was pesticide self-poisoning globally (Gunnell et al., 2007). And also pesticide self-poisoning is most common method of suicide within the rural residents engaging in small scale agriculture in low and middle income country (Wu et al., 2012; Behere and Bhise, 2009).

Male suicide rate is higher than the rate of female suicide in many countries (Jayasinghe and Foster, 2011; Poorolajal et al., 2015; Purushothaman et al., 2015; WHO, 2014b). In Sri Lanka, the rate of male suicide is

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**Table 1.** Risk Factors and total suicidal deaths in Sri Lanka during 2005-2014 (Sri Lanka Police Statistics Department).

Factor	Total
Harassment by the husband/wife and family disputes	8194
Chronic diseases and physical disabilities	5423
Mental disorders	3530
Disappointment and frustration caused by love affairs	3383
Economic problems (poverty, indebtedness)	2695
Addiction to narcotic drugs	2575
Problems with elders in the family	1422
Aggrieved over the death of parents/relations	868
Employment problems	534
Ill-treatment by the children	305
Loss of property	116
Failure at the examination	67
Due to sexual harassment/Rape	58
Sexual incapacity	52

the highest as same in globally (Rajapakse et al., 2014). Further, it was revealed that, physical and psychological disorders and economic and social conditions have been recognized as main factors to prevalence suicide (Behere and Bhise, 2009; Poorolajal et al., 2015; Jayasinghe and Foster, 2011; Garand et al., 2006). The social adaptability, social relationships and childhood abuse and sexual assault have been categorized under the social factors. Under economic factors, unemployment, foreclosures and other economic losses have been identified which often result in feelings of shame, humiliation, and despair in individuals where isolation, a lack of sense of connectedness or belonging and hopelessness have been the outcomes. These are themselves significant risk factors for suicide, and they can in turn lead to more serious manifestations such as increased substance use, addiction or depression (Satya et al., 2009).

Considering the earlier mentioned factors, it is convenient to describe suicide as a complex human behavior that cannot easily be predicted. And trends of suicide incidents have been varying within deferent age categories and also gender. Therefore, the objective of this research is to identify the trend of risk factors of completed suicide (CS) and the relationship of risk factors in CS with gender and age group.

## METHODOLOGY

This study is based on population data on completed suicide during 2005 to 2014 in Sri Lanka. The data was quoted from the records of the Sri Lanka Police Statistics Department. Dependent variable is a risk factor of completed suicide and the two independent variables are gender, age and time. Time series analysis and one-way analysis of variance (ANOVA) were implemented to identify whether risk factors of completed suicide have changed during the last decade. Chi-square test was used to find out the dependency

between the age groups and gender with the risk factors of completed suicide. Age of suicides was categorized as children -8 to 16 years, Young -17 to 30 years, Middle age -31 to 45 years, Elder -46 to 55 years, Senior -56 and above.

## RESULTS AND DISCUSSION

### Risk factors of completed suicide and trends

Considering trends of CS by risk factors in the past ten years, the mean deference of CS due to each risk factors within time (years) is not statistically significant (ANOVA  $F=0.987$ ,  $p>0.05$ ), which concludes that risk factors of CS has been not significantly changed for last ten years. Specially, Harassment by the husband and family disputes, chronic diseases and physical disabilities and mental disorders have been top in considering time period. Some of the risk factors show simple fluctuations with some years, but cannot identify a clear fluctuation over the past decade (Table 1).

The results show that most motivational factor of last 10 years is "Harassment by the husband and family disputes" (28%). In society, the family has played a central role. However most significant shadow of collapsing the unity of the family is that the increasing trend of divorce rate in Sri Lanka (Department of Census and Statistics, 2006). Divorce, the formation of a new family with step-parents and step-siblings, or shift to a new community can be stressful and can build up self-doubts. In some cases, suicide appears to be a solution especially for children who face family issues. Psychologists say that parents who feel that their child is suicidal or troubled should ask him or her to talk about their feelings (Abeyasinghe and Gunnell, 2008; Rachel et al., 2012). The parent should reassure them that they are loved, and remind them that no matter how awful their

problems seem, they can be worked out. They must listen to their children patiently rather than just dismissing them. The important thing is to pay attention, encourage them to talk, be on their side and reassure them. According to Duthé et al. (2014), it is very important to talk to someone who might be contemplating suicide. Do not accuse people of being suicidal, listen and let them do most of the talking. The important thing to do is to continue to listen to the person who is suicidal; "Bringing up the question of suicide and discussing it without showing shock or disapproval is one of the most helpful things.

The second most common motivational factor of CS is chronic diseases and physical disorders (19%). WHO (2014a) reveal that chronic diseases accounted for 75% of total deaths. People can be disabled for various reasons. Some are born with mental and physical disabilities. Due to 30 years of armed conflict, not only armed forces personnel and combatants but also considerable number of children, youth, and adults, both male and female became disabled. This was adding more numbers apart from the people who met with regular accidents or born with disabilities or became disabled due to sickness or disease. The senior citizens were also proved to be restricted of movements due to dysfunction of the body as the results of aging. According to the world accidents statistics, in recent years the rate of road accidents has been increasing in Sri Lanka at an alarming rate. Sometimes victims are not fully recovered and became physically disabled permanently (Chen et al., 2015; Fernando, 2003; Pil et al., 2013; Sadanandan, 2014). The challenges faced by people who experience forms of disabilities are influenced more by negative social expectations and tacit ideas concerning disability than by any emotional, physical, or cognitive impairment a person may experience (Chapman et al., 2005). Research on disability and depression has consistently shown that when people with disabilities report dissatisfaction with their lives, they are not nearly as concerned with things such as reliance on machines or medications as they are with their relationships, financial security, or difficulties while at work (Jose and Duarte, 2006; Mohamed et al., 2011; Rajkumar et al., 2015; Robinson et al., 2015). Despite this, the social message repeatedly presented is that life with a form of disability is miserable and when the people around them believe that without questioning it, it may become very hard for people with disabilities to think anything different. Through this, people with disabilities come to internalize oppressive images and after that happens, it becomes very difficult for people with disabilities to hope for something better in their lives. At this point, suicide also becomes an issue. So many people need to stop tolerating the notion that people with disabilities have a reason to die and instead become active partners with the disability community to create a world that is both inclusive and accessible (Sadanandan, 2014). Raising

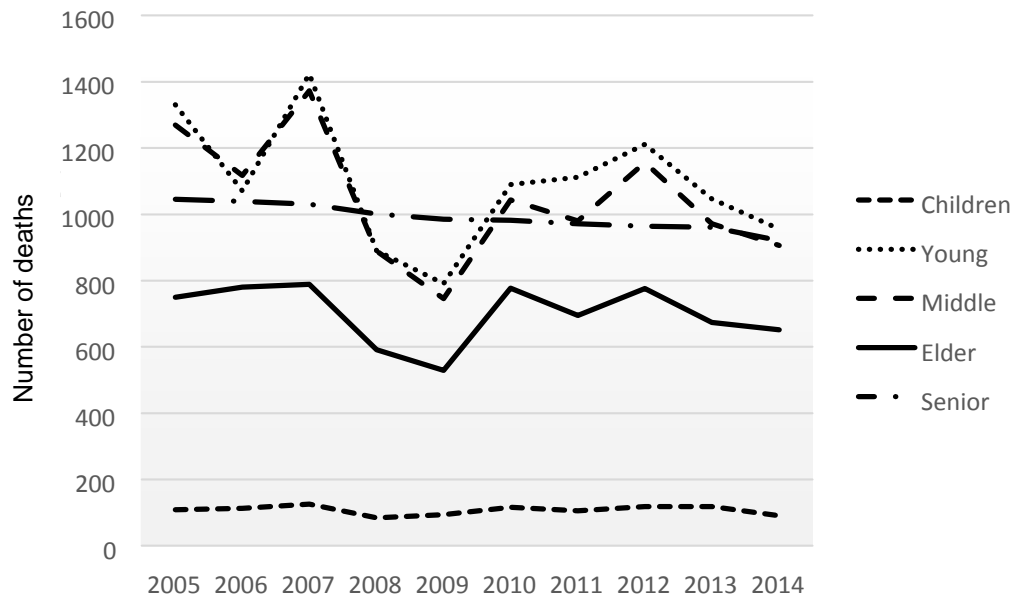
awareness about suicide will make the disability community visible while bringing people together so they can prevent unnecessary suffering and pain (Behere and Bhise, 2009).

The number of people suffering from mental illness in Sri Lanka is on the rise, and the third highest motivation risk factor for CS is "Mental disorders". Statistics reveals that prevalence of mental illness has been critical in Sri Lanka (Samarasekare et al., 2012; Weerasundera, 2012). Somasundaram and Rajadurai (1995), who have investigated psychological problems among people in the Northern Province, has said there is a need to re-establish mainline psychiatric services in the North. The minor mental health disorders due to war trauma and postwar factors are widely prevalent, and are not being addressed adequately, and according to Somasundaram and Rajadurai (1995), 13% suffer from Post Traumatic Disorder (PTSD), 49% from anxiety disorders and 42% from depression in Northern Province. These figures reveal that the island's protracted civil war combined with poor socio-economic conditions such as poverty, unemployment, poor nutrition and a lack of basic services significantly influenced to prevalence mental illness of the people in Sri Lanka. Nevertheless, Kathriarachchi and Perera (2011) claims that the tsunami disaster in 2004 has had a strong negative impact on mental health in Sri Lanka. Somasundaram and Rajadurai (1995) claimed that in Sri Lanka, 6.7% had PTSD, 15% had depressive disorder, and 9.5% had psychosis schizophrenia, while suffering from alcohol and substance abuse. Most mental ill patients are reluctant to get medication. One-to-one basis though the treatment is not very convenient in Sri Lanka at present (Kathriarachchi and Perera, 2011; Poorolajal et al., 2015).

### **Trend of completed suicide by age group**

Considering the last 10 years, CS rate of children indicates relatively low rate with regular trends (Figure 1). However, number of incidents of CS of children is still considerable. Compared with other age groups, children do not face huge problems and most of the children's suicides have occurred due to precipitant reasons which are emerged due to strong feelings of stress, confusion, self-doubt, pressure to succeed, financial uncertainty, and other fears while growing up (Jose and Duarte, 2006). For some teenagers, divorce of parents, the formation of a new family with step-parents and step-siblings, or moving to a new community can be very unsettling and can intensify self-doubts and shock and revenge (Kaushal, 2015; Kinder and Cooper, 2009; Bagalkot et al., 2014).

CS trend of young and middle age group have relatively similar distribution (Figure 1). Though, from 2005 to 2008, CS rate of the young has decreased, during 2008 to 2010 it has increased slightly whereas



**Figure 1.** Completed suicide incidents by age groups over the 10 years 2005-2014 (Sri Lanka Police Statistics Department).

from 2010 to 2014, the CS rate has decreased significantly. The middle age has the second highest CS rate till 2008. It shows a huge downward slope but afterward the CS rate has decreased in a decreasing rate. Increased alcohol and substance use, the increased availability of firearms, and the fact that many mental disorders (such as depression and schizophrenia) accounted for CS in young and middle age groups (Bagalkot et al., 2014). When elders (46 to 55 years old) and seniors (56 years old and above) are concerned, CS rate of seniors is high considerably than elders (Figure 1).

The highest incidents of CS in children and young age groups are reported due to disappointment and frustration which is respectively 35 and 30% (Table 2). However, majority of the middle aged and elders have committed suicide due to harassment by the husband and family disputes accounting 41 and 31%, respectively (Table 2). And the highest CS incidents among seniors were reported due to mental disorders which is 17% out of total CS in this category. The aforementioned result concludes that risk factors of CS depend on age groups. Moreover, this association is also statistically significant (Chi-square=15581.28,  $\chi^2_{0.05,70}=90.5$ ).

### Trend of completed suicide by gender

According to the population data presented in Table 3, during the last ten years the completed suicide number is 39368. This includes 8703 (23%) females and 30665 (77%) males. Compared to the year 2005, the number of CS has decreased by 33% although the CS is relevantly

high. The total number of male CS over total male deaths in the past decade is 5.92% while the total number of CS over total female deaths over the past decade is 2.20%.

As shown in Table 3, in 2014, though the rate of male completed suicide has indicatively decreased by 33%, while female completed suicide decreased by 36%, amount CS of both male and female is still in critical level (Table 3). In addition to the fact that the male completed suicide is three times higher than the female completed suicide. Women who attempt suicide tend to use nonviolent means, such as overdosing (Freeman and Freeman, 2015). Men often use firearms or hanging, which are more likely to result in death (Russell and Joyner, 2001). Once men are affected by financial, professional, or personal problems, they get easily depressed and end in suicide more frequently than women do (Russell and Joyner, 2001).

According to the figure in Table 4, the highest rate of total CS incidents in both male and female is harassment by the husband or family disputes which reported as 24 and 33%, respectively. The second highest CS risk factor of male is chronic diseases and physical disabilities accounting for 31%. Followed by mental disorders (13%), economic problems (poverty, indebtedness) (11%), addiction to narcotic drugs (11%) and disappointment frustration caused through love affairs (9%) (Table 4). Considering CS of female, 18% of suicide deaths was reported due to mental disorders whereas disappointment and frustration caused through love affairs accounted for 16%, chronic diseases and physical disabilities (14%) and problems with elders in the family (8%) (Table 4). This reveals that risk factors of CS

**Table 2.** Trend of completed suicide by age (Sri Lanka Police Statistics Department).

Age group (years)	Economic problems (Poverty, indebtedness, %)	Employment problems (%)	Problems caused with the elders (%)	Harassment by the husband & family disputes (%)	Using disappointment frustration caused through love affairs (%)	Addiction to narcotic drugs (%)	Aggrieved over the death parents/relations (%)	Mental disorders (%)	Chronic diseases & physical disabilities (%)	Other (%)	Total
08 - 16 (children)	1	2	34	4	35	-	6	11	4	3	100
17 - 30 (Young)	5	3	9	29	30	4	3	12	4	1	100
31 - 45 (Middle ages)	12	2	3	41	3	12	3	15	9	-	100
46 - 55 (Elders)	13	2	1	31	-	14	3	15	20	1	100
56 & above (Seniors)	8	1	-	8	-	8	3	17	50	5	100

**Table 3.** Population and the suicide death and total death by gender in Sri Lanka.

Year	Population (million)	Completed suicide		Total number of deaths	
		M	F	M	F
2005	19.7	3708	1034	75,663	56,434
2006	19.9	3558	946	69,895	47,572
2007	20	3281	944	71,207	47,791
2008	20.2	3260	860	73,690	50,124
2009	20.45	3097	921	76,094	51,682
2010	20.65	2914	950	74,170	54,433
2011	20.87	2939	831	20,300	35,566
2012	20.32	2721	805	18,400	16,700
2013	20.483	2703	752	18,800	17,000
2014	20.675	2484	660	19,200	17,500
Total		30665	8703	517,419	394,802

Source: Central bank of Sri Lanka (2014), Department of Census and Statistics, Sri Lanka (2015), Sri Lanka Police Statistics Department.

**Table 4.** Trend of Completed suicide by gender (Sri Lanka Police Statistics Department).

Factor	Male (%)	Female (%)
Harassment by the husband/wife and family disputes	24	33
Chronic diseases and physical disabilities	21	14
Mental disorders	13	18
Economic problems (Poverty, indebtedness)	11	5
Addiction to narcotic drugs	11	-
Using disappointment frustration caused through love affairs	9	16
Problems caused with the elders	4	8
Aggrieved over the death parents/relations	3	3
Employment problems	2	1
Other	2	2
Total	100	100

depend on gender. Further, chi-square statistics (chi-square= 2109.71,  $\chi^2_{0.05, 27} = 40.1$ ) proved that this association is statistically significant.

## Conclusion

Risk factors of completed suicide in Sri Lanka during the last decades have not been changing significantly. During the past decade in every year the most motivational risk factor for CS is “harassment by the husband/wife and family disputes” while second and third motivational risk factors for CS are chronic diseases and physical disabilities and mental disorders in both sex. Risk factors of CS are different in each age group and as well as gender.

## Conflict of Interests

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# Benefits of animal intervention strategies in the control of neglected zoonotic diseases in Nigeria

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**Nigeria among many other developing countries of Africa, Asia and Latin America still suffers the impact of neglected zoonotic diseases (NZDs) such as rabies, brucellosis, cysticercosis, echinococcosis and other geo-helminths which have been successfully eradicated in industrialized countries. These diseases cause economic bankruptcy among over 70% of Nigerians who live in the rural areas and whose livelihood is dependent on mini-livestock production. In the current review, the employment of animal intervention strategies to control these NZDs through animal vaccination, strategic de-worming, enactment and re-enforcement of legislations and policies on NZDs control, efficient veterinary meat inspection, public education and depopulation as a last option are discussed. The benefits of animal intervention strategies are affordability, safety to animals and the general public as well as improvement of national economy.**

**Key words:** Benefits, animal intervention strategies, control, neglected zoonotic diseases, risk factors, Nigeria.

## INTRODUCTION

NZDs remain a major problem in resource-limited countries of Africa, Asia and Latin America, despite their eradication in industrialized countries. However, global disease control focus has been on the millennium development goal 6; which is to combat non-zoonotic tuberculosis, HIV and AIDS as well as malaria. It has resulted in over emphasis on these three diseases and the abandoning of majority of zoonotic diseases affecting the poor populations of low income countries especially in the area of policy making towards disease control (Molyneux, 2008).

Neglected zoonoses exert dual effects either through direct causation of illnesses in man and animals or

indirectly through economic losses caused to poor rural people whose livelihood is dependent on livestock production. Majority of the Nigerian rural populations depend on incomes generated from livestock production to meet emergency expenditures such as food, school fees and medical bills (Welburn et al., 2015). Intervention by way of controlling these diseases will ensure triple benefits by improving the health of livestock, livelihoods and protection of human health (World Health Organization, 2007, 2010).

The role of animals in the control of zoonoses can never be over emphasized considering the significant role of domestic and wild animals in maintaining, amplifying

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and transmission of zoonotic pathogens in nature (WHO, 2010). At least 61% of all emergent human pathogens reported during the last two decades are said to be zoonotic, with majority (71.8%) being from animals and their products (Jones et al., 2008) whereas only 3% are utilizing humans as primary reservoirs (Shaffer, 2008). The mechanisms of zoonoses transmission may be direct as in the cases of rabies, anthrax and trichinosis or indirect via vectors (human African trypanosomiasis, leishmaniasis, onchocerciasis), through foods of animal origin (cysticercosis, echinococcosis, brucellosis) and via water as in the cases of salmonellosis and campylobacteriosis (WHO, 2010).

It is evident that current strategies for the control of NZDs in Nigeria which include the use of injectable vaccinations, treatment of infected animals, VMI, and legislations have yielded poor results probably due to inadequacy of vaccine production, unwillingness of animal owners to seek veterinary care, un-standardized VMI and un-enforced legislations. Documented reports shows that NZDs including brucellosis (Bertu et al., 2010; Gusi et al., 2010; Aworh et al., 2013), rabies (Abubakar and Bakari, 2012; Karshima et al., 2013a; Eke et al., 2015), *Taenia solium* cysticercosis (Biu and Ijudai, 2012; Karshima et al., 2013b), echinococcosis (Saulawa et al., 2011; Adediran et al., 2014) and zoonotic tuberculosis (Raufu and Ameh, 2010; Nwanta et al., 2011; Ejeh et al., 2014) have remained endemic in Nigeria for decades despite efforts towards their control. For instance, studies among humans in Nigeria have revealed 100% case fatality due to rabies (Eke et al., 2015), prevalence rates ranging between 24.1 and 55.0% for brucellosis (Alausa and Awoseyi, 1976; Cadmus et al., 2006; Aworh et al., 2013) as well as 0.6 and 9.6% for cysticercosis (Dada, 1980; Weka et al., 2013). This review has attempted to outline the strategies and benefits of animal intervention in the control of NZDs in Nigeria and presents these strategies as a way forward towards the control of NZDs in Nigeria.

### **Risk factors associated with the spread of neglected zoonoses in Nigeria**

Understanding the risk factors associated with the spread of neglected zoonoses in Nigeria is essential for their control; because reducing these risk factors will definitely retard transmission of zoonotic diseases. The consumption of unpasteurized milk, undercooked or raw meat and blood of animals increase the risk of neglected zoonoses transmission. For instance Onoja et al. (2010) reported increased risk of milk-borne NZDs like zoonotic tuberculosis and brucellosis among nomads due to their habit of taking raw milk directly from the udder of cows. Similarly, the consumption of raw or undercooked meat increases the risk of meat-borne NZDs like cysticercosis

which is incriminated in African epilepsy (Diop et al., 2003) as well as echinococcosis, brucellosis and zoonotic tuberculosis. Moreover, it is advised that the habit of consuming blood of animals slaughtered in abattoirs in some parts of Nigeria must be discouraged as this practice may transmit zoonotic pathogens to the consumers.

Lack of vaccination or un-vaccinated livestock and pets against vaccinate NZDs are additional risk factor for the existence of these diseases among humans and animals. For example, low rabies vaccination coverage were reported in Africa (Jibat et al., 2015) and different parts of Nigeria including Zaria (Dzikwi et al., 2011), Lagos (Hambolu et al., 2014) and Aba (Otolorin et al., 2014), suggesting high risk of rabies transmission in the country. The consumption of "bush meat" which refers to meat from wild animals is another risk factor associated with the transmission of NZDs especially those originating from wild animal reservoirs (Alexander et al., 2012). In Nigeria, all food animals intended for human consumption are expected to be slaughtered in the abattoir where they are subjected to veterinary meat inspection and are certified safe before forwarding for human consumption. However, meats from wild animals are not subjected to inspection by the veterinarian and so pose the risk of transmission of NZDs like cysticercosis, echinococcosis, brucellosis and zoonotic tuberculosis to man.

The trade of live wildlife species is beneficial to the economy of many nations; however, it poses public health risk of emergence and maintenance of NZDs (Karshima, 2013). For instance, non-human primates reported as reservoirs of ebola virus in West Africa (Leroy et al., 2004; Bermejo et al., 2006) are domesticated in Nigeria as companion animals thereby increasing the risk of transmission of zoonotic diseases between wildlife and man. People living with immuno-suppressed conditions such as AIDS and cancer among the healthy individuals have increased susceptibility to disease conditions including neglected zoonoses. For instance, the risk of zoonoses transmission will be higher among the 5.4 million Nigerians living with HIV and AIDS (World Bank, 2013) and the 100,000 people reported to suffer from cancer yearly (Ferlay et al., 2010).

Veterinary inspection of food animals and carcasses in abattoirs is aimed at providing wholesome meat for human consumption (Karshima, 2012). However, the debilitating state of Nigerian abattoirs at present and the negligence of duty by some professionals who are supposed to inspect meat after slaughter and certify it safe for human consumption make this a mirage and so the consumption of un-hygienically processed and uninspected meat has become the order of the day thereby exposing consumers to the risk of meat-borne neglected zoonoses like zoonotic tuberculosis, cysticercosis, echinococcosis and brucellosis.

Attitudes of professionals towards the control of

zoonosis in Nigeria also pose risk of transmission of NZDs among humans and animals. Of particular concern is the low level of collaboration among the veterinary, medical and environmental professionals in the country (Karshima, 2012), despite the global loud cry on the need to embrace the one health concept. Veterinarians assigned the responsibility of conducting meat inspection in the abattoirs must ensure timely resumption at the abattoir and efficient meat inspection. Veterinary professionals must also imbibe the habit of using protective wears during practice to avoid introducing NZDs of animal origin to the human populace.

### **Animal intervention strategies applicable in Nigeria**

#### ***Vaccination against vaccinable NZDs***

Prevention is said to be cheaper and safer than cure. Vaccination of animals against vaccinable NZDs will go a long way in the control of these diseases among animals and humans. The use of anti-rabies vaccine for dogs, *Brucella* S19 and anthrax spores vaccine produced by National Veterinary Research Institution (NVRI), Vom against these zoonotic diseases is highly recommended for their control in Nigeria. Vaccinating over 70% of animal population against these zoonoses will ensure herd immunity and subsequent protection of the animal population and humans from these NZDs. Free vaccination campaigns which has been neglected, should be encouraged by the government and stakeholders in the veterinary and health sectors to overcome the challenge of low vaccination coverage reported in several parts of the country (Dzikwi et al., 2011; Hambolu et al., 2014; Otolorin et al., 2014). Vaccine failure arising from poor storage, wrong route of administration and incorrect reconstitution among other factors should also be addressed for adequate vaccination result.

Though this may require enormous efforts, curtailing the transmission of NZDs between wildlife, domestic animals and man through the vaccination of wildlife species will help in breaking the cycle of transmission originating from wildlife. The production of water soluble vaccine for NZDs and their administration in artificial dams at strategic places where wildlife visit to drink water was suggested (Karshima, 2013). The water soluble alternative vaccines suggested for the control of NZDs among livestock and wildlife reservoirs in Nigeria include: anti-rabies and hepatitis D and E in canids and felids as well as anthrax spores, *Brucella* S19 and foot and mouth disease vaccines in domestic and wild ruminants. Legislations governing the use of vaccines in animals by veterinarians who are mandated to provide these services should be enforced to prevent abuses from non veterinary professionals. The National Veterinary Research Institute which is responsible for the production of animal vaccines must also increase their capacity to

meet up with their demand.

#### **Routine screening of companion animals against zoonotic helminths**

Veterinarians are thought to be on the “front line” of prevention of pet-associated zoonotic helminth infections (Smith et al., 2009). The WHO recommended that puppies and kittens should be de-wormed at the age of 2 weeks to eliminate larvae acquired through trans-mammary and trans-placental transmission (Stull et al., 2007). People living with immuno-compromised conditions have higher risk of acquiring zoonoses from companion animals. Therefore, they should always present their pets to Veterinarians for strategic de-worming. Kahn, (2007) recommended that animals that can bite or scratch should not be considered as pets for this group of people. The contamination of environment, food, vegetables and water by animal excreta which is usually the source of human infection with taeniasis/cysticercosis, echinococcosis and soil-transmitted helminths can be controlled through the regulation of indiscriminate keeping of animals.

#### **Efficient veterinary meat inspection in the abattoirs**

The benefits of efficient veterinary meat inspection (VMI) are improvement of human health (Biffa et al., 2010), animal disease control through disease trace back mechanism and improved environmental health (Nwanta et al., 2008). VMI is believed to protect the 10% of the human population that may be affected by meat-borne zoonotic diseases yearly (Schlundt et al., 2004). To be able to achieve this, stakeholder responsible for abattoir management must ensure the renovation and equipping of Nigerian abattoirs as well as sponsor legislations and policies to support meat inspection. Veterinarians must also stand up to their responsibilities by timely reporting to the abattoir for meat inspection and adequate judgement. In addition to the training on VMI offered in veterinary schools, refresher courses are highly recommended for Meat Inspectors for optimal performance.

#### **Regulation of importation of domestic, wild animals and their products**

Regulating the importation of domesticated animals, wildlife species and their products will play vital roles in the control of NZDs in Nigeria. For instance, the Animal Disease Control Act of 24th February, 1988 clearly prohibits the importation of animals, hatching eggs, poultry and animal products into Nigeria from any country by land, sea or air without permission. Strict observance of the provision of this act will go a long way to control the

spread of NZDs from imported animals and their products. It is also pertinent to subject imported and trade animals to inspection at designated quarantine sections and control posts. Veterinarians should also be backed-up to conduct surveillance of suspected premises believed to harbour diseased animals as required by the law. It is also advised that communities rearing livestock should report increased frequencies of illnesses and deaths in animals to Veterinarians. To enforce this act, contraveners should be penalized as stipulated by law, and the fines recommended by this act should be reviewed upward to meet the contemporary reality in Nigeria.

### **Public education**

Neglected endemic zoonoses are usually transmitted via the consumption of raw, undercooked, unpasteurised milk or close contact with animals (Ash et al., 2015). For instance, cysticercosis, echinococcosis, brucellosis, zoonotic tuberculosis can all be transmitted via the consumption of undercooked meat, however, in addition to this, brucellosis and zoonotic tuberculosis can also be transmitted through the consumption of unpasteurised milk and close contact with infected animals. It is therefore necessary to educate the general public about the routes of transmission of these endemic zoonoses so as to protect themselves from their menace. Poor hygiene and sanitation influence the transmission of these diseases and so the public must also be educated on the health risks of unhygienic practices like indiscriminate disposal of human and animal excreta.

### **Depopulation of animals**

Though this is not a humane method of disease control, it is a last option especially when deadly zoonotic pathogens like anthrax and rabies are already circulating in animal reservoirs. Depopulation decreases the number of diseased animals in circulation and thus reduces public health risk. Depopulation was employed in Nigeria during 2006 when outbreak of highly pathogenic avian influenza took place. To achieve commendable success in depopulation; the government must also be committed to the compensation component of this disease control strategy. Carcass disposal is a very important component of depopulation and methods such as composting, burial, incineration, rendering and landfilling are recommended.

### **Benefits of animal intervention in the control of neglected zoonotic diseases in Nigeria**

NZDs control through animal intervention is beneficial to

the animal itself, man and national economy. These benefits can be broadly summarized into three segments as follows:

#### ***Improvement of animal health***

Neglected zoonotic pathogens like *Mycobacterium bovis*, *Cysticercus cellulosae* of *Taenia solium*, *Brucella abortus*, *Brucella melitensis*, *hydatid cyst* of *Echinococcus* cause different levels of morbidity and mortality in animals. These pathogens and their associated diseases if adequately curtailed through the use of vaccination, routine screening, strategic de-worming as well as enactment and enforcement of zoonoses control laws and policies will go a long way in improving animal health. Efficient veterinary meat inspection at the abattoirs will also help in eliminating NZDs from their primary sources through the trace back mechanism.

#### ***Promotion of human health***

Substantive evidence shows that at least 61% of all human pathogens that emerged during the last 2 decades are zoonotic, and over 71% of these pathogens were from animals and their products (Jones et al., 2008). This suggests that humans would have been protected if these zoonotic diseases could have been identified in animals through surveillance and by curtailing transmission to humans. For instance, several workers reported brucellosis among herdsmen, butchers and meat sellers with prevalence rates ranging between 11.0 and 55.0% (Alausa and Awoseyi, 1976; Aworh et al., 2013; Adamu et al., 2015) despite the fact that this zoonosis can be prevented in animals through the use of *Bruella* S19 vaccine which is produced by NVRI, Vom, Nigeria and readily available for farmers. Human rabies cases have also been reported in Nigeria for more than 4 decades (Kemp et al., 1972; Ogunkoya et al., 1990; Abubakar and Bakari, 2012; Eke et al., 2015) despite the availability of anti-rabies vaccines for dogs which are the major source of human rabies in Nigeria. Transmission of NZDs in Nigeria can be curtailed through efficient zoonoses surveillance, vaccination of animals against neglected zoonoses like rabies, brucellosis and anthrax, veterinary inspection of meat and the regulation of importation of animals and their products. By this, animal sources of human zoonotic infections will be controlled and transmission to humans can be curtailed.

#### ***Improvement of national economy***

Economic losses due to neglected zoonoses are numerous and may include; losses due to treatment of

sick animals, death of animals which are usually sources of income for rural population of Nigeria, hospitalization of ill people as a result of neglected zoonoses, misdiagnosis as well as prolonged and combined antimicrobial therapies required for neglected zoonosis like brucellosis (Seimenis et al., 2006; Dean et al., 2012; McDermott et al., 2013). Losses can also be due to condemnation of carcasses as a result of neglected zoonoses like zoonotic tuberculosis, cysticercosis, hydatidosis among many others. For example economic losses due to bovine brucellosis in Nigeria alone were estimated at 575,608 USD per year (Ajogi et al., 1998). Employing animal intervention in the control of these neglected zoonoses will improve the economy of livestock producers and in turn add to the gross domestic product of the nation through cost-savings. It was also observed that it is 50 times cheaper to employ animal intervention in the control of rabies in Nigeria through the vaccination of dogs using NVRI anti-rabies vaccine for dogs than administration of both pre and post-exposure Anti-Rabies Vaccine in humans (Karshima, 2012).

## Conclusion

NZDs are still major problems in Nigeria causing morbidity and mortality among humans and animals. These controls will relieve burdens on human and animal health as well as reduce poverty levels especially among the rural population. The use of animal intervention strategies in the control of NZDs like rabies, brucellosis, zoonotic tuberculosis, cysticercosis, anthrax, echinococcosis among many others is cost-effective. It is therefore recommended that the veterinary, health, environmental sectors as well as policy makers, should embrace the animal intervention strategies which are affordable, safe, cost-saving and beneficial to humans, animals and the environment.

## Conflict of Interests

The author has not declared any conflict of interests.

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