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SEXUAL DIMORPHISM AND AGE-RELATED CHANGES IN THE SHAPE OF THE EXTERNAL HUMAN NOSE

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Abstract: The external nose is a central facial structure influencing respiration, olfaction, and aesthetics. Sexual dimorphism and age-related changes in nasal morphology are well-documented across populations, with implications for clinical practice (otolaryngology, plastic surgery), forensic anthropology, and anthropometric research. Emphasis is placed on external nasal dimensions (length, height, width, nasolabial angle, nasal projection), patterns of sexual dimorphism, and trajectories of nasal growth and involution from infancy through late adulthood. Males generally present larger absolute nasal dimensions (length, breadth, projection) while females often show relatively narrower nasal bases and more acute nasolabial angles. Sexual differences emerge during puberty and are maintained into adulthood. Aging leads to common morphological trends: increased nasal length and projection due to soft tissue sagging and continued growth of cartilaginous and bony structures, widening of nasal base and alar flaring, and changes in nasal tip rotation (tending toward ptosis). Ethnic and population variation modifies the magnitude and pattern of these changes. Nasal morphology reflects both genetic and environmental influences and undergoes predictable sex- and age-related transformations. Clinicians should consider these dynamics during reconstructive and aesthetic procedures; forensic and anthropological fields should integrate age- and sex-specific models for improved accuracy.

Keywords: nose morphology; sexual dimorphism; aging; anthropometry; nasal anthropometry; nasolabial angle, external nose, nasal dimensions, forensic anthropology.

Introduction. The human nose occupies a prominent position on the facial skeleton and serves critical functional and aesthetic roles. External nasal form is the product of underlying bony and cartilaginous frameworks together with soft tissues and skin envelope. Anthropometric and morphometric investigations of the nose have a long history, informing our understanding of growth, sexual dimorphism, population differences, and clinical practice in rhinoplasty and reconstructive surgery.

Sexual dimorphism of facial structures, including the nose, has been reported in numerous populations. Typically, males present larger absolute dimensions compared to females, yet relative proportions and angles (e.g., nasolabial angle) may differ in sex-specific ways. Age-related changes add another layer of complexity: longitudinal and cross-sectional studies indicate continued nasal growth into late adolescence and measurable morphological changes in adulthood due to tissue remodeling and gravitational effects.

The goals are to (1) present commonly used anthropometric measurements and methods, (2) summarize major findings on sexual dimorphism across ages, (3) describe typical aging changes in nasal morphology, and (4) discuss clinical and forensic implications.

Methods

Review design and scope

The scope includes external nasal anthropometry, sexual dimorphism across life stages, and age-related morphological changes from infancy to late adulthood. The focus is on measurable external dimensions (linear and angular), descriptions of qualitative changes (e.g., tip ptosis), and clinical relevance.

Selection criteria and sources

Priority was given to classical anthropometric references and peer-reviewed morphometric and clinical studies addressing nasal form, sexual dimorphism, and aging. Sources included seminal textbooks on craniofacial anthropometry, comparative population studies, surgical literature on rhinoplasty outcomes and nasal aging, and forensic anthropology papers addressing sex estimation using nasal metrics.

Measurements and definitions

Key external nasal landmarks and standard measurements used throughout the literature are summarized here. Consistent definitions are essential when comparing studies.

Landmarks (external):

- Nasion (n): midline point where frontal and nasal bones meet (at root of nose externally).
- Pronasale (prn): most protruding point of nasal tip in the midline.
- Subnasale (sn): junction between the columella base and the upper lip in the midline.
- Alare (al): most lateral point on the nasal ala on each side.
- Alare curvature (al'): point at maximum curvature of the ala.
- Columella (cm): midpoint of the columella.

Common measurements:

- Nasal height or length (n-prn): linear distance from nasion to pronasale.
- Nasal breadth or width (al-al): maximum distance between right and left alare.
- Nasal projection: distance from the plane of the face to pronasale (measured variously as subnasal reference to pronasale).
- Nasolabial angle: angle between columella and upper lip.
- Nasal tip rotation: clinically described angle relating to tip elevation or ptosis.

Analysis approach

Because this is results synthesize consistent patterns across studies and describe variability by sex, age, and population group. Where available, ranges of values are presented qualitatively (e.g., males demonstrate 5–20% greater nasal breadth than females in many populations) rather than asserting specific pooled statistics.

Results

Measurement methods and tools

The primary tools used to study nasal morphology include direct anthropometry (calipers and measuring tapes), photogrammetry (2D photographs with standardized poses), and 3D surface scanning (structured light, laser scanning). Each method has strengths and limitations: direct anthropometry has been the historical standard but is time-consuming and subject to interobserver variability; 2D photogrammetry allows large-sample studies with archival photos but can distort true 3D geometry; 3D scanning offers accurate surface geometry and repeatable landmarking but requires equipment and processing.

Modern studies increasingly use 3D methods to capture nasal curvature and detailed tip anatomy. Nonetheless, many foundational studies and normative datasets remain based on direct linear measurements and angles.

Emergence and development of sexual dimorphism

Childhood and prepubertal phase (0–12 years): During early childhood, sexual differences in nasal size are small or absent. Nasal proportions follow somatic growth patterns, and inter-sex differences are primarily attributable to overall body size differences rather than sex-specific nasal shaping.

Peripubertal phase (12–18 years): Sexual dimorphism becomes more pronounced during puberty. Male adolescents experience a faster increase in nasal length and breadth relative to females, coinciding with secondary sexual maturation and overall craniofacial growth spurts.

Studies that follow adolescents longitudinally show a clear divergence starting in mid-puberty: male noses lengthen and increase in projection more than female noses.

Adult phase (18–40 years): In early adulthood, sex differences stabilize: males have statistically larger nasal length, breadth, and projection. Nasal tip rotation tends to be higher (more elevated) in females, often producing a more acute nasolabial angle. These differences are consistent across many ethnic groups, although the absolute magnitudes vary by population.

Middle age and older adults (>40 years): Absolute nasal size often continues to increase slightly with age in both sexes. However, changes in soft tissue, cartilage resilience, and skin elasticity result in sex-specific aging patterns—males may show more pronounced increases in nasal projection while females show earlier tip ptosis in some cohorts.

Age-related dynamics of the external nose

Continued growth vs. morphological change: While traditional teaching posited that craniofacial growth completes by late adolescence, longitudinal and cross-sectional evidence suggests that the nose exhibits continuing dimensional changes into middle and older age. These changes are due in part to subtle skeletal remodeling and, more prominently, to soft tissue and cartilaginous changes: loss of skin elasticity, weakening of septal and alar cartilages, and gravitational effects leading to tip descent.

Common aging trends:

1. Increase in nasal length and projection. Multiple studies and clinical observations note a tendency for the nasal tip to become more prominent and for the nose to lengthen with age. This is attributed to cartilage morphology changes (e.g., caudal septal cartilage lengthening), descent of the tip-supporting structures, and soft tissue sagging.
2. Widening of nasal base. The alar base may broaden, and alar flaring increases with age due to weakening of lateral cartilages and changes in the soft tissues.
3. Tip ptosis and decreased tip rotation. The nasolabial angle commonly decreases with age (tip rotates downward) producing a more drooped appearance. Loss of tip support and descent of the columella contribute to this change.
4. Skin and soft tissue changes. Skin thinning in some individuals and thickening or laxity in others affects nasal contours. Elderly patients often show increased dorsal irregularities and visible cartilage contours.
5. Sex-specific timing and magnitude. Females may experience earlier and more noticeable tip ptosis after menopause due to hormonal changes affecting skin elasticity, while males may have later but progressive increases in nasal projection.

Population and ethnic variability

Absolute nasal dimensions and the patterns of sexual dimorphism vary by population. For example, populations of European descent often have narrower nasal breadths relative to some African or South Asian populations; East Asian populations may exhibit lower nasal bridges and shorter nasal heights on average. However, the direction of sex differences (males larger than females) is remarkably consistent across populations, underscoring a conserved sexual dimorphism pattern tempered by population-level variation.

Functional and clinical correlates

Age- and sex-related changes in nasal morphology have functional consequences. Increased nasal length and tip ptosis can alter airflow dynamics and nasal valve geometry. Clinically, rhinoplasty and reconstructive considerations must account for ongoing age-related transformations: for example, overzealous dorsal reduction in a young face may exacerbate aging changes later, and tip-supporting techniques should be tailored to the patient's age and sex to maintain long-term outcomes.

Forensic and anthropological implications

Nasal metrics are used in sex estimation algorithms and in reconstructing facial appearance from skeletal remains. Because nasal dimensions change with age, age-specific models and correction factors are recommended. Applying adult-derived standards to juvenile remains or to elderly individuals without age-correction can introduce errors.

Discussion

Summary of main findings

This review highlights consistent patterns: sexual dimorphism in external nasal form emerges clearly at puberty and persists into adulthood, with males showing larger absolute nasal dimensions and females displaying relatively more rotated tips and narrower bases. Aging introduces predictable morphological changes (lengthening, projection increase, base widening, tip ptosis) mediated primarily by soft tissue and cartilage remodeling rather than dramatic bone changes.

Mechanisms behind observed changes

Hormonal influences and growth patterns. Sex hormones during puberty stimulate differential craniofacial growth trajectories. Androgenic influences contribute to larger nasal dimensions in males. Estrogen and progesterone, conversely, are implicated in soft tissue characteristics that may influence tip rotation and skin elasticity.

Cartilage and soft tissue remodeling. Cartilage does not ossify with age but undergoes degenerative-matrix changes and re-orientations that can change nasal shape. Supporting ligaments and septal cartilage relax or deviate with age, producing tip descent and increased projection.

Environmental and lifestyle factors. Repeated mechanical forces (e.g., minor trauma), chronic rhinitis, and smoking can affect skin quality and cartilage integrity, potentially accelerating or accentuating morphological changes.

Clinical implications

Surgeons should incorporate sex- and age-specific norms into surgical planning. Key practical takeaways:

- Preserve tip support in younger patients to avoid exaggerated ptosis with aging.
- Anticipate continued nasal changes when planning aesthetic modifications, especially in males seeking reduction rhinoplasty.
- In elderly patients, augmentation of tip support and conservative management of soft tissue envelope may yield better long-term satisfaction.

Forensic and anthropological practice

Researchers using nasal metrics for sex estimation should employ age-matched standards and consider population-specific baselines. Multivariate models that integrate nasal measurements with other craniofacial metrics improve sex estimation accuracy compared to single-measure predictors.

Limitations of the review and knowledge gaps. There is a need for longitudinal 3D studies that track nasal morphology across decades in diverse populations to precisely quantify trajectories and inter-individual variation. Research linking molecular and histologic cartilage changes with macroscopic morphological shifts would deepen mechanistic understanding.

Conclusion. Sexual dimorphism and age-related dynamics of the external human nose are well-established phenomena with broad implications. Males typically have larger absolute nasal dimensions, and aging commonly leads to lengthening, increased projection, widened base, and tip ptosis. Clinicians and researchers should apply age- and sex-specific knowledge to improve surgical outcomes, forensic reconstructions, and anthropological interpretations.

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