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Study on the prevalence of Bovine Trypanosomiasis and Associated Risk Factors in Dangur District, metekel zone, North-western Ethiopia

Adane Wase
Dangur Wereda Livestock Development Office
Seid Kassaw
Mekdela Amba University
Gashaw Molla
gashawmolla387@gmail.com

Injibara University

Research Article

Keywords: Cattle, Dangur, Prevalence, Risk Factors, Trypanosomosis

Posted Date: September 18th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-7497458/v1

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Additional Declarations: No competing interests reported.

Abstract

Trypanosomosis is an endemic parasitic disease that impairs livestock production and productivity significantly within Ethiopia. Thus, the present study sought to determine the prevalence of bovine trypanosomosis and associated risk factors in Dangur district, Metekel Zone, northwest Ethiopia. This study design was cross-sectional, carried out from September 2023 to May 2024, with blood samples taken from 384 randomly selected cattle representing both sex and body condition across three peasant associations. Results showed that 106 cattle (27.6%) were positive for trypanosomes. The highest prevalence was recorded in Manbuk district (37.7%); the lowest was observed in Chamich district (13.3%). Statistically significant variations were observable in trypanosome prevalence in relation to the body condition scores ($p = 0.003$) and age ($p = 0.000$), and the district ($p = 0.000$); while no significant difference was found between sex categories ($P > 0.05$). The findings highlight the detrimental effects of trypanosomosis on livestock production in Dangur district. There could be awareness campaigns directed toward pastoral communities on the parasite and its vector, which could be critical for the integrated control of trypanosomes and tsetse flies. Improving knowledge and methods of intervention will help reduce the effects of the disease, eventually assisting in lessening economic losses on both the regional and national levels. Acute cases of trypanosomosis can be recognized by their sudden onset and severe clinical signs, which may include high fever, weakness, swelling of lymph nodes, and rapid weight loss. We've just acquired quite a large amount of pure type in which may be a very oblique plea to the team at about I'm very glad to say that 348 fit into the normal; there consist of some six or seven female sex which is not just with the manly pride of many old 'metaphoric lines' on top of this judgment.

1. Introduction

Trypanosomiasis, known as "sleeping sickness" in humans and nagana in animals, is a disease with protozoan organisms belonging to Trypanosoma species, which can affect both humans and livestock throughout the world (Mirshekar et al., 2019; Tamarit et al., 2010; Sumbria et al., 2014). The disease has been primarily transmitted by the tsetse fly (Glossina spp.) and poses a major constraint to livestock productivity in sub-Saharan Africa, where it incurs high economic loses. It renders vast semiarid and lowland areas unsuitable for breeding domestic animals that are a source of dairy and meat products; it is one of the main hindrances to food security. Since livestock rearing is mostly practiced in rural communities, these results in an economic loss of approximately 20% of agricultural productivity as well as a slowdown in rural development (Okello et al., 2022). In developing countries where many families are dependent on smallholder livestock farming, the adverse economic impact can at times lead to death, which would be twice those in developed countries.

Trypanosomiasis continues to be a major problem in Sub-Saharan Africa, where more than 70% of the population is rural. The disease has a detrimental effect on livestock and humans in places of tsetse flies' presence. Trypanosomosis (which affects various livestock species as well as human) has been diagnosed in 40 countries of Africa; Comprising an area of 11 million km2 or roughly one third of the continent (Ilemobade, 2009). Whereas the primary vectors of the disease (tsetse fly) infest over 10

million km2 of the most suitable land spread across 37 countries. Trypanosomosis is the main constraint to the livestock production on the continent of Africa and prevents full utilization of land and impose significant negative impact in food production and Economic growth in many parts of the world, particularly in sub- Saharan Africa (Ilemobade, 2009). trypanosomosis is responsible for an estimated loss of 3 million livestock annually and over USD 4.5 billion in economic losses across sub-Saharan Africa (FAO, 2019).

In Ethiopia, the main Trypanosoma species affecting livestock include T. *congolense,* T. *vivax,* and T. *brucei,* infesting cattle, sheep, and goats, while T. *evansi* infects camels and T. *equiperdem* horses (Getachew, 2005). Hoping to overcome trypanosomiasis challenges for production purpose and subsequent economic returns, In Ethiopia, approximately 65.35 million cattle are at risk within the 180 000 to 220 000 km² of agriculturally viable land affected by trypanosomosis (Seyoum et al.,2013; CSA, 2020). Low livestock productivity and low economic output due to a plethora of factors in Dangur district, Metekel Zone, are the areas where trypanosomiasis occurs as one of the considerably limiting factors. However, there is no sufficient information regarding the prevalence of bovine trypanosomosis and its parasitological data in this region. The following objectives were established to fill the existing gaps:

1.1 General Objectives

- To determine the prevalence of bovine trypanosomosis in Dangur district and identify associated risk factors.

1.2 Specific Objectives

- To assess the prevalence of trypanosomiasis in cattle in the study area.
- To identify the risk factors associated with trypanosomosis infection in cattle.
- To determine the Trypanosoma species responsible for trypanosomosis infection in the study area.

2. Materials and Methods

2.1. Description of the Study Area

The research was carried out in Dangur district, which falls under Metekel zone in the Benishangul-Gumuz regional state of Ethiopia. The above districts include the Manbuk, Boraley, and Chamich administrative areas of Dangur district. These three PAs were chosen because of the geographical differences that exist, as well as the differences in livestock population across the selected PAs. The district lies about 563 km northwestern side of Addis Ababa. The area covered by Dangur district is 837,700 hectares; it basically has a semi-arid climate with long summer rains from June to September, drying off in winter from December to March. The mean annual rainfall ranges from 900 to 1400 mm, with recorded temperatures from 30˚C to 38˚C. Being located in the Blue Nile valley, this area is favorable

for tsetse fly populations and subsequent transmission of trypanosomosis (Lelisa et al., 2016; District Agricultural Office, 2023, unpublished report).

2.2. Study Animals

The study considered livestock populations in Dangur district to include indigenous cattle, sheep, goats, mules, donkeys, and poultry. Cattle are the dominant livestock in the district, with an estimated cattle population of 49,124 in three study peasant associations. The traditional extensive husbandry systems in the area are mostly communally hersed. According to reports from the district agricultural office, livestock production is impeded by so many health constraints, such as infectious diseases, internal and external parasitic infections, and protozoal diseases, including trypanosomosis *(*District Agricultural Office, 2023, *unpublished report)*.

2.3. Study Design

The study was cross-sectional and was conducted from September 2023 to May 2024 to determine prevalence and risk factors associated with bovine trypanosomosis. This period was selected to capture any seasonal variation in Trypanosoma infection rates. Earlier reports suggest that tsetse fly activity and trypanosomosis transmission may be seasonal under varying climatic conditions, especially concerning post-rainy and dry seasons.

The sampling strategy applied was simple random sampling, meaning that all eligible animals, irrespective of their sex, age, or body condition, had an equal chance of being picked from the target population; this was to minimize selection bias and allow for better representation of the sampling across the study area. Samples were collected once per animal; hence, the study does not account for fluctuations in infection status over time.

Cattle were grouped into three age categories according to dentition and records cited by their owners: less than 3 years, from 3 to 6 years, above 6 years. Body condition was determined based on the scoring system provided by Nicholson and Butterworth (1986), which utilizes a 1–5 scale dependent on the visibility and palpability of bones, including ribs, spine, and pelvis. For purposes of analysis, body condition scores were classified into: Poor (score 1–2), Medium (score 3), Good (score 4–5), Trained assessors evaluated the criteria to reduce subjectivity and enhance consistency. The evaluations were carried out following a standardized form with visual aids employed for scoring calibration.

2.4. Sampling Method and Sample Size

Sample size was determined using a formula recommended by Thrusfield (2007) for studies of prevalence. There is little recent data available on the prevalence of bovine trypanosomosis in the study area, and therefore, an expected prevalence of 50% was considered to maximize sample size with a 5% absolute precision and a 95% confidence level. The formula used was:

$n = 1.96^2 * P_{exp} (1-P_{exp}) / d^2$

Where:

n = required sample size

P = expected prevalence (50%)

d = desired absolute precision (5%)

Applying the above formula, the total sample size computed was 384 cattle.

The cattle population was first stratified according to geographical areas (kebeles), and then animals were randomly selected from within each stratum. This design ensured a proportionate and representative sampling across the district, based on population data provided by the local veterinary office.

Animals were randomly selected within each stratum, while sex, age, and body condition score were recorded during sampling. However, no conscious attempts were made to balance the sampling echelons on the basis of these variables. Instead, these factors were considered for data collection for risk factor analysis afterwards. This design not only produced representative prevalence estimates across the study area, but also facilitated investigation of associations between trypanosome infection and animal-level risk factors, including age, sex, and body condition.

2.5. Blood Collection and Diagnostic Approaches

Physical health examinations were undertaken in all the selected animals prior to blood collection. Such examinations include assessments of body temperature, respiration rate, heart rate, pulse, and the condition of mucous membranes and lymph nodes for a general health status evaluation. Following adequate physical restraint, blood was drawn from the marginal ear vein using sterile hematocrit capillary tubes and centrifuged at 12000 rpm for 5 minutes for Packed Cell Volume (PCV) determination. PCV was used as a supportive indicator of health status, particularly to assess anemia, which may reflect the physiological impact of trypanosome infection, with values below 25% considered indicative of anemia (Douglas and Wardrop, 2010). Following centrifugation, the buffy coat method was employed to detect motile trypanosomes by extruding the plasma-buffy coat interface onto a microscope slide and examining it under ×40 magnification. Thin blood smears were prepared to identify to the species, air-dried, fixed in methanol, Giemsa-stained, and examined under oil immersion (×100 objective). Trypanosome species identification was done by using morphological features and movement patterns but according to Buscher et al. (2009) and OIE (2009).

One should note that diagnosis was established purely on the basis of microscopy and there was no molecular confirmation (PCR) or expert validation to authenticate the species. Though morphologic and motility-based diagnosis can be applied in field studies, it comes with limitations, among which are that it is prone to misidentification due to morphological similarities between species and less sensitivity

compared to molecular techniques. These are acknowledged as a possible constraint on the diagnostic accuracy of this study.

2.6. Questionnaire Survey

In addition to the parasitological assessment, a semi-structured questionnaire was administered to collect qualitative data from local farmers and herders with the intention of gathering information on community knowledge, perceptions, and practices with regards to bovine trypanosomosis, such as patterns of disease occurrence, seasonal trending of prevalence and transmission, and control or prevention measures in use.

The questionnaire was originally drafted in English and then translated into the local tongue, Amharic, to heighten clarity and comprehension. The questionnaire was divided into four main categories: Demographics- Age, sex, educational level, and experience in livestock rearing. Knowledge of trypanosomosis- Awareness of the disease, signs and symptoms in anything associated with cattle, as well as apparent causes. Seasonality and transmission- Observed patterns in the disease prevalence over various seasons, reported by respondents. Management and Controlling Practices- Veterinary services used, vector control measures, and indigenous practices applied.

The instrument was pre-tested to check for reliability and content validity with 10 respondents from a neighboring kebele not included in the main study. Suggestions obtained from the pre-test were used for further refining the wording and sequence of questions. A total of 60 respondents were selected using a purposive sampling method to include individuals with cattle ownership and a minimum of one year of livestock rearing experience, representing different kebeles and herd sizes.

All responses were collected through face-to-face interviews undertaken by trained local enumerators, providing additional clarification where required to ensure an accurate interpretation of the questions.

2.7. Data Management and Analysis

Data collected from the wild were entered on the database and then Data analysis was performed using SPSS version 26 (IBM Corp., Armonk, NY, USA). No missing values were observed in the dataset; all variables were complete at the time of analysis. Bovine trypanosomoses prevalence is the number of infected animals divided by the total number of sampled cattle expressed in percentage form. The association of risk factors such as age, sex, body condition, and district with trypanosomosis prevalence was tested using the chi-square test. The cut-off point for statistical significance was a p-value of less than 0.05.

3. Results

3.1 Bovine Trypanosomosis Prevalence and Related Risk Factors

In total, of the 384 cattle examined, 106 (27.6%) were found positive for trypanosome infection. The study assessed some factors, including age, sex, body condition score, and district of origin, which may influence the prevalence of trypanosomosis. Below are results from this analysis.

Table 1
Prevalence rate of bovine trypanosomosis on the basis of age, body condition and sex, District of the animal at study site

Risk factors	No of examined	No. of cattle infected	(Prevalence (%)	χ^2	P-Value
Sex					
Male	180	49	27.2%	0.025	0.909
Female	204	57	27.9%		
Total	384	106	27.6%		
Age					
Young	110	12	10.9%	21.661	0.000
Adult	179	60	33.5%		
Old	95	34	35.8%		
BCS					
Poor	71	27	38.0%	11.652	0.003
Medium	263	74	28.1%		
Good	50	5	10.0%		
District					
Manbuk	191	72	37.7%	21.254	0.000
Borenja	95	21	22.1%		
chamich	98	13	13.3%		

Table 2
Prevalence of trypanosome infections and species of trypanosomes identified in cattle

District	No of animal Examined	Species of parasite and its prevalence per districts			
		T.Congolense(%	T.Vivax(%)	Mixed	Prevalence rate (%)
Manbuk	191	45(62.5%)	15(20.8%)	12(16.7%)	72(37.7%)
Boraley	95	11(52.4%)	5(23.8%)	5(23.8%)	21(22.1%)
chamich	98	7(53.8%)	3(23.1%)	3(23.1%)	13(13.3%)
Total	384	63(59.4%)	23(21.7%)	20(18.9%)	

3.1.1. Body Condition Score (BCS)

There was a statistically significant variation in the prevalence of trypanosomosis with the body condition score of the cattle assessed in the present study. Out of the 384 cattle assessed in this study, the highest infection rate (38.0%) was recorded from animals with a poor body condition. On the other hand, medium and good body condition cattle had a lower infection rate with prevalence values of 28.1% and 10.0%, respectively. The observed difference was statistically significant ($\chi^2 = 11.652$, $p = 0.003$), confirming that trypanosome infection poses a more serious threat to cattle in poor condition (Table 1).

3.1.2. Sex

Between male and female cattle, no difference was observed in the prevalence rates of trypanosomosis. In other words, from the 180 male cattle examined, 49 (27.2%) tested positive for trypanosomes, while 57 out of 204 female cattle (27.9%) were infected. The difference in infection rates between sexes was not statistically significant ($\chi^2 = 0.025$, $p = 0.909$), hence sex may not be an important factor that influenced trypanosome prevalence in the population under study (Table 1).

3.1.3. Age

Age was a significant risk factor affecting the prevalence of trypanosomosis. The youngest category (less than 3 years) of the examined cattle showed the least prevalence of infection at 10.9%. Adult cattle (3 to 6 years) had a prevalence of 33.5%, while older cattle (over 7 years) had the highest prevalence of 35.8%. There was a highly significant difference among the three age groups in their infection rates ($\chi^2 = 21.661$, $p = 0.000$), implying that older cattle were more likely to acquire trypanosome infection than were younger ones (Table 1).

3.1.4. Districts/Peasant Associations

Prevalence rates differ significantly with respect to the various districts in Dangur. The highest prevalence of trypanosomosis was noted in Manbuk district, with 37.7% of cattle infected, whereas in Boraley district, 22.1% of cattle were infected and the lowest prevalence was found in Chamich at 13.3%. The variation of prevalence among the different districts was statistically significant ($\chi^2 = 21.254$, $p =$

0.000); hence, it can be concluded that geographical location plays a key role in the epidemiology of trypanosomosis (Table 1).

3.1.5. Trypanosome Species

The species composition of the trypanosome infections was considerably dominated by Trypanosoma congolense, which was diagnosed in 59.4% of the infected cattle. Trypanosoma vivax was implicated in 21.7% of infections, whereas mixed infections of both species occurred in 18.9% of the cases. There were differences in the distribution of the trypanosome species among the different districts, with the highest prevalence of T. congolense in Manbuk district (62.5%), followed by Boraley (52.4%) and Chamich (53.8%). Table 2 presents a brief report on species distributions in each district (Table 2).

4. Discussion

The current study has determined the burden of bovine trypanosomosis in the Dangur district, with an overall prevalence rate of 27.6% among the cattle population. The prevalence in this study is significantly higher than some previous reports from Ethiopia and abroad. For example, Metekel and Awi Zones in northwestern Ethiopia reported prevalence at 12.4% (Solomon and Fitta, 2010), while other studies in Hawa Gelan, Oromia Region, reported lower values. On the other hand, the current prevalence is in concert with studies reporting higher infection rates, i.e., Sam-Wobo et al. (2010) 46.8% in Nigeria, and Ayodele et al. (2013) 31.62% in Ogun and Jos.

The great variation in reported prevalence from study to study may be due to many factors. First, differences in agro-ecological conditions and seasonalities would give rise to differences in the abundance and distribution of the tsetse flies, the main vectors of Trypanosoma species. In the Dangur district, the semi-arid climate, coupled with the seasonal pattern of rainfall, is perhaps an important confounding factor in determining the density of the tsetse fly, whereby during the rainy season the activity of the adult vector would be obvious. The seasonal variation in abundance of tsetse flies is very crucial in understanding the transmission of trypanosomosis, as higher populations of adult vectors during the wet season could lead to higher transmission and higher infection rates.

Also, diagnostic methods practiced over various studies could more or less affect the reported prevalence. In this particular study, trypanosomes were identified by morphological characteristics and motility under the microscope, and while this is cheap, it has a tendency to yield a lower estimate of infection rates.

Body Condition and Infection Rate

Trypanosomosis was found to occur significantly more in cattle in poor body condition and may reflect the nexus of the nutritional condition, parasitic infection, and general management of health status. Poor body condition is generally associated with a range of nutritional deficiencies, burdens of parasites, and poor management of health, all of which inhibit the ability of the animal to mount a vaccine-like immune

response. Therefore, animals in poor condition are more likely to get infections like trypanosomosis in comparison with well-nourished animals that seem to show some level of acquired natural immunity.

Sex and Infection Rate

As noted above, no remarkable difference in trypanosomosis prevalence between male and female cattle exists, which conforms to similar studies by Abebayehu et al. (2011), Terzu and Getachew (2008), and Teka et al. (2012). It is perhaps explained based on both male and female cattle having similar tsetse exposure both during grazing and, therefore, having similar infection rates. Also, in most farming systems, cattle are gazed as a herd, and both sexes are exposed to the same vector populations in the same grazing areas. The lack of sex-related differences aligns with findings from several studies (e.g., Abebayehu et al., 2011), suggesting that both sexes are equally exposed to infection due to shared grazing patterns, and that biological sex alone may not significantly influence susceptibility.

Age and Infection Rate

This is the only age-related difference associated with the prevalence of trypanosomosis, as older cattle have been found to have higher infection rates compared to younger and adult cattle. According to Alemayehu et al. (2012) and Gona et al. (2016), older animals tend to get infected most of the time. Years of exposure to tsetse flies enhance the cumulative chances of acquiring infections, while in younger animals, less exposure and some degree of natural immunity may prevail.

Interestingly, other studies (Ayele et al., 2012; Tilahun, 2012) found similar trend results in the infection rates with no significant difference across age groups. The discrepancies could be attributed to differences in sample sizes or local ecological conditions or husbandry practices. For example, older cattle in Dangur district may be more exposed to bites from tsetse flies due to local grazing patterns, movement through more tsetse-infested areas by cattle, or prolonged exposure to infected vectors. In contrast, studies conducted in different regions may have observed lower exposure or different husbandry practices that did not result in significant age-related differences.

Species of Trypanosoma and Prevalence

Of the detected Trypanosoma species, the most dominant was T. congolense (59.4%), followed by T. vivax (21.7%). These findings are in agreement with those of Muturi et al. (2000) and Siyum et al. (2014), who identified T. congolense as the major species in cattle populations. Local ecological conditions favoring both parasite and vector could be responsible for the greater prevalence of T. congolense in Dangur district. This parasite is characterized by serological variability that can easily enhance its spread among the entire cattle population. In fact, T. vivax prefers other biting flies besides tsetse flies, such as tabanids and stomoxys, because it is not as widely transmitted by tsetse flies. Consequently, areas that host heavy tsetse populations, such as Dangur, tend to have less transmission of T. vivax when compared to T. congolense. Thus, T. congolense predominantly implies that control measures should

focus on this species in the region since it has been reported to cause more severe and indelible infections in cattle than others.

5. Conclusion and Recommendations

5.1 Conclusion

Bovine trypanosomosis is a major constraint to livestock production in Dangur district adversely affecting agricultural development and food security. Causative agents include Trypanosoma congolense as the most common. Factors relating to infection rates include body condition, age, farmer associations, while sex is not among them. Immediate interventions are required for the management of the disease in order to enhance livestock productivity.

5.2 Recommendations

- Community-Based Control Programs: Develop and implement a community-based program for the control of tsetse flies and trypanosomosis concerned with the participation of local communities in the management of vectors and treatment of animals.
- Strengthening Veterinary Services: Strengthening and expanding veterinary services to ensure correct diagnosis and treatment of trypanosomosis while ensuring that trypanocidal drugs are properly used to prevent the emergence of drug resistance
- Farmer Awareness and Education: Farmers should be made aware of transmission of the disease, proper management of diseases, and the importance of vector control.
- Further Research: Further research should be done on the transmission of trypanosomosis and monitoring of drug resistance for the ecological improvement of management strategies.

5.3. Limitations

Diagnosis relied on microscopic detection methods, which may underestimate true prevalence due to limited sensitivity compared to molecular techniques. The use of morphological criteria for species identification may also result in misclassification.

Declarations

Ethical Statement

This study was conducted in accordance with accepted ethical standards and guidelines. No experimental procedures were performed on animals. Blood sample collection was limited to routine diagnostic purposes and did not require ethical approval under national guidelines. Verbal informed consent was obtained from all participating livestock owners prior to both sampling and interview participation. All data were anonymized to ensure confidentiality and privacy of the respondents.

Competing Interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Author Contribution

Conceptualization: Adane Wasie, Gashaw Molla • Data Curation: Adane Wasie, Seid Kassaw, Gashaw Molla • Formal Analysis: Adane Wasie, Gashaw Molla • Investigation: Adane Wasie, Gashaw Molla • Methodology: Adane Wasie, Gashaw Molla • Project Administration: Gashaw Molla • Resources: Gashaw Molla • Supervision: Seid Kassaw, Gashaw Molla• Validation: Gashaw Molla • Visualization: Seid Kassaw, Gashaw MollaWriting – Original Draft: Adane Wasie, Gashaw Molla, • Writing – Review & Editing: Adane Wasie, Seid Kassaw, Gashaw Molla,

Acknowledgement

We would like to express our sincere gratitude to all individuals who contributed to the success of this study. Special thanks go to the staff of the Pawi Research and Laboratory Center, the administrators of Dangur Wereda, and the local district offices for their cooperation and support during data collection. Their invaluable assistance greatly contributed to the smooth execution and successful completion of this research.

Data Availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

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Supplementary Files

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- trypOutput.spv
- QuestionnaireSurvey.pdf