

Sample-Size, Verification, and Replication Concerns Regarding the Pre-Columbian Origin Hypothesis for the Modern Pedigree Chihuahua

A Response to van Asch et al. (2013)

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Abstract.

van Asch et al. (2013, *Proc. R. Soc. B* 280: 20131142) reported that the modern Mexican breed Chihuahua shares a unique mitochondrial control-region haplotype (A185) with a single pre-Columbian Mexican specimen (D25), and concluded direct ancestry of the modern breed from pre-Columbian Mexican dogs. Here we evaluate that conclusion against three concerns. **(i)** The result rests on a Chihuahua sample of $n = 14$, with five carrying A185; the binomial 95% confidence interval for the breed-wide A185 frequency under that sample is 12.8% to 64.9%, a range too wide to support a strong inference. **(ii)** Sample-level provenance is not reported in the original paper or its supplementary materials; “pure-bred” status is asserted without registry data, breeder identification, or country of origin. **(iii)** The same haplotype A185 appears in the authors’ own supplementary data in a Canadian street dog (GenBank HQ126892), and in modern Puerto Rican street dogs as cited in the paper itself, complicating the claim of breed exclusivity. We then present partial results from the Stringer Integrated Pedigree-Genomic Study (SIPGS), an ongoing dataset of $n = 123$ confirmed Chihuahuas across five countries with full Embark whole-genome panels and verified country of birth, in which A185 has not been observed. We argue that the pre-Columbian Mexican origin hypothesis for the modern pedigree Chihuahua is not adequately supported by the original data, and that the breed’s deep maternal ancestry, paternal uniformity, and documented late nineteenth-century commercial history are consistent with an Old-World founding population introduced into Mexico during the historical period.

Keywords: Chihuahua; mitochondrial DNA; haplotype A185; breed origin; sample verification; pre-Columbian; replication; forensic genealogy.

1. Background

The geographic origin of the modern pedigree Chihuahua has been the subject of more than a century of speculation. Popular accounts trace the breed to a putative pre-Columbian Mesoamerican dog, the Techichi, though the empirical basis for that continuity has remained thin. van Asch et al. (2013) addressed the question through mitochondrial DNA control-region analysis and reported genetic continuity between the modern Chihuahua and pre-Columbian Mexican dogs, anchoring the claim on a single shared haplotype, A185 (modern) and D25 (ancient).

The conclusion has since been cited widely both within and beyond the scientific literature as direct evidence of pre-Columbian Mexican ancestry for the breed. The strength of the supporting evidence warrants reexamination. We raise three concerns with the original study and present partial results from a larger, pedigree-anchored dataset that does not replicate the headline finding.

2. Concerns regarding the original study

2.1. Sample size and statistical power

van Asch et al. analysed mitochondrial control-region sequences from $n = 14$ Chihuahuas. Five of those individuals (5/14, 35.7%) carried haplotype A185, which the authors describe as private to the breed and shared with one ancient Mexican sample. The remaining nine individuals carried universal types or types shared across multiple regions.

A binomial 95% confidence interval for an underlying breed-wide A185 frequency, given five successes in fourteen trials, is approximately 12.8% to 64.9% (Clopper-Pearson exact). The point estimate is imprecise by an order of magnitude, and a true breed-wide frequency anywhere in this range would be consistent with the original observation. A sample of $n = 14$ is insufficient to characterise haplotype distribution in a breed population numbering in the millions globally, particularly when the inference being drawn is one of deep ancestry.

2.2. Provenance and verification of samples

The Methods section of van Asch et al. describes the Chihuahua samples as follows:

“The American breeds were sampled from pure-bred dogs avoiding known common female ancestry among individuals. Sampling was obtained from European as well as American lineages of the breeds.” (van Asch et al. 2013, Methods)

No further provenance information is provided in the paper or in supplementary tables S1–S4. Specifically, the supplementary data do not list, for any individual Chihuahua sample: registry of origin (e.g. AKC, FCI, KC, FCM); registration number; country of birth; breeder identification; or pedigree depth verified beyond self-report. The criterion “pure-bred” is asserted but not documented.

This is a consequential omission. “Chihuahua” is also a common informal label applied to small short-haired dogs of mixed ancestry in many regions, particularly in Mexico, the southern United States, and the Caribbean. Without registry-anchored verification, a sample collected under the label “Chihuahua” may include individuals whose breed identity is not independently confirmed. The interpretation of any haplotype frequency from such a sample is correspondingly uncertain.

2.3. Internal evidence against breed exclusivity

The original paper characterises haplotype A185 as a private type in the Chihuahua. However, the supplementary data in the same paper (Table S4, Castroviejo-Fisher et al. street-dog dataset reanalysis) list A185 in a Canadian street dog under accession HQ126892. The paper also notes (citing Brown et al. 2013, ref. 29) that A185 has been reported in Puerto Rican street dogs, and offers two competing interpretations—either ancient widespread distribution across the Americas, or recent introgression from abandoned breed dogs:

“Interestingly, A185 and A29 have been reported also for modern Puerto Rican ‘street dogs’ ... there remains the possibility that A185 and A29 in Puerto Rico originate from abandoned dogs of these breeds.” (van Asch et al. 2013, Discussion)

If A185 is not exclusive to the Chihuahua, the chain of inference from the modern breed to the single ancient Mexican specimen (D25) weakens substantially. The shared haplotype no longer marks a lineage-specific signal between the breed and the ancient population; it marks a haplotype that occurs at low frequency in several modern American dog populations and in at least one ancient burial dog. Multiple historical scenarios are consistent with that pattern.

2.4. Direction of historical inference

Even granting the A185–D25 match, the direction of historical transmission is not determined by the haplotype data alone. The match establishes that one ancient Mexican burial dog and a subset of dogs labelled Chihuahua share a maternal haplotype. It does not establish that the modern breed descends from the ancient lineage. Equally consistent alternatives include: (a) introgression from European or other Old-World dogs into the local Mexican dog population at any point during the historical period, with later incorporation into the breed; (b) shared deep ancestry through common Asian or Eurasian source populations rather than direct lineage continuity; or (c) sample-labelling effects, where modern individuals with admixed local ancestry were classified as Chihuahua under the broader colloquial usage of the term in Mexico.

3. New evidence: the SIPGS dataset

The Stringer Integrated Pedigree-Genomic Study (SIPGS) is an ongoing collection of Embark whole-genome DNA profiles from Chihuahuas with verified country of birth and, where available, registry documentation. At the time of writing (April 2026), the dataset comprises 123 confirmed individuals across five countries: the United States, Canada, the United Kingdom, continental Europe, and Mexico. The sample is approximately 8.8 times the size of the original van Asch et al. Chihuahua sample.

	van Asch et al. 2013	SIPGS (current)
<i>Sample size (n)</i>	14	123
<i>Sex distribution</i>	not reported	50 M / 72 F (1 unspecified)
<i>Countries represented</i>	not specified	5
<i>Continents represented</i>	1 (North America)	4
<i>Method</i>	mtDNA control region (582 bp)	Embark whole-genome panel
<i>Pedigree verification</i>	self-reported “pure-bred”	registry- and country-of-birth verified
<i>A185 frequency</i>	5 / 14 (35.7%)	0 / 123 (0%)
<i>95% CI for A185 frequency</i>	12.8% – 64.9%	0% – 3.0%

Table 1. Comparison of sample characteristics between van Asch et al. (2013) and SIPGS. SIPGS confidence interval calculated by the Clopper-Pearson exact method.

Across all 123 individuals, haplotype A185 has not been observed. The exact 95% confidence interval for A185 frequency in the Chihuahua, given zero successes in 123 trials, is 0% to 3.0%. The two confidence intervals from the original study and the present dataset are non-overlapping at conventional significance: van Asch et al. estimate 12.8–64.9%, SIPGS estimates 0–3.0%. The two results cannot be simultaneously consistent with a single underlying breed-wide haplotype frequency.

Across the maternal lineages observed in the SIPGS dataset, all haplogroups identified to date ($n = 7$) have documented presence in European or broader Eurasian dog populations. None has been characterised as exclusive to pre-Columbian American specimens. The paternal picture is more striking: across all confirmed males in the dataset ($n = 50$ at present), Y-chromosome haplogroup is uniform. A

single founder paternal lineage is consistent with a recent narrow-bottleneck breed history, and is the genetic signature of a small founding population propagated within a relatively short historical window. It is not the signature one would expect from a breed claimed to descend from a regionally distributed pre-Columbian population.

4. Historical context

Genetic data should be interpreted alongside the documentary record. The earliest English-language references to a small Mexican-named dog in the United States are commercial advertisements and travel correspondence dating to the 1880s; primary sources from earlier periods, including Spanish colonial chronicles and nineteenth-century Mexican accounts, do not describe a small short-haired dog matching the modern breed standard with the specificity later breeders claimed. The first AKC registration of the breed dates to 1904. Show records and kennel-club correspondence from the late 1880s and 1890s document a small group of American breeders, most prominently based along the Texas–Mexico border, who acquired and promoted small dogs under the name “Chihuahua,” “Texas dog,” “Arizona dog,” and “Mexico dog” more or less interchangeably during the formative decade. The geographic name was applied to a commercial type, not to a documented pre-existing breed.

A lineage of European toy dogs, including the Maltese pocket dog (*Melitaesus catulus* of Roman writers, recently confirmed in Bartnik 2024), and small short-haired companion dogs of the British and continental European show registries, was already well established by the mid-nineteenth century. Movement of toy dogs across the Atlantic during the period of intensive American kennel club development (ca. 1880–1910) is documented in trade press and customs records. A scenario in which the modern Chihuahua was assembled in the late nineteenth century from European toy-dog stock available in the United States, given a Mexican geographic name for commercial reasons, and subsequently adopted and elevated in Mexico as a national symbol during the twentieth century, is consistent with both the documentary record and the genetic data presented here.

5. Conclusion

The conclusion of van Asch et al. (2013) that the modern Chihuahua descends directly from pre-Columbian Mexican dogs rests on a fourteen-individual sample without documented provenance, on a single shared haplotype that is not in fact exclusive to the breed, and on a chain of inference that does not establish direction of historical transmission. A larger, pedigree-anchored, multinational dataset (SIPGS, $n = 123$) does not replicate the headline finding and provides positive evidence inconsistent with deep regional ancestry, including paternal uniformity across all confirmed males.

We do not contend that the Chihuahua is not Mexican in any meaningful sense. The breed’s adoption, elevation, and cultural centrality in Mexico are matters of historical record. We contend that the genetic evidence for pre-Columbian biological continuity, as presented in van Asch et al. 2013, is not adequately supported by the data available. A revised account, in which the breed’s deep ancestry is Old-World and its Mexican identity is historical rather than pre-Columbian, is consistent with both the genetic and documentary records.

Declaration of competing interests

The author breeds Chihuahuas under the kennel name Alfheim-Andromeda Chihuahuas, and is a contributor to the Chihuahua Club of America's health committee publications. The author has no financial relationship with the original van Asch et al. (2013) study or its authors. SIPGS receives no commercial funding; participating breeders and owners contribute Embark DNA results without compensation.

Data availability

Anonymised SIPGS aggregate haplotype frequency data are available on request from the corresponding author. Individual-level data are withheld for participant privacy; release is contingent on owner consent and pedigree-confidentiality protocols. Submission of the complete dataset to a public archive will accompany formal publication of the primary SIPGS paper, in preparation.

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