Supplemental Data

The Genetic Ancestry of Modern Indus Valley

Populations from Northwest India

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Supplemental Text

Indus Valley Civilization and its antiquity

Alongside those developed in ancient Egypt and Mesopotamia, the Indus Valley Civilization was among the greatest early civilizations of the Old World during the early-to mid-third millennium BCE[1–3]. The Indus Valley Civilization extending across present-day Northwest Pakistan deep into Northwestern India had major settlements established on the plains between Indus and Ganges basin, with an urban-phase beginning ~4.6 kya BP[3,4]. This Civilization thrived in the Indus River basin [5,6] that flows through the whole Pakistan, and along a network of recurrent, monsoon-fed rivers that on one occasion flowed near Ghaggar-Hakra river, which is also known as Sarasvati (now dried up) in northwest India and eastern Pakistan[3,7,8].

Though so far, the least studied among the three, the emerging archaeological evidence suggests that the Indus Valley one (earlier often called narrowly as Harappan), might have been the most widespread encircling an area of ~1 million square km and the largest of the Bronze Age developed civilization[2,9]. During its peak, this Civilization possibly has had a population of about five million[10].

Archaeologists link the urbanism of the Indus Valley with the expansion of five huge settlements considered as cities, and several minor built-ups that are categorized by typical architectural elements and material culture[1,3,11]. The Indus Valley Civilization is also known as the Harappan Civilization after Harappa a place in the Punjab province of British India and now in Pakistan, where the first excavation had happened[12]. Mohenjo-daro was another main site of Indus Valley Civilization, discovered soon after the Harappa, whereas, other major urban centers were Dholavira, Ganeriwala, and Rakhigarhi[3].

Mehrgarh, a Neolithic site (~7000 BCE to c. 2500 BCE) located at the west of the Indus river valley, was considered to be one of the earliest center of the civilization with an indication of early farming and cattle herding in South Asia[13–16] and shift from foraging to settled agriculture and domestication[17]. Though a recent study links the spread of Neolithic farming into Northwest India from the Near East, they also found a decent signal for the indigenous domestication of barley, and zebu cattle at Mehrgarh similar to the humped Indian aurochs that is frequently depicted on Indus seals[15,18].

There are also archaeological traces of trade seals, decked with animals and mythical existences, demonstrating the Indus people's involvement in booming trade with faraway lands like Sumer in Mesopotamia[21]. Excavation of archaeological artifacts from Iraq, Central Asia, and Afghanistan e.g., the occurrence of Indus seals in Central Asia besides Iraq, and portable Indus beads, pottery across Iranian plateau, Oman and Mesopotamia, display the extended Indus trade networks[2,5].

The abrupt fall of the Indus Valley Civilization, which flourished from 2600 BCE until 1900 BCE, is highly debatable issue. Many theories like floods, tectonic shifts, droughts, and foreign invaders have been invoked to explain the remarkable sudden and entire disappearance of this thriving civilization[5,9,22–24]. Many scholars proposed that climate must have had an indirect effect on the Indus Valley[25,26] facilitating the drying-up of mighty river Sarasvati (Ghaghra Hakkar). It has been also proposed that these events triggered the migration of Indus people towards Gangetic plain [22,23], along

with the theory of strategic local shifts in agriculture during extended droughts in 2200 BC by Madella and Fuller[27]. Nevertheless, none of the theories could solve this puzzle satisfactorily so far.

Studied Populations:

Ror

Ror is a Kshatriya community from Northwest India, especially from Haryana state that counts almost 750,000 in number all over India[28]. They have their roots primarily from an area, extending across the Gujarat – Rajasthan border[28]. Historically the Ror people were found concerted around Ror (Sukkur) in Sindh region of Pakistan[28] but, now they found mainly in Haryana, Rajasthan, Himachal Pradesh, western Uttar Pradesh and Uttaranchal in India. H. A. Rose describes the Ror as fine, stalwart men in his famous work *"A Glossary of the Tribes and Castes of Punjab and North-West Frontier Provinces"*[29]. A.C.L. Carlleyle also reports about the finding of a Ror warrior image at the site of Kaga Ror or Kagarol in the Archaeological Survey of India Report for the year 1871-72[30]. Ror Mahasabha claims that Sir Denzil Ibbetson classified Ror as one of the "Other dominant tribes" of United Punjab during the British rule in India[31]. In fact, the Ror people vary from other neighboring groups in their lifestyle like ethnic wears etc.

Conferring to the Indian Puranic tradition, Ror claim to belong to the solar race of *Ikshvaku Kul* and connect themselves to Lord *Sri Rama*, the hero of epic *Ramayana*.

Ror clans ruled from the Rori, also known by names of Roruka and Rorik since ancient times. It was the capital of Sindh for years and has been mentioned as of the most important Indian cities during seventh century B.C.[32] During first few centuries and a couple of centuries prior to the Christian era, Ror have ruling seats of power in Gujarat, Rajasthan, Haryana, and Sindh; and afterward, in the 5th century AD, they consolidated their influence in the entire region from Afghanistan to Kannauj in India during the time of rai Dewaji[34,35].

Gujjar (Gurjar)

Gujjar also known as Gurjar, a pastoral ethnic group of India and Pakistan that used to be nomadic earlier [36]. The other synonymous of Gujjar are *Gurjjar, Gurjara, Gojar and Gūjar* [37–39].

The term Gujjar is derived from the Sanskrit word gurjara, which many scholars refer to the word Gurjaratra or Gujarat. The Gurjar origin is debatable, Cunningham[40] places them among Scythian tribe who conquered the Kabul around 100 BC and came to India and established the Gujjara or Gurjara kingdom while Smith[41] traces their origin to the white Huns who came to India around AD 465 as nomadic hordes.

In the 6th to 12th century, the Gujjar were primarily classified into Kshatriya and Brahmins many of whom are converted to Islam during Muslim rule in South Asia[42,43]. In some states in India, Gujjar are classified under the Other Backward Class (OBC)[44], Hindu Gujjars are now assimilated into several vernas. Many Gujjars link themselves with *Ramayana*[45], claiming that they are related with legendary hero *Lakshmana* brother of *Lord Rama*[46,47]. They claim to be Suryavanshi Kshatriya [48].

Gujjar of Northwestern India have ethnic affinities with Jats, Rajputs, Ahirs and belongs to one ethnic group[49,50]. Gujjars are widely spread over Jammu-Kashmir, Punjab, Chandigarh, Haryana, Himachal Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh, Uttaranchal, and Delhi[36,51,52]. Muslim Gujjars are the prominent tribe in Pakistan occupied Kashmir and Pakistan and contributes almost twenty percent of the country's entire population[53]. The Gujjar population size in India is expected to be around 1,073,000[54].

Kamboj

Kamboj or Kamboh are an ethnic group from Northwest India, which may relate to the ancient Kamboja of Iron Age India and mentioned repeatedly in ancient Sanskrit texts and epigraphs[55–58]. The earliest reference to the Kambojas are recorded in _Pānini's_ work (5th century BCE). Later they were referred in _Manusmirti_ (2nd century BCE) and the _Mahabharata_ (1st century BCE), describing Kambojas as former Warrior kshatriyas who could not stand by Hindu sacred rituals[59]. The ancient Kambojas were supposed of Indo-Iranian origin[56], however, they are also described as Indo-Aryans[57,58,60] or royal clan of the Sakas[61] time to time. The kingdom Kambojas territories were positioned beyond Pakistan, Gandhara, Afghanistan placing in Tajikistan, Uzbekistan, and Kyrgyzstan, and the _Edicts of Ashoka_ (3rd century BCE) refers the Kamboja controlled territory an independent entity from the Mauryan empire in which it was located[59]. Clans of Kambojas together with Sakas, Pahlvas and the Yavanas, migrated from Central Asia during 2nd and 1st centuries BCE. They entered Afghanistan and India, setting up independent territories in Western and South-western India[62,63].

In Punjab, Haryana and Rajasthan region of India, many Kamboj frequently use Kamboj as their surname in lieu of the sub-caste or the gotra name, while their Muslim counterparts in Pakistan mostly use Kamboh as the last name instead of gotra name. A sizable number of Muslim Kamboh are also found in doab of Uttar Pradesh, India. The total population size of Kamboj Hindu, Kamboj Sikhs, and Kamboj Muslims are 508000, 546000 and 30000 respectively in India (Joshua Report). Kamboj of Indian sub-continent are having an ethnic affinity with Khatris, Rajputs, Brahmins, Jats, Aryans, and others.

Khatri

Khatri, a caste population in India and Pakistan, are mostly from the Punjab region. Additionally, they also live in Delhi, Uttar Pradesh, Madhya Pradesh, Himachal Pradesh, Chandigarh, Gujarat, Haryana, Rajasthan, Maharashtra and J & K. During the Mughal Empire, Khatris played a significant role in India's trans-regional trade[64]. Khatris have also been described among the "utmost vital merchant communities of early modern India"[65]. Khatri also claim Kshatriya status and regardless of individual ranking within the community, they believed themselves to be of pure Vedic stock and superior to Rajputs[66]. Although the Indian and the British authorities did not accept the Khatri claim of Kshatriya status since large number of mainstream Khatris were engaged in mercantile occupations[67]. Khatri of different regions follow different professions. Khatri claim that they were warriors who took to trade[68]. Historically, Khatri were formerly involved in the knitting of silk saris, and later some of them turned out to be merchants[52]. Khatri in India have a population size of 2,303,000 and follow mainly Hinduism and Sikhism[69].

Jat

Jat (also spelled as "Jatt" and "Jaat") people are an ethnic agricultural group that has apparently settled in Northwest South Asia for several thousand years[70]. The term Jat is supposedly derived from Jatta, a broad word used for cattle gazers and camel breeders, moving in a group – jatha. Jats have been known as zamindars (landowner) since the period of Mogul emperor Akbar in 16th century[71].

Jat have been identified as related to the Indo-Scythians that entered India between 200 BC and 600 AD[41]. Greek historians *Pliny* and *Ptolemy* suggested the movement of the Jat people from the banks of Oxus river to India around a century before Christ. They spoke Indo-Aryan languages and considered to be amongst the oldest ancient people of India, who settled in the fertile plains of Punjab along the Indus River turning into a pastoral and farmer community[71], few scholars believed Jat related to the Rajput tribes[50,72].

Jat largely belong to three main religious faiths, Hindu, Muslim, Sikhs and mostly are inhabited in Indian states of Haryana, Punjab, Delhi, Rajasthan, Uttar Pradesh and also Punjab, Sindh provinces of Pakistan[70,71,73]. the people in India were numbered to be around 82.5 million in 2012 and are classified as OBCs (other backward castes) in some states of India though, though only the Rajasthani Jats are entitled to OBC category by the central government of India[74].

Supplementary Figures

Figure S1. Principal Component Analysis (PCA) using haplogroup frequencies in South Asians, Iranians and Central Asians (A) mtDNA PC plot and **(B) Y-chromosome PC plot** triangle indicate new samples from Northwest Indian (NWI) and Gujjar_NW refers to the new Gujjar sampled from NWI.

Figure S2. Genome-wide structure and genetic differentiation of Northwest India (NWI) (A) PCA of NWI with Eurasians PCA of NW India and other Eurasian populations. Mean eigenvalues of South Asians are shown in the inset plot, and **(B) Mean population pairwise F_{ST}** was computed between Northwest Indians and world populations, given in diagonal. Indian IE_Caste, Indian Indo-European castes; Indian IE_Tribe, Indian Indo-European tribes; Indian IE_Rel gr, Muslim; Munda, Indian Austro Asiatic (Indian_AA) speakers.

Figure S3. Genetic structure of PNWI in context of ancient DNA: (A) PC plot for modern Eurasians with a subset of ancient sources from Steppe, Iran, Anatolia, Central Asia, and South Asia, and **(B) PC plot for modern South Asians** with a subset of ancient sources.
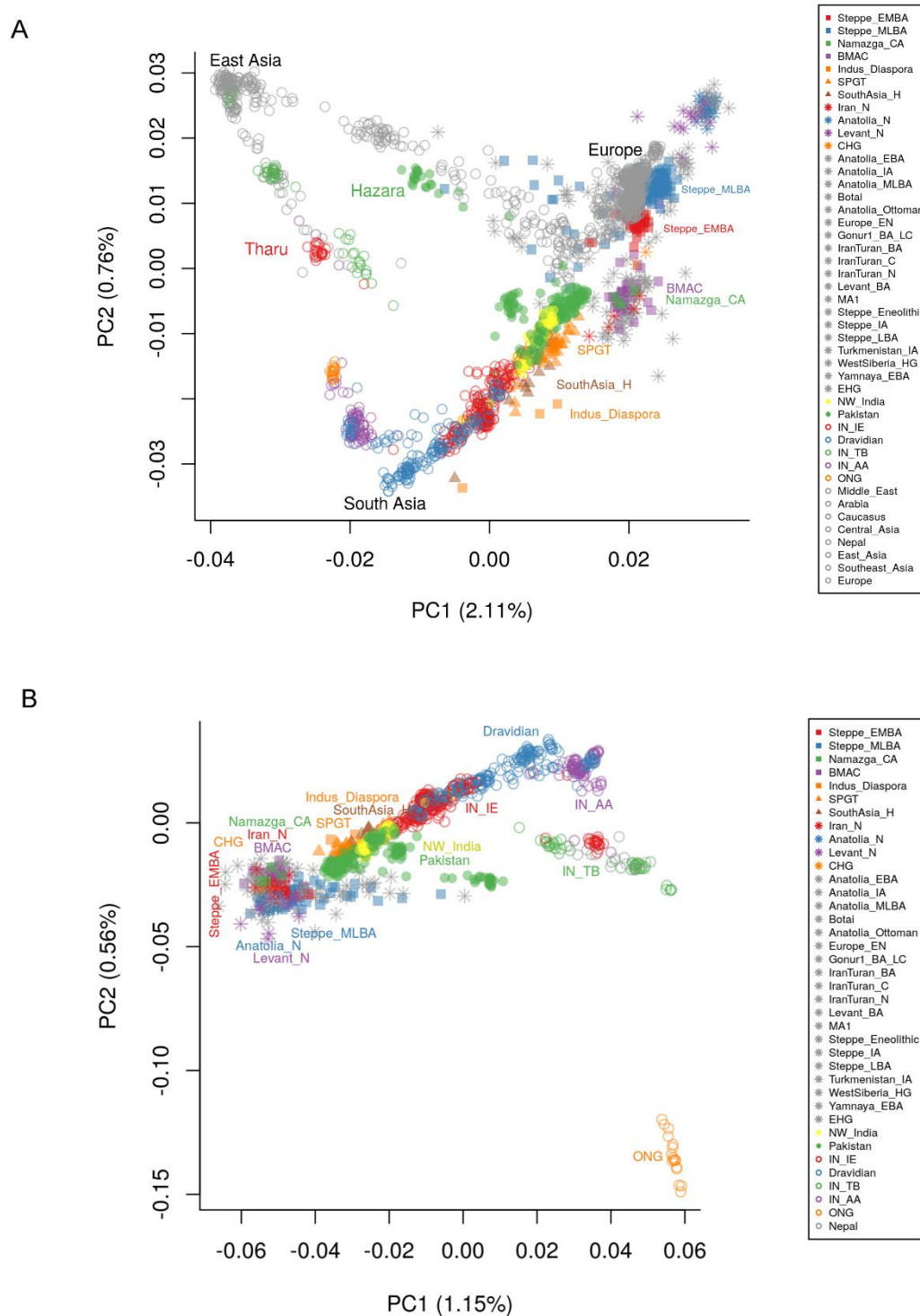
Figure S4. Cross-Validation for ADMIXTURE run plot showing cross-validation (CV) indexes of all runs of the Admixture analysis.

CV index @ all Ks
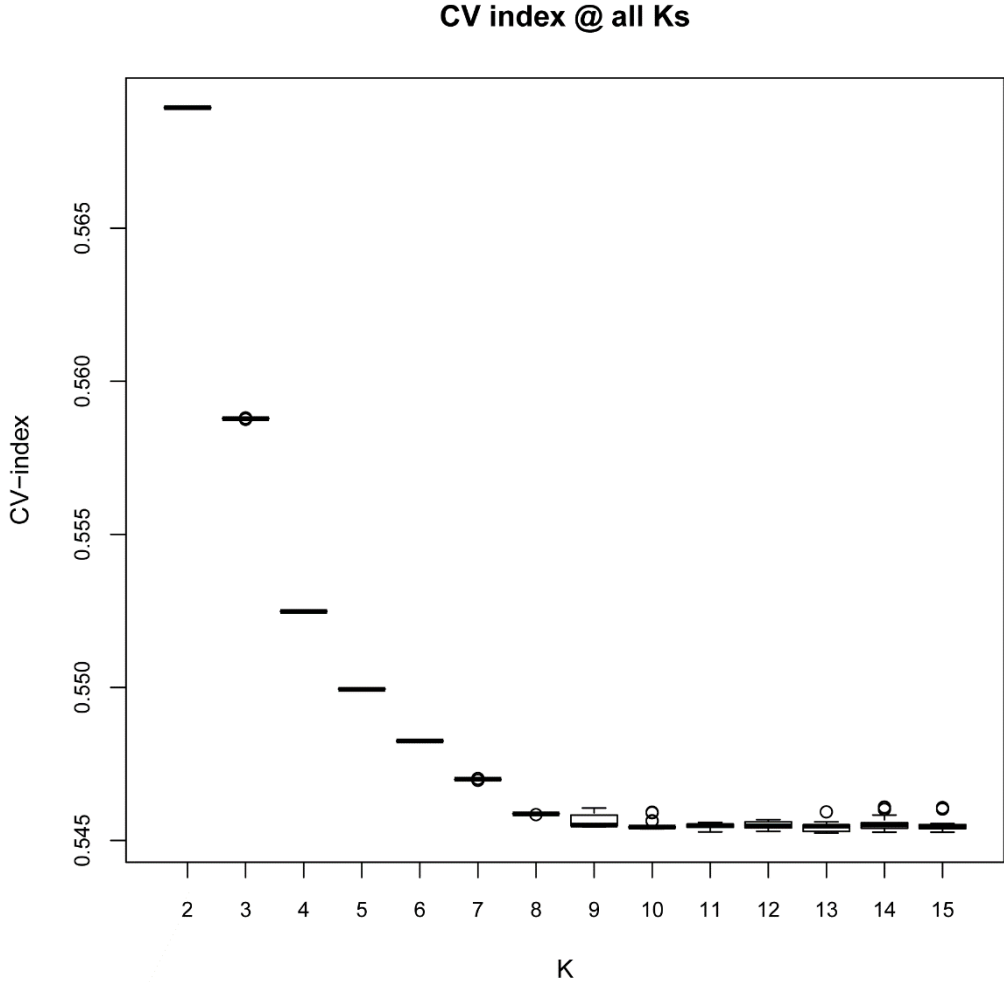
Figure S5. Derived allele sharing between modern PNWI and Eurasian groups (A) and **(B) plots of derived allele sharing** obtained for PNWI and Indian Gujaratis using Outgroup f_3 (NWI/Pakistan/Gujaratis, X; Yoruba) test, where X is any other modern Eurasian population. Error bars represent jack-knife standard errors.

B

Kamboj
Kamboj_f3out

Gujjar
Gujjar_f3out

Gujaratis
Gujaratis_f3out
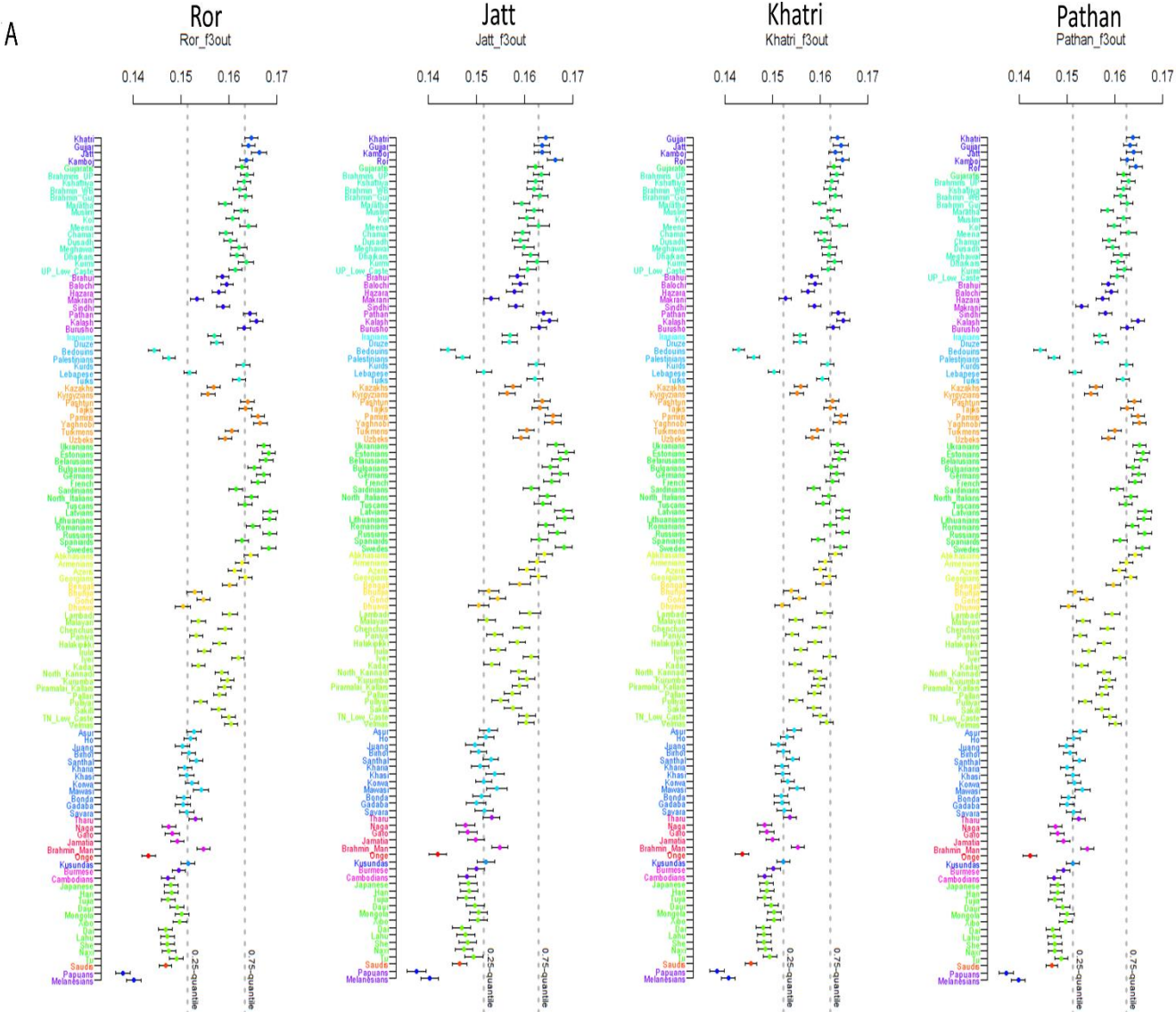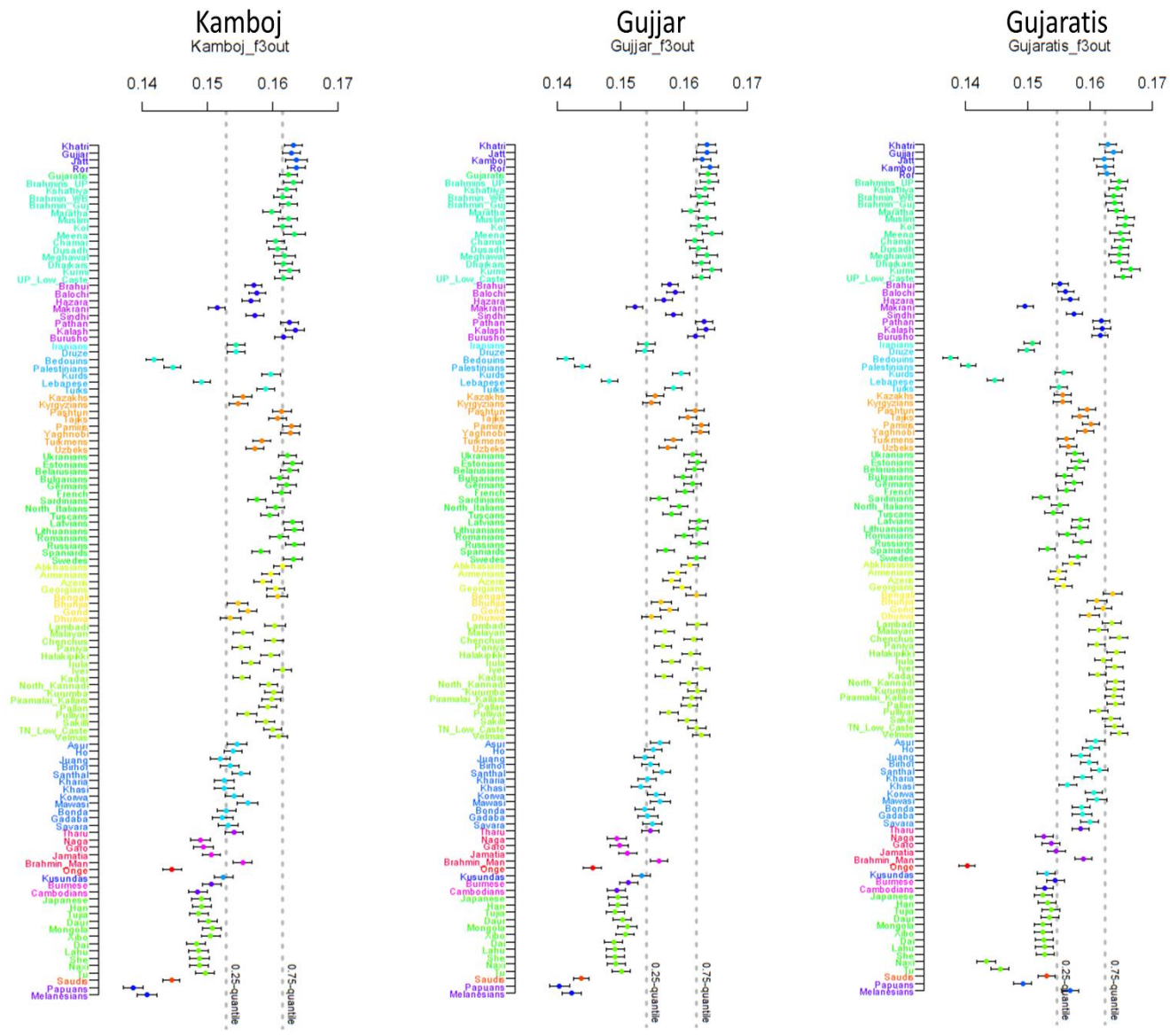
Figure S6. Comparing Outgroup f_3 for PNWI groups with ancient sources (A) Steppe_EMBA vs Iran_N scatter plot of Outgroup f_3 (Iran_N, X; Yoruba) on x-axis vs Outgroup f_3 (Steppe_EMBA, X; Yoruba as outgroup) on y-axis indicating the distinct pattern of PNWI in their affinity to Steppe highlighting Ror and Jat the closest ones, **(B) Steppe_EMBA vs EHG scatter plot** of Outgroup f_3 (EHG, X; Yoruba) on x-axis vs Outgroup f_3 (Steppe_EMBA, X; Yoruba as Outgroup) on y-axis indicating the distinct pattern for PNWI and Ror (and Jat) in their higher affinity to Steppe and EHG than other Indian and **(C) Anatolia_N vs Iran_N scatter plot** of Outgroup f_3 (Iran_N, X; Yoruba) on x-axis vs Outgroup f_3 (Anatolia_N, X; Yoruba) highlighting Ror as the only group in their relative higher affinity to Neolithic Anatolian than that of other South Asians. Here X refers to different West Eurasian and South Asian populations. Steppe_EMBA, Early and Bronze Age Steppe; Iran_N, Iran_Neolithic; EHG, Eastern Hunter Gatherer; Anatolia_N, Anatolia_Neolithic. Error bars represent jack-knife standard errors.

B

C Asia
Caucasus
Dravidians
Europe
IN_IE
Iranians
Middle east
NW India
Pakistan
Ror

f3(Steppe,X;Outgroup)

f3(EHG,X;Outgroup)

C

C Asia
Caucasus
Dravidians
Europe
IN_IE
Iranians
Middle east
NW India
Pakistan
Ror

f3(Anatolia_N,X;Outgroup)

f3(Iran_N,X;Outgroup)
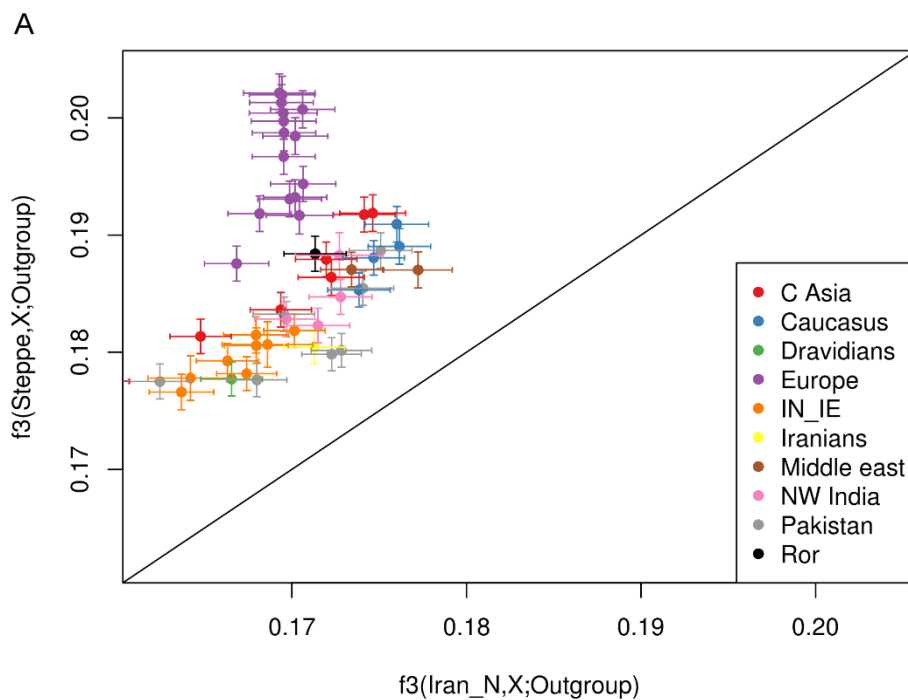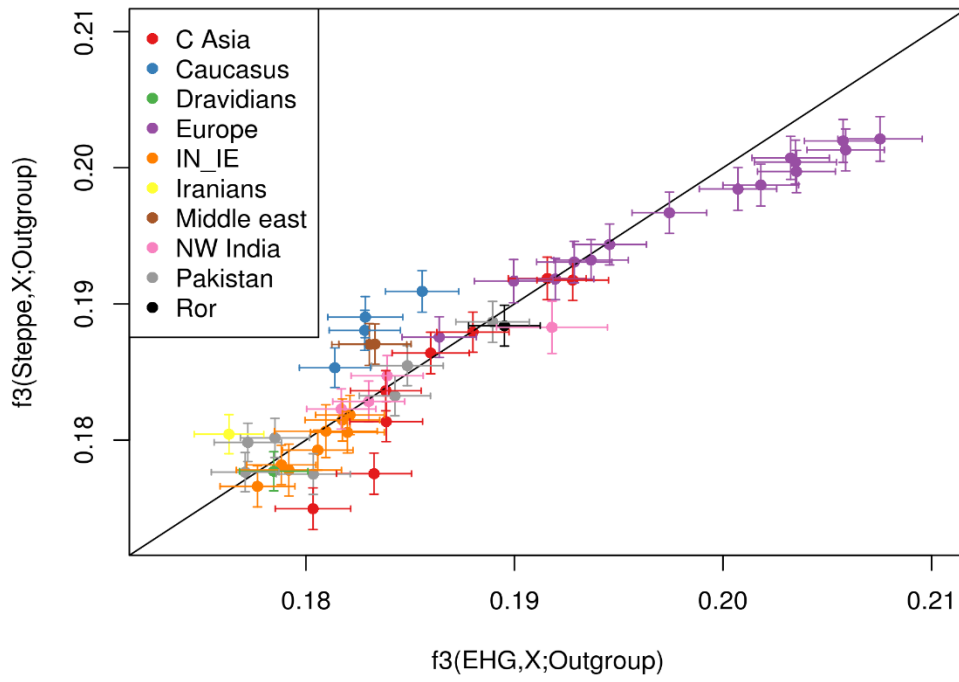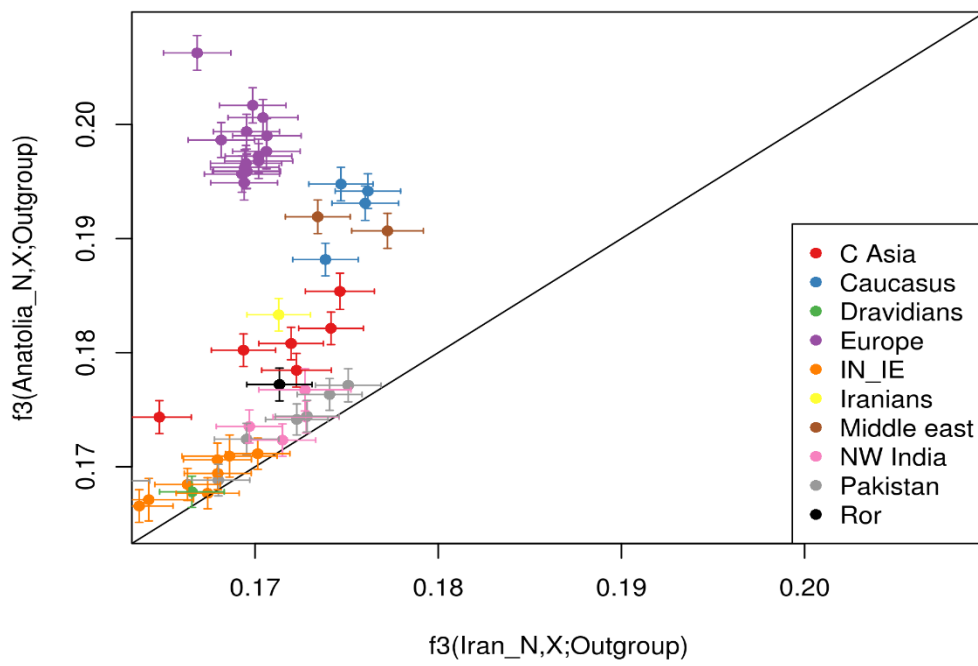
Figure S7. Outgroup *f₃* for South Asians and West Eurasians with ancient sources (A) EHG, (B) Anatolia_N, (C) Iran_N and (D) Steppe_EMBA Derived allele sharing obtained by Outgroup *f₃* (Ancient Sources, X; Yoruba) test, where Ancient sources are EHG/Anatolia_N/Iran_N/Steppe_EMBA and X is any population from South Asia and West Eurasia. Error bars represent jack-knife standard errors.
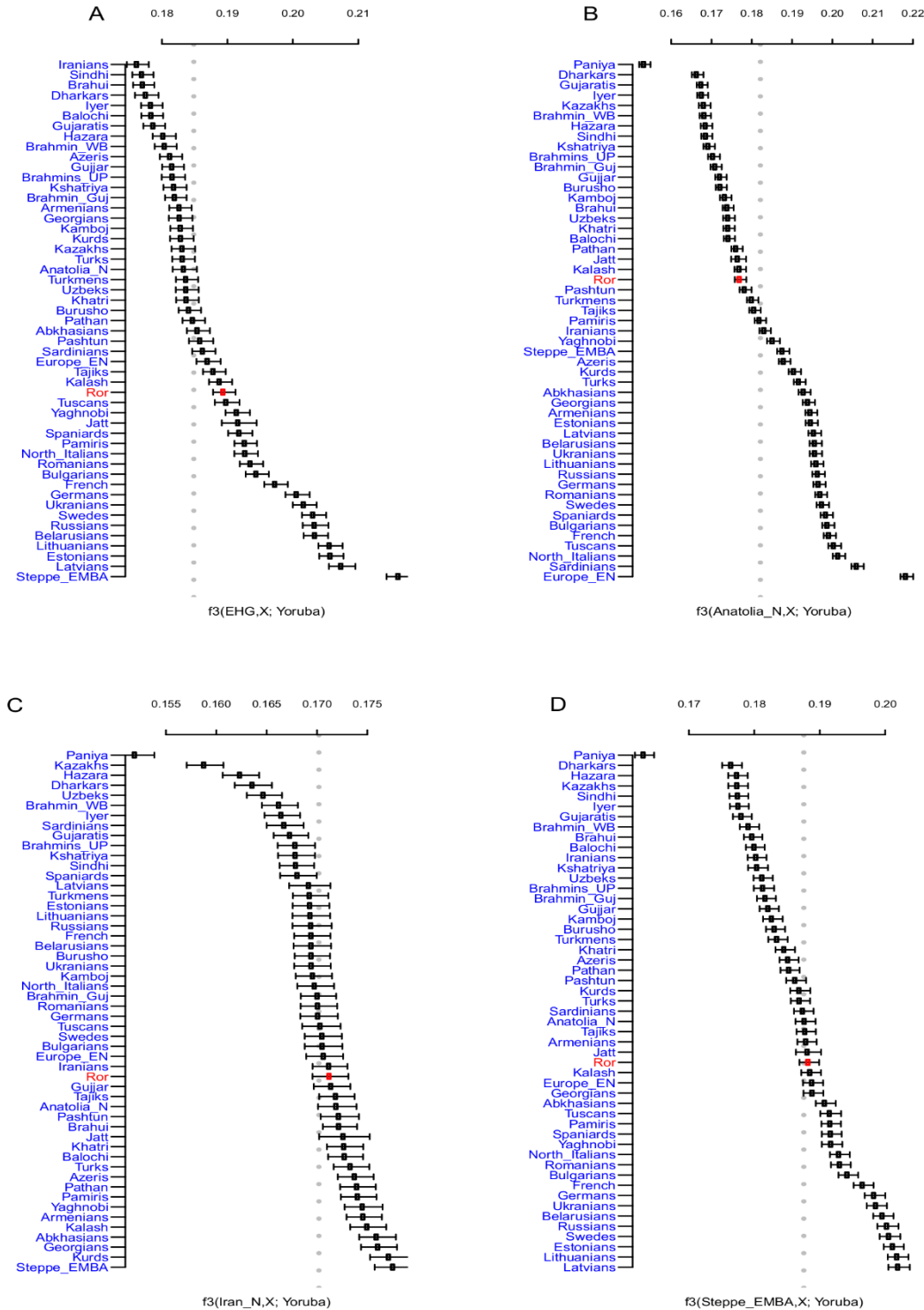
Figure S8. *D* **statistics of South Asians with distant ancient sources (A) EHG vs Steppe_EMBA scatter plot** comparing *D*(X, Ror; EHG, Yoruba) vs *D*(X, Ror; Steppe_EMBA, Yoruba), where X is a South Asian/West Eurasian, showing distinct affinity-based clustering of PNWI, striking out Ror and Jat in their highest allele sharing to EHG than Steppe_EMBA (or Yamnaya) in South Asia, **(B) Anatolia_N vs Iran_N scatter plot** comparing *D*(X, Ror; Anatolia_N, Yoruba) vs *D*(X, Ror; Iran_N, Yoruba) where X is a South Asian/West Eurasian, showing distinct affinity-based clustering of PNWI highlighting Ror in their highest allele sharing to Anatolia_N than Iran_N, in South Asia, **(C)** *D* **stat with CHG** *D*(X, Ror; CHG, Yoruba) reports distinct affinity of PNWI to CHG, Ror and Jat are the closest to CHG among South Asians, **(D)** *D* **stat with EHG** *D*(X, modern Iran; EHG, Yoruba) indicate the relative allele sharing of West Eurasians and South Asians to EHG when compared to modern Iranians. ME, Middle East; E Asia, East Asia; IN_IE, Indian Indo-European; NW and NW India, Northwest India; SE Asia, South East Asia; TB, Tibeto-Burman; Pak, Pakistan. Error bars represent jack-knife standard errors.

B

f4(X, Ror; Anatolia_N, Yoruba)

f4(X, Ror; Iran_N, Yoruba)

Pak+NWI

C Asia+Cau+ME

Eur

IN_DRA+IN_IE

ME

IN_DRA+IN_AA+IN_IE

- C Asia
- Cau
- E Asia
- Eur
- IN_AA
- IN_DRA
- IN_IE
- Iran
- ME
- NW India
- Pak
- SE Asia
- TB

C

D stat(X, Ror; CHG, Yoruba)
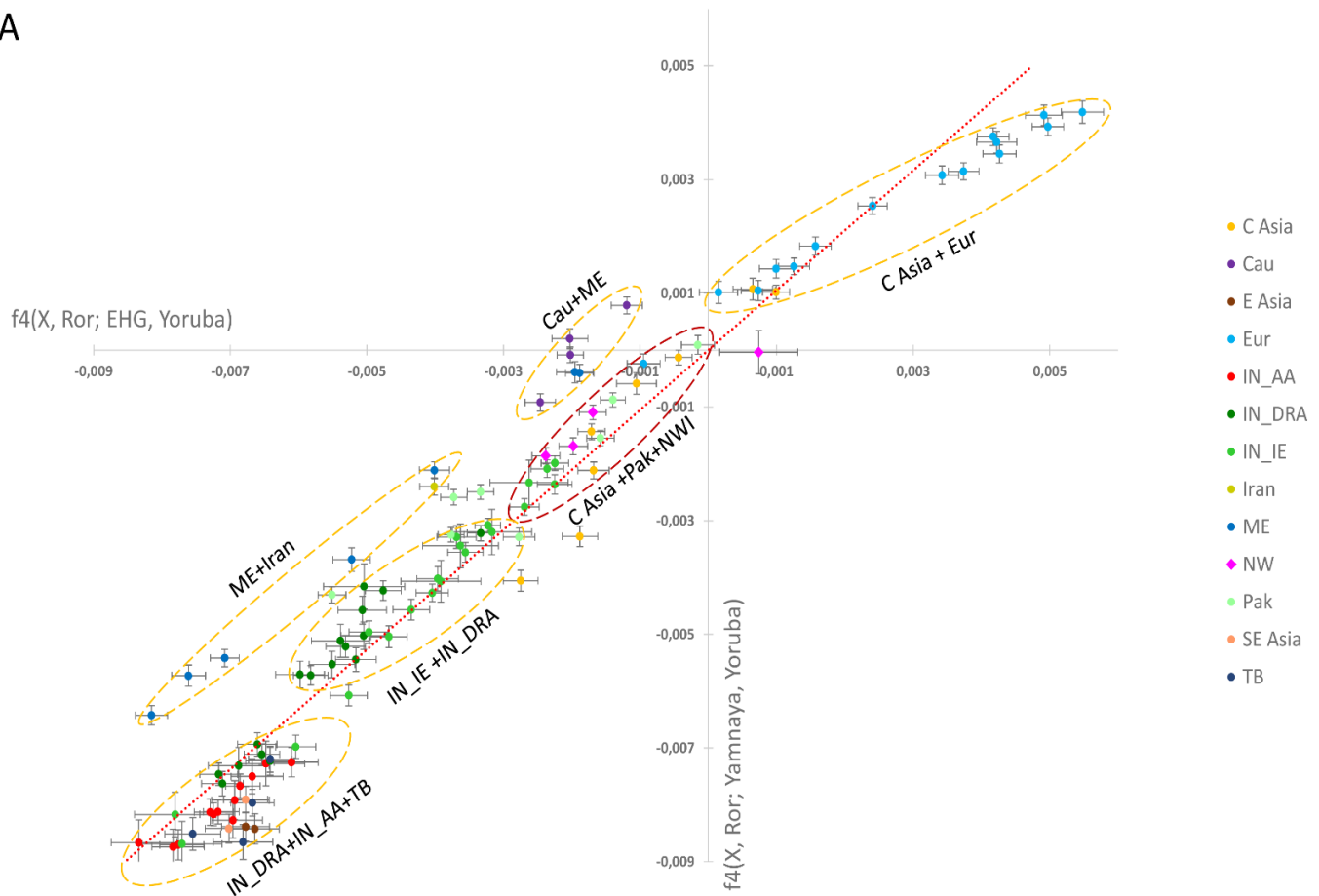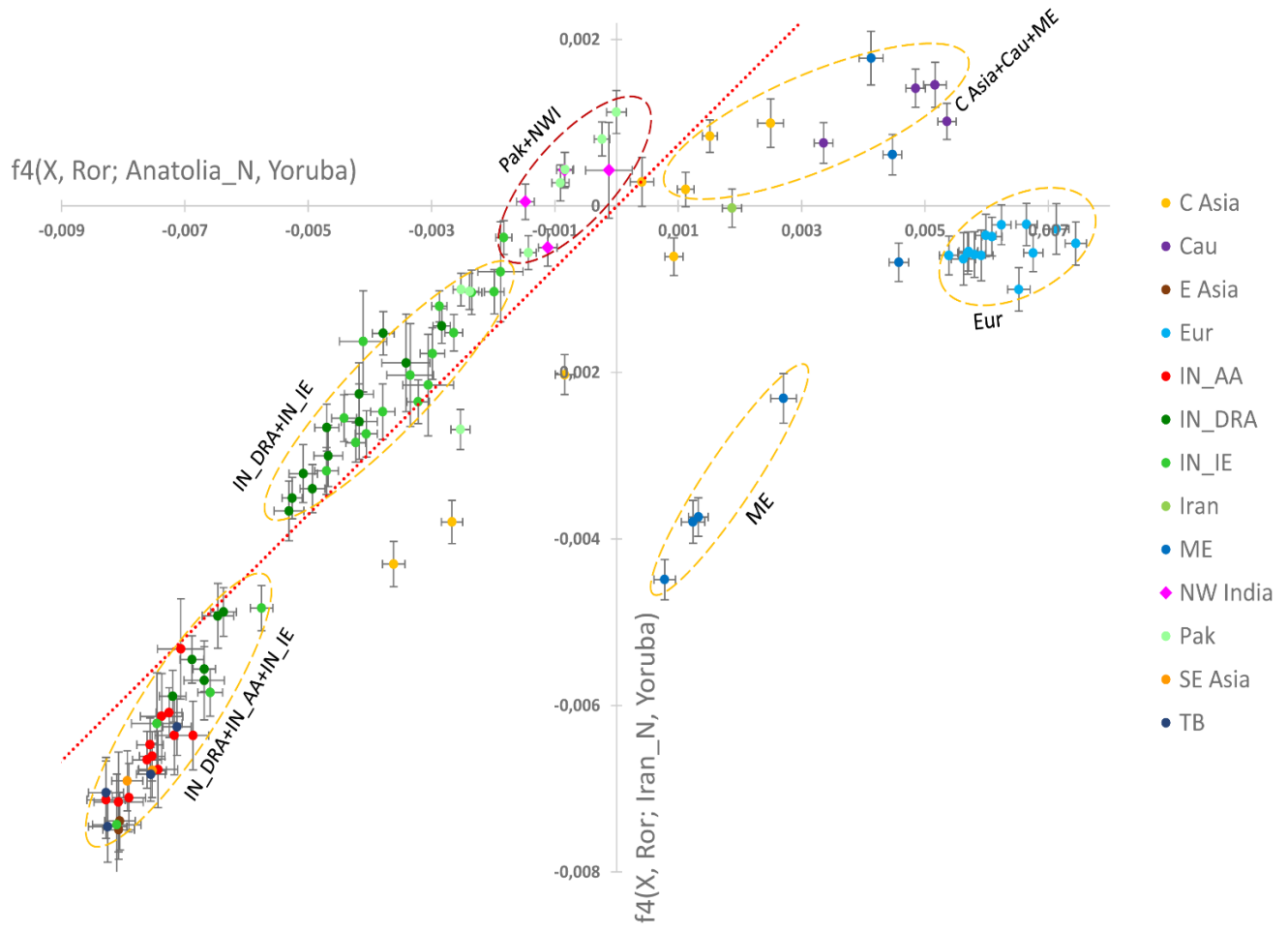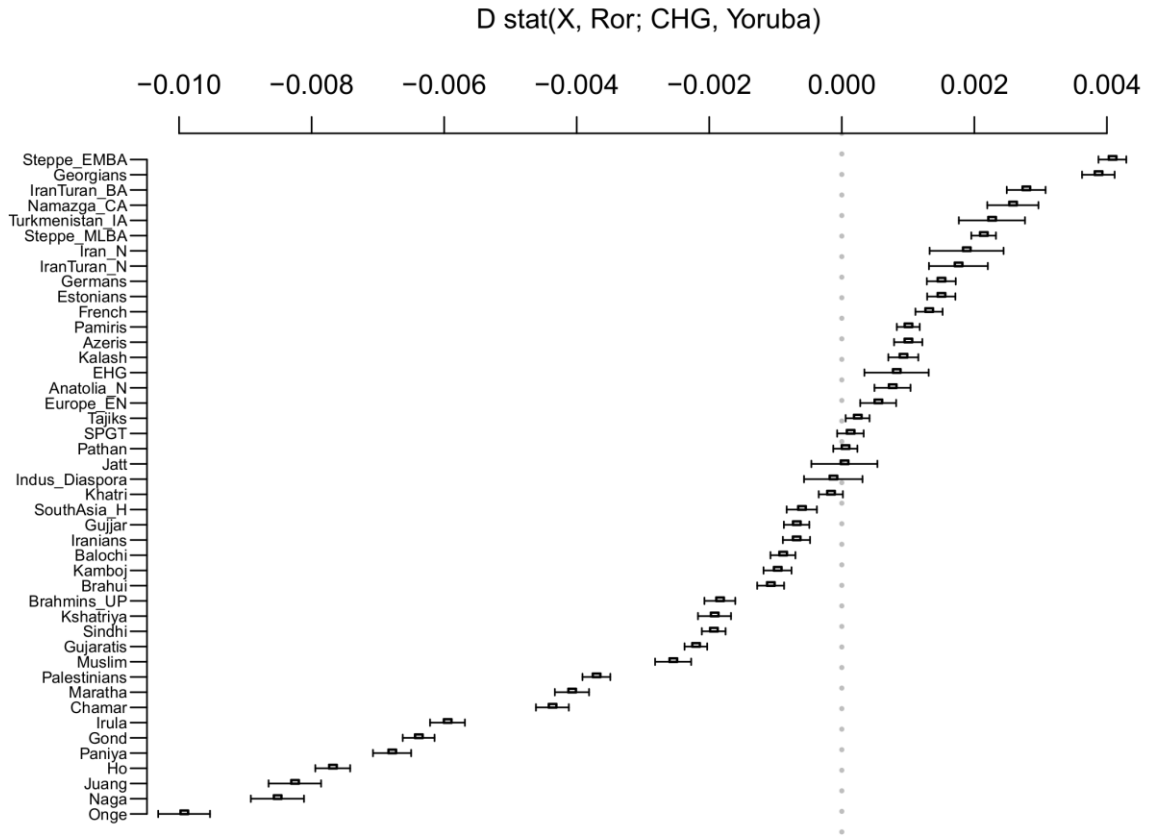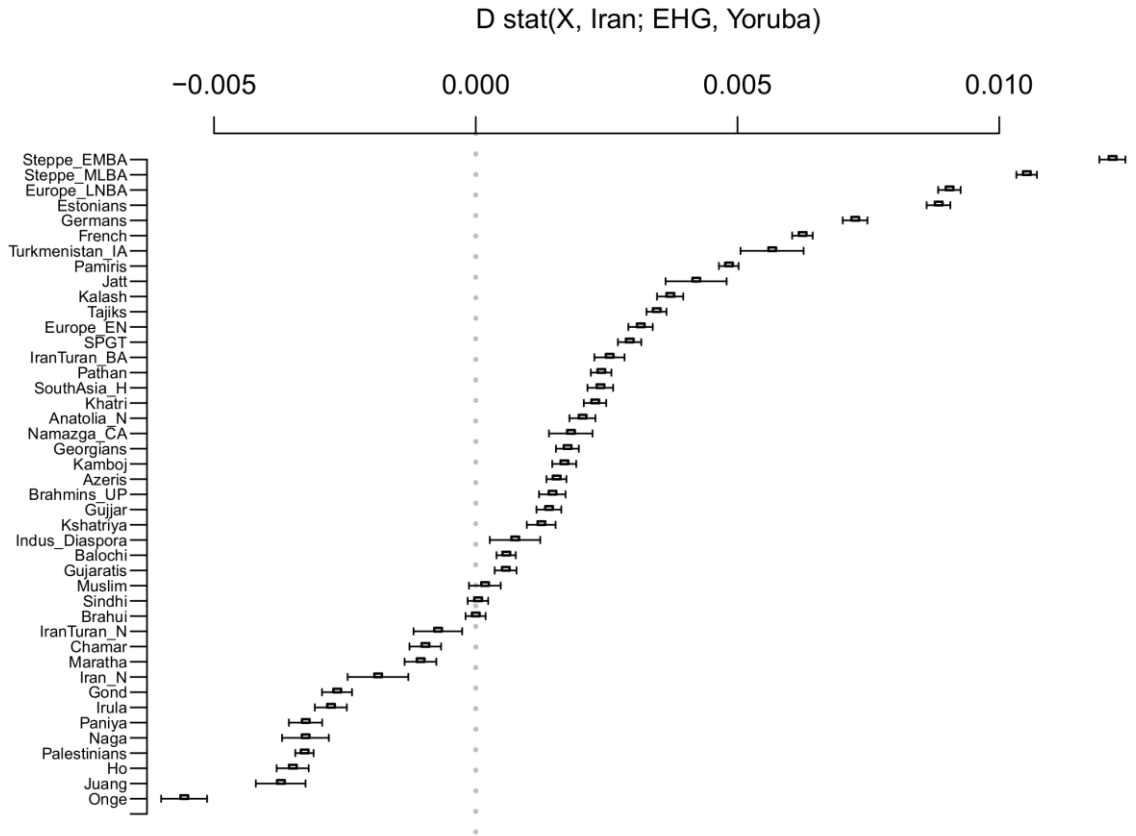
Figure S9. ***D* statistics comparing allele sharing of South Asians with proximal ancient sources**. We used *D* stat in form *D*(X, Ror; aDNA, Yoruba) where Yoruba X is a modern South Asian/West Eurasian/ancient group, aDNA is any of Steppe_MLBA/Namazga_CA/SPGT/Indus_Periphery/SouthAsia_H **(A) *D* stat with Steppe_MLBA** shows distinct affinity of NWI to Steppe_MLBA, highlighting Ror the closest to Steppe_MLBA among South Asians, **(B) *D* stat with Namazga_CA** showing equivalent affinity of NWI to Namazga_CA, striking out Kalash in their highest allele sharing to Namazga_CA than others, **(C) *D* stat with SPGT** showing distinct affinity of NWI to SPGT, striking out Ror and Kalash in their highest allele sharing to SPGT than any other South Asians, **(D) *D* stat with Indus_Periphery (Indus_Diaspora)**showing equivalent affinity of all NWI populations to Indus_Periphery, **(E) *D* stat with SouthAsia_H** showing distinct affinity of NWI to SouthAsia_H, striking out Ror and Kalash in their highest allele sharing than other South Asians. Used acronyms: Steppe_MLBA, Middle to Late Bronze Age Steppe; Namazga_CA, Chalcolithic Namazga; Indus_Diaspora, Indus_Periphery; SPGT, Iron Age to pre-historical South Asia; SouthAsia_H, Early historical South Asia; BMAC, Bactria Margiana Complex; Turkmenistan_IA, Iron Age Turkmenistan; IranTuran_N, Neolithic IranTuran; IranTuran_BA, Bronze Age IranTuran. Error bars represent jack-knife standard errors.

C D stat(X, Ror; SPGT, Yoruba)

D D stat(X, Ror; Indus_Diaspora, Yoruba)

E D stat(X, Ror; South Asia_H, Yoruba)

F D stat(X, Ror; BMAC, Yoruba)
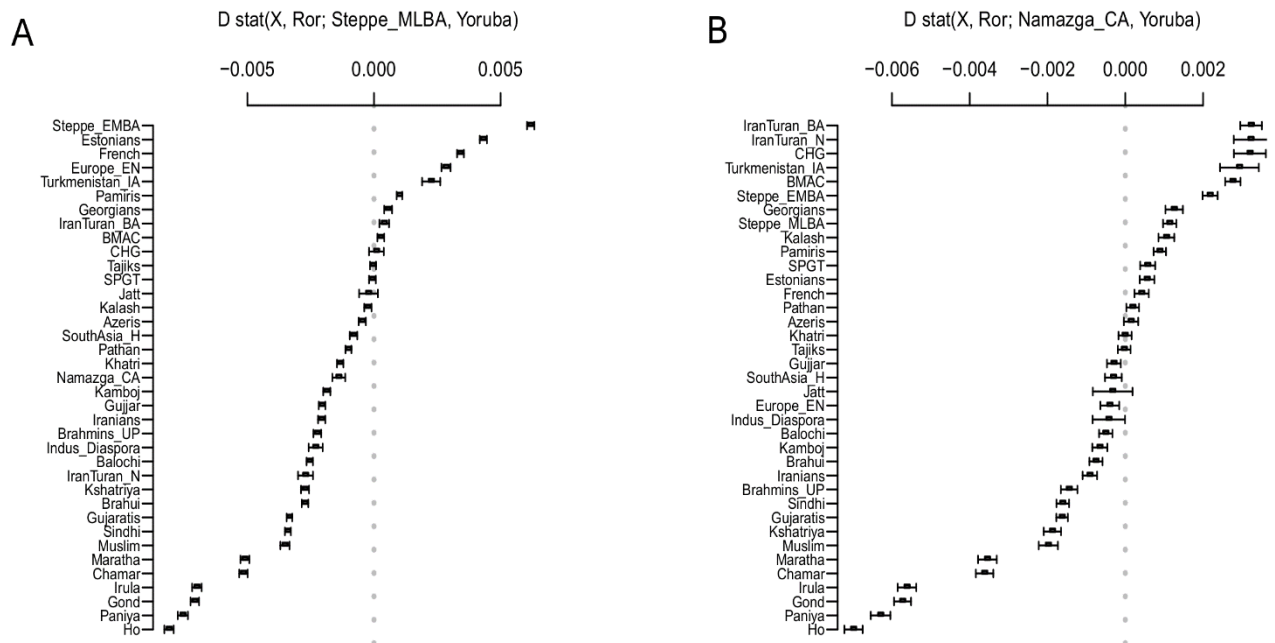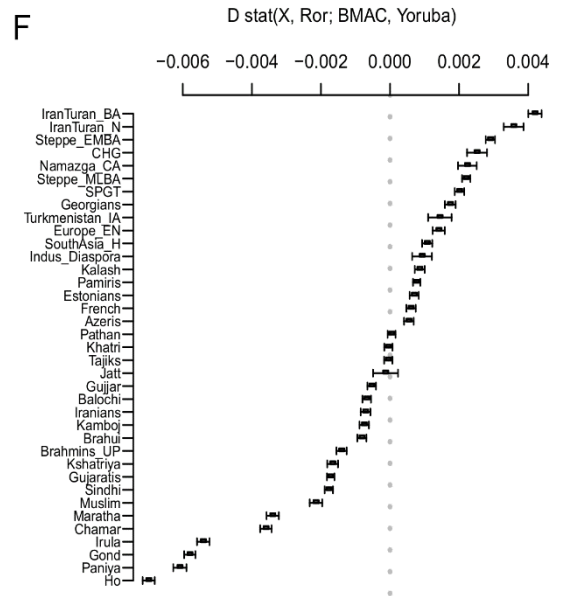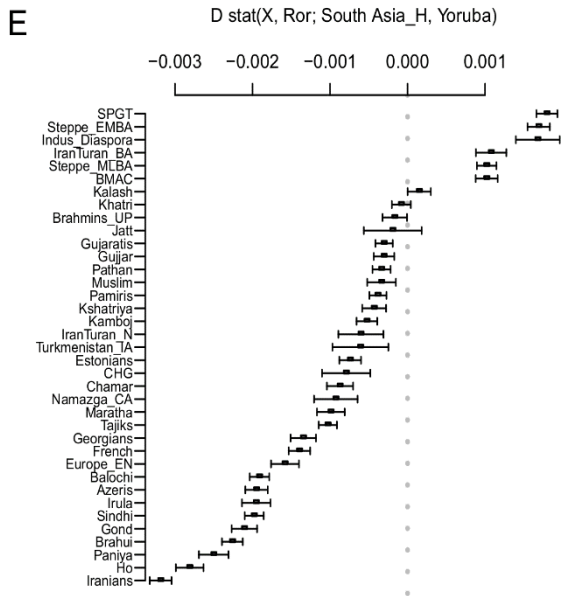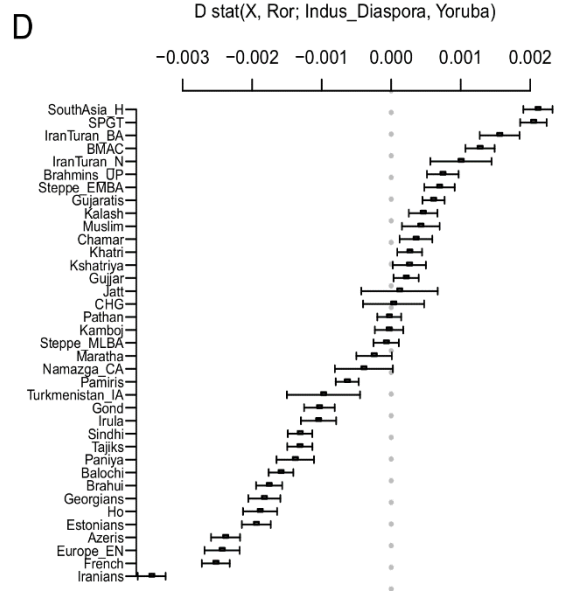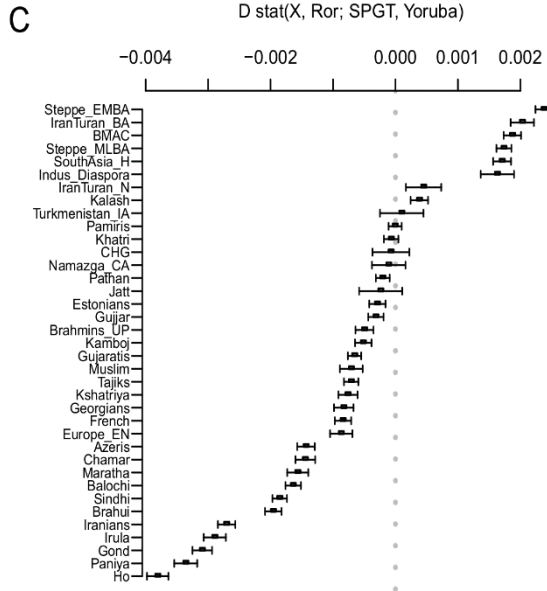
Figure S10. LD Decay Curve for ALDER run (A) and **(B) Ror** weighted admixture LD Decay curve for best representative ALDER results for Ror, **(C) Kamboj** weighted admixture LD Decay curve for best representative ALDER results for Kamboj, **(D) Gujjar** weighted admixture LD Decay curve for best representative ALDER results for Gujjar.
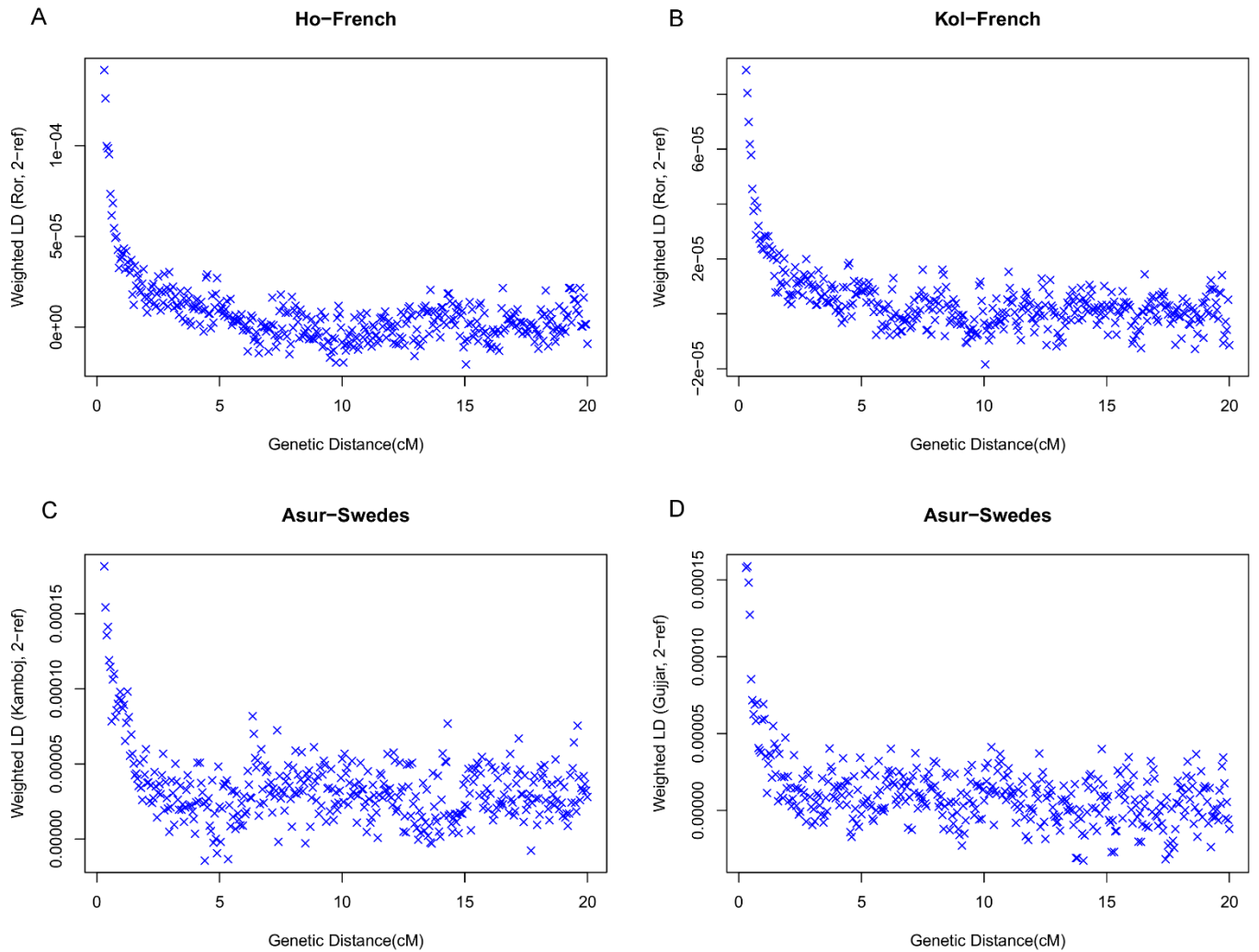
Figure S11. Maximum Likelihood tree of *TreeMix* relationship of Northwest Indian groups with neighboring Pakistani and other Eurasians inferred by *TreeMix* showing Ror and Kalash in the same clade.
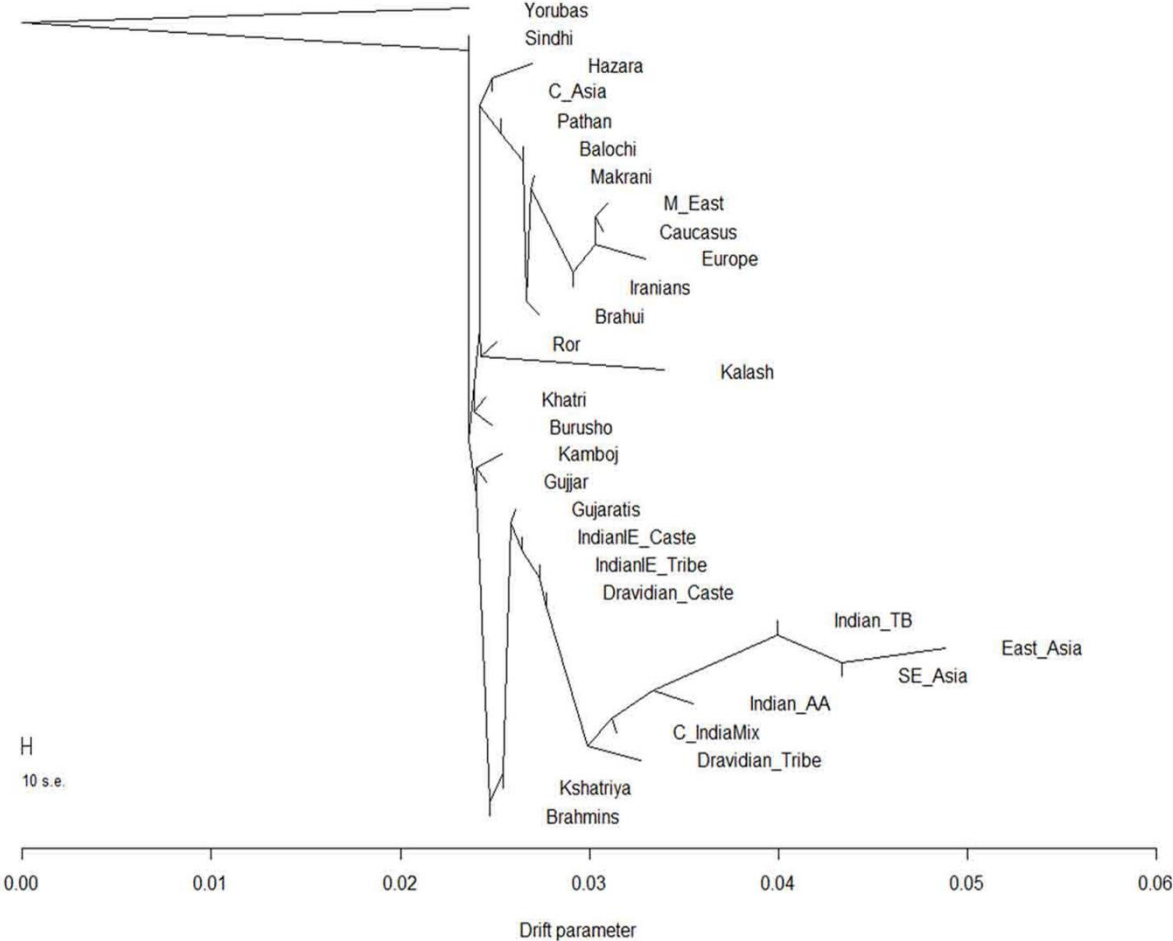
Figure S12. Runs of Homozygosity suggesting high density and population size for Ror the plot of Runs of Homozygosity (RoH) for Northwest Indians and other South Asians comparing the average length of RoH amongst them, using three different windows of 1000, 2500 and 5000 kb.
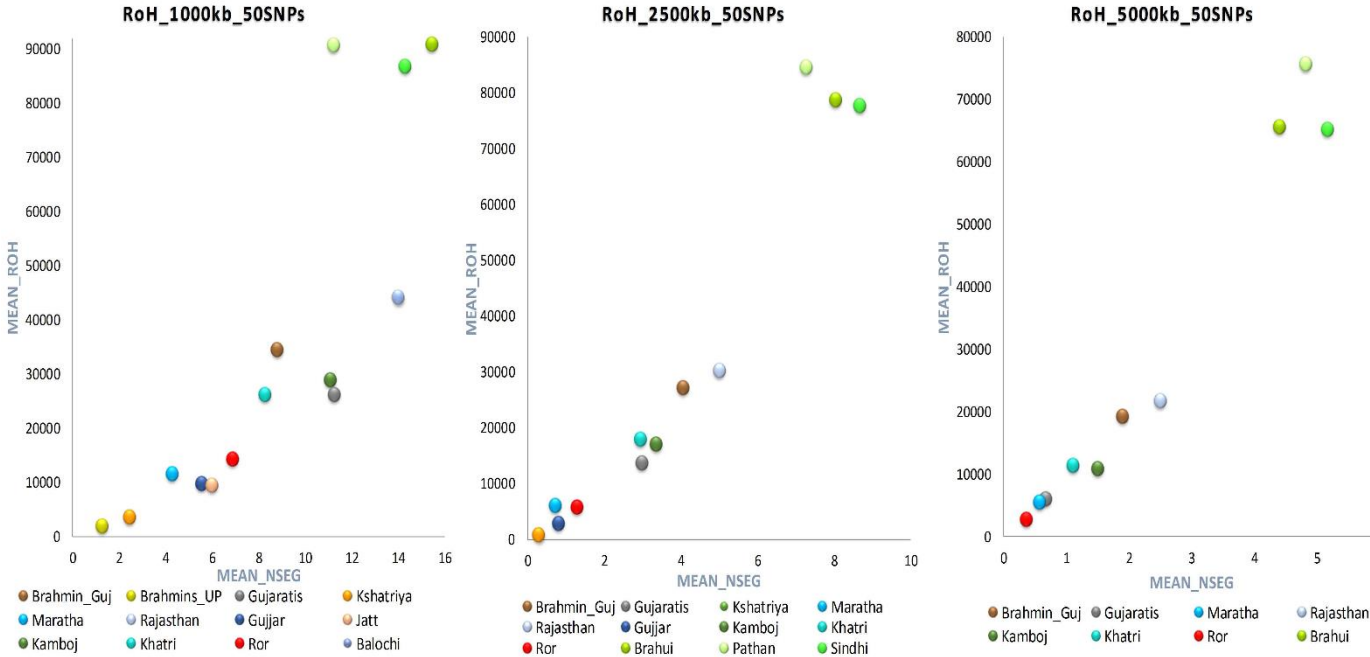
Figure S13. Mean Chunk received by PNWI and NI_IE (A) Chunks received from across Eurasia number of average Chunks received by PNWI and adjoining Gujaratis from across Eurasia and **(B) Chunks shared among PNWI individuals** number of average Chunks shared among PNWI and Gujarati is shown on the right.
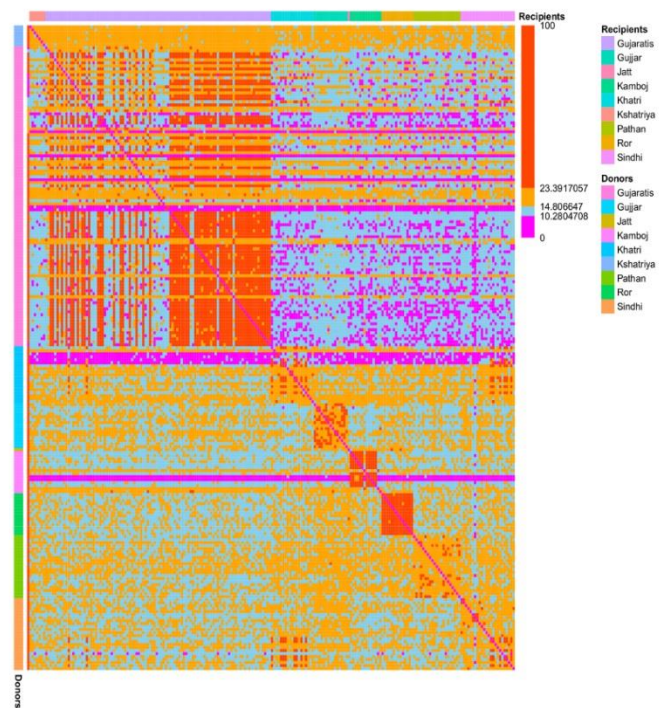
Figure S14. NNLS based Ancestry estimated for PNWI and neighboring populations (A) All populations as donor population-based ancestry estimates for PNWI and neighboring groups from North Indian Gangetic Plain inferred by CHROMOPAINTER using NNLS-based analysis including all populations as donor. **and (B) UNLINKED model** Ancestry estimates for PNWI and neighboring groups from North Indian Gangetic Plain inferred by UNLINKED CHROMOPAINTER run using NNLS-based analysis removing PNWI groups from donors. IN_IE, Indo-Europeans from India; Pak, Pakistan; Eur, Europe; M East, Middle East; Cau, Caucasus; IN_DRA, Indian Dravidians.
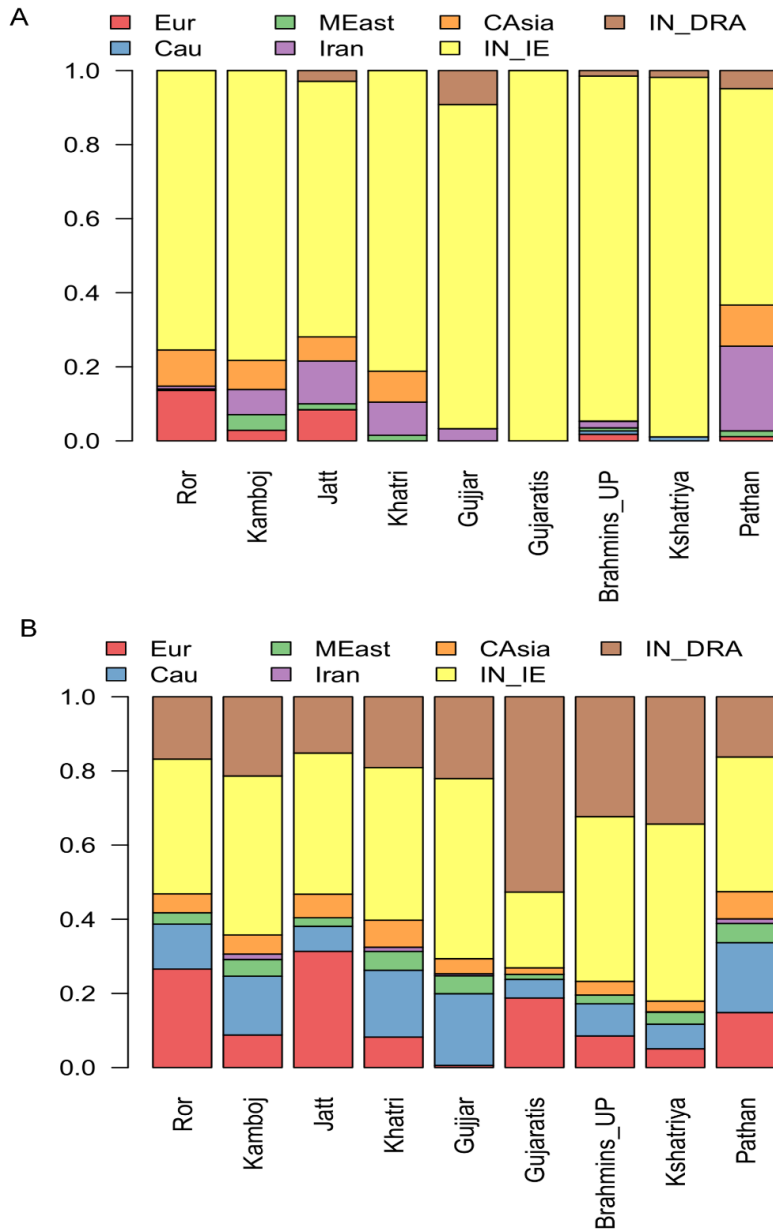
Figure S15. Correlation of IBD sharing of Ror with Steppe Ancestry in Europeans the scatter plot for correlation using "Pearson" method indicating the higher number of IBD segment shared between Ror and Europeans is positively correlated with the increasing Steppe ancestry in modern Europeans. Gray shade shows the 95% Confidence Interval.
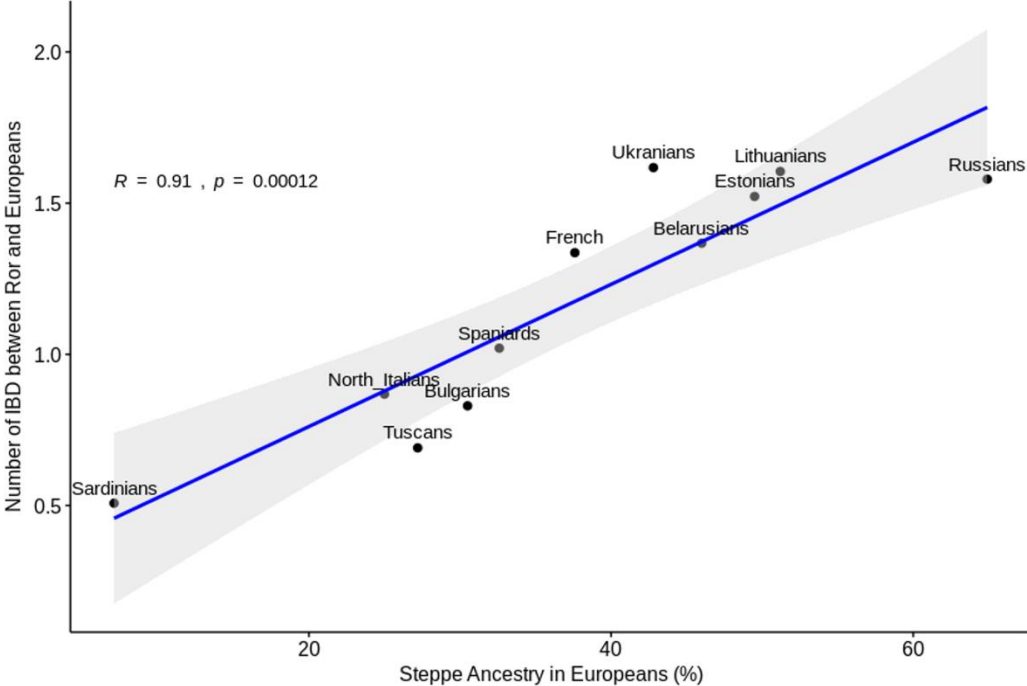
Supplemental Tables

Table S1. Details of modern populations and number of overlapping SNPs used for genome-wide data analyses of the study
Separate file: Table_S1.xls

Table S2. Detail information of ancient samples used in various analyses of this study
Separate file: Table_S2.xls

Table S3. Mitochondrial genotyping in sampled Northwest Indians

(A). Haplogroup wise mtDNA frequency

Population	n	D	F	M9	M	M18	M1	M2	M3	M30	M31	M33	M34	M4	M40	M5	M52	M57	M6	R5	U2	N	R	R0	R2	R2'JT	T	H	HV	HV2	I	J	K	U3	U5	U7	U9	W
Gujjar	44	0.068	0.000	0.023	0.068	0.000	0.000	0.000	0.091	0.045	0.000	0.000	0.000	0.000	0.023	0.045	0.045	0.000	0.000	0.045	0.068	0.000	0.000	0.000	0.045	0.045	0.068	0.023	0.000	0.000	0.000	0.068	0.000	0.000	0.023	0.182	0.000	0.023
Ror	104	0.010	0.010	0.019	0.067	0.000	0.000	0.010	0.115	0.125	0.000	0.010	0.010	0.029	0.000	0.125	0.010	0.000	0.000	0.000	0.096	0.010	0.000	0.038	0.000	0.000	0.038	0.010	0.038	0.010	0.000	0.029	0.000	0.010	0.019	0.077	0.010	0.077
Kamboj	42	0.048	0.000	0.024	0.048	0.024	0.000	0.024	0.095	0.024	0.000	0.000	0.000	0.000	0.000	0.095	0.000	0.024	0.024	0.000	0.071	0.048	0.048	0.000	0.000	0.000	0.024	0.048	0.000	0.000	0.024	0.024	0.024	0.000	0.000	0.262	0.000	0.000

(B). Regional mtDNA haplogroups the acronyms we used are: C Asia, Central Asia; E Asia, East Asia; SE Asia, Southeast Asia; S Asia, South Asia; W Eurasia, West Eurasia.

Population	n	C Asia	E Asia + SE Asia	S Asia	W Eurasia
Gujjar	41	0.073	0.024	0.390	0.512
Ror	96	0.010	0.031	0.583	0.375
Kamboj	36	0.056	0.028	0.444	0.472

Table S4. Y-chromosomal genotyping in sampled Northwest Indians

(A). Y haplogroups frequency tabling the occurrence of main haplogroups

Population	n	C-M356	H-M69	R2-M124	L-M11	J2-M172	R1a1-M17	Q-M242
Ror	139	0.06	0.08	0.08	0.29	0.13	0.35	0.01
Kamboj	52	0.04	0.15	0.06	0.17	0.06	0.52	0.00
Gujjar	57	0.00	0.07	0.09	0.63	0.02	0.19	0.00

(B). Regional haplogroups we display the occurrence of major regional Y chromosomal haplogroups in newly sampled individuals

Population	n	S Asian	W Eurasian	R1a	C Asian/ C Siberian
Ror	139	0.52	0.13	0.35	0.01
Kamboj	52	0.42	0.06	0.52	0.00
Gujjar	57	0.79	0.02	0.19	0.00

Table S5. The population wise F_{ST} values based on autosomal dataset of studied populations

Separate file_Table S5.xls

Table S6. Formal test of admixture for PNWI and Gangetic Plain populations we used f_3 *test* in form of f_3 (X, Y; PNWI/NI_IE) where X is related to ancient or modern groups from West Eurasia and Y is a modern South Asian population (Paniya) representing the Ancestral South India (ASI). Steppe_EMBA = Early Bronze Age Steppe, Steppe_MLBA= Middle Late Bronze Age Steppe, Anatolia_N = Neolithic Anatolia, IranTuran_N = Neolithic Iran Turan, Iran_N = Neolithic Iran, BMAC = Bactrian Margiana Complex, CHG = Caucasus Hunter-Gatherers, WHG = Western Hunter-Gatherers, EHG = Eastern Hunter-Gatherers, Indus_Diaspora = Indus_Periphery, SPGT = Iron Age South Asians, SouthAsia_H = Early historical South Asia.

source1	source2	Target	*f3*	std err	Z score
Steppe_MLBA	Paniya	Ror	-0.007603	0.000315	-24.165
Steppe_EMBA	Paniya	Ror	-0.008151	0.000343	-23.768
French	Paniya	Ror	-0.007271	0.000324	-22.475
Anatolia_N	Paniya	Ror	-0.006213	0.000433	-14.353
BMAC	Paniya	Ror	-0.003462	0.000337	-10.269
Iranians	Paniya	Ror	-0.003012	0.000324	-9.296
EHG	Paniya	Ror	-0.00684	0.000756	-9.045
Namazga_CA	Paniya	Ror	-0.004222	0.000576	-7.332
CHG	Paniya	Ror	-0.004933	0.000678	-7.279
WHG	Paniya	Ror	-0.002781	0.000626	-4.439
IranTuran_N	Paniya	Ror	-0.002564	0.000646	-3.968
Iran_N	Paniya	Ror	-0.002897	0.00112	-2.587
Kalash	Paniya	Ror	0.001265	0.000388	3.261
SPGT	Paniya	Ror	0.004528	0.00034	13.334
Indus_Diaspora	Paniya	Ror	0.010129	0.00071	14.271
SouthAsia_H	Paniya	Ror	0.007152	0.000375	19.07
BMAC	Paniya	Gujjar	-0.006989	0.000297	-23.54
Steppe_EMBA	Paniya	Gujjar	-0.007728	0.000334	-23.157
Steppe_MLBA	Paniya	Gujjar	-0.006815	0.000309	-22.084
French	Paniya	Gujjar	-0.007148	0.000336	-21.283
Iranians	Paniya	Gujjar	-0.005664	0.000298	-19.019
Anatolia_N	Paniya	Gujjar	-0.007043	0.000397	-17.72
Namazga_CA	Paniya	Gujjar	-0.008219	0.000565	-14.546
CHG	Paniya	Gujjar	-0.008741	0.00063	-13.874
IranTuran_N	Paniya	Gujjar	-0.008236	0.000624	-13.2
Iran_N	Paniya	Gujjar	-0.008134	0.001101	-7.387
Kalash	Paniya	Gujjar	-0.002188	0.000328	-6.677
EHG	Paniya	Gujjar	-0.004514	0.000757	-5.962
Ror	Paniya	Gujjar	-0.000864	0.000295	-2.926
WHG	Paniya	Gujjar	-0.001178	0.00062	-1.899
SPGT	Paniya	Gujjar	0.000318	0.000295	1.077
Indus_Diaspora	Paniya	Gujjar	0.004152	0.000668	6.219
SouthAsia_H	Paniya	Gujjar	0.002968	0.000325	9.132
Steppe_EMBA	Paniya	Kamboj	-0.005587	0.00035	-15.986
French	Paniya	Kamboj	-0.005505	0.000353	-15.597
Steppe_MLBA	Paniya	Kamboj	-0.004983	0.000325	-15.311
Anatolia_N	Paniya	Kamboj	-0.005769	0.00044	-13.122
BMAC	Paniya	Kamboj	-0.004049	0.000342	-11.827
Iranians	Paniya	Kamboj	-0.00321	0.000333	-9.641
Namazga_CA	Paniya	Kamboj	-0.004907	0.000594	-8.262
CHG	Paniya	Kamboj	-0.00571	0.000697	-8.196
IranTuran_N	Paniya	Kamboj	-0.004751	0.000644	-7.375
EHG	Paniya	Kamboj	-0.003596	0.000748	-4.807
Iran_N	Paniya	Kamboj	-0.004286	0.00111	-3.86
WHG	Paniya	Kamboj	-0.000397	0.00064	-0.62
Kalash	Paniya	Kamboj	0.00067	0.000376	1.778
Ror	Paniya	Kamboj	0.002141	0.000323	6.625
SPGT	Paniya	Kamboj	0.003248	0.000332	9.771
Indus_Diaspora	Paniya	Kamboj	0.007481	0.000697	10.728
SouthAsia_H	Paniya	Kamboj	0.005899	0.000362	16.274

Steppe_EMBA	Paniya	Khatri	-0.007207	0.000311	-23.18
French	Paniya	Khatri	-0.006927	0.000313	-22.153
Steppe_MLBA	Paniya	Khatri	-0.006301	0.000286	-22.037
BMAC	Paniya	Khatri	-0.005825	0.000279	-20.913
Anatolia_N	Paniya	Khatri	-0.006566	0.000403	-16.291
Iranians	Paniya	Khatri	-0.00455	0.000286	-15.924
Namazga_CA	Paniya	Khatri	-0.00673	0.000521	-12.924
CHG	Paniya	Khatri	-0.007331	0.000621	-11.812
IranTuran_N	Paniya	Khatri	-0.006125	0.0006	-10.216
EHG	Paniya	Khatri	-0.004702	0.000722	-6.51
Iran_N	Paniya	Khatri	-0.005892	0.001044	-5.642
Kalash	Paniya	Khatri	-0.000788	0.000322	-2.446
WHG	Paniya	Khatri	-0.00122	0.000591	-2.064
Ror	Paniya	Khatri	0.00115	0.000281	4.095
SPGT	Paniya	Khatri	0.002147	0.000267	8.038
Indus_Diaspora	Paniya	Khatri	0.006635	0.000654	10.144
SouthAsia_H	Paniya	Khatri	0.004834	0.00032	15.103
French	Paniya	Pathan	-0.009491	0.000281	-33.748
Steppe_MLBA	Paniya	Pathan	-0.008505	0.000255	-33.296
Steppe_EMBA	Paniya	Pathan	-0.009326	0.000296	-31.544
BMAC	Paniya	Pathan	-0.007356	0.000265	-27.779
Iranians	Paniya	Pathan	-0.006722	0.00026	-25.874
Anatolia_N	Paniya	Pathan	-0.009425	0.000384	-24.52
Namazga_CA	Paniya	Pathan	-0.008525	0.000538	-15.835
CHG	Paniya	Pathan	-0.009156	0.000592	-15.469
IranTuran_N	Paniya	Pathan	-0.007976	0.00058	-13.748
EHG	Paniya	Pathan	-0.006436	0.000682	-9.441
Iran_N	Paniya	Pathan	-0.008657	0.000986	-8.78
WHG	Paniya	Pathan	-0.003808	0.000556	-6.847
Kalash	Paniya	Pathan	-0.001983	0.000309	-6.426
Ror	Paniya	Pathan	0.000204	0.000262	0.778
SPGT	Paniya	Pathan	0.001166	0.000252	4.621
Indus_Diaspora	Paniya	Pathan	0.006603	0.000647	10.206
SouthAsia_H	Paniya	Pathan	0.004243	0.000309	13.726
BMAC	Paniya	Gujaratis	-0.00697	0.000242	-28.806
Steppe_EMBA	Paniya	Gujaratis	-0.007409	0.000261	-28.413
Steppe_MLBA	Paniya	Gujaratis	-0.006494	0.000239	-27.189
French	Paniya	Gujaratis	-0.007031	0.000262	-26.85
Iranians	Paniya	Gujaratis	-0.005871	0.00024	-24.454
Anatolia_N	Paniya	Gujaratis	-0.006482	0.000325	-19.939
Namazga_CA	Paniya	Gujaratis	-0.008034	0.00044	-18.256
IranTuran_N	Paniya	Gujaratis	-0.007774	0.000485	-16.019
Kalash	Paniya	Gujaratis	-0.004007	0.000252	-15.886
CHG	Paniya	Gujaratis	-0.007501	0.000508	-14.753
Ror	Paniya	Gujaratis	-0.002904	0.000205	-14.183
SPGT	Paniya	Gujaratis	-0.002103	0.000188	-11.214
EHG	Paniya	Gujaratis	-0.005673	0.00059	-9.613
Iran_N	Paniya	Gujaratis	-0.008246	0.000858	-9.609
WHG	Paniya	Gujaratis	-0.002584	0.000485	-5.328
SouthAsia_H	Paniya	Gujaratis	-0.000468	0.00021	-2.229
Indus_Diaspora	Paniya	Gujaratis	-0.000101	0.000497	-0.204
Steppe_EMBA	Paniya	Brahmins_UP	-0.011508	0.000402	-28.612
Steppe_MLBA	Paniya	Brahmins_UP	-0.010736	0.000394	-27.247
French	Paniya	Brahmins_UP	-0.010907	0.000415	-26.294
BMAC	Paniya	Brahmins_UP	-0.009068	0.000406	-22.336
Iranians	Paniya	Brahmins_UP	-0.008516	0.000403	-21.147
Anatolia_N	Paniya	Brahmins_UP	-0.01016	0.000483	-21.049
Namazga_CA	Paniya	Brahmins_UP	-0.009662	0.000663	-14.572
IranTuran_N	Paniya	Brahmins_UP	-0.009571	0.000703	-13.607
Kalash	Paniya	Brahmins_UP	-0.005703	0.000427	-13.354
CHG	Paniya	Brahmins_UP	-0.009513	0.00072	-13.206
Ror	Paniya	Brahmins_UP	-0.004646	0.000386	-12.036
EHG	Paniya	Brahmins_UP	-0.010244	0.000855	-11.982
WHG	Paniya	Brahmins_UP	-0.007495	0.000671	-11.162
SPGT	Paniya	Brahmins_UP	-0.003662	0.000391	-9.37
Iran_N	Paniya	Brahmins_UP	-0.010985	0.001215	-9.038
SouthAsia_H	Paniya	Brahmins_UP	-0.002036	0.00041	-4.971
Indus_Diaspora	Paniya	Brahmins_UP	-0.000647	0.000729	-0.888

Table S7. *D* statistics to test if Ror and Kalash belong to same clade we applied *D* stat in form of *D*(Yoruba,X; Ror, Kalash) where X is a global population.

Yoruba	pop1	pop2	pop3	Dstat	Z score
Yoruba	Ho	Ror	Kalash	-0.0048	-4.722
Yoruba	Onge	Ror	Kalash	-0.0057	-4.711
Yoruba	Gond	Ror	Kalash	-0.0045	-4.554
Yoruba	Paniya	Ror	Kalash	-0.0043	-4.047
Yoruba	Irula	Ror	Kalash	-0.0041	-3.952
Yoruba	Juang	Ror	Kalash	-0.0049	-3.857
Yoruba	Chamar	Ror	Kalash	-0.0034	-3.372
Yoruba	Kol	Ror	Kalash	-0.0026	-2.765
Yoruba	Tharu	Ror	Kalash	-0.0027	-2.649
Yoruba	Dharkars	Ror	Kalash	-0.0025	-2.569
Yoruba	Kshatriya	Ror	Kalash	-0.0024	-2.475
Yoruba	Burmese	Ror	Kalash	-0.0026	-2.353
Yoruba	Kurmi	Ror	Kalash	-0.0035	-2.272
Yoruba	Papuans	Ror	Kalash	-0.0026	-2.122
Yoruba	Naga	Ror	Kalash	-0.0026	-2
Yoruba	Brahmins_UP	Ror	Kalash	-0.0018	-1.887
Yoruba	Gujaratis	Ror	Kalash	-0.0017	-1.874
Yoruba	Japanese	Ror	Kalash	-0.0022	-1.866
Yoruba	Han	Ror	Kalash	-0.0018	-1.567
Yoruba	Estonians	Ror	Kalash	-0.0015	-1.516
Yoruba	Cambodians	Ror	Kalash	-0.0017	-1.458
Yoruba	Gujjar	Ror	Kalash	-0.0013	-1.413
Yoruba	Kurumba	Ror	Kalash	-0.0015	-1.328
Yoruba	Germans	Ror	Kalash	-0.0012	-1.165
Yoruba	French	Ror	Kalash	-0.0011	-1.145
Yoruba	Kamboj	Ror	Kalash	-0.0006	-0.643
Yoruba	Kazakhs	Ror	Kalash	-0.0006	-0.601
Yoruba	Hazara	Ror	Kalash	-0.0001	-0.094
Yoruba	North_Italians	Ror	Kalash	0.0001	0.132
Yoruba	Sindhi	Ror	Kalash	0.0003	0.302
Yoruba	Khatri	Ror	Kalash	0.0003	0.352
Yoruba	Pathan	Ror	Kalash	0.0009	0.978
Yoruba	Palestinians	Ror	Kalash	0.0012	1.404
Yoruba	Balochi	Ror	Kalash	0.0013	1.51
Yoruba	Yaghnobi	Ror	Kalash	0.002	1.852
Yoruba	Burusho	Ror	Kalash	0.0017	1.875
Yoruba	Makrani	Ror	Kalash	0.0019	2.203
Yoruba	Pamiris	Ror	Kalash	0.0021	2.325
Yoruba	Brahui	Ror	Kalash	0.0021	2.408
Yoruba	Armenians	Ror	Kalash	0.0025	2.702
Yoruba	Iranians	Ror	Kalash	0.0025	2.827
Yoruba	Azeris	Ror	Kalash	0.0026	2.878
Yoruba	Georgians	Ror	Kalash	0.0039	4.046

Table S8. Gene flow among PNWI and NI_IE and their relative affinity with Europe *D* statistics in form *D*(pop1, Yoruba; pop2, pop3), where pop1 is any South Asians/French and pop2 is Gujaratis/Pathan/Ror and pop3 is any of modern South Asians, show relative allele sharing of Pakistani, Northwest Indians and North Indians among themselves striking out the Ror's closeness with Pathan and Kalash and their highest affinity with Europe than other South Asians. PNWI = Pakistani and Northwest Indians, NI_IE = North Indian Indo-Europeans from Gangetic Plain, Brahmins_UP = Brahmins from Uttar Pradesh.

pop1	Yoruba	pop2	pop3	Dstat	Z score
Pathan	Yoruba	Gujaratis	Ror	-0.0057	-8.208
Pathan	Yoruba	Gujaratis	Kalash	-0.0066	-8.062
Pathan	Yoruba	Gujaratis	Khatri	-0.0044	-7.596
Pathan	Yoruba	Gujaratis	Gujjar	-0.0030	-5.439
Pathan	Yoruba	Gujaratis	Brahmins_UP	-0.0023	-3.218
Pathan	Yoruba	Gujaratis	Kamboj	-0.0017	-2.777
Pathan	Yoruba	Gujaratis	Jatt	-0.0046	-2.382
Pathan	Yoruba	Gujaratis	Kshatriya	0.0000	0.029
Pathan	Yoruba	Gujaratis	Sindhi	0.0081	14.447
Kalash	Yoruba	Gujaratis	Ror	-0.0083	-10.948
Kalash	Yoruba	Gujaratis	Khatri	-0.0063	-9.982
Kalash	Yoruba	Gujaratis	Pathan	-0.0063	-9.759
Kalash	Yoruba	Gujaratis	Gujjar	-0.0035	-5.673
Kalash	Yoruba	Gujaratis	Kamboj	-0.0032	-4.644
Kalash	Yoruba	Gujaratis	Jatt	-0.0068	-3.187
Kalash	Yoruba	Gujaratis	Brahmins_UP	-0.0023	-2.911
Kalash	Yoruba	Pathan	Ror	-0.002	-2.612
Kalash	Yoruba	Gujaratis	Kshatriya	-0.0003	-0.356
French	Yoruba	Ror	Jatt	0.0013	0.643
French	Yoruba	Ror	Kalash	0.0011	1.145
French	Yoruba	Ror	Pathan	0.0041	5.242
French	Yoruba	Ror	Khatri	0.0076	9.532
French	Yoruba	Ror	Kamboj	0.0102	11.075
French	Yoruba	Ror	Burusho	0.0108	13.669
French	Yoruba	Ror	Brahmins_UP	0.014	14.326
French	Yoruba	Ror	Gujjar	0.0129	14.994
French	Yoruba	Ror	Brahui	0.0131	15.605
French	Yoruba	Ror	Kshatriya	0.0182	17.795
French	Yoruba	Ror	Muslim	0.0227	19.351
French	Yoruba	Ror	Sindhi	0.0203	26.019
French	Yoruba	Ror	Makrani	0.0238	26.793
French	Yoruba	Ror	Gujaratis	0.0213	27.305
French	Yoruba	Ror	Maratha	0.0335	27.42
French	Yoruba	Ror	Chamar	0.0348	29.353
French	Yoruba	Ror	Irula	0.0469	35.408
French	Yoruba	Ror	Ho	0.0547	41.695

Table S9. *D* statistics for relative allele sharing of South Asians with a set of distal ancient sources we used *D* stat in form *D*(pop1, Yoruba; pop2, pop3), where pop1 is any South Asians and pop2 is Steppe_EMBA/Anatolia_N and pop3 is any of modern South Asians/Iran_N/EHG/Levant_N, highlighting Ror as the closest South Asian to Steppe_EMBA and Anatolia_N.

pop1	Yoruba	pop2	pop3	Dstat	Z score
Jatt	Yoruba	Steppe_EMBA	Iran_N	0.0045	7.314
Paniya	Yoruba	Steppe_EMBA	Iran_N	0.0032	8.369
Sindhi	Yoruba	Steppe_EMBA	Iran_N	0.0028	8.434
Gujjar	Yoruba	Steppe_EMBA	Iran_N	0.0031	8.905
Chamar	Yoruba	Steppe_EMBA	Iran_N	0.0033	9.181
Kshatriya	Yoruba	Steppe_EMBA	Iran_N	0.0036	9.392
Ho	Yoruba	Steppe_EMBA	Iran_N	0.0035	9.558
Gujaratis	Yoruba	Steppe_EMBA	Iran_N	0.0031	9.609
Pathan	Yoruba	Steppe_EMBA	Iran_N	0.0033	9.872
Khatri	Yoruba	Steppe_EMBA	Iran_N	0.0035	10.039
Brahmins_UP	Yoruba	Steppe_EMBA	Iran_N	0.0040	10.525
Kamboj	Yoruba	Steppe_EMBA	Iran_N	0.0038	10.789
Kalash	Yoruba	Steppe_EMBA	Iran_N	0.0040	11.209
Ror	Yoruba	Steppe_EMBA	Iran_N	0.0050	14.259
Ho	Yoruba	Steppe_EMBA	EHG	-0.0014	-4.948
Paniya	Yoruba	Steppe_EMBA	EHG	-0.0011	-3.508
Chamar	Yoruba	Steppe_EMBA	EHG	-0.0009	-2.866
Jatt	Yoruba	Steppe_EMBA	EHG	-0.0013	-2.499
Kshatriya	Yoruba	Steppe_EMBA	EHG	-0.0006	-1.967
Ror	Yoruba	Steppe_EMBA	EHG	-0.0005	-1.804
Gujaratis	Yoruba	Steppe_EMBA	EHG	-0.0004	-1.444
Brahmins_UP	Yoruba	Steppe_EMBA	EHG	-0.0003	-1.019
Kalash	Yoruba	Steppe_EMBA	EHG	-0.0003	-0.859
Kamboj	Yoruba	Steppe_EMBA	EHG	-0.0002	-0.729
Gujjar	Yoruba	Steppe_EMBA	EHG	0.0000	-0.152
Sindhi	Yoruba	Steppe_EMBA	EHG	0.0000	-0.036
Pathan	Yoruba	Steppe_EMBA	EHG	0.0000	0.079
Khatri	Yoruba	Steppe_EMBA	EHG	0.0000	0.127
Gujaratis	Yoruba	Anatolia_N	Iran_N	0.0000	-0.064
Gujjar	Yoruba	Anatolia_N	Iran_N	0.0001	0.237
Sindhi	Yoruba	Anatolia_N	Iran_N	0.0001	0.412
Chamar	Yoruba	Anatolia_N	Iran_N	0.0002	0.523
Kshatriya	Yoruba	Anatolia_N	Iran_N	0.0002	0.594
Paniya	Yoruba	Anatolia_N	Iran_N	0.0003	0.68
Khatri	Yoruba	Anatolia_N	Iran_N	0.0003	0.906
Kalash	Yoruba	Anatolia_N	Iran_N	0.0006	1.49
Jatt	Yoruba	Anatolia_N	Iran_N	0.0010	1.642
Pathan	Yoruba	Anatolia_N	Iran_N	0.0006	1.725
Brahmins_UP	Yoruba	Anatolia_N	Iran_N	0.0007	1.834
Ho	Yoruba	Anatolia_N	Iran_N	0.0007	1.944
Kamboj	Yoruba	Anatolia_N	Iran_N	0.0010	2.732
Ror	Yoruba	Anatolia_N	Iran_N	0.0017	4.572

Ho	Yoruba	Anatolia_N	EHG	-0.0042	-12.203
Ror	Yoruba	Anatolia_N	EHG	-0.0039	-12.066
Gujaratis	Yoruba	Anatolia_N	EHG	-0.0036	-11.83
Chamar	Yoruba	Anatolia_N	EHG	-0.0039	-11.598
Paniya	Yoruba	Anatolia_N	EHG	-0.0041	-11.392
Kshatriya	Yoruba	Anatolia_N	EHG	-0.0040	-11.196
Kalash	Yoruba	Anatolia_N	EHG	-0.0037	-10.796
Brahmins_UP	Yoruba	Anatolia_N	EHG	-0.0036	-10.491
Gujjar	Yoruba	Anatolia_N	EHG	-0.0031	-9.882
Khatri	Yoruba	Anatolia_N	EHG	-0.0031	-9.532
Kamboj	Yoruba	Anatolia_N	EHG	-0.0031	-9.125
Sindhi	Yoruba	Anatolia_N	EHG	-0.0027	-8.874
Pathan	Yoruba	Anatolia_N	EHG	-0.0028	-8.642
Jatt	Yoruba	Anatolia_N	EHG	-0.0048	-7.727
Jatt	Yoruba	Anatolia_N	Levant_N	0.0032	7.098
Ho	Yoruba	Anatolia_N	Levant_N	0.0019	7.185
Paniya	Yoruba	Anatolia_N	Levant_N	0.0021	7.328
Chamar	Yoruba	Anatolia_N	Levant_N	0.0023	8.122
Kshatriya	Yoruba	Anatolia_N	Levant_N	0.0026	9.168
Brahmins_UP	Yoruba	Anatolia_N	Levant_N	0.0028	10.154
Gujaratis	Yoruba	Anatolia_N	Levant_N	0.0026	10.552
Sindhi	Yoruba	Anatolia_N	Levant_N	0.0025	10.554
Gujjar	Yoruba	Anatolia_N	Levant_N	0.0028	10.7
Pathan	Yoruba	Anatolia_N	Levant_N	0.0028	11.051
Kamboj	Yoruba	Anatolia_N	Levant_N	0.0029	11.204
Ror	Yoruba	Anatolia_N	Levant_N	0.0031	11.289
Kalash	Yoruba	Anatolia_N	Levant_N	0.0031	11.541
Khatri	Yoruba	Anatolia_N	Levant_N	0.0030	11.765

Table S10. *D* statistics for relative allele sharing of South Asians with a set of proximal ancient sources we computed *D stat* in form of *D* (pop1, Yoruba; pop2, pop3), where pop1 is South Asians, pop2 is different aDNA sources and pop3 refers to aDNA samples or modern Dravidian displaying relative allele sharing of South Asians with neighboring (proximal) ancient sources from South Asia and Central Asia.

Separate file_Table S10.xls

Table S11. *qpAdm* with Steppe_MLBA we used *qpAdm* to deduce ancestry proportion from distal ancient sources (Iran_N, Steppe_MLBA and Onge) among South Asians. Only populations with p value > 0.5 have been reported leaving out Kalash, SPGT, Burusho, Hazara, IN_AA and IN_TB (p value < 0.5).

Target Pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	std err1	std err2	std err3	Source1	Source2	Source3
Ror	0.295723	0.179	0.621	0.2	0.028	0.024	0.014	Iran_N	Steppe_MLBA	Onge
Khatri	0.0898528	0.198	0.553	0.249	0.03	0.025	0.015	Iran_N	Steppe_MLBA	Onge
Gujjar	0.266217	0.214	0.492	0.295	0.032	0.028	0.016	Iran_N	Steppe_MLBA	Onge
Kamboj	0.124754	0.253	0.485	0.263	0.032	0.027	0.017	Iran_N	Steppe_MLBA	Onge
Pathan	0.334088	0.236	0.547	0.217	0.027	0.024	0.014	Iran_N	Steppe_MLBA	Onge
Jatt	0.258625	0.084	0.703	0.213	0.08	0.07	0.038	Iran_N	Steppe_MLBA	Onge
Sindhi	0.116182	0.51	0.291	0.199	0.04	0.034	0.019	Iran_N	Steppe_MLBA	Onge
Balochi	0.777542	0.583	0.287	0.13	0.043	0.037	0.021	Iran_N	Steppe_MLBA	Onge
Brahui	0.355776	0.629	0.269	0.102	0.046	0.04	0.022	Iran_N	Steppe_MLBA	Onge
Makrani	0.47551	1	NA	NA	0.062	NA	NA	Iran_N	Steppe_MLBA	Onge
Brahmin_Guj	0.148345	0.211	0.489	0.3	0.03	0.025	0.015	Iran_N	Steppe_MLBA	Onge
Gujaratis	0.0905237	0.171	0.443	0.385	0.031	0.026	0.015	Iran_N	Steppe_MLBA	Onge
Brahmins_UP	0.220679	0.142	0.51	0.348	0.036	0.031	0.018	Iran_N	Steppe_MLBA	Onge
Kshatriya	0.173372	0.175	0.464	0.361	0.037	0.031	0.018	Iran_N	Steppe_MLBA	Onge
Chamar	0.0602319	0.076	0.357	0.567	0.039	0.035	0.02	Iran_N	Steppe_MLBA	Onge
Kanjars	0.734447	0.182	0.373	0.445	0.038	0.033	0.02	Iran_N	Steppe_MLBA	Onge
Kurmi	0.291761	0.083	0.51	0.408	0.076	0.067	0.04	Iran_N	Steppe_MLBA	Onge
Dharkars	0.53426	0.099	0.463	0.437	0.035	0.03	0.018	Iran_N	Steppe_MLBA	Onge
Muslim	0.0880746	0.108	0.443	0.449	0.046	0.04	0.022	Iran_N	Steppe_MLBA	Onge
Maratha	0.50061	0.139	0.336	0.525	0.04	0.036	0.02	Iran_N	Steppe_MLBA	Onge
Meena	0.256096	0.16	0.512	0.328	0.078	0.07	0.038	Iran_N	Steppe_MLBA	Onge
Meghawal	0.0920744	0.183	0.339	0.479	0.084	0.07	0.04	Iran_N	Steppe_MLBA	Onge
Kol	0.260324	0.063	0.408	0.528	0.034	0.031	0.017	Iran_N	Steppe_MLBA	Onge
Gond	0.210592	NA	0.28	0.72	NA	0.035	0.021	Iran_N	Steppe_MLBA	Onge
Kurumba	0.445845	0.227	0.3	0.473	0.048	0.042	0.025	Iran_N	Steppe_MLBA	Onge
Paniya	0.309749	0.074	0.162	0.764	0.044	0.039	0.023	Iran_N	Steppe_MLBA	Onge
Irula	0.138575	0.136	0.198	0.667	0.045	0.038	0.023	Iran_N	Steppe_MLBA	Onge
SouthAsia_H	0.629248	0.165	0.542	0.293	0.03	0.027	0.015	Iran_N	Steppe_MLBA	Onge
BMAC	0.53134	0.544	0.407	0.048	0.04	0.035	0.019	Iran_N	Steppe_MLBA	Onge
Namazga_CA	0.703087	0.588	0.412	NA	0.069	0.06	NA	Iran_N	Steppe_MLBA	Onge
Indus_Diaspora	0.0914973	0.305	0.378	0.316	0.064	0.056	0.03	Iran_N	Steppe_MLBA	Onge
Turkmenistan_IA	0.804688	0.307	0.648	0.045	0.072	0.066	0.035	Iran_N	Steppe_MLBA	Onge
IranTuran_BA	0.171678	0.52	0.445	0.035	0.046	0.04	0.022	Iran_N	Steppe_MLBA	Onge

Table S12. *qpAdm* **with Steppe_EMBA** we used *qpAdm* to deduce ancestry proportion from distal ancient sources (Iran_N, Steppe_EMBA and Onge) among South Asians. Only populations with p value > 0.5 have been reported leaving out Burusho, Hazara, IN_AA and IN_TB (p value < 0.5).

Target Pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	std err1	std err2	std err3	Source1	Source2	Source3
Ror	0.862682	0.244	0.544	0.212	0.027	0.022	0.015	Iran_N	Steppe_EMBA	Onge
Kalash	0.627904	0.228	0.583	0.189	0.031	0.026	0.017	Iran_N	Steppe_EMBA	Onge
Khatri	0.185302	0.261	0.483	0.256	0.029	0.024	0.016	Iran_N	Steppe_EMBA	Onge
Gujjar	0.624598	0.269	0.429	0.302	0.03	0.025	0.017	Iran_N	Steppe_EMBA	Onge
Kamboj	0.215046	0.306	0.424	0.27	0.031	0.025	0.018	Iran_N	Steppe_EMBA	Onge
Pathan	0.242626	0.3	0.476	0.225	0.029	0.023	0.016	Iran_N	Steppe_EMBA	Onge
Jatt	0.380243	0.172	0.611	0.218	0.071	0.06	0.038	Iran_N	Steppe_EMBA	Onge
Sindhi	0.348933	0.532	0.263	0.205	0.037	0.03	0.02	Iran_N	Steppe_EMBA	Onge
Balochi	0.726245	0.617	0.249	0.135	0.042	0.034	0.022	Iran_N	Steppe_EMBA	Onge
Brahui	0.432531	0.658	0.236	0.106	0.044	0.036	0.023	Iran_N	Steppe_EMBA	Onge
Makrani	0.55936	0.947	0.053	NA	0.057	0.047	NA	Iran_N	Steppe_EMBA	Onge
Brahmin_Guj	0.577213	0.264	0.428	0.307	0.028	0.023	0.015	Iran_N	Steppe_EMBA	Onge
Gujaratis	0.833375	0.218	0.389	0.393	0.028	0.022	0.015	Iran_N	Steppe_EMBA	Onge
Brahmins_UP	0.487651	0.2	0.445	0.355	0.033	0.027	0.019	Iran_N	Steppe_EMBA	Onge
Kshatriya	0.693484	0.224	0.409	0.367	0.034	0.028	0.018	Iran_N	Steppe_EMBA	Onge
Chamar	0.512026	0.113	0.319	0.569	0.034	0.029	0.02	Iran_N	Steppe_EMBA	Onge
Kanjars	0.956662	0.223	0.327	0.45	0.036	0.03	0.021	Iran_N	Steppe_EMBA	Onge
Kurmi	0.141331	0.155	0.433	0.411	0.068	0.058	0.04	Iran_N	Steppe_EMBA	Onge
Dharkars	0.184288	0.159	0.397	0.444	0.034	0.027	0.019	Iran_N	Steppe_EMBA	Onge
Muslim	0.4431	0.158	0.39	0.453	0.04	0.033	0.022	Iran_N	Steppe_EMBA	Onge
Maratha	0.779805	0.178	0.292	0.53	0.036	0.031	0.02	Iran_N	Steppe_EMBA	Onge
Meena	0.497844	0.211	0.454	0.335	0.071	0.061	0.038	Iran_N	Steppe_EMBA	Onge
Meghawal	0.140849	0.221	0.298	0.481	0.075	0.06	0.041	Iran_N	Steppe_EMBA	Onge
Kol	0.556904	0.114	0.353	0.533	0.031	0.026	0.017	Iran_N	Steppe_EMBA	Onge
Gond	0.178967	NA	0.264	0.736	NA	0.03	0.021	Iran_N	Steppe_EMBA	Onge
Kurumba	0.75005	0.256	0.268	0.476	0.044	0.037	0.025	Iran_N	Steppe_EMBA	Onge
Paniya	0.420394	0.092	0.143	0.765	0.04	0.033	0.023	Iran_N	Steppe_EMBA	Onge
Irula	0.294562	0.154	0.177	0.669	0.04	0.032	0.023	Iran_N	Steppe_EMBA	Onge
SPGT	0.768161	0.271	0.496	0.233	0.027	0.022	0.015	Iran_N	Steppe_EMBA	Onge
SouthAsia_H	0.949565	0.23	0.47	0.3	0.028	0.025	0.016	Iran_N	Steppe_EMBA	Onge
BMAC	0.264358	0.599	0.348	0.053	0.04	0.033	0.021	Iran_N	Steppe_EMBA	Onge
Indus_Diaspora	0.320086	0.336	0.341	0.323	0.058	0.049	0.03	Iran_N	Steppe_EMBA	Onge
Turkmenistan_IA	0.907793	0.383	0.567	0.05	0.067	0.06	0.036	Iran_N	Steppe_EMBA	Onge
IranTuran_BA	0.238759	0.57	0.387	0.042	0.043	0.037	0.024	Iran_N	Steppe_EMBA	Onge
Namazga_CA	0.684163	0.64	0.36	NA	0.065	0.054	NA	Iran_N	Steppe_EMBA	Onge

Table S13. *qpAdm* with both Steppe_EMBA and Steppe_MLBA we used *qpAdm* to deduce ancestry proportion from distal ancient sources (Iran_N, Steppe_EMBA, Steppe_MLBA and Onge) among South Asians. Only populations with p value > 0.5 have been reported leaving out Burusho, Hazara, BMAC, IN_AA and IN_TB (p value < 0.5).

Target Pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	Mix coeff4	std err1	std err2	std err3	std err4	Source1	Source2	Source3	Source4
Makrani	0.554654	0.968	NA	NA	0.032	0.067	NA	NA	0.028	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Brahui	0.484494	0.629	NA	0.265	0.106	0.05	NA	0.122	0.02	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Balochi	0.133865	0.672	0.239	NA	0.089	0.045	0.099	NA	0.019	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Sindhi	0.426382	0.523	0.262	NA	0.215	0.045	0.101	NA	0.019	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Pathan	0.492786	0.26	0.205	0.314	0.221	0.03	0.069	0.075	0.013	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kalash	0.599629	0.215	0.486	0.112	0.187	0.036	0.087	0.093	0.016	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Ror	0.950983	0.218	0.351	0.224	0.208	0.03	0.07	0.076	0.013	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Khatri	0.236179	0.236	0.317	0.192	0.254	0.033	0.073	0.08	0.014	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Gujjar	0.616238	0.248	0.274	0.18	0.298	0.035	0.079	0.086	0.015	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kamboj	0.235878	0.281	0.236	0.218	0.266	0.036	0.081	0.09	0.016	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Jatt	0.381769	0.163	0.554	0.066	0.217	0.085	0.201	0.218	0.036	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Gujaratis	0.917428	0.218	0.389	NA	0.393	0.033	0.068	NA	0.014	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Brahmins_UP	0.542499	0.21	0.446	NA	0.344	0.039	0.089	NA	0.017	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kshatriya	0.783016	0.23	0.409	NA	0.361	0.04	0.09	NA	0.017	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Chamar	0.620047	0.107	0.317	NA	0.577	0.041	0.101	NA	0.018	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Dharkars	0.268219	0.153	0.396	NA	0.45	0.042	0.093	NA	0.018	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Muslim	0.476656	0.17	0.392	NA	0.438	0.047	0.103	NA	0.02	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Maratha	0.875488	0.181	0.292	NA	0.526	0.044	0.102	NA	0.019	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Meena	0.638788	0.215	0.455	NA	0.33	0.081	0.198	NA	0.034	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Meghawal	0.181145	0.245	0.3	NA	0.455	0.094	0.211	NA	0.04	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kol	0.697869	0.115	0.353	NA	0.532	0.037	0.085	NA	0.016	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Gond	0.217194	NA	0.253	NA	0.747	NA	0.102	NA	0.02	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kurumba	0.777743	0.243	0.266	NA	0.491	0.052	0.125	NA	0.023	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Paniya	0.561081	0.094	0.144	NA	0.762	0.049	0.113	NA	0.022	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Irula	0.295332	0.134	0.176	NA	0.69	0.049	0.106	NA	0.021	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Namazga_CA	0.762098	0.642	0.358	NA	NA	0.079	0.196	NA	NA	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Indus_Diaspora	0.386398	0.354	0.34	NA	0.306	0.071	0.169	NA	0.027	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
SPGT	0.177337	0.238	0.18	0.363	0.219	0.031	0.074	0.083	0.013	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
SouthAsia_H	0.884903	0.185	0.144	0.381	0.291	0.032	0.08	0.088	0.014	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
IranTuran_BA	0.0543647	0.531	NA	0.469	NA	0.051	NA	0.14	NA	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Turkmenistan_IA	0.765259	0.334	NA	0.666	NA	0.08	NA	0.234	NA	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge

Table S14. *qpAdm* **using proximal model with Namazga_CA** we used *qpAdm* to deduce ancestry proportion from distal ancient sources (Namazga_CA, Steppe_MLBA and Onge) among South Asians. Only populations with p value > 0.5 have been reported.

Target pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	std err1	std err2	std err3	Source1	Source2	Source3
Ror	0.1103	0.388	**0.436**	0.176	0.103	0.066	0.042	Namazga_CA	Steppe_MLBA	Onge
Khatri	0.1128	0.578	0.244	0.178	0.078	0.047	0.038	Namazga_CA	Steppe_MLBA	Onge
Gujjar	0.4164	0.529	0.244	0.227	0.079	0.048	0.039	Namazga_CA	Steppe_MLBA	Onge
Kamboj	0.1433	0.54	0.243	0.217	0.093	0.055	0.045	Namazga_CA	Steppe_MLBA	Onge
Pathan	0.608	0.589	0.239	0.172	0.071	0.045	0.033	Namazga_CA	Steppe_MLBA	Onge
Sindhi	0.9338	0.58	0.218	0.202	0.066	0.042	0.031	Namazga_CA	Steppe_MLBA	Onge
Brahui	0.1223	0.699	0.179	0.122	0.072	0.049	0.031	Namazga_CA	Steppe_MLBA	Onge
Brahmins_UP	0.054	0.309	0.335	0.356	0.146	0.08	0.072	Namazga_CA	Steppe_MLBA	Onge
Chamar	0.0996	0.122	0.268	0.61	0.087	0.054	0.048	Namazga_CA	Steppe_MLBA	Onge
Kanjars	0.0865	0.262	0.289	0.449	0.123	0.067	0.065	Namazga_CA	Steppe_MLBA	Onge
Kurmi	0.4326	0.588	0.131	0.281	0.201	0.103	0.116	Namazga_CA	Steppe_MLBA	Onge
Maratha	0.3011	0.135	0.308	0.557	0.095	0.059	0.051	Namazga_CA	Steppe_MLBA	Onge
Meena	0.8675	0.333	0.301	0.365	0.191	0.114	0.098	Namazga_CA	Steppe_MLBA	Onge
Meghawal	0.2495	NA	0.288	0.712	NA	0.099	0.115	Namazga_CA	Steppe_MLBA	Onge
Gond	0.2566	NA	0.183	0.817	NA	0.047	0.047	Namazga_CA	Steppe_MLBA	Onge
Kurumba	0.0888	0.246	0.234	0.52	0.125	0.068	0.073	Namazga_CA	Steppe_MLBA	Onge
Paniya	0.3473	NA	0.185	0.815	NA	0.052	0.049	Namazga_CA	Steppe_MLBA	Onge
Irula	0.5916	0.129	0.159	0.713	0.076	0.048	0.047	Namazga_CA	Steppe_MLBA	Onge
Ho	0.0701	NA	0.111	0.889	NA	0.045	0.048	Namazga_CA	Steppe_MLBA	Onge
Asur	0.3203	NA	NA	1	NA	NA	0.072	Namazga_CA	Steppe_MLBA	Onge
Juang	0.1246	NA	NA	1	NA	NA	0.079	Namazga_CA	Steppe_MLBA	Onge
SouthAsia_H	0.5284	0.644	0.159	0.197	0.076	0.047	0.038	Namazga_CA	Steppe_MLBA	Onge

Table S15. *qpAdm* **using proximal model with Indus_Periphery (Indus_Diaspora)** we used *qpAdm* to deduce ancestry proportion from distal ancient sources (Indus_Diaspora, Steppe_MLBA and Onge) among South Asians. Only populations with p value > 0.5 have been reported.

Target pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	std err1	std err2	std err3	Source1	Source2	Source3
Ror	0.641608	0.468	0.473	0.059	0.092	0.056	0.04	Indus_Diaspora	Steppe_MLBA	Onge
Kalash	0.386132	0.555	0.445	NA	0.129	0.078	NA	Indus_Diaspora	Steppe_MLBA	Onge
Khatri	0.072829	0.765	0.235	NA	0.13	0.078	NA	Indus_Diaspora	Steppe_MLBA	Onge
Gujjar	0.148636	0.717	0.214	0.069	0.131	0.08	0.056	Indus_Diaspora	Steppe_MLBA	Onge
Kamboj	0.130149	0.85	0.15	NA	0.134	0.081	NA	Indus_Diaspora	Steppe_MLBA	Onge
Pathan	0.076498	0.71	0.29	NA	0.12	0.073	NA	Indus_Diaspora	Steppe_MLBA	Onge
Jatt	0.37967	0.601	0.399	NA	0.232	0.14	NA	Indus_Diaspora	Steppe_MLBA	Onge
Brahmin_Guj	0.138981	0.675	0.234	0.091	0.129	0.078	0.055	Indus_Diaspora	Steppe_MLBA	Onge
Gujaratis	0.61345	0.56	0.214	0.226	0.109	0.065	0.047	Indus_Diaspora	Steppe_MLBA	Onge
Brahmins_UP	0.456242	0.429	0.34	0.23	0.141	0.083	0.062	Indus_Diaspora	Steppe_MLBA	Onge
Kshatriya	0.90496	0.553	0.247	0.2	0.123	0.074	0.054	Indus_Diaspora	Steppe_MLBA	Onge
Chamar	0.261509	0.307	0.218	0.475	0.167	0.097	0.072	Indus_Diaspora	Steppe_MLBA	Onge
Kanjars	0.518784	0.608	0.143	0.249	0.152	0.091	0.066	Indus_Diaspora	Steppe_MLBA	Onge
Kurmi	0.425804	0.199	0.385	0.416	0.269	0.161	0.115	Indus_Diaspora	Steppe_MLBA	Onge
Dharkars	0.165794	0.25	0.351	0.399	0.155	0.091	0.067	Indus_Diaspora	Steppe_MLBA	Onge
Muslim	0.662533	0.428	0.232	0.341	0.15	0.088	0.065	Indus_Diaspora	Steppe_MLBA	Onge
Maratha	0.742817	0.473	0.149	0.378	0.149	0.089	0.063	Indus_Diaspora	Steppe_MLBA	Onge
Meena	0.324146	0.445	0.313	0.242	0.304	0.182	0.128	Indus_Diaspora	Steppe_MLBA	Onge
Meghawal	0.555112	0.855	NA	0.146	0.285	NA	0.122	Indus_Diaspora	Steppe_MLBA	Onge
Kol	0.621467	0.256	0.267	0.477	0.123	0.073	0.053	Indus_Diaspora	Steppe_MLBA	Onge
Kurumba	0.688289	0.801	NA	0.199	0.179	NA	0.077	Indus_Diaspora	Steppe_MLBA	Onge
Paniya	0.74176	0.389	NA	0.611	0.171	NA	0.075	Indus_Diaspora	Steppe_MLBA	Onge
Irula	0.869405	0.476	NA	0.524	0.157	NA	0.068	Indus_Diaspora	Steppe_MLBA	Onge
SPGT	0.8029	0.616	0.338	0.046	0.098	0.06	0.042	Indus_Diaspora	Steppe_MLBA	Onge
SouthAsia_H	0.710365	0.469	0.363	0.168	0.105	0.063	0.045	Indus_Diaspora	Steppe_MLBA	Onge

Table S16. *qpWave* results

(A): *qpWave* p value for all models we used *qpWave* for various modellings of South Asian populations indicating the differentiation of sources by the listed outgroups.

p value	f4 rank	source1	source2	source3	source4	Outgrp1	Outgrp2	Outgrp3	Outgrp4	Outgrp5	Outgrp6	Outgrp7	Outgrp8	
4.13E-44	1	Iran_N	Steppe_MLBA	Onge	NA	Ust_Ishim	MA1	Kostenki14	Papuans	Chukchis	Karitiana	Mbuti_Pygmies	NA	distal model1
7.60E-52	1	Iran_N	Steppe_EMBA	Onge	NA	Ust_Ishim	MA1	Kostenki14	Papuans	Chukchis	Karitiana	Mbuti_Pygmies	NA	distal model2
2.52E-25	2	Iran_N	Steppe_MLBA	Onge	Steppe_EMBA	Ust_Ishim	MA1	Kostenki14	Papuans	Chukchis	Karitiana	Mbuti_Pygmies	Anatolia_N	distal model3
3.956E-10	1	Namazga_CA	Steppe_MLBA	Onge	NA	Ust_Ishim	MA1	Kostenki14	Switzerland_HG	Clovis	Natufian	NA	NA	proximal mode2
1.899E-08	1	Indus_Diaspora	Steppe_MLBA	Onge	NA	Ust_Ishim	MA1	Kostenki14	Dai	Chukchis	Karitiana	Mbuti_Pygmies	NA	proximal model2

(B): Differentiation of Iran_N, Steppe_EMBA or Steppe_MLBA and Onge the Outgroups (Ust_Ishim, MA1, Kostenki14, Papuans, Chukchis, Karitiana and Mbuti_Pygmies) could significantly distinguish the reference sources (p < 0.0001).

f4rank:	p-value	Sources
0	3.01E-70	Iran_N, Steppe_EMBA
1	7.60E-52	Iran_N, Steppe_EMBA, Onge

f4rank:	p-value	Sources
0	1.03E-55	Iran_N, Steppe_MLBA
1	4.13E-44	Iran_N, Steppe_MLBA, Onge

(C): Differentiation of Iran_N, Steppe_EMBA, Steppe_MLBA and Onge the Outgroups (Ust_Ishim, MA1, Kostenki14, Papuans, Chukchis, Karitiana, Mbuti_Pygmies and Anatolia_N) could distinguish the reference sources (p < 0.0001).

f4rank:	p-value	Sources
0	2.63E-69	Iran_N, Steppe_EMBA
1	7.22E-64	Iran_N, Steppe_EMBA, Steppe_MLBA
2	2.52E-25	Iran_N, Steppe_EMBA, Steppe_MLBA, Onge

Table S17. Cross-validation for the unbiasedness due to varying sample sizes

(A): *D* statistics we applied *D statistics* and *qpAdm* using equal number (52 each) of individuals from Steppe_EMBA and Steppe_MLBA to cross-verify if there is any biasedness in results due to different sample sizes for ancient sources like Steppe_EMBA and Steppe_MLBA in our earlier analyses and observed there is negligible deviation.

pop1	Yoruba	pop2	pop3	Dstat	Z score
Ror	Yorubas	Steppe_EMBA	Steppe_MLBA	0.00061	5.342
Jatt	Yorubas	Steppe_EMBA	Steppe_MLBA	0.00062	3.096
Gujjar	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000759	6.632
Kamboj	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000587	5.152
Khatri	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000748	6.88
Pathan	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000686	6.316
Kalash	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000932	7.818
Sindhi	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000742	6.927
Brahmins_UP	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000645	5.582
Kshatriya	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000635	5.417
Chamar	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000467	3.982
Gujaratis	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000684	6.424
Paniya	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000234	1.934
Ho	Yorubas	Steppe_EMBA	Steppe_MLBA	0.000111	0.997
Ror	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.002219	-8.358
Jatt	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.001881	-3.822
Gujjar	Yorubas	Indus_Diaspora	Steppe_MLBA	0.000049	0.178
Kamboj	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.000398	-1.405
Khatri	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.000677	-2.532
Kalash	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.001623	-5.53
Pathan	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.001304	-4.947
Sindhi	Yorubas	Indus_Diaspora	Steppe_MLBA	-0.000133	-0.518
Brahmins_UP	Yorubas	Indus_Diaspora	Steppe_MLBA	0.000662	2.216
Kshatriya	Yorubas	Indus_Diaspora	Steppe_MLBA	0.000659	2.309
Chamar	Yorubas	Indus_Diaspora	Steppe_MLBA	0.003119	10.797
Gujaratis	Yorubas	Indus_Diaspora	Steppe_MLBA	0.00163	6.436
Paniya	Yorubas	Indus_Diaspora	Steppe_MLBA	0.003746	12.544
Ho	Yorubas	Indus_Diaspora	Steppe_MLBA	0.003761	13.317

(B): _qpAdm_ we applied _qpAdm_ for same number (52 each) of individuals from Steppe_EMBA and Steppe_MLBA to cross-verify if there is any biasedness in results due to different sample sizes for ancient sources like Steppe_EMBA and Steppe_MLBA in our earlier analyses and observed there is no significant deviation.

Target Pop	p value	Mix coeff1	Mix coeff2	Mix coeff3	Mix coeff4	std err1	std err2	std err3	std err4	Source1	Source2	Source3	Source4
Ror	0.942223	0.226	0.355	0.214	0.205	0.029	0.073	0.081	0.012	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Khatri	0.29553	0.24	0.303	0.205	0.252	0.032	0.076	0.084	0.013	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Gujjar	0.673977	0.253	0.274	0.177	0.297	0.034	0.084	0.093	0.014	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kamboj	0.257426	0.288	0.242	0.205	0.265	0.034	0.086	0.095	0.015	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Jatt	0.537537	0.178	0.61	0	0.213	0.082	0.21	NA	0.033	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Pathan	0.532103	0.271	0.207	0.305	0.217	0.03	0.073	0.08	0.012	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Kalash	0.63285	0.22	0.496	0.098	0.186	0.035	0.09	0.098	0.015	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Sindhi	0.263567	0.51	0.264	0	0.226	0.044	0.108	NA	0.017	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Gujaratis	0.916619	0.216	0.39	0	0.395	0.032	0.072	NA	0.013	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Brahmins_UP	0.580855	0.208	0.446	0	0.346	0.037	0.091	NA	0.016	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge
Balochi	0.244612	0.668	0.236	0	0.096	0.045	0.107	NA	0.018	Iran_N	Steppe_EMBA	Steppe_MLBA	Onge

Table S18. ALDER dating for admixture in Northwest Indians we estimated the Admixture dates in newly sampled Northwest Indians using ALDER, results reveal admixture at around 1500 years ago in the Ror, quite recent admixture event in Gujjar and the very old event in Kamboj. We used 30 years per generation (gens) to convert dates in generations to years.

Test status	p-value	test pop	ref A	ref B	Z-score	Admixture Date (gens)
success	0.0075	Ror	Asur	French	4.37	43.68 +/- 8.59
success	5.6E-07	Ror	Kol	French	6.12	48.69 +/- 7.42
success	7.6E-07	Ror	Ho	French	6.07	46.72 +/- 7.44
success	0.0017	Ror	Tharu	French	4.68	42.36 +/- 7.62
success	6.2E-05	Ror	Santhal	French	5.32	54.17 +/- 9.43
success	6.3E-05	Ror	Gond	French	5.32	59.56 +/- 10.02
success	9.3E-05	Ror	Kol	Germans	5.24	49.70 +/- 8.50
success	3.9E-05	Ror	Ho	Germans	5.4	49.06 +/- 8.47
success	0.0011	Ror	Tharu	Germans	4.78	40.12 +/- 7.67
success	0.015	Ror	Santhal	Germans	4.21	54.27 +/- 11.40
success	0.00023	Ror	Gond	Germans	5.08	63.09 +/- 9.79
success	0.0057	Gujjar	Asur	Swedes	4.43	15.04 +/- 3.40
success	0.028	Gujjar	Asur	Germans	4.07	13.20 +/- 3.24
success	0.0046	Kamboj	Asur	Estonians	4.47	144.23 +/- 22.54
success	0.008	Kamboj	Asur	North_Italians	4.35	130.33 +/- 20.26
success	0.0019	Kamboj	Asur	Swedes	4.66	148.00 +/- 23.06
success	0.044	Kamboj	Asur	Ukranians	3.97	147.76 +/- 22.30
success	0.017	Kamboj	Swedes	UP_Low_Caste	4.19	79.99 +/- 19.09

Table S19. standard error for NNLS with jack-knife method

(A): All populations as donor

	Eur	Cau	MEast	IN_IE	IN_DRA	Iran	CAsia
Ror	0.0066	0	0.0015	0.0092	0.0008	0.0213	0.0025
Kamboj	0.0038	0.004	0.0063	0.2039	0	0.0608	0.0071
Jatt	0.0051	0.0049	0.0019	0.0176	0.0034	0.0535	0.006
Khatri	0	0	0.004	0.0012	0	0.0307	0.0023
Gujjar	0	0	0	0.0255	0.0056	0.0147	0
Gujaratis	0	0	0	0.1634	0	0	0
Brahmins_UP	0.001	0.0027	0.0006	0.0298	0.0011	0.0126	0.0005
Kshatriya	7E-05	0.0031	0.0005	0.0409	0.0012	0.0035	0
Pathan	0.0004	0.0014	0.0021	0.0264	0.0011	0.0141	0.0037

(B): Without PNWI as donor

	Eur	Cau	MEast	IN_IE	IN_DRA	Iran	CAsia
Ror	0.0385	0.0153	0.0064	0.0302	0.0081	0	0.0042
Kamboj	0.0121	0.0582	0.0184	0.0266	0.0093	0.061	0.0059
Jatt	0.0331	0.0325	0.0064	0.0276	0.0036	0.043	0.0098
Khatri	0.0086	0.0717	0.0281	0.0797	0.0087	0.0768	0.0136
Gujjar	0.0054	0.0056	0.0001	0.0413	0.0044	0	0
Gujaratis	0	0	0	0.0704	0	0	0
Brahmins_UP	0.0145	0.0031	0.003	0.03	0.0053	0	0.0009
Kshatriya	0.0037	0.0022	0.0004	0.0537	0.0027	0	0
Pathan	0.0115	0.1609	0.0132	0.0392	0.0044	0.248	0.0196

(C): UNLINKED model

	Eur	Cau	MEast	IN_IE	IN_DRA	Iran	CAsia
Ror	0.0436	0.0182	0.0044	0.0383	0.0192	0	0.0107
Kamboj	0.0345	0.0157	0.0116	0.041	0.0318	0.0037	0.0063
Jatt	0.0846	0.0398	0.0075	0.0811	0.0481	0	0.0112
Khatri	0.0328	0.0133	0.0039	0.0398	0.0242	0.0038	0.0085
Gujjar	0.0114	0.0165	0.004	0.0468	0.0324	0.0052	0.0097
Gujaratis	0.0354	0.0106	0.0083	0.0314	0.0641	0	0.0056
Brahmins_UP	0.0349	0.0198	0.0056	0.0587	0.0541	0.0021	0.0063
Kshatriya	0.0254	0.0174	0.005	0.0631	0.0543	0.0038	0.0089
Pathan	0.0317	0.0177	0.0036	0.0406	0.0184	0.0026	0.0064

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