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# Late Middle Pleistocene Harbin cranium represents a new *Homo* species

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In eastern Asia, several Middle-Late Pleistocene human fossils, such as the Dali, Jinniushan, Hualongdong, and Harbin crania, evidently resemble each other and are phylogenetically closer to *H. sapiens* than to *H. neanderthalensis* or other archaic humans.<sup>1</sup> The Harbin cranium is the best preserved of this group. It shows a mosaic combination of plesiomorphic and apomorphic features. Here, we suggest that the Harbin skull should be recognized as a new species of *Homo*.

# SYSTEMATIC BIOLOGY

Order Primates Linnaeus, 1758 Suborder Anthropoidea Mivart, 1864 Superfamily Hominoidea Gray, 1825 Family Hominidae Gray, 1825 Tribe Hominini Gray, 1825 Genus *Homo* Linnaeus, 1758 *Homo* longi sp. nov. Ji & Ni (Figure 1)

# Etymology

The species name is derived from the geographic name Long Jiang, which is a common usage for the Heilongjiang Province and literally means "dragon river."

# Holotype

An undistorted and almost complete cranium (HBSM2018-000018(A)). The specimen was donated to Hebei GEO University (HGU) in 2018. The repository is the Geoscience Museum of HGU, Shijiazhuang, China. The holotype of *Homo longi* sp. nov. has been deposited in the ZooBank database (http://zoobank.org/) with Life Science Identifier urn:lsid:zoobank.org; act:B2179E99-5CDF-44DA-A1F1-A2BBAFB47185.

# Locality and age

Middle Pleistocene, upper part of the Upper Huangshan Formation (~138–309 ka), near the Dongjiang Bridge in Harbin City, Heilongjiang Province, China. A reliable minimum U-series age is 148±2 ka.<sup>2</sup>

# Diagnosis

Differing from all the other named Homo species by presenting a combination of the following features: an extinct hominin massive in size with a very large maximum cranial length, nasio-occipital length and supraorbital torus breadth; cranial vault long and low, with receding frontal, evenly curved parietal contour, and rounded occipital contour; no sagittal keeling; upper face extremely wide, with large and almost square orbits; facial height low relative to the upper facial breadth; supraorbital torus wide, massively developed, and gently curved. Interorbital area wide, with a flat and recessed nasal saddle: cheekbone flat and low, with a shallow canine fossa; no maxillary inflation; nasal aperture wide inferiorly and almost triangular: cranial lateral walls nearly parallel, without lateral expansion at the parietal prominence; occipital torus weak, without suprainiac fossa; palate in U-shape, with shallow and thick alveolar bone; incisor sockets angled, suggesting the presence of alveolar prognathism; mastoid process large, inclining forward and inward; tympanic plate anteroinferior surface flat and moderately thick; styloid process fused to the tympanic.

# **Comparative morphology**

The Harbin cranium is massive in size, larger than all other known-archaic humans.<sup>1</sup> The endocranial capacity is estimated as  $\sim$ 1,420 ml, falling in the range of *H. sapiens* and Neanderthals, and larger than other *Homo* species such as *H. erectus*, *H. naledi*, *H. floresiensis*, and even some *H. heidelbergensis/H. rhodesiensis*.

The Harbin cranium is relatively long and low and lacks the globularity of the modern human braincase. The frontal is receding, and the parietal is evenly curved. The supraorbital torus is massive and continuous, and the postorbital constriction is much deeper than in *H. sapiens*. The large endocranial volume of Harbin cranium is reflected in more parallel side walls of the

> Figure 1. The Harbin cranium (HBSM2018-000018(A)) (A) Anterior view.

(B) Lateral view, left side. Scale bar indicates 50 mm.



# Commentary

temporals and parietals, but the cranium lacks the *H. sapiens*-like parietal bosses. The thickness of the supraorbital torus is proportionally much greater than that of later *H. sapiens*. The Harbin cranium does also share some similarities with *H. sapiens*. Its facial height is very low, the zygomaxillary region is flat with a shallow canine fossa, and the overall prognathism is reduced, showing a similar condition to recent humans. The basion angle-nasion angle plot indicates that the Harbin cranium is much closer to *H. sapiens* than to *H. erectus* and *H. heidelbergensis/H. rhodesiensis*, and the face is hafted onto the braincase with reduced prognathism. In its combination of traits Harbin is more like fossils attributed to early *H. sapiens*, such as Jebel Irhoud 1 and Eliye Springs, than to later members of our lineage.

There are very small angular tori inferiorly on the parietals, proportionally much smaller than those in *H. erectus*. The occipital has a relatively rounded lateral profile, presenting a less flexed form than that typical of *H. erectus*. The occipital torus is almost absent, much weaker than in *H. erectus*. The face is relatively low, and lacks the anterior projection typical of *H. erectus*. Postorbital constriction is also proportionally shallower than in most members of *H. erectus*. The tympanic bone of the Harbin cranium is flat and thin, and lacks the robusticity typical of *H. erectus*.

The Harbin cranial vault lacks the parasagittal flattening and keeling found in some *H. heidelbergensis/H. rhodesiensis.* The occipital bone lacks the angulation and strong transverse torus. The face is relatively low, and lacks the anterior projection as in the Broken Hill, Petralona, Bodo, and Arago fossils. Postorbital constriction is also proportionally shallower than in most members of *H. heidelbergensis/H. rhodesiensis.* The cheekbones do not show the Neanderthal-like inflation found in large specimens of *H. heidelbergensis/H. rhodesiensis.* 

Compared with Neanderthals, the Harbin cranium also has a massive and curved supraorbital torus, with strong lateral thickness. Postorbital constriction of the Harbin cranium is proportionally deeper than those of Neanderthals. The occipital surface lacks both a "chignon" and a centrally developed suprainiac fossa typical of Neanderthals. The zygomaxillary angle is somewhat larger than in Neanderthals and approaches that of *H. sapiens*, indicating a less medial projection of the midface. The zygomaxillary area is flattened and without maxillary inflation. The single molar tooth is huge by Neanderthal standards.

H. antecessor is much smaller than the Harbin cranium, with weaker supraorbital development, much smaller endocranial volume, narrower upper face width, and much smaller  ${\rm M.}^2$ 

Differing from the Dali cranium, Harbin lacks sagittal keeling and presents proportionally larger and almost square orbits, overall thinner and smoother supraorbital tori with a weaker superciliary arch, and weaker lateral thinning. The Jinniushan cranium has a similar cranial capacity (~1,390 ml) to the Harbin, but is more gracile. Harbin has a proportionally broader anterior maxillary region, larger and squarer orbits, thicker supraorbital tori, and a larger molar than the Jinniushan. The recently described Hualongdong skull belonged to an adolescent individual. It resembles the Dali cranium and differs from the Harbin in presenting strong frontal sagittal keeling and thick supraorbital tori with a strong superciliary arch. Compared with the Harbin and Dali, the

Hualongdong skull has a proportionally narrower and longer face, narrower nasal aperture, and shallower canine fossae. Some of these differences may be due to the younger age of the Hualongdong individual. The Xuchang cranium has a much larger cranial capacity, but a wider, lower braincase with reduced bone thickness. Its supraorbital tori are much thinner, and its mastoid processes are much smaller. The supraorbital torus of the Maba partial cranium is thinner and more curved, the nasal bone more projecting, and the frontal and parietal are thinner than in the Harbin cranium. The orbital shape and projecting upper nasal region of the Maba cranium look particularly similar to those of Neanderthals.

# REMARKS

Overall, the Harbin cranium shows a distinctive combination of apomorphic and plesiomorphic features. These features present a clear diagnosis, supporting the Harbin cranium as a new species of *Homo*, which is distinctive from other designated Middle-Late Pleistocene human taxa, such as *H. sapiens*, *H. erectus*, *H. neanderthalensis*, and *H. heidelbergensis/ rhodesiensis*.

The Dali cranium was initially proposed as a subspecies of *H. sapiens* (*H. s. daliensis*) by Xinzhi Wu, but Wu abandoned the subspecies name and called the cranium "archaic *H. sapiens*" in his later publications.<sup>3</sup> It was also suggested to be a subspecies of *H. heidelbergensis* (*H. h. daliensis*),<sup>4</sup> or should be raised to the species level (*H. daliensis*).<sup>5</sup> The Hualongdong cranium shows a lot of interesting similarities with the Dali cranium. Based on our morphological comparisons and the phylogenetic analyses,<sup>1</sup> we suggest that both the Dali and Hualongdong crania should be referred to *H. daliensis*. The Harbin cranium, on the other hand, shows clear diagnostic features differing from the Dali and Hualongdong crania. Here, we raise a new species name for the Harbin cranium to reflect these significant differences. Given the sister-group relationship between the Harbin cranium and the Xiahe mandible,<sup>1</sup> it is possible that both specimens belong to *H. longi* sp. nov. Further human fossils from the Middle Pleistocene of China and neighboring areas will test this idea.

# **DECLARATION OF INTERESTS**

The authors declare no competing interests.

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