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General Section

Depressive symptoms and hormonal profile in climacteric women

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Summary

Objectives: The aims of the study were: evaluation of depressive symptoms in climacteric women, comparison of depressive symptoms between peri- and post-menopausal women, and assessment of a possible relationship between the presence of depressive symptoms and the hormonal profile of the studied women. *Materials and Methods:* The study included 45 peri-menopausal and 95 post-menopausal women admitted to the Department of Gynecological Endocrinology, Poznań University of Medical Sciences, because of climacteric symptoms. The following parameters were evaluated in all studied women: intensity of climacteric symptoms (Kupperman Index), intensity of depressive symptoms (Hamilton depression scale), serum concentrations of hypothalamic-pituitary-gonadal axis hormones (FSH, LH, 17β-estradiol), prolactin (PRL) and androgens [total testosterone, dehydroepiandrosterone sulfate (DHEAS)]. FSH, LH, 17β-estradiol, PRL, and total testosterone were evaluated by the immunoenzymatic methods and DHEAS was measured by the radioimmunological method. *Results:* Psychic and somatic manifestations of anxiety and fear, shallow sleep, and general somatic symptoms were the most frequent depressive symptoms in both studied groups. Both investigated groups differed in relation to the incidence and intensity of symptoms from the genital system (observed more often in post-menopausal women) and hypochondria (noted more frequently in peri-menopausal women). Numerous relationships between the incidence and intensity of certain symptoms and serum concentrations of the investigated hormones were found in both groups. The correlations were different in peri- and post-menopausal subjects.

Key words: Menopause; Depression; FSH; LH; PRL; 17β-estradiol; Total testosterone; DHEAS.

Introduction

Psychic, as well as vasomotor symptoms, including irritability, agitation, attention deficit, distrust even of family members and partners, sleep disorders, lack of libido, hyperactivity and quarrelsomeness, are a common clinical problem in menopausal women [1]. Their presence during menopause was the basis for the notion of climacteric depression or involutional melancholia, which was regarded as one of the forms of endogenous depression. The concept was developed by Kraepelin [2], who emphasized the diagnostic importance of uninhibited thought and will, presence of anxiety and fear, often accompanied by intensified suicidal tendencies, and who treated climacteric depression as a separate form of involutional melancholia.

According to Ballinger, depression may be diagnosed in about 50% of women seeking medical advice due to climacteric symptoms [3]. Freeman *et al.*, [4] and Bromberger *et al.*, [5] estimate that menopausal women are at a threefold higher risk for depressive symptoms. Martens *et al.*, [6] report the relative risk for depression at that time of life to be 1.8. In most cases menopause-related depression runs a mild course [3]. The incidence of severe depression at the time of pre-, peri-, and post-menopause has been estimated at 5.8 - 11% [7, 8], 4 - 9.1%, and 1 - 9.8% [4, 7], respectively.

History of depression and severe premenstrual syndrome, as well as disturbed sleep and hot flashes that are supposed to be connected with incidence of depressive symptoms in the so-called 'domino-effect', are among the predictive factors of climacteric depression [4]. The typical for the menopause drop in the 17β-estradiol levels [9], changes in the cerebral blood flow [10], as well as genetic predisposition [11], are among the etiological factors for climacteric depression.

The aims of the study were: evaluation of depressive symptoms in climacteric women, comparison of depressive symptoms between peri- and post-menopausal women, and assessment of a possible relationship between the presence of depressive symptoms and the hormonal profile of the studied women.

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Table 1. — *Characteristics of the study groups (mean ± standard deviation).*

Parameter	Peri-menopausal group	Post-menopausal group
Age (years)	50.8±3.3**	56.1±4.4**
Time since last menstruation (months)	4.0±3.3**	67.6±51**
BMI (kg/m^2)	26.2±3.7	27±4.8
Kupperman Index	30	26
Hamilton scale	12	11
FSH (IU/l)	57.8±43.2**	77.6±29.7**
LH (IU/l)	34.4±23.5	37.1±14.5
E2 (pg/ml)	71.1±103.3**	20.5±22.5**
PRL (ng/ml)	12.9±5.3*	10.6±4.3*
Total testosterone (ng/ml)	0.3±0.16	0.26±0.16
DHEAS (mg/dl)	1.5±0.8	1.29±0.65

*Mann-Whitney test, * $p < 0.05$; ** $p < 0.001$*

Materials and Methods

The study included 45 peri-menopausal (still menstruating but with climacteric symptoms) and 95 post-menopausal (at least one year since the last menses) women, who were admitted to the Department of Gynecological Endocrinology, Poznań University of Medical Sciences, because of climacteric symptoms. Conditions unrelated to menopause that usually influence the occurrence of depressive symptoms, i.e. chronic diseases such as hypertension, neurological and mental diseases, digestive tract and endocrine system diseases, ischemic heart disease, history of ischemic episodes connected with the central nervous system, vascular changes within the peripheral vessels, and excessive alcohol consumption, constituted the exclusion criteria. Use of anti-depressants and hormone replacement therapy in the six weeks prior to the study also excluded the candidates from the study.

The intensity of climacteric and depressive symptoms was evaluated with the Kupperman Index [12] and the Hamilton depression scale [13], respectively, for all study participants. The BMI index was calculated with the use of the BMI = body mass/height^2 formula.

Serum FSH, LH, 17β-estradiol, prolactin (PRL), total testosterone, and dehydroepiandrosterone sulfate (DHEAS) levels were evaluated in all studied women. FSH, LH, 17β-estradiol, PRL, and total testosterone concentrations were tested by immunoenzymatic methods. *Intra-* and *interassay coefficient of variation* (CV) ranges were 1.2 - 3.3% and 2.0 - 5.6%, respectively. DHEAS level was evaluated with the radioimmunological method: intraassay CV and interassay CV ranges were 5.1% and 11%, respectively.

The following methods were used for the statistical analysis:

- Spearman's test for the correlation between variables
- Mann-Whitney test for assessing the relationship between the existence of depressive symptoms and serum hormone concentrations
- Fisher's test for comparing the incidence of depressive symptoms between the groups

The study was approved by the Ethics Committee, Poznań University of Medical Sciences, and financed by the State Committee for Scientific Research (project no: 50305-01109136-12261-08039).

Table 2. — *Incidence of depressive symptoms in the study groups.*

Depressive symptoms	Peri-menopausal group	Post-menopausal group
Depressive mood	18 (40%)	39 (41.1%)
Feeling of guilt	15 (32.2%)	38 (40%)
Suicidal thoughts and tendencies	9 (20%)	25 (26.3%)
Sleeping disorders	26 (57.8%)	55 (57.9%)
Shallow sleep	31 (68.9%)	67 (70.5%)
Waking up early	28 (62.2%)	57 (60%)
Loss of interest in activities	28 (62.2%)	58 (62.2%)
Slowness of movement	10 (22.2%)	22 (23.2%)
Sensorimotor anxiety	12 (26.7%)	18 (19%)
Psychic symptoms of anxiety and fear	34 (75.6%)	65 (68.4%)
Somatic symptoms of anxiety and fear	34 (75.6%)	67(70.5%)
Symptoms from the digestive tract	6 (16.3%)	16 (16.8%)
General somatic symptoms	31 (68.9%)	68 (71.6%)
Symptoms from the genital system	24 (53.3%)*	57 (60%)*
Hypochondria	12 (26.7%)*	9 (9.5%)*
Weight loss	1 (2.2%)	4 (4.2%)
Self-criticism	2 (4.4%)	6 (6.3%)

* Fisher's test ($p < 0.05$)

Results

The studied groups differed significantly as far as age and time since last menstruation were concerned, that was the result of the criteria used for dividing the subjects. No differences in the BMI, mean Kupperman Index, and Hamilton scale scores were found between the groups. In the post-menopausal group, mean FSH concentration was significantly higher, whereas mean 17β-estradiol and PRL concentrations were significantly lower than in the peri-menopausal group. No differences in LH, total testosterone, and DHEAS levels were observed between the groups. Characteristics of the studied groups of peri- and post-menopausal women and the results with regard to the level of intensity of climacteric syndrome and depressive symptoms, as well as serum concentrations of the investigated hormones, are presented in Table 1.

The same depressive symptoms: psychic and somatic manifestations of anxiety and fear, shallow sleep and general somatic symptoms, were the most frequently observed in both studied groups. Both investigated groups differed in relation to the incidence and intensity of symptoms from the genital system (observed more often in post-menopausal women) and hypochondria (noted more frequently in peri-menopausal women). The incidence of depressive symptoms in both studied groups is presented in Table 2.

Numerous relationships between the incidence and intensity of certain symptoms and serum concentrations of

Table 3. — *Results of hormonal investigations depending on the incidence of selected depressive symptoms in the peri-menopausal group (mean ± standard deviation). Comparison of hormone concentrations vs. the incidence of selected depressive symptoms (Mann-Whitney test: *p < 0.05; **p < 0.01). Correlation between symptom intensity and serum hormone concentrations (Spearman test: X p < 0.05; Y p < 0.01).*

Depressive symptom		FSH (IU/l)	LH (IU/l)	17b-estradiol (pg/ml)	PRL (ng/ml)	T (ng/ml)	DHEAS (mg/dl)
Depressive mood	- yes	70.6±34.5*X	36.3±17	65.2±127.7	13.5±6.4	0.32±0.17	1.45±0.83
	- no	49.3±46.8*	33.1±23.7	75.1±85.8	12.4±4.4	0.27±0.15	1.46±0.85
Feeling of guilt	- yes	55.5±29.8	31.9±11.9	86.5±140.7	13.9±6.1	0.29±0.09	1.39±0.85
	- no	58.9±49	35.6±27.7	63.5±80.4	12.4±4.8	0.3±0.19	1.49±0.84
Suicidal thoughts and tendencies	- yes	50.5±33.3	29±14.8	102.3±166.7	14.9±6.8	0.39±0.2*X	1.99±0.96*X
	- no	59.6±45.6	36.8±25.2	63.4±82.3	12.3±4.8	0.27±0.14*	1.31±0.75*
Sleeping disorders	- yes	58.6±38.3	35.6±21.7	50.6±56.9X	14.2±5.6	0.31±0.18	1.46±0.84
	- no	56.7±50.2	32.7±26.4	99.2±142	11.1±4.2	0.27±0.13	1.45±0.84
Shallow sleep	- yes	65.2±45	38.4±23.9	57.1±100.3*X	13.7±5.3	0.3±0.16	1.47±0.84
	- no	41.3±34.9	25.5±20.6	102.2±106.9*	10.9±4.7	0.28±0.17	1.43±0.84
Early waking up	- yes	62.5±45.1	37.9±24.9	69.9±114.1	12.6±4.3	0.29±0.16	1.54±0.86
	- no	50.1±39.9	28.5±20.2	73.1±86.1	13.3±6.7	0.29±0.16	1.31±0.79
Lack of interest in activities	- yes	64.3±34.6*	35.5±16.2	58.4±107.7**	13.8±6.1	0.3±0.17	1.48±0.94
	- no	47±54*	32.6±32.8	92.1±94.9**	11.3±3	0.28±0.15	1.4±0.58
Slowness of movement	- yes	53.7±44.1	32.3±30.9	1181±160.7	10±3.9X	0.4±0.16**Y	1.67±0.95
	- no	58.9±43.5	34.9±21.5	57.7±78.5	16.7±5.4	0.26±0.15**	1.39±0.18
Sensomotor anxiety	- yes	61.5±38.5	36.4±27.5	91.9±52.1	11.4±4.5	0.37±0.22	1.62±1.07
	- no	56.4±45.3	33.7±22.4	63.6±80.7	13.4±5.5	0.27±0.13	1.39±0.73
Psychic symptoms of anxiety and fear	- yes	64.7±43.7	38.4±23.8*	64.3±101.6	13.7±5.6	0.31±0.15	1.47±0.86
	- no	36.3±35.3	22.1±18.5*	92.3±110.9	10.3±2.7	0.25±0.19	1.39±0.78
Somatic symptoms of anxiety and fear	- yes	62.2±43.2	35.9±24.2	62.7±101.8	13.5±5.7	0.32±0.17*	1.53±0.87
	- no	44±42.3	29.5±21.7	97.4±108.5	10.9±3.2	0.21±0.1*	1.12±0.56
Symptoms from the digestive tract	- yes	81.4±33.5	41.1±16.9	53.9±99.7	12.7±6	0.27±0.07	1.27±0.62
	- no	54.2±43.7	33.4±24.4	73.8±104.9	12.9±5.2	0.3±0.17	1.5±0.87
General somatic symptoms	- yes	62.5±37.6	36.6±22.4	57.5±103.2*	13.3±6	0.3±0.15	1.5±0.89
	- no	47.3±53.7	29.6±26	101.3±100.8*	11.9±2.8	0.28±0.18	1.33±0.68
Symptoms from the genital system	- yes	45.6±31.5	30±16.2	88.7±125.2	13.9±6.5	0.33±0.14*Y	1.61±0.81
	- no	71.7±50.8	39.4±29.5	51.1±68.5	11.6±3	0.25±0.17*	1.26±0.84
Hypochondria	- yes	76.1±33.7*X	39.7±13.9	30.4±29.5	14.4±7.1	0.29±0.07	1.29±0.5
	- no	51.1±44.8*	32.5±26.1	85.9±116.4	12.3±4.4	0.3±0.18	1.52±0.93
Weight loss	- yes	58.3	37.7	11.1	9.64	0.24	1.49
	- no	57.8±43.7	34.3±23.8	72.5±104.1	12.9±5.3	0.29±0.16	1.45±0.84
Self-criticism	- yes	42.6±19.1	34.6±10.4	75.9±71.6	10.7±6.1	0.29±0.11	2.14±0.8
	- no	58.5±43.9	34.4±24	70.9±105.2	12.9±5.3	0.29±0.16	1.44±0.84

the investigated hormones were found in both groups. The correlations were different in peri- and post-menopausal subjects.

In the peri-menopausal group, the incidence and intensity of depressive mood, loss of interest in activities, and hypochondria were connected with elevated levels of FSH. The presence of psychic symptoms of anxiety and fear was correlated with higher levels of LH. Incidence and intensity of sleeping disorders, shallow sleep, loss of interest in activities and general somatic symptoms were connected with decreased levels of 17β-estradiol. Incidence and intensity of suicidal thoughts and tendencies, slowness of movement, somatic symptoms of anxiety and fear, and symptoms from the genital system were related to higher levels of total testosterone (suicidal thoughts and tendencies also to higher DHEAS). Increased intensity of slowness of motion was connected with lower PRL.

In the post-menopausal group, the incidence of shallow sleep was related to higher levels of FSH. Loss of weight and the intensity of that symptom was connected with higher LH concentrations. Incidence and intensity of suicidal thoughts and tendencies, as well as psychic symptoms of anxiety and fear, were correlated with higher 17β-estradiol (the latter was also related with higher levels of total testosterone). Higher intensity of waking up early was connected with lower PRL concentrations.

Levels of the investigated hormones, depending of the presence of selected depressive symptoms, as well as the relationship between symptom intensity and serum hormone concentrations are presented in Tables 3 (peri-menopausal women) and 4 (post-menopausal women).

Table 4. — *Results of hormonal investigations depending on the incidence of selected depressive symptoms in the postmenopausal group (mean ± standard deviation). Comparison of hormone concentrations vs. the incidence of selected depressive symptoms (Mann-Whitney test: *p < 0.05; **p < 0.01). Correlation between symptom intensity and serum hormone concentrations (Spearman test: X p < 0.05; Y p < 0.01).*

Depressive symptom		FSH (IU/l) (pg/ml)	LH (IU/l)	17b-estradiol	PRL (ng/ml)	T (ng/ml)	DHEAS (mg/dl)
Depressive mood	- yes	72.8±32.1	36±15.1	24.9±27	10.9±4.8	0.28±0.16	1.35±0.6
	- no	80.9±27.7	37.8±14.2	17.4±18.3	10.3±3.9	0.24±0.16	1.25±0.69
Feeling of guilt	- yes	77.9±31.9	37.7±13.7	21.9±22.4	10.9±4.6	0.25±0.15	1.28±0.63
	- no	77.4±28.5	36.7±15.1	19.5±22.7	10.3±4.2	0.26±0.17	1.3±0.68
Suicidal thoughts and tendencies	- yes	71.5±29.4	34.9±15.4	28.3±32.4**Y	10.8±5.1	0.27±0.15	1.33±0.59
	- no	79.8±29.8	37.8±14.2	17.7±17.1**	10.5±4	0.25±0.16	1.28±0.68
Sleeping disorders	- yes	77.8±25.5	37.4±12.9	17.1±10.9	10.2±3.9	0.24±0.16	1.26±0.62
	- no	77.3±35	36.7±16.5	25.2±31.8	11.1±4.7	0.28±0.16	1.35±0.71
Shallow sleep	- yes	80.9±26.1*	37.2±12.7	18.6±17.2	10.3±4.2	0.26±0.16	1.36±0.69
	- no	69.5±36.2*	36.9±18.4	25.1±31.7	11.1±4.6	0.26±0.17	1.13±0.52
Early waking up	- yes	78.7±28	35.5±12.3	19.1±18	10±4.3X	0.24±0.15	1.22±0.54
	- no	75.9±32.4	39.5±17.2	22.6±27.9	11.4±4.2	0.29±0.17	1.41±0.8
Lack of interest in activities	- yes	79.5±28.9	38.1±14	22.9±25.4	10.8±4.4	0.25±0.17	1.23±0.4
	- no	74.6±31.2	35.4±15.3	16.7±16.6	10±4.1	0.27±0.15	1.39±0.72
Slowness of movement	- yes	77.1±25.8	39.3±14.9	19.5±12.4	10.1±4.5	0.24±0.15	1.16±0.49
	- no	77.7±30.9	36.4±14.4	20.8±24.8	10.7±4.3	0.26±0.16	1.33±0.7
Sensomotor anxiety	- yes	66.9±26.5	36.9±16.1	22.1±28.9	9.7±3.5	0.29±0.16	1.33±0.77
	- no	80.1±30	37.1±14.2	20.1±20.9	10.7±4.5	0.25±0.16	1.29±0.63
Psychic symptoms of anxiety and fear	- yes	73.9±25.6	35±12.9	22.6±24.3**X	10.6±4.6	0.28±0.16*X	1.32±0.69
	- no	85.4±36.3	41.6±16.9	15.9±17.4**	10.4±3.7	0.21±0.15*	1.23±0.58
Somatic symptoms of anxiety and fear	- yes	79.3±29.2	37±13.3	19.6±20.3	10.6±4.5	0.26±0.15	1.29±0.68
	- no	73.5±31.2	37.2±17.3	22.6±27.3	10.6±4	0.25±0.19	1.31±0.61
Symptoms from the digestive tract	- yes	68.6±27.6	34.6±14.4	30.1±36.7	9.5±4.7	0.27±0.16	1.43±0.57
	- no	79.4±29.9	37.6±14.6	18.5±18.1	10.8±4.2	0.25±0.16	1.27±0.67
General somatic symptoms	- yes	76.8±27.8	35.8±12.9	21.3±24.2	10.6±4.4	0.25±0.16	1.26±0.64
	- no	79.6±34.6	40.4±17.8	18.3±17.7	10.6±4.2	0.28±0.17	1.39±0.71
Symptoms from the genital system	- yes	78.5±33.2	37.4±16.9	22±23.4	10.4±4.2	0.28±0.15	1.33±0.68
	- no	76.2±23.9	36.6±9.8	18.2±21.1	10.7±4.5	0.23±0.17	1.24±0.62
Hypochondria	- yes	69.7±35.1	36.8±15.5	18.8±17.9	11.2±2.9	0.19±0.11	0.99±0.62
	- no	78.4±29.2	37.1±14.5	20.7±22.9	10.5±4.4	0.16±0.16	1.33±0.67
Weight loss	- yes	96.4±22.4	49.9±10.5*X	19.8±7.8	14.1±6.4	0.21±0.14	1.16±0.73
	- no	76.8±29.8	36.5±14.4*	20.5±22.9	10.4±4.17	0.26±0.16	1.3±0.65
Self-criticism	- yes	62.3±26.5	36.4±18.9	23±20.6	13.7±5.6	0.25±0.08	1.41±0.41
	- no	78.6±29.8	37.1±14.5	20.3±22.7	10.4±4.2	0.26±0.17	1.29±0.67

Discussion

The present results show that intensity of depressive symptoms was similar in peri- and post-menopausal women. Ballinger [14] and Bungay *et al.*, [15] suggest that symptoms of climacteric depression are more intense in the period of time proceeding the last menstruation and persist for about one year. The same authors point to the relationship between the intensity of depressive and climacteric symptoms. In the present study, the level of climacteric symptom intensity was similar both in peri- and postmenopausal women, what was probably the reason behind the similarities in the intensity of depressive symptoms. In both studied groups, the mean result of the Hamilton Scale was the basis for the diagnosis of moderate-intensity depression. Most authors underline that depression during menopause usually runs a mild course [7, 8]. The discrepancy between reports in the literature and the present results might be caused by that fact that the present study participants were referred to the department due to greater intensity of symptoms.

In both groups of women, similar depressive symptoms: psychic symptoms of anxiety and fear, somatic symptoms of anxiety and fear, shallow sleep, general somatic symptoms, were found in the majority of cases. It is in accordance with observations of other authors, who at the same time point to high incidence of suicidal thoughts and tendencies around the time of menopause [2]. Both investigated groups differed as far as incidence and intensity of symptoms from the genital system and hypochondria were concerned. Disorders of the genital system (dyspareunia,

lack of libido) were observed more often and with greater intensity in post-menopausal women, whereas hypochondria was noted more frequently and with higher intensity in peri-menopausal women.

Other authors demonstrated similar results concerning symptoms from the genital system. Avis *et al.*, [16] and Dennerstein *et al.*, [17] reported decreased libido during menopause. Lack of sex drive depends on the intensity of climacteric as well as depressive symptoms. Llaneza *et al.*, [18] found a reversed correlation between the level of intensity of the climacteric symptoms (Menopause Rating Scale) and symptoms from the genital system (Changes in Sexual Functioning Questionnaire). Mezones-Holguín *et al.*, [19] demonstrated that sexuality (Female Sexual Function Index) was reversely correlated with depression and depended on the intensity of atrophic changes within the urogenital system. In the present study, disorders of the genital system included dyspareunia and lack of libido. The SWAN study analyzed these problems separately and concluded that lowered sex drive is noted more often in late perimenopause and post-menopause, while dyspareunia is more prevalent in early peri-menopause and post-menopause [20]. The same investigation found that suicidal thoughts and tendencies were more frequently observed during postmenopause, while hyperactivity, early waking up, and appetite loss were typical of peri-menopause [20].

As far as hypochondria is concerned, Bungay [15] found it to be more intensified during post-menopause, similarly to insomnia, whereas anxiety and fear peaked during perimenopause. Similar results were reported by Ballinger *et al.*, [3], who also demonstrated that the most frequent fear in women during menopause was the fear of breast cancer.

Estrogen deficiency is believed to be the main reason of psychic symptoms during menopause [21]. It is consistent with the present findings of a relationship between lowered levels of 17β-estradiol and higher, as well as more intensified, incidence of sleeping disorders, shallow sleep, loss of interest in activities and general somatic symptoms. Interestingly, these connections were observed only in peri-menopausal women. Moreover, other correlations, that are not present during peri-menopause, between higher levels of 17β-estradiol and higher incidence and intensity of suicidal thoughts and tendencies, as well as psychic symptoms of anxiety and fear, appear at the time of post-menopause. These investigations conclude that decreased 17β-estradiol is a significant risk factor for depression at the time of peri-menopause.

The present findings concerning the correlations between higher FSH levels and higher incidence and intensity of the depressive mood, loss of interest in activities, hypochondria and shallow sleep, as well as between a higher concentration of LH and the loss of weight, and psychic symptoms of anxiety and fear, constitute an indirect proof that 17β-estradiol plays a role in the etiology of depressive symptoms.

Freeman *et al.*, [22] reported similar results and concluded that during pre-menopause the level of intensity of depressive symptoms correlates with higher concentrations of FSH, and in peri-menopause with lower levels of LH and inhibin B, as well as increased variability of estradiol, FSH and LH concentrations. Ryan *et al.*, [23] found a relationship between the incidence of depression in postmenopause and the drop in the 17β-estradiol levels and increase in the FSH concentration in the course of two years. Sherwin *et al.*, [24] demonstrated a correlation between the extent of estrogen decrease and lowered mood in women after surgical menopause.

The dependency between 17β-estradiol and intensity of depression was confirmed by studies on the effects of hormone replacement therapy in menopausal women. Saletu *et al.*, [25] demonstrated that administration of conjugated estrogens at the dose of 1.25 mg/day significantly improved the clinical condition of post-menopausal women with mild depression. Ditkoff *et al.*, [26] reported that conjugated estrogens used both, at the dose of 0.625 and of 1.25 mg/day for three months, relieved depressive symptoms in women after menopause. Klaiber [27] found that very large doses of conjugated estrogens (from five to 25 mg/day) administered for three months, significantly improved the mood in women with severe depression, non-responsive to conventional methods (anti-depressants, psychotherapy, electroconvulsive stimulation). Also, estrogen therapy was proven to prevent depression in the elderly [28].

Studies on the relationship between depression and serum testosterone levels brought divergent results. Bromberger *et al.*, [5] found a dependency between the intensity of depressive symptoms in pre-menopause and increased serum testosterone concentration. Also, higher testosterone levels were observed in women with moderate depression during pre-menopause [29], as well as lack of age-related decrease in testosterone concentrations in postmenopausal women with moderate depression [30]. The present findings are similar to these results, as the authors confirmed a dependency between higher levels of total testosterone and incidence and intensity of suicidal thoughts and tendencies, slowness of movement, somatic symptoms of anxiety and fear, symptoms from the genital system, and psychic symptoms of anxiety and fear. Contradictory results are reported by Santoro *et al.*, [31], who found a relationship between the intensity of depressive symptoms and decreased levels of total and free testosterone, as well as Turna *et al.*, [32], who demonstrated a correlation between low levels of total testosterone and lack of libido in pre- and post-menopausal women. Studies on the use of testosterone in hormone replacement therapy seem to confirm its beneficial effect. That kind of therapy resulted in improved confidence and mood in most women, causing hyperactivity and irritability only in some subjects [33]. Zweifel and O'Brien [34], demonstrated that improved mood after high-dose androgen treatment was more significant than after androgens in

combination with estrogens, only estrogens, estrogens in combination with gestagens, and gestagens alone.

Studies on the relationship between the incidence of depressive symptoms and DHEAS and DHEAS concentrations give divergent results. Apart from reports on lower intensity of depression in women with higher serum DHEAS concentrations [35, 36], there are findings that suggest a contradictory correlation [31, 37], or none at all [38]. The present authors found a higher intensity of suicidal thought and tendencies in peri-menopausal women with higher DHEAS levels. Similar results were demonstrated by Morrison *et al.*, [8], who observed a higher intensity of depressive symptoms in younger women with higher DHEAS and older women with lower DHEAS. Yet another finding was reported by Schmidt *et al.*, [35], who noted a dependency between the first episode of depression during peri-menopause and lowered levels of DHEAS.

The present study found a correlation between higher intensity of both, slowness of movement, and early waking up and lower levels of PRL. It seems to be the result of decreased 17β-estradiol concentration during menopause. PRL concentration at that time of life drops and the changes correlate with 17β-concentration levels [39]. As no changes in the PRL secretion are observed in depression, its increased concentration may be the result of antidepressant therapy [40].

Conclusions

Intensity of depressive symptoms during peri-menopause and post-menopause is comparable. The profiles of depressive symptoms of pre-menopause and post-menopause are similar. Hypochondria is most common during peri-menopause, while symptoms from the genital system are typical for post-menopause. Individual depressive symptoms in menopausal women are correlated with serum 17β-estradiol, total testosterone, DHEAS, and PRL concentrations.

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