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Exploring the Role of Some Morphological Traits in Predictive Human Screening: Key Insights and Findings

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Abstract

This comprehensive exploration highlights the significance of morphogenetic traits in anthropological and forensic studies, emphasizing their potential applications in predictive human screening. Facial features, earlobe attachment, dimples, index finger ratios, chin shape, tongue rolling, hitchhiker's thumb, handedness, widow's peak, and hair nature contribute to individual identification and diverse medical contexts. While DNA sequencing remains a valuable tool, the study of these observable traits offers an alternative approach, providing insights into human diversity and addressing health concerns. This review underscores the importance of ongoing research to unlock the full potential of morphogenetic traits in enhancing our understanding of genetics, forensics, and predictive screening methodologies.

Keywords: Morphological traits; Screening; Human screening; Potential tool

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Introduction

Morphogenetic traits are external appearance of character that can be observed by naked eye. Facial morphology, which is used to identify individuals, varies significantly across human populations [1]. Like facial morphology there are many more morphogenetic traits that we can use for the individual identification. Also morphogenetic have application in predictive human screening. Cappella, et al. (2022), predict sex from the cranial skeleton structure of Italian population. Stewart et al. (2017), worked on human remains for sex determination using peptide found in the tooth enamel. In the past, forensic examinations have utilized numerous morphological and metric features of the human body for personal identification.

Fingerprints, footprints, facial characteristics and features, iris, gait, teeth, bite marks, gait pattern, lip prints, voice characteristics, and DNA fingerprinting from a variety of human body tissues have been successfully used in forensic situations and for criminal identification.

Although DNA sequencing is possible in predictive human screening but it is time consuming, costly method. So it is important to find out how this external appearance character will help in anthropological studies, forensic studies, study of population, etc. Present report enlisted some morphogenetic traits and how these traits can be used for the predictive human screening.

Earlobe attachment: Shape of ear

Krishan et al. (2019), studied different ear shape in subject Oval, Oblique, Rectangular, Round, Triangular and showed different character expression in different subject. The work explains the variability in shape of ear for solving the criminal cases. The attachment of the earlobe is often used as a screening tool in human genetics research.

Dimples

Dimples are small indentations that can occur on the cheeks, chin, or other areas of the face. They are caused by variations in the structure of the facial muscles and skin. Dimples can be found in various locations on the body, including the shoulder, abdomen, back, and limbs. However, when dimples appear on the face, they serve as a significant means to convey thoughts and emotions that transcend verbal expression [2]. Wilson et al. (2016), investigate the use of ultrasonography to screen for spinal dysraphism in infants with sacral dimples. The study was a retrospective chart review of infants who underwent spinal ultrasonography in the first week of life.

Index finger

2D (index) and 4D (ring) finger lengths and their ratio, known as the 2D: 4D ratio, are used as a measure of the relative lengths of these two fingers. Results from Williams et al. (2000), work validate the consistent prior findings that 2D: 4D ratios display sexual dimorphism among healthy human subjects, typically showing lower ratios in males. It's possible that 2D: 4D ratios could also change in both males and females after birth, especially during the per pubertal period when significant fluctuations in androgenic and estrogenic hormone levels occur [3]. The consensus is that, on average, 2D: 4D ratios are higher in females, with gender differences typically more pronounced in the right hand than the left [4,5]. The 2D: 4D ratio, which measures the relative lengths of the second (index) and fourth (ring) fingers, may have limited direct utility in solving criminal cases, especially when considered in isolation. However, it could potentially be used as a supplementary piece of information in certain circumstances like suspect identification, behavioural profiling, etc.

Chin

The shape and size of the chin is a genetically determined trait that has been studied in genetics research. Recognizing individuals through their facial characteristics is a common ability. Nevertheless, in forensic scenarios, relying on facial features for person identification introduces complexity. This feature can be particularly valuable in suspect identification, as it stands out as one of the most prominent and noticeable facial characteristics [6].

Rolling of tongue

The tongue is a muscular organ with important functions in swallowing, taste perception, and speech, and it possesses the ability to roll [7]. Tongue rolling is a simple genetic trait that is inherited, with the ability to roll the tongue being dominant over the inability to roll the tongue. The muscle structure of the tongue is generally consistent across humans, but there is known variations in its innervation among individuals [8,9]. Which could play a role in the unique capabilities of this organ on a person-to-person basis? Kappert et al. (2021) studied different tongue movement including rolling, cloverleaf, folding, twisting left, and twisting right. Kappert et al. (2021) discussed the hypothesis that genetically influenced tongue versatility may impact postoperative rehabilitation outcomes. Despite the absence of existing literature confirming this correlation, the logical connection between neural control, mobility, and specific tongue movements suggests it could be a crucial factor in predicting postoperative tongue function for patients with tongue cancer. It underscores the importance of patients recalling their pre-tumor tongue mobility for assessment.

Hitchhiker's thumb

A hitchhiker's thumb, or hypermobile thumb, is characterized by the joint closest to the thumb's nail being exceptionally flexible. Hypermobile, in this context, denotes the ability to move this joint beyond its typical range of motion. Hitchhiker's thumb is commonly associated with genetic conditions and disorders such as joint hypermobility syndrome, diastrophic dysplasia, Atelosteogenesis type 2, and Atelosteogenesis type 3, each affecting bone and cartilage development.

The study of Fontana et al., (2007) showed that many risk factors have been suggested in the development of carpometacarpal (CMC) joint arthritis of the thumb, the exact causes remain elusive. CMC arthritis showed a correlation with occupations involving minimal rest breaks and repetitive thumb use. These findings underscore the importance of further research to uncover additional specific risk factors, with the potential to inform targeted preventive and therapeutic strategies for CMC arthritis.

Overall, while hitchhiker's thumb is not commonly used as a screening tool in general population screening, it has been studied in relation to specific medical conditions and may have potential as a clinical marker in certain contexts. However, further research is needed to fully understand the significance of hitchhiker's thumb in these contexts.

Handedness

Handedness, or the preference for using one hand over the other, has been studied in relation to various medical conditions and may be used as a screening tool in certain contexts.

Eglinton, E., & Annett, M. (1994) related the handedness with the dyslexia a learning disorder which include difficulty in reading. Bayan et al., (1973) suggest that left-handedness in children may result from genetic predisposition for right-handedness, switching to the left due to birth stress or brain damage, particularly affecting the left hemisphere's vulnerability.

Furthermore, birth stress is linked to several conditions, which are also correlated with left-handedness, such as autism, epilepsy, cerebral palsy, Down syndrome, intellectual disability, strabismus, and schizophrenia [10] One study on the patients with stroke found that individuals with the dominant hand affected experienced fewer impairments compared to those with the non-dominant hand affected. Notably, hand dominance did not influence paretic arm usage or performance in daily activities [11].

Some author associated the handedness with the heart disease which found irrelevant [12].

Widow's peak

Widow's peak is associated with various genetic conditions Aarskog-Scott syndrome, Acrofacial dysostosis, Congenital disorder of glycosylation type IIc, Cyprus facial-neuro musculoskeletal syndrome, Hypertelorism and other facial dysmorphism, brachydactyly, genital abnormalities, mental retardation, and recurrent inflammatory episodes etc [13]. A widow's peak serves merely as a morphological feature indicative of these conditions, rather than as a definitive criterion [14].

Hair nature

Hair forms into basic curvature modes or simply shapes while highlighting the role of genetic pathways but could benefit from more detailed explanations, especially regarding the intricate

relationships between twists, curls, and their genetic causes [15]. The human integument serves as a dynamic hair factory, where follicles function as individual production units generating the hair shaft. Various factors, including nutrition, health, and environmental conditions, significantly impact the productivity of these follicles ultimately affecting the hair quality and its nature [16].

Trost et al., (2006), explores the potential link between iron deficiency and hair loss, advocating for screening and treating iron deficiency as a complementary approach in managing both cicatricial and noncicatricial hair loss [17-20].

James et al., (2005) studied changes in the diffraction pattern of body hair, particularly mouse whiskers, directly correspond to the presence and replication of human breast cancer cells, proposing a potential non-invasive screening method for early detection and treatment monitoring [21-23].

The case study by Inzinger et al., (2013) highlights a unique presentation of melanoma in a 91-year-old woman with progressive hair repigmentation, suggesting a potential diagnostic indicator for early detection in white-haired individuals, emphasizing the importance of vigilant screening for concealed scalp melanomas to improve prognosis.

The Boumba et al. (2006) addresses key methodological aspects, including hair structure, mechanisms of drug incorporation, sample preparation, extraction methods, and analytical techniques. It explores the application of hair analysis across various categories, encompassing drugs of abuse, benzodiazepines, prescribed drugs, pesticides, organic pollutants, doping agents, and other substances [24].

Conclusion

In conclusion, morphogenetic traits encompass a diverse array of external characteristics that are observable without specialized tools. Facial morphology, a prominent example, varies across human populations and has applications in predictive human screening. Beyond facial features, various morphogenetic traits, such as earlobe attachment, dimples, index finger ratios, chin shape, tongue rolling, hitchhiker's thumb, handedness, widow's peak, and hair nature, contribute to individual identification and have implications in anthropological and forensic studies.

Studies on ear shape reveal its potential in solving criminal cases, while dimples serve as expressive features conveying emotions. The 2D: 4D finger ratio, exhibiting sexual dimorphism, may offer supplementary information in suspect identification. Chin shape, a genetically determined trait, holds significance in suspect identification. Tongue rolling, a heritable trait, may impact postoperative outcomes for patients with tongue cancer.

Hitchhiker's thumb, associated with genetic conditions, has been explored in medical contexts, although its general screening utility requires further research. Handedness, studied in relation to conditions like dyslexia and stroke, may serve as a screening tool in specific contexts.

Widow's peak, associated with genetic conditions, serves as a morphological feature indicative of underlying issues. Hair nature, influenced by genetic pathways, has implications in health and disease, with potential applications in screening for conditions such as iron deficiency and cancer.

While DNA sequencing is a powerful but time-consuming method in predictive human screening, the study of morphogenetic traits provides an alternative approach with diverse applications in anthropology, forensics, and medical research. Further exploration of these traits and their genetic underpinnings holds promise for enhancing our understanding of human diversity and addressing various health concerns.

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