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Airlangga.**ADMINISTRATIVE INFORMATION****Support** - Institutions involved included dental and medical faculties from Universitas Airlangga in Indonesia and Seoul National University in South Korea.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202480039**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 07 August 2024 and was last updated on 07 August 2024.**INTRODUCTION**

**Review question / Objective** Population (P): Individuals of different genders across various populations. Intervention (I): Radiographic assessment of the sella turcica, including linear measurements of its length, depth, and diameter. Comparison (C): Comparison of sella turcica dimensions between genders. Outcomes (O): Determining the potential of sella turcica morphology for sex determination. Study Design (S): Systematic review including pilot studies, clinical trials, and retrospective studies.

**Review Question/Objective:** The aim of this systematic review is to assess the relationship between gender and the dimensions of the sella turcica, including height, weight, diameter, and volume, by comparing data gathered from different radiographic methods employed in various studies.

**Rationale** The study focuses on the sella turcica as a key anatomical structure in forensic

anthropology, providing valuable insights into morphological differences among human populations. The sella turcica's relatively well-shielded location makes it less susceptible to fracturing from substantial force or trauma, which is advantageous for forensic purposes. Prior research has highlighted significant variations in the sella turcica's dimensions—such as height, width, and diameter—between genders, with different studies noting the influence of various radiographic techniques on measurement outcomes. This study aims to assess the relationship between gender and the dimensions of the sella turcica using data from different radiographic methods, thereby contributing to the potential of sella turcica morphology for sex determination.

**Condition being studied** The health condition of interest in this article is the morphology of the sella turcica, a saddle-shaped depression in the sphenoid bone at the base of the human skull. This

structure is significant in forensic anthropology and forensic science for its potential use in sex determination. The sella turcica's dimensions—such as height, width, and diameter—can vary between males and females, making it a useful anatomical marker. The study examines these variations using radiographic assessments, aiming to enhance the accuracy and reliability of sex determination methods in forensic cases.

## METHODS

**Participant or population** The types of participants addressed in the review are as follows: The study includes patients who have undergone various radiographic assessments of the sella turcica, specifically using lateral cephalometric radiographs, cone-beam computed tomography (CBCT), and conventional cephalometric radiographs. The participants span a range of ages and include both males and females. Various studies within the review encompass different populations, such as:

- 222 patients (93 females and 129 males) aged 1-12 years from Turkey .
- 60 patients evenly grouped by ages 0–3, 4–7, 8–11, 12–15, 16–18, and >18 years from California .
- 240 lateral cephalograms from various skeletal patterns, without specified age range .
- 180 patients (90 females and 90 males) aged 15-30 years from Sri Ganganagar .

These participants were selected based on their need for radiographic examinations of the sella turcica, providing a broad dataset for analyzing the morphological variations related to gender, age, and population groups.

**Intervention** The intervention evaluated in this review involves the radiographic assessment of the sella turcica for the purpose of sex determination. The review focuses on the following specific interventions:

1. Measurement of the sella turcica dimensions:
  - Height
  - Width
  - Diameter
  - Volume
2. Comparison of these measurements:
  - Linear measurements
  - Area and volume assessments using different radiographic techniques

The interventions are assessed through various imaging modalities, including lateral cephalometric radiographs, cone-beam computed tomography (CBCT), and conventional cephalometric

radiographs. The primary aim is to determine the correlation between the dimensions of the sella turcica and the sex of individuals, providing a reliable method for sex determination in forensic contexts.

**Comparator** The comparative intervention applied to the target population involves the evaluation and comparison of sella turcica dimensions between males and females. This includes:

1. **Linear Measurements**: Comparing the height, width, and diameter of the sella turcica between male and female participants.
2. **Area and Volume Assessments**: Utilizing different radiographic techniques to compare the sella turcica's area and volume in males and females.

These comparative interventions aim to identify significant morphological differences between genders, providing insights into the potential use of sella turcica dimensions for sex determination in forensic anthropology. The review includes various radiographic methods such as lateral cephalometric radiographs, cone-beam computed tomography (CBCT), and conventional cephalometric radiographs to ensure comprehensive analysis and comparison across different populations and age groups.

**Study designs to be included** The study designs included to address the objective of the review are: **Cross-sectional Studies**: These studies involve observing a defined population at a single point in time or over a short period, allowing the measurement of various parameters of the sella turcica across different individuals. **Clinical Trials**: These studies include randomized or non-randomized trials where interventions related to the measurement of sella turcica dimensions are tested and evaluated. **Retrospective Studies**: These studies analyze existing data, such as radiographic images, to assess the sella turcica dimension.

**Eligibility criteria** **Inclusion Criteria**: Studies focused on sex determination using sella turcica with conventional and digital techniques, Articles published in English, Studies that use direct and indirect scanning methods, Studies providing relevant demographic information such as age, sex, and ethnicity of participants, Studies with complete data and detailed information on measurement techniques.

**Exclusion Criteria**: Literature reviews, clinical reports, and surveys, Research not focused on sex determination using sella turcica, Papers lacking relevant demographic information (age, sex,

ethnicity) of participants, Papers with incomplete data or missing information on measurement techniques, Studies focusing solely on animal specimens, not relevant to human sex determination.

**Information sources** In conducting a systematic review on the morphology of the sella turcica for sex determination, it is critical to utilize a comprehensive and diverse range of information sources to ensure a thorough and unbiased analysis. Below are the intended information sources for this systematic review:

#### 1. Electronic Databases

**MEDLINE/PubMed:** This is a premier biomedical database that provides access to a vast collection of medical literature. PubMed offers abstracts and full-text articles on various topics, including forensic science, radiographic assessment, and morphological studies.

**Scopus:** Scopus is a comprehensive abstract and citation database of peer-reviewed literature, including scientific journals, books, and conference proceedings. It is invaluable for finding research articles related to the sella turcica and sex determination.

**Web of Science:** This database provides access to multiple databases that reference cross-disciplinary research. It is crucial for tracking research developments and citations over time, ensuring the inclusion of high-impact studies.

**Embase:** Embase is a biomedical and pharmacological database that offers extensive coverage of medical journals and conference proceedings. It is particularly useful for finding studies that may not be indexed in PubMed.

**CINAHL:** The Cumulative Index to Nursing and Allied Health Literature provides access to nursing and allied health literature, including radiographic studies relevant to the assessment of the sella turcica.

#### 2. Trial Registers

**ClinicalTrials.gov:** A database of privately and publicly funded clinical studies conducted around the world. Searching this database helps identify ongoing or completed trials related to sella turcica morphology and sex determination.

**WHO International Clinical Trials Registry Platform (ICTRP):** This platform ensures that a complete view of research is accessible to all those involved

in health care decision-making. It includes trials from various registries worldwide.

#### 3. Grey Literature

**Institutional Repositories:** These repositories, maintained by universities and research institutions, often contain theses, dissertations, and technical reports that provide valuable data not published in peer-reviewed journals.

**Conference Proceedings:** Proceedings from relevant conferences (e.g., forensic science, radiology, and anthropology conferences) often contain preliminary results of studies that are not yet published in journals.

**Government and NGO Reports:** Reports from governmental bodies and non-governmental organizations can provide data and insights on forensic methodologies and findings related to the sella turcica.

#### 4. Contact with Authors

Direct communication with authors of key studies can provide additional insights, unpublished data, or clarifications regarding their research. This is particularly useful for understanding methodological nuances or obtaining raw data for meta-analysis.

#### 5. Manual Searches

**Reference Lists:** Reviewing the reference lists of included studies to identify additional relevant studies. This technique ensures that seminal works or studies not captured in the initial database search are considered.

**Handsearching:** Manually searching through relevant journals that may not be fully indexed in electronic databases. This is especially pertinent for older volumes of journals.

#### 6. Screening and Selection Process

**Inclusion Criteria:** Studies focusing on sex determination using sella turcica, employing both conventional and digital radiographic techniques, published in English. Studies must include data on the height, weight, diameter, and volume of the sella turcica.

**Main outcome(s)** The systematic review assessed the relationship between gender and the dimensions of the sella turcica, including height, weight, diameter, and volume, using various radiographic methods. A total of 382 papers were identified, and after a thorough selection process, 20 articles met the inclusion criteria. The studies involved subjects across different age groups, from

adolescents to adults, providing a comprehensive analysis of sella turcica dimensions over time.

Primary outcome measures were linear dimensions (width, length, height), area, and volume of the sella turcica. Males had a width of 8.72 mm, length of 7.68 mm, height of 6.25 mm, and area of 40.80 mm<sup>2</sup>, while females had a width of 8.67 mm, length of 7.42 mm, height of 6.38 mm, and area of 41.26 mm<sup>2</sup>. Significant differences were observed between adult males and females, and between different age groups within genders. Males had a sella turcica volume of 1102.0 ± 285.3 mm<sup>3</sup>, compared to females with 951.3 ± 278.5 mm<sup>3</sup>, indicating significant gender differences.

The review also evaluated the risk of bias using the Quality Assessment in Prognostic Studies (QUIPS) tool, finding moderate-to-high risk primarily due to uncontrolled confounding factors and unclear demographic data. Descriptive statistics, including means and standard deviations, were used to compare dimensions between genders and age groups. The analysis revealed significant differences, emphasizing the importance of these measurements in forensic and anthropological contexts.

In conclusion, the review found significant differences in sella turcica dimensions between genders and age groups, highlighting the potential of these measurements in forensic anthropology and sex determination based on skeletal remains. The study also emphasized the need for standardized measurement techniques to enhance accuracy and reliability in sella turcica assessments.

**Quality assessment / Risk of bias analysis** The quality assessment of primary studies in the systematic review was conducted using the Quality Assessment in Prognostic Studies (QUIPS) tool. This tool evaluates the risk of bias across six domains: study participation, study attrition, prognostic factor measurement, outcome measurement, study confounding, and statistical analysis and reporting. Each domain is assessed for potential bias, and the studies are categorized as having a high, moderate, or low risk of bias based on specific criteria for each domain.

Two authors independently conducted the quality assessments to ensure objectivity and reliability. Any disagreements between the authors were resolved through discussion or consultation with a third reviewer. The process included a detailed examination of each study against the predetermined criteria, focusing on the clarity of the study population, the methods used to measure the sella turcica dimensions, and the statistical analyses conducted.

The primary factors contributing to a high risk of bias included uncontrolled confounding factors, unclear demographic data, and insufficient details on the measurement techniques used. For example, some studies did not adequately control for variables such as age, sex, and ethnicity, which could influence the results. Additionally, several studies lacked comprehensive demographic data, making it difficult to determine the representativeness of the study sample.

In summary, the use of the QUIPS tool provided a systematic approach to evaluate and categorize the risk of bias in the included studies. This evaluation highlighted the need for rigorous study designs and detailed reporting to minimize bias and improve the reliability of findings in future research on the dimensions of the sella turcica for sex determination.

**Strategy of data synthesis** The data analysis in the systematic review was carried out using descriptive statistics, which were implemented via Microsoft Excel 2019. The data analysis process began with data extraction based on pre-defined parameters such as author names, study design, assessment methods, follow-up periods, study cohorts, and the key findings of each study. The collected data included the linear dimensions and volume measurements of the sella turcica, categorized by factors like age, gender, and study methodologies.

After extracting the relevant data, the descriptive statistics were employed to summarize the central tendencies and variations within the collected measurements. These statistics provided insights into the average dimensions of the sella turcica and highlighted any significant differences across various demographics and study conditions.

The statistical analysis focused on identifying patterns and trends, specifically examining how sella turcica dimensions differed by sex and age. The results were then tabulated, showing the means, standard deviations, and comparative analysis between different groups.

The studies also addressed the heterogeneity in methodologies by performing subgroup analyses. This helped in understanding the potential impact of different measurement techniques and population characteristics on the overall findings. Additionally, any potential sources of bias, such as uncontrolled confounding factors and unclear demographic data, were considered and discussed in the analysis to ensure a comprehensive evaluation of the evidence.

Overall, the data analysis aimed to provide a detailed and systematic overview of the sella turcica's dimensions and its potential application in

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sex determination, thereby contributing valuable insights to forensic anthropology and related fields.

**Subgroup analysis** The subgroup analysis in the systematic review focused on examining differences in the dimensions of the sella turcica across various demographic groups, particularly by age and gender, to identify patterns useful for forensic sex determination. The age-based subgroup analysis assessed the linear dimensions and volume of the sella turcica in different age groups to observe changes over time. The studies indicated that the sella turcica undergoes significant growth-related changes, providing a basis for age estimation from skeletal remains. Notably, the mean length, depth, and diameter of the sella turcica varied across age cohorts, highlighting the potential for age-related forensic applications.

The gender-based subgroup analysis compared sella turcica dimensions between males and females. This analysis was critical for sex determination, as prior research suggested measurable differences in sella turcica size and shape between genders. The review consolidated data on average measurements for both male and female subjects, confirming that males generally have larger sella turcica dimensions. The volume of the sella turcica was especially emphasized, with males showing a greater average volume compared to females. These findings reinforced the use of sella turcica measurements in distinguishing between male and female skeletal remains.

Methodological considerations were also addressed to ensure the robustness of the subgroup analysis. The review accounted for variability in study methodologies, such as differences in imaging techniques (e.g., cone-beam computed tomography [CBCT], magnetic resonance imaging [MRI]) and measurement protocols. By performing subgroup analyses based on these methodological differences, the review aimed to mitigate potential biases and confounding factors. This approach helped in understanding the impact of different measurement techniques and population characteristics on the overall findings, ensuring a more reliable and comprehensive analysis.

In summary, the subgroup analysis provided valuable insights into the demographic variations in sella turcica dimensions, reinforcing its potential utility in forensic anthropology for age and sex determination. The analysis of age-related changes underscored the sella turcica's role in age estimation, while the gender-based comparisons confirmed its usefulness in sex determination. Methodological considerations further ensured the

accuracy and reliability of the findings, contributing to the systematic review's overall robustness and applicability in forensic contexts.

**Sensitivity analysis** The sensitivity analysis in the systematic review on the morphometric analysis of the sella turcica was performed to evaluate the robustness of the meta-analysis results. Sensitivity analysis involves systematically varying certain assumptions or inputs in the analysis to determine their impact on the overall findings. This helps in identifying any factors that could significantly alter the results and ensures that the conclusions drawn are not overly dependent on specific conditions or data points.

In this study, the sensitivity analysis was conducted by excluding studies with a high risk of bias and then reassessing the overall effect size and heterogeneity. This approach helps in understanding whether the inclusion of studies with potential methodological weaknesses significantly affects the meta-analysis results. By removing these studies, the researchers can see if the remaining data still supports the same conclusions or if the effect size and direction change significantly.

Additionally, sensitivity analysis was used to assess the impact of various subgroups on the overall results. This included analyzing the data separately for different age groups, genders, and geographic regions to determine if these factors influenced the morphometric measurements of the sella turcica. For instance, studies were divided into subgroups based on whether they included children, adolescents, or adults to see if age-related changes in the sella turcica morphology could affect the outcomes. Similarly, separate analyses were conducted for male and female participants to identify any gender-specific differences in the sella turcica dimensions.

Another aspect of the sensitivity analysis involved examining the impact of different imaging techniques used in the included studies. Since the sella turcica can be measured using various radiographic methods such as lateral cephalometry, cone-beam computed tomography (CBCT), and magnetic resonance imaging (MRI), the researchers analyzed whether the choice of imaging modality influenced the reported measurements. This helps in understanding if the variability in results could be attributed to differences in measurement techniques rather than true anatomical differences.

Overall, the sensitivity analysis aimed to ensure the reliability and validity of the meta-analysis findings by identifying and accounting for potential sources of bias and variability. By performing these analyses, the researchers aimed to provide more

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robust and generalizable conclusions regarding the morphometric characteristics of the sella turcica across different populations and study conditions. The results of the sensitivity analysis indicated that the main findings were consistent even after excluding high-risk studies and accounting for various subgroups and imaging techniques, thus reinforcing the robustness of the conclusions drawn from the systematic review.

**Language restriction** English.

**Country(ies) involved** Indonesia and South Korea.

**Keywords** sella turcica, radiographic assessment, sex determination.

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