

Participatory Epizootiological Approaches and Sero-prevalence of Sheep Pox in Selected Localities in Kassala State, Sudan

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ملخص البحث

بما أن مرض جدري الضأن بأنه متوطن في ولايات شرق السودان. لقد تم تصميم وإجراء هذه الدراسة للكشف عن انتشار هذا المرض في ولاية كسلا ، استخدم كل من علم الوبائيات المشارك والتقصي المصلي في قطعان الضأن من مختلف محليات الولاية. التقصي الاستثنائي والبيانات الصادرة من السلطات البيطرية بالولاية استخدمت لهذا الغرض. استخدم اختبار الانتشار المناعي لهلام الجل للكشف عن وجود الاضداد لفيروس المرض في أمصال الضأن غير المطعمة.

أوضح التقصي الاستثنائي ان غالبية ملاك الضأن في منطقة الدراسة على دراية تامة بالمرض كمرض مستوطن في الولاية وان ٨٠% منهم اكدوا ظهور المرض بحيواناتهم في فترات مختلفة. تم رصد خمسة عشر بلاغاً لجدري الضأن في الولاية في الخمس سنوات الأخيرة (٢٠٠١-٢٠٠٥) قبل إجراء هذه الدراسة.

عند الكشف المصلي لمجموع ٥٠٢ عينة، اتضح أن ٦٣,٥% مصل دم منها إيجابي للأجسام المضادة لفيروس جدري الضأن. وان أعلى معدل للأجسام المضادة تم رصده بمحلية القاش (٦٩,٥%) تليه محليات كسلا (٦٦,٨٩%)، نهر عطبرة ومحلية سنيت (٥٣,٣٣%). باستخدام تحليل عوامل المخاطر فيما يتعلق بعامل عمر الحيوان وجنسه اتضح أنه لا توجد دلالة إحصائية بين إنتشار المرض وتلك العوامل مع أن نسبة انتشار المرض أعلى نسبياً بين الإناث (٦٤,٠٥%) مقارنة بالذكور وبين الحيوانات التي يقل عمرها عن عام (٦٥,٦٣%) مقارنة بالأعمار الأكبر منها سناً.

خلصت الدراسة بأن استخدام علم الوبائيات المشارك يمكن أن يوضح نسبة انتشار مرض جدري الضأن في ولاية كسلا بالسودان التي فيها المرض ولذلك نوصى بتصميم وتطبيق برنامج وقاية إستراتيجي للحد من تلك المشكلة الصحية في الضأن.

Summary

Sheep pox (SP) is known to be enzootic in the Eastern States of Sudan. The present study was conducted to investigate the prevalence rate in four localities in Kassala State during the period 2001-2005.

To determine the prevalence rate of SP in Kassala State, both participatory epizootiological approaches and serological survey in sheep populations in selected localities were employed.

A Questionnaire survey among sheep herders and veterinary authorities' records consultations in the state were carried out. Serologically, Agar Gel Immuno-diffusion Test (AGIDT) was used to detect anti SPV antibodies (Abs) in blood sera of non-vaccinated sheep.

Out of the 502 sera tested, 63.55% were positive for anti-SPV abs. The highest prevalence rate was recorded in Algash locality (69.57%, n=115), followed by Kassala (66.89%, n=151), Nahr Atbara (63.79%, n=116) and Setiet locality (53.33%, n=120). Risk factors analysis with respect to age groups and sex of sampled animals showed no statistical significance between SP prevalence rate and age or sex ($\chi^2= 2.3751$, P -value= 0.498 and $\chi^2= 0.2039$, P -value= 0.652, respectively). However, higher prevalence rate was observed in female animals (64.05%, n=253) and among the group of less than one-year-old (65.63%, n=233). In conclusion, our findings indicate that the disease is enzootic in Kassala State, using participatory epidemiological approaches. It is recommended that strategic control programmes should be designed and applied to address the health problem imposed by sheep pox in Kassala State of the Sudan.

Introduction

Sheep pox (SP) is a contagious viral disease which causes mortality in lambs and mastitis and abortion in ewes (Losos, 1986). It is one of the most economically important and enzootic diseases of sheep in Northern and Central Africa, Southwest and Central Asia, and the Indian sub-Continent (Esposito and Fenner, 2001). The disease is manifested by pyrexia, cutaneous and lung lesions and lymphadenopathy (Munz and Dumbell, 1994; Esposito and Fenner, 2001).

In the Sudan, SP was firstly reported by Bennet *et al* (1944). They confirmed that the disease was enzootic and of seasonal occurrence in many parts of the country. Clinical cases of SP were usually associated with the dry cold season. However, outbreaks of the disease were observed at different seasons of the year (Sheikh-Ali *et al*, 2004).

Many serological assays were previously employed to detect anti-SPV abs, including Agar Gel Immunodiffusion (AGID) test (Kitching *et al*, 1986), Counter-Immuno Electrophoresis (Sharma *et al.*, 1988), Passive Haemagglutination (PHA) Test (Tiwari *et al.*, 1995), Serum Neutralization test (SNT) (Kitching and Carn, 1996), and Enzyme-Linked Immunosorbent Assay (ELISA) (Tiwari *et al*, 1996).

The modern participatory epidemiological approaches were conducted to address some animal health problems in southern Sudan and showed high levels of validity and reproducibility (Catley *et al*, 2001). In the present study, these approaches as well as AGID test, were adopted to determine the prevalence rate of SP in Kassala State, Eastern Sudan. AGID was used to detect anti-SPV abs in sera collected from non-vaccinated sheep, as this test was proved to be reasonably sensitive and applicable for the purpose (Sheikh-Ali *et al.*, 2004).

Materials and Methods

Study Area and Sheep Population:

This study was conducted in Kassala State, Eastern Sudan (40. 34 -37) and 45. 14-17. It borders other four states namely The Red Sea, The River Nile, Khartoum and Gedaref besides the border with Eritrea (Fig. 1).

Sheep population in the State is estimated to be 1,383,840 head (Anon, 2005) distributed all over the state localities as follows: 400,585 head in Nahr Atbara; 360,527 in Setiet; 267,057 in Algash; 200,293 in Kassala and 155,378 in Hameshkoreib locality. Nomadism is the husbandry practice adopted by the animal owners in the state. The regular pattern of the animal movement is usually from the north to the south, but sometimes it may extend during the dry season to the grazing lands in the neighbouring states or to the border with Eritrea. The study covered all the state localities except Hameshkoreib due to the civil unrest.



Fig. 1: Kassala State situated in the Eastern region, Sudan and its borders and localities

Questionnaire Survey:

A questionnaire was designed and distributed to 50 pastoralists at the four localities to come up with data related to SP manifestations, its impacts on their flocks, their acceptability of vaccination, effect of animal movement on the spread of the disease and pastoralists' awareness of the disease.

Veterinary Service Authorities Reports Consultation:

Retrospective data were collected from the Kassala State Veterinary records during 2001-2005. The necessary data were collected from the monthly and annual reports of the General Directorate of Animal Resources. The data extracted included the prevalence rate of the SP in the state in the study area, and the ability of the General Directorate of Animal Resources

to control the disease. Detailed information about the personnel, infra-structures, previous disease outbreaks and its control by vaccination was also collected.

Serum Collection:

Five ml of blood were withdrawn from the jugular vein of each animal into a plain vacutainer. The blood was left at room temperature for one hour, to clot, placed into the Mobile clinic refrigerator and transferred to the laboratory in Kassala. The vacutainers were kept overnight at 4°C, centrifuged at 1500 rpm for 5 min. and the serum was separated and stored at -20°C until used.

A total of 502 blood serum samples were randomly collected from apparently healthy non-vaccinated sheep in the four selected localities, namely Kassala, Algash, Nahr Atabra and Setiet. Twenty five sheep flocks in 18 different sites were tested. These sites represented the most popular sheep watering points within these localities. All animals sampled were not vaccinated against SPV for the last three years.

Serology:

A hyper-immune serum (HIS) against the SPV strain 0240 was essentially prepared as described by Subba Rao and Malik (1979) and used as a positive control in AGID. The SPV strain 0240, was also used as antigen following preparation of the stock virus in cell cultures as described by Jassim and Keshavamurthy (1982). Freshly prepared 2% Sodium deoxycholate (SDC) was mixed with an equal volume of diluted antigen prior to conducting the test to enhance antigen/ antibody binding. The AGID test was carried out according to Kitching *et al* (1986).

Data management and analysis:

Microsoft Excel (Windows XP) was used for data analysis. The significance of differences between some factors including animal age and sex and the prevalence rates of SP obtained was determined using chi-square test.

Results

Questionnaire Survey Outcomes:

The data obtained from the questionnaire survey among sheep owners in four localities of Kassala state is summarized in Table 1. The results demonstrated that the production system of sheep owners in the state at large comprised 52% nomads and 48% sedentary. Thirty-eight percent of the sheep owners in the state were aware about SP constituted the most important disease in their areas. Eighty percent of them had previously experienced the occurrence of disease in their animals.

Table 1: Summary of the responses of the sheep owners in four localities in Kassala state to the questionnaire survey.

Subject	Locality				Total
	Kassala	Algash n (%)	Setiet	Nahr Atbara	
No. of sheep owners responded	21 (42.00)	11 (22.00)	9 (18.00)	9 (18.00)	50 (100.00)
No. of flocks & composition					
a. Sheep only	16 (76.19)	6 (54.55)	7 (77.78)	5 (55.56)	34 (68.00)
b. mixed	5 (23.81)	5 (45.45)	2 (22.22)	4 (44.44)	16 (32.00)
Production system					
a. nomadic	13 (61.90)	2 (18.18)	5 (55.56)	6 (66.67)	26 (52.00)
b. sedentary	8 (38.10)	9 (81.82)	4 (44.44)	3 (33.33)	24 (48.00)
Migratory route of nomads					
a. East, middle, west	9 (42.85)	0 (0.00)	5 (55.56)	6 (66.67)	20 (40.00)
b. North, middle, south	4 (19.05)	2 (18.18)	0 (0.00)	0 (0.00)	6 (12.00)
Most important diseases					
a. Sheep pox	7 (33.33)	5 (45.45)	5 (55.56)	2 (22.22)	19 (38.00)
b. other diseases	9 (42.86)	5 (45.45)	4 (44.44)	6 (66.67)	24 (48.00)
c. no idea	5 (23.81)	1 (09.09)	0 (0.00)	1 (11.11)	7 (14.00)
Owners had SP in the herd					
a. yes	15 (71.43)	10 (90.91)	6 (66.67)	9(100.00)	40 (80.00)
b. no	6 (28.57)	1 (09.09)	3 (33.33)	0 (0.00)	10 (20.00)
Awareness of SP signs					
a. yes	18 (85.71)	10 (90.91)	8 (88.89)	9(100.00)	45 (90.00)
b. no	3 (14.29)	1 (09.09)	1 (11.11)	0 (0.00)	5 (10.00)
Age of animals mostly effected					
a. adult	4 (19.05)	4 (36.36)	3 (33.33)	3 (33.33)	14 (28.00)
b. young	5 (23.81)	2 (18.18)	1 (11.11)	1 (11.11)	9 (18.00)
c. both	6 (28.57)	4 (36.36)	2 (22.22)	5 (55.56)	17 (34.00)

d. no idea	6 (28.57)	1 (09.09)	3 (33.33)	0(0.00)	10 (20.00)
Effect of SP on animals					
a. high morbidity	15 (71.43)	10 (90.91)	6 (66.67)	9 (100.00)	40 (80.00)
b. high mortality	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
c. no answer	6 (28.57)	1 (09.09)	3 (33.33)	0 (0.00)	10 (20.00)
Presence of abortion					
a. yes	6 (28.57)	5 (45.45)	3 (33.33)	8 (88.89)	22 (44.00)
b. no	9 (42.86)	5 (45.45)	3 (33.33)	1 (11.11)	18 (36.00)
c. no answer	6 (28.57)	1 (09.09)	3 (33.33)	0 (0.00)	10 (20.00)
Economic impact					
a. death	2 (09.52)	0 (0.00)	0 (0.00)	0 (0.00)	2 (04.00)
b. loss of production	9 (42.86)	7 (63.64)	5 (55.56)	7 (77.78)	28 (56.00)
c. both	4 (19.05)	3 (27.27)	1 (11.11)	2 (22.22)	10 (20.00)
d. no comment	6 (28.57)	1 (09.09)	3 (33.33)	0 (0.00)	10 (20.00)
Vaccination against SP					
a. yes	6 (28.57)	0 (0.00)	1 (11.11)	0.00	7 (14.00)
b. no	15 (71.43)	11(100.00)	8 (88.89)	9 (100.00)	43 (86.00)

n = number of sheep owners responded; (%) = percentage of owners responded

Ninety percent of them witnessed their awareness of SP manifestations and described it as pyrexia, skin lesions, anorexia, emaciation, respiratory disturbance, abortion and death. Thirty four percent, 28% and 18% of sheep owners indicated that only adults and young were susceptible to the disease, respectively; whereas 20% reported, that they had no idea about age susceptibility. Eighty percent of owners reported that morbidity rate due to SP is higher than its mortality rate. Forty-eight percent of the owners associated the incident of abortion to the disease. A slight majority (56%) of sheep owners thought that, reduced animal's productivity and the economic loss are due to SP; while 4% of the owners strongly think that, the majority of sheep mortality was due to SP. It is worthy to mention that only 14% of the sheep owners vaccinated their animals against the disease.

Veterinary Services Facilities and Cases Reports:

A total of 226 individuals were working for Kassala State veterinary services. They were; veterinarians, veterinary technical staff, veterinary assistants, community animal health workers (CAHWs) and subordinate staff. They were distributed in the various localities of the state with the

rates of 50%, 19.91%, 19.91% and 10.18% for Kassala, Algash, Setiet and Nahr Atbra, respectively.

Fifteen SP outbreaks were recorded to the Federal General Directorate (FGD) of Animal Health and Epizootic Diseases Control, Kassala State. Table 2 shows the SP outbreaks reported during 2001- 2005.

Table 2: Number of outbreaks of sheep pox reported in Kassala State during 2001-2005.

Year	No. of outbreaks	No. of AAR	Morbidity (%) rate	Mortality (%)	CFR (%)	Intervention
2001	2	877	49 (5.59)	0 (0.00)	0.00	Isolation & Treatment
2002	3	unkno wn	24 (NA)	3 (NA)	12.5	Treatment & isolation
2003	7	936	149 (15.92)	24 (2.56)	16.11	Treatment
2004	2	1084	3 (0.28)	1(0.09)	33.33	Isolation
2005	1	1100	5 (0.45)	0 (0.00)	0.00	Vaccination
Total	15	NA	230 (NA)	28 (NA)	12.17	

AAR = animal at risk; CFR= case fatality rate; NA= not applicable as the number of animals at risk in 2002 is unknown.

Sero-prevalence of Sheep Pox in Kassala State:

Three hundred and nineteen (63.55%) samples were positive while 183 (36.45%) were negative. The prevalence rate of anti-SP antibodies in the different localities by AGID test is shown in Fig. 2. The high SP prevalence rate of SP was 69.57% (n=115) that was observed at Algash locality. The prevalence of the disease in Kassala, Nahr Atbara, and Setiet locality were 66.89% (n=151), 63.79% (n=116), and 53.33% (n=120), respectively.

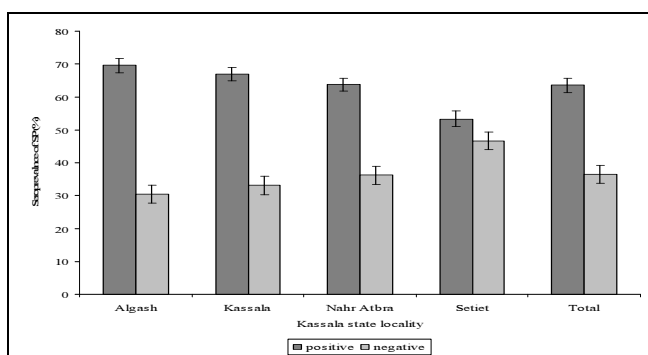


Fig. 2: The Sero-prevalence of anti-SPV abs in Kassala state during the period 2001-2005. Data represent the percentage of positive and negative samples in each locality of the state \pm SE.

The prevalence rate of SP among different animal age groups is shown in Table 3. No significant difference ($P < 0.05$) in the disease prevalence rate (Chi-square= 2.3751, P -value= 0.498) in different age group of sheep was noted. However, a slightly high prevalence rate of SP was observed in the age group of less than one year old (65.63%, $n = 233$).

No statistical significance ($P > 0.05$) was detected between the presence of anti-SPV abs and sex of sheep tested. The AGID test positive cases were 66 (61.68%) for males and 253 (64.05%) for females.

Table 3: Susceptibility of sheep of different age groups to SPV infection in selected localities in Kassala State during the period 2001-2005.

(Age :month)	Total No. tested	No. positive	% Positive
1-12	355	233	65.63
13-24	88	51	57.59
25-36	50	30	60.00
37-48	9	5	55.56
Total	502	319	63.55

Discussion

Kassala is a highly sheep-populated State as compared to the other eastern states of Sudan. The results obtained show that 68% of the interviewed animal owners in the state owned sheep. It is also evident that the majority of them are nomads and that sheep pox constitutes a major constitute by their flock's health condition. This finding may refer to quick build up of sheep flocks due to the nomads demand to increase their income to face their ever increase family needs. However, keeping sheep under nomadic husbandry practice is associated with the basic needs for pastures and water and the movement of animals, depending on the tribe's behaviour and rainfall season, from east to west or north to south. The perpetuation and transmission of SPV to sheep flocks is basically attributed to the hardness of the virus and its resistance to desiccation (Esposito and Fenner, 2001). This is additionally enhanced by lack of quarantine measures and restriction of sheep movement in the border station with other neighbouring states. The questionnaire results also revealed that the majority of sheep owners had previously experienced the disease in their flocks and are familiar with its clinical manifestations. This is an indication of presence of the disease in the area of study since long time ago and hence the accumulation of local knowledge.

It also revealed that the economic impacts of the disease are not only due to animal death, but mainly to production and reproduction losses. The questionnaire pointed out the enzootic nature of the disease in the area. Animals exposed to the virus and exhibit a better protective immunity against the lethal effect of the virus. This is compatible with previous results (Losos, 1986; Mondal *et al.*, 2004) who reported a low mortality rate due to SP in enzootic areas. Eighty-six percent of owners reported that most of them do not vaccinate their animals against SP and this is probably due to inadequacy of vaccine as well as to some tribal traditions that lead them to refraining from vaccination.

Data obtained from the State Veterinary authorities records had indicated that the inadequate manpower and other logistic facilities for SP control were encountered. It is therefore, not possible to conduct a regular investigation for diseases and disease mapping in the state. Rearrangement of personnel distribution within the various localities in the state is urgently required. The reports also elucidated that many outbreaks of SP had occurred during the previous five years (2001-2005). No efforts were made to investigate these outbreaks. Interestingly, there were no reports of SP outbreaks in Algash locality. Although, the highest prevalence rate of anti-SPV abs were detected in that locality.

The serological survey for SP had showed that the disease is spreading in the state at high rate, especially when the total population of animals at risk is considered. The high prevalence rate of the disease in Algash locality is expectable as it borders the Red Sea State was recently reported (Ali *et al.*, 2004). This is because of the continuous free movement of animals between these eastern Sudan states. No statistical significant correlation between SP and age or sex was observed during this study. These findings coincide with those of Woldemeskel and Ashenafi (2003). However, the spread of the disease is probably due to poor management, climatic factors, feed scarcity and inadequate veterinary services. The high prevalence rate of SP reported in this study is less than one-year-old as documented by Losos (1986) who showed higher susceptibility in lambs than in adult sheep. It is generally known that females are more stressed due to their physiological state during pregnancy when immune status is compromised. It may be concluded that SP is a real animal health hazard in Kassala State, Eastern Sudan. The participatory epidemiology is of value in collecting data on infectious diseases. Further epidemiological analysis of the disease and adoption of strategic vaccination regimes would be of value in the control of SP in Kassala State.

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