Reducing camel young stock mortality in Ethiopia

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REDUCING CAMEL YOUNG STOCK MORTALITY IN ETHIOPIA

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SUMMARY

Mortality of young stock is a challenge for livestock producers globally. This pilot study, part of a Government-led Young Stock Mortality Reduction Consortium project was undertaken to identify and evaluate interventions to reduce camel young stock mortality in pastoral production systems in Ethiopia. Key interventions were selected in alignment with national objectives in the Ethiopian Livestock Master Plan. Pastoralists were enrolled by convenience sampling across two regions. The pilot study findings demonstrated highly significant reductions in mortality, risk of diarrhoea and respiratory disease, and death from malnutrition post-intervention, with the greatest impact in larger herds. These findings should contribute to improved livestock productivity in Ethiopia. Indeed, activities from a wider study also piloted are now being scaled up for bovine calves, and it is anticipated that this will be extended to camel and small ruminant young stock as well.

INTRODUCTION

In Ethiopia, all camels are owned by pastoralists and, like cattle and small ruminants, they are a source of milk, meat and hides and are financial investments, contributing to pastoralist livelihoods (Dawo, 2010). Ethiopia has the largest livestock population in Africa, including 8 million camels (Central Statistical Agency of Ethiopia, 2021), with livestock production contributing significantly to the national economy (Bekele et al., 2018). However, livestock morbidity and mortality, particularly in young stock, are production constraints in Ethiopia (Fentie, 2016; Mayberry et al., 2018). The mortality estimates for the 2020 fiscal year, excluding nomadic areas, were 3.43 million cattle (4.9%), 6.51 million (15.1%) sheep, 8.74 million (16.5%) goats, and 0.53 million (6.6%) camels (Central Statistical Agency of Ethiopia, 2021).

Pastoralism is the most extensive farming system in Ethiopia (Amede et al., 2017), and considered one of the two major agricultural systems of the country along with mixed crop-livestock (Getahun, 1978), yet little information is available for the system. In the limited number of recent studies of young stock mortality, mean camel calf mortality rates of 14.9-

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35.6% have been reported (Megersa et al., 2008; Awoke and Ali, 2015). More than 60% of camel calf mortalities are reported as being in calves less than three months of age (Megersa, 2014), and most deaths predominantly due to infectious diseases (Khalafalla and Hussein, 2021), specifically respiratory problems (Zeleke and Bekele, 2000; Megersa, 2014; Fentie, 2016). Keskes et al. (2013) reported high disease prevalence to be the predominant cause of camel calf mortality, with camel pox, trypanosomiasis, diarrhoea and respiratory disease the most common diseases.

Management practices have previously been shown to contribute to camel mortality (Megersa, 2014; Awoke et al., 2015). To contribute to understanding and addressing young stock mortality in Ethiopia, the Young Stock Mortality Reduction Consortium (YSMRC) was formed under the auspices of the Ethiopian Ministry of Agriculture (MoA), as a collaborative effort between Addis Ababa University's College of Veterinary Medicine and Agriculture (AAU-CVMA); Aklilu Lemma Institute of Pathobiology (AAU-ALIPB); University of Gondar; the National Animal Health Diagnostic and Investigation Centre (NAHDIC); Tufts University; the University of California, Davis (UCD); and Supporting Evidence Based Interventions in Livestock (SEBI-Livestock). Together with the Ethiopian MoA, the YSMRC represented an innovative collaboration with a tripartite funding mechanism.

The YSMRC set out to design, implement and monitor interventions targeted for pastoralists in Ethiopia. This pilot study describes mortality and morbidity risks in camel young stock and a series of interventions implemented to reduce young stock losses.

MATERIALS AND METHODS

Study Design

The interventions were developed to align with national objectives detailed in the Ethiopian Livestock Master Plan i.e. they were designed to be appropriate and sustainable for the locale. The study expanded on previous health intervention packages developed by the MoA and Tufts University, arising from a previous assessment of young stock mortality causes (Fentie, 2016). Originally highly detailed and comprised of many interventions, the packages were focused down to key interventions, selected for impact and reproducibility potential. Staggered baseline evaluations were conducted across the study areas from March to August 2019, prior to the introduction of the interventions. The year-long pilot interventions were implemented, with farmer training conducted by government livestock extension agents, and followed by staggered final evaluations from March 2020 to July 2020, timed to match baseline evaluations where possible, in order to minimise seasonal variations.

Study Area and household selection

Two study regions, Afar and Somali, representing the pastoral production system in Ethiopia were selected, with selection criteria including livestock population density and accessibility. Study districts were selected across the two regions, consisting of two pastoral districts: Awash Fentale and Gursum.

Within each of the two study districts, three kebeles were selected per district (kebeles generally have three villages, each with 150 households). Within each kebele, one village was purposively selected, with 50 households from that village then randomly selected, resulting in

150 households per district. To avoid substantial differences in traditional practices during the implementation phase, neighbouring kebeles within a district were selected. In total, 300 households were invited to enroll in the study, representing six villages from six kebeles, in two districts.

Households were identified from regional livestock office registers and households were eligible if they owned at least one of the following: pregnant camels, or camel with camel-calf of < 6 months of age. Households in which no animals were born in the past 12 months, either at baseline or final evaluations, were excluded.

Interventions

Questionnaires and Standard Operating Procedures (SOPs) were developed to guide the interventions. The aim of this government-implemented pilot study was to assess applicability for scaling up. Farmer training for a total of 22 interventions was provided but it was not possible to monitor all so a subset of eight interventions were selected for monitoring purposes. A monitoring and evaluation plan was developed, with a results framework, through which indicators were selected to monitor intervention uptake and change. Participants were trained to carry out interventions and supported by extension officers over the year.

Data collection

Trained enumerators used questionnaires to collect data. Data were standardised and stored on a bespoke Bases & Datos server, created by Ijaki Albizu (Zaragoza, Spain) using database engine FileMaker Pro software (version 12, Claris International Inc., Cupertino, CA, USA). Data were exported to and cleaned in Microsoft Excel (version 2013, Microsoft, Redmond, WA, USA) and statistical summaries were produced using Excel and R (version 4.0.3) via RStudio (version 1.3.1093, RStudio, Boston, MA, USA).

Changes in practice between baseline and final evaluation were assessed, where households were evaluated as having 1) made an improvement to practices; 2) made no change but were already practicing the recommended practice; or 3) made no change and were not practicing the intervention as recommended or had a negative change.

Only households present for both the baseline and final evaluations, with sufficient data to calculate mortality risk, were included in the subsequent summaries and analyses. We analysed the change in mortality and morbidity using a generalised linear mixed model with a Poisson distribution and farm ID as random effect (Croissant, 2021). The relatively low number of households in Gursum prohibited any analysis of whether the effect of the intervention was modified by district.

Outcomes

Data were collected at baseline and final evaluations, and included reproductive parameters (e.g. birth and death of young stock), health outcomes (e.g. incidence of diarrhoea and respiratory disease) and intervention uptake. Baseline and final mortality, diarrhoea and respiratory disease risk, and risk of death from malnutrition for camel calves were calculated (Table 1). Morbidity and mortality risks are the outcome indicators, comparing baseline with final median risk to give a measure of success.

Table 1. Definitions used in the calculation of risk parameters. All parameters are calculated for the previous 12-month period

Parameter	Numerator	Denominator
Mortality risk	Total no. camel calves born alive but died	Total no. of camel calves born alive
Risk of diarrhoea	Total no. camel calves with diarrhoea	Total no. of camel calves born alive
Risk of respiratory disease	Total no. of camel calves with respiratory disease	Total no. of camel calves born alive
Risk of death from malnutrition	Total no. of camel calves that died from malnutrition	Total no. of camel calves born alive

RESULTS

At the study baseline, a total of 160 households were enrolled in the study, with 129 households enrolled in Awash Fentale, and 31 in Gursum; at final evaluation there were 115 households in Awash Fentale and 20 in Gursum. After excluding those households with no animals born in the past 12 months, there were 100 households in Awash Fentale and 13 in Gursum, giving a total of 113 households included in the subsequent descriptive statistical summaries and analysis.

Intervention uptake

Households were counted as performing an intervention if the response was anything greater than the minimum level. At baseline, households were practicing an average of 5.1 interventions (SD 1.5) in the previous 12 months. At final evaluation, households were practicing an average of 7.7 interventions (SD 0.5).

Six of the eight monitored interventions had a high level of uptake (> 50% of households), with the largest improvements seen in the use of calf supplementary feed (89% households improved their practices), and supplementary feeding of pregnant camels (87% improved). This was followed by households starting calf supplementary feeding early (75% improved), having sick calves examined (70% improved), and increasing the frequency of water provision (66% improved). For the practice of separating pregnant camels, 53% of households improved, while 21% had no change as they were already optimal. A similar situation was seen with giving calves colostrum: 50% of households improved their practices, while 27% of households had no change due to optimal practices. For two of the interventions, a relatively larger proportion of households reported either no change or a negative change in practices – these were the frequency of water provision (35% households reporting no or negative change) and the volume of milk fed (67% of households).

Mortality, diarrhoea and respiratory disease risk, and death due to malnutrition

Median risk at baseline and final evaluations are presented in Fig.1, showing decrease in the prevalence of all parameters at final evaluation. Pre-intervention in Awash Fentale, on average two calves died in every herd, ranging from a total of zero to nine calves. Post intervention, on average only one calf died, with a quarter of all herds reporting zero deaths. A similar trend

was seen in Gursum, with median number of deaths reducing from one calf per herd pre-intervention, to zero calves post intervention.

More than three quarters of pastoralists pre-intervention had at least one calf with diarrhoea, more than a half had at least one calf with respiratory disease, and more than a half had at least one calf that died from malnutrition. Pastoralists in Gursum reported lower numbers of morbidity and mortality in calves.

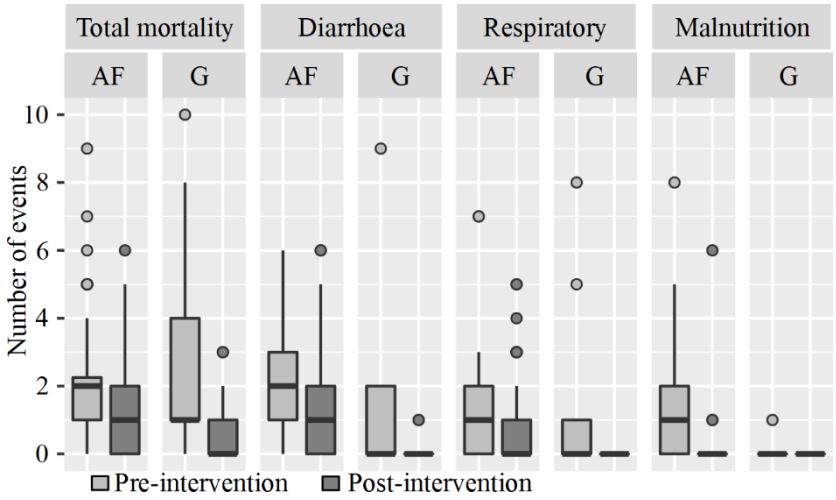

Figure 1. Box and whisker plots showing median mortality risk and prevalence of diarrhoea, respiratory disease and death from malnutrition in camel calves, in each pastoral area. Baseline measures are represented in light grey and post-intervention represented in dark grey. AF = Awash Fentale; G = Gursum

This represents an overall baseline median mortality risk, prevalence of diarrhoea and respiratory disease, and death from malnutrition of 40%, 44%, 20% and 20%, respectively. Post-intervention, median mortality risk, prevalence of diarrhoea and respiratory disease, and death from malnutrition reduced to 10%, 8%, 0% and 0%, respectively.

In both study areas, the average herd experienced a reduction of one fewer calves dying over the study period, post-intervention (Fig.2). Mortalities ranged from up to 10 fewer deaths to six additional calves dying after the intervention. A quarter of all herds either had no change in mortality or at least one additional death post intervention.

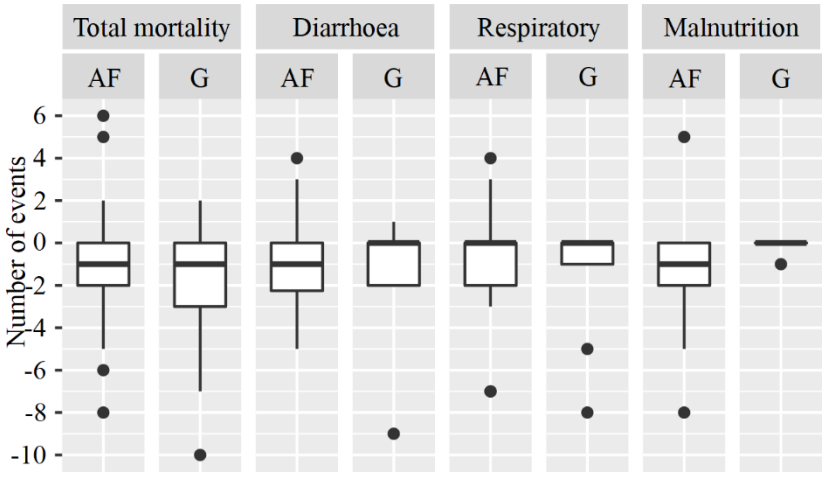

Figure 2. Box and whisker plots showing change in median mortality risk and prevalence of diarrhoea, respiratory disease and death from malnutrition in camel calves, in each pastoral area. AF = Awash Fentale; G = Gursum

Rate ratios for mortality risk, prevalence of diarrhoea and respiratory disease, and death from malnutrition post-intervention compared to the baseline were 0.43, 0.40, 0.37 and 0.02, respectively. All reductions were statistically significant ($p < 0.01$).

DISCUSSION

The intervention packages selected for camels (and cattle, previously described (Wong et al., 2022)) were successful in significantly reducing the prevalence of young stock mortality, diarrhoea, respiratory disease, and death from malnutrition. The interventions included a range of basic health and husbandry practices, selected by local and visiting experts, and did not require advanced technologies. As such, they should be relatively straightforward, cost-effective and impactful if implemented on a broader scale. However, different interventions had different levels of uptake in different areas of pastoral production. Therefore, scoping studies are recommended for future applications to ascertain a) what pastoralists are already doing in any particular area, b) what pastoralists and local livestock experts think would be most useful to implement, and c) how many additional interventions pastoralists would be willing and able to perform, in order to select appropriate interventions for new areas.

However, despite the overall success of the interventions, not all households benefitted from the interventions, with a few households reporting increased mortality and morbidity. This is a concern, especially for those pastoralists with very few animals, or those with very low mortality pre-intervention, where no improvements in mortality, or indeed increased losses during the period of the interventions would lead one to interpret the interventions as a failure. Only over a longer period would benefit be expected, but this would require investment which would be unlikely to occur if the interventions were not already seen as beneficial.

This latter outcome likely also relates to the main limitation of the study, in that it was conducted over a single year, without a control group, therefore between-year effects could not be accounted for in the changes observed. Additionally, the contribution of each individual factor is difficult to ascertain as the interventions were implemented in a combined package rather than individually, and only a selection of interventions were monitored. Furthermore,

the contribution of the different management improvements to a decreased mortality might have varied depending on the area; in pastoralist areas in particular, the environment could have played a role in feed availability and animal survival, however the weather differences between the previous year and the study year were unremarkable. Flooding in early 2020 in Ethiopia was considered the most severe in a decade (European Commission, 2020), but flooding in the Awash River basin is a common occurrence (Achamyeleh, 2003; Wondim, 2016) and pastoralists local to this region may already practice adaptation strategies. The improved management of the interventions might have reduced the environmental influences by producing more resilient young animals.

There are limited published studies of baseline camel mortality and morbidity in Ethiopia. Ahmed and Hedge (2007) observed similar mortality (39%) to our study, but a lower mortality due to pneumonia (7%). Also similarly, malnutrition has also been found to contribute to mortality in camel calves (Fentie, 2016), and diarrhoea has been reported as the predominant cause of morbidity in camel calves (Ahmed and Hedge, 2007; Gebru et al., 2018; Abraha et al., 2019).

There were some conceptual and methodological limitations with the study. A large number of households were excluded from data analysis due to inaccuracies in pastoralist recall or enumerator error. Examples include where the number of animals born exceeded the possible number that the number of adult reproductive females could produce, or where the total number of animals born dead or alive, the number of stillborn animals, and the number of animals that died or lived did not 'add up'. There is the potential for bias in the loss of these data, however we can only speculate on how this could affect the outcomes. Future field data collection could be improved by training enumerators to check data during interviews, or use of digital data collection tools with automatic checking. Many households had very few animals which made it challenging to measure impact.

Administrative support from all levels of the Ethiopian government was instrumental in the successful implementation of this project. Additionally, use of local language translations for SOPs, pastoralist training and data collection tools was important to pastoralists and helpful for enumerators. Involvement of NAHDIC in the consortium helped with availability of laboratory diagnostic capability domestically and should aid the sustainability of the activity during scaling up. Some inputs for veterinary care and management were provided specifically by the study, such as weighing scales, drugs and drug delivery systems. These inputs facilitated the animal health care, however providing free veterinary drugs during scaling up would be challenging, as the cost has to be recovered. It is important to assess the financial cost and benefits of the interventions, and a cost-benefit analysis is presented in a poster by Kirk *et al.* at SVEPM 2023.

Targeted interventions for improving knowledge and uptake of basic animal husbandry, feeding and housing are recommended strategies for the reduction of morbidity and mortality in Ethiopian young stock. These findings should contribute to improved livestock productivity in Ethiopia. Indeed, the authors are aware that the activities from a wider study piloted are currently being scaled up for bovine calves by the MoA, and it is hoped that this will be extended to camel and small ruminant young stock as well.

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