

## RELATIONS BETWEEN SOMATIC, NEUROPHYSIOLOGICAL AND PSYCHOPHYSIOLOGICAL MARKERS OF HUMAN HEALTH

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**ABSTRACT** — THE PURPOSE of this paper is to investigate relations between somatic, neurophysiological and psychophysiological markers of human health and to find out these markers' associations.

**METHODS:** anthropometry, bioimpedancemetry, biological age determination, electroencephalography, evaluation of anxiety and depression levels. A total of 1000 young healthy persons were examined (409 males and 511 females).

**RESULTS:** inverse correlation has been revealed between sexual dimorphism index (SDI) and the level of self-reported anxiety according to the Beck Anxiety Inventory. Insignificant alterations in situational and interpersonal anxiety alongside with significant increase in depression level were common to persons with low body mass indices (BMI). Low scores in situational and interpersonal anxiety together with low depression level were revealed in persons with increased BMI. Increase in anxiety was found in both males and females with sexual inversion, more often in male gynecomorphs. The degree of situational anxiety level elevation (in points) was positively correlated with the degree of sexual inversion manifestation.

**CONCLUSION:** the present research has demonstrated interrelation (association) between somatic (BMI, sexual inversion), neurophysiological (coherence coefficient) and psychophysiological (anxiety and depression level) markers in healthy adolescents.

**KEYWORDS** — human, health, somatic status, anthropometry, sexual dimorphism index (SDI), body mass index (BMI), electroencephalography, anxiety, depression, markers.

## INTRODUCTION

National programmes of Healthcare development in the Russian Federation are aimed at disease prevention and healthy lifestyle promotion in the Russian population [1, 2, 7, 13]. Our previous studies have demonstrated that human physical health and human psychological health form an integral unit [5, 7]. Indicators of physical development have been identified that could be used as markers or predictors of socially significant diseases.

### *The purpose*

of the present study is to investigate relations between somatic, neurophysiological and psychophysiological markers of human health and to find out these markers' associations.

## METHODS

The investigation was carried out at the premises of the "Morphology and Physiology of a Healthy Person" research educational centre at Prof. V.F. Voino-Yasenetsky Krasnoyarsk State Medical University (KrasSMU). The study was approved by the KrasSMU Ethics Committee. Inclusion of healthy volunteers was performed upon informed consent signing. The volunteers received no reward for participation in the study.

Examination of the volunteers was free of charge. Population of the city of Krasnoyarsk and the Krasnoyarsk Territory became the object of the research. A total of 4919 males and females at the age over 18 were examined. Among the study participants there were representatives of three age periods: adolescence, adulthood, old age. For the present study, a group of healthy adolescent volunteers was formed that comprised 409 young males and 511 young females. Methods of examination included anthropometry with somatometry indices calculation, bioimpedancemetry, biological age determination, electroencephalography, as well as evaluation of anxiety and depression levels.

Following the classical method of V.V. Bunak (1931), anthropometry was performed with the use of a standardised toolset [3]. A total of five markers were defined: height and weight, transverse thoracic diameter, shoulder and pelvic diameters. Bioimpedancemetry was conducted by means of the ABC "Medass" analyser (RF). Fat, muscular, bone and lean body masses were evaluated. Additionally, total body water, active cell mass (ACM), basal metabolic rate and phase angle were measured [8]. Moreover, index constitution assessment was performed. The BMI made it possible to reveal alterations in body mass [4]. The sexual dimorphism index (SDI) detection by the method of D. Tanner allowed us to evaluate the degree of compliance of the constitution with the phenotypic sex including andromorphy, mesomorphy, and gynecomorphy [12]. The ageing rate coefficient (ARC) and biological age were evaluated by methods of A.G. Gorelkin and B.B. Pinkhasov, correspondingly [9].

Electroencephalography (EEG) was performed by means of a "Neurocartograph" computer complex (MBN, RF) including spectral, power and coherence methods of analysis. Characteristics of neurophysiological maturity of brain bioelectrical activity, inter- and intrahemispheric connections status were evaluated [5, 10]. Assessment of the levels of anxiety and depression was performed by means of the Beck Anxiety Scale [11].

Statistical processing of the study results was carried out by means of SPSS 22.0, "StatPlus Professional 5.8" and Microsoft Excel 9 (USA). The type of data distribution was defined using the Kolmogorov-Smirnov Criterion. The Spearman's non-parametric correlational criterion was applied for evaluation of the statistical significance of associations between the studied parameters.

Two-phase clustering and visualisation by means of varying regression diagrams were used. Data mining analysis based on decision trees was applied to assess associations between various anthropometric and neurophysiological parameters [6].

Results and their discussion. Statistically significant correlation between physical (SDI), neurophysiological (coherence coefficient) and psychophysiological (levels of anxiety and depression) status markers was found. In particular, inverse correlation between SDI and self-evaluated anxiety level according to the Beck Anxiety Scale was revealed. However, correlations between neurophysiological and psychophysiological markers were medium or weak (fig. 1).

A method of two-stage cluster analysis was used to identify group similarity between studied index characteristics (fig. 2).

Shifts into elevated levels of depression, situational and interpersonal anxiety were peculiar to persons with normal levels of BMI. Low indices of situational and interpersonal anxiety and depression were found in persons with slightly increased BMI. Insignificant alterations in situational and interpersonal anxiety

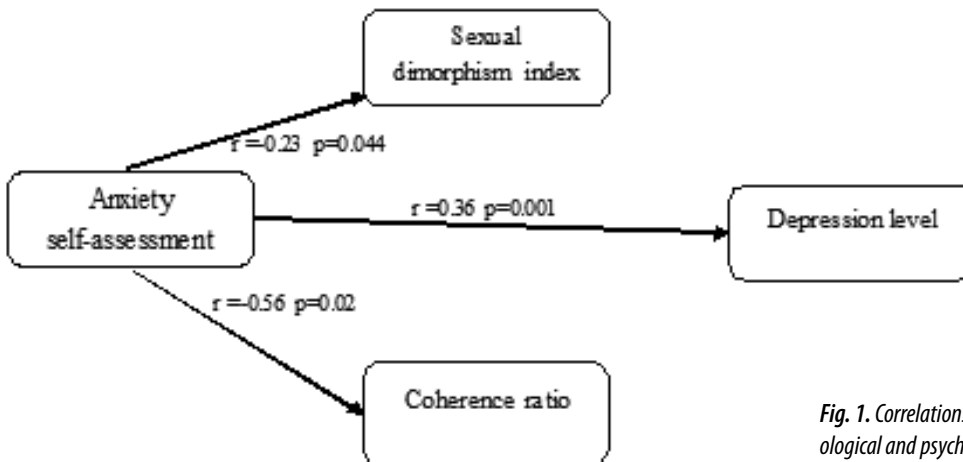


Fig. 1. Correlations between somatic, neurophysiological and psychophysiological markers

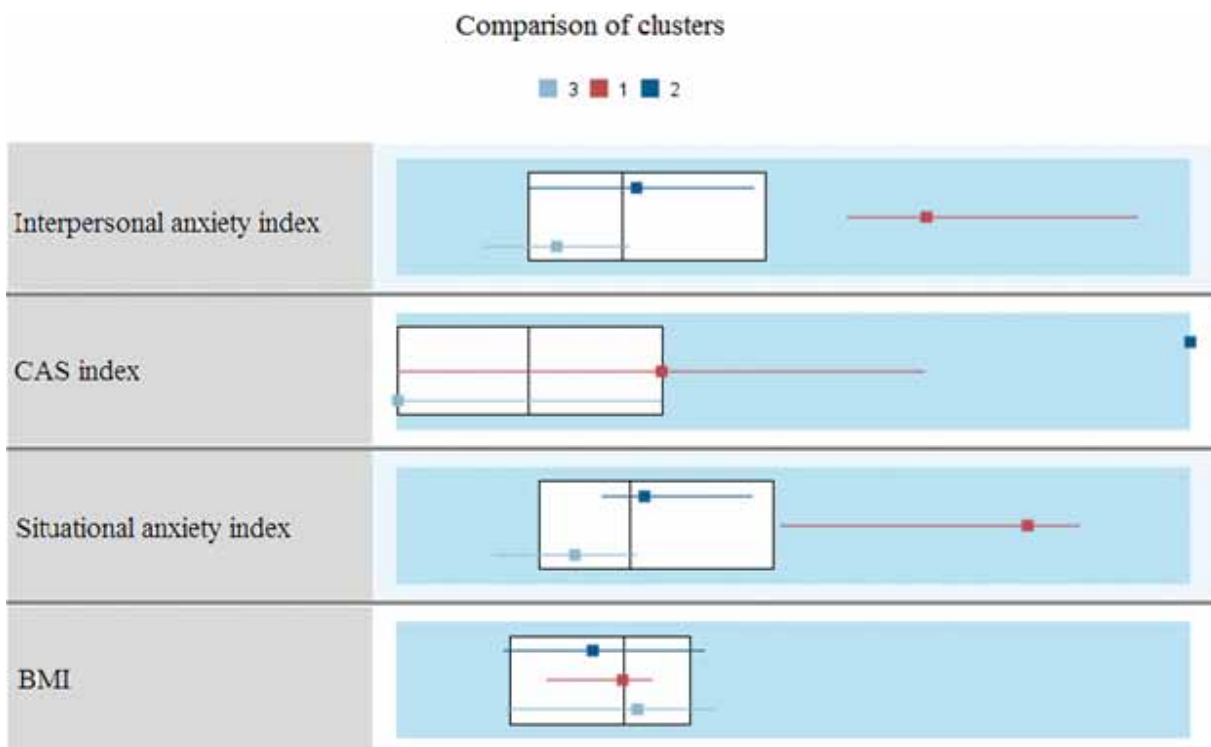


Fig. 2. Comparison of clusters by somatic (BMI), neurophysiological and psychophysiological markers

alongside with significant increase in depression level were common to persons with low body mass indices (BMI). Low scores in situational and interpersonal anxiety together with low depression level were revealed in persons with slightly increased BMI.

The somatisation subscale (one of the Beck Anxiety Scale criteria) was used for qualitative and quantitative evaluation of depression. The decision tree analysis showed statistically significant correlation between the somatisation subscale rate (in points) and the examined volunteers' sex (fig.3).

A regressor variable diagram of the level of prevailing anxiety in males and females depending on their SDI made it possible to visualize a particular association (fig. 4). The existence of this association was confirmed by the data from decision tree, as shown in fig. 5.

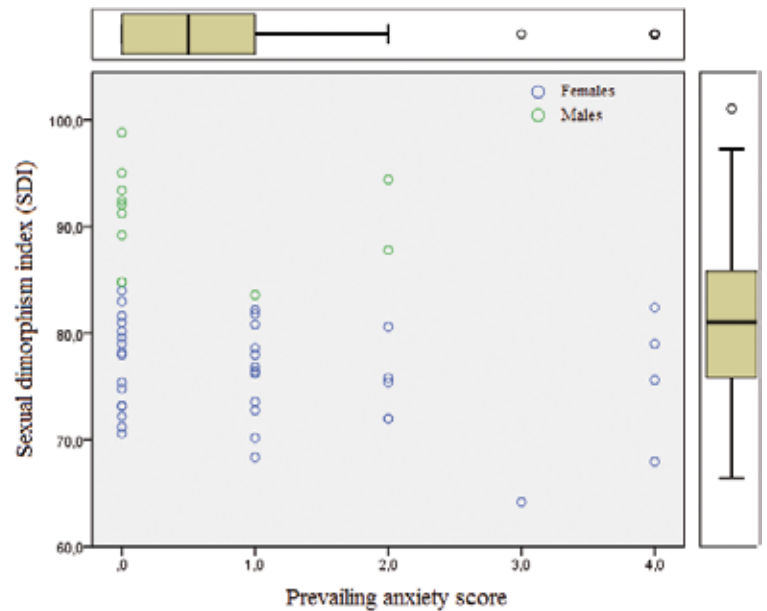


Fig. 4. A regressor variable diagram of the level of prevailing anxiety in males and females depending on their SDI

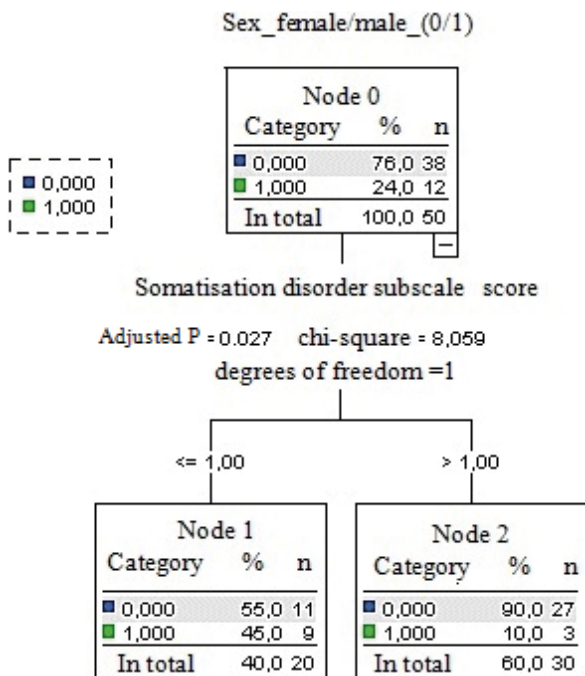


Fig. 3. Decision Tree Based Depression Classification in relation to sex

Prevailing elevation of anxiety level was inherent in persons with the average SDI of 79.7. This index was typical for female mesomorphs and male gynecomorphs. Prevailing anxiety was found to be equal or lower than 0 points (subgroup 1) in 50% of the surveyed subjects and above 0 points in the other 50% of the volunteers (subgroup 2). In subgroup 1, SDI was 82.3 which is associated with andromorphy

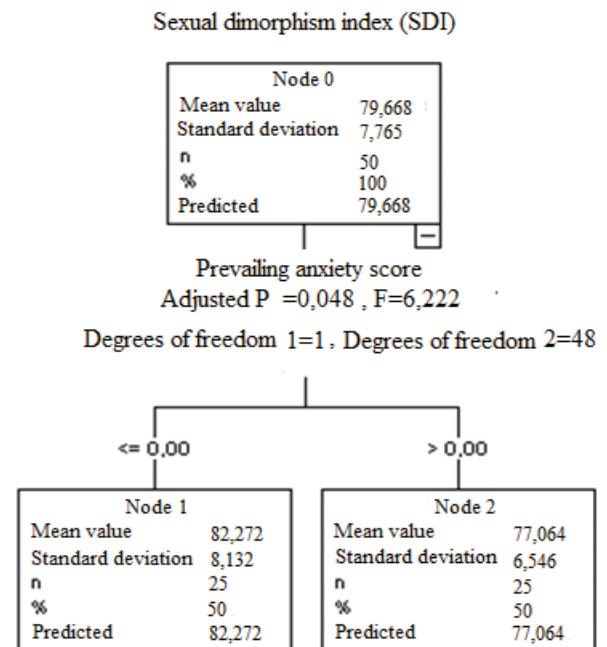


Fig. 5. A Decision Tree for prevailing anxiety level in males and females in relation to SDI

in females and gynecomorphy in males. In the second subgroup, SDI was 77.1 which is common to female mesomorphs and male gynecomorphs.

In general, elevation of anxiety in both males and females with sexual inversion was revealed, more often

in male gynecomorphs. The degree of situational anxiety level elevation (in points) was positively correlated with the degree of sexual inversion manifestation.

## CONCLUSION

The present investigation has demonstrated the existence of interrelation (association) between somatic (SDI, sexual inversion) neurophysiological (coherence coefficient) and psychophysiological (anxiety and depression levels) markers in healthy adolescents. This means that both BMI and SDI can be used as additional markers to evaluate neuropsychophysiological health of the population.

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