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Study of Dermatoglyphic Fluctuating Asymmetry in Female Breast Cancer

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Abstract

Dermatoglyphic fluctuating asymmetry patterns are occasionally studied in cancer patients. The present examination covers 82 women with breast cancer and 60 healthy women from the region of Varna, Bulgaria. The dermatoglyphic examinations were performed by the method of Cummins and Midlo and the degree of the fluctuating asymmetry was assessed according to 1-r2 formula and R-L/R+L formula. The comparison of the palmar ridge counts of a-b II, c-d IV and a-d revealed considerably higher fluctuating asymmetry values in breast cancer females than in healthy controls. There were greater correlation coefficient values of the fluctuating asymmetry (1-r2) in the ridge count of the homologous thumbs, forefingers and little fingers of both hands but smaller ones of the third and fourth fingers of both hands in breast cancer females than in healthy controls. These traits could be used within a diagnostic algorithm for breast cancer screening among genetically predisposed female population.

Key words: dermatoglyphics, fluctuating asymmetry, breast cancer, region of Varna

Introduction

Fluctuating asymmetry is defined as random deviations on both sides of the body (limb or organs), with the average values in the population equal on both sides of the body [12, 15]. Fluctuating asymmetry is regarded as a promising measure of the stress experienced by individuals during their development, as well as the interaction between genetic and environmental forces which affect that development [6]. Fluctuating asymmetry is the most sensitive indicator of the ability to cope with stresses during ontogeny [14].

The small, random deviations from perfect symmetry that result from such factors are termed fluctuating asymmetry [11]. 'Fluctuating' refers to a pattern of bilateral variation where variation on the right and left sides is both random and independent. It tends to be small (around 1% of trait size or less). These random departures from bilateral symmetry provide a surprisingly convenient measure of developmental precision: the more precisely each side develops the greater the symmetry. Fluctuating asymmetry is a measure of developmental stability. It is one of many issues at the interface between

biology and medicine that offer valuable information at the whole organism level [11]. Such comprehensive information is a concept familiar to, and frequently used by, biologists, but is often overlooked in medicine [6, 14].

Fluctuating asymmetry is common in morphometric traits and its intensity is determined by the ability of the genotype to create a symmetrical phenotype, despite the intra- and extra-uterine environmental pressures exerted on the embryonal body during its development [5]. The level of fluctuating asymmetry reflects the relative success of developmental homeostasis to block developmental disturbances.

Assessing the developmental stability of individuals or populations by measuring fluctuating asymmetry is a well-established biological concept which has great potential for medical application [10]. The study of the correlations between anthropometric traits (height, palm length, etc.) and dermatoglyphic traits established a drop in the fluctuating asymmetry of finger ridge counts in individuals located in the centre of the distribution curve for morphological traits [4].

Recent biological theoretical treatments pertaining to developmental stability are applied to a range of human health issues such as cancer, genetic diseases, infectious diseases, etc. [14]. Dermatoglyphic fluctuating asymmetry patterns are occasionally studied in cancer patients. There is certain evidence that they could add some essential diagnostic and prognostic information in breast cancer patients, too, and thus contribute to more effective screening and prevention.

The objective of the present study was to comparatively analyze some peculiarities of some dermatoglyphic fluctuating asymmetry patterns in female breast cancer patients and healthy women in terms of the diagnostic significance of this method.

Material and Methods

The present investigation was performed during the period from January 1, 2014 till December 31, 2017. It covered 82 women with clinically, histologically and mammographically confirmed breast cancer as well as 60 healthy women from the region of Varna, Bulgaria. Breast cancer patients were aged between 36 and 80 years while healthy females were aged between 31 and 79 years. All of them were of Bulgarian ethnical origin.

The dermatoglyphic examinations were performed by the basic method of Cummins and Midlo [2]. The degree of the fluctuating asymmetry was assessed by using the ridge count of homologous fingers, palmar ridge counts and three maximal angles according to $1\text{-}r^2$ formula [8, 9] and R-L/R+L formula after the method of univariate ANOVA. Correlation and regression analyses were also applied. Statistical data processing was done by means of SPSS software package, version 19.

Results

Our results were presented in three tables and three figures.

The values of the correlation coefficients of ridge count of homologous fingers and their differences in breast cancer females and healthy controls were compared in **Table 1**. The results from the regression analysis demonstrate statistically significantly higher correlation coefficient values of the fourth fingers of both hands in breast cancer females than in healthy controls only ($p<0.05$) (**Table 1**).

The values of the coefficients of the fluctuating asymmetry (l-r2) of ridge count of homologous fingers and their differences in breast cancer females and healthy controls

were compared in **Table 2**. Correlation coefficient values (r) of the fluctuating asymmetry (l-r2) for the ridge count of the homologous thumbs, forefingers and little fingers are slightly greater while those of the homologous third and fourth fingers of both hands are insignificantly smaller in breast cancer females than in healthy controls (**Table 2**).

The results from univariate ANOVA of three ridge counts concerning the variation type were compared in **Table 3**. There is a statistically significant difference between the intergroup variation and residual (unexplained) variation concerning the b-c ridge count only (**Table 3**).

The results from the comparative analysis of the fluctuating asymmetry patterns in breast cancer females and healthy controls are juxtaposed on **Figure 1, Figure 2** and **Figure 3**. There is a considerable difference in terms of fluctuating asymmetry of the fourth homologous fingers between breast cancer females and healthy controls in favour of the patients only (0,979 versus 0,709) (**Table 2** and **Fig. 1**). There are considerably greater values of a-b II, c-d IV, and a-d palmar ridge counts concerning the fluctuating asymmetry in breast cancer females than in healthy controls (**Fig. 2**). There are relatively small differences between the breast cancer females and healthy controls concerning the fluctuating asymmetry (l-r2) of atd, dat and adt maximal angles (**Fig. 3**).

Table 1. Correlation coefficients (r) of ridge count of homologous fingers in breast cancer females and healthy controls

Left and right hand fingers	Correlation coefficients (r)		
	breast cancer females (n=82)	healthy controls (n=60)	Difference between coefficients
I	0.217	0.327	p>0.05
II	0.370	0.452	p>0.05
III	0.362	0.329	p>0.05
IV	0.593	0.145	**p<0.05**
V	0.387	0.400	p>0.05

Table 2. Fluctuating asymmetry (l-r2) of ridge count of homologous fingers in breast cancer females and healthy controls

Left and right hand fingers	Correlation coefficients (r)		
	breast cancer females (n=82)	healthy controls (n=60)	Difference between coefficients
I	0.953	0.893	+0.060
II	0.863	0.796	+0.067
III	0.869	0.892	-0.023
IV	0.709	0.979	-0.270
V	0.850	0.840	+0.010

Discussion

In the present study, there is a considerably higher fluctuating asymmetry value of the ridge count of the fourth homologous fingers of both hands in breast cancer females than in healthy controls only. The comparison of the palmar ridge counts of a-b II, c-d IV and a-d reveals considerably higher fluctuating asymmetry values in breast cancer females than in healthy controls. There are higher correlation coefficient values of the fluctuating asymmetry ($1\text{-}r^2$) in the ridge count of the homologous thumbs, forefingers

Table 3. Univariate ANOVA of a-b, b-c and c-d ridge counts in breast cancer females and healthy controls

Ridge count	Variation	sum of squares	mean square	F	p
a-b	intergroup	13.6	13.64901	0.17	0.68
	residual (unexplained)	10977.4	78.4102		
b-c	intergroup	3459.4	3459.439	77.134	**0.0001**
	residual (unexplained)	6278.9	44.85		
c-d	intergroup	471.104	471.104	0.68	0.411
	residual (unexplained)	96997.093	692.836		

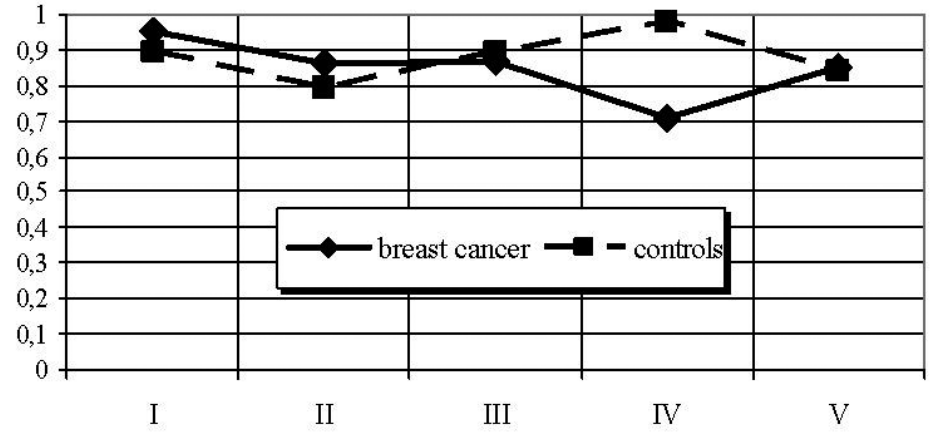

Fig. 1. Fluctuating asymmetry (l-r2) of ridge count of homologous fingers of both hands in breast cancer females and healthy controls

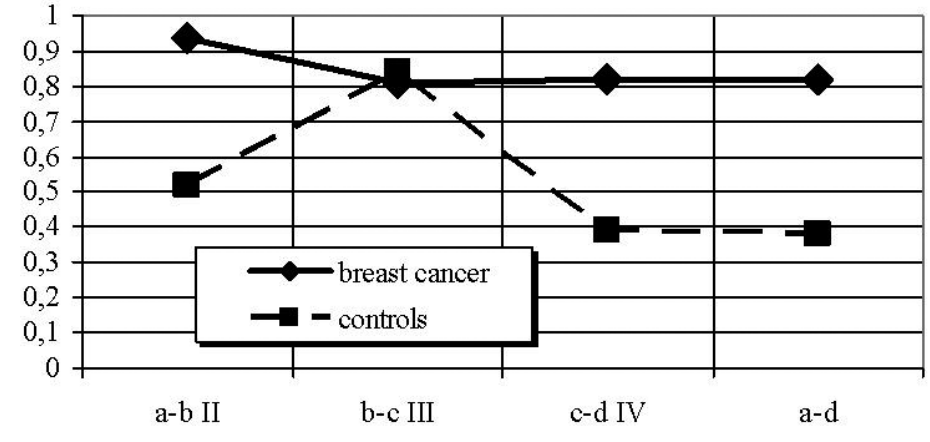

Fig. 2. Fluctuating asymmetry (l-r2) of palmar ridge counts in breast cancer females and healthy controls

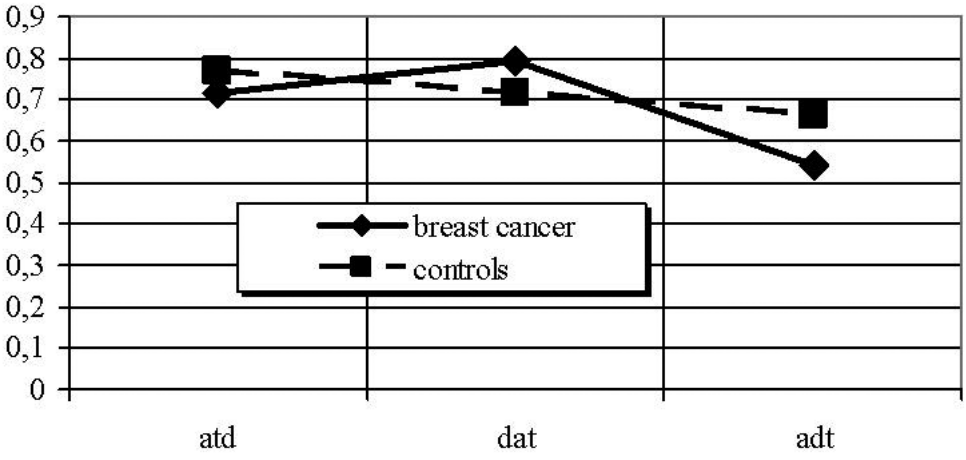

Fig. 3. Fluctuating asymmetry (l-r2) of atd, dat and adt maximal angles in breast cancer females and healthy controls

and little fingers of both hands but smaller ones of the third and fourth fingers of both hands in breast cancer females than in healthy controls.

The fluctuating asymmetry of finger and palmar dermatoglyphics of both hands was compared between 112 breast cancers women and 112 healthy controls in Han ethnic from Ningxia, China [7]. There were statistically significant differences between both groups in terms of the right finger ridge count of the thumb and atd angle ($p<0.05$), the fluctuating asymmetry of the little finger and atd angle ($p<0.01$) as well as in terms of the fluctuating asymmetry of the little finger and the ridge count of the fourth finger ($p<0.05$). There was also a significant difference in radial and ulnar loops ≥ 7 on the distribution of atd angle between these groups.

The fluctuating asymmetry of finger and palmar dermatoglyphic patterns of both hands was comparatively assessed between 100 breast cancer females and 100 healthy controls in India [8]. Fluctuation asymmetry values derived from quantitative parameters such as finger ridge counts, a-b ridge counts and palmar angles were statistically significantly higher in breast cancer females than in healthy controls for the thumb (by 2.01 times), subtotal ridge count (by 2.10 times) and palmar atd angle (by 2.01 times). The following different values of Person's correlation coefficient between both groups for the fluctuating asymmetry were established: thumb – r=0.31 and r=0.79; forefinger – r=0.62 and r=0.77; fourth finger – r=0.71 and r=0.64; subtotal finger ridge count – r=0.66 and r=0.11, and atd angle – r=0.74 and r=0.50. The values of correlation coefficients between both groups for the fluctuating asymmetry ($l\text{-}r^2$) were the following: subtotal finger ridge count – 0.55 versus 0.98; thumb – 0.90 versus 0.36; forefinger – 0.60 versus 0.39, and atd angle – 0.43 versus 0.74.

The relationship between genetic anomalies of different levels and deviations in dermatoglyphic traits of 40 Israeli-Jewish females with cervical cancer and 54 ones with endometrial cancer, on the one hand, and of 874 healthy males and females was comprehensively analyzed [1, 13]. There were statistically significant differences for some dermatoglyphic patterns between cancer patients and the control groups. The indices of fluctuating asymmetry proved more suitable for discrimination, yielding the highest discrimination level between women with cancer and control females.

The environmental and hereditary influence on tumour development using digito-palmar dermatoglyphic traits is assessed in 126 patients of both genders with pituitary tumors

(60 non-functional and 66 functional pituitary tumour patients) in comparison to a control group of 400 phenotypically healthy individuals [3].

Conclusion

Dermatoglyphic fluctuating asymmetry traits deserve further comprehensive and large-scale research in human oncology as they could provide reliable information about the possible effective screening and prevention of the malignant diseases.

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