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The effect of a combination of motivational counselling with armodafinil therapy in obese patients with shift work disorder in primary care

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Obesity is a complex medical problem which still needs options of pathogenetic treatment.
Objectives. To determine the effect of the complex therapy of patients with obesity and circadian rhythm sleep-wake disorders (shift work disorder) by armodafinil in addition to motivational counselling in primary care.
Material and methods. 38 obese patients with shift work disorder were treated with armodafinil 150 mg daily and an motivational interview regarding healthy lifestyle. The examinations were at baseline after the 1st, 3th and 6th months and included: BMI, waist and hip circumference, body surface area, Waist-to-Hip Ratio, Conicity Index, A body shape index, Abdominal Volume Index, blood pressure, levels of serotonin, leptin, glucose, lipidogram, International Questionnaire on Physical Activity, FINDRISC, HADS, Beck&Hamilton Scale, Dutch Eating Behaviour Questionnaire, Epworth Sleepiness Scale, Pittsburgh Sleep Quality Questionnaire, and SF-36. Statistical analysis was carried out with SPSS Statistics, Statistica 12, Excel 2010.
Results. BMI at baseline of the study was 33.85 ± 0.5 kg/m^2. The percentage of body weight showed a significant loss starting from the 3rd month ($p < 0.0001$). Impaired carbohydrate tolerance, dyslipidaemia, moderate risk of developing diabetes, low serotonin levels and physical activity improved their values over time. Patients had clinically pronounced depression and anxiety, disturbed eating behaviour, excessive daytime sleepiness, poor sleep quality and quality of life at baseline, which normalised by the 6th month.
Conclusions. The complex treatment of obese patients with shift work disorder by motivational counselling with a patient-oriented approach enhanced by armodafinil 150 mg daily allowed them to reduce body weight by 15% in 6 months, as well as reduce metabolic, eating, mental and sleep disorders and improve quality of life.
Key words: obesity, circadian rhythm sleep disorders, shift work schedule, sleepiness, sleep quality.

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Background

According to the World Health Organization, the prevalence of obesity equates to 39% of adults aged 18 and over who are overweight and 13% of people living with obesity. The epidemic scale of obesity stimulates researchers and doctors around the world to search for the latest effective, affordable and safe means of its treatment. The main aspect in obesity treatment recommendations is the modification of patients' lifestyle, but this is not always effective solely through motivational counselling; hence, the additional use of medication is needed [1– 9]. Drugs with central mechanisms of action and influence on hypothalamus, mediated by serotonergic system, showed the greatest effectiveness, e.g.: sibutramine, liraglutide, semaglutide, naltrexone/bupropion, phentermine, phentermine/topiramate, lorcaserin [2, 10–17]. The drug of peripheral action, orlistat, is a semi-synthetic derivative of lipstatin, a powerful, long-acting selective inhibitor of pancreatic lipase, and the average body mass decrease is 2.9% after 1 year from the start of therapy, excluding the placebo effect [18– 21].

However, the pathogenesis of obesity is often connected with psycho-emotional and circadian rhythm sleep-wake disorders, which leads to hormone disbalance, influence on appetite, metabolism and weight gain. The treatment of these aspects is not well established in obesity recommendations [2–4, 13, 15, 22].

Armodafinil is an indirect agonist of dopamine receptors, which is directly used for the treatment of excessive daytime sleepiness, disorders of the circadian rhythm of sleep and wakefulness (shift work disorders) and psycho-emotional disorders, and it also additionally reduces body weight [23, 24]. Armodafinil is the R-enantiomer of racemic modafinil, an oral drug that promotes wakefulness and is distinct from nervosa stimulants [24, 25]. It has a selective effect on the transmission of catecholamine signals through dopaminergic, serotonergic and norepinephrine receptors [26–28]. Armodafinil can stimulate the secretion of hypocretin (orexin A and orexin B) by the hypothalamus, which, in turn, stimulates the release of dopamine and norepinephrine, which promote wakefulness [28–32]. Hypocretins influence homeostatic and physiological behaviours such as food intake, attention, sleep/wake cycle, locomotion, habituation, learning and memory through extensive neural projections to the region mediating these phenomena [33]. Armodafinil also increases the synthesis of serotonin and inhibits its reuptake, as a result of which, its concentration in the synaptic clefts increases, which leads to a change in eating behaviour, while in obesity, serotoninergic systems are insuffi-

cient. Thus, there is a need to study the effect of armodafinil on weight reduction in patients with obesity and sleep disorders.

Objectives

To determine the effect of complex therapy on patients with obesity and circadian rhythm sleep-wake disorders (shift work disorder) by armodafinil in addition to motivational counselling in primary care.

Materials and methods

38 patients with I (24 people) and II (14 people) degrees of obesity, with circadian rhythm sleep-wake disorders (shift work disorder) and aged 40 ± 1.33 years (19 women and 19 men) were included in study. Shift work disorder was established according to the criteria of DSM-V (Diagnostic and Statistical Manual of Mental Disorders, fifth edition), where it was defined as a type of circadian rhythm sleep disorder characterised by complaints of insomnia or severe sleepiness that occur in connection with working hours scheduled during the normal sleep period [32]. The next indexes were measured at the baseline of the study and after 1 month, 3 months and 6 months: body mass index (BMI), waist circumference (WC) and hip circumference (HC), anthropometric indicators – body surface area (BSA), Waist-to-Hip Ratio (WHR), Conicity Index (ConI), A body shape index (ABSI), Abdominal Volume Index (AVI), International Questionnaire on Physical Activity (IPAQ). Sleep disorders were assessed using the Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Questionnaire (PSQI); psycho-social status – with the Hospital Anxiety and Depression Scale (HADS), Beck's Scale, Hamilton Scale (HAM-A), Dutch Eating Behaviour Questionnaire (DEBQ); diabetes risks – using the FINDRISC questionnaire; quality of life – by SF-36. Clinical and laboratory examination included measurement of blood pressure, determination of blood levels of serotonin and leptin, indicators of lipid profile, glucose, insulin and HOMA index. All patients were given patient-oriented motivational counselling regarding a healthy lifestyle to manage obesity in combination with the use of armodafinil in a dose of 150 mg once daily in the morning with the purpose to treat shift work disorder. The target of weight loss was set at 5–10% in 6 months. The patient-oriented approach included recommendations regarding diet and caloric content [1], physical activity (control using pedometer), compliance with sleep hygiene and correction of psycho-emotional disorders. All patients gave informed consent for such therapy. Statistical analysis was performed using IBM SPSS Statistics, Statistica 12, Excel 2010.

Results

At baseline, the body weight of the patients was 97.76 ± 2.16 kg, with increased BMI that respond to obesity – 33.85 ± 0.5 kg/m^2 (34.48 ± 0.58 in women and 33.22 ± 0.49 in men, $p > 0.05$). The abdominal type of obesity was confirmed by WHR, ConI, ABSI and AVI indices. There were no significant differences in the mentioned indexes between men and women, with the exception being BSA ($p < 0.05$). All indexes are represented in Table 1. Normal high blood pressure levels were found in the patients (BP = 136.18 ± 2.58 mm Hg; BP = 86.58 ± 1.59 mm Hg), which also did not depend on gender. Levels of glucose, insulin, NOMA index and total cholesterol were increased (Table 1). The risk of diabetes (FINDRISC) was 12.50 ± 0.72, meaning that diabetes in the next 10 years occurs in 1 of 6 people. Physical activity (IPAQ) was insufficient (16.08 ± 1.42 points). The level of depression and anxiety was clinically relevant. The eating behaviour of patients (DEBQ) on the scale of Emotiogenic, External and Restrictive types significantly exceeded the reference values. The level of sleepiness on the Epworth scale was excessive – 9.55 ± 0.66 points, and sleep quality (PSQI) and quality of life (SF36) were low (Table 1). The level of serotonin was insufficient – 154.37 ± 3.89 µg/ml, and leptin exceeded normal values. In women, this was 13.04 ± 0.87 ng/ml, in men 12.65 ± 1 ng/ml.

The first control point of complex treatment with motivational interviewing based on the "5 As" "5 R" system and armodafinil was conducted 1 month after the start of treatment. The reduction of most indexes was not significant, and the percentage of body weight loss was small (see Table 1). A significant decrease was found in the levels of depression and anxiety and eating behaviour disorders (DEBQ). The quality of life (SF-36) saw a significant increase in the components of PF, RP, VT, GH ($p < 0.05$), and in terms of sleep quality, all components showed a significant decrease (Table 1).

After 3 months, the percentage of body weight loss increased to 10.65 ± 0.96% ($p < 0.0001$), and other anthropometric indicators also had statistically positive dynamics (Table 1). The levels of blood pressure ($p < 0.001$), insulin ($p < 0.05$) and HOMA index ($p < 0.05$) significantly decreased. The indicators of lipid metabolism did not undergo significant changes, with the exception of the level of HDL, which significantly increased ($p < 0.05$). The fasting glucose level tended to decrease, as well as diabetes risk (FINDRISC), when physical activity increased ($p < 0.001$). Indicators of depression and anxiety decreased ($p < 0.001$), and changes in eating behaviour on all scales showed reliable positive dynamics. The sleep quality PSQI scores became better; however, they still exceeded 5 points (Table 1). The level of drowsiness was lower than at baseline ($p < 0.05$). The patients quality of life increased in all components ($p < 0.05$), with

Table 1. Indicators of obese patients with shift work disorder who were treated with a combination of lifestyle changes and motivational counselling with a patient-oriented approach enhanced by the use of armodafinil in dynamics

Indicator	Baseline (n = 38), M ± m	1 month (n = 38), M ± m	3 months (n = 38), M ± m	6 months (n = 38), M ± m
Weight, kg	97.76 ± 2.16	97.27 ± 2.72	87.47 ± 2.36**$^{\#\#}$	81.67 ± 2.17$^{\#\#}$
% of body weight loss	0.81 ± 0.98		10.65 ± 0.96***$^{\#\#\#}$	16.52 ± 0.98***$^{\#\#\#}$
BMI, kg/m^2	33.85 ± 0.54	33.69 ± 0.78	30.31 ± 0.67*$^{\#\#\#}$	28.30 ± 0.62*$^{\#\#\#}$
WC, m	1.05 ± 0.02	1.05 ± 0.02	0.95 ± 0.02**$^{\#\#}$	0.89 ± 0.02*$^{\#\#\#}$
HC, m	1.15 ± 0.03	1.15 ± 0.03	1.13 ± 0.74	1.05 ± 0.03$^{\#}$
BSA, m^2	2.19 ± 0.04	2.18 ± 0.04	2.08 ± 0.04$^{\#}$	2.02 ± 0.03$^{\#}$
WHR	0.92 ± 0.01	0.92 ± 0.01	0.85 ± 0.01***$^{\#\#\#}$	0.86 ± 0.01$^{\#}$
ConI, m$^{3/2}$/kg$^{1/2}$	1.27 ± 0.02	1.27 ± 0.02	1.22 ± 0.02	1.18 ± 0.02$^{\#}$
ABSI, m$^{5/3}$·kg$^{-2/3}$	0.0770 ± 0.0010	0.0773 ± 0.0011	0.0755 ± 0.0009	0.0740 ± 0.0013
AVI	22.40 ± 0.87	22.35 ± 0.89	18.76 ± 0.83**$^{\#\#}$	16.42 ± 0.72*$^{\#\#\#}$
BPs, mm Hg	136.18 ± 2.58	137.24 ± 2.51	127.63 ± 1.37**$^{\#\#}$	123.55 ± 0.89**$^{\#\#\#}$

Table 1. Indicators of obese patients with shift work disorder who were treated with a combination of lifestyle changes and motivational counselling with a patient-oriented approach enhanced by the use of armodafinil in dynamics

Indicator		Baseline (*n* = 38), M ± m	1 month (*n* = 38), M ± m	3 months (*n* = 38), M ± m	6 months (*n* = 38), M ± m
BPd, mm Hg		86.58 ± 1.59	84.34 ± 1.38	79.21 ± 0.93**$^{\#\#\#}$	79.08 ± 0.8$^{\#\#\#}$
Glucose, mmol/l		6.34 ± 0.16	6.33 ± 0.16	6.02 ± 0.15	5.70 ± 0.13$^{\#}$
Insulin, μIU/ml		17.14 ± 0.74	17.01 ± 0.73	15.11 ± 0.68$^{\#}$	12.71 ± 0.55**$^{\#\#\#}$
HOMA index, μmol·μl·ml^2		4.94 ± 0.29	4.90 ± 0.28	4.13 ± 0.24*$^{\#}$	3.28 ± 0.18**$^{\#\#\#}$
Total cholesterol, mmol/l		5.25 ± 0.16	5.20 ± 0.16	5.11 ± 0.2	5.09 ± 0.18
HDL, mmol/l		1.57 ± 0.04	1.66 ± 0.05	1.72 ± 0.05$^{\#}$	1.85 ± 0.06$^{\#\#\#}$
LDL, mmol/l		3.70 ± 0.16	3.54 ± 0.16	3.36 ± 0.15	3.08 ± 0.14$^{\#\#}$
VLDL, mmol/l		0.80 ± 0.04	0.76 ± 0.04	0.70 ± 0.04	0.61 ± 0.03*$^{\#\#\#}$
Atherogenic index		2.49 ± 0.18	2.28 ± 0.17	2.12 ± 0.18	1.90 ± 0.17$^{\#}$
Serotonin, μg/l		154.37 ± 3.89	156.97 ± 3.99	171.53 ± 4.18*$^{\#\#}$	212.87 ± 5.95***$^{\#\#\#}$
Leptin, ng/ml		12.84 ± 0.92	12.36 ± 0.93	8.85 ± 0.6**$^{\#\#\#}$	6.22 ± 0.4***$^{\#\#\#}$
Hamilton anxiety scale, points		13.76 ± 0.91	10.79 ± 0.71*$^{\#}$	8.82 ± 0.48*$^{\#\#\#}$	6.29 ± 0.36***$^{\#\#\#}$
HADS, points	anxiety	12.13 ± 0.74	7.84 ± 0.58***$^{\#\#\#}$	6.79 ± 0.51$^{\#\#\#}$	5.39 ± 0.49*$^{\#\#\#}$
	depression	13.84 ± 0.74	8.16 ± 0.58***$^{\#\#\#}$	6.66 ± 0.54$^{\#\#\#}$	4.03 ± 0.41***$^{\#\#\#}$
Beck's (depression scale), points		15.47 ± 1.15	12.08 ± 0.72*$^{\#}$	10.61 ± 0.77$^{\#\#\#}$	8.29 ± 0.56*$^{\#\#\#}$
Dutch Eating Behaviour Questionnaire (DEBQ)	Emotional eating type, points	3.02 ± 0.14	2.48 ± 0.1**$^{\#\#}$	2.16 ± 0.08*$^{\#\#\#}$	1.7 ± 0.05***$^{\#\#\#}$
	Externality eating type, points	3.66 ± 0.14	2.39 ± 0.08***$^{\#\#\#}$	2.15 ± 0.07*$^{\#\#\#}$	1.9 ± 0.08*$^{\#\#\#}$
	Restrained eating type, points	3.79 ± 0.13	3.39 ± 0.07**$^{\#\#}$	2.95 ± 0.09***$^{\#\#\#}$	2.35 ± 0.14***$^{\#\#\#}$
Pittsburgh Sleep Quality Questionnaire PSQI	Global score, points	9.32 ± 0.49	6.84 ± 0.28***$^{\#\#\#}$	5.58 ± 0.23**$^{\#\#\#}$	3.63 ± 0.19***$^{\#\#\#}$
	Sleep quality, points	2.21 ± 0.12	1.84 ± 0.07*$^{\#}$	1.18 ± 0.07***$^{\#\#\#}$	1.11 ± 0.05$^{\#\#\#}$
	Sleep latency, points	1.92 ± 0.14	1.5 ± 0.12*$^{\#}$	1.11 ± 0.08**$^{\#\#\#}$	0.87 ± 0.09*$^{\#\#\#}$
	Sleep duration, points	1.34 ± 0.17	0.68 ± 0.16**$^{\#\#}$	0.66 ± 0.11$^{\#\#}$	0.29 ± 0.11*$^{\#\#\#}$
	Habitual sleep efficiency, points	0.63 ± 0.1	0.29 ± 0.07*$^{\#}$	0.34 ± 0.08$^{\#}$	0.03 ± 0.03***$^{\#\#\#}$
	Sleep disturbance, points	1.66 ± 0.09	1.37 ± 0.09*$^{\#\#\#}$	1.16 ± 0.06*$^{\#\#\#}$	1.05 ± 0.04$^{\#\#\#}$
	Use of sleeping medication, points	0 ± 0	0 ± 0	0 ± 0	0 ± 0
	Daytime dysfunction), points	1.5 ± 0.13	1.16 ± 0.08*$^{\#}$	1.13 ± 0.08$^{\#}$	0.29 ± 0.1***$^{\#\#\#}$
Drowsiness (ESS), points		9.55 ± 0.66	9.03 ± 0.65	7.42 ± 0.51$^{\#}$	5.39 ± 0.36**$^{\#\#\#}$
Quality of life - SF-36, points	PF	62.89 ± 1.8	84.08 ± 2.14***$^{\#\#\#}$	90.53 ± 1.76*$^{\#\#\#}$	97.89 ± 0.79**$^{\#\#\#}$
	RP	45.39 ± 4.89	57.24 ± 4.61	68.42 ± 3.73$^{\#\#\#}$	88.82 ± 2.44***$^{\#\#\#}$
	BP	62.24 ± 3.67	69.89 ± 4.07	79.29 ± 3.46$^{\#\#}$	94.21 ± 1.44***$^{\#\#\#}$
	GH	44.54 ± 3.45	57.87 ± 3.53**$^{\#\#}$	73.49 ± 2.95**$^{\#\#\#}$	83.97 ± 1.89**$^{\#\#\#}$
	VT	54.37 ± 2.67	63.16 ± 2.14*$^{\#}$	70.39 ± 2.17*$^{\#\#\#}$	79.08 ± 2.23**$^{\#\#\#}$
	SF	55.33 ± 3.51	61.71 ± 3.16	70.33 ± 2.71*$^{\#\#}$	83.88 ± 2.55***$^{\#\#\#}$
	RE	49.1 ± 5.99	50.84 ± 4.83	63.12 ± 4.84	80.67 ± 3.7**$^{\#\#\#}$
	MH	52.95 ± 4,37	58.11 ± 2,74	75.05 ± 3.2***$^{\#\#\#}$	82.95 ± 2.82$^{\#\#\#}$
Physical activity – IPAQ, points		16.08 ± 1.42	19.55 ± 1.4	23.24 ± 1.4$^{\#\#\#}$	29.29 ± 1.42**$^{\#\#\#}$
Diabetes risk – FINDRISC, points		12.50 ± 0.72	11.61 ± 0.64	10.84 ± 0.58	9.42 ± 0.53$^{\#\#\#}$

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ – in comparison with the previous control point.
$^{\#}p < 0.05$, $^{\#\#}p < 0.01$, $^{\#\#\#}p < 0.01$ – in comparison with the baseline.

the exception of role functioning ($p > 0.05$). The hormonal background of both serotonin and leptin had positive dynamics. The level of serotonin increased when the leptin levels significantly decreased in women ($p < 0.01$) and in men ($p < 0.05$).

After 6 months, it was noted that the percentage of body weight loss reached 16.52 ± 0.98% ($p < 0.0001$). As we can see from Table 1, almost all measured indicators had reliably significant positive changes, with the exception of the ABSI index and level of total cholesterol. The average levels of BMI decreased to 28.3 ± 0.62 kg/m^2, glucose and insulin levels reached recommended targets, indicators of lipid profile were normalised, and the risk of developing diabetes in the next 10 years decreased to 9.42 ± 0.53 points. The level of serotonin increased to 212.87 ± 5.95 μg/l. Leptin decreased; however, in men, it did not reach normalisation (6.22 ± 0.45 ng/ml), and in women, it remained within reference values (6.23 ± 0.36 ng/ml). Depression and

anxiety scales showed significantly lower scores, and the changes in eating behaviour were normalised. Daytime sleepiness significantly decreased (Epworth $p < 0.001$). Sleep quality (PSQI Global score) improved significantly (3.63 ± 0.19) ($p < 0.001$). The quality of life by SF-36 revealed a significant increase in scores for all components (PF, BP, GH, SF, VT, MH, RE, RP).

Discussion

At baseline, all the patients in the study had a BMI corresponding to I and II degrees of obesity and had shift work disorder. Waist circumstances exceeded the WHO recommended values for men (> 94 cm) and women (> 80 cm) in Europe, indicating all patients had the abdominal type of obesity (WHR, ConI, ABSI, AVI) and had increased cardiovascular risks. It was also found that patients had normal high levels of blood pressure, which did not depend on gender, disturbance of tolerance to carbohydrates and lipid metabolism. Hypercholesterolemia was detected in 21 of 38 patients (55.26%). Similar metabolic changes were obtained in a randomised, double-blind, placebo-controlled study in patients with shift work disorder in 2018 by Chapman et al., confirming the dependence of shift work disorder and obesity [23]. The risk of diabetes in the next 10 years was 1 in 6. The physical activity of patients at baseline level was not sufficient for this age group of patients. Mental health was characterised by clinically expressed depression and anxiety. The eating behaviour of patients (DEBQ) was disturbed, and according to the scale of Emotional eating type, a tendency to "eat emotions" was noted. According to the scale of the Externality type, patients had a tendency to overeat when food was available. The level of sleepiness on the Epworth scale corresponded to the excessive daytime sleepiness of patients. Quality sleep according to the PSQI questionnaire was "bad", a Subjective assessment of sleep by patients was poor quality sleep, manifested by the inability of patients to fall asleep within 30–60 minutes, 1–2 times a week; the average duration of sleep was 6 hours; episodes of waking up at night, difficulty breathing, snoring, pain, cold or heat and bad dreams were noted 1–2 times per night; difficulty for patients 1–2 times a week to maintain a sufficient mood to be socially active and perform their tasks. The patients' quality of life according to the SF-36 questionnaire in all components was low. The level of serotonin in the blood had low reference values, and the level of leptin exceeded normal values, which indicates the presence of hormonally active adipose tissue. A combination of behavioural, psycho-social and clinical-laboratory disorders was revealed, which required lifestyle modification and elimination of excessive daytime sleepiness. Our results confirm the relationship and impact of sleep disorders on psycho-social status, hormone activity and metabolic disorders, which was also confirmed by correlation analysis of these indicators and the data of many researchers [34–41].

Considering these pathogenetic features of obesity and the influence of sleep disorder on obesity development, the hypothesis that armodafinil should be effective in complex treatment of patients with obesity and shift work disorder is clearly understandable. The results of research by Howard, Ryan et al. and Chapman et al. showed that the use of armodafinil led to normalisation of sleep and psycho-emotional disorders, as well as to weight loss [23, 42].

Our study showed that complex treatment with lifestyle changes and armodafinil intake had positive results on weight loss and sleep disorders. After 1 month of treatment, body weight, BMI, WC, HC, WHR, BSA, ConI, ABSI, AVI, indicators of lipid and carbohydrate metabolism, leptin, serotonin, blood pressure and the level of physical activity started to decrease, but not significantly. By the 6th month, the average levels of BMI reached overweight category, but 10 of the 38 patients remained in the category of obese at the end of study; however, the percentage of body weight loss reached over 15% for 6 months, which was much more than the recommended target for this period. The risk of diabetes (FINDRISC) gradually decreased, and by the end of the study, diabetes could occur not in every 6th but in every 25th patient in the next 10 years, both in men and in women. Physical activity became sufficient from the 3rd month of follow-up. The level of blood pressure normalised to average values as early as in the 3rd month. Dyslipidaemia was modestly corrected, although total cholesterol and LDL were above targets by the end of study. The degree of depression and anxiety after 1 month corresponded to the subclinical degree and were absent in patients until the end of observation; thus, psycho-emotional status was normalised. Eating behaviour in patients (DEBQ) gradually reached normal values by the 6th month. Daytime sleepiness after 1 month of treatment was at a moderate level and disappeared after 6 months of treatment. The level of sleep quality in the first month was still assessed as bad sleep, and it was normalised in the 6th month; thus, it was subjectively assessed by patients as sleep of sufficiently good quality. The number of minutes falling asleep also decreased (up to 15 min), and sleep was prolonged to more than 7 h/night, improved sleep efficiency by more than 85%. Patients' quality of life according to the SF-36 questionnaire after 1 month of using motivational counselling and armodafinil showed an average level, and an above-average level of quality of life was achieved in 6 months according to indicators of the physical and mental components of the SF-36 questionnaire. Armodafinil was well tolerated, and no side effects were registered for the whole period of study. Positive changes in the hormonal status in patients differed by gender. The level of leptin was normalised in women from the 3rd month, although in men, it did not reach normalisation even after 6 months of treatment, although it had reliably significant positive changes. The serotonin level showed positive changes in both genders.

Limitations of the study

This article describes the 6-month follow-up of patients with obesity and shift work disorder, who were treated by complex therapy of patient-oriented motivational interviews with a combination of armodafinil. The 6-month follow up of patient with obesity treated only by patient-oriented motivational interviews had an insignificant effect and is not represented in the article. It was published as a separate article [43, 44].

Conclusions

Obese patients who have circadian rhythm sleep-wake disorders (shift work disorder), connected with mental health disorders, metabolic and hormone disorders (serotonin, leptin), need additional correction for successful treatment of obesity. Armodafinil is an indirect dopamine receptor agonist, which is used to treat excessive daytime sleepiness and shift work disorder, and has additional positive effect on psycho-emotional disorders and reduces body weight. The complex treatment of obese patients with shift work disorder through motivational counselling with a patient-oriented approach enhanced by the use of armodafinil in a dose of 150 mg once a day in the morning showed positive results and allowed them to reduce body weight by more than 15% in 6 months, reduce levels of metabolic disorders, blood pressure, eliminate manifestations of depression and anxiety, as well as sleeping and eating disorders, improve the quality of sleep and life of patients and reduce the risk of non-infectious diseases.

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