

Causal Association between Enterotoxaemia and its Determinants in Small Ruminants

G. Selvaraju

Associate Professor, Department of Veterinary Epidemiology and Preventive Medicine,
Veterinary College and Research Institute, Namakkal - 637 002, Tamil Nadu, India

Abstract: An epidemiological study was undertaken to assess the measures of causal association between enterotoxaemia and its determinants in north-west agroclimatic zone of Tamil Nadu. Study population of 155 animals from 14 different enterotoxaemia outbreak flocks were taken with respect to the exposed determinants such as feeding of carbohydrate rich diet, overcrowding and endoparasitic infestation. Relative risk, odds ratio and attributable fraction were 5.53, 11.0 and 0.82 for feeding of carbohydrate rich diet, 1.14, 1.20 and 0.12 for overcrowding and 2.42, 4.03 and 0.59 for endoparasitic infestations, respectively. Above results indicates that all the determinants under the study were causally associated with the occurrence of enterotoxaemia outbreak in this region.

Keywords: Enterotoxaemia, Causal association, Agroclimatic zone, Small ruminants

1. Introduction

Enterotoxaemia caused by *Clostridium perfringens* type D is a disease of great economical and sanitary importance for sheep and goat farming worldwide [1] due to a high fatality rate, decreased productivity, and increased treatment costs [2]. Reports from countries around the world have indicated the prevalence rates of enterotoxaemia ranging between 24.13% and 100% [2]. Outbreak of enterotoxaemia was reported from almost all states of India [3], [4]. Young age group [5], cold weather stress and a concomitant infestation with coccidia [6], tapeworm infestation [7], oversupply of young fresh fodder plants during rainy season [8], high stocking intensity and transporting animals [9] and sudden change to a diet which is rich in carbohydrates [10] are the main predisposing factor for the outbreak of enterotoxaemia. Hence, this study was made to ascertain the association between enterotoxaemia and its determinants in the north-west agroclimatic zone of Tamil Nadu, India.

2. Materials and Methods

A total of 155 animals from 14 different enterotoxaemia outbreaks were identified in the above zone based on the history and clinical symptoms and laboratory confirmation. Endoparasitic infestation was assessed by faecal sample examination. Relative risk, odds ratio, and attributable rate were used to determine the causal association between enterotoxaemia and hypothetical determinants as per the formula described by Martin [11].

These measures are independent of sample size and include the strength of association and the effect of different risk factors in exposed individuals. The association is assessed by 2x2 contingent table (Table-1).

2.1. Relative risk (RR)

It is calculated as the ratio between the rate of disease in the exposed group and the rate of disease in the unexposed group.

$$\text{Relative risk} = \{a/(a+b) / c/(c+d)\}$$

If relative risk values are equal to 1, < 1 and >1 indicates that there will be no, sparing and strong associations between hypothetical factor and disease respectively.

2.2. Odds ratio (OR)

It is a cross product ratio and used to measure the strength of association. It is interpreted exactly the same as relative risk.

$$\text{Odds ratio} = ad / bc$$

2.3. Attributable rate (AR)

It is determined by subtracting the rate of disease in the unexposed group from the rate in the exposed group. The larger the attributable rate, the greater the effect of the factor in the exposed group.

$$\text{Attributable rate} = \{a/(a+b) - c/(c+d)\}$$

3. Results and Discussion

Animal's exposure and disease status, values of epidemiological measures and nature of association are shown in table - 2.

3.1. Feeding of carbohydrate rich diet

Relative risk and odds ratio were 5.53 and 11.00 respectively, which were greater than one. Attributable fraction was 0.82, which indicates that 82% of outbreaks in animals under the study are due to feeding of carbohydrate rich diet. This indicates that Feeding of carbohydrate rich diet is causally associated and may be viewed as a putative causal factor in the occurrence of enterotoxaemia. Ershaduzzaman [12], Gokce [5] and Uzal and Songer [10] also observed that sudden change to a diet rich in carbohydrates, was the main predisposing factor for the outbreak of enterotoxaemia.

3.2. Overcrowding

Relative risk and odds ratio were 1.14 and 1.20 respectively, which were greater than one. Attributable fraction was 0.12, which indicates that 12% of enterotoxaemia cases in overcrowded animals are due to overcrowding. The present study indicates that overcrowding is causally associated. This corroborates with the reports of Aschfalk [9] who reported high hazard from all toxin type *Clostridium perfringens* due to high stocking intensity and transportation of animals. This might be due to increased stresses in overcrowded animal predisposes the outbreak of enterotoxaemia as said by Ershaduzzaman [12].

3.3 Endoparasitic infestations

Relative risk and odds ratio were 2.42 and 4.03 respectively, which were less than one. Attributable fraction was 0.59. This indicates that parasitism is causally associated and may be viewed as a putative factor in the occurrence of enterotoxaemia. Vibe [13] also stated that high incidence of enterotoxaemia has been associated with *Moniezia* infections. This might be due to damage of intestinal mucosa caused by the endoparasites which favours the absorption of Clostridial toxins from the gut as said by Smith and Sherman [7].

4. Conclusion

Assessment of epidemiological measures indicates that feeding of carbohydrate rich diet, overcrowding and endoparasitic infestation were causally associated with the occurrence of enterotoxaemia outbreak in this region and indicates that appropriate steps have to be taken to minimize the effect of these determinants.

5. Future Scope

Enterotoxaemia is an economically importance diseases of sheep and goat farming worldwide. Assessing the role of predisposing factors in the outbreak of enterotoxaemia will be helpful to strengthen the biosecurity and managerial measures.

6. Acknowledgments

The authors thank the Dean, Veterinary College and Research Institute, Namakkal, Tamil Nadu, India for providing necessary facilities to carry out this study.

References

[1] N.P.J. Kriek, M.W. Odendaal and P. Hunter, “*Clostridium perfringens* type D enterotoxaemia,” In: Coetzer, J.A.W., G. R., Thomson and R.C., Tustin (ed.), Infectious Diseases of Livestock with Special Reference to Southern Africa, Oxford University Press, Cape Town, pp. 1314-1344, 1994.
 [2] G. Greco, A. Madio, D. Buonavoglia, M. Totaro, M. Corrente, V. Martella and C. Buonavoglia, “*Clostridium*

perfringens toxin-types in lambs and kids affected with gastroenteric pathologies in Italy,” Veterinary Journal, 170, pp. 346-350, 2005.
 [3] N.K. Parhi, B.C. Kar, A.T. Rao and P.K. Ray, “Enterotoxaemia in Orissa goats,” Indian Journal of Comparative Microbiology, Immunology and Infectious Diseases, 14, pp. 46, 1993.
 [4] V. Senthilkumar, M. Thirunavukarasu and G. Kathiravan, “Certain epidemiological aspects of enterotoxaemia in sheep in Dharmapuri district of Tamil Nadu,” Indian Journal of Veterinary and Animal Sciences Research, 2, pp. 647-650, 2006.
 [5] H.I. Gokce, O. Genc, M. Sozmen and G. Gokce, “Determination of *Clostridium perfringens* toxin types in sheep with suspected enterotoxaemia in Kars Province, Turkey,” Turkey Journal of Veterinary and Animal Sciences, 31, pp. 355-360, 2007.
 [6] S.A. Mannan, “Study on goats mortality and their probable causes in Madhupur Upazilla of Tangail District,” M.S., Thesis, Department of Medicine, Bangladesh Agricultural University, Mymensingh, Bangladesh, 1989.
 [7] M.C. Smith and D.M. Sherman, “Goat medicine,” Smith, M.C. and D.M., Sherman (ed.), Lee and Febiger, Pennsylvania, United State of America, pp. 275-358, 1994.
 [8] G.J. Songer, “Clostridial enteric diseases of domestic animals,” Clinical Microbiology Reviews, 9, pp. 216-234, 1996.
 [9] Aschfalk, M. Younan, W. Drochner and W. Muller, “The distribution and frequency of *Clostridium perfringens* toxin types in healthy sheep in Benin,” Tropical Animal Health and Production, 34, pp. 289-293, 2002.
 [10] F.A. Uzal and J.G. Songer, “Diagnosis of *Clostridium perfringens* intestinal infections in sheep and goats,” Journal of Veterinary Diagnostic Investigation, 20, pp. 253-265, 2008.
 [11] S.W. Martin, A.H. Meek and P. Willeberg, “Veterinary epidemiology: Principles and methods,” Iowa State University Press, Ames, Iowa, U.S.A., pp. 22-148, 1994.
 [12] M. Ershaduzzaman, M.M. Rahman, B.K. Roy and S.A. Chowdhury, “Studies on the diseases and mortality pattern of goats under farm conditions and some factors affecting mortality and survival rates in Black Bengal kids,” Bangladesh Journal of Veterinary Medicine, 5, pp. 71-76, 2007.
 [13] P.P. Vibe, “Parasitic coenurosis in sheep,” Veterinariya Moscow, 6, pp. 58-60, 1976.

Table 1: 2X2 Contingent table for calculating these measures of association

Risk factor status	Disease status		Total
	Disease present	Disease absent	
Exposed	a	b	a+b
Not exposed	c	d	c+d
Total	a+c	b+d	a+b+c+d

Table 2: Animal's exposure and disease status, values of epidemiological measures and nature of association

Factors	Exposure	Disease		RR	OR	AF	Association
		Present	Absent				
Feeding of carbohydrate rich diet	Present (64)	35	29	5.53	11.00	0.82	Present
	Absent (91)	9	82				
Overcrowding	Present (83)	25	58	1.14	1.20	0.12	Present
	Absent (72)	19	53				
Endoparasitic infestation	Present (32)	17	15	2.42	4.03	0.59	Present
	Absent (123)	27	96				

RR – Relative risk; **OR** – Odds ratio; **AF**- Attributable fraction

Author Profile



Dr. G. Selvaraju was born on July 26, 1973 in Namakkal city, Tamil Nadu, India. He achieved the B.V.Sc. degree in 1997, M.V.Sc. degree in 2000 and Ph.D. in 2010 from Veterinary College and Research Institute, Namakkal, Tamil Nadu, India. He has received four gold medals for his excellent research work on “Development of forecasting model against diseases of small ruminants”. He is working in the capacity of Associate Professor in Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu, India. He has published more than 25 research articles in reputed journals.