

Variations of the anterior belly of the digastric muscle: a cadaveric and meta-analysis study

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SUMMARY

Variations of the anterior belly of the digastric muscle are frequently reported in adult populations; however, the developmental timing of their appearance remains insufficiently understood. This study aimed to describe the morphology and prevalence of anterior digastric belly variations and to contextualize these findings through a meta-analysis of published anatomical studies. Twenty-six formalin-fixed human fetuses (13 male, 13 female) were dissected and analyzed morphologically. Variations were classified according to De-Ary-Pires, Ary-Pires and Pires-Neto. A systematic review and meta-analysis of observational studies reporting the prevalence of anterior belly variations was conducted following PRISMA guidelines. The mean gestational age was 29.4 ± 3.58 weeks. Variations were observed in six fetuses (23.1%), all classified as type II, with no association with sex or gestational age. The meta-analysis of 16 studies ($n = 787$) yielded a pooled prevalence of 25.1% (95% CI: 15.5–35.9;

$I^2 = 90.6\%$), with variation across geographical regions and sexes. Variations of the anterior belly of the digastric muscle are established during fetal development and occur at frequencies comparable to those reported in postnatal populations. These findings support a developmental origin for this anatomical variability and provide a morphological framework for future embryological and anatomical investigations of the suprahyoid region.

Key words: Anatomic variation – Fetal development – Meta-analysis – Neck muscles – Prevalence

INTRODUCTION

The digastric muscle is a suprahyoid muscle characterized by two muscular bellies, anterior and posterior, connected by an intermediate tendon. The posterior belly originates from the mastoid notch of the temporal bone and runs anteroinferiorly, whereas the anterior belly arises

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from the digastric fossa of the mandible, near the symphysis, and extends posteroinferiorly. The intermediate tendon passes through the stylohyoid muscle and attaches to the body and greater horn of the hyoid bone via a fibrous loop (Standring, 2008). This anatomical configuration contributes to several functions, including mandibular depression, elevation of the hyoid bone, and stabilization of the larynx during swallowing and speech (Kim and Loukas, 2019).

Several anatomical studies have reported the presence of accessory bellies of the digastric muscle, consisting of additional muscular bundles that may follow ipsilateral, contralateral, or even midline-crossing trajectories (Mangalagiri et al., 2009). De-Ary-Pires et al. (2003) proposed a classification system comprising five types, ranging from a single belly (type I) to multiple accessory bellies or the presence of an independent mentohyoid muscle (type V). Singular cases include trapezoid-shaped accessory bellies connecting both sides or multiple heads with atypical insertions (Aragão et al., 2022).

Although variations of the anterior belly of the digastric muscle generally have no direct pathological significance, they represent a source of anatomical diversity that may complicate anatomical interpretation, particularly in imaging-based or surgical contexts when unrecognized (Kim and Loukas, 2019). Most available evidence describing these variations is anatomical in nature, and their developmental origin remains incompletely understood (Gross et al., 2023). Therefore, the study of the digastric muscle and its variations, especially of the anterior belly, is essential not only to expand classical anatomical knowledge but also to improve clinical and surgical practice through more accurate interpretation of imaging and safer approaches to the cervical region.

Despite extensive documentation of anterior digastric belly variations in adults, limited data exist regarding the timing of their emergence during human development. Whether these variants represent congenital anatomical patterns established during early myogenesis or postnatal modifications remains unclear. Examination of fetal specimens offers a unique opportunity to clarify this issue by directly assessing the presence and

morphology of these variants during gestation.

Accordingly, the present study combines a fetal anatomical investigation with a meta-analysis of published prevalence data in order to test the hypothesis that variations of the anterior belly of the digastric muscle are established early in development and persist throughout life.

MATERIAL AND METHODS

Anatomical study

The study included 26 human fetuses (13 male and 13 female) fixed in formalin, without macroscopic deformities, belonging to the Human Anatomy Laboratory of the Federal University of Sergipe (Brazil). All specimens were obtained in accordance with Brazilian Law No. 8.501/1992, which regulates the use of unclaimed cadavers for teaching and research purposes. The authors hereby confirm that every effort was made to comply with all local and international ethical guidelines and laws concerning the use of human cadaveric donors in anatomical research. Gestational age (GA) was estimated using the equation $GA = 8.2982 + (0.38764 \times F)$, where F represents the heel-to-great-toe length (Goldstein, Reece and Hobbins, 1988). Measurements were performed with a digital caliper accurate to 0.01 mm.

Morphological and morphometric analysis

The components of the digastric muscle were analyzed through careful dissection under natural light. Measurements were taken using a 0.01 mm precision digital caliper. The morphology of the anterior belly was classified according to De-Ary-Pires, Ary-Pires and Pires-Neto (2003), as follows:

Type I: Single belly originating from the inferior border of the mandible near the symphysis.

Type II: Two bellies, with additional bundles connected to the mandible or mylohyoid muscle, either ipsilaterally or contralaterally.

Type III: Three bellies, with additional bundles connected to the mandible or mylohyoid muscle, either ipsilaterally or contralaterally.

Type IV: Four bellies, with additional bundles

connected to the mandible or mylohyoid muscle, either ipsilaterally or contralaterally.

Type V: Often described as an independent muscle, a rare variation known as the mentohyoid (Macalister's) muscle.

The length of the anterior belly was measured from its insertion on the mandible (anterior point) to its connection with the intermediate tendon on the hyoid bone (posterior point). The length of the posterior belly was measured from its insertion on the temporal bone (posterior point) to its connection with the intermediate tendon (anterior point). The width of these bellies was measured at their respective points according to the mentioned insertion.

Statistical analysis

Data normality was assessed using the Shapiro-Wilk test to determine the use of parametric or non-parametric tests (Royston, 1992). Associations between quantitative variables were analyzed using Pearson's correlation for normally distributed data and Spearman's correlation for non-normal data, with correlation strength classified as weak (0–0.4), moderate (0.4–0.7), or strong (0.7–1).

Comparisons between sides were performed using a paired t-test for normal data or the Wilcoxon test for non-normal data (Rosner, Glynn and Lee, 2006). Comparisons between sexes used an independent-sample t-test when normality was met or the Mann-Whitney test otherwise. Statistical analyses were performed using JAMOVI 2.6.26, adopting a significance level of 5% ($p < 0.05$).

Meta-analysis

Registration and Guidelines

The present study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the code CRD420251151451.

Search Strategy

Systematic search was conducted in PubMed,

Scopus, and Web of Science databases in order to identify studies reporting variations of the anterior belly of the digastric muscle. The following search strategy was applied:

("Digastric Muscle" OR "anterior belly of digastric" OR "anterior digastric" OR "anterior belly" OR "digastricus anterior") AND ("anatomic variation" OR "anatomical variation" OR "muscle variation" OR "morphological variation" OR "variant" OR "accessory muscle" OR "duplicated muscle" OR "muscle anomaly" OR "asymmetry").

Eligibility Criteria

Inclusion criteria comprised observational studies with primary human data that investigated the anterior belly of the digastric muscle and reported quantitative data on the prevalence or frequency of variations. Exclusion criteria included animal studies, computational simulations, review articles, and primary studies lacking sufficient quantitative data.

Data Extraction

Records retrieved from databases were imported into Zotero software for organization and screening. Two authors independently performed data extraction, removing duplicates and assessing eligibility based on titles and abstracts. The following information was collected: first author's name, year of publication, sample size, sex distribution, age, geographic origin, and prevalence of variations.

Meta-analytical procedures

Effect sizes were calculated for prevalence estimates. Confidence intervals (95% CI) were computed using the Freeman-Tukey double arcsine transformation. Cochran's Q test and the I^2 statistic were used to assess heterogeneity; values of $p < 0.05$ and $I^2 > 25\%$ were considered indicative of significant heterogeneity. All statistical analyses were performed using OpenMeta[Analyst] software.

RESULTS

Anatomical study

The mean gestational age of the fetuses was

29.4 (± 3.58) weeks. Among the 26 dissected specimens, six fetuses (three male and three female) exhibited variations in the anterior belly of the digastric muscle. All accessory bellies were classified as type II, with one bilateral and five unilateral occurrences (Fig. 1). Morphometric data of the accessory bellies are presented in Table 1.

No association was found between gestational age, sex, or morphometric parameters of the accessory bellies.

Study identification

A total of 441 records were retrieved from the three databases. After the removal of 202 duplicates, the remaining records were screened by title and abstract to determine relevance. Thirty-one studies were selected for full-text assessment, of which 16 met the inclusion criteria and were included in the present review (Fig. 2).

Characteristics of the included studies

The review comprised 787 individuals, with 14 cadaveric dissection studies and two imaging-based studies. Of these, five were conducted in Brazil, four in Turkey, three in the United States, one in Kenya, one in Taiwan, one in Thailand, one in China, and one in India (Table 2).

Prevalence of variation in the anterior belly of the digastric muscle

The variations in the anterior belly of the digastric muscle, across the sample of studies, presented an overall prevalence of 25.1% (95% CI:

15.5 – 35.9; $I^2 = 90.6\%$; $p < 0.001$; Fig. 3). In subgroup analysis by geographical regions, Turkey showed a prevalence of 22.9% (95% CI: 1.4 – 57.3; $I^2 = 96.56\%$; $p < 0.001$; Fig. 4A), followed by Brazil with 25.2% (95% CI: 13 – 39.4; $I^2 =$

77.14%; $p < 0.001$; Fig. 4B) and the United States with 16.9% (95% CI: 1.6 – 41.7; $I^2 = 89.33\%$; $p < 0.001$; Fig. 4C).

The analysis of laterality among the digastric muscles of the sample revealed that the right side presented 6.8% (95% CI: 3.4 – 11.2; $I^2 = 70.51\%$; $p < 0.001$; Fig. 5A) of variations, while the left side presented 8.6% (95% CI: 4.1 – 14.5; $I^2 = 80.7\%$; $p < 0.001$; Fig. 5B).

For sex subgroups, variations were present in 26% (95% CI: 13.1 – 41.3; $I^2 = 79.93\%$; $p < 0.001$; Fig. 6A) of the male sample and 15.4% (95% CI: 5.4 – 27.9; $I^2 = 36.13\%$; $p = 0.201$; Fig. 6B) of the female sample.

DISCUSSION

This study aimed to investigate the characteristics of variations in the anterior belly of the digastric muscle by integrating two distinct investigative approaches: ontogenetic validation in a fetal sample and a global quantitative synthesis through meta-analysis. The relevance of this dual approach lies in its ability not only to quantify the prevalence of these variations across different populations, but also to anchor their origin in early embryonic developmental events. The results revealed the following findings regarding the digastric muscle: (1) no relationship was

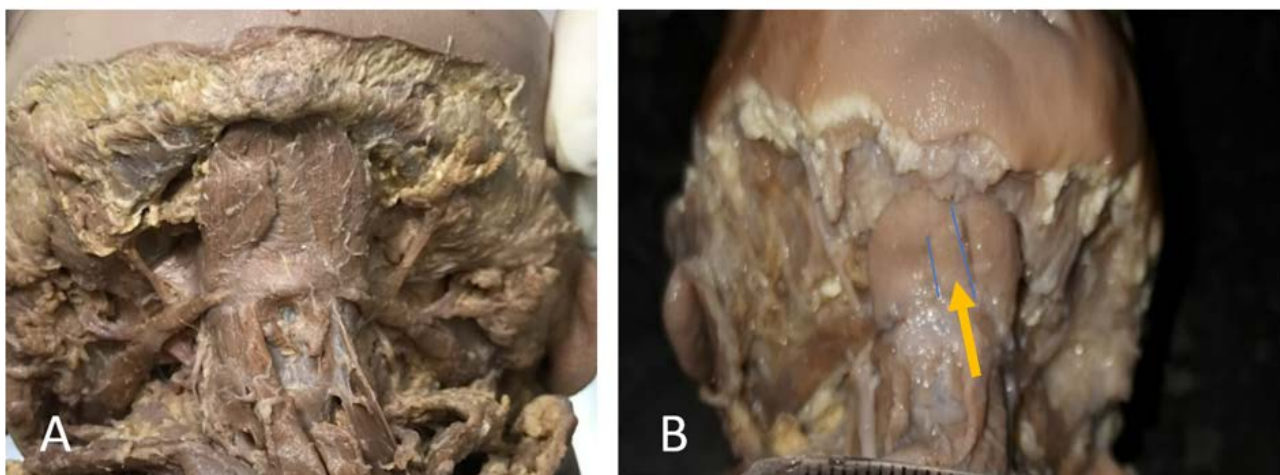


Fig. 1.- Classification of the anterior belly of the digastric muscle in human fetuses. A) Type I anterior bellies. B) Type II right anterior belly; Yellow arrow indicating the accessory belly.

Table 1. Morphological characteristics

	Gestacional Age (weeks)	RAAB (mm)	LAAB (mm)	AT RAAB (mm)	MT RAAB (mm)	PT RAAB (mm)	AT LAAB (mm)	MT LAAB (mm)	PT LAAB (mm)
N	6	4	3	4	4	4	3	3	3
Mean	29.1	12.8	16.3	2.13	2.59	2.95	1.33	1.92	2.54
Median	28.8	13.0	17.0	2.50	2.53	2.71	1.12	1.86	2.56
Standard Deviation	2.83	3.64	1.38	0.977	0.991	1.31	0.703	0.393	0.226
Minimum	25.9	8.22	14.7	0.680	1.44	1.74	0.750	1.56	2.30
Maximum	33.9	17.0	17.1	2.83	3.86	4.62	2.11	2.34	2.75
Shapiro-Wilk W test	0.942	0.988	0.790	0.781	0.951	0.930	0.935	0.983	0.992
Shapiro-Wilk P-value	0.676	0.947	0.090	0.072	0.721	0.594	0.508	0.747	0.829
25th percentile	27.3	11.3	15.8	2.00	2.23	2.00	0.935	1.71	2.43
50th percentile	28.8	13.0	17.0	2.50	2.53	2.71	1.12	1.86	2.56
75th percentile	30.1	14.5	17.1	2.62	2.88	3.66	1.61	2.10	2.66

RAAB – Right accessory anterior belly; LAAB – Left accessory anterior belly; AT RAAB- Anterior third of Right accessory anterior belly; MT RAAB- Middle third of Right accessory anterior belly; PT RAAB- Posterior third of Right accessory anterior belly; AT LAAB- Anterior third of Left accessory anterior belly; MT LAAB- Middle third of Left accessory anterior belly; PT LAAB- Posterior third of Left accessory anterior belly.

found between fetal age or sex and the characteristics of the accessory anterior belly; (2) the overall prevalence was 25.1% (95% CI: 15.5–35.9); (3) prevalence varied among different geographic subgroups; and (4) a higher occurrence was observed on the left side and in the male population. In the present study, conducted with human fetuses of mean gestational age 29.4 (3.58) weeks, most specimens presented a type I morphology of the anterior belly, while six fetuses exhibited a type II accessory belly, with similar mean lengths to the main bellies but smaller mean widths (Prado et al., 2025). This morphometric pattern is consistent with findings in adult populations describing accessory bellies as thinner bundles than the main belly. The smaller width of the accessory belly suggests that it does not represent a complete duplication of the main belly, but rather a secondary or partial muscular condensation (Gross et al., 2023). De-Ary-Pires et al. (2003) reported a similar mean length between type I and type II anterior bellies in both sexes, but smaller mean widths for type II in males.

In the present fetal sample, no relationship was found between gestational age or sex and the occurrence of variations, but age was shown to influence the morphometry of the main bellies.

The anterior and posterior bellies of the digastric muscle derive embryologically from the first and second pharyngeal arches, respectively (Kim and Loukas, 2019; Tranchito and Bordoni, 2025). Consequently, variations in this muscle arise from the complex development of these arches, and since other muscles originate from the same embryonic structures, their anomalies are often found together (Sargon and Çelik, 1994).

The identification of anterior belly variations in fetuses demonstrates that these anatomical patterns arise during early stages of muscle differentiation, rather than representing postnatal adaptations. The consistent presence of type II configurations before the third trimester suggests that such variations are the result of deterministic embryological processes involving the first pharyngeal arch. From an anatomical perspective, recognizing that these variants are congenital and stable contributes to a more accurate understanding of normal muscular diversity in the suprahyoid region. This knowledge may indirectly support anatomical interpretation in clinical settings; however, the present findings should primarily be interpreted within the context of developmental and descriptive anatomy.

In the literature, several reports describe varia-

Table 2. Characteristics of the included studies

Study (Year)	Country	Study Design	Sample Size (n)	Population	Age Range (Years)	Sex (M/F)
Larsson & Lufkin (1987)	USA	Imaging (CT/MR) observational	75 (40 CT, 35 MR)	Mixed clinical cohort	NR	37M / 38F
Unur et al. (1999)	Turkey	Cadaveric cross-sectional	50 cadavers	Turkish adults	NR	NR
De-Ary-Pires et al. (2003)	Brazil	Cadaveric cross-sectional	74 cadavers (146 sides)	Brazilian adults	20–86	37M / 37F
Liquidato et al.(2007)	Brazil	Cadaveric cross-sectional	10 cadavers	Brazilian male adults	NR	10M / 0F
Ozgun et al. (2007)	Turkey	Cadaveric observational	30 cadavers (60 sides)	Anatolian adult males	43–75	30M / 0F
Mangalgi et al. (2009)	India/Saudi Arabia	Cadaveric cross-sectional	15 cadavers	Indian/Saudi adults	63–81	15M /
Zdilla et al.(2018)	USA	Cadaveric cross-sectional	19 cadavers	White Americans	F: 76.1 ±17.2, M: 81.6 ±11.2*	11M / 8F
Ortug et al.(2020)	Turkey	Cadaveric cross-sectional	40 cadavers	Turkish adults	65.27 ± 6.82*	22M / 18F
Hsiao & Chang (2019)	Taiwan	Cadaveric observational	15 cadavers	Taiwanese adults	45–56	11M / 4F
Anderson & Tucker (2021)	USA	Cadaveric observational	48 cadavers	Ethnically diverse (California)	75*	23M / 25F
Arayapisti et al.(2022)	Thailand	Cadaveric cross-sectional	91 cadavers	Thai adults	47–96	55M / 36F
Sarna et al. (2023)	Kenya	Cadaveric cross-sectional	41 cadavers (82 sides)	Kenyan adults	20–35	33M / 8F
Alves et al. (2023)	Brazil	Cadaveric cross-sectional	50 digastric muscles	Brazilian adults	NR	NR
Gross et al. (2022)	Brazil	Cadaveric observational	31 cadavers	Brazilian adults	18–80	29M / 2F
Ünsal et al. (2024)	Cyprus/Turkey	Ultrasonographic cross-sectional	151 patients	Mixed population	19–60	81M / 70F
Shen et al. (2025)	China	Cadaveric observational	72 cadavers (144 sides)	Chinese adults	38–97	48M / 24F

NR - not reported; M – male; F- female; *These papers did not reported age range, but mean age.

tions in the anterior belly of the digastric muscle, including accessory bellies with ipsilateral origin and insertion relative to the main belly, contralateral insertion into the intermediate tendon, origin or insertion into the mylohyoid raphe, crossing between accessory bellies, and the presence of multiple accessory bellies (Kim and Loukas, 2019). In the present dissections, the accessory bellies were found ipsilateral to the main bellies, and thus the De-Ary-Pires et al. (2003) classification was applied, with type II bellies predominating.

The meta-analysis, which included 16 observational studies totaling 787 individuals, revealed

an overall combined prevalence of 25.1% (95% CI: 15.5–35.9) for variations in the anterior belly of the digastric muscle. This finding robustly establishes that approximately one in every four individuals may present some form of variation. Tranchito and Bordoni (2025) reported a prevalence of 65.8%, while Kim and Loukas (2019) observed digastric muscle variations in 33.4% of cadaveric populations.

The subgroup analysis by geographic region showed prevalence rates of 22.9% in Turkey, 25.2% in Brazil, and 16.9% in the United States. Although these subgroups exhibited high heterogeneity, the prevalence range (16.9-25.2%) re-

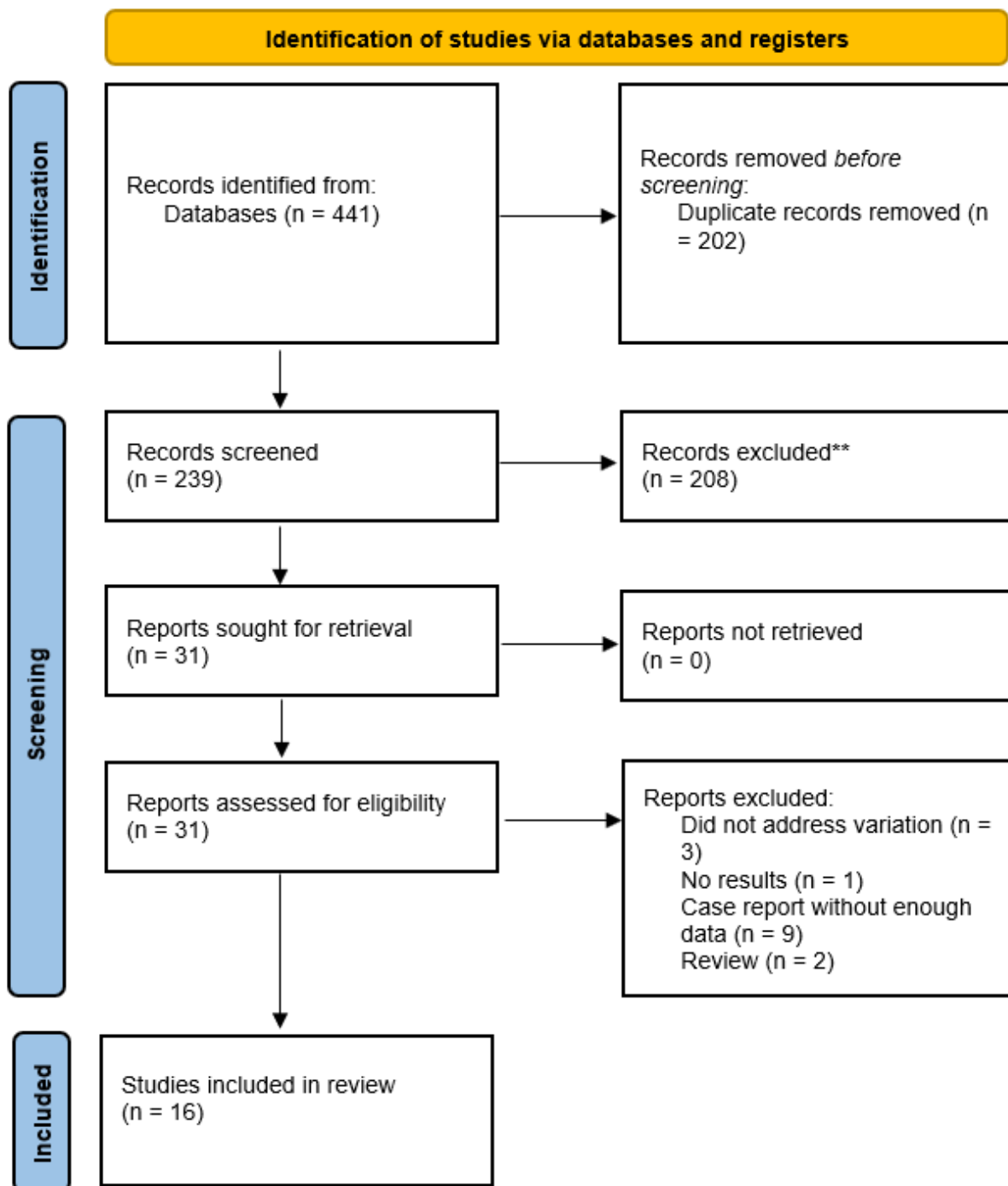


Fig. 2.- Study selection process.

mained relatively homogeneous, reflecting populations that are mostly of European or mixed ancestry. Similarly, Kim and Loukas (2019) reported that digastric variations were present in 51.7% of Asian populations, and when excluding Asian samples from their overall analysis, they found lower prevalence rates, suggesting that these variations may be more frequent among Asians. This observation implies that the occurrence of digastric muscle variations may be influenced by genetic or ethnic factors, emphasizing

the importance of further studies to identify such underlying determinants.

The combined data revealed no major discrepancies in variation incidence between sides, but a higher prevalence in males. Kim and Loukas (2019) reached similar conclusions. The male predominance may be interpreted from two perspectives: (a) it could reflect a sampling bias inherent in anatomical literature, as many cadaveric studies included predominantly male specimens; or (b) it could indicate a biological difference, pos-

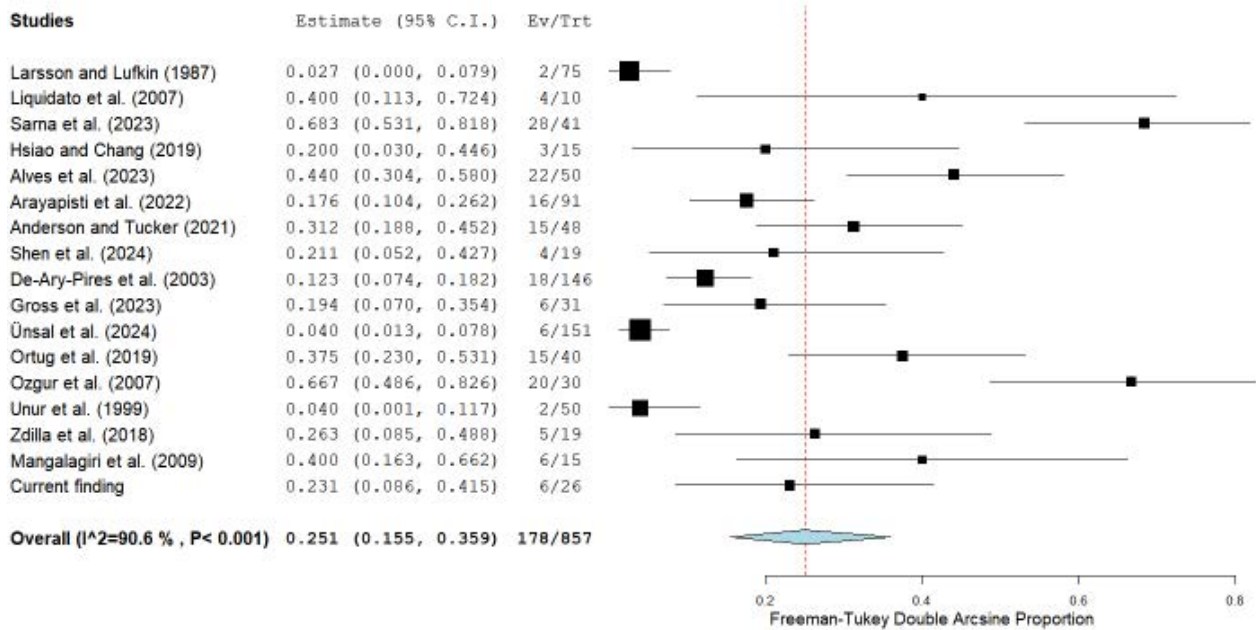


Fig 3.- Overall prevalence.

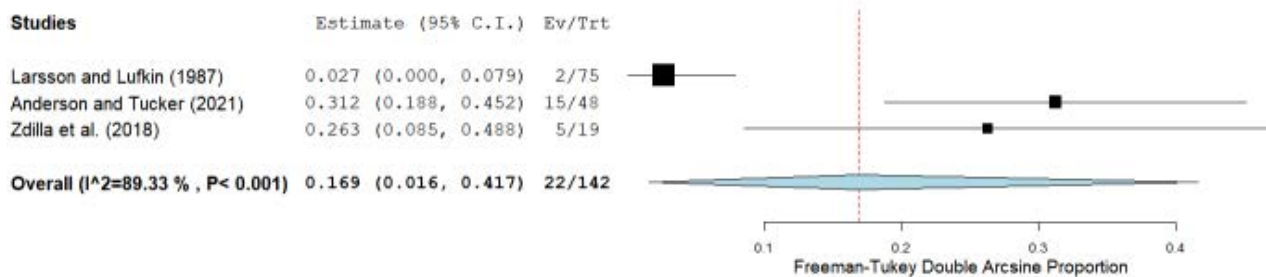
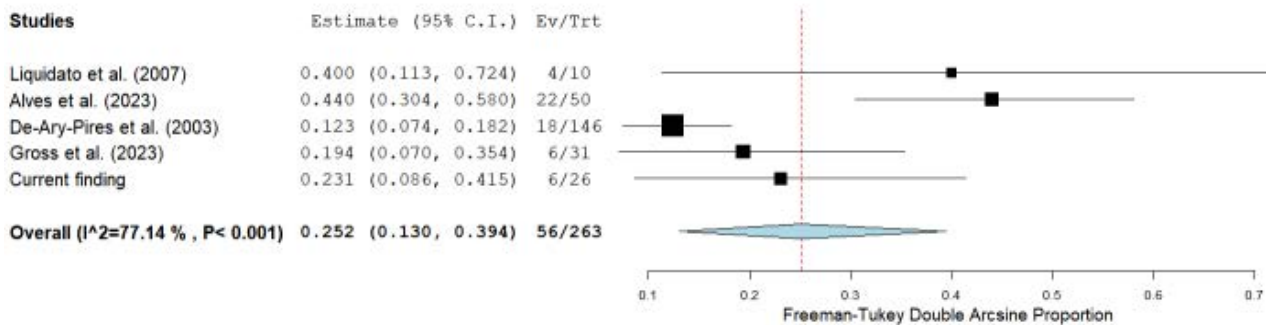
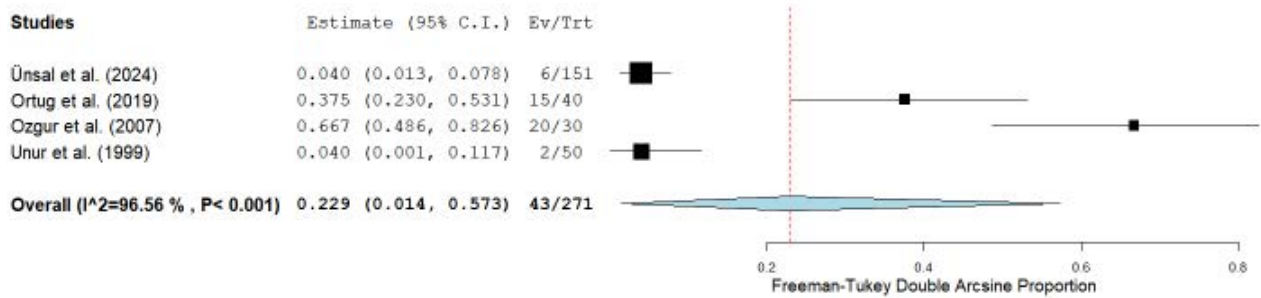
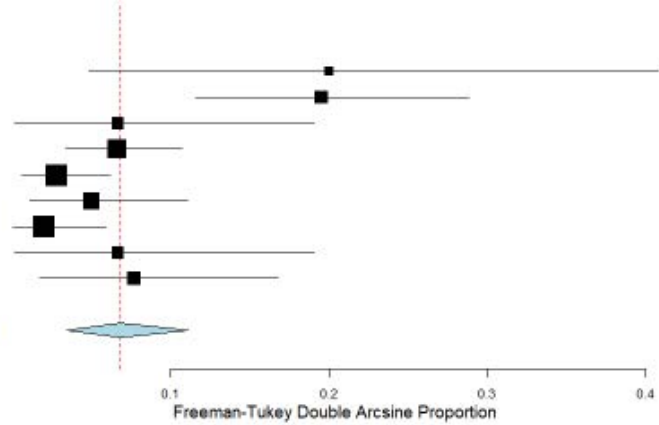


Fig. 4A.- Prevalence in the population of Turkiye. 4B.- Prevalence in the population of Brazil. 4C.- Prevalence in the population of USA.

sibly linked to subtle genetic factors or hormonal

influences affecting extracellular matrix organi-

Studies	Estimate (95% C.I.)	Ev/Trt
Liquidato et al. (2007)	0.200 (0.049, 0.408)	4/20
Sarna et al. (2023)	0.195 (0.116, 0.289)	16/82
Hsiao and Chang (2019)	0.067 (0.001, 0.191)	2/30
Arayapisti et al. (2022)	0.066 (0.034, 0.107)	12/182
Shen et al. (2024)	0.028 (0.006, 0.062)	4/144
Ortug et al. (2019)	0.050 (0.011, 0.111)	4/80
Unur et al. (1999)	0.020 (0.000, 0.059)	2/100
Mangalagiri et al. (2009)	0.067 (0.001, 0.191)	2/30
Current finding	0.077 (0.017, 0.168)	4/52
Overall (I²=70.51 % , P< 0.001)	0.068 (0.034, 0.112)	50/720



Studies	Estimate (95% C.I.)	Ev/Trt
Liquidato et al. (2007)	0.100 (0.002, 0.278)	2/20
Sarna et al. (2023)	0.268 (0.177, 0.370)	22/82
Hsiao and Chang (2019)	0.100 (0.013, 0.238)	3/30
Arayapisti et al. (2022)	0.077 (0.042, 0.121)	14/182
Shen et al. (2024)	0.028 (0.006, 0.062)	4/144
Ortug et al. (2019)	0.075 (0.026, 0.145)	6/80
Unur et al. (1999)	0.020 (0.000, 0.059)	2/100
Mangalagiri et al. (2009)	0.200 (0.073, 0.365)	6/30
Current finding	0.058 (0.007, 0.141)	3/52
Overall (I²=80.7 % , P< 0.001)	0.086 (0.041, 0.145)	62/720

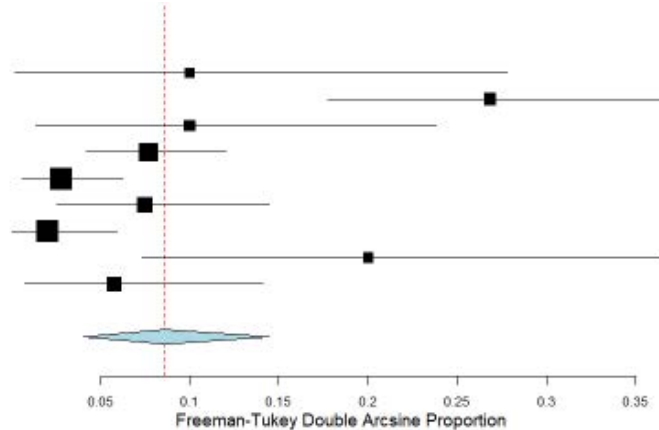
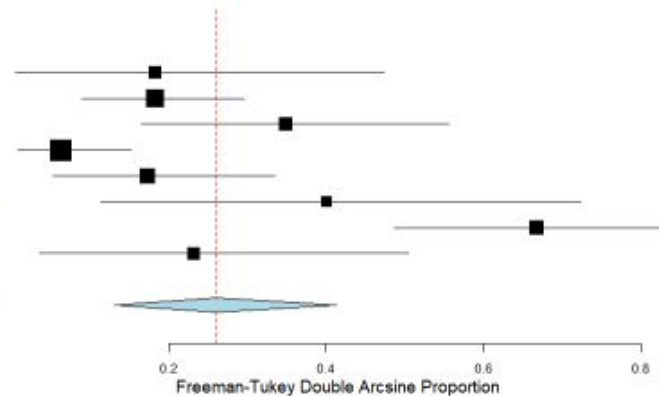


Fig. 5A.- Prevalence on the right side. 5B.- Prevalence on the left side.

Studies	Estimate (95% C.I.)	Ev/Trt
Hsiao & Chang (2019)	0.182 (0.005, 0.474)	2/11
Arayapisti et al. (2022)	0.182 (0.090, 0.296)	10/55
Anderson & Tucker (2021)	0.348 (0.164, 0.556)	8/23
Shen et al. (2024)	0.062 (0.008, 0.152)	3/48
Gross et al. (2023)	0.172 (0.053, 0.335)	5/29
Liquidato et al. (2007)	0.400 (0.113, 0.724)	4/10
Ozgur et al. (2007)	0.667 (0.486, 0.826)	20/30
Current finding	0.231 (0.036, 0.504)	3/13
Overall (I²=79.93 % , P< 0.001)	0.260 (0.131, 0.413)	55/219



Studies	Estimate (95% C.I.)	Ev/Trt
Hsiao & Chang (2019)	0.250 (0.000, 0.793)	1/4
Arayapisti et al. (2022)	0.167 (0.060, 0.309)	6/36
Anderson & Tucker (2021)	0.280 (0.119, 0.474)	7/25
Shen et al. (2024)	0.042 (0.000, 0.170)	1/24
Gross et al. (2023)	0.500 (0.000, 1.000)	1/2
Current finding	0.231 (0.036, 0.504)	3/13
Overall (I²=36.13 % , P=0.201)	0.154 (0.054, 0.279)	19/104

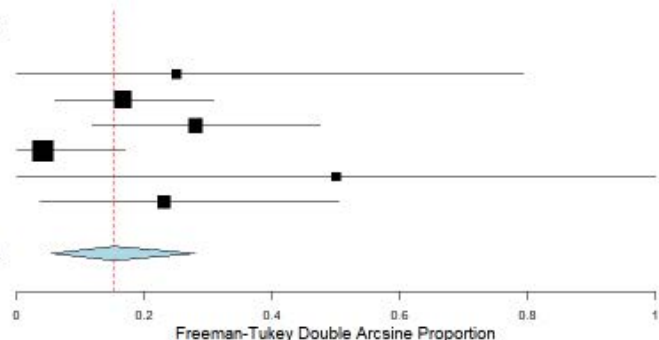


Fig. 6A.- Prevalence in the male population. 6B.- Prevalence in the female population.

zation or differential muscle growth during development. The absence of laterality differences reinforces the symmetrical embryonic development of the pharyngeal arches.

Evaluating the characteristics of the digastric muscle and its variations can be helpful, because this muscle is involved in various clinical and surgical procedures. The presence of an accessory belly alters the expected anatomical map. In procedures such as neck dissection (used in head and neck cancer staging) or floor-of-mouth approaches, surgeons rely on correct identification of muscular boundaries to ensure safety and preserve adjacent neurovascular structures (Alagöz et al., 2004; Buffoli et al., 2016). An unexpected variation may lead to disorientation and, consequently, increase the risk of iatrogenic injury (Kikuta et al., 2019). Therefore, recognizing digastric variations is essential for accurate differential diagnosis in imaging examinations and for surgical interventions involving the cervical region (Larsson and Lufkin, 1987).

The meta-analysis was not intended to redefine prevalence estimates, but rather to determine whether the frequency of variations observed in fetuses aligns with the range reported across postnatal populations, thereby supporting the hypothesis of developmental continuity. Among the limitations of this study were the high number of case reports found during the search and the heterogeneity of data, since the included studies differed in origin, age, and ethnicity of their samples, requiring subgroup analyses for more precise estimates. Additionally, some studies lacked sufficient data for analysis, necessitating the exclusion of certain comparisons or isolated interpretation. Future multicenter investigations, incorporating genetic analyses and standardized imaging methodologies, may help clarify the influence of ethnic factors and contribute to the development of a universal morphological classification.

CONCLUSION

The present study demonstrates that variations of the anterior belly of the digastric muscle are established during fetal development and occur at frequencies comparable to those reported in post-

natal populations. These findings support a congenital and developmentally stable origin of this anatomical variability. By integrating fetal morphological data with a comprehensive synthesis of existing literature, this study contributes to the understanding of normal developmental diversity of the suprahyoid musculature. The meta-analysis revealed different prevalence rates according to geographic and sex subgroups, although without disproportionate differences between sexes.

AUTHORS' CONTRIBUTION

MLL Prado– Protocol/project development; Data collection or management; Data analysis; Manuscript writing/editing. JCOMM Neto– Manuscript writing/editing. CVR Basto– Manuscript writing/editing. ICS Aragão– Manuscript writing/editing. FMS Aragão– Manuscript writing/editing. JA Aragão– Protocol/project development; Manuscript writing/editing. FP Reis– Manuscript writing/editing.

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