Modeling the possibility of occurrence of overactive bladder in women of different ages, depending on anthro-po-somatotypological indicators or hormonal background with the help of discriminant analysis

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One of the important problems of modern urology is the improvement of the treatment-diagnostic algorithm and prevention of overactive bladder syndrome (OAB). The purpose of the work is to construct and analyze discriminant models of the possibility of OAB occurrence in pregnant women of different age groups depending on the characteristics of anthro-po-somatotypological indicators or hormonal background. 75 pregnant women with clinical signs of OAB syndrome and 60 healthy pregnant women had hormonal screening in the 1st and 3rd trimester of pregnancy and at 16 weeks postpartum using radioimmunoassay and immune enzyme methods (estradiol, progesterone, thyroid stimulating hormone and testosterone levels were determined). The anthropometry was carried out according to the method of V. V. Bunak, the components of the somatotype were determined according to the method of J. Carter and B. Heath, as well as the components of the body composition according to the method of J. Matiegka and the American Institute of Nutrition (AIN). By age, all pregnant women were divided into 3 subgroups: I - from 17 to 25 years, II - from 26 to 35 years, III - from 36 to 41 years. A discriminant analysis of the possibility of OAB occurrence, depending on the anthropo-somatotypological or hormonal indices in women of different age groups, was conducted using the licensing program "Statistica 5.5". When taken into account anthropo-somatotypological indices in women aged from 17 to 25 years, the model is correct in 86.7% of cases; in women aged from 26 to 35 years - in 90.9% of cases; in women between the ages of 36 and 41 years - in 89.3% of cases. Between healthy and OAB patients, women aged from 17 to 25 years discriminating variables are the width of the distal epiphysis of the shoulder (which has the greatest contribution to discrimination), conjugate externa, the muscle component of the body weight by AIN and the forearm's girth in the upper third; women from 26 to 35 years - dist. Interrochondralis, the width of the distal epiphyses of the forearm (the greatest contribution to discrimination), hip circumference, conjugate externa, mesomorphic component of the somatotype according to Heath-Carter, fat mass component of the body by Matiegka, the forearm's girth in the upper third and the shoulder girth; women of age from 36 to 41 years - the width of the distal epiphysis of the leg (which has the greatest contribution to discrimination) and the length of the body. In general, the aggregate of all variables has a low level of discrimination between healthy and sick with OAB women between the ages of 17 and 25 (Wilkes Lambda statistics = 0.531; F = 5.521; p <0.01) and 36-41 years (Wilkes Lambda statistics = 0.445; F = 15.62; p <0.001), while among women between the ages of 26 and 35 - the average level of discrimination (Wilkes Lambda statistics = 0.386; F = 13.52; p <0.001). When taken into account characteristics of the hormonal background in women of all ages, the model is correct in 100% of cases. Between healthy and OAB patients, of 17-25 years age, discriminant variables are estradiol levels at 16 weeks of postpartum (with the largest contribution to discrimination) and prolactin levels in the first trimester of pregnancy; women aged from 26 to 35 years - estradiol levels at 16 weeks of postpartum.
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Introduction

One of the components of functional disorders of urination and the most important problems of modern urology is overactive bladder syndrome (OAB) [6, 17, 21]. Being among the dozens of the most common diseases, OAB over the frequency Ahead of diseases such as diabetes mellitus, stomach ulcer and duodenal ulcer [2, 5]. In the analysis of literature data on the impact of specific pathological conditions and diseases on social activity and self-esteem, disorders of urination and, in particular, OAB, worsen the quality of life of patients more than arterial hypertension, atherosclerosis and diabetes [7], having a comprehensive impact on the labor, social and sexual life and health of patients [1, 29]. The prevalence among the population, the severity of the course and the socially-disadaptive nature of functional disorders on the part of the urinary tract determine the relevance of further studies of OAB in order to improve its diagnostic and therapeutic algorithm, since every fourth woman in the world after 30 years marks the symptoms of incontinence, including in Ukraine [10, 16].

Most authors consider pregnancy and childbirth to be the leading risk factors that contribute to the development of symptoms of urination [13, 18, 23-25, 28]. Statistically significant risk factors are the age of a woman, the number and quality of previous births, the weight of the newborn, as well as the body mass index [15, 19, 22, 27].

Insufficient effectiveness of methods of conservative treatment of urination disorders in pregnant women and the impossibility of operative correction of urinary incontinence for women after childbirth and contraindications to the use of any medical treatment during pregnancy, make it particularly relevant to improve the early prevention of OAB in pregnant women.

The purpose of the work is to construct and analyze discriminant models of the possibility of OAB occurrence in pregnant women of different age groups depending on the characteristics of anthropo-somatotropical indicators or hormonal background.

Materials and methods

75 pregnant women with clinical signs of OAB syndrome were selected at the bases of the Vinnytsia Clinical Maternity Hospital No. 1 and the Municipal Hospital "Mother and Child Center" for the period 2015-2017. The control group consisted of 60 practically healthy pregnant women who were registered in pregnancy in the women's consultation of these medical institutions. The criteria for inclusion in the group with OAB were: fertile age; pregnancy and lactation; presence of symptoms OAB - urinary frequency (more than 8 times a day), urgency (more than 3 per day), nocturia (more than 1 time per night) for more than 3 months; the presence in the patient of urgent urges for urination with or without urinary incontinence (grade 3 or 4) within 3 days according to the diary of the urinary tract; volume of residual urine more than 30 ml. All patients were consulted by a urologist and gynecologist to exclude patients with a profile somatic pathology that could cause the OAB symptom complex.

Bioethics Committee of National Pirogov Memorial Medical University, Vinnytsya (protocol from 16.11.2016) found that the research conducted corresponded to the ethical and moral-legal requirements of the Order of the Ministry of Health of Ukraine No. 281 of November 1, 2000.

By age, all pregnant women were divided into 3 subgroups: I - from 17 to 25 years, II - from 26 to 35 years, III - from 36 to 41 years.

Laboratory examination of pregnant women included hormonal screening in the 1st and 3rd trimesters of pregnancy and at 16 weeks of postpartum using radioimmunoanalytical and enzyme immunoassay methods. Blood levels were determined for estradiol, progesterone, thyroid stimulating hormone and testosterone.

Anthropometry was carried out according to the method of V. V. Burak [3]. The components of the somatotype were determined according to the method of J. Carter and B. Heath [6], and the components of the body mass composition by the methods of J. Matygeka [12] and the
American Institute of Nutrition (AIN) [20].

A discriminant analysis of the possibility of OAB occurrence, depending on the anthropo-somatotopological or hormonal indices in women of different age groups, was conducted using Statistics program 5.5 of Statsoft Company (license number AXXR910A374805FA).

**Results**

When taken into account anthropo-somatotopological indicators, the discriminatory function covers 55.6% of patients with OAB and 100% healthy women between the ages of 17 and 25 years. In general, the model is correct in 86.7% of cases. Between healthy and OAB patients women in the ages of 17-25, the discriminating variables are the width of the distal shoulder epiphysis, conjugata externa, the muscle component of the body weight by AIN and the forearm's girth in the upper third. The greatest contribution to discrimination between healthy and sick OAB women aged from 17 to 25 years makes the size of the width of the distal epiphysis of the shoulder. In general, the totality of all variables has a low level of discrimination (Wilkes Lambda statistics = 0.531; F = 5.521; p <0.01) between healthy and sick with OAB women between the ages of 17 and 25 years. The definition of the classification index (Df) is given in the form of equations, where the classification of patients with OAB women between the ages of 17 and 25 years is possible at a value of Df close to 222.4, and to healthy women between the ages of 17 and 25 years, at a value of Df close to 228.3:

\[ D_f \text{ (for patients with } OAB \text{ women aged from 17 to 25 years)} = \text{width of the distal epiphysis of the shoulder } \times 4.130 + \text{conjugata externa } \times 15.93 - \text{muscle mass component of the body for } AIN \times 0.154 + \text{forearm girth in the upper third } \times 5.802 - 222.4; \]

\[ D_f \text{ (for healthy women between the ages of 17 and 25)} = \text{width of the distal epiphysis of the shoulder } \times 2.115 + \text{conjugata externa } \times 17.31 + \text{muscle component of the body weight for } AIN \times 0.252 + \text{forearm circumference in the upper third } \times 5.208 - 228.3; \]

where (here and in the future), the width of distal epiphyses of long tubular limb bones - in cm; the size of the pelvis - in cm; indicators of the body weight composition - in kg; girth dimensions of the body - in cm.

When taken into account anthropo-somatotopological indicators, the discriminatory function covers 95.9% of patients with OAB and 82.1% of healthy women aged from 26 to 35 years. In general, the model is correct in 90.9% of cases. Between healthy and sick with OAB women between the ages of 26 and 35 discriminatory variables are dist. Intertrochanterica, hip circumference, conjugata externa, mesomorphic component of the somatotype by Heath-Carter, width of the distal epiphysis of the forearm, fat mass of the body mass behind Matiegka, upper arm circumference and shoulder girth. The largest contribution to discrimination between healthy and sick OAB women between the ages of 26 and 35 make dist. Intertrochanterica and width of the distal epiphysis of the forearm. In general, the aggregate of all variables has an average level of discrimination (Wilkes Lambda statistics = 0.386; F = 13.52; p <0.001) among healthy and sick OAB women aged from 26 to 35 years. The classification indices (Df) for different groups of women, depending on the characteristics of anthropo-somatotopological indicators, have the form of the following equations:

\[ D_f \text{ (for OAB patients women aged from 26 to 35 years)} = \text{dist. Intertrochanterica } \times 111.5 - \text{hip circumference } \times 0.553 - \text{conjugata externa } \times 11.02 - \text{mesomorphic component of the somatotype according to Heath-Carter } \times 2.967 - \text{width of the distal epiphysis of the forearm } \times 8.813 + \text{fat mass of the body by Matiegka } \times 1.643 - \text{upper arm circumference } \times 4.591 + \text{shoulder girth } \times 5.003 - 1558; \]

\[ D_f \text{ (for healthy women between the ages of 26 and 35)} = \text{dist. Intertrochanterica } \times 115.2 - \text{hip circumference } \times 0.720 - \text{conjugata externa } \times 11.90 - \text{mesomorphic component of Heath-Carter } \times 2.496 - \text{width of the distal epiphysis of the forearm } \times 14.51 + \text{fat component on Matiegka } \times 3.005 - \text{ forearm circumference in the upper third } \times 5.241 + \text{shoulder girth } \times 5.417 - 1625; \]

where (here and in the future), components of the somatotype - in points.

When considering anthropo-somatotopological indicators, the discriminatory function covers 100% of patients with OAB and 72.7% of healthy women between the ages of 36 and 41 years. In general, the model is correct in 89.3% of cases. Between healthy and OAB patients 36-41-year-old women discriminating variables are the width of distal epiphysis of the shin and body length. The greatest contribution to discrimination between healthy and sick with OAB women aged from 36 to 41 years is the size of the width of the distal epiphysis of the shin. In general, the totality of all variables has a low level of discrimination (Wilkes Lambda statistics = 0.445; F = 15.62; p <0.001) among healthy and sick with OAB women aged from 36 to 41 years. The classification indices (Df) for different groups of women, depending on the characteristics of anthropo-somatotopological indicators, have the form of the following equations:

\[ D_f \text{ (for patients with OAB, women aged from 26 to 35 years)} = \text{width of the distal foot of the epiphysis } \times 2.084 + \text{body length } \times 4.667 - 398.2; \]

\[ D_f \text{ (for healthy women between in ages of 26-35)} = \text{width of the distal epiphysis of the leg } \times 1.005 + \text{body length } \times 4.926 - 421.6; \]

where, the longitudinal dimensions of the body - in cm.

In determining the significance of discriminatory functions with the help of criterion 72, it was established that a reliable interpretation of the classification indices obtained between healthy and sick on OAB women of different age groups is possible, depending on the characteristics of anthropo-somatotopological indicators.

With regard to the features of the hormonal background, the discriminatory function covers 100% of patients with OAB and 100% healthy women between the ages of 17
and 25 years. Between healthy and OAB patients in the 17-25 age group discriminant variables are the level of estradiol at 16 weeks postpartum and the level of prolactin in the first trimester of pregnancy. The greatest contribution to discrimination between healthy and sick with OAB in women aged from 17 to 25 years has the value of estradiol at 16 weeks of postpartum. In general, the totality of all variables has a low level of discrimination (Wilks Lambda statistics = 0.619; F = 131.4; p <0.001) among healthy and sick with OAB in women between the ages of 17 and 25 years. The classification (Df) for different groups of women, depending on the characteristics of the indicators of the hormonal background, the form of the following equations:

$$Df (for \ women \ with \ OAB \ in \ age \ 17-25 \ years) = \text{estradiol in 16 weeks of postpartum period} \times 0.023 + \text{prolactin in the first trimester of pregnancy} \times 0.574 - 56.43;$$

$$Df (for \ healthy \ women \ between \ the \ ages \ of \ 17 \ and \ 25) = \text{estradiol at 16 weeks of postpartum period} \times 0.030 + \text{prolactin in the first trimester of pregnancy} \times 0.303 - 12.97;$$

where (here and thereafter), estradiol - in pg/ml; prolactin - in ng/ml.

When considering the indicators of the hormonal background, the discriminatory function covers 100% of patients with OAB and 100% healthy women between the ages of 26 and 35 years. Between healthy and OAB patients women aged from 26 to 35 years, discriminant variables are estradiol levels at 16 weeks postpartum, testosterone in the third trimester of pregnancy, estradiol in the third trimester of pregnancy, prolactin in the third trimester of pregnancy, estradiol in the first trimester of pregnancy, and testosterone levels in the first trimester of pregnancy. The greatest contribution to discrimination between healthy and sick OAB women aged from 26 to 35 years has the value of estradiol at 16 weeks of postpartum period. In the whole, the totality of all variables has a low level of discrimination (Wilks Lambda statistics = 0.493; F = 224.9; p <0.001) among healthy and sick OAB women aged from 26 to 35 years. Classification indicators (Df) for different groups of pregnant women, depending on the characteristics of the hormonal background, look like the following equations:

$$Df (for \ patients \ with \ OAB \ women \ aged \ from \ 26 \ to \ 35 \ years) = \text{estradiol at 16 weeks postpartum period} \times 0.056 + \text{testosterone in the third trimester of pregnancy} \times 23.07 + \text{estradiol in the third trimester of pregnancy} \times 0.005 + \text{prolactin in the third trimester of pregnancy} \times 0.242 - \text{estradiol in the first trimester of pregnancy} \times 0.002 + \text{testosterone in the first trimester of pregnancy} \times 1.057 -103.7;$$

$$Df (for \ healthy \ women \ aged \ from \ 26 \ to \ 35 \ years) = \text{estradiol at 16 weeks postpartum period} \times 0.312 - \text{testosterone in the third trimester of pregnancy} \times 17.83 + \text{estradiol in the third trimester of pregnancy} \times 0.008 + \text{prolactin in the third trimester of pregnancy} \times 0.171 + \text{estradiol in the first trimester of pregnancy} \times 0.002 + \text{testosterone in the first trimester of pregnancy} \times 28.65 - 134.3;$$

where (here and in the future), testosterone - nmoll.

With regard to the indicators of the hormonal background, the discriminatory function covers 100% of patients with OAB and 100% healthy pregnant women aged from 36 to 41 years. Among healthy and sick with OAB women between the ages of 26 and 35 discriminant variables in the third trimester are estradiol and estradiol at 16 weeks of postpartum. The greatest contribution to discrimination between healthy and sick OAB in women aged from 36 to 41 years has the value of estradiol in the third trimester of pregnancy. In general, the aggregate of all variables has an average level of discrimination (Wilks Lambda statistics = 0.371; F = 207.4; p <0.001) among healthy and sick with OAB women between the ages of 36 and 41 years. Classification indicators (Df) for different groups of women, depending on the characteristics of the hormonal background, has the form of the following equations:

$$Df (for \ patients \ with \ OAB \ women \ aged \ from \ 36 \ to \ 41 \ years) = \text{estradiol in the third trimester of pregnancy} \times 0.020 + \text{estradiol in 16 weeks postpartum period} \times 0.450 - 276.0;$$

$$Df (for \ healthy \ women \ between \ the \ ages \ of \ 36 \ and \ 41) = \text{estradiol in the third trimester of pregnancy} \times 0.032 + \text{estradiol at 16 weeks postpartum period} \times 0.664 - 361.9;$$

In determining the significance of discriminatory functions with the help of criterion $\chi^2$, it is established that a reliable interpretation of the classification indices obtained between healthy and sick on OAB women in all age groups is possible, depending on the peculiarities of the hormonal background.

**Discussion**

Taking into account that among the risk factors for the development of urinary incontinence in women an important place have heredity [11, 28], metabolic syndrome and overweight [24, 26], age [9] it is quite understandable to study the possibility of OAB in pregnant women of different age groups depending on the characteristics of anthroposomatotypological indicators or hormonal background.

When taken into account anthropometric and somatotypological indicators it was established that in women of different age groups, the discriminant model of the possibility of OAB occurrence covers 86.7% of pregnant women aged from 17 to 25 years, 90.9% of pregnant women aged from 26 to 35, and 89.3% of pregnant women aged from 36 to 41 years. Between healthy and OAB patients, of 17-25 years of age, discriminating variables are the width of the distal epiphysis of the shoulder which has the greatest contribution to discrimination between healthy and patients, conjugate externa, upper arm circumference and muscle mass of the body by AN; respectively in women aged from 26 to 35 years - clast. Intertrochanterica and width of the distal epiphyses of the forearm which have the greatest contribution to discrimination, conjugate externa, hips girth, upper limb and shoulder, a mesomorphic component of the somatotype by the J. Carter and B. Heath and the fat mass of the body mass at Malegkia, respectively, in women between the ages of 36 and 41, the width of the distal epiphysis of the shin that has the greatest contribution
to discrimination and body length. In general, the aggregate of all variables has an average level of discrimination (Wilkes Lambda statistics = 0.386; \( p < 0.001 \)) only among healthy and sick with OAB women aged from 26 to 35; and women of other age groups have a low level of discrimination, respectively, between women of the ages from 17 to 25 (Wilkes Lambda statistics = 0.531; \( p < 0.01 \)) and between women of the ages of 36 and 41 (Wilkes Lambda statistics = 0.445; \( p < 0.001 \)).

Attention is drawn to the fact that in all age groups, the greatest contribution to discrimination between healthy and sick with OAB women, in most cases, make the parameters of the width of distal epiphyses of long limb bones, which are highly genetically determined indicators [14].

Taking into account the peculiarities of the hormonal background, it has been established that in women of all age groups, the discriminant model of the possibility of OAB occurrence covers 100% of pregnant women. Between healthy and OAB patients between the ages of 17 and 25, discriminant variables are the level of estradiol at 16 weeks postpartum, which has the greatest contribution to discrimination and the level of prolactin in the first trimester of pregnancy, respectively, in women aged from 26 to 35 years - the level of estradiol in the 16 weeks postpartum, which has the greatest contribution to discrimination, estradiol in the first and third trimesters of pregnancy, prolactin in the third trimester of pregnancy, and testosterone in the first and third trimesters of pregnancy; respectively, in women between the ages of 36 and 41 - estradiol in the third trimester of pregnancy, which has the largest contribution to discrimination and estradiol in the 16 weeks postpartum period. In general, the aggregate of all variables has an average level of discrimination (Wilkes Lambda statistics = 0.371; \( p < 0.001 \)) only between healthy and sick with OAB women between the ages of 36 and 41; and women of other age groups have a low level of discrimination, respectively, between women of the ages from 17 to 25 (Wilkes Lambda statistics = 0.619; \( p < 0.001 \)) and between women aged from 26 to 35 (Wilkes Lambda statistics = 0.493; \( p < 0.001 \)).

Attention is drawn to the fact that in all age groups, the greatest contribution to discrimination between healthy and sick with OAB women has the level of estradiol. As is known, estrogens are female hormones of "youth", as they improve blood supply to the urethra and bladder, increase the elasticity of the connective tissue and smooth muscle fibers, which form the wall of the urethra, ensure the presence of mucus in the lumen of the urethra to maintain adequate intrarectal pressure [4].

The application of the integrated approach in the study of disorders of urination will improve the criteria for diagnosis, which in turn will enable to more accurately approach the issue of early detection of risk groups for the development of OAB to increase the effectiveness of prevention of urinary tract disorders at the pre-pregnancy stage.

**Conclusions**

In the constructed by discriminant analysis reliable models of the possibility of OAB occurrence, depending on anthropo-somatotypological or hormonal indicators, the greatest contribution to discrimination between healthy and sick on OAB pregnant women of different age groups, in most cases, have indicators of the width of distal epiphyses of long limb bones or estradiol level.

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**References**


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МОДЕЛИРОВАНИЕ ЗА ДОПОМОГОЮ ДИСКРИМИНАНТНОГО АНАЛИЗУ МОЖЛИВОСТИ ВИКИНЕНЯ ГИПЕРАКТИВНОГО СЕЧОВОГО МІКУРУ У ЖІНОК РІЗНОГО ВІку В ЗАЛЕЖНОСТІ ВІД АНТРОПО-САМОТАПОЛОГІЧНИХ ПОКАЗНИКІВ АБО ГОРМОНАЛЬНОГО ФОНУ

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Одним з найбільш важливих проблем соціально-урозначальних є удосконалення лікувально-діагностичного алгоритму та профілактики синдрому гіперактивного сечового мікуру (ГАСМ). Метою роботи було отримання ефективності дискримінантних моделей можливості викинення ГАСМ у вікових жінок різних вікових груп в залежності від особливостей антропо-самотапологічних показників або гормонального фона. 75 відомим жінкам з клінічними ознаками синдрому ГАСМ зі 100 фактично здоровим відомим жінкам проведено гормональний скринінг е і іІІ тримісяць вагітності та в 16 тиждень після вагітності. Після цього було проведено антропометрію е з метою визначення антропометричних показників. Результати показали, що в групі жінок з ГАСМ вищу частоту виникнення ГАСМ мають жінки зі зменшеною масою тіла та антропометричними показниками, що відповідають медичному критерію. Натомість у жінок без ГАСМ гівень відсутність антропометричних показників.
Моделювання з допомогою дискримінантного аналізу можливості відокремлення гіперактивного мочового пузыря у жінок різного віку у залежності від антропо-комплексологічних показників або гіменоальних показників у жінок різних вікових груп.

Ключові слова: дискримінантний аналіз, вагітність, синдром гіперактивного мочового пузыря, антропометрія, гіменологія, вік.