ОРИГІНАЛЬНІ ДОСЛІДЖЕННЯ

MODELING USING DISCRIMINANT ANALYSIS OF THE POSSIBILITY OF OCCURRENCE AND FEATURES OF THE COURSE OF VARIOUS FORMS OF URTICARIA IN UKRAINIAN WOMEN DEPENDING ON THE FEATURES OF ANTHROPO-SOMATOTYPOLOGICAL INDICATORS

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Annotation. *Predicting the risk of occurrence and course of any disease is the most important and central topic of any branch of clinical medicine. This especially applies to chronic and recurrent diseases that lead to deterioration of the bone of life. One of these diseases is urticaria. The use of anthropometric indicators to achieve this goal is an economically, pathogenetically and logically justified choice. The purpose of the study is to build and analyze discriminative models of the possibility of occurrence and features of the course of urticaria in Ukrainian women depending on anthropometric and somatotypological indicators. On the basis of the Military Medical Clinical Center of the Central Region and the Department of Skin and Venereal Diseases with a postgraduate course at the National Pirogov Memorial Medical University, Vinnytsya, a clinical-laboratory and anthropo-somatotypological examination of 40 young Ukrainian women with acute and chronic urticaria of the mild and severe course As a control group, the indicators of body structure and dimensions of 101 practically healthy Ukrainian women of a similar age group were used, which were taken from the data bank of the research center of the National Pirogov Memorial Medical University, Vinnytsya. With the help of the license package "Statistica 6.0", discriminant models of the possibility of occurrence and characteristics of the course of urticaria in Ukrainian women were built, depending on anthropometric and somatotypological indicators. In Ukrainian women, based on the characteristics of anthropo-somatotypological indicators, reliable discriminative models were built, which allow with a high probability to classify them as "typical" for practically healthy or patients with urticaria, as well as "typical" for mild or severe acute urticaria course (correspondingly correct in 89.4 % of cases, Wilks' Lambda statistic=0.080, p<0.001). When taking into account the structure and body size indicators among women with urticaria, a reliable interpretation of the obtained classification indicators is possible only between a mild and severe course of the disease (correspondingly, the correctness of 52.5 % of cases, Wilks' Lambda statistic=0.465, p<0.001).*
Keywords: *skin diseases, practically healthy and urticaria-afflicted Ukrainian women, anthropometric and somatotypological indicators, discriminant models.*

Introduction

Urticaria is an inflammatory skin disease that manifests itself in the form of blisters, angioedema. The basis of this disease is the mechanism of activation and degranulation of skin mast cells with subsequent release of histamine and other mediators of inflammation. Depending on the duration of the symptoms, acute and chronic forms of the disease are distinguished, and the chronic form, in turn, is spontaneous or induced [14].

In Korea, the average prevalence of chronic urticaria between 2010 and 2013 was 3.1 %, chronic spontaneous urticaria was 1.4 %. An increased prevalence of pathologies was observed among women with disease peaks at the age of 0-9 and 70-79 years [12]. Among children in Korea, the prevalence of various forms of urticaria ranged from 22.5 to 1.8 %, depending on the form of the disease. The authors of the study also found a relationship between the frequency of acute urticaria and allergic diseases and allergies in the history of parents (p<0.001) [15]. Using the example of the population of Thai children, it was established that remission rates for this disease are 18.5 %, 54.0 %, and 67.7 %, respectively, 1, 3, and 5 years after the onset of symptoms [22]

In Taiwan, the prevalence of urticaria is gradually increasing. If in 2009 the indicator was 0.69 %, then in 2012 it rose to 0.79 %. The incidence rate from 2010 to 2012 was 0.50 % [4].

The higher prevalence of some concomitant diseases among patients with urticaria is also noteworthy. A review of literature sources shows that vitiligo, bacterial and viral diseases (including COVID-19), metabolic syndrome, asthma, atopic rhinoconjunctivitis [7], drug allergy, stomach, thyroid, liver, and prostate cancer are common among them [12]. Compared to the healthy population, rheumatic diseases, thyroid diseases, inflammatory diseases, and mental disorders are more common in these patients (2.74, 1.81, 1.57, and 1.87 times more frequent, respectively) [4].

The fact that urticaria affects the quality of life is definitely proven. A study conducted in Japan, which included almost 1,500 patients with this pathology, revealed that the average dermatological quality of life index (DLQI) was 4.8 [9]. From 10 to 70 % of patients experience problems in the field of personal care, 73-84 % - in the field of recreation and social interaction, 54-60 % in the field of mobility and 16-86 % in the field of emotional factors. About 38 % report sleep

disturbances [18].

Annual medical costs for the treatment of urticaria in the United States alone reach $244 million, of which 62.5 % are drug costs and 15.7 % are hospital costs [19].

Thus, it becomes clear that urticaria is not just a skin disease, but a pathology that significantly affects the patient's life, affecting various areas of his life [25]. Therefore, the search for markers that would allow predicting the risk of occurrence and features of the course of this disease is an important and relevant topic for research.

The purpose of the study is to build and analyze discriminative models of the possibility of occurrence and features of the course of urticaria in Ukrainian women depending on anthropometric and somatotypological indicators.

Materials and methods

On the basis of the Military Medical Clinical Center of the Central Region and the Department of Skin and Venereal Diseases with a post-graduate course at the National Pirogov Memorial Medical University, clinical-laboratory and anthropo-somatotypological (according to the schemes of V. V. Bunak [2], J. Carter and B. Heath [3], J. Matiegka [16] and the American Institute of Nutrition [21]) examination of 40 young Ukrainian women (25-44 years old according to the age periodization of WHO, 2015) with acute and chronic urticaria of a mild and severe course .Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № From 23.12.2021) found that the studies do not contradict the basic bioethical standards of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine (1977), the relevant WHO regulations and laws of Ukraine.

As a control group, the indicators of the body structure and dimensions of 101 practically healthy Ukrainian women of a similar age group were used, which were taken from the data bank of the research center of the National Pirogov Memorial Medical University.

With the help of the license package "Statistica 6.0", discriminant models of the possibility of occurrence and characteristics of the course of urticaria in Ukrainian women were built, depending on anthropometric and somatotypological indicators.

Results. Discussion

When dividing Ukrainian women into *practically healthy and patients with mild and severe acute urticaria* and chronic mild and severe urticaria, taking into account anthropometric and somatotypological indicators, the discriminant function covers 100 % of practically healthy women, 60.0 % of women with acute urticaria mild urticaria, 70.0 % of women with severe acute urticaria, 70.0 % of women with mild chronic urticaria, and 50.0 % of women with severe chronic urticaria. In general, the model that takes into account indicators of body structure and size in practically healthy and patients

Table 1. A report of a step-by-step discriminant analysis of practically healthy and patients with various forms of urticaria of different course in women depending on the features of the indicators of structure and body size.

Wilks' Lambda: 0.080 approx. F (2.47)=14.54 p<0.0000				
Discriminant variables	Wilks' Lambda	Partial Lambda	F-remove	p-level
anterior-posterior mean thoracic diameter	0.106	0.753	10.48	0.0000
skinfold thickness on crus	0.103	0.780	9.009	0.0000
thigh girth	0.144	0.557	25.45	0.0000
forearm girth in the upper part	0.105	0.767	9.719	0.0000
width of the distal epiphysis of the forearm	0.106	0.756	10.33	0.0000
width of the distal epiphysis of the crus	0.090	0.887	4.080	0.0038
skinfold thickness at the lower angle of the scapula	0.102	0.782	8.910	0.0000
skinfold thickness on the side	0.102	0.783	8.859	0.0000

with acute or chronic urticaria of a mild or severe course of Ukrainian women is correct in 89.4 % of cases.

It was established that between practically healthy and patients with various forms of mild and severe urticaria in women, the discriminating variables are anterior-posterior mean thoracic diameter, skinfold thickness on crus, under the lower angle of the scapula and on the side, girth of the thigh and forearm in the upper part, the width of the distal epiphyses of the forearm and crus (Table 1), among which the hip girth has the greatest contribution to discrimination. In general, the totality of all anthropometric and somatotypological variables has a pronounced (Wilks lambda statistic = 0.080; p<0.001) discrimination between healthy and patients with various forms of urticaria in Ukrainian women (see Table 1).

In the form of equations, the definition of the Df indicator is given, where classification as practically healthy women is possible with a Df value close to 190.2; to women with mild acute urticaria - with a Df value close to 260.4; to women with severe acute urticaria - with a Df value close to 222.4; to women with mild chronic urticaria - with a Df value close to 268.6; to women with severe chronic urticaria - with a Df value close to 239.3:

Df (*for healthy women*) = anterior-posterior mean thoracic diameter 1.248 - skinfold thickness on crus 2.152 + thigh girth 2.857 - forearm girth in the upper part 0.770 + width of the distal epiphysis of the forearm 32.67 + width of the distal epiphysis of the crus 17.38 - skinfold thickness at the lower angle of the scapula 0.900 - skinfold thickness on the side 1.248 - 190.2;

Df (*for women with mild acute urticaria*) = anterior-posterior mean thoracic diameter x 3.347 - skinfold thickness on crus x 3.651 + thigh girth x 4.303 - forearm girth in the

upper part 2.944 + width of the distal epiphysis of the forearm x 42.76 + width of the distal epiphysis of the crus x 11.16 - skinfold thickness at the lower angle of the scapula x 1.778 - skinfold thickness on the side x 1.070 - 260.4;

Df (*for women with severe acute urticaria*) = anterior-posterior mean thoracic diameter x 1.920 - skinfold thickness on crus x 3.583 + thigh girth x 3.966 - forearm girth in the upper part x 2.486 + width of the distal epiphysis of the forearm x 39.91 + width of the distal epiphysis of the crus x 13.08 - skinfold thickness at the lower angle of the scapula x 1.995 - skinfold thickness on the side x 0.591 - 222.4;

Df (*for women with mild chronic urticaria*) = anterior-posterior mean thoracic diameter x 2.740 - skinfold thickness on crus x 3.818 + thigh girth x 4.471 - forearm girth in the upper part 3.186 + width of the distal epiphysis of the forearm x 46.49 + width of the distal epiphysis of the crus x 10.61 - skinfold thickness at the lower angle of the scapula x 1.977 - skinfold thickness on the side x 0.830 - 268.6;

Df (*for women with severe chronic urticaria*) = anterior-posterior mean thoracic diameter x 1.983 - skinfold thickness on crus x 3.591 + thigh girth x 4.050 - forearm girth in the upper part x 2.353 + width of the distal epiphysis of the forearm x 42.86 + width of the distal epiphysis of the crus x 11.93 - skinfold thickness at the lower angle of the scapula x 2.174 - skinfold thickness on the side x 0.532 - 239.3;

where (here and in the following), the transverse dimensions of the body are in cm; skinfold thickness - in mm; girth body measurements - in cm; width of distal epiphyses of long tubular bones - in cm.

Using the χ^2 criterion, the statistical significance of all discriminant functions was determined (Table 2). From the results presented in Table 2, it can be seen that taking into account the parameters of body structure and size, it is possible to reliably interpret the obtained indicators of classification between healthy and sick women, as well as between women with a mild and severe course of acute urticaria.

When dividing Ukrainian women into *acute urticaria of a mild and severe course and chronic urticaria of a mild and severe course*, taking into account anthropometric and somatotypological indicators, the discriminant function covers 80.0 % of women with acute urticaria of a mild course, 40.0 % of women with severe acute urticaria, 40.0 % of women with mild chronic urticaria and 50.0 % of women with severe chronic urticaria. In general, the model that takes into account indicators of body structure and size in patients with acute or chronic urticaria of a mild or severe course in Ukrainian women is correct in 52.5 % of cases.

It was established that among women with various forms of mild and severe urticaria, the discriminating variables are the muscle component of body weight according to the formula of the American Institute of Nutrition and skinfold thickness on the forearm (Table 3), among which the greatest contribution to discrimination is made by muscle the lean component of body weight according to the formula of the American Institute of Nutrition. In general, the totality of all

Table 2. Report of a step-by-step analysis with the inclusion of the χ^2 criterion for all canonical roots in practically healthy and patients with various forms of urticaria in women, taking into account indicators of structure and body size.

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	7.709	0.941	0.080	334.4	32	0.0000
1	0.312	0.488	0.698	47.60	21	0.0008
2	0.067	0.251	0.916	11.65	12	0.4745
3	0.023	0.150	0.978	3.013	5	0.6980

anthropometric variables has an average (Wilks lambda statistic = 0.465; p<0.001) discrimination between Ukrainian women with different forms of urticaria (see Table 3).

In the form of equations, the definition of the Df indicator is given, where the assignment to women of patients with acute urticaria of a mild course is at a Df value close to 13.84; to women with severe acute urticaria - with a Df value close to 7.399; to women with mild chronic urticaria - with a Df value close to 12.11; to women with severe chronic urticaria - with a Df value close to 8.876:

Df (f*or women with mild acute urticaria*) = the muscle component of body weight according to the formula of the American Institute of Nutrition x 0.622 - skinfold thickness on the forearm x 1.162 - 13.84;

Df (*for women with severe acute urticaria*) = the muscle component of body weight according to the formula of the American Institute of Nutrition x 0.332 + skinfold thickness on the forearm x 0.377 - 7.399;

Df (*for women with mild chronic urticaria*) = the muscle component of body weight according to the formula of the American Institute of Nutrition x 0.502 - skinfold thickness on the forearm x 0.123 - 12.11;

Df (*for women with severe chronic urticaria*) = the muscle component of body weight according to the formula of the American Institute of Nutrition x 0.282 + skinfold thickness on the forearm x 1.249 - 8.876;

where, indicators of the component composition of body weight - in kg.

Using the χ^2 criterion, the statistical significance of all discriminant functions was determined (Table 4). From the results of the determined Df indicators and given in Table 4, it can be seen that, taking into account the parameters of body structure and size, a reliable interpretation of the obtained classification indicators is possible only between women with mild and severe urticaria.

Thus, in the analysis of the obtained discriminant equations, it was established that in Ukrainian women, a reliable (p<0.001) interpretation of the obtained classification indicators is possible both between practically healthy and patients with urticaria, and between women with a mild and severe course of acute urticaria (Wilks' Lambda statistic=0.080). The composition of these models includes skinfold thickness (37.5 %), girth dimensions of the body and the width of the distal epiphyses of the long tubular

Table 3. Report of a step-by-step discriminant analysis of patients with various forms of urticaria of different course in women, depending on the features of the indicators of structure and body size.

Wilks' Lambda: 0.465 approx. F (2.70)=5.44 p<0.0001				
Discriminant variables	Wilks' Lambda	Partial Lambda	F-remove	p-level
the muscle component of body weight according to the formula of the American Institute of Nutrition	0.898	0.518	10.86	0.0000
skinfold thickness on the forearm	0.713	0.653	6.206	0.0017

Table 4. Report of a step-by-step analysis with the inclusion of the χ^2 criterion for all canonical roots in patients with various forms of different courses of urticaria in women, taking into account the indicators of structure and body size.

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0.978	0.703	0.465	27.55	6	0.0001
1	0.087	0.283	0.920	3.000	2	0.2231

bones of the limbs (25.0 % each), anterior-posterior mid-sternal diameter (12.5 %). The greatest contribution to the discrimination between healthy and urticaria-afflicted women, as well as between women with mild and severe acute urticaria, is hip girth. The almost uniform entry into the discriminant models of the width of the distal epiphyses of the long tubular bones of the limbs and the transverse dimensions of the trunk, which according to literary sources [11] have a high genetic determinism, as well as the skinfold thickness and the girth dimensions of the body, which have a low genetic determinism, indicate on the uniform influence of genetic and environmental factors on the occurrence and peculiarities of the course of this multifactorial disease.

When dividing Ukrainian women only into acute and chronic urticaria of a mild and severe course, it was established that, taking into account the indicators of structure and body size, a reliable (p<0.001) interpretation of the obtained classification indicators is possible only between patients with mild and severe urticaria (statistics Wilks' Lambda=0.465). The composition of these models includes the muscle component of body weight according to the formula of the American Institute of Nutrition (makes the largest contribution to discrimination) and skinfold thickness on the forearm (50.0 % each), which, according to literary sources [11], are low genetically determined.

The presence of a deep, at first glance incomprehensible connection between human skin and other parameters of the human body is a long-proven fact [20]. The relationship between anthropometric indicators and the risks of occurrence and course of various skin diseases was established by both domestic and foreign researchers. Thus, Gunas I. and co-authors [8], when analyzing the population of children, residents of Podilia, found that boys and girls with acne, compared to the healthy population, had higher

values of muscle mass, bone mass index, the component of the mesomorphic somatotype and vice versa. lower values of body fat mass and the endomorphic component of the somatotype. At the same time, the authors did not find any differences between different groups of acne severity and anthropometric indicators.

In the study of psoriasis, another group of scientists managed to identify differences in anthropometric indicators at different degrees of severity of psoriasis. In patients with a mild course, greater values of the girth of the leg in the lower part were found compared to individuals with a severe course. Compared to healthy individuals, patients with psoriasis have higher values of shoulder girth (both in tense and relaxed state), forearm girth (both upper and lower), arm girth, hip, hip, neck, waist and chest [1]. The connection of psoriasis with suspended indicators of body weight, increased girth indicators is easy to explain, knowing the biological properties of various elements of adipokinesis in obesity. Thus, with obesity, an increase in the level of leptin is noted, which causes an increase in the processes of lipolysis, a decrease in lipogenesis; the level of adiponectin decreases, which leads to an increase in sensitivity to insulin, uptake of glucose by adipose tissue, oxidation of free fatty acids in the liver. Ultimately, all these processes are pathogenetic links that lead to psoriasis [10].

At the same time, in patients with alopecia, on the contrary, a decrease in body mass index and waist-to-hip ratio is observed compared to healthy individuals (p=0.012 and p=0.002, respectively). In addition, it was found that people with severe alopecia have significantly higher systolic and diastolic blood pressure compared to patients with mild alopecia (p <0.001) [5].

The results of an 18-month follow-up of 366 patients with purulent hidradenitis revealed that the prevalence of metabolic syndrome in this category of patients was 50.6 %, which was significantly higher than in the control group of healthy individuals - 30.2 % (p<0.001) [6]. Another disease associated with metabolic syndrome is acanthosis nigricans. This especially applies to persons with increased body weight during adolescence [17].

Low birth weight can be a marker for various diseases, including eczema. Data from a 6-year follow-up of more than 1,200 children found that low birth weight (adjusted odds ratio 5.12, 95 % CI 1.92-13.64) was independently associated with an increased risk of eczema. At the same time, the authors of the study did not find any associations with gender [23].

A Ukrainian group of researchers created discriminative models for predicting the risk of various forms of eczema, based on anthropometric indicators, which were correct from 76 % of cases (classification between healthy and sick) to 87.7% (classification between healthy and sick, and between sick and true microbial eczema). Most often, the constructed discriminant equations included the skinfold thickness and body diameters [24].

Publications related to the study of the relationship

between anthropometric indicators and the risk of occurrence or course of urticaria are few in the literature. Kim Y. S. and others [13] carried out a meta-analysis covering more than 23 million people with a follow-up period of about 5.4 years, of which almost 300 thousand developed urticaria during this period. Urticaria developed significantly more often in the elderly, women, with low values of the body mass index, waist circumference and concomitant diseases in the anamnesis (p<0.0001).

Thus, the models built in our study based on anthropometric indicators are completely consistent with the data obtained earlier by both domestic and foreign researchers regarding both urticaria and other skin diseases.

Conclusion and prospects for further developments

1. Based on indicators of body structure and size, reliable discriminative models have been developed that allow predicting with high probability the possibility of the occurrence and specifics of the course of urticaria in women with an acute form of the disease (correctness 89.4 %, Wilks' Lambda statistic=0.080; p<0.001). The built models most often include the skinfold thickness (37.5 %), girth dimensions of the body, and the width of the distal epiphyses of the long tubular bones of the limbs (25.0 % each).

2. When modeling only Ukrainian women with urticaria, reliable discriminant models were built (accuracy 52.5 %, Wilks' Lambda statistic=0.465; p<0.001) allowing to predict only the course of the disease (mild or severe). The built models include the muscle component of body weight and skinfold thickness on the forearm (50.0 % each).

In further research, on the basis of constructed discriminative models, there is an opportunity to develop a computer program that will allow doctors to carry out a prognostic assessment of whether or not patients belong to the group of increased risk of urticaria in Ukrainian women, and the features of its course depending on anthropo-somatotypological body parameters.

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МОДЕЛЮВАННЯ ЗА ДОПОМОГОЮ ДИСКРИМІНАНТНОГО АНАЛІЗУ МОЖЛИВОСТІ ВИНИКНЕННЯ ТА ОСОБЛИВОСТЕЙ ПЕРЕБІГУ РІЗНИХ ФОРМ КРОПИВ'ЯНКИ В УКРАЇНСЬКИХ ЖІНОК У ЗАЛЕЖНОСТІ ВІД ОСОБЛИВОСТЕЙ АНТРОПО-СОМАТОТИПОЛОГІЧНИХ ПОКАЗНИКІВ

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Анотація. *Передбачення ризику виникнення та перебігу будь якого захворювання є чи найважливішою і центральною темою будь якої галузі клінічної медицини. Особливо це стосується хронічних і рецидивуючих захворювань, що призводять до погіршення кості життя. Одним з таких захворювань є кропив'янка. Застосування антропометричних показників для досягнення даної цілі є економічно, патогенетично і логічно обґрунтованим вибором. Мета дослідження - побудувати та провести аналіз дискримінантних моделей можливості виникнення та особливостей перебігу кропив'янки в українських жінок у залежності від антропометричних і соматотипологічних показників. На базі Військово-медичного клінічного центру Центрального регіону та кафедри шкірних і венеричних хвороб з курсом післядипломної освіти Вінницького національного медичного університету ім. М. І. Пирогова проведено клініко-лабораторне та антропо-соматотипологічне обстеження 40 українських жінок молодого віку хворих на гостру та хронічну кропив'янку легкого і тяжкого перебігу. В якості контрольної групи використані показники будови та розмірів тіла 101 практично здорової української жінки аналогічної вікової групи, які були взяті з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М. І. Пирогова. За допомогою ліцензійного пакету "Statistica 6.0" побудовані дискримінантні моделі можливості виникнення та особливостей перебігу кропив'янки в українських жінок у залежності від антропометричних і соматотипологічних показників. В українських жінок на основі особливостей антропо-соматотипологічних показників побудовані достовірні дискримінантні моделі, які дозволяють з високою ймовірністю віднести їх до "типових" для практично здорових або хворих на кропив'янку, а також до "типових" на гостру кропив'янку легкого або тяжкого перебігу (відповідно коректність 89,4 % випадків, статистика Wilks' Lambda=0,080, p<0,001). При урахуванні показників будови та розмірів тіла між хворими на кропив'янку жінками можлива достовірна інтерпретація отриманих показників класифікації лише між легким та тяжким перебігом захворювання (відповідно коректність 52,5 % випадків, статистика Wilks' Lambda=0,465, p<0,001).*

Ключові слова: *шкірні захворювання, практично здорові та хворі на кропив'янку українськи жінки, антропометричні та соматотипологічні показники, дискримінантні моделі.*