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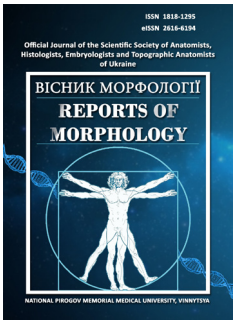

Discriminative models of the possibility of occurrence and features of the course of alopecia areata in Ukrainian men depending on the features of body structure and size indicators

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Hair loss in men is not only an aesthetic problem, but can also indicate deeper systemic changes in the body. The increase in the number of cases of such conditions requires a detailed study of the factors that influence their development and course. Researchers pay special attention to the morphofunctional characteristics of the body, which can play a prognostic role in the formation of pathological processes. This opens up prospects for a more personalized approach to the diagnosis and prevention of this pathology. The aim of the study is to build and analyze discriminant models of the possibility of occurrence and features of the course of alopecia areata in young Ukrainian men depending on the features of the structure and body size. A clinical, instrumental and anthropological examination of 81 patients with alopecia areata in young Ukrainian men was conducted. The severity of the disease was determined according to Shutsky I. V. The control group (according to anthropological indicators) consisted of 82 practically healthy young Ukrainian men, whose were taken from the data bank of the scientific research center of the National Pirogov Memorial Medical University. Discriminant models of the possibility of occurrence and features of the course of alopecia areata in dependence on the features of the structure and body size were built in the "Statistica 6.0" license package. It was established that both when dividing Ukrainian men into practically healthy and patients with alopecia areata in general, and when dividing into practically healthy and patients with alopecia areata with different degrees of severity of the disease, reliable ($p<0.001$) highly informative discriminant models of the possibility of the occurrence of this disease were constructed depending on the features of the structural indicators and body sizes (respectively, the correctness of entering the models of anthropological indicators is 100 % and 77.78 % of cases; Wilks' Lambda statistics are 0.097 and 0.098). The greatest contribution to the discrimination between practically healthy and patients with alopecia areata in general, and between practically healthy and patients with different degrees of severity of Ukrainian men is shoulder width and the width of the distal epiphysis of the tibia. It is impossible to determine the course of alopecia areata based on anthropometric body parameters. The most common differences in the constructed models include: between the practically sighted and the general group of patients – transverse dimensions of the trunk and pelvis (42.86 %) and longitudinal dimensions of the body (28.57 %); between the practically sighted and patients with alopecia areata with varying degrees of disease severity – longitudinal dimensions of the body (33.33 %).

Keywords: *skin diseases, alopecia areata, discriminant analysis, practically healthy and sick Ukrainian men, anthropometry.*

Introduction

Alopecia is a general term describing pathological hair loss from various parts of the body, most often from the scalp. There are several forms of alopecia, the most common of which are androgenetic alopecia (AGA) and alopecia

areata (AA). These conditions differ in their clinical course, pathogenesis, and impact on the quality of life of patients [9, 21].

The classification of alopecia is based on etiological and clinical features. The main forms are: AGA, AA, telogen effluvium and anagen alopecia, as well as traction, cicatricial, and other rare forms. Androgenic alopecia is the most common type of hair loss and is observed in both men and women. Alopecia areata, on the other hand, is autoimmune in nature and is manifested by the formation of clearly defined bald patches on the scalp or body [8, 9, 10].

The pathogenesis of alopecia depends on its form. In the development of androgenic alopecia, the action of dihydrotestosterone plays a key role, causing miniaturization of hair follicles, shortening of the anagen phase and lengthening of the telogen phase, which leads to gradual thinning and hair loss [10]. Alopecia areata, on the other hand, is an autoimmune disease in which T lymphocytes attack hair follicles, disrupting their normal function. This process occurs against the background of genetic predisposition, trigger factors (stress, infections, injuries) and impaired immune tolerance [20].

Epidemiological studies demonstrate a significant prevalence of alopecia in the general population. A large national survey in Japan reported a prevalence of 2.18 % for all age groups, with a peak at 30-39 years of age [2]. A similar population-based study in the United States estimated the prevalence of alopecia areata at 0.21 % of the general population, with slightly higher rates in women (0.24 %) than in men (0.18 %) [3]. Studies based on electronic medical records of children in the United States report an annual prevalence of alopecia areata in the pediatric population of 0.11 % to 0.14 % [16]. Another large study of insured adults and children in the United States reported an overall prevalence of 0.25 % for alopecia areata, 0.02 % for alopecia totalis, and 0.01 % for alopecia universalis [18, 26].

Global epidemiological data also show regional variation in prevalence. For example, a global analysis found that the highest incidence rates of alopecia areata were observed in high-income countries, particularly North America and Western Europe, while rates were lower in low-income countries, likely due to under-representation and limited access to dermatological care [27].

Androgenic alopecia is also highly prevalent: in a study in Turkey, 47.6 % of men and 19.2 % of women presenting to a dermatological clinic had clinical signs of AGA [22]. This high incidence, especially in men, is associated with a genetically determined hypersensitivity of hair follicles to androgens. Because the disease is progressive and chronic, it significantly affects the psychoemotional state of patients, reducing their quality of life [9, 21].

It is also worth noting that alopecia, regardless of the type, has a significant psychosocial impact, especially in women. Patients often suffer from depression, anxiety, social isolation and reduced self-esteem [6, 21]. The quality of life in alopecia areata is often compared to other chronic dermatological diseases, such as psoriasis or atopic dermatitis [8, 21]. Thus, alopecia is a multifactorial disease with different clinical forms and a complex pathogenesis. Its significant prevalence in the world, the impact on the quality of life and emotional health of patients make it an important problem in dermatological practice and the object of active scientific study.

The purpose of the study – to build and analyze discriminant models of the possibility of occurrence and features of the course of alopecia areata in young Ukrainian men depending on the features of the structure and size of the body.

Materials and methods

Clinical-instrumental and anthropo-somatotypological (in accordance with the recommendations of Shaparenko P. P. [23]) examination, based on voluntary informed consent, of 81 patients with alopecia areata, young Ukrainian men (25-44 years old according to the WHO age periodization, 2015) was conducted at the Military Medical Clinical Center of the Central Region and the Department of Skin and Venereal Diseases with a postgraduate course of the National Pirogov Memorial Medical University, Vinnytsya. Committee on Bioethics of National Pirogov Memorial Medical University, Vinnytsya (protocol № 4 From 18.03.2023) 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.

The diagnosis of alopecia areata was made using the ARAMO ASW 300 dermatoscope-trichoscope (Korea), which allows assessing the density, thickness of the hair, the condition of the cuticle, keratin and capillary vessels of the scalp. The severity of the disease was determined according to Shutsky I. V. [15]: I degree – single lesions with a diameter of 3-5 cm; II degree – lesions with a diameter of 5-10 cm; III degree – subtotal alopecia; IV degree – total alopecia. The following distribution of sick men was established: I degree – 35 men; II degree – 33 men; III degree – 12 men; IV degree – 1 man.

As a control group, anthropological and somatotypological body parameters of 82 practically healthy Ukrainian men of a similar age group were used, which were taken from the data bank of the National Pirogov Memorial Medical University, Vinnytsya Research Center.

The construction of discriminant models of the possibility of occurrence and features of the course of alopecia areata in relation to the features of the structure and size of the body was carried out in the “Statistica 6.0” license package.

Results

It was found that when dividing the general group of Ukrainian men into practically healthy and patients with alopecia areata, taking into account anthropometric body parameters, the classification matrix covers 100 % of cases. Between practically healthy and patients with alopecia areata, the discriminant variables are shoulder width (ACR), body

weight (W), width of the distal epiphysis of the tibia (EPG_R), height of the trochanteric anthropometric point (ATV), height of the acromial anthropometric point (ATPL), transverse lower thoracic diameter (PNG) and intertrochanteric distance (TROCH), among which the width of the distal epiphysis of the tibia and shoulder width have the greatest contribution to discrimination (Table 1). The set of identified anthropometric variables has a pronounced reliable discrimination (Wilks' Lambda statistic=0.097; p<0.001) between practically healthy and the general group of patients with alopecia areata in men (see Table 1).

Table 1. Report of a step-by-step discriminant analysis of practically healthy and the general group of patients with alopecia areata of Ukrainian men depending on the characteristics of anthropometric body parameters.

Discriminant Function Analysis Summary (schakatira.sta)						
Step 7, N of vars in model: 7; Grouping: DZ (2 grps)						
Wilks' Lambda: 0.097 approx. F(7.16)=207.2 p<0,0000						
	Wilks' Lambda	Partial Lambda	F-remove -1.155	p-level	Toler.	1-Toler. (R-Sqr.)
ACR	0.129	0.749	51.96	0.0000	0.637	0.363
W	0.108	0.894	18.38	0.0000	0.344	0.656
EPG_R	0.131	0.735	55.90	0.0000	0.810	0.190
ATV	0.117	0.822	33.48	0.0000	0.469	0.531
ATPL	0.119	0.812	35.78	0.0000	0.500	0.500
PNG	0.107	0.899	17.51	0.0000	0.478	0.522
TROCH	0.105	0.916	14.30	0.0002	0.500	0.500

Notes: in this and subsequent similar tables, Wilks' Lambda – Wilks' Lambda statistic; Partial Lambda – Wilks' Lambda statistic of the single contribution of the variable to the discrimination between populations; F-remove – standard F-criterion associated with the corresponding Partial Lambda; p-level – p-level associated with the corresponding F-remove; Toler. – tolerance (measure of redundancy of the feature); 1-Toler. (R-Sqr.) – coefficient of multiple correlation of the feature with all other features (necessary for calculating tolerance).

The determined classification indicators (Df) allow us to attribute the obtained anthropometric indicators to "typical" ones, to the group of practically healthy (with a Df value close to 608.5) or to the general group of patients with alopecia areata (with a Df value close to 531.2) of Ukrainian men:

– Df (for practically healthy men)= ACR×9.170 - W×2.640 + EPG_R×25.24 - ATV×0.034 + ATPL×2.516 + PNG×4.483 + TROCH×10.96 - 608.5;

– Df (for the general group of patients with male alopecia areata)= ACR×7.541 - W×2.383 + EPG_R×18.78 - ATV×0.799 + ATPL×3.087 + PNG×5.762 + TROCH×9.637 - 531.2;

where (here and hereinafter), transverse dimensions of the trunk – in cm; body weight – in kg; width of the distal epiphyses of the long tubular bones of the limbs – in cm; longitudinal dimensions of the body – in cm; dimensions of the pelvis – in cm.

The calculated χ^2 criterion with the removal of consecutive roots confirms the statistical significance of both discriminant functions (Table 2).

Table 2. Step-by-step analysis report with the inclusion of the χ^2 criterion for practically healthy and the general group of patients with alopecia areata of Ukrainian men.

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	9.356	0.950	0.097	368.2	7	0.0000

Notes: in this and subsequent similar tables, Eigenvalue – root values for each discriminant function; Canonicl R – canonical R value for different roots; Wilks' Lambda – Wilks' Lambda statistic; Chi-Sqr. – standard χ^2 test of consecutive roots; Df – number of degrees of freedom; p-level – p-level is associated with the corresponding χ^2.

When dividing Ukrainian men into practically healthy and patients with alopecia areata by the severity of the disease, taking into account body structure and size indicators, the classification matrix covers 100 % of practically healthy men, 74.29 % of patients with stage I alopecia, 48.48 % of patients with stage II alopecia, and 16.67 % of patients with stage III alopecia. In general, the classification matrix correctly covers 77.78 % of cases. Between practically healthy men with alopecia areata of I, II and III degrees of severity of the disease, the discriminating variables are shoulder width (ACR), body surface area (S), width of the distal epiphysis of the tibia (EPG_R), height of the acromial anthropometric point (ATV), height of the acromial anthropometric point (ATPL) and skinfold thickness on the chest (GGR), among which the greatest contribution to discrimination is made by shoulder width and width of the distal epiphysis of the tibia (Table 3). The set of identified anthropometric variables has a pronounced reliable discrimination (Wilks' Lambda statistic = 0.098; p<0.001) between practically healthy men and groups of patients with alopecia areata of various degrees of severity (see Table 3).

Table 3. Report of a step-by-step discriminant analysis of practically healthy and patients with alopecia areata of I, II and III degree of severity in Ukrainian men depending on the characteristics of anthropometric body parameters.

Discriminant Function Analysis Summary (schakatira.sta)						
Step 6, N of vars in model: 6; Grouping: DZ_ST_SC (4 grps)						
Wilks' Lambda: 0.098 approx. F(18.43)=30.66 p<0.0000						
	Wilks' Lambda	Partial Lambda	F-remove -3,153	p-level	Toler.	1-Toler. (R-Sqr.)
ACR	0.129	0.757	16.33	0.0000	0.665	0.335
S	0.115	0.849	9.052	0.0000	0.483	0.517
EPG_R	0.126	0.779	14.45	0.0000	0.872	0.128
ATV	0.120	0.815	11.60	0.0000	0.463	0.537
ATPL	0.111	0.880	6.960	0.0002	0.452	0.548
GGR	0.109	0.901	5.608	0.0011	0.848	0.152

The determined classification indicators (Df) allow us to attribute the obtained anthropometric indicators to "typical"

groups of practically healthy (with a Df value close to 406.5), patients with alopecia areata of the first degree of severity (with a Df value close to 355.2), patients with alopecia areata of the second degree of severity (with a Df value close to 361.2) and patients with alopecia areata of the third degree of severity (with a Df value close to 555.0) of Ukrainian men:

– Df (for practically healthy men)= ACR×6.934 - S×88.30 + EPG_R×22.66 + ATV×0.437 + ATPL×3.157 + GGR×3.721 - 406.5;

– Df (for patients with alopecia areata grade I in men)= ACR×5.507 - S×73.10 + EPG_R×17.48 - ATV×0.298 + ATPL×3.599 + GGR×4.771 - 355.2;

– Df (for patients with alopecia areata grade II in men)= ACR×5.469 - S×70.76 + EPG_R×17.46 - ATV×0.298 + ATPL×3.605 + GGR×4.979 - 361.2;

– Df (for patients with alopecia areata grade III in men)= ACR×5.279 - S×65.45 + EPG_R×16.56 - ATV×0.277 + ATPL×3.558 + GGR×4.912 - 355.0;

where, body surface area – in m^2; thickness of skin-fat folds – in mm.

The calculated χ^2 criterion with removal of consecutive roots confirms statistical significance only between the group of practically healthy and groups of patients with alopecia areata of various degrees of severity in men (Table 4).

Table 4. Step-by-step analysis report with the inclusion of the χ^2 criterion for practically healthy and groups of patients with alopecia areata of various severity in Ukrainian men.

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	8.558	0.946	0.098	362.5	18	0.0000
1	0.055	0.227	0.936	10.34	10	0.4109
2	0.013	0.115	0.987	2.060	4	0.7248

Discussion

Thus, when dividing Ukrainian men by anthropometric indicators into practically healthy and the general group of patients with alopecia areata, when analyzing discriminant equations, a reliable pronounced discrimination (Wilks' Lambda=0.097, p<0.001) of the obtained classification indicators (Df) was established. The structure of the constructed models between practically healthy and the general group of patients with alopecia areata men includes: trunk diameters (28.57 %), height of anthropometric points (28.57 %), intertrochanteric distance (14.29 %), width of the distal epiphysis of the tibia (14.29 %) and body weight (14.29 %). The greatest contribution to the discrimination between practically healthy and the general group of patients with alopecia areata of Ukrainian men is the width of the distal epiphysis of the tibia and the width of the shoulders.

When dividing Ukrainian men into practically healthy and patients with alopecia areata with different degrees of severity, the analysis of discriminant equations also established a reliable pronounced discrimination (Wilks' Lambda=0.098, p<0.001) of the obtained classification indicators (Df). However, according to the results of stepwise analysis with the inclusion of the χ^2 criterion, the course of this disease based on anthropometric body parameters does not have reliable differences. The built models between practically healthy and patients with alopecia areata with different degrees of severity include: height of anthropometric points (33.33 %), shoulder width (16.67 %), width of the distal epiphysis of the tibia (16.67 %), body surface area (16.67 %) and skinfold thickness on the chest (16.67 %). The greatest contribution to the discrimination between practically healthy and patients with alopecia areata of varying severity in Ukrainian men is shoulder width and the width of the distal epiphysis of the tibia.

The significantly higher percentages of entry into discriminant models between practically healthy and the general group of patients with alopecia areata of Ukrainian men of transverse and longitudinal body dimensions (85.71 % of all anthropometric variables) established by us, as well as the higher percentage of entry into discriminant models between practically sighted and patients with alopecia areata of varying severity in Ukrainian men of longitudinal and transverse body dimensions (66.67 % of all anthropometric variables), indicate, according to literature sources [7], a predominant genetic predisposition to the occurrence of this multifactorial disease.

Somatic features, such as body composition components, anthropometric indicators, gender and ethnicity, are increasingly considered as predictors or modifiers of the course of dermatological diseases, including alopecia. The variability of these factors among populations of different regions necessitates an in-depth analysis of their influence on the risk of occurrence and course of various forms of hair loss.

According to the study by Mishalov V. et al. [17], in Ukraine there is a significant demographic variability of somatotypes among men depending on the region of residence, which may have clinical significance for assessing the risks of developing skin diseases, in particular alopecia. In patients with urticaria, significant differences in skin fold thickness by gender were found – in men it was significantly smaller compared to women (p<0.01), which indicates the potential role of adipose tissue in the pathogenesis of immune-dependent dermatoses [1].

In the context of alopecia, especially androgenetic, the relationship with anthropometric indicators has been significantly confirmed. In the study by Colgecen E. et al. [4], it was found that epicardial adipose tissue (as an indicator of visceral obesity) is positively correlated with the severity of androgenetic alopecia in men (r=0.62; p<0.001), indicating a systemic metabolic interaction between fat metabolism and follicular activity. M. Danesh-Shakiba and colleagues [5] found a statistically significant association between body mass index (BMI) and androgenetic alopecia (p=0.04), and also noted the influence of lifestyle, in particular physical inactivity and dietary habits, on the risk of developing this pathology.

A meta-analysis by Yueqi Q. I. U. et al. [29] confirmed a significant association between metabolic syndrome (MS) and androgenetic alopecia: the risk of developing alopecia in individuals with MS increased by 1.62 times (95 % CI: 1.33-1.98). Similar findings were presented in the study by Ozbas Gok S. et al. [19], which found an increased incidence of MS in patients with androgenetic alopecia (45 % vs. 18 % in the control group; p<0.05). Also, Sheikh F. Z. [24] et al. demonstrated that early onset of alopecia (before age 35) was associated with a higher prevalence of MS (p=0.001).

Regarding alopecia areata, Lee Y. B. and Lee W. S. [12] found that patients with a BMI>25 had a higher prevalence of severe MS compared to those with a normal BMI (p=0.038). Similar results were reported by Wróblewska-Kończalik K. et al. [28], who found a positive association between BMI, body mass index, and decreased ferritin in 74 patients with non-scarring alopecia.

A comparison of dermatoses shows that the association between obesity and skin diseases is not unique to alopecia. For example, Snast I. et al. [25], in a sample of over 600,000 In adolescents, obesity was associated with an increased risk of acne (OR=1.25; 95 % CI: 1.22-1.28). At the same time, Lu L. et al. [13] in Chinese young people established a similar association (p<0.05), while another study in Taiwan, on the contrary, found an inverse relationship between BMI and the number of affected foci in postpubertal acne in women (p=0.03) [14], which indicates the complex, heterogeneous nature of such relationships depending on population characteristics.

Taking into account the ethnic factor is also important. As demonstrated by the experience of studies in Ukraine, differences between regional groups of men are manifested not only in gender and age anthropometric characteristics, but also in body types, which determines a different degree of susceptibility to somatic and dermatological diseases [17]. These ethno-constitutional features may be important for the formation of nationally adapted preventive programs and risk stratification in clinical practice.

Thus, the totality of modern data confirms the presence of a reliable relationship between anthropometric indicators (in particular, BMI, distribution of adipose tissue), gender, ethnic characteristics and the risk and severity of both alopecia and other skin diseases [11]. In the future, an important area of research should be the standardization of anthropometric assessments in the context of dermatological diseases and the introduction of such criteria into clinical practice for personalized diagnosis and prevention.

Conclusions

1. Based on the features of anthropometric body parameters, reliable discriminant models have been developed that allow predicting with high probability the possibility of alopecia areata occurrence in young Ukrainian men (the classification matrix covers 100 % of cases, Wilks' Lambda statistics=0.097, p<0.001). Taking into account the results of the step-by-step analysis with the inclusion of the χ^2 criterion, the course of this disease based on anthropometric body parameters does not have reliable differences – only reliable discrimination is possible between the group of practically healthy and groups of men with alopecia areata of various degrees of severity (the classification matrix covers 77.78 % of cases, Wilks' Lambda statistics=0.098, p<0.001).

2. The constructed models between practically sighted and the general group of patients with alopecia areata of Ukrainian men most often include transverse dimensions of the trunk and pelvis (42.86 %) and longitudinal dimensions of the body (28.57 %); and between practically sighted and patients with alopecia areata of varying severity of the disease Ukrainian men – longitudinal dimensions of the body (33.33 %).

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ДИСКРИМІНАНТНІ МОДЕЛІ МОЖЛИВОСТІ ВИНИКНЕННЯ ТА ОСОБЛИВОСТЕЙ ПЕРЕБІГУ ГНІЗДОВОЇ АЛОПЕЦІЇ В УКРАЇНСЬКИХ ЧОЛОВІКІВ У ЗАЛЕЖНОСТІ ВІД ОСОБЛИВОСТЕЙ ПОКАЗНИКІВ БУДОВИ ТА РОЗМІРІВ ТІЛА

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Порушення волосяного покриву у чоловіків є не лише естетичною проблемою, але й може вказувати на глибші системні зміни в організмі. Зростання кількості випадків таких станів вимагає детального вивчення факторів, що впливають на їх розвиток та перебіг. Особливу увагу дослідники приділяють морфофункціональним характеристикам організму, які можуть відігравати прогностичну роль у формуванні патологічних процесів. Це відкриває перспективи для більш персоналізованого підходу в діагностиці та профілактиці цієї патології. Мета дослідження – побудувати та провести аналіз дискримінантних моделей можливості виникнення та особливостей перебігу гніздової алопеції в українських чоловіків молодого віку в залежності від особливостей будови та розмірів тіла. Проведено клініко-інструментальне та антропологічне обстеження 81 хворих на гніздову алопецію українських чоловіків молодого віку. Тяжкість захворювання визначали за Шуцьким І. В. Контрольну групу (за антропологічними показниками) складали 82 практично здорових українських чоловіків молодого віку, дані яких були взяті з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М. І. Пирогова. Дискримінантні моделі можливості виникнення та особливостей перебігу

гніздової алопеції в залежності від особливостей будови та розмірів тіла побудовані у ліцензійному пакеті «Statistica 6.0». Як при розподілі українських чоловіків на практично здорових і хворих на гніздову алопецію загалом, так і при розподілі на практично здорових і хворих на гніздову алопецію з різним ступенем тяжкості захворювання побудовані достовірні (p<0,001) високоінформативні дискримінантні моделі можливості виникнення даного захворювання в залежності від особливостей показників будови та розмірів тіла (відповідно коректність входження до моделей антропологічних показників складає 100 % і 77,78 % випадків; статистика Wilks' Lambda дорівнює 0,097 і 0,098). Найбільший внесок у дискримінацію як між практично здоровими та хворими на гніздову алопецію загалом, так і між практично здоровими та хворими з різним ступенем тяжкості українськими чоловіками мають ширина плечей та ширина дистального епіфіза гомілки. Перебіг гніздової алопеції на основі антропометричних параметрів тіла визначити неможливо. Найбільш часто до складу побудованих моделей входять: між практично здоровими та загальною групою хворих – поперечні розміри тулуба й таза (42,86 %) та поздовжні розміри тіла (28,57 %); між практично здоровими та хворими на гніздову алопецію з різним ступенем тяжкості захворювання – поздовжні розміри тіла (33,33 %).

Ключові слова: *шкірні захворювання, гніздова алопеція, дискримінантний аналіз, практично здорові та хворі українськи чоловіки, антропометрія.*

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