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PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF LOCAL COWS IN GURAGHE ZONE, SOUTH WEST ETHIOPIA

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ABSTRACT: In tropics the genetic diversity of indigenous livestock provides a range of options that are likely to be valuable in adaptation to poor-quality diets and tolerance of climatic extremes as well as resistance to specific diseases. The aim of this study was to assess productive and reproductive performance of local dairy cattle in Guraghe Zone. Formal survey was used to collect data from three district, which were selected from three agro-ecological zones namely, highland, midland and lowland. A total of 180 respondents (60 from each agro-ecology) that have at least one local milking cow were randomly selected. The data were analyzed by general linear model procedure of SPSS version 20 (SPSS, 2015). The breeding practices reported in the study area were mostly natural mating but AI also rarely practiced. In all agro-ecologies, farmers reported milk production as preferred trait, followed by reproduction, growth rate and longevity. In the follow up study, except agro-ecology all sources of variation had significant effect on morning and evening milk yields, however, the survey analysis revealed that agro-ecology was significant for all reproductive traits under this study. The average milk off-take of Guraghe highland cows was 1.7±0.02 liter/cow/day and on average cows gave a lactation yield of 379.14±12.11 liters/cow and an average lactation period of 7.90±0.08months. Overall mean of calving interval and days open were 22.03±0.37 and 12.70±0.37 months, while mean age at first service and age at first calving of cows in Guraghe Zone were quite late (33.51±0.70 and 42.85±0.70 months, respectively) even by local standard. In conclusion, this study has shown that performances of Guraghe highland cows less than the optimum values desirable for market-oriented dairy production. Therefore, there is a need for intervention to develop infrastructure, enhance input supply system and undertake appropriate breeding plan based on breeding objective and trait preferences of local farmers.

Keywords: Breeding objectives, Guraghe highland, Production and Reproductive traits

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INTRODUCTION

Livestock are an important component of nearly all farming systems in Ethiopia and provide of great socio-economic and cultural values. The diversified use of livestock on average contributing 45% of the total Agricultural Gross Domestic (GDP) of the country (IGAD, 2010). In Ethiopia dairy production is still in extensive system and depends mainly on indigenous livestock genetic resources; with animals having multipurpose use and as such no specialized and systematic breeding is used (Giday, 2001). To date local cattle are characterized by an average lactation length of 6 months and an average daily milk production of 1.37 liters per cow/day (CSA, 2017). To meet the ever-increasing demand for animal products and thus contribute to poverty alleviation in Ethiopia, genetic improvement of the indigenous cattle basically focusing on crossbreeding. About 99.19 percent of the dairy cattle are non-descriptive indigenous breeds, while the hybrids and pure exotic breeds were represented by 0.72 and 0.09 percent, respectively (Zelalem et al., 2011). This suggests that the total number of both exotic and hybrid female cattle produced through the crossbreeding work for many decades in the country is quite insignificant indicator of successful crossbreeding work (Aynalem et al., 2011).

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Although the indigenous Zebu cattle are poor in performance, the genetic improvement of Ethiopia also have a look at selection of the most promising breeds as the genetic diversity of Ethiopian's livestock provides a range of options that are likely to be valuable in climate change adaptation, including resistance and tolerance to specific diseases, adaptation to poor-quality diets and tolerance of climatic extremes. The Guraghe highland breed is Small East African Zebu type found in the Guraghe Zone in close proximity to the tsetse infested Ghibe valley, Ethiopia (Rege, 1999; DAGRIS, 2007). Accurate evaluation of the productive and reproductive performance of local cattle probably the most important factor that is a prerequisite for sustainable dairy production system. However, little research efforts have been made in Ethiopia in general and in Guraghe Zone in particular on productive and reproductive performances of local cows as most of the efforts are directed towards cross breed dairy animals. In addition, the dairy sector does not have specific institution or custodian which collects and analyses dairy related data that can be used to inform investors, policy makers and other industry stakeholders (SNV, 2008). Hence, in order to design relevant dairy development strategies and implement context specific interventions, understanding of the breeding objectives, trait preferences and productive and reproductive performances of local cows under existing management is indispensable. This study was therefore, carried-out to assess breeding practice, trait preferences and production and reproduction performances of Guraghe highland cattle in tropical highland environment of Guraghe Zone, Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Guraghe Zone, Southern Nation Nationalities and peoples of Ethiopia Regional State, located 155 km south west of Addis Ababa between 7.8^0 to 8.5^0 North latitude and 37.5^0C - 38.7^0 East longitude (CSA, 2017). The mean annual temperature of the zone ranges between 13-30^0c and the mean annual rain fall ranges 600-1600mm. The rainfall pattern in the Guraghe Zone is bimodal in which 80% of rain falls in the rainy period of June to August whereas 20% in the short rainy period of February to May.

Sampling technique and sample size

In the present study, multi-stage sampling method was used. In the first step, districts were stratified in to three groups based on agro-ecology (lowland, midland and highland). Accordingly, three Districts (Geta, from highland, Enmore from midland and Mareko from lowland were selected. In the second step, from each agro-ecology, two *kebeles* were selected by using randomizing sampling method; totally six *kebeles* were selected. In the same manner, 30 households were selected from each selected *kebeles* making a total of 180 households.

The questionnaire was pre-tested and modified as necessary. Finally, the formal survey was conducted by trained enumerators under close supervision and participation of the researchers. During the formal survey, all the required data were collected for the period 2015/16 using 180 respondents. A focus group discussion with eight to 10 farmers, who had previously participated in the household survey, was carried out in each of the six villages.

Animal management and Monitoring

The cows are managed in free grazing throughout the day and closed houses with ordinary floor structure is allowed during night. The feed on which the animals are fed include natural pasture, hay, *Enseteventricosum,* crop residue and rarely none-conventional feeds. Cows were hand milked with twice per day milking frequency, early in the morning (3:00-4:00 pm) and late in the afternoon (3:00 - 4:00 pm). There was no regular vaccination and spray for external parasite, but farmers took their animals for treatment whenever diseases occurred.

A follow-up study was conducted to evaluate milk yield of cows based on lactation stages, parity and lactation month. In this section, a diagnostic survey was undertaken to identify households that have lactating cows in all agro-ecologies. Lactating cows were stratified into early (1–2 months), mid (3–4 months), and late (5–6 months) lactation stages depending on their lactation length in order to see the production potential at different stages. In order to see the effects of parity lactations were classified into three parities as 1, 2, and 3^+. Party three and above were all pooled together as parity three due to very few number of observations in later lactations as well as due to the higher correlation between 3^{rd} and later lactations. In addition, lactation month during monitoring period (Jun, July and August) was considered. Finally, daily cow milk yield (morning and evening) was measured using a calibrated plastic jog for a period of three month.

Data Analysis

The data were analyzed with SPSS version 20 software (SPSS, 2015). This involved simple descriptive statistics. GLM (General Linear Model) procedure was used to test the effects of lactation phase, parity, agro-

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ecology and lactation month on morning milk yield (MMY) and evening milk yield (EMY). Similarly, daily milk yield, lactation milk yield, lactation length, age at fist service, age at first calving, calving interval and days open were compared under different agro-ecologies. The presence of any significant differences was checked by using Tukey Kramer multiple comparison tests at $\alpha < 0.05$. The model equation for MMY and EMY were:

$$Y_{ijklm} = \mu + A_i + P_j + L_k + S_l + e_{ijklm}$$

Where

Y_{ij} = the i^{th} observation of morning and evening milk yield

μ= the over all mean

A_i= the effect of agro-ecology

p_j= the effect of parity

L_k = the effect of lactation phase

S_m= the effect of lactation month

e_{ijkm} = random error, which is assumed to be normally and independently distributed with a mean of zero and constant variance

RESULTS AND DISCUSSION

Breeding objectives

Breeding objective is the reason (s) for which animals are specifically bred for, assuming that farmers have made a deliberate choice to genetically improve the next generation of animals in terms of their performance in relation to their parent generation. In Guraghe Zone, local farmers had a clear hierarchy for their production objectives, with high importance of livestock functions linked to crop production, such as milk production, draft power and a savings. Strong desire for milk production might be related with culture of Guraghe people which is known in consumption of traditional foods made from milk and milk products. Additionally, the importance of draught power, saving and manure functions, underline the strong integration of crop and cattle production in the study area. Similar to the current study, Tekleyohannes et al. (2012) noted that in the crop-cattle livestock production environment farmers will prefer hardy and docile animal. In general, our finding is comparable with the findings of similar studies conducted in Kenya and southern Mali (Mwacharo and Drucker, 2005; Traoré et al., 2016).

Trait preferences

A trait is any observable or measurable characteristic of an animal, and we usually characterize them either in terms of appearance or performance or some combination of both. Thus, for effective and sustainable breeding programs, breeding research should ensure that improved genotypes maintain the traits that are preferred by owners. In this study, milk production, fertility and growth rate rank between one to three in terms of importance (Tables 1,2). There was variation in the third rank preferential traits across agro-ecologies. Unlike the highland and lowland farmers, midland farmers give attention for draft power instead of growth rate. The preference for draft power traits might be unconnected to availability of irrigable farm land in the area. These results are in line with Wurzinger et al. (2006) who found that milk yield, fertility and body size were ranked highest by Ankole cattle breeders in different production systems in Burundi, Rwanda, Tanzania and Uganda. These traits were also scored higher by goat, sheep and cattle keepers as selection criterion in recent findings of Ejlertsen et al. (2013) in The Gambia. The significance of production and fertility traits emphasized by farmers might be related to the revenue from product sales related to a genetic change in the target trait. Contrary to our results, Tabbaa and Al-Atiyat, 2009 found that livestock farmers in general place more weight on morphological selection criteria (subjective selection) than production selection criteria. The discrepancy could be the selection criteria differ with breed, herd size, production system and marketing opportunities available in their area (Tabbaa and Al-Atiyat, 2009; Kebede et al., 2012).

Breeding practice

The breeding practices that reported in the study areas were mostly natural mating but AI also rarely practiced. Majority of the respondents 93.3%, 80%, 75% from lowland, midland and highland respectively; reported that natural mating is common breeding system of dairy animals, however, practice of AI service was very rare in all studied areas (Table 2). According to focus group discussion, the low adoption of AI was due to lack of efficiency of artificial insemination, the cost of artificial insemination is not affordable by small holder farmers and the absence of technological intervention to introduce foreign (improved) breed in the area affects the dissemination of AI

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technology in Guraghe Zone. In line with the current study, Desalegn (2008) reported similar constraints for the low adoption of AI in Ethiopia.

Table 1 - Breeding objectives of Guraghe highland cattle keepers in Guraghe Zone

Breeding objectives	Agro-ecology						Overall (n=180)	
	Highland		Midland		Lowland			
	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank
Ceremonial & dowry	62(0.05)	6	103(0.08)	6	54(0.05)	6	219(0.06)	6
Draught power	250(0.2)	2	220(0.18)	2	206(0.17)	2	634(0.19)	2
Manure	133(0.11)	4	156(0.13)	5	158(0.13)	5	447(0.13)	5
Milk for home consumption	329(0.26)	1	378(0.31)	1	312(0.26)	1	1019(0.29)	1
Milk & product for sale	132(0.10)	5	195(0.16)	3	176(0.15)	3	503(0.14)	4
Prestige	14(0.01)	7	22(0.02)	7	19(0.02)	7	55(0.02)	7
Saving	221(0.18)	3	188(0.15)	4	164(0.14)	4	615(0.16)	3

N=number of observation (households); Index=the sum of (7 times first order + 6 times second order +5 times third order + 4 times fourth order + 3 times fifth order + 2 times sixth order + 1 times seventh order) for individual variables divided by the sum of (7 times first order + 6 times second order +5 times third order + 4 times fourth order + 3 times fifth order + 2 times sixth order + 1 times seventh order) for all variables.

Table 2 - Trait preference and breeding practice in Guraghe zone

Farmers trait Preferences	Agro ecology						Over all (n=180)	
	Highland (n=60)		Midland (n=60)		Lowland (n=60)			
	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank	N(Index)	Rank
Longevity	138(0.12)	5	186(0.16)	3	128(0.11)	5	444(0.13)	5
Fast growing calves	220(0.18)	3	167(0.14)	5	222(0.19)	3	609(0.18)	3
Traction ability	219(0.18)	4	172(0.14)	4	217(0.18)	4	608(0.17)	4
Milk yield	271(0.23)	1	249(0.21)	1	252(0.21)	1	772(0.22)	1
Fertility	226(0.19)	2	210(0.17)	2	231(o.19)	2	667(0.19)	2
Temperament	126(0.11)	6	126(0.11)	6	120(0.10)	6	380(0.11)	6
Breeding practice	N=60	%	N=60	%	N=60	%	N=60	%
AI	15	25	12	20	4	6.67	31	17.22
Natural mating	45	75	48	80	56	93.3	149	82.78

AI= artificial insemination, N=number of observation (households), %= percentage; Index=the sum of (6 times first order + 5 times second order +4 times third order + 3 times fourth order + 2 times fifth order + 1 times sixth order) for individual variables divided by the sum of (6 times first order + 5 times second order +4 times third order + 3 times fourth order + 2 times fifth order + 1 times sixth order) for all variables.

Milk Production Performance

Morning and evening daily milk yield. The overall least squares mean of morning and evening milk yield of Guraghe highland in the follow up study were 0.99±0.02 and 0.73±0.02, respectively. The mean value found in this study is lower than morning and evening milk yield reported for cross bred dairy cows in Jimma (Belay et al., 2012). Lactation phase, lactation month and parity had significant effect on MMY and EMY, while agro-ecology had no significant (P>0.05) effects on (Table 3). In all aspects the milk yield was observed significantly higher in the morning than in the evening for the three phases of lactations. The highest value of morning and evening daily milk yield was observed in the first phases of lactation than second and third phases of lactation, respectively. The lowest milk yield in the first lactation phase is due to the fact that cows that were anestrous during the first 63 days postpartum consumed less feed, produced less milk, and lost more body reserves than cows that resumed estrous activity prior to 63 days in milk (Staples et al., 1990). The subsequent rate of increase in the second stage of lactation is due to increase feed intake and cows experience a period of significant negative energy balance in early lactation and need to mobilize their tissue reserves to supply substrates and energy for milk production and nonmammary tissues needs (Bell and Bauman, 1997).

Similar to the present study significant effect of parity was reported for Holstein Friesian cows in Ethiopia (Destaw et al., 2016). The results of the current finding revealed that lactation milk yield look like linearly increasing from 1st to 3rd parity. This increasing trend might be due to the increase in body weight combined with advancing age at full development of secretary tissues of the udder.

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Morning and evening milk yield of monitored Guraghe highland cows were significantly influenced by the respective lactation months. The average morning and evening milk yields were gradually increased from Jun to August. The significant effect of lactation months could be related with availability of feed resource, since in June it is well known that cows reduce production with either acute or chronic exposure to feed shortage, whilst in wet season (July and August) the availability of green forages is better. Similar to current study significant effect of lactation month reported on morning and evening milk yield of Holstein Friesian cows in Ethiopia (Destaw et al., 2016).

Daily milk yield. The overall mean daily milk yield per cow from survey data was 1.7 liters (Table 4). The overall daily milk yield per cow in the present study was comparable with 1.8 liters/cow/day for Horro cattle in eastern Wollega reported by (Alganesh, 2002). A similar result was reported for local cows for pre urban production system central zone of Tigray, Ethiopia (1.87±0.79 liters/day) (Gebrekidan et al., 2012). Moreover, the value of daily milk yield per cow obtained in the current study is comparable with earlier report for national level (1.377 liters) (CSA, 2010). This low productivity Guraghe highland caws under smallholder management conditions could be due to lack of proper supplementary feeding for the dairy cattle, poor nutritive value of pastures and forages offered to the animals.

Table 3 - Lest square means and standard errors of Morning and evening milk yield of Guraghe highland cows under farmers management in Guraghe Zone

Factors	Milking time			
	MMY		EMY	
	N	LMS±SE	N	LSM±SE
Over all mean	90	0.99±0.02	90	0.73±0.02
CV (%)		14.9		19.6
Lactation phase		*		**
phase 1	44	0.95±0.04^{a}	44	0.71±0.03^{a}
phase 2	30	1.02±0.03^{b}	30	0.75±0.03^{b}
phase 3	16	0.81±0.05^{c}	16	0.74±0.04^{c}
Parity		**		**
1	18	0.92±0.04^{b}	18	0.41±0.05^{b}
2	24	0.99±0.04^{a}	24	0.72±0.03^{a}
3	48	1.00±0.02^{a}	48	0.81±0.02^{a}
Agro ecology		NS		NS
Highland	30	1.00±0.03	30	0.73±0.02
Midland	30	0.96±0.03	30	0.71±0.04
Lowland	30	1.02±0.03	30	0.70±0.03
Lactation Month		**		*
Jun	23	0.94±0.03^{b}	23	0.61±0.03^{b}
July	41	0.96±0.03^{ba}	41	0.78±0.03^{a}
August	26	1.04±0.03^{a}	26	0.79±0.03^{a}

**P< 0.01; *P<0.05; NS= Not Significant. Means with the same letter are not significantly different MMY= Morning milk yield, EMY= Evening milk yield

Table 4 - Production and reproductive performances of Guraghe highland cows in Guraghe Zone

Traits	Agro-ecology			Overall	*p* value
	Highland	Midland	Lowland		
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
DMY	1.70±0.11^{a}	1.75±0.31^{a}	1.65±21^{a}	1.70±0.05	0.06
LMY	402.43±22.89^{a}	412.63±23.32^{a}	393.42±28.21^{a}	402.14±12.11	0.21
LL	7.90±0.12^{a}	7.86±0.17^{a}	7.80±0.13^{a}	7.90±0.08	0.13
AFS	33.20±1.21^{a}	31.40±1.59^{a}	37.38±1.46^{b}	33.51±0.70	0.01
AFC	42.53±1.21^{a}	40.73±1.59^{a}	46.71±1.46^{b}	42.85±0.70	0.01
CI	21.69±0.48^{a}	19.61±0.54^{b}	22.44±0.78^{a}	22.03±0.37	0.02
DO	12.36±0.48^{a}	10.28±0.54^{b}	13.11±0.78^{a}	12.70±0.37	0.04

LMY=lactation milk yield, LL=lactation length, AFS= age at first service, AFC= age at first calving, CI= calving interval, Do= days open, SE= Standard error

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Lactation milk yield. In this study the average lactation milk yield of Guraghe highland breed was 402.49±12.11kg. The value obtained in the current study is comparable with the average value reported by Ababu et al. (2004) for locals (399.5 liters/cow/lactation) in Degem district, Ethiopia. However, the result obtained in this study is lower than the mean of 947±42.3 litres in Boran and 1201±37.9 litres in Horro breeds in Ethiopia (Gebregziabher et al., 2013) and 550 litres in Horro breed and 645 litres in Begait breed (Rege et al., 2006). Such variability might be due to difference in genetic material (breed), availability of the feed resource and other husbandry practices. This result indicated that agro ecology could not be the factor of lactation milk yield of Guraghe highland cows (Table 3). In contrary to the current finding the significant effect of agro ecology was reported on lactation milk yield of Holstein cattle (Destaw et al., 2016).

Lactation length. The average lactation length of Guraghe highland cows was 7.90±0.08 months. This agrees with the report of Gebregziabher (2013) who indicated that an average lactation length of Horro cows 7.8 months. However, the current result is lower than the 9.5 months reported by Lemma et al. (2005) for local cows in the East Showa Zone and 9.13±2.63 months North Shoa Zone, Ethiopia (Mulugeta and Belayeneh, 2013). Moreover, the LL of the indigenous cows observed in this study was almost similar with the national average (7 months) (CSA, 2005). However, the estimate of average lactation length in Guraghe highland cows were shorter than the standard lactation period of 305 days.

Reproductive Performance

Age at first service. The overall estimated mean age of heifers at first service was 33.51±0.70 months. Our finding was slightly higher than what has been reported for Boran breeds in Southern Ethiopia (Adugna and Aster, 2007), but closer to those reported for Horro cattle in West Wallaga (Alganesh et al., 2004). The longer age at first service and calving in Ziway area might reflect later maturity. Nutrition and overall management of the cow can impact the circulating concentrations of hormones and metabolites, and these alterations can have positive and negative impacts on reproductive performance. Therefore, improved management levels such as good nutrition, housing and health care enhance growth rate of heifers to come on first heat at early age.

Age at first calving. The mean age at first calving was found to be 42.85±0.70 months. Our finding is comparable with 39.8±5.6 months of AFC for local caws (Tadele and Nibret, 2014). Lower mean AFC is recorded as 33.8 months reported in Arsi breed in Ethiopia (Gabriel et al., 1983). However, the mean age at first calving revealed in this study is shorter than the mean of 60 months in Begait breed, 53.4 months in Fogera breed and 53 months in Horro breed reported by Rege et al. (2006). Similarly, 1729.9±58.2 days reported in Boran cows at Tatesa cattle breeding center in Guraghe Zone, central Ethiopia Yifat et al. (2012) and 47.16±8.7 months in local cows in Chacha Town, North Shoa Zone, Ethiopia (Mulugeta and Belayeneh, 2013).

Calving interval. The average calving interval of Guraghe highland cow was 22.03±0.37 months. The mean calving interval observed in the present study was comparable with the reported values of 21.36±3.84 months (Belay et al., 2012), 666 days in Ginch watershed in Ethiopia (Getachew, 2002); 622.6±15.3 days in Boran cows at Tatesa cattle breeding center in Guraghe Zone, central Ethiopia (Yifat et al., 2012). On the other hand, it is significantly higher than the reported values of 527 days in Horro breed, 525 days in Fogera breed and 458 days in Begait breed (Rege et al., 2006) and 431.08±78.03 days for indigenous cows in and around Mekelle (Kumar et al., 2014). Our result indicates that CI is longer than the ideal value of 365 days (Khan et al., 1992). This might be due to poor oestrous detection, silent heats, poor feed quality and health care and poor management.

Days open. In this study the average days open till conception was 12.70±0.37 months. This finding was comparable with reports of Yifat et al. (2012) being 340.3±15.8. The present result indicates prolonged days open beyond ideal, of 90 days interval. Feed shortage, silent estrus, lack of proper heat detection and nutritional deficiencies coupled with heavy internal and external parasite load on the cows might have other contributory factors for long DO reported in this study. Similarly, Tadesse and Zelalem (2004) reported that increasing the level of protein supplementation from low (2 kg/day) to high (4 kg /day) reduced post partum interval from 159 to 100 days in Borana x Jersey crossbred cows.

CONCLUSION

Cattle production was found to be an important enterprise and significantly contribute to poverty alleviation, food security, improved family nutrition and income and youth employment. The assessment showed that the breeding practices of the study areas were mostly natural mating although also rarely practiced. Cattle production in Guraghe Zone is multipurpose of which Milk production, draft power and saving were the main breading objectives of small holder farmers. Similarly, farmers were give strong emphasize on milk production, fertility and growth performance traits. Productive and reproductive potential of Guraghe highland cow found to be less than the optimum values desirable for profitable milk production. Since the multipurpose use and as such no specialized

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and systematic breeding is used it may be wrong to say indigenous breeds as low potential simply putting them in a harsh condition as concept of genetic potential should be related to the condition in which the animals are expected to perform. Therefore, this calls for a planned technical and institutional intervention for improved support services for appropriate breeding programmes based on farmers trait preference and breeding objectives. Moreover, in line with this, a sustainable extension service to improve animal feed resources management and animal health care also deserve due attention.

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Authors' Contribution

WA and TF designed the research, analyzed the data, interpret the results, drafted the manuscript and writ up the manuscript. At last the authors revised the manuscript, read and approved the final version.

Conflict of interests

The authors have not declared any conflict of interests.

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