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Original Article

Facial Asymmetry in Slavic Populations: Sex Dimorphism in Healthy Young Ukrainians

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Abstract

Introduction: Facial and body asymmetry to some extent is present in all individuals. Because fluctuating asymmetry is of a stochastic nature, it cannot be studied at the level of individuals, but only its groups can be considering during studying the populations. **Material and Methods:** We conducted a survey of 200 students of 8–11 grades, from 13 to 17 years old, residents of Ukraine. Asymmetry measurements were made in the program GIMP-2.8. **Results:** Population distribution of eight points of the face asymmetry among the population of Ukraine was studied. Sex dimorphism was found under all average indicators of absolute and relative asymmetry. Higher indicators of asymmetry were common to males and also typical for the lower part of the face. **Discussion and Conclusion:** Obtained data complement the existing study on facial asymmetry in human. Some of our results are consistent with the existing data from previous studies of the world population, while others point to the differences of Slavic population in a number of features related to the facial asymmetry.

Keywords: *Facial asymmetry, sex dimorphism, Ukraine*

Introduction

Absolutely symmetrical objects are nonexistent in nature. The assumption is that minor deviations from absolute symmetry are random and have weak genetic basis, or do not have it at all.[1-3] There are several types of asymmetry. For example, in most vertebrates, it is the following: Back – belly, head – body, left – right. Is also distinguished individual asymmetry, in which there is an equal probability of prevailing of right and left hemispheres of each species, and specific, in which is recorded species-specific dominance of one of the hemispheres. Dominance of hemispheres is a dynamic phenomenon; in other words, in animals the potential change in the dominant hemisphere activity is possible, for example, during rest and sleep. Maximum domination is expressed during the performance of complex experimental tasks.[4] Hemispheric asymmetry is a temporal domination of structures' activity of one hemisphere associated with the type of tasks; functional specialization of hemispheres is based on each hemisphere ability to process the information of a certain type.[1,5] In addition, the following asymmetry types can be observed. Namely, morphological asymmetry can be demonstrated by an unequal structure of two hemispheres; biochemical asymmetry is manifested by the different content of biologically active substances in the left and right hemispheres of the brain; and psychophysiological asymmetry is reflected by the difference in physiological and psychological parameters caused by the specificity of each hemisphere.

Facial and body asymmetry, to some extent, is indigenous to every person. Small inequality of eyebrows, right and left eyes, corners of the mouth, different size and position of the wings of the nose, ears, cheek fullness is a fairly frequent phenomenon. Such small deviations from perfect symmetry are called fluctuating asymmetry (FA), which describes the environmental–genetic population imbalance at the level of individuals.[5-7] Many researchers review FA as a result of the impact of unfavorable environment on the fetus – "ontogenetic noise" – an incomplete ability of organisms to develop under strictly defined ways. Some authors believe that injuries during pregnancy affect

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the occurrence of FA in children.[8] Some authors studied the relationship of FA to the level of sex hormones in males and females.[9]

It is believed that the FA in the body reflects the instability of its development.[10] Most works related to FA are devoted to examining of facial and body symmetry due to eye appeal.[11,12] In the opinion of the most authors, symmetrical faces are more attractive than asymmetric to persons of the opposite sex and indicate a high level of development.[13-17] However, in one of the studies, male facial symmetry was perceived attractive, while symmetrical faces of the females did not receive a high score on a scale of attractiveness.[18] It is assumed that the body with high symmetry is the bearer of good genes resistant to parasites and other sources of disturbances in development. Conversely, a body with low symmetry might be sick or carry low-quality genes, so its resistance to disorders has been reduced.[13]

A connection between sex facial dimorphism and FA has been found. One study examined the FA in association with male and female traits. As a result, it was found that feminity of a face was not directly related to facial symmetry, and in males, such associations were not found.[19] During the study of facial symmetry and sex dimorphism, it was shown that these two phenomena are linked together in human populations, which differ by origin, particularly among immigrants from Europe and Africa. Similar effect was observed for primates that are not related to Homo sapiens. In all studied samples, symmetrical males and females had masculine and feminine features, respectively. Results pointed to the universality of the phenomenon of symmetry in human populations and ancient phylogenetic origin of relation of symmetry and sex dimorphism in the structure of the face in primates in general.[20]

Recently, more attention is paid to the FA in dermatoglyphics, particularly correlation between oscillatory asymmetry and breast cancer[21] and relationship between the FA and predisposition to schizophrenia are found.[22] A connection between asymmetry and hemostasis indicators was also found.[23]

Facial asymmetry can be an indicator of psychological, emotional, and physiological disorders and can signal about various stresses.[4,24] A group of authors studied the relationship between facial attractiveness and symmetry in relation to human health. The authors found that attractive features and facial symmetry are perceived as a sign of human health. And, conversely, facial asymmetry was associated with poor health in childhood for males, and for females – with diseases that occur in adolescence,[11,12,19] but was not an indicator of health in older age.[25]

The works are known, which studied the reaction of photographs perception, where mentally diseased people with asymmetrical faces were presented. In one of these studies, in the case of presenting the pictures with cleft lip and palate patients to healthy volunteers, the fixation of the eyes of these study participants was observed at the region of a nose and a mouth.[26] In fact, in patients with congenital facial anomalies, the greatest degree of facial asymmetry was characteristic for the middle part of the face.[27] Some studies have shown gender differences in visual processing of faces of people associated with hemispheric asymmetry. Activities are usually observed in the right hemisphere in males, whereas brain of females in visual processing of faces showed more bilateral activity.[28]

Because FA is of a stochastic nature, it cannot be studied at the level of individuals, but its groups can be considered during studying samples. Despite numerous studies in the field of FA, many questions remain open and disputed, and a small number of population genetic studies of human asymmetry depending on gender dictate the timeliness of this work. In connection with the above findings, the objective of this work was to study the population distribution and the effect of sex facial dimorphism using Ukrainian population as an example.

Material and Methods

We conducted a survey of 200 students of 8–11 grades, from 13 to 17 years old of Municipal Institution "Regional Specialized Boarding School of II-III educational levels "Obdarovanist" of Kharkiv Regional Council," who gave informed consent for questioning. All participants of the research are residents of Ukraine, most from Kharkiv and Kharkiv regions. Among them, 117 were girls and 83 were boys. Data collection was made taking into consideration ethical requirements and Helsinki guidelines for human volunteers' participation in scientific studies (World Medical Association Declaration of Helsinki, Ethical Principles for Medical Research Involving Human Subjects). All participants gave their written consent.

A digital camera Nikon Coolpix L12, with standard zoom, set to portrait orientation was used to take photographs of the participants. Photographs were made in daylight from 9:00 to 13:00, at the same background, in a distance of 50 cm from the photographer to the child. Full face angle was used.

Asymmetry measurements were made in the computer GIMP-2.8 software for Windows (developed by The GIMP Development Team) with zoom of 200%. The perpendicular line was done through the point between the eyebrows, reflecting the center part of distances under study, namely, between inner and outer corner of the eye, between the wings of noses and between lip angle on the left and right side of the face. To make measurements, the following parameters of GIMP-2.8 software were used: Scale; meter; pencil, set to normal thickness of 01:00, opacity 100.0; net measurements were in millimeters [Figure 1].

Relationship between data, distribution of which does not meet the normal law, was evaluated by Spearman's method. Statistical hypothesis was tested using criterion *t*. Conclusion

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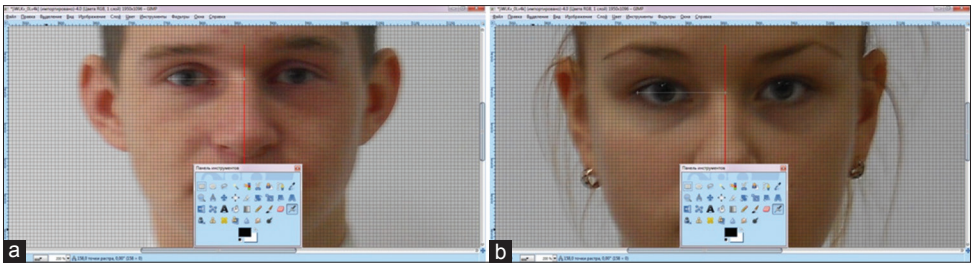

Figure 1: Processing of actual photographic material in GIMP-2.8 software (from permission of two study participants, a male (a) and a female (b))

on statistical hypotheses was performed at the level of significance $P \leq 0.05$. Database was created with Microsoft Excel 2010 program, and calculations were made in the program Statistica 6.1 for Windows (developed by StatSoft, Dell, Round Rock, Texas, USA).

Results and Discussion

Effect of facial asymmetry was examined under the following factors: (1) distance from the midline to the inner corner of the right and left eyes; (2) distance from the midline to the outer corner of the right and left eyes; (3) distance to wing of noses from the right and left sides; (4) distance to the corner of the lips on the right and left sides [Table 1].

As shown in Table 1, all the measurements found statistically significant asymmetry between males and females. Males had significantly higher levels of asymmetry according to all indications. However, this greater asymmetry could be due to a larger absolute dimensions of male faces. Hence, the previous study of adult healthy people has shown that male faces were wider, were more elongated, and preferably had a triangular shape, whereas female faces had more rectangular shape. Gender differences were evident especially in the lower third of the face.[29] In the study of young males and females from India, whose faces brought esthetic pleasure, the effect of sex dimorphism in facial asymmetry was also present. In particular, higher asymmetry indices were present in males.[30] In contrast, a study of facial asymmetry of Turkish students showed that the number of statistically significant asymmetric distances between the two halves of the face was higher in females compared with males.[31] However, the results of other studies should be mentioned that indicate that evident sex differences in soft facial tissues become statistically insignificant when modifications to the face dimensions are introduced.[32] In another study of the facial asymmetry in eighty healthy individuals of European origin the left and right half faces were shown to be asymmetrical, but asymmetry was demonstrated in the facial shape, rather than in the facial size.[33] In another study in the observation of facial asymmetry of young and adult males and females, a small asymmetry was found in general, but there was no connection of gender and age with the distance between different points of the face and the line of symmetry. The authors made a conclusion on the possibility of using maximum asymmetry indicators in healthy individuals for getting boundary indicators of asymmetrical patients.[34] Take this into account, we have introduced relative indicators of facial asymmetry as follows: difference of a distance from the midline to the inner corner of the eye on the left and right sides, divided by the distance from the midline to the inner corner of the eye on the right side; difference of the distance from the midline to the outer corner of the eye on the left and right sides, divided by the distance from the midline to the outer corner of the eye on the right side; difference of the distance from the midline to the wing of the nose on the left and right sides, divided by the distance to the distance from the midline to the wing of nose on the right side; and difference of the distance from the midline to the corner of the lips on the left and right sides, divided by the distance to the corner of the lips to the right. As is well known, the results of such research can significantly influence the chosen method of determining the facial asymmetry. There are many techniques in the world to study the effect of asymmetry that use a different number of points of the face and skull, as well as bilateral and three-dimensional imaging.[35] The objective of some of these types of research is the classification of the types of facial asymmetry, which is required for application in medical practice, particularly in plastic surgery. In one of those researches, three-dimensional computed tomography imaging was used, where people with facial asymmetry were classified into four groups depending on the asymmetry features of upper and lower jaws.[36] The choice of methods for determining facial asymmetry is essential for correct measurement and interpretation of results. When assessing two-dimensional arrays of graphical information such as photographs, vertical or horizontal reference lines are often chosen or are oriented at the centers of bilaterally located reference points. For a more accurate measurement, a sufficient number of facial points is used.[37] Measurements of relative indicators of facial asymmetry in faces of males and females in the current study are presented in Table 2.

Statistical analysis showed that the facial asymmetry is significantly different both in absolute and in relative indicators in the representatives of different gender, which is reflecting sex dimorphism in the facial architectonics of Slavic population, namely among residents of Ukraine. It

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Table 1: Gender differences in absolute measurements of facial asymmetry

Variable	x_w	x_m	s_w	s_m	*t*	*P*
Distance to the inner corner of the right eye	4.94	5.36	0.88	0.94	0.88	0.94
Distance to the inner corner of the left eye	4.86	5.10	0.73	0.89	0.73	0.89
Distance to the outer corner of the right eye	13.43	14.25	1.94	1.94	1.94	1.94
Distance to the outer corner of the left eye	13.29	13.85	1.73	1.80	1.73	1.80
Distance to the wing of noses from the right	5.39	5.86	1.10	1.13	1.10	1.13
Distance to the wing of noses from the left	5.64	6.08	0.98	0.94	0.98	0.94
Distance to the corner of the lips on the right	7.50	8.14	1.43	1.48	1.43	1.48
Distance to the corner of the lips on the left	7.81	8.28	1.36	1.26	1.36	1.26

t: Student's test, x_w: Arithmetic mean value for females (n=117), x_m: Arithmetic mean value for males (n=83), *P*: Significance level, s_w: Standard deviation for females, s_m: Standard deviation for males

Table 2: Gender differences in relative indicators of facial asymmetry

Variable	x_w	x_m	s_w	s_m	*t*	*P*
Distance from the midline to the inner corner of the eye to the left - distance to the inner corner of the eye to the right/distance from the midline to the inner corner of the eye to the right	−0.008	−0.12	0.17	0.11	2.32	0.02
Distance from the midline to the outer corner of the eye to the left - distance to the outer corner of the eye to the right/distance from the midline to the outer corner of the eye to the right	−0.01	−0.05	0.06	0.05	2.28	0.02
Distance from the midline to the wing of nose to the left - distance to the wing of nose to the right/distance from the midline to the wing of nose to the right	0.08	−0.08	0.24	0.18	2.51	0.01
Distance from the midline to the corner of the lips to the left - distance to the corner of the lips to the right/distance from the midline to the corner of the lips to the right	0.07	−0.09	0.23	0.15	2.47	0.01

Note: See references in Table 1

should be noted that relatively low asymmetry indicators may be related to the fact that the population of modern Ukrainian cities,where the majority of the participants of the study lives may have increased the degree of heterozygosity, as evidenced by the intense migration processes[38-40] and a large number of interethnic marriages in Ukraine in the recent past.[41-43] Modern young generation of Ukraine are children from such marriages. As we know, in the last few years, in the world of science, new statistically significant associations appeared between FA and heterozygosity. In particular, the relationship between genetic ancestry and individual asymmetry was studied in mixed populations of Latin America. The presence of specific facial asymmetry was revealed that is inherent in the people who belong to groups with different genetic origins. Also, it was shown that heterozygous individuals have lower levels of asymmetry.[44] Another study found no relation between facial asymmetry and heterozygosity of individuals.[45] Assumptions on theoretically possible connection between heterozygosity and asymmetry in the Ukrainian population are interesting, but require further research and confirmation.

It should also be noted that the results of our study on the higher values of asymmetry indicators (mean values and standard deviation) in the bottom of the face are quite consistent with the data obtained in the study of sixty young Chinese people. Perhaps, this effect is universal and characteristic of all human populations regardless of genetic origin.[46] Previously, it was also shown that a small degree of asymmetry is present both in individuals and in the population as a whole. It was particularly noticeable in the middle and lower third parts of the face. Moreover, the right side of the face on an average was bigger than the left.[47]

Differences between measurements of similar length on the left and right to the midline of persons of the same gender in our study were small and statistically insignificant. Effect of the dominant half of asymmetry in the Indian study was also found neither in males nor in females.[30] In contrast, in Turkish students, the left half of the face is usually characterized by dominance effect in both males and females.[31]

Obtained data complement the existing study on facial asymmetry in human, which needs further study in connection with a number of unresolved problems and phenomena that are not categorical. Some of our results are consistent with the existing data from previous studies of the world population, while others point to the differences of Slavic population in a number of features related to the facial asymmetry. In general, the first results are the basis for further studies on the search for possible associations of facial asymmetry with clinically significant indicators in the relatively healthy population of Ukraine.

Conclusions

1. Population distribution of eight points of the face asymmetry among the population of Ukraine was studied

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2. Sex dimorphism was found under all average indicators of absolute and relative asymmetry. Higher indicators of asymmetry were common to males and also typical for the lower part of the face.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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