

Research Article

Characterization of Oasis Livestock Systems in the Region of Béni Abbès (Southwestern Algeria)

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Abstract | This study aims to characterize oasis livestock systems, through a typological analysis of their structure, management and zootechnical performances in the Saharan region of Béni Abbès (southwestern Algeria). The methodology adopted is based on field observations and a series of surveys with 55 oasis farmers in the three selected oases (Béni Abbès, Oued Khoudir, Tabelbala) in the wilaya of Béni Abbès. The results reveal the intensification of crops in association with livestock practices in oasis agrosystems. The production systems are characterized by intensive crop systems (three-stage: Phoeniculture, Arboriculture and herbaceous crops) associated with livestock farming mainly consisting of small rustic ruminants with a good ability to adapt to desert conditions. The main types of livestock farming practiced in the oases are sheep, goat and poultry farming. These animals are well adapted to eco-oasis conditions, characterized by a continental desert climate. The main activity of the farmers 86% of the farms surveyed is mixed (crop-livestock) and 14% are of the crop-only type. It should be noted that livestock farming in oasis systems is based on family farming based on isolation, where sheep are separated for fattening, while goats and ewes are tangled for giving birth and milking, and chickens are raised for laying. Oasis livestock farming occupies a prominent place on the socio-economic level for local populations in order to satisfy the family's needs for milk, meat and eggs; and to provide manure for maintaining the fertility of the farms' soil.

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Introduction

The Algerian Sahara is a vast area extending across the south of the country and is considered one of the largest deserts in the world. It covers an area estimated at about 80% of the total area of the country, is home to lush and surprising oases, where

the inhabitants have managed to cultivate crops and raise animals (Chehma, 2012).

Oases are desert areas containing green spaces and water sources in a hostile environment, also an important source of agriculture and providing shelter to diverse plant and animal life (Jouve, 2012). By

combining several plant and animal productions, oasis farmers managed to maintain a balance of more efficient and high value-added production systems. Through these multiple functions, livestock farming associated with oasis production ensures a high level of productivity for oasis production systems (Dollé, 1990).

According to Lhoste (1984), the livestock system is a set of techniques and practices implemented by a community to exploit, in a given space, plant resources by animals, in conditions compatible with its objectives and with the constraints of the environment. In the oasis, domestic livestock farming is considered a complementary and essential activity of the oasis economic activity. Despite the destabilizing issues of agricultural activity, livestock farming remains a tradition of the oasis dwellers (Salhi, 2017).

Maghreb livestock systems have always been characterized by the mobility of breeders and herds, in search of pastures to support the herd and families. However, this mobility has changed over time. Some breeders no longer move and hire salaried shepherds; the richest breeders sometimes even have their sheep transported in trucks (Deleule, 2016).

In the Algerian southwest and for centuries, farmers, oasis breeders, have developed diversified agricultural systems, in accordance with their ambient conditions, using techniques and practices, proven over time, in order to provide a fundamental ecological and economic, cultural and social whole (Bessaoud, 1999; Amrani, 2021).

The aim of this work is to clarify the characteristics of mixed oasis farming, to study the specificities of livestock farming practiced in the oases of Béni Abbès, such as the species of animals raised, the methods of reproduction and feeding used, as well as the traditional systems of herd management.

Materials and Methods

Study area

Béni Abbès is a newly created wilaya by law 19-12 of December 11, 2019 on the regional organization of the country. It includes 06 Daïra and 10 communes with a total area of approximately 112,000 km², and a population of approximately 60,000 inhabitants. It is located in the southwest of Algeria in the Saoura

region (Figure 1). It is located in the middle, between the wilaya of Béchar to the north, and the wilayas of Timimoune and Adrar to the south, on national road No. 06. It includes twenty-eight oases, according to the Directorate of Agricultural Services. The main activity of the population of Béni Abbès is agriculture associated with livestock breeding. The number of farmers is 546 in the study oases (Béni Abbès, Ouled Khoudir and Tabelbala) (DAS, 2022).

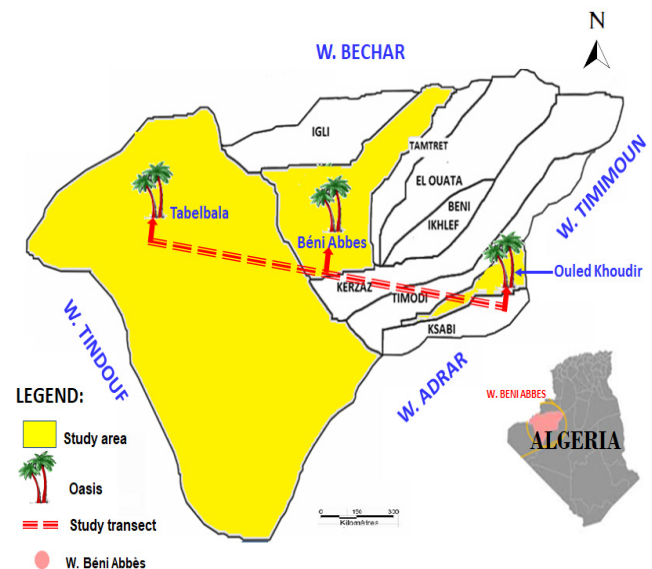


Figure 1: Geographical location of the study area (Modified Map, DAS, 2022).

The Béni Abbès region is characterized by a temperate Mediterranean climate, desert, with a hot and dry summer, a cold winter, characterized by low rainfall which represents only 92 mm of the annual total and fluctuations from one season to another (Benaradj, 2010; Benaradj, 2017).

Choice of study stations

The choice of study stations is based on three oases following a North, Center and south transects (Tabelbala; Béni abbès; Ouled Khoudir) in the wilaya of Béni Abbès (Figure 1). The reason for this choice is justified in order to have a general regional vision of existing oasis agrosystems at the level of the wilaya of Béni Abbès.

Methodological approach

The method used is the process of a series of surveys in the form of a questionnaire, which is maintained by field observations. This affects several compartments or aspects such as the identification of farms, their nature, the real estate framework, the status and area, the social profile, the level of education and the age of

the farmer-breeder, in addition to the management of herd production and marketing, type of breeding and feeding. A total of 55 oasis farmer-breeders participated; the survey lasted three months (from February 10 to May 15, 2022). The visits or passage was carried out at a rate of two or more times, if necessary.

Information was collected on the location of farms and farmer-breeders from the list of farmers obtained from the Directorate of Agricultural Services of the Wilaya of Béni Abbès, the information was collected from veterinarians and agricultural subdivisions (Table 1).

Analysis of surveys

A review of the questionnaires will facilitate our subsequent data analysis. The analysis consists of displaying all the parameters and indicators taken into consideration for each site surveyed. The survey data are processed by Microsoft Excel (2010) software.

Results and Discussion

Socio-economic situation of farmer-breeders

The age of the farmer-breeders interviewed in the three study oases (Béni Abbès, Ouled Khoudir and Tabelbala) varies from 34 to 66 years; the average age is 53 years. For the case of the Ouled Khoudir Oasis is 48 years, and for the 2 Oases Béni Abbès and Tabelbala (54 years). This explains the predominance of the average age group of over 34 years (adults) for this type of livestock which represent 42% of the farmer-breeders interviewed and this is due to the customs of the region and the traditions of the oasis society, as well as certain environmental difficulties and the absence of state subsidies (Figure 2a).

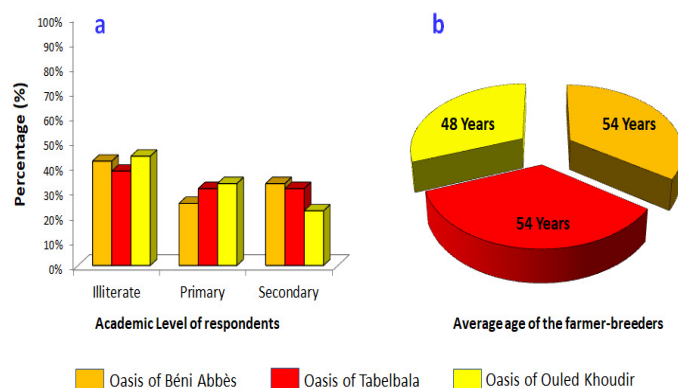


Figure 2: Distribution of breeders surveyed according to (a, age of the farmer-breeders; b, Academic level of farmer breeders).

Since ancient times, farmers in oasis regions have

known how to combine agriculture with livestock farming, and farmer-herders have lived since childhood. Livestock farming is the main activity and almost all respondents, 100% of them have no other activity.

About 42% of the surveyed farmer-herders have no education or illiteracy, and 30% have a primary level, 28% have a secondary level and those with a university level represent 0% of the total (Figure 2b). Oasis agriculture is characterized by the low level of education, which is a criterion that limits the introduction of new techniques (Boumadda, 2019).

According to Salhi (2017), domestic livestock farming is generally carried out by women. They milk, clean the stables, feed the livestock and collect eggs.

Status and area of farms

The real estate character has a close relationship with the area of farms, especially in oasis systems. This indicates that the Oases are old and that its history is rooted throughout history in the study oases. In the study oasis, the land status of the majority of farms consists of inherited land (Figure 3a).

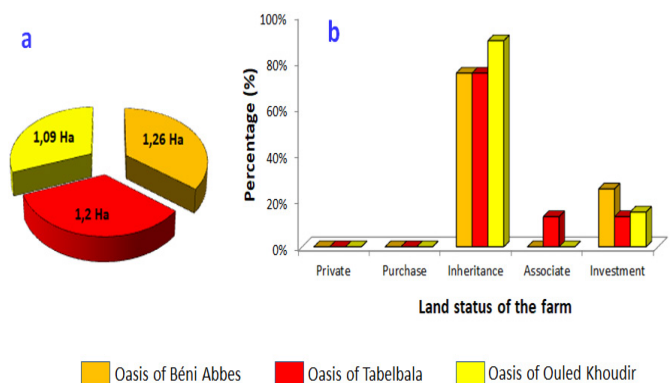


Figure 3: Status and area of farms in oasis of Béni Abbès (a: Status of the owners of the farm, b: area of farm).

The area of the farms is limited between 0.4 and 3 hectares approximately, and this is due to the initial degree of the nature of the property, which is 80% patrimonial inheritance, the rest 16% investment and 4% partnership. The average area of the farms studied in Tabelbala was 1.2 hectares, Béni Abbès 1.26 hectares and Ouled Khoudir 1.09 hectares (Figure 3b), which partly explains the small extent of the farms (Otmame and Bendjeldi, 2018).

What indicates a fragmentation is very important in the study oases. Indeed, the problem of fragmentation

Table 1: *Geographic coordinates of the study oases.*

Study oases	Coordinates	Area (ha)	Number of farmers surveyed
Oasis of Béni Abbès	30° 7' 60"N and 2°10' 0"W	42	12
Oasis of Tabelbala	29°24'22"N and 3°15'33"W	400	16
Oasis of Ouled Khoudir	29°15'16"N and 1°3'27"W	541	27

is much accentuated, this largely explained by the impossibility of extending the exploitations and the rules of inheritance. Similar results are noted like Algerian oases and the oases of North Africa (Ben Khalfallah, 2019; Otmane, 2019; Boumadda, 2019; Benaradj *et al.*, 2020; Boucherit *et al.*, 2020; Adair *et al.*, 2022; Gharbi and Elloumi, 2023; Amrani and Senoussi, 2023).

Composition of livestock

In the study oases, the livestock consists of 63% sheep (*Ovis aries*), 20% goats (*Capra hircus*), 16%), poultry (*Gallus gallus domesticus*) and 1% cattle (*Bos taurus*).

The Table 2 summarizes the statistical results of the surveys carried out across the study area and concerning the practice of livestock farming.

In the farms surveyed, 86% are considered mixed, plant production (production of dates, cereals, fodder, vegetables, etc.) and animal production (sheep, goat, cattle and chicken farming) (Figure 4).

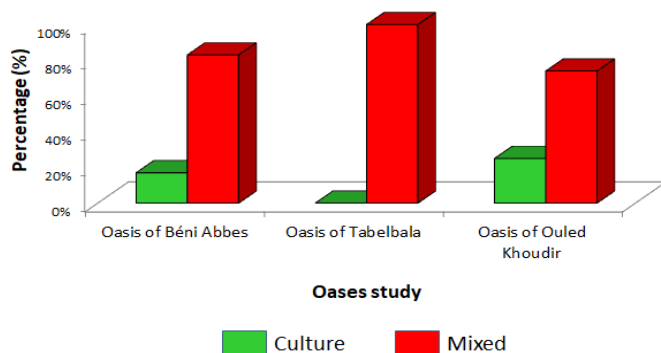


Figure 4: *Distribution of activities in the oases studied.*

As in other agro-ecosystems in the southern Mediterranean, the traditional crop-livestock association is a way of dealing with adversity (Alary *et al.*, 2012). The breeding of small ruminants is represented by reduced numbers of sheep and goats associated with the date palm (Boubekeur, 2010).

In the majority of the farms studied, livestock farming is a family heritage from grandparents and then from fathers to sons.

The majority of respondents practice mixed farming where sheep are associated with goats in the study oases. To this end, the practice of breeding constitutes a main component for this type of oasis farms.

Table 2: *Specific composition of livestock (number of heads).*

Study oases	Sheep	Goats	Cattle	Poultry
Oasis of Béni Abbès	116	44	0	26
Oasis of Tabelbala	244	62	4	72
Oasis of Ouled Khoudir	114	49	0	19
Total	474	155	4	117

Types of livestock systems

Oasis farms are mainly run by two livestock systems depending on the availability of feed and drinking water:

- Family livestock system is made up of small-scale sheep/goat livestock in permanent housing and “living with the family” and strongly associated and linked to the crop system
- Semi-extensive livestock system, it is generally conducted in mixed herds (sheep, goats) mobile. It is therefore based essentially on pastures outside oases according to the availability of grass and rainfall in the rangelands.

Farmers are increasingly turning to sheep and goat farming (Abderrazak *et al.*, 2006).

Livestock size

In the oases, these are small mixed family herds (sheep and goats). The animals are permanently exploited in the oasis and integrated into the farm.

The size of the herd, the farmer-breeders interviewed, the size is 6 to 20 heads of sheep, 2 to 7 goats and 2 to 5 chickens, approximately in the oasis of Béni Abbès. As for the oasis of Ouled Khoudir, the sheep are 5 to 23 heads, the cows 0 to 4 heads, the goats 1 to 7 heads and 2 to 8 chickens. As for the Tabelbala Oasis, 5 to 16 sheep, 1 to 7 goats and 1 to 2 chickens.

Regarding the distribution of livestock, in the oasis of Ouled Khoudir, for sheep farming, 40% have less than 10 heads and 60% have more than 10 heads. For goats, 52% have less than 4 heads and 48% have more than 4 heads. In the oasis of Béni Abbès, for sheep farming, 33% have less than 10 heads and 67% have more than 10 heads. For goat farming, 30% have less than 4 heads and 70% have more than 4 heads.



Figure 5: Types of livestock farming (a, Sheep; b, Goat; c, Mixt: Sheep and goat).

For Tabelbala sheep farming, 50% have less than 10 heads and 50% have more than 10 heads. Concerning goat farming, 38% have less than 4 heads and 62% have more than 4 heads (Figure 5). As is common, breeds in oasis areas have a great variety, we can find all breeds. In sheep, we find the local types, hybrids, *El-hamra*, *Ouled-djallal*, the *Sédauin* breed and the *D'man* breed the most representative and famous, where their percentage can exceed 70%, as for goats, the same thing, because the *Arbia* breed is considered the most representative in the farms studied because of its adaptation to difficult environmental conditions and its known production.

Indeed, for the majority of breeders-farmers, goats are mixed with female sheep and sometimes even domestic chickens. Small ruminant or short-cycle animal breeding (rabbit and poultry breeding) participate more easily in covering the household's food needs without engaging in a process of decapitalization (Alary *et al.*, 2011).

Livestock management

Animal breeding habitats in oases: Livestock buildings are one of the important elements that influence the animal production process. For good management, good monitoring and control of livestock, the construction of a sheepfold or breeding place is necessary.

These livestock buildings are small and tiled and contain the minimum equipment necessary for

feeding and watering animals to carry out this livestock activity (feeders, water troughs, etc.).

In the farms surveyed, the animals are housed in the village itself in old disused premises and certain types of livestock the animals live under the palm grove. In the majority of the farms visited, 100% of livestock is raised in an enclosed environment in shelters (*Zriba*, *Stables*, *Gourbis* often fragile) which include an exercise area and a covered corridor. For most old houses, these shelters are generally built of clay or stone with sheet metal, zinc or dry palm roofs. They are generally divided into a number of parts according to the species and categories of animals raised: one part for sheep, another for goats and a part reserved for weaning the young.

The same findings are reported by Boubekur (2010), in the case of the oases of Adrar (Algeria) and Alami *et al.*, (2005) and Sraïri *et al.* (2024) in the case of oases in Morocco. Sheep and goats are kept in stables enclosed by wire mesh or in hard. Chickens are released into the open air on the farm. According to Salhi (2017), livestock farming in oases is generally carried out in stables in rooms on the terrace of houses or in courtyards behind the house.

Reproduction management: In these oasis farms, the herd reproduction management is very traditional (total freedom of animals of all categories combined for both sheep and goats). For sheep herds, rams are permanently with the ewes, resulting in lambing's spread out throughout the year. Concerning goats, the reduced number of male goat heads is observed in 82% of the farms surveyed and it forces the farmer to call on loans of goats from other farmers. This management suggests the existence of inbreeding problems due to the use of the same goat in the farms during several breeding cycles with often unknown animal origins (Boubekur, 2010; Sraïri et Bentahar, 2021).

Feeding habits of small ruminants (Food sources): In the study oases, the feed sources provided to the animals vary from one farm to another depending on the available resources, crops and the agricultural season. Feeding is an important indicator in livestock management during the different physiological stages of the animal (production and health). The livestock feed resources come mainly from several sources by the oasis farmers. The livestock feed is mainly based

on green fodder, such as weeds, alfalfa, green cereals (barley, sorghum), as well as fibrous foods such as straw and hay.

Indeed, farmers give more importance to fodder crops (case of *Medicago sativa*) in relation to the importance of livestock in the production system. Farmers generally supplement their ration according to the nature and availability of concentrated feed for sheep and goats (corn grains, wheat, barley grain, date waste and dry bread. In the farms studied, it is common for farmer-breeders to directly use palm grove harvest waste and cereal residues to feed their animals.

The frequency of distribution of food rations is mainly twice a day (morning and evening) for sheep and goats for the watering of animals is proportional to the high number, the species, the season (climatic conditions) and the nature of the feed distributed.

Livestock feeding is presented by the following sources:

- Cereal by-products Cereal straw and stubble are crucial feed resources. In summer, when other fodder is scarce or non-existent, cereal stubble becomes a valuable source of feed for livestock.
- By-products of the date palm (are stored and given whole or crushed

The date palm generates a wide range of by-products that can be used to feed livestock. These practices, established for a long time, are commonly used by local breeders. Among the most frequently valued by-products, we mainly find:

- Date waste, the constituents are very varied, immature date, spoiled dry date, not having reached the ripening date, lacking water and nutrients. And dates attacked by birds and others and crushed date.
- Date pits
- Dry palms
- Date pedicels
- Household food waste (vegetable residues, dry bread, etc.);
- Harvest residues: bean tops, corn residues, straw, olive leaves dry
- Waste and residues from market garden crops (carrot and onion leaves, bean stems, etc.).

Importance of family farming in the study oases

The practice of domestic livestock farming is

widespread in oasis farms. Generally, in the study oases, the production of family-type livestock farming is intended for family self-consumption and the surplus production is intended for sale on the local market (for trade).

[Salhi \(2017\)](#), indicates that products in large quantities are marketed at the local market or purchased locally by traders from other neighboring areas.

Livestock production is largely oriented towards self-consumption. Meat and milk, as well as leather and wool, and a small percentage for sale or exchange with other products such as dates, which are generally dominant in oasis systems, this trend is focused on the valorization of these products and the perpetuation of the continuity of these systems. This has been highlighted by many researchers from Mediterranean countries such as Morocco ([Chentouf et al., 2005](#)).

Milk production

The majority of farmers practice livestock farming for milk production. Milk production in the family farms surveyed is provided by goat herds. The dairy goat is present in all the farms studied, but in very small numbers (1 to 3 goats).

According to [Gaddour et al. \(2008\)](#), the low milk productivity of the local goat in oasis family farms seems to be due to insufficient food resources or perhaps to its limited genetic potential. Thus, goats are milked manually and carried out once a day by women. The relatively low milk production is intended primarily for family self-consumption or possibly as a supply for neighbors ([Bouebkr and Benyoucef, 2014](#)).

[Romdhane and Abdeladhim, \(2008\)](#) in Tunisia dairy livestock farming (goat, cow), considered a saving crop and a way to avoid the abandonment of oases, is practiced in a poorly controlled and uncontrolled manner.

Meat production

In the study oases, meat production is intended for family self-consumption. According to [Bouebkr and Benyoucef \(2014\)](#), the role they can play in covering the regular protein needs of the population is therefore limited.

Slaughtering is carried out for the occasion of socio-religious festivities where a few heads, generally

sheep, are sacrificed to celebrate them. Among these festivities we can cite wedding ceremonies, child circumcisions, returns from Umrah or Hadj without forgetting the most important this is the sacrifice festival of Aid Adha (El-Kebir). These cases are observed throughout the Maghreb territory (Alary and Boutonnet, 2006; Bouebkr and Benyoucef, 2014; Benaradj *et al.*, 2020).

Egg production

In oases, poultry is an integrated part of livestock farming. Generally, poultry farming is widely practiced according to traditional methods, especially laying chickens of Arab strain for egg production.

According to Salhi (2017), the search for eggs of Arab strain hens for medical (therapeutic) purposes suggests a future for this livestock farming in this oasis.

Manure production

Oasis livestock farming provides significant quantities of manure, used for fertilizing agricultural land, and therefore contributes to improving the yields of different crops in a global manner and fodder crops to ensure livestock feed. Manure is represented as a source of supply for oasis farming in organic manure for soil fertilization and preparation of plant production.

The organic matter essential for the fertility of the plots of the oasis plantation comes mainly from the livestock farming activity of the stables distributed in the different oasis dwellings. This manure is a supplementary production allowing the integration between crops and livestock farming, depending on the size of the livestock and the farm, the needs of the oasis plantations.

The recovery and easy use of manure, requested by farmers for the organic amendment of the date palm, also predicts a certain future for this livestock activity (Salhi, 2017).

Other productions (animal by-products)

These are by-products from milk derivatives (butter), wool (weaving) and skins. These local products are made by local women in homes at the study oases. They are intended for self-consumption and marketing, part of them on the local market.

Conclusions and Recommendations

Livestock farming in southwestern Algeria contributes to the local economy by providing meat, milk and other animal products. In addition, it plays an important role in preserving the region's oasis traditions and way of life.

For centuries, the Saharan oases of the Béni Abbès region have fed many generations, based on an original organization of the oasis Agro-Systems, based on the efficient use of water and the diversification of crop systems. In the wilaya of Béni Abbès, Oasis livestock farming is of a desert nature, mainly oriented towards subsistence self-consumption to meet the needs of the family.

The average size of the sheep herd is 2 to 20 heads, of local breeds raised for meat. As for the size of the goat herd, it is smaller and is 2 to 7 heads of local breeds raised for milk. The breeding management is traditional. Indeed, the method of livestock farming can be described as intensive family type. This oasis farming can contribute to ensuring food security and constitute an important source to meet the demand of the local population for animal products. Meat, milk, eggs, wool, and leather can be produced using simple breeding techniques and palm grove byproducts (dates and palm residue), fodder, and cereal crops for food.

Farmers can make the most of their available resources by integrating cultivation and livestock farming. The sheep and goats are fed using products from the farm (date waste, straw, barley and alfalfa, crop residues, etc.).

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Novelty Statement

This highlights the importance of Livestock farming in southwestern Algeria contributes to the local economy by providing meat, milk and other animal products. In addition, it plays an important role in preserving the region's oasis traditions and way of life.

Author's Contribution

Lahbib Cheikhi: Conceptualized and designed the study, conducted field surveys, wrote the abstract, introduction, methodology, Overall Management of the article, data collection, Conducted the statistical analysis, wrote the results and discussion, conclusion, and references.

Hafidha Boucherit: Editing of draft, Supervised the research, Analyzed data, reviewed the manuscript, proofread, reviewed the manuscript, Overall Management of the article, performed proof-reading, and revised the manuscript.

Abdelkrim Benaradj: Supervised the research, Conceptualized, designed, and revised the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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