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Prevalence and Associated Risk Factor of Gastrointestinal Nematode Parasites of Small Ruminant in Humbo District, Southern Ethiopia

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Abstract
A cross sectional study was conducted to determine the prevalence and associated risk factors of small ruminants gastrointestinal nematode parasites in Humbo town and surrounding districts , southern Ethiopia from November 2017 to April 2018 Gregorian calendar. Fecal samples were collected from 384 randomly selected animals (204 sheep and 180 goats) and examined for the presence of nematode eggs using 10x microscope. Identification of nematode parasites was done based on egg types (flotation technique) and morphology of parasite after larva culture (Baermann technique). Out of 384 study animals, 184 (47.92%) were found positive for nematode eggs of which, 105(51.47%) sheep and 79 (43.89%) goats harbored one or more gastrointestinal nematodes. Species, sex, age, body conditions and origin of the animals were identified as risk factors for the occurrence of nematode infections in small ruminants. But, statistically significant ($p<0.05$) difference in the prevalence of gastrointestinal nematodes were observed only in different age and body condition groups of study animals. But, the prevalence of the parasites were not varies between different origin, species and sex groups of animals ($p>0.05$). Coproscopic examination of eggs revealed that different types of nematode eggs were isolated from 184 small ruminates of which, *Strongyle* types (160), *Strongyloide* (20) and *Trichuris* (4). The most common genera of nematodes were *Haemonchus* (48) and *Trychostrongylus* (36) as single infection, whereas, in mixed infection, trychostrongylus and *Bunostomum*, and *Trychostrongylus/Haemonchus* genera were most common parasites. In conclusion, high prevalence of nematode parasites was observed in the study area, which implies nematode parasites are the major constraints which decrease the production and growth rate of sheep and goats. Therefore, strategic de-worming of small ruminant and checking drug resistance patterns of gastrointestinal nematodes should be implemented to overcome the adverse effect of the disease.
Keywords: Gastrointestinal nematodes; Prevalence; Risk Factors; Small ruminants; Species
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1. Introduction

A wide variety of gastro intestinal nematodes (GINs) have been involved in prodigious morbidity and mortality of small ruminants (sheep and goats) since, nematode infections lowered productivity, performance, weight gain of animals (reduction of food intake) additional to retarding the growth, increase treatment and control cost of nematode infections (Abebe , 2001; Abdulkadir *et al*., 2017). Infections with GIN affect the health and wellbeing of the livestock and leads to immense economic loss in sheep and goat framing sectors (Bhat *et al*., 2011; Shahnawaz *et al*., 2011 Stepek *et al*., 2004).

Gastrointestinal parasites in general or nematode infection of small ruminants in particular pose a great challenge in small ruminants of sub-Saharan Africa including Ethiopia (Ayalneh, 2017; Ragassa *et al*., 2006). Thus, GIN infections of small ruminants have a great challenge and much more sever problem in Ethiopia due to the availableness of suitable agro-ecological factors for diversified nematode species (Fikru *et al*., 2006; Kumsa and Wossene, 2007) like favorable environmental condition for parasite transmission, poor nutrition of host (sheep and goats), unhygienic environment (poor sanitation in facilities where animals are housing, grazing and watering), inappropriate care and close contact of healthy and disease animals (Gadahi *et al*., 2009; Kumsa and Abebe, 2009).

A range of nematode species usually cause infection in small ruminants and the most important species of nematode that cause single or mixed infections includes *Haemonchus spp.* (Perry *et al*., 2002*), Trychostrongylus spp.* (Seyoum *et al*., 2018), *Bunustomum* and *Oesophagostomum spp. (*Mideksa et al., *2016), Ostertagia spp.* (Ibrahim *et al*., 2014), *Cooperia spp.* (Seyoum *et al*., 2018) and *Trichrius spp.* (Rashid *et al*., 2016).

In different localities of Ethiopia, many studies have been conducted by different researchers to investigate prevalence of nematode infection in small ruminants and the results varied greatly among different localities as described by Kumsa (2006) in Ogaden region, Kumsa *et al.* (2010) in Hawassa, Yimer and Birhan (2016) in

north Gondar and Dilgasa *et al*. (2015) in Arsi Negele, Ethiopia. Even though, there is large population of small ruminants in the Humbo (study) area, the prevalence and risk factors of GINs infection has not been reported, yet. Therefore, the aim of this study was to determine the prevalence of GINs of small ruminants (sheep and goat) in Humbo town and surrounding districts of Wolaita Zone in Sothern Nation Nationality and People Regions (SNNPRs), Ethiopia; to determine potential risk factors associated with prevalence of GIN and to identify the genera of nematode parasites involved in small ruminant infections.

2. MATERIALS AND METHODS

2.1. Description of the Study Area:

The study was conducted from November 2017 to April 2018 G.C. in Humbo woreda and surrounding areas, Wolaita Sodo Zone, SNNPRs of Ethiopia. Humbo is located 350 km south of Addis Ababa (capital city of Ethiopia). It is located 1100 to 2300 meter above sea level, 6° 40'N latitude and 37°50'E. The climatic condition of the study area has a mean annual temperature of 22.0°C and mean annual rainfall of 1123.15 mm. It is bordered on the South by West Abaya woreda, North by Sodo Zuria woreda, East by Damote Woyde woreda, and West by Ofa woredas. The human population in the area is estimated to be 152,495; which comprise 75,487 males and 77,008 females (CSA, 2008).

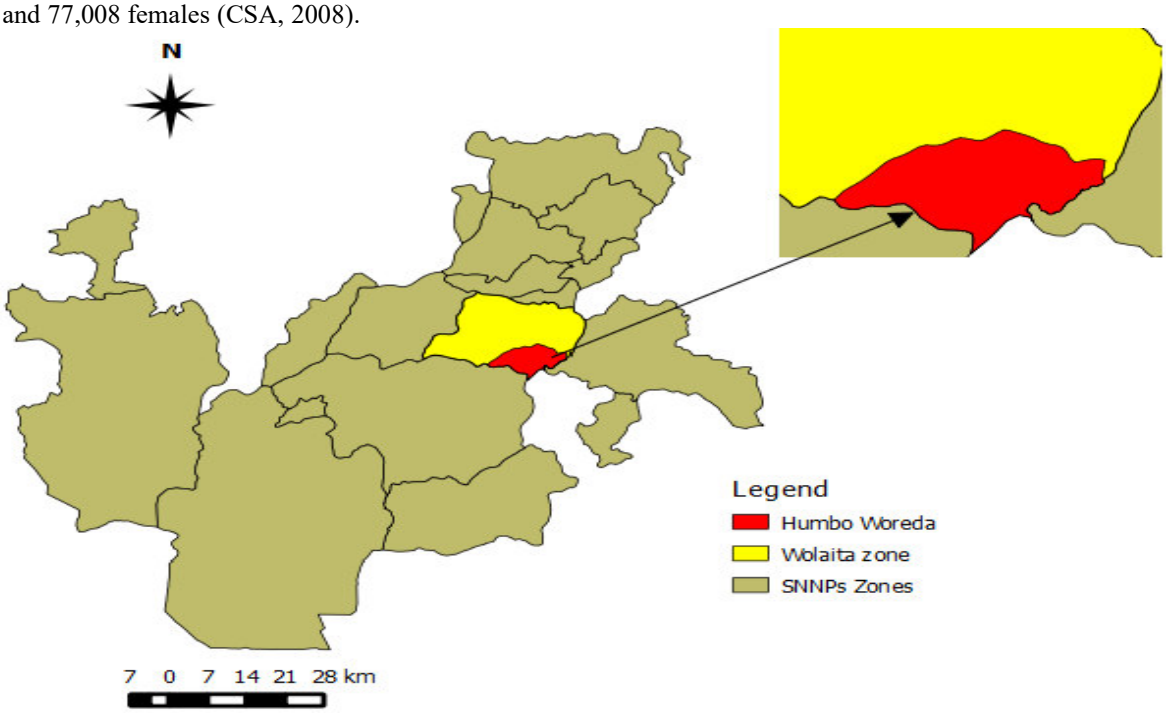


Figure 1: The map of Humbo woreda

2.2. Study Animals

Sheep and goats having different age, sex and body conditions and kept under extensive production system in different peasant association were considered as study animals. All study animals sampled were indigenous breed and the age of the animal was classified as young (age less than or equal to one year) adult (age greater than one year) (Bersisa *et al*., 2011) and age was estimated based own owners information and using eruption pattern of teeth. Moreover, body conditions of the small ruminant were determined by palpating and observing the vertebrae of loin regions. Thus, the body conditions were classified as poor, medium and good (Yimer and Birhan, 2016).

2.3. Study Design

A cross sectional study design was applied to determine the prevalence of GINs of small ruminant in Humbo town and surrounding based coproscopy /coproculture examinations.

2.4. Sampling Methods and Sample Size Determination

Sample size was determined using 95% level of confidence, 50% expected prevalence since there was no previous work conducted in this study area and 0.05% desired absolute precision as described by Thrusfield (2005). The formula is as follow:

$$n = \frac{Z^2 Pexp\ (1-Pexp)}{d^2}$$

Where n= require sampling size
Pexp= expected prevalence
d^2 = desired absolute precision
Z= Constant value from normal distribution table at a given confidence level (1.96)

Therefore, a total of 384 small ruminants (204 sheep and 180 goats) were selected from localities within Humbo towns and surrounding peasant associations. Four peasant associations were purposively selected based on accessibility as well as availability of small ruminants (sheep and goats). The selected peasant associations include Gututo, Ampo, Kosho and Elakebel and different number of animals were selected using simple random sampling techniques. Thus, the owner of the small ruminants and the number of animals (sheep and goats) were recorded. Owners of animal having one sheep and one goat, both animals were sampled but, for those owners having more number of small ruminants, simple random sampling method was applied to select sheep and goats participating in the study.

2.5. Coproscopic Examinations

For examination of the fecal samples, a simple test tube flotation technique was employed as described by Hansen and Perry (1994). Slides were examined under microscope (x10) and eggs of different nematodes were identified on the base of morphological appearance and size of eggs (Foriet, 1999). Then, sheep and goats' fecal samples having *Strongyle* type of eggs were cultured in petri-plates for 7-10 days. The L3 forms of the parasites were observed under the help of microscope after performing modified baermann technique. Identification of the hatched L3 was performed on the basis of key morphological differences among different parasite genera of *Trychostrongylus, Oesophagostomum, Bunostomum and Haemonchus* (Van Wyk et al., 2004).

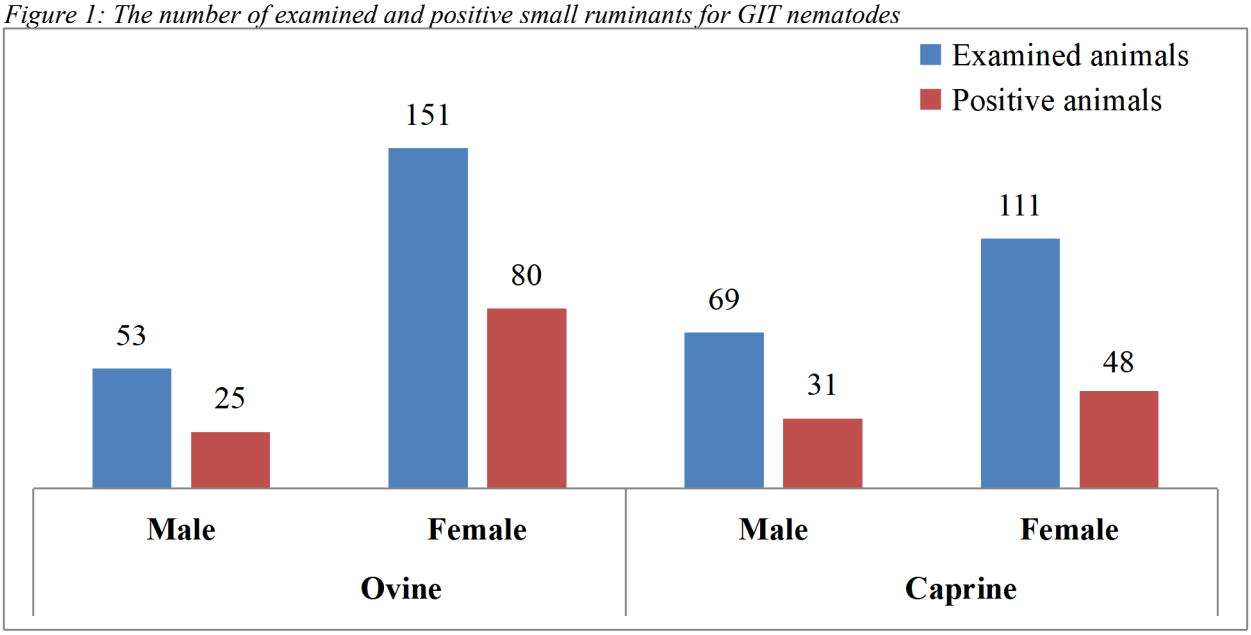
2.6. Data Management and Analysis

The data obtained in this study were recorded in Microsoft-Excel spread sheet and coded. Then, the coded data were imported into SPSS data view window and analyzed using SPSS version 20 analysis software. The presences of association between different risk factors and nematode infections were compared using Chi-square (χ^2) test and P value ($P<0.05$) were considered as statistically significant. The results of this study were presented in forms of descriptive tables and graphs.

3. Results

Out of 384 small ruminants constituted under this study, 204 sheep and 180 goats were examined for GIN infections. Among study sheep, 151 were female of which, 80 were positive for GIT nematodes; and 53 male sheep were considered for the study and 25 were positive for nematodes. On the other hand, 111 female and 69 male goats were considered in the study of which, 48 female and 31 male goats were positive for GINs as shown in Graph 1 below.

Figure 1: The number of examined and positive small ruminants for GIT nematodes



Among 384 study animals, 184(47.92%) were positive for GINs. The relationship between different risk

factors like species, age, sex, body conditions and origin of the animal with prevalence of nematodes were also described. Hence, higher prevalence of major GINs infection was observed in female animals (48.85%) as compared to males (45.9%). But, this difference is not statistically ($p>0.05$). Similarly, the prevalence of GIN in sheep and goats species is difference and higher prevalence in sheep (51.47%) and lower in goats (43.89%) were recorded but, the difference is not statistically significant ($p>0.05$). All study animals were collected from four areas and higher prevalence was recorded in Kosho (52.94%) and lower occurrence in Ampo (44.21%) but, this difference is not statically significant ($p>0.05$) like that of species and sex of study animals as depicted in Table 1 below.

In the present study, prevalence of GINs was 39.91% in young and 59.01% in adults small ruminants and this difference is statistically significant ($p<0.05$). Moreover, different body condition categories were also considered. Higher prevalence of parasite in medium BCs (58.60%) and almost equal prevalence of parasite in good (40.82%) and poor (40.00%) BCs. The differences in the prevalence among different BCs of small ruminant were statistically significant since $p<0.05$ as shown in Table 1 below.

The egg types found under fecal microscopic examination assured that 169 *Strongyle* types of eggs were identified of which, 89 from sheep and 71 from goats. *Trichuris* eggs were also identified from 4 ovine species and a total of 20 small ruminants were positive for *Strongyloide* eggs as shown in Table 2 below.

Table 1: The prevalence of nematode parasites in small ruminants and its association with potential risk factors.

Risk factors	Categories	No. of examined animals	No. of positive animals	Prevalence (%)	$\chi 2$	P-value
Species	Ovine	204	105	51.47	2.203	0.138
	Caprine	180	79	43.89		
Age	Young	223	89	39.91	13.66	0.000*
	Adult	161	95	59.01		
Sex	Male	122	56	45.90	0.291	0.59
	Female	262	128	48.85		
	Good	147	60	40.82	12.157	0.002*
BCs	Medium	157	92	58.60		
	Poor	80	32	40.00		
Origin	Gututo	99	45	45.45	1.732	0.63
	Ampo	95	42	44.21		
	Kosho	85	45	52.94		
	Elakebela	105	52	49.52		
Total		**384**	**184**	**47.92**		

*= Statistically Significant, BCs = Body Conditions

Table 2: The egg types found on coproscopy examination

	Small ruminants		
Nematode eggs	**No. of positive sheep**	**No. of positive goats**	**Total**
*Strongyle*types	89	71	**160**
Trichuris	4	0	**4**
Strongyloide	12	8	**20**
Total	**105**	**79**	**184**

The coproculture finding of study animals having *Strongyle* types revealed that *Trychostrongylus, Oesophagostomum, Bunostomum* and *Haemonchus* genera of parasites were found as single or mixed infections. Generally, 133 animals were affected by single infection of *Trychostrongylus* (36), *Oesophagostomum* (22), *Bunostomum* (27) and *Haemonchus* (48) parasites. On the other hand, 27 study animals were infected by mixed infection of parasites i.e. *Trychostrongylus* and *Oesophagostomum* (4), *Trychostrongylus* and *Bunostomum* (8), *Trychostrongylus* and *Haemonchus* (7), *Haemonchus* and *Bunostomum* (5), *Haemonchus* and *Oesophagostomum* (1), *Bunostomum* and *Oesophagostomum* were exposed for dual parasitic infections. But, one ovine was infected by triple *Trichostrongylus, Haemunchus* and *Bunostomum* parasites as indicated in Table 3.

Table 3: Genera of GIT nematode identified from coproculture

	Small ruminants		
Genera of nematodes	**No. of positive sheep**	**No. of positive goats**	**Total**
Single infection			
Trychostrongylus	19	17	36
Oesophagostomum	14	8	22
Bunostomum	18	9	27
Haemonchus	25	23	48
Total	**76**	**56**	**133**
Mixed infection			
Trychostrongylus& Oesophagostomum	1	3	4
Trychostrongylus&Bunostomum	3	5	8
Trychostrongylus&Haemonchus	5	2	7
Haemonchus&Bunostomum	2	3	5
Haemonchus& Oesophagostomum	1	0	1
Bunostomum& Oesophagostomum	0	1	1
Trichostrongylus,Haemunchus&Bunostomum	1	0	1
Total	**13**	**14**	**27**

4. Discussion

The current study revealed that an overall prevalence of nematode parasites in sheep and goats was 47.92% in Humbo town and surroundings. The current finding was almost similar with the finding (47. 67%) of Dagnachew et al. (2011) in North Gondar, Shimelis *et al*. (2011) (46.07%) in Gondar, Welemehret *et al*. (2012) (48.21%) in Mekele, Regassa *et al*. (2006) (50.20%) in Western Oromia and Rashid *et al*. (2016) who reported 45.60% in Pakistan. However, the prevalence of GIT nematode parasites in small ruminants was lower than report of Emiru *et al*. (2013) (82%) in Gechi district, Tefera *et al*., (2011) (92.3%) in Bedelle, Asres (2016) (88.8%) in Haramaya of Ethiopia and 96.15% prevalence in India (Pant et al., 2009). The lower prevalence of GINs in this study might be associated with difference in climatic and environmental factors, extensive use of anthelmintic and seasonal difference of the study period as described by (Rossanigo and Grunder, 1995).

In the present study, a higher prevalence of GIN parasites were observed in sheep (51.47%) than in goats (43.89%) but, the deference is not statistically significant ($p>0.05$). Similar studies were performed throughout the world and higher prevalence of parasites in sheep than goats were recorded as described by Teklye (1991) in sub-Saharan Africa, Waruiru *et al*. (2005) in Kenya; Yimer and Birhan (2016) in Northern Ethiopia. The higher prevalence of nematode parasites found in sheep and goats might be due to the feeding habit of sheep since they are grazers from the ground where the GIN egg hatches and reaches the infective stage while goats are browsers in behavior. Moreover, difference could be due to the management condition of sheep and goats (Ragassa *et al*., 2006).

In this study, higher prevalence of infection was observed in adults (59.01%) than young (39.91%) animals and the difference was highly significant ($p<0.05$). Similarly, higher prevalence of nematode parasites in adult ruminants was reported by Rashid et al. (2016). This could be the result of longer exposition of adult sheep and goats to the parasite eggs and larvae during several grazing seasons.

The present study revealed that sex of the animal did not show statistically significant association ($p>0.05$) with the prevalence of the parasites even though, higher prevalence (48.85%) in female than male of small ruminant (45.90%). The absence of statistically significant association between male and female small ruminant was consistent with previous report of Nigatu (2008) in Awi zone; Regassa (2006) in Western Oromia; Dagnachew *et al.* (2011) in North Gondar; Ghanem *et al.* (2009) in Somaliland. Relatively higher prevalence nematode parasites in female animals might be due to stress and decreased in the immunity of females animals during pregnancy and lactation (Urquhart, 1996), deference in hormonal composition of female and male animals could also contribute for the difference in the prevalence (Gualy *et al.,* 2006).

With regard to the body condition of the examined small ruminants, the prevalence rate was higher in medium BCs (58.60%) than poor (40.00%) and good BCs (40.82%) small ruminants and this difference is statistically significant ($P<0.05$). Similarly, higher prevalence of nematode parasites in medium BCs small ruminant was reported by Kadi et al. (2017) in Asella and Dilgasa *et al*., (2015) in Arsi Negele, Ethiopia**.** The higher prevalence of nematode parasitism in medium BCs small ruminants might be associated with the presence of parasite in GIT but not causing disease due to host immunity (Urquhart, 1996) but, lower prevalence of nematode in poor BCs animals could be due to deworming habit of the owner mostly for thin and debilitated animals.

Among different peasant association, higher prevalence of nematode parasites were observed in Kosha and

Elakebela, 52.94% and 49.52% respectively. Slightly lower prevalence's were found in Gututo (45.45%) and Ampo (44.215) peasant associations but, this prevalence different among peasant association is not statistically significant (P>0.05). A similar geographical difference in the prevalence of nematode parasites was also reported by Armour (1980).

In this study, infections with *strongyles* were the dominant one among the small ruminants. Infections with *Strongyloides* and *Trichuris* were also identified with limited proportions. This is in agreement with several studies conducted so far by Fikru (2006) in Western Oromia, Diriba and Birhanu (2013) in Asella, Abdulkadir *et al*., (2017) Kombolcha and Dessie town, Abebe and Eseyas (2001) in Bedele and Dilgasa *et al*., (2005) in Arsi Negele, who reported high proportion of *strongyle* infection. This difference might be due to the fact that small ruminants have different level of resistance for different species of parasitic infections as described by Urquhar *et al*. (1996).

According to this study, high number small ruminates (48) were affected by genera of *Haemonchus* parasite as single infections. Large numbers of small ruminant infected by Haemonchus were also reported by Kumsa and Wossene (2006) in Ogaden and Abunna *et al*. (2009) in Bishooftu, Ethiopia. However, this result contradicts with report of Kumsa *et al*. (2011) in central Oromia, Ethiopia who showed the predominance genera of small ruminants nematode was *Trychostrongylus*.

Moreover, current study has shown the presence of mixed infection characterized by the presence of more than one nematode parasites both in sheep and goats which agrees with the findings of other researchers in different localities of Ethiopia as described by Abebe and Esayasu (2001) in eastern Ethiopia, Regassa *et al*. (2006) in Western Oromia, Kumsa *et al.* (2011 in Central Oromia and Tefera *et al*. (2011) in Bedelle area. Thus, mixed infections might be the cause of high morbidity in sheep and goats since co-infection by different parasites compromise immune response in susceptible small ruminant as described by Lello1 *et al*., (2017).

5. Conclusion and recommendations

Gastrointestinal nematode parasites are the major animal health constraints in small ruminants' production and contributing a great loss in the productivity sheep and goats. The present study showed that gastrointestinal nematode of small ruminants is prevalent disease in the area. Among assumed risk factors, age and BCs showed statistically significant association. The small ruminants were affected by different types of nematode parasites like *Strongyle* types, *Trichuris* and *Strongyloide* in fecal examination. The infection of small ruminants is caused single or co-infections of nematodes parasites. Six genera of nematode parasites like *Haemonchus*, *Trichostrongylus*, *Oesophsgostomum*, *Bunostomum*, *Trichuris* and *Strongyloide* were recorded and responsible for small ruminant nematode infection of which, the genera of *Haemonchus* parasite was responsible for the majority of small ruminants' nematode infection and followed by *Trichostrongylus* genera in the study area. This higher prevalence of single or mixed infection of nematodes in Humbo town and surrounding causes decrease in their production, growth rate and death of small ruminants. Extensive production system (keeping ruminant on communal grazing field) and lack of deworming activity activities are also responsible for high prevalence of nematode infection in the area. However, piodical and strategic de-worming with effective broad spectrum antihelminths and further studies on drug resistance patterns of GINs should be conducted.

Conflict of interest

The author declared there is no potential conflict of interest

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