RESEARCH ARTICLE

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Social Network Analysis of Giardiasis Positive Calves to those of Healthy One

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Abstract

In the present multidisciplinary study, the researchers on a field trial performed a Social Network approach and a group of 9 calves (3 males/6 females) aged 10 to 16 weeks. A 24 hours digital camera was used for location registration (X-Y position) and interactions on each calf, both individually and collectively. Based on the simple methodology nearest neighbor matrix positive and negative associations were analyzed. The field study lasted 4 weeks and the maximum interaction day was chosen, when individual calf activity was high. To those of 9 calves solely no 2 was infected with giardiasis on the first week, whereas calves with no: 2, 7, and 8 were also infected on the second week. No: 4 and 6 were also infected with a total of 5 calves on the third week. This was followed by the final 6 calves in total infected. During the observation period, both by investigators and camera records, infected calf 2 was in close contact with no: 8 (at morning observation) and a slight degree of contact with no: 3 and 4 which were detected with giardiasis on the third and fourt weeks, respectively. Due to close contact with no: 8, infection was determined on the second week, earlier than others (except no: 7). Calves with no: 1 and 5 were never infected nor determined by PCR, fecal smear, or rapid diagnostic test kits throughout the study. In conclusion, the present authors suggested that social networking might be an important predisposing factor for giardiasis infection among calves.

Keywords: Calf, giardiasis, social networking.

INTRODUCTION

Available data presented that early social interactions dominate several components throughout the lives of individual animals, involving the existence of temperament (Bergmüller and Taborsky, 2010), behavioural stability (Novak et al., 2006), response to stress (Meaney et al., 1996), prone to disease (Tuchscherer et al., 2006) and influence of habitat (Burton and Metcalfe, 2014). Single discrepancies in premature social experiences and mature environments may result in compatible dissimilarity in adult social behaviour (Sachser, 1993; Boogert et al., 2014). A brief explanation might involve differences in the way individuals form and maintain social relationships (Aplin et al., 2013), which can affect social network position and overall social group structure (Boogert et al., 2014). It should not be unwise to draw a hypothesis that perception of earlier social-environmental affecting farm animals under human supervision, is quite important for maximized productivity and welfare (Bolt et al., 2017).

Regarding dairy populations, it has been postulated that approximately 60 of 100 calves were under restriction following birth and thereafter moved to individual pens (Marcé et al., 2010). On the other hand, the EU Council Directive 97/2/EC regarding calves denoted the importance of social contact among calves of bigger than 8 weeks of age. In addition according to the same regulations tactile and visual contact among similar age groups should be available. The outcome of social restrictive cautions for earlier life of calves was entirely recognized. Given the well-known data that calves were housed in individual pens consequently resulting in diminished disease transmission and practical analysis/interpretation of health concerns (Svensson et al., 2003), elevated contact among calves might probably increase infectious disease transmission (Houe, 1999; Gulliksen et al., 2009).

The purpose of the present study is to detect the social network analysis of Giardia transmission among calves.

MATERIALS AND METHODS

Animals and housing

This study was conducted by using 9 calves (3 males/6 females) aged 10 to 16 weeks, on a private commercial farm in Aydin Municipality, Turkey. The self-control group was enrolled, as each case was its control comparatively, which meant the previous analyte day. The calves were housed individually and moved to an open pack pen. The open pack pen measured 20 m^2 which was equipped with feeders allowing free access to water, hay, and calf starter, on previous days. There afterward, the calves at the age of 3 months, were moved to a free-stall pen measuring 44 m^2. The new pen consisted of 9 individual free-stall lying spaces. Calves were available with hay and total mixed ration (TMR) along with free water access, similar to what has been reported elsewhere (Lecorps et al., 2019). Infected calves were treated with secnidazole as described by Toros and Ural, (2018).

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Diagnostic interpretation

The diagnostic evaluation involved veterinary academical staff of the study by use of a) microscopical examination, b) DNA extraction, followed by nested PCR (Caccio et al. 2002) by use of G7 F5'- AAGCCCGACGACCT-CACCCGCAGTGC-3' forward and G759R 5'-GAGGCCGCCCTGGATCTTCGAGACGAC-3' reverse primers, BG1F 5'- GAACGAGATCGAGGTCCG-3' forward and BG2R 5'-CTCGACGAGTTCGTGTT-3' reverse primers (Lalle et al., 2005), targeting β-giardin gene location amplification c) rapid diagnostic test kit used on bedside (on-farm conditions actually) by use of Bovid-5 solitary phase test cassettes and thereof d) social network analysis.

Social network recording

Two cameras (iphone8 plus, USA) were placed 10 m above each pen for enabling undisturbed behavior analysis. Calves were video recorded in the open pack for 24 hours in two different periods of the day; morning and night before moving to the free-stall pen. Calves were fully recorded for 4 weeks with a full battery phone camera. Red lighting onto the pens allowed researchers detailed viewing of social networks among calves at night also (Lecorps et al., 2019). All records were watched by same investigator.

RESULTS

During the observation period both by investigators and camera records infected calf 2 was in close contact with no 8 (at morning observation) and a slight degree of contact with no 3 and 4 which were detected with giardiasis on weeks 4, and 3, respectively. Due to close contact with no 8, infection was determined on week 2, earlier than others (except no 7). This might be briefly explained with no7's close contact in the evening with infected calf no 2 (Figure 1-2). On week 1 to those of 9 calves, solely no 2 was infected with giardiasis, whereas on week 2 calves with no:2, 7, and 8 were also infected. On week 3, no 4, and 6 were also infected with a total of 5 calves. This was followed by the final 6 calves in total infected. Calves with no 1 and 5 were never infected nor determined by PCR, FS, or Rdtk throughout the study (Table 1). In the evening observation, period no1 had no contact with other calves.

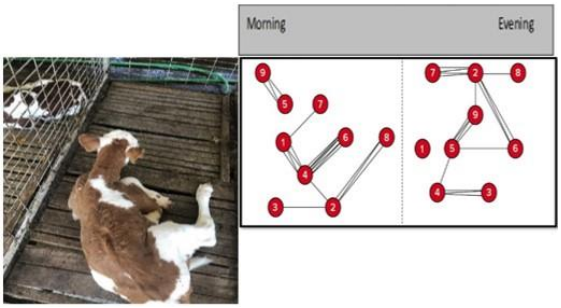

Figure 1. Calf no: 2 was diagnosed positive on week 1 before the study in which was housed solely. This schematic representation showed limited social network analysis of animal movements (a day morning and evening). Case no: 2 was infected with giardiasis and had close contact with calves no: 8 both at morning and evening and with no: 7 at evening monitorization.

Figure 2. Even if calves were housed individually in pens/boxes, the transmission may be limited, whereas calves are social hubs, thoroughly contact among social groups would have helped microbiota existence, would later boost the immune system. Case no: 2 (on the left side of the photograph), located individually on its box during week 1 of the study, diagnosed positive by rapid diagnostic test kits, fecal smear, and PCR analysis.

Table 1. Diagnostic following of calves by weeks for giardiasis.

Calf no	Week I			Week 2			Week 3			Week 4		
	PCR	Fs	Rdtk	PCR	Fs	Rdtk	PCR	Fs	Rdtk	PCR	Fs	Rdtk
I	-	-	-	-	-	-	-	-	-	-	-	-
II	†	†	†	†	†	†	†	†	†	-	-	†
III	-	-	-	-	-	-	-	-	-	†	†	†
IV	-	-	-	-	-	-	†	†	-	†	†	†
V	-	-	-	-	-	-	-	-	-	-	-	-
VI	-	-	-				†	†	-	†	†	†
VII	-	-	-	†	†	†	†	†	†	†	†	†
VIII	-	-	-	†	†	†	†	†	†	†	†	†
IX	-	-	-	-	-	-	-	-	-	-	-	-

DISCUSSION AND CONCLUSION

As the major purpose of the present study was to confirm a probable statement that close contact and probable social networking play a central role in disease transmission for Giardiasis, the disease literature was selectively discussed, other than pathogenesis, laboratory findings, or possible treatment options. Therefore, discussion would be held on not the disease itself, but social networking behaviour. The authors of the present study worked on Giardiasis with several published materials (Alıç Ural et al., 2014; Ayan et al., 2016; Alıç Ural et al., 2017; Ayan et al., 2017; Ayan et al., 2019; Camkerten et al., 2019; Erdoğan et al., 2020). It should not be unwise to draw a preliminary conclusion that the study group of academicians has enough experience within giardiasis. The interest of the present authors' in this subject was aroused following several years of academic and field experience regarding giardiasis among large or small animals.

It was postulated that increased disease incidence presented to those of group-housed calves in comparison to pair-housed ones (Maatje et al., 1993), whereas contrary findings were also available (Kung et al., 1997; Ha¨nninen et al., 2003). On the other hand, no statistically important alterations were available for any type of rearing among calves (healthy or diseased) (Chua et al., 2002; Cobb et al., 2014). Earlier evolution of social bonding among members of the same species to those of domestic herbivores and privileged bonds among unattached animals frequently exist without the existence of dams (Veissier et al., 1998; Napolitano et al., 2008). Group housed calves might ease separation stress through social supportive measurements (Rault, 2012). Given the significance of social contact for calves (Holm et al., 2002; Rault, 2012), advantages and disadvantages should be cautiously taken into account. Taking into account the latter statement, the present study might be predicted to disease transmission activity among calves with giardiasis, probably detecting one of the disadvantages of social networking.

In a prior study, searching for the relationship between social behaviour and its influence on disease transmission in dairy cattle was focused on leptospirosis, capable of transmission directly. It was assumed that contact behaviour between dairy cattle belonging to a group might be altered by individual cow movements due to the structural properties of the social network. The latter study involved a milking cow group (n = 170) and 2 weaning calf groups (each n = 33). Specifically, 3 different contact behaviours (sniffing, licking, and rubbing), directly observed for 4 weeks (for calves) under record, proposed as risk factors leading to transmission of leptospirosis. According to the results of that study, although most of the individuals in both groups were directly/indirectly connected, network data was highly sparsing. The vast majority of animals presented few contacts; whereas mostly cows in oestrus and male calves exhibited a very high degree of interaction. As a keynote finding in that study highly connected individuals might counteract major role during outbreaks with proof of heterogeneous social interactions in dairy cattle (de Freslon et al., 2019). Taking into account the latter knowledge, possessing high importance, highly connected calves (9-5, 1-4, 4-6, 2-8 at morning; whereas 7-2, 2-6, 9-5 and 4-3 at evening observations) in this study might have helped the dissemination of giardiasis infection among calves involved. The advantages and probable disadvantages (as was detected for probable transmission to those of calves that participated in this study) should be taken into consideration before social networking among calves. Particularly prevention measures (point of care testing directed against infectious diseases on field conditions by use of rapid diagnostic test kits) and isolation of sick calves at the early onset of disease (by veterinary surgeons experienced at epidemiology, isolation, and of course infectious diseases) must be performed before socialization.

According to Bouissou and Boissy (2005) regarding calves social networks, even if grouped entirely might present some stability and relationships with heterogeneity. Furthermore, social interactions were guided by prior familiarity. In addition, calves could preferentially be deemed having interactions prior to 3.5 months of age, with questions aroused; a) calves with social stability levels as low or absent? b) housing calves entirely beginning with an early age could therefore possess benefit? (Bouissou and Boissy, 2005) remain still as unknown parts.

Given a study by de Freslon et al., (2019) increased interactions among individual calves could participate as actor Keane (the present authors' comment and portrayal) at outbreaks. There was negative age heterophily presenting those cows interacted thoroughly with other relevant cows of a unique age. Male calves were detected to exhibit more initial contacts in contrast to females. This interesting and valuable study proofed that social networking in dairy cattle is heterogeneous and took a role in the classification of the contact group structure. Thus, regarding this contact structure, better surveillance systems and mitigation strategies might be compulsory for preventing or decreasing disease transmission (de Freslon et al., 2019), which was also supported by the result of our 1 month's study. Our study was self-funded, in which by declaration interest by financial focus would be welcomed for larger-scale further studies.

In conclusion, the present authors suggested that social networking might be an important predisposing factor for giardiasis infection among calves.

Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: D.A.U., K.U., S.E., A.Y., H.E., Data Collection or Processing: D.A.U., K.U., S.E., A.Y., H.E., Analysis or Interpretation: D.A.U., K.U., S.E., A.Y., H.E., Literature Search: D.A.U., K.U., S.E., A.Y., H.E., Writing: D.A.U., K.U., S.E., A.Y., H.E.

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Ethical approval

This study was approved by The Local Ethical Committee of Aydin Adnan Menderes University- HADYEK with number 64583101/2014/119.

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