



# Phenotypic Characterization of Kachchhi-Sindhi Horses of India

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## ABSTRACT

**Background:** Kachchhi-Sindhi horses are famous for their 'Rewal chal' (a unique style of running). These horses dominantly exist in the western-northern border of India adjoining Pakistan. The breeding tract of these horses is Surat, Navsari, Kachchh district of Gujarat and Jaisalmer-Barmer districts of Rajasthan in India. Most familiar colors in the Kachchhi-Sindhi horses are bay and chestnut. Roman nose, ears curved at tips but not touching each other, short back, short pastern length, broader hoof for better grip and docile temperament are major characteristics of these horses.

**Methods:** The present study is an effort to phenotypically characterize Kachchhi-Sindhi horse breed based on their different biometric indices for selection and conservation of stallions and mares for breeding purposes by private breeders. Fourteen biometric indices were recorded for phenotypic characterization of each breed viz., height at wither (HW), body length (BL), heart girth (HG), neck length (NL), face length (FL), face width (FW), pole, ear length (EL), ear width (EW), foreleg length (FLL), canon, pastern, hoof length (HoL) and hoof width (HoW). On average, these horses stand 148 cm height, have a body length of ~140 cm, a heart girth of ~165 cm, an ear length of ~15 cm and a face length of ~61 cm.

**Result:** Horse keepers sustain horses in intensive as well as an extensive system of rearing. It has also been ascertained from various sources that horse number is declining rapidly, however, breed population statistics are not available. There is, therefore, an urgent need to conserve this breed. Proper managerial practices and conservation efforts will pave the way for the multiplication of this valuable equine genetic resource of India.

**Key words:** Biometry, Characterization, Horses, Kachchhi-Sindhi, Phenotype.

## INTRODUCTION

Before the beginning of mechanized vehicles, the horse was commonly used as a draft animal and riding on horseback was one of the imperative means of transportation. Presently, horses are an excellent means of transportation in the mountains and hilly terrains. India has seven distinct breeds of horses; Marwari, Kathiawari and Kachchhi-Sindhi are the horses of the northwestern region used for sports and transport, Spiti and Zanskari as pack animals for high altitude temperate Himalayan region and Bhutia and Manipuri as pack and transport ponies of the eastern region. Kachchhi-Sindhi breed of horse has been accessioned (INDIA\_HORSE\_0417\_KACHCHHISINDHI\_07007) recently by ICAR-National Bureau of Animal Genetic Resources, Karnal (<http://www.nbagr.res.in/reghorse.html> retrieved on 6/9/2019). Most of the information on phenotypic characterization is confined mainly to Marwari, Kathiawari, Spiti, Zanskari, Bhutia and Manipuri breeds (Gupta *et al.* 2012a). But, the literature on the phenotypic characterization of Kachchhi-Sindhi horse is very scanty. Earlier, we reported the phenotypic and genetic diversity reports of various horse and donkey breeds (Gupta *et al.* 2012a; Gupta *et al.* 2012b; Gupta *et al.* 2013; Gupta *et al.* 2014; Gupta *et al.* 2015; Gupta *et al.* 2016; Gupta *et al.* 2018) and their conservation along with scientific management and breeding strategies (Pal *et al.* 2013). Studies on phenotypic characters in native livestock is very significant as across animal species in India, many researchers reported the relationship between the production and performance traits with phenotypic characters (Pandey *et al.* 2001; Dixit *et al.* 2009; Chakraborty

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and Dhaka 2012; Nehara *et al.* 2013; Atay and Gokdal 2016; Khan *et al.* 2017; Islaam *et al.* 2018). The present study is an effort to phenotypically characterize Kachchhi-Sindhi horse breed based on their different biometric indices for selection and conservation of stallions and mares for breeding purposes by private breeders. This breed is also called Mustangs of India (<https://timesofindia.india.com/city/chandigarh/indias-only-desert-horse-gallops-into-spotlight/articleshow/65555627.cms> retrieved on 6/9/2019). There are about four thousand Kachchhi-Sindhi horses in India (<https://epashupalan.com/644/animal-husbandry/indias-desert-horse-kachchhi-sindhi-horse-breed-recognized/> retrieved on 11/1/2019). But, true to breed horses of this breed are much less in number than as reported above. For the conservation and promotion of Kachchhi-Sindhi horses, the shepherds of Kutch formed the

Ram-Raheem Kutchi Sindhi Horsepower Cooperative Society in 2008 and the same organized competitions at several places in Kutch for creating awareness about this horse breed in Kutch region (<https://english.newstracklive.com/news/gujarat-horse-racing-tournament-after-kutch-horse-get-recognition-mc23-nu-1060486-1.html> retrieved on 29/01/2020). The government of Gujarat and Rajasthan should come forward with concrete plans and efforts not only for creating awareness among the owners but also for conserving this precious breed. Although, for preservation and propagation of valuable germplasm of Kathiwari horse, Department of Animal Husbandry, Gujarat state has established two horse breeding farm at Inaj, Ta: Veraval and Junagadh. Horse breeding farm for the Marwari breed has been established at Chanasma, District Patan to meet local requirements. On similar lines, horses of Kachchhi-Sindhi breed may be conserved and propagated at any of these farms to upgrade, propagate and conserve the breed. The horses of Kachchhi-Sindhi breed are capable of thriving in hot climates and can survive such adverse conditions such as scarcity of feed and high temperatures (45°C- 50°C). To the best of our knowledge, this is the first report on the phenotypic characterization of Kachchhi-Sindhi horses. Proper managemental practices and conservation efforts will pave the way for the multiplication of this valuable equine genetic resource of India.

## MATERIALS AND METHODS

### Data collection

Fifty adults of 3-32 years old, healthy, unrelated and true to breed horses of Kachchhi-Sindhi breed registered by the Indian National Bureau of Animal Genetic Resources (ICAR-NBAGR) of the Indian Council of Agricultural Research (ICAR), Karnal, India were selected based on their morphological features in their home tracts (Fig 1) in Bhuj (Gujarat, India) and Jaisalmer (Rajasthan, India). The selected animals belonged to the private horse breeders maintaining the animals for the breeding purpose (Samples were collected from farmers door, random sampling was done). Efforts were made to select animals from different

parts of their home tract to include adequate representatives of the breed. The breeding tract of Kachchhi-Sindhi horses is Surat, Navsari, Kachchh (Kutch) district of Gujarat and Jaisalmer and Barmer districts of Rajasthan (Fig 1; Breeding tract of Kachchhi-Sindhi horses). For phenotypic characterization, both biometric indices and some of the salient qualitative morphological characteristics of the breeds were recorded.

### Biometric indices and breed characteristics

Fourteen biometric indices were recorded for phenotypic characterization of each breed viz., height at wither (HW), body length (BL), heart girth (HG), neck length (NL), face length (FL), face width (FW), pole, ear length (EL), ear width (EW), foreleg length (FLL), canon, pastern, hoof length (HoL) and hoof width (HoW). Animals of both sexes (Male-12 and Female-31) were included in this study. Coat color, the texture of hair and the age of individual horses were also recorded. Besides these data, good quality photographs were also taken along with typical breed characteristics for their documentation.

### Statistical analysis

Physical characteristics and coat color were expressed in percentage/frequency. Data on different body measurements were analyzed by using the standard statistical SPSS package (SPSS Inc., 1998).

## RESULTS AND DISCUSSION

The breeding tract of Kachchhi-Sindhi horses is Surat, Navsari, Kachchh (Kutch) district of Gujarat and Jaisalmer and Barmer districts of Rajasthan. The Kachchhi-Sindhi is known as a complete desert horse. Its broader hoofs make it easy to walk through desert sand while the covered nostrils and strong stamina allow it to perform in harsh conditions. The breeding tract of Kachchhi-Sindhi horses is shown in Fig 1.

### Physical characteristics

Distinguished characteristics of Kachchhi-Sindhi horses are mainly the Roman nose, ears curved at tips but not touching each other, short back, short pastern length, broader hoof



Fig 1: Breeding tract of Kachchhi-Sindhi horses.



for better grip. The nasal bone of Kathiawari was concave, while in the case of Marwari it was flat or convex (Gupta *et al.* 2012a) while Kachchhi-Sindhi horses have a distinct Roman nose as observed in this study (Fig 2 and 3). Ears of Kachchhi-Sindhi breed are curved at tips but not touching each other whereas horses of both Marwari and Kathiawari Indian breeds can rotate their ear tips by 180°, leading the tips to meet together at the open end (Gupta *et al.* 2012a). It is famous for its 'Rewal chal' -royal style of running. Rewal in itself a different version of trot and is faster and comfortable for the rider. As per the belief of breeders, it runs rewal faster than the Marwari horses. The horses are docile in temperament.

### Management practices

Kachchhi-Sindhi horse breeders who are farmers by occupation sustain horses in an intensive system of rearing but in the same area owners who are livestock breeders/pastoralists by occupation rear horses in the semi-intensive system. In the Banni area, most horse owners are pastoralist and they follow an extensive system of a horse rearing. Open mating is practiced. Owners usually keep the female horse and avoid keeping stallion. Stallions are very carefully selected, keeping knowledge of their pedigree and physical characters. In the extensive system of rearing, *challa* system (means a ring is put on the vagina) is practiced to avoid unwanted breeding. The herd size per farmer ranged from 1 to 10 horses. The horses are housed in *pucca/kachcha* houses (Fig 4). In Kachchhi area of Gujarat, Kachchhi-Sindhi horses play an important role in the lifestyles of *Maldhari's* by helping them to manage their livestock while grazing and providing entertainment through horse racing and riding.

### Utility

Generally used for transportation of goods or other materials like fodder, raw construction materials. These animals are also utilized for riding, sports, safaris and trading.

### Body colour

Most common colours in the Sindhi horses are bay and chestnut. The predominant colour is bay.

### Body measurements

The least-squares means of different body measurements in adult Kachchhi-Sindhi horses are presented in Tables 1-3. Overall mean $\pm$ SE for various body measurement was recorded to be 147.72 $\pm$ 0.80, 139.69 $\pm$ 1.08, 164.96 $\pm$ 1.30, 46.38 $\pm$ 0.61, 60.74 $\pm$ 0.46, 18.30 $\pm$ 0.27, 14.46 $\pm$ 0.28, 15.30 $\pm$ 0.21, 16.16 $\pm$ 0.16, 103.33 $\pm$ 0.49, 24.97 $\pm$ 0.25, 11.76 $\pm$ 0.25, 12.20 $\pm$ 0.16, 11.38 $\pm$ 0.13 cm for height at wither (HW), body length (BL), heart girth (HG), neck length (NL), face length (FL), face width (FW), pole, ear length (EL), ear width (EW), foreleg length (FLL), canon, pastern, hoof length (HoL), hoof width (HoW), respectively. In respect of locations, non-significant differences were found for all parameters except pole, ear length and hoof length where significant ( $P<0.05$ ) variation was observed. Different body



Fig 2: Full body view of Kachchhi-Sindhi horse.



Fig 3: Facial view of Kachchhi-Sindhi horse.



Fig 4: Housing pattern for Kachchhi-Sindhi horses in their breeding tract horse.

measurements in adult Kachchhi-Sindhi males and females were statistically non-significant (Fig 5). The variations recorded across locations could only be attributed to the variation due to the population included in the study. Otherwise, as such no other reasons seem to be explainable. Interaction of sex and locations significantly ( $P<0.05$ ) affect pole, ear length, pastern and hoof length in Kachchhi-Sindhi horses.

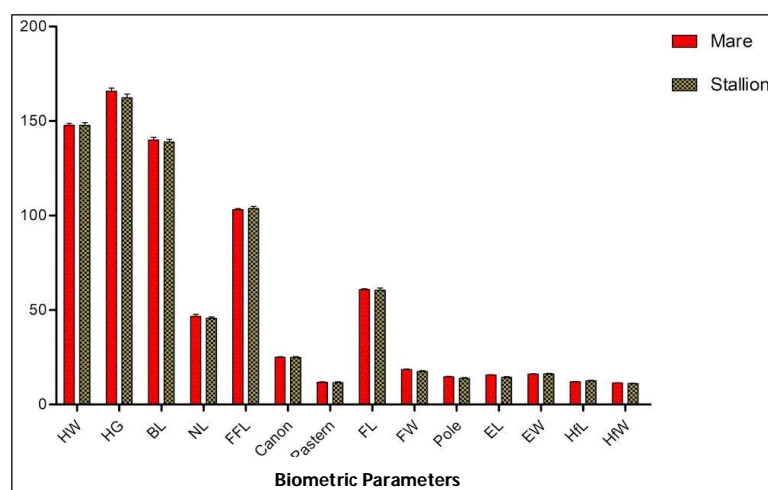


Fig 5: Schematic representation of body parameters in Kachchhi-Sindhi Male and Female horses through bar diagram.

Table 1: Least-squares means (cm), standard errors and number of observations for different body measurements of Kachchhi-Sindhi horses.

Traits/ effects	No. of observations	Height	Body length	Heart girth	Neck length
Overall	43	147.72±0.80 (135-162)	139.69±1.08 (124.5-156)	164.96±1.30 (151-191)	46.38±0.61 (40-54)
<b>Locations</b>					
Jaisalmer	17	147.53±1.46 (141-162)	138.85±1.99 (124.5-156)	165.68±2.03 (153-179)	45.61±0.83 (40-50)
Bhuj	26	147.85±0.91 (140-154)	140.23±1.21 (126-150)	164.48±1.68 (151-191)	46.79±0.77 (41-54)
<b>Sex</b>					
Male	12	147.75±1.41 (135-152)	139.00±1.31 (132-150)	162.36±1.92 (155-174)	45.73±0.67 (40-51)
Female	31	147.71±0.96 (140-162)	139.95±1.39 (124.5-156)	165.89±1.39 (151-191)	46.65±1.09 (41-54)
<b>Locations × Sex</b>					
Jaisalmer male	7	147.00±2.28 (143-151)	138.00±1.29 (132-142)	164.86±2.71 (159-174)	44.43±1.44 (40-50)
Jaisalmer female	10	147.90±1.99 (141-162)	139.45±3.35 (124.5-156)	166.25±2.99 (153-179)	47.00±0.77 (43-50)
Bhuj male	5	148.80±1.36 (144-152)	140.40±2.66 (135-150)	158.00±0.97 (155-160)	48.00±1.09 (45-51)
Bhuj female	21	147.62±1.09 (140-154)	140.19±1.38 (126-153)	165.71±1.92 (151-191)	46.55±0.91 (41-54)

Average height at wither of Kachchhi-Sindhi horses was found to be 148 cm which is slightly less than Marwari horses but at par with Kathiawari horses. Gupta *et al.* (2012) observed mean height at wither as 155.42±0.61 cm in Marwari horses and 149.30±0.08 cm in Kathiawari horses. Horses less than 150 cm are grouped under pony category and those above 150 cm are considered as horses, while the International Federation for Equestrian Sports defines the official cut-off point at 148 cm without shoes and 149 cm with shoes (<http://en.wikipedia.org/wiki/Pony>). It was quite interesting to record that like Kathiawari horses the average HW of the Kachchhi-Sindhi was around or less than 150 cm. If suitable breeding measures are not taken by the

Gujarat and Rajasthan Government or concerned breeders, this breed may be reclassified as a pony breed.

Face length of Kathiawari (64.79±0.30 cm) and Marwari (65.62±0.61 cm) animals were almost at par (Gupta *et al.* 2012a) but FL was observed as 60.74±0.46 cm in the Kachchhi-Sindhi horses in this study which is lower than Kathiawari and Marwari horse. Gupta *et al.* (2012) reported that the face width of Kathiawari (19.35±0.36 cm) is much wider than that of the Marwari horse (18.39±0.21 cm), whereas face width of Kachchhi-Sindhi horses was 18.30±0.27 in this study which is very much similar to Marwari horse. The average ear to ear distance was 14.46 cm and ears are straight and make about 45° to 60° angle

to the pole. Ear to ear distance is more in Kachchhi-Sindhi horses than Marwari and Kathiawari horses as the same has been reported as  $8.36 \pm 0.18$  and  $7.19 \pm 0.42$  cm, respectively by Gupta *et al.* (2012).

Mean heart girth was observed as  $164.96 \pm 1.30$  cm in Kachchhi-Sindhi horses, whereas Gupta *et al.* (2012) reported

heart girth in Marwari and Kathiawari horses as  $174.02 \pm 1.34$  and  $165.90 \pm 1.17$  cm, respectively indicated that HG is at par in Kathiawari and Kachchhi-Sindhi horses. Ear length is another important breed characteristic of Kachchhi-Sindhi horses as this breed has lengthy ears ( $15.30 \pm 0.21$  cm) than Marwari and Kathiawari horses. Ear length of

**Table 2:** Least-squares means (cm), standard errors and number of observations for different body measurements of Kachchhi-Sindhi horses.

Traits/ effects	No of observations	Face length	Face width	Pole	Ear length	Ear width
Overall	43	$60.74 \pm 0.46$ (53-65)	$18.30 \pm 0.27$ (16-23)	$14.46 \pm 0.28$ (10-18)	$15.30 \pm 0.21$ (12.5-17.5)	$16.16 \pm 0.16$ (15-19)
<b>Locations</b>						
Jaisalmer	17	$59.93 \pm 0.84$ (53-65)	$18.39 \pm 0.48$ (16-23)	$13.15 \pm 0.37^*$ (10-15)	$14.27 \pm 0.32^*$ (12.5-17)	$16.15 \pm 0.29$ (15-19)
Bhuj	26	$61.21 \pm 0.46$ (57-65)	$18.25 \pm 0.30$ (16-22)	$15.17 \pm 0.27^*$ (13-18)	$15.85 \pm 0.18^*$ (14-17.5)	$16.17 \pm 0.18$ (15-18)
<b>Sex</b>						
Male	12	$60.50 \pm 1.11$ (53-65)	$17.50 \pm 0.49$ (16-21)	$13.95 \pm 0.35$ (11-15)	$14.40 \pm 0.36$ (12.5-16)	$16.20 \pm 0.35$ (15-18)
Female	31	$60.82 \pm 0.44$ (57-64)	$18.59 \pm 0.29$ (16-23)	$14.65 \pm 0.33$ (10-18)	$15.63 \pm 0.21$ (13-17.5)	$16.15 \pm 0.17$ (15-19)
<b>Locations × Sex</b>						
Jaisalmer male	7	$58.83 \pm 1.46$ (53-64)	$17.83 \pm 0.81$ (16-21)	$13.58 \pm 0.54$ (11-14.5)	$13.67 \pm 0.37^*$ (12.5-15.0)	$15.67 \pm 0.31$ (15-17)
Jaisalmer female	10	$60.75 \pm 0.99$ (56-64)	$18.81 \pm 0.58$ (17-23)	$12.78 \pm 0.50^*$ (10-15)	$14.78 \pm 0.45^*$ (13-17)	$16.57 \pm 0.44$ (15-19)
Bhuj male	5	$63.00 \pm 1.09$ (60-65)	$17.00 \pm 0.36$ (16-18)	$14.50 \pm 0.26$ (14-15)	$15.50 \pm 0.26^*$ (15-16)	$17.00 \pm 0.63$ (15-18)
Bhuj female	21	$60.85 \pm 0.47$ (57-65)	$18.50 \pm 1.54$ (16-20)	$15.30 \pm 0.32^*$ (13-18)	$15.92 \pm 0.21^*$ (14-17.5)	$16.00 \pm 0.72$ (15-17)

**Table 3:** Least-squares means (cm), standard errors and number of observations for different body measurements of Kachchhi-Sindhi horses.

Traits/ effects	No of observations	Fore leg length	Canon	Pastern	Hoof length	Hoof width
Overall	43	$103.33 \pm 0.49$ (97-109)	$24.97 \pm 0.25$ (22-30)	$11.76 \pm 0.25$ (10-18)	$12.20 \pm 0.16$ (10-14)	$11.38 \pm 0.13$ (10-13)
<b>Locations</b>						
Jaisalmer	17	$103.26 \pm 0.89$ (97-109)	$24.59 \pm 0.41$ (22-28)	$12.29 \pm 0.52$ (10-18)	$12.59 \pm 0.21^*$ (10-14)	$11.30 \pm 0.19$ (10-13)
Bhuj	26	$103.37 \pm 0.57$ (100-108)	$25.25 \pm 0.31$ (23-30)	$11.37 \pm 0.21$ (10-14)	$11.93 \pm 0.19^*$ (10-13)	$11.43 \pm 0.15$ (10-13)
<b>Sex</b>						
Male	12	$103.82 \pm 1.07$ (97-109)	$24.95 \pm 0.43$ (22-27)	$11.64 \pm 0.43$ (10-15)	$12.54 \pm 0.32$ (10-14)	$11.10 \pm 0.25$ (10-12)
Female	31	$103.15 \pm 0.55$ (100-109)	$24.98 \pm 0.31$ (23-30)	$11.80 \pm 0.31$ (10-18)	$12.07 \pm 0.16$ (10-13)	$11.48 \pm 0.13$ (10-13)
<b>Locations × Sex</b>						
Jaisalmer male	7	$103.43 \pm 1.64$ (97-109)	$24.5 \pm 0.57$ (22-26.5)	$11.71 \pm 0.68$ (10-15)	$12.57 \pm 0.48$ (10-14)	$11.00 \pm 0.34$ (10-12)
Jaisalmer female	10	$103.15 \pm 1.07$ (100-109)	$24.65 \pm 0.59$ (23-28)	$12.70 \pm 0.75^*$ (10-18)	$12.61 \pm 0.15^*$ (12-13)	$11.50 \pm 0.22$ (11-13)
Bhuj male	5	$104.50 \pm 1.18$ (102-108)	$25.75 \pm 0.56$ (24-27)	$11.50 \pm 0.45$ (11-13)	$12.50 \pm 0.45$ (11-13)	$11.25 \pm 0.43$ (10-12)
Bhuj female	21	$103.15 \pm 0.65$ (100-108)	$25.15 \pm 0.36$ (23-30)	$11.35 \pm 0.24^*$ (10-14)	$11.82 \pm 0.20^*$ (10.5-13)	$11.47 \pm 0.17$ (10-13)



Marwari and Kathiawari horses was depicted as  $13.41 \pm 0.21$  and  $11.74 \pm 0.08$  cm, respectively by Gupta *et al.* (2012).

Also, due to indiscriminate breeding, decreased demand and introduction of exotic horse breeds, the populations of the native breeds of equines have declined rapidly during the last few decades (Gupta and Pal, 2010; Gupta *et al.*, 2012a). There is an urgent need to increase their number and to conserve them for future demand for draft power. Gupta *et al.* (2014) observed genetic closeness among Marwari and Kathiawari breeds, which could be due to possible sharing of a common breeding tract which results in an admixed population in the absence of strict maintenance of pedigree records. Similarly, Kachchhi-Sindhi horses are also sharing breeding tract with Kathiawari and Marwari horses, hence there is a need to study the closeness among three important breeds of horses in India.

## CONCLUSION

In view of all the biometric indices and breed characteristics, it is clear that Kachchhi-Sindhi horse breed can be differentiated based on their FL, FW, EL, EW and pole. More precisely, the face of Kachchhi-Sindhi horse has a distinct Roman nose. The ears are long and remain apart and the tip of ears doesn't touch or overlap like Marwari and Kathiawari horses. The genetic characterization of these horses may reveal the heterozygosity and diversity indices for further research and conservation of true to breed animals.

## Data availability

The original data are available upon request to the corresponding author.

## Competing interests

The authors declare that they have no conflict of interest.

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