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Current trends in the treatment of prediabetes in reproductive-age women

M.M. Ivanishchak[1,2], I.O. Kostitska[1], I.O. Basiuha[1], O.I. Babenko[1]

[1]Ivano-Frankivsk National Medical University
[2]Communal Non-commercial Enterprise «Regional Clinical Hospital of Ivano-Frankivsk Regional Council»

Abstract. Prediabetes remains a pressing medical and social issue, as it is considered one of the key factors increasing the risk of infertility in women of reproductive age. This metabolic condition causes dysfunction of the pancreatic insular apparatus due to the progression of insulin resistance (IR) and leptin resistance (LR), which increase the risk of developing type 2 diabetes (T2D). An important task for the medical community is to develop and scientifically substantiate patient-oriented treatment algorithms for prediabetes while preserving female fertility. **Aim.** To evaluate the effectiveness of a 12-week course of treatment with sodium-glucose co-transporter 2 inhibitors (SGLT-2i: dapagliflozin (DAPA)) and glucagon-like peptide-1 receptor agonists (GLP-1 RAs: liraglutide (LIRA)) in reproductive-age women with prediabetes. **Material and methods.** The study involved 42 female patients aged 19 -45 years with prediabetes, who were divided into three groups according to the treatment algorithm: Group I (n=14) received basic drug therapy (BDT): metformin –500–2000 mg/day, alpha-lipoic acid – 600 mg/day, cholecalciferol (vitamin D3) –800–10.000 IU/day, and inositol – 2,000 mg/day; Group II (n=14) used BDT in combination with SGLT-2i (DAPA – 10 mg/day); Group III (n=14) took BDT in combination with subcutaneous injections of GLP-1 RAs (LIRA at a daily dose of 0.6–3.0 mg). The study duration was 12 weeks. **Results.** After 12 weeks of treatment, compared to baseline data, the best improvement in glucose metabolism was observed in patients who received LIRA injections as part of BDT. In Group III, glycosylated hemoglobin (HbA1c) decreased by 8.5% ($\beta=-0.085$, 95% CI [–0.112; –0.058], $p<0.001$), while in Group II, this parameter was 7.0% lower ($\beta=-0.070$, 95% CI [–0.097; –0.043], $p<0.001$). In contrast, in patients receiving BDT alone, a positive effect was observed with an HbA1c reduction of 3.67% ($p<0.05$). Women in Groups II and III demonstrated significant improvements in both insulin and leptin resistance indicators. The IR index decreased by 23.8% ($\beta=-0.238$, 95% CI [–0.360; –0.117], $p<0.001$) in Group II and by 28.4% ($\beta=-0.284$, 95% CI [–0.405; –0.162], $p<0.001$) in Group III. The LR index decreased by 18.3% ($\beta=-0.183$, 95% CI [–0.314; –0.051], $p=0.007$) and by 30.7% ($\beta=-0.307$, 95% CI [–0.439;–0.176], $p<0.001$), respectively. **Conclusions.** The timely administration of DAPA (10 mg/day) or LIRA (0.6–3.0 mg/day) as part of BDT in reproductive-age women with prediabetes should be considered an effective personalized approach to treatment. This approach serves as a preventive measure against the progression of IR, LR, and the development of T2D.

Keywords: prediabetes, reproductive-age women, sodium-glucose cotransporter 2 inhibitors (dapagliflozin), glucagon-like peptide 1 receptor agonists (liraglutide).

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For a long time, the population of Ukraine has been experiencing the devastating effects of stress factors that negatively impact fertility potential. A large number of young people are diagnosed with comorbid diseases, including disorders of carbohydrate and lipid metabolism, excess body weight or obesity, hypertension, eating disorders, vitamin D deficiency states, and other pathologies. Stress factors contribute to disturbances in carbohydrate metabolism, which in turn initiate a cascade of metabolic changes, leading to the development and progression of IR and LR syndromes [1-3]. These comorbid conditions are accompanied by excessive calorie intake, resulting in an increased incidence of obesity. According to current scientific research trends, prediabetes is also considered one of the key clusters contributing to infertility in reproductive-age women. Preserving women’s reproductive potential in the context of the growing prevalence of metabolic disorders, particularly prediabetes, requires a deep understanding of the pathogenetic chains of influence on reproductive function. One of the key factors is hyperinsulinemia, which disrupts the function of the hypothalamic-pituitary-ovarian axis, causing a decrease in gonadotropin secretion, disruption of the ovulatory cycle, and the development of anovulation. In addition, excess insulin stimulates the production of androgens by theca cells of the ovaries and reduces the concentration of sex hormone-binding globulin, contributing to the development of hyperandrogenism. In this regard, reproductive-age women often have comorbidities of prediabetes and polycystic ovary syndrome (PCOS). Even a moderate increase in blood glucose levels leads to the formation of chronic oxidative stress, which damages the vascular endothelium and disrupts microcirculatory processes in the tissues of the ovaries and endometrium. This adversely affects folliculogenesis, the implantation process, and may reduce the likelihood of conception and pregnancy maintenance. The activation of inflammatory processes at the prediabetes stage is manifested by elevated levels of pro-inflammatory cytokines, in particular interleukin-6 and tumor necrosis factor-α (TNF-α), which are associated with ovulation disorders and an increased risk of early reproductive losses. In addition, prediabetes indirectly impairs oocyte quality by disrupting glucose metabolism in granulosa cells, which play a key role in providing energy for follicular maturation and egg development. Disruption of energy homeostasis in oocytes can cause genetic instability, a decrease in morpho-functional characteristics, and, as a result, a decrease in reproductive potential [4, 5].

At present, the scientifically substantiated concept of timely correction of carbohydrate metabolism disorders focuses on overcoming the main metabolic challenges of IR syndrome in women of reproductive age [6]. The relevance of this study is determined by the growing need to develop and improve patient-oriented treatment algorithms for prediabetes to enhance fertility potential in reproductive-age women.

According to a comparative analysis of different SGLT2i, it has been established that DAPA effectively prevents the development of T2D in one out of three patients. In the meta-analysis of the studies «Dapagliflozin and Prevention of Adverse Outcomes in Heart Failure» (DAPA-HF, n=2605 individuals without T2D) and the combined analysis of DAPA-HF and «Dapagliflozin And Prevention of Adverse Outcomes in Chronic Kidney Disease» (DAPA-CKD, n=4003 patients with prediabetes and normoglycemia), a relative risk reduction of new T2D cases was confirmed in patients receiving DAPA by 32.0% (HR 0.68; 95% CI: 0.50-0.94, p=0.019) and 33.0% (HR 0.67; 95% CI: 0.51-0.88, p=0.0040), respectively [7, 8].

A recent meta-analysis revealed that GLP-1 RAs significantly prevent the occurrence of new T2D cases (RR=0.28, 95% CI: 0.19-0.43, p<0.00001), as well as significantly reduce HbA1C levels, fasting plasma glucose (FPG), body weight (BW), waist circumference (WC), and lipid profile indicators (triglycerides (TG) and low-density lipoprotein cholesterol (LDL-C)) [9].

The results of a 52-week randomized clinical trial demonstrated the efficacy and safety of LIRA injections in women with a history of gestational diabetes for prediabetes prevention. Specifically, the number of women with prediabetes decreased from 64% to 10% in the LIRA group compared to a reduction to only 50% in the placebo group (adjusted odds ratio – 0.10 [0.03–0.032], p=0.002) [10]. Real-world clinical practice findings indicate that LIRA injections contribute to effective weight loss and prediabetes remission even among patients preparing for metabolic surgery [11-13].

Aim: To evaluate the effectiveness of a 12-week course of treatment with SGLT2i (DAPA) and GLP 1RAs (LIRA) for prediabetes in reproductive-age women.

Material and methods

The study was conducted in compliance with current ethical standards, adhering to the main provisions of the Helsinki Declaration on Human Rights and the Council of Europe Convention on Human Rights and Biomedicine. The study included 42 female patients aged 19-45 years with prediabetes undergoing treatment at the endocrinology and outpatient departments of the Ivano-Frankivsk Regional Clinical Hospital. Upon providing written informed consent for participation, all participants underwent a comprehensive set of clinical, laboratory, and instrumental examinations.

Inclusion criteria: women of reproductive aged 18-45 years diagnosed with prediabetes who over the past three months, adhered to behavioral strategies for a healthy lifestyle and general principles of healthy nutrition, limiting the consumption of easily digestible carbohydrates and animal fats.

Exclusion criteria:

- women over 45 years of age;
- male individuals;
- type 1 and type 2 diabetes;
- ketoacidosis or ketoacidotic coma of any genesis;
- episodes of hypoglycemia or hypoglycemic coma;
- thyroid or adrenal dysfunction;
- history of bariatric surgery;
- use of hormone replacement therapy, cytostatic drugs, vitamin D_3, inositol, or multivitamin complexes containing these within the last three months before screening;
- severe somatic diseases;
- pregnancy or lactation;
- alcohol or drug dependence;
- known contraindications to the study medications;
- legal incapacity or limited legal capacity.

According to the Ministry of Health of Ukraine Order No. 1300 dated 24.07.2024, «Unified Clinical Protocol for Primary and Specialized Medical Care: Type 2 Diabetes in Adults», and the annually updated standards of the American Diabetes Association, laboratory criteria for carbohydrate metabolism disorders include [14, 15]:

- Prediabetes was diagnosed at an HbA1c level of 5.7–6.4%;
- Impaired fasting glucose was identified at an FPG level of 5.6–6.9 mmol/L, while impaired glucose tolerance was diagnosed at a blood glucose level of 7.8–11.0 mmol/L two hours after an oral glucose tolerance test.

Anthropometric and body composition analyses were performed using bioelectrical impedance analysis with the Tanita BC-601 body composition monitor (Japan). The following parameters were assessed: total body fat percentage (BFP, %), visceral body fat percentage (VBFP, units), fat-free mass (FFM, %), bone mass (kg), muscle mass (kg), metabolic age (years), as well as BMI (kg/m^2), waist circumference (WC, cm), hip circumference (HC, cm), and visceral adiposity index (VAI).

Diagnostic interviews were conducted using a validated and adapted questionnaire for detecting PCOS [16]. If a positive result was obtained, further diagnostic evaluations were conducted according to international guidelines for PCOS assessment and treatment [17], followed by a gynecologist consultation.

Eating behavior disorders, including night eating syndrome (NES), were screened using the validated and adapted Night Eating Questionnaire (NEQ). The NEQ comprises 14 questions assessing four key NES components: nighttime food consumption, evening hyperphagia, morning anorexia, and mood/sleep disturbances. A total score of ⩾25 indicates a likelihood of NES, while a score of ⩾30 is diagnostic [18, 19].

Specific parameters were determined using calculation methods:

1. VAI – a sex-specific parameter that considers anthropometric indicators, metabolic criteria, and empirical coefficients [20]:

$$VAI = \left(\frac{WC}{36.58 + (1.89 \times BMI)}\right) \times \left(\frac{TG}{0.81}\right) \times \left(\frac{1.52}{HDL - C}\right),$$

where WC – waist circumference (cm); BMI – body mass index (kg/m^2); TG – triglycerides (mmol/L); HDL-C – high-density lipoprotein cholesterol (mmol/L).

Reference values for VAI in women depending on age:

- up to 30 years – VAI <2.52,
- 31–42 years – VAI <2.23,
- 43–52 years – VAI <1.9,
- 53–66 years – VAI <1.93,
- over 67 years – VAI <2.00.

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2. IR: HOMA-IR Index (Homeostasis Model Assessment for IR):

$$\text{HOMA} - \text{IR} = \frac{FPG \text{ x } FPI}{22.5}$$

where FPG – fasting plasma glucose (mmol/L);

FPI – fasting plasma insulin (μU/mL).

The reference norm for the HOMA-IR index is considered to be no higher than 2.77.

3. Leptin Resistance:

$$\text{Leptin Resistance Index (LRI)} = \frac{Leptin}{TG},$$

where TG – triglycerides. The reference value for the LRI is below 2.7 [21, 22].

Table 1 presents the baseline characteristics of reproductive-age women with prediabetes who participated in the study

Table 1. Baseline characteristics of the studied reproductive-age women (n=42)

Parameters	Studied reproductive-age women
Age, years	34.06±6.73
Duration of prediabetes, months	15.60±9.58
Smoking status: current (n, %)	13 (30.95)
Polycystic ovary syndrome (n, %)	20 (47.62)
Night eating questionnaire, total score	25.38±7.77
Night eating syndrome (n, %)	21 (50.00)
BMI, kg/m^2	34.97±3.16
VAI	7.35±0.69
Waist circumference, cm	98.50±6.85
BFP, %	44.39±4.05
Visceral body fat percentage, unit	55.98±3.73
Impaired body weight profile	55.98±3.73
Overweight (n, %)	2 (4.76)
Class I obesity (n, %)	22 (52.38)
Class II obesity (n, %)	15 (35.72)
Class III obesity (n, %)	3 (7.14)
The main metabolism, kcal	1987.93±198.51
Glycated hemoglobin, %	6.05±0.25
Fasting plasma glucose, mmol/L	6.32±0.45
HOMA-IR	7.24±1.47
LR index	8.18±1.86
Thyroid-stimulating hormone, mU/L	2.31±0.37
Vitamin D, ng/mL	19.60±2.15
Vitamin D insufficiency (n, %)	19 (45.24)
Vitamin D deficiency (n, %)	23 (54.76)

It has been established that vitamin D deficiency significantly affects carbohydrate and lipid metabolism disorders, promotes the development of IR, and contributes to obesity progression. All examined women were found to have hypovitaminosis D: 54.76% had a vitamin D deficiency, while 45.24% had insufficient levels. In the presence of IR and LR, half of the participants were diagnosed with NES. Body composition abnormalities were observed in all women: 4.76% were overweight, while 95.24% were obese. PCOS was diagnosed in 47.62% of reproductive-aged women with prediabetes. Notably, the metabolic age of the patients was twice their biological age, indicating significant metabolic disorders.

Reproductive-aged women who met the inclusion criteria were randomized into study groups according to the prediabetes treatment algorithm: Group I (n=14) received BDT: metformin (500–2000 mg/day), alpha-lipoic acid (600 mg/day), cholecalciferol (vitamin D3) (800–10,000 IU/day), and inositol (2000 mg/day). Group II (n=14) received BDT combined with an SGLT2i (DAPA – 10 mg/day). Group III (n=14) received BDT combined with subcutaneous GLP-1 receptor agonist injections (LIRA) at a daily dose of 0.6–3.0 mg).

Following standard protocols and adhering to all national and international regulations, comprehensive diagnostic and therapeutic procedures were conducted for all patients at baseline and after 12 weeks. This was confirmed by the ethics committee of Ivano-Frankivsk National Medical University (Protocol No. 139/23 dated 16.11.2023).

The statistical analysis was performed using Python 3.11 with the statsmodels, numpy, zepid, and scipy.stats libraries. The Shapiro-Wilk test was used to assess the normality of data distribution. Categorical variables were analyzed using the χ^2 test, while quantitative variables were assessed using the Student's t-test for normally distributed data or the Mann-Whitney test for non-normal distributions. The impact of treatment on studied parameters was evaluated using a Generalized Linear Model, accounting for baseline values to ensure accurate adjustment for initial variables. Statistical significance was defined as $p<0.05$.

Results and discussion

The modern approach to prediabetes treatment in reproductive-aged women focuses on controlling and correcting metabolic disorders, particularly improving insulin sensitivity, reducing leptin levels, decreasing plasma atherogenicity, enhancing glucose tolerance, preventing the progression of eating disorders (NES), and normalizing body weight [23, 24]. This supports the rationale for prescribing BDT with DAPA or LIRA to normalize metabolic parameters.

According to the NEQ survey, in Group I (BDT alone), NES prevalence increased from 57.10% to 64.30%. The addition of DAPA to BDT reduced NES frequency by half (42.90% to 21.40%). Meanwhile, in Group III, no NES symptoms were observed after treatment (50.00% to 0.00%). After 12 weeks of treatment, compared to Group I, the NEQ score decreased by 26.3% in reproductive-aged women with prediabetes who received DAPA alongside BDT ($\beta=-0.263$, 95% CI [−0.459; −0.067], p=0.009). The addition of LIRA to BDT resulted in a significantly greater reduction of 55.3% ($\beta=-0.553$, 95% CI [−0.749; −0.357], p<0.001).

Recent studies suggest that SGLT2 inhibitors (e.g., dapagliflozin) indirectly reduce appetite by alleviating IR in individuals with carbohydrate metabolism disorders and obesity [25–27]. Additionally, substantial evidence indicates that LIRA is a physiological regulator of food intake and appetite, enhancing satiety and reducing hunger, with a positive effect on NES [28–30]. Notably, our findings align with most published research data.

The primary integrated anthropometric parameters indicating IR, LR, and a high risk of metabolic complications progression in prediabetic women include BMI, WC, and VAI, along with body composition assessment, particularly VBF% and TBF%. Therefore, during the treatment process, changes in several key parameters were analyzed **(Table 2)**.

Table 2. Dynamics of selected anthropometric and body composition parameters in reproductive-aged women with prediabetes

Indicators	Treatment	Research group			Reliability coefficient, p		
		I (n=14)	II (n=14)	III (n=14)	I-II	I-III	II-III
BMI, kg/m^2	before	34.59 (32.36; 35.91)	34.57 (33.56; 36.31)	34.45 (32.77; 37.65)	0.696	0.448	0.696
	after	34.55 (33.86; 36.38)	31.04 (29.79; 32.08)	31.96 (28.96; 32.66)	0.001	0.006	0.662
	Δ%, p	1.55% p=0.663	-11.17%, p<0.001	-13.27%, p<0.001			
Waist circumference, cm	before	99.00 (92.00; 103.75)	102.00 (96.00; 105.75)	95.00 (94.00; 101.00)	0.475	0.800	0.146
	after	99.00 (94.00; 103.75)	91.00 (87.25; 97.75)	89.00 (86.25; 95.00)	0.048	0.004	0.300
	Δ%, p	0.58% p=0.842	-7.28% p=0.018	-7.77% p=0.004			
VAI	before	7.54 (7.06; 8.12)	7.04 (6.81; 7.24)	7.22 (7.01; 7.85)	0.168	0.408	0.301
	after	5.33 (4.88; 6.71)	3.54 (3.03; 3.83)	3.01 (2.84; 3.47)	<0.001	<0.001	0.206
	Δ%, p	-23.18% p<0.001	-51.60% p<0.001	-55.41% p<0.001			
BFP, %	before	44.50 (39.81; 46.17)	45.09 (41.69; 46.37)	44.30 (42.75; 48.64)	0.662	0.462	0.448
	after	44.53 (41.13; 45.68)	39.59 (36.20; 41.59)	40.83 (38.77; 42.65)	0.004	0.033	0.421
	Δ%, p	1.47% p=0.663	-10.60% p<0.001	-12.45% p<0.001			
VBFP, unit	before	56.25 (52.44; 58.83)	57.89 (54.62; 59.92)	54.08 (53.53; 57.34)	0.475	0.800	0.146
	after	56.25 (53.53; 58.84)	51.89 (49.86; 55.57)	50.81 (49.31; 54.07)	0.048	0.004	0.300
	Δ%, p	0.56% p=0.842	-6.97% p=0.018	-7.43% p=0.004			

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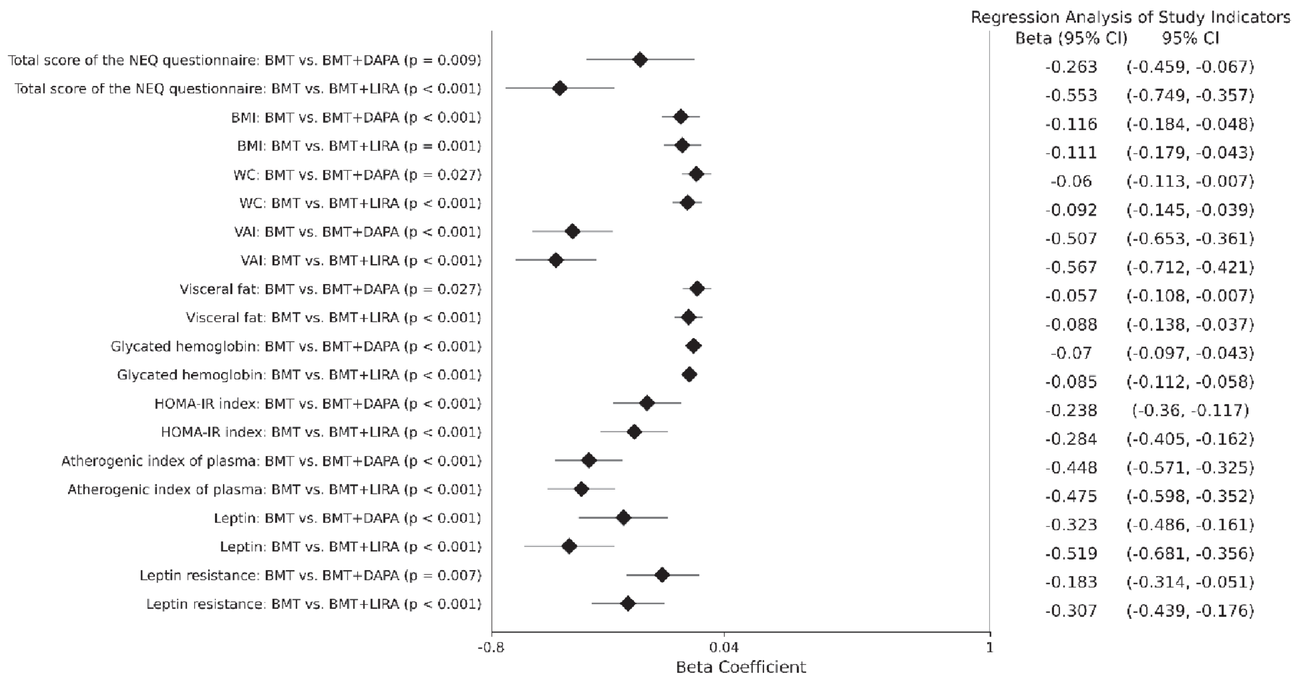

Figure. Regression analysis diagram of certain studied parameters in reproductive-aged women with an intergroup comparison based on prediabetes pharmacotherapy algorithms.

A linear regression analysis of specific studied parameters was conducted in reproductive-aged women with prediabetes, with an intergroup comparison depending on the applied pharmacotherapy algorithms (**Fig.**).

After 12 weeks of treatment, all study groups showed positive multidirectional changes in body mass profile. Notably, only in reproductive-aged women with prediabetes who received BMT combined with LIRA injections, 7.10% reached the reference BMI values. The proportion of individuals with class II obesity decreased from 21.40% to 14.30%, while the number of patients with class I obesity declined from 57.10% to 50.00%. In contrast, among those receiving BDT alone, 14.30% of women with prediabetes and excess weight progressed to class I obesity, making up 57.10% of patients in Group I. Meanwhile, the percentage of individuals with class II obesity remained unchanged at 42.90%. In Group II, a reduction in body weight was observed: 28.60% had excess weight, 64.30% had class I obesity, and only 7.10% had class II obesity. Importantly, across all patient groups, regardless of the prescribed treatment algorithm, no cases of class III obesity were recorded.

Among patients in Groups II and III, a significant reduction in BMI was observed: 11.6% (β=−0.116, 95% CI [−0.184; −0.048], $p<0.001$) and 11.1% (β=−0.111, 95% CI [−0.179; −0.043], $p=0.001$), respectively. The average WC values in Group II patients were 6.0% lower (β=−0.060, 95% CI [−0.113; −0.007], $p=0.027$), while in Group III, this difference was 9.2% (β=−0.092, 95% CI [−0.145; −0.039], $p<0.001$).

Compared to Group I, patients receiving DAPA in combination with BDT exhibited a 50.7% reduction in VAI (β=−0.507, 95% CI [−0.653; −0.361], $p<0.001$). In patients prescribed BDT and LIRA, the VAI index was 56.7% lower (β=−0.567, 95% CI [−0.712; −0.421], $p<0.001$). A similar significant positive trend was observed in Groups II and III regarding VBFP: it was 5.7% lower in women receiving BDT and DAPA (β=−0.057, 95% CI [−0.108; −0.007], $p=0.027$) and 8.8% lower in patients treated with BDT and LIRA injections (β=−0.088, 95% CI [−0.138; −0.037], $p<0.001$).

A significant reduction in carbohydrate metabolism laboratory parameters was recorded in reproductive-aged women, depending on the prescribed prediabetes treatment algorithm (**Table 3**).

The best dynamics in carbohydrate metabolism compensation was achieved in Group III, where HbA1c levels decreased by 8.5% (β=−0.085, 95% CI [−0.112; −0.058], $p<0.001$). In Group II, this indicator was 7.0% lower (β=−0.070, 95% CI [−0.097; −0.043], $p<0.001$). Additionally, in patients who received BDT alone, a positive result was observed with an HbA1c reduction of 3.67% ($p<0.05$).

Table 3. Dynamics of selected laboratory indicators of carbohydrate metabolism in reproductive-aged women with prediabetes

Indicators	Treatment	Research group			Reliability coefficient, p		
		I (n=14)	II (n=14)	III (n=14)	I-II	I-III	II-III
Glycated hemoglobin, %	before	5.95 (5.87; 6.15)	6.04 (5.88; 6.24)	6.02 (5.93; 6.27)	0.679	0.629	0.872
	after	5.80 (5.69; 5.93)	5.45 (5.24; 5.58)	5.37 (5.14; 5.49)	<0.001	<0.001	0.29
	Δ%, p	-3.67% p=0.022	-10.95% p<0.001	-11.93% p<0.001			
Fasting plasma glucose, mmol/L	before	6.35 (6.09; 6.69)	6.47 (6.05; 6.77)	6.16 (5.93; 6.62)	0.679	0.505	0.369
	after	5.90 (5.80; 6.00)	5.20 (5.10; 5.30)	5.15 (5.03; 5.35)	<0.001	<0.001	0.797
	Δ%, p	-5.84% p=0.026	-18.98% p<0.001	-17.14% p<0.001			
Insulin, U/mL	before	25.40 (20.05; 28.52)	28.00 (23.30; 29.68)	26.70 (24.90; 29.88)	0.280	0.358	1.000
	after	25.20 (22.10; 26.75)	22.85 (19.75; 25.68)	22.05 (19.68; 23.30)	0.103	0.016	0.408
	Δ%, p	3.12% p=0.696	-15.90% p=0.018	-19.00% p=0.011			
HOMA-IR	before	7.12 (5.49; 8.17)	7.71 (6.91; 8.11)	7.64 (6.62; 8.65)	0.241	0.301	0.765
	after	6.60 (5.90; 7.16)	5.33 (4.57; 5.87)	4.92 (4.35; 5.40)	0.002	<0.001	0.476
	Δ%, p	-2.33% p=0.760	-31.83% p<0.001	-33.04% p<0.001			
Leptin, ng/mL	before	16.87 (15.18; 18.94)	19.34 (16.13; 20.21)	16.46 (15.01; 19.22)	0.270	0.836	0.312
	after	12.81 (10.79; 15.05)	9.27 (8.83; 11.14)	7.70 (6.95; 9.69)	0.001	<0.001	0.113
	Δ%, p	-23.73% p=0.004	-47.49% p<0.001	-53.23% p<0.001			
LR index	before	8.09 (6.96; 8.62)	8.73 (7.54; 10.07)	7.79 (6.75; 9.32)	0.301	0.909	0.476
	after	6.55 (5.53; 6.76)	5.09 (4.72; 6.03)	4.86 (4.17; 5.00)	0.009	<0.001	0.113
	Δ%, p	-20.78% p=0.001	-38.78% p<0.001	-41.90% p<0.001			

A key marker of metabolic complications in individuals with prediabetes is reduced tissue sensitivity to insulin/leptin and the progression of IR/LR. After 12 weeks of treatment, the HOMA-IR index decreased by 23.8% in Group II (β= −0.238, 95% CI [−0.360; −0.117], p<0.001) and by 28.4% in Group III (β=−0.284, 95% CI [−0.405; −0.162], p<0.001). Among women receiving BDT alone, there was a positive trend toward normalization of this indicator (Δ−2.33%, p>0.5).

A reduction in leptin concentration is considered an indirect sign of normalization of eating behavior disorders, particularly NES, as it indicates improved insulin sensitivity, decreased body weight, and reduced VBFP [31, 32].

After three months of treatment, leptin levels in Group III patients receiving BDT in combination with LIRA decreased by 51.9% (β=−0.519, 95% CI [−0.681; −0.356], p<0.001), while in Group II, where patients received BDT and DAPA, leptin lev-

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els decreased by 32.3% (β=−0.323; 95% CI [−0.486; −0.161], p<0.001). In Group I, a less pronounced positive result was achieved (Δ−23.73%, p<0.005). A similar positive trend in LR laboratory indicators was observed in Group II, where the LR index decreased by 18.3% (β=−0.183, 95% CI [−0.314; −0.051], p=0.007). Meanwhile, in reproductive-age women with prediabetes receiving BDT combined with LIRA injections, this indicator decreased by 30.7% (β=−0.307, 95% CI [−0.439; −0.176], p<0.001) (Fig.).

In most cases, comprehensive treatment of prediabetes and metabolic disorders, which includes restoring cellular insulin sensitivity, reducing LR, and decreasing body weight through VBFP reduction, contributes to the normalization of lipid profile indicators. A decrease in the following levels was recorded across all groups: total cholesterol: Group I - Δ−3.99% (p>0.5); Group II – Δ−17.43% (p<0.001); Group III - Δ−14.38% (p<0.01). Triglycerides: Group I – Δ−5.00% (p>0.5); Group II – Δ−15.48% (p<0.01); Group III – Δ−20.49% (p<0.001). Low-density lipoprotein cholesterol: Group I – Δ−9.82% (p>0.5); Group II – Δ−34.53% (p<0.001); Group III – Δ−28.19% (p<0.001). Very low-density lipoprotein cholesterol: Group I – Δ−4.96% (p>0.5); Group II – Δ−15.58% (p<0.01); Group III - Δ−20.58% (p<0.001). After 12 weeks of therapy, a significant increase in high-density lipoprotein cholesterol levels was observed in all study groups: Group I – an increase of 26.08% (p<0.001); Groups II and III – an increase of 65.08% and 66.02%, respectively (p<0.001) (**Table 4**).

Table 4. Dynamics of selected laboratory indicators of lipid metabolism in reproductive-aged women with prediabetes

Indicators	Treatment	Research group			Reliability coefficient, p		
		I (n=14)	II (n=14)	III (n=14)	I-II	I-III	II-III
Total cholesterol, mmol/L	before	5.65 (5.34; 6.01)	5.83 (5.49; 6.04)	5.75 (5.46; 6.16)	0.491	0.597	0.982
	after	5.32 (5.18; 5.53)	4.74 (4.63; 5.04)	5.05 (4.79; 5.30)	<0.001	0.033	0.141
	Δ%, p	-3.99% p=0.313	-17.43% p<0.001	-14.38% p=0.002			
Triglycerides, mmol/L	before	2.20 (1.99; 2.31)	2.13 (2.00; 2.25)	2.10 (1.94; 2.21)	0.462	0.357	0.836
	after	2.13 (1.86; 2.22)	1.85 (1.71; 1.90)	1.67 (1.52; 1.77)	0.007	<0.001	0.089
	Δ%, p	-5.00% p=0.258	-15.48% p=0.001	-20.49% p<0.001			
High-density lipoprotein cholesterol, mmol/L	before	0.78 (0.71; 0.85)	0.78 (0.76; 0.87)	0.76 (0.71; 0.83)	0.420	0.695	0.269
	after	0.98 (0.91; 1.06)	1.32 (1.25; 1.44)	1.31 (1.23; 1.35)	<0.001	<0.001	0.334
	Δ%, p	26.08% p<0.001	65.08% p<0.001	66.02% p<0.001			
Low-density lipoprotein cholesterol, mmol/L	before	3.71 (3.50; 4.28)	4.10 (3.87; 4.29)	3.88 (3.76; 4.58)	0.448	0.408	0.945
	after	3.36 (3.19; 3.83)	2.62 (2.35; 2.95)	3.02 (2.89; 3.13)	<0.001	0.007	0.098
	Δ%, p	-9.82% p=0.123	-34.53% p<0.001	-28.19% p<0.001			
Very low-density lipoprotein cholesterol, mmol/L	before	1.00 (0.91; 1.05)	0.96 (0.91; 1.02)	0.95 (0.88; 1.00)	0.491	0.433	0.836
	after	0.97 (0.85; 1.01)	0.84 (0.78; 0.86)	0.76 (0.69; 0.81)	0.006	<0.001	0.084
	Δ%, p	-4.96% p=0.264	-15.58% p=0.001	-20.58% p<0.001			
Atherogenic index of plasma	before	2.82 (2.70; 2.90)	2.67 (2.42; 2.74)	2.73 (2.65; 2.87)	0.036	0.448	0.123
	after	2.09 (1.88; 2.37)	1.40 (1.25; 1.48)	1.27 (1.18; 1.45)	<0.001	<0.001	0.597
	Δ%, p	-23.81% p<0.001	-48.08% p<0.001	-51.80% p<0.001			

The average AIP values significantly decreased both in women of Group III and Group II of the study - by 47.50% (β=−0.475; 95% CI [−0.598; −0.352], p< 0.001) and 44.80% (β=−0.448; 95% CI [−0.571; −0.325], p<0.001), respectively.

The results of our study regarding lipid metabolism indicators in reproductive-aged women with prediabetes, depending on the prescribed treatment algorithm, align with the data presented in the works of other researchers [33-35].

It should be noted that regardless of the personalized approach, during the 12-week course of drug treatment, no symptoms of hypoglycemia or other adverse events were diagnosed in any of the patients.

Therefore, adding DAPA (10 mg/day) or LIRA (0.6-3.0 mg/day subcutaneously) to BDT in reproductive-aged women with prediabetes is a justified precautionary measure to prevent the development of T2D and reduce manifestations of IR, and LR.

Conclusions

1. In 47.62% of the studied reproductive-aged women with prediabetes, PCOS was diagnosed. Screening for PCOS should be performed in all women with prediabetes and/or signs of IR or LR, which will help preserve fertility in this category of patients.
2. Timely prescribing DAPA (10 mg/day) or LIRA (0.6-3.0 mg/day) as part of BDT for reproductive-aged women with prediabetes should be considered effective personalized treatment approaches, serving as preventive measures against the progression of IR, LR, and the development of T2D.

References

1. Соколова ЛК, Пушкарьов ВМ, Тронько МД. Предіабет і метаболічний синдром. Характеристика і маркери. Ендокринологія. 2021;26(2):179-87 (Sokolova LK, Pushkarev VM, Tronko MD. Prediabetes and metabolic syndrome. Characteristics and markers. Endokrynologia. 2021;26(2):179-87. Ukrainian). doi: 10.31793/1680-1466.2021.26-2.179.
2. Орленко ВЛ, Іваськіва КЮ, Добровинська ОВ, Тронько КМ, Болгарська СВ, Прохорова ГО. Удосконалені методи лікування хворих на ожиріння на основі вивчення деяких патогенетичних чинників цього захворювання. Ендокринологія. 2023;28(2):136-50 (Orlenko VL, Ivaskiva KY, Dobrovynska OV, Tronko KM, Bolgarska SV, Prohorova GO. Improved methods for treatment of patients with obesity based on the study of some pathogenetic factors of this disease. Endokrynologia. 2023;28(2):136-50. Ukrainian). doi:10.31793/1680-1466.2023.28-2.136.
3. Чернявська ІВ, Кравчун НО, Дунаєва ІП, Тиха ІА, Олійникова СП, Рассолова СП. Взаємозв’язок гіперлептинемії та кардіометаболічного ризику в осіб з ожирінням. Міжнародний ендокринологічний журнал. 2024;20(1):53-7 (Chernyavska I, Kravchun N, Dunaieva I, Tykha I, Oliynikova S, Rassolova O. Relationship between hyperleptinemia and cardiometabolic risk in persons with obesity. International Journal of Endocrinology (Ukraine). 2024;20(1):53-7. Ukrainian). doi:10.22141/2224-0721.20.1.2024.1358.
4. Shapiro AJ, Holden EC, McGovern PG, Alderson D, Morelli SS. Comparison of 2-hour oral glucose tolerance test and hemoglobin A1C in the identification of pre-diabetes in women with infertility and recurrent pregnancy loss. Clin Med Insights Reprod Health. 2019 Mar 22;13:1179558119831280. doi: 10.1177/1179558119831280.
5. Lazaridou S, Dinas K, Tziomalos K. Prevalence, pathogenesis and management of prediabetes and type 2 diabetes mellitus in patients with polycystic ovary syndrome. Hormones (Athens). 2017 Oct;16(4):373-80. doi: 10.14310/horm.2002.1757.
6. Papaetis GS, Kyriacou A. GLP-1 receptor agonists, polycystic ovary syndrome and reproductive dysfunction: current research and future horizons. Adv Clin Exp Med. 2022 Nov;31(11):1265-74. doi: 10.17219/acem/151695.
7. Inzucchi SE, Docherty KF, Køber L, Kosiborod MN, Martinez FA, Ponikowski P, et al. Dapagliflozin and the incidence of type 2 diabetes in patients with heart failure and reduced ejection fraction: an exploratory analysis from DAPA-HF. Diabetes Care. 2021 Feb;44(2):586-94. doi:10.2337/dc20-1675.
8. Rossing P, Inzucchi SE, Vart P, Jongs N, Docherty KF, Jhund PS, et al; DAPA-CKD and DAPA-HF Trial Committees and Investigators. Dapagliflozin and new-onset type 2 diabetes in patients with chronic kidney disease or heart failure: pooled analysis of the DAPA-CKD and DAPA-HF trials. Lancet Diabetes Endocrinol. 2022 Jan;10(1):24-34. doi: 10.1016/S2213-8587(21)00295-3.
9. Salamah HM, Marey A, Abugdida M, Abualkhair KA, Elshenawy S, Elhassan WAF, et al. Efficacy and safety of glucagon-like peptide-1 receptor agonists on prediabetes: a systematic review and meta-analysis of randomized controlled trials. Diabetol Metab Syndr. 2024 Jun 14;16(1):129. doi: 10.1186/s13098-024-01371-3.
10. Forman JL, Mathiesen ER, Svare JA, Clausen TD, Damm P, Holst JJ, et al. Liraglutide treatment for the prevention of glucose tolerance deterioration in women with prior gestational diabetes mellitus: A 52-week randomized controlled clinical trial. Diabetes Obes Metab. 2024 Jan;26(1):201-14. doi: 10.1111/dom.15306.
11. Wilmington R, Ardavani A, Simenacz A, Green C, Idris I. Liraglutide 3.0 mg (Saxenda©) for weight loss and remission of pre-diabetes. Real-world clinical evaluation of effectiveness among patients awaiting bariatric surgery. Obes Surg. 2024 Jan;34(1):286-9. doi: 10.1007/s11695-023-06895-7.
12. Grannes H, Ueland T, Simeone P, Liani R, Guagnano MT, Aukrust P, et al. Liraglutide and not lifestyle intervention reduces soluble CD163 after comparable weight loss in obese participants with prediabetes or type 2 diabetes mellitus. Cardiovasc Diabetol. 2024 Apr 29;23(1):146. doi: 10.1186/s12933-024-02237-8.
13. Лембрик ІС, Костіцька ІО, Жиляк ОВ, Сарецян Е., Кулинич ДО, Шелевер СА, Хруняк ЮТ. Дисфункція гіпоталамуса пубертатного віку: епідеміологія, чинники ризику, особливості клінічного перебігу та наслідки патології у дорослих. Міжнародний ендокринологічний журнал. 2025;21(1):50-6 (Lembryk IS, Kostitska IO, Zhyliak OV, Saretsian EA, Kulynych DO, Shelever SA, Khruniak YuT. Pubertal hypothalamic dysfunction: epidemiology, risk factors, features of the clinical course and consequences of pathology in adults. International Journal of Endocrinology (Ukraine). 2025;21(1):50-6. Ukrainian). doi:10.22141/2224-0721.21.1.2025.1491.
14. Клінічна настанова, заснована на доказах «Цукровий діабет» [інтернет]. Київ, 2022 [цитовано 1 лютого 2025 року] (Evidence-based clinical guideline «Diabetes mellitus» [Internet]. Kyiv, 2022 [cited 2025 Feb 1]. Ukrainian). Available from: https://www.dec.gov.ua/wp-content/uploads/2023/01/2023_nastanova-czd_dorosli.pdf.
15. American diabetes association professional practice committee. 2. Diagnosis and classification of diabetes: standards of care in diabetes-2024. Diabetes Care. 2024 Jan 1;47(Suppl 1):S20-S42. doi: 10.2337/dc24-S002.
16. Pedersen SD, Brar S, Faris P, Corenblum B. Polycystic ovary syndrome: validated questionnaire for use in diagnosis. Can Fam Physician. 2007 Jun;53(6):1042-7, 1041.

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17. Teede HJ, Tay CT, Laven JJE, Dokras A, Moran LJ, Piltonen TT, et al.; International PCOS Network. Recommendations from the 2023 international evidence-based guideline for the assessment and management of polycystic ovary syndrome. Eur J Endocrinol. 2023 Aug 2;189(2):G43-G64. doi: 10.1093/ejendo/lvad096.
18. Ланюш ФВ, Урбанович АМ. Опитувальник для визначення синдрому нічного переїдання (NEQ) – валідація та адаптація для української популяції. Ендокринологія. 2021;26(3):311-18 (Laniush FV, Urbanovych AM. Night-Eating Questionnaire (NEQ) – validation and adaptation for the Ukrainian population. Endokrynologia. 2021;26(3):311-18. Ukrainian). doi:10.31793/1680-1466.2021.26-3.311.
19. Nolan LJ, Geliebter A. Validation of the Night Eating Diagnostic Questionnaire (NEDQ) and its relationship with depression, sleep quality, «food addiction», and body mass index. Appetite. 2017 Apr 1;111:86-95. doi: 10.1016/j.appet.2016.12.027.
20. Luo Y, Zhan X, Liu Y, Chen L, Zhu L, Cai W. Predicted visceral adiposity index in relation to risk of coronary heart disease and all-cause mortality: insights from NHANES. Front Endocrinol (Lausanne). 2024 Jan 8;14:1296398. doi: 10.3389/fendo.2023.1296398.
21. Silha JV, Krsek M, Skrha JV, Sucharda P, Nyomba BL, Murphy LJ. Plasma resistin, adiponectin and leptin levels in lean and obese subjects: correlations with insulin resistance. Eur J Endocrinol. 2003 Oct;149(4):331-5. doi: 10.1530/eje.0.1490331.
22. Li Y, Chen X, Gong X, Yao J, He D, Du W. Effect of gender on serum leptin in type 2 diabetes mellitus: a system review and meta-analysis. Comput Math Methods Med. 2022 Sep 10;2022:4875799. doi: 10.1155/2022/4875799.
23. Teede HJ, Tay CT, Laven JJE, Dokras A, Moran LJ, Piltonen TT, et al. Recommendations from the 2023 international evidence-based guideline for the assessment and management of polycystic ovary syndrome. Fertil Steril. 2023 Oct;120(4):767-93. doi: 10.1016/j.fertnstert.2023.07.025.
24. Busetto L, Dicker D, Frühbeck G, Halford JCG, Sbraccia P, Yumuk V, et al. A new framework for the diagnosis, staging and management of obesity in adults. Nat Med. 2024 Sep;30(9):2395-9. doi: 10.1038/s41591-024-03095-3.
25. Veelen A, Andriessen C, Op den Kamp Y, Erazo-Tapia E, de Ligt M, Mevenkamp J, et al. Effects of the SGLT2i dapagliflozin on substrate metabolism in prediabetic insulin resistant individuals: a randomized, double-blind crossover trial. Metabolism. 2023 Mar;140:155396. doi: 10.1016/j.metabol.2022.155396.
26. Ng HY, Leung FF, Kuo WH, Lee WC, Lee CT. Dapagliflozin and xanthine oxidase inhibitors improve insulin resistance and modulate renal glucose and urate transport in metabolic syndrome. Clin Exp Pharmacol Physiol. 2021 Dec;48(12):1603-12. doi: 10.1111/1440-1681.13574.
27. Hong X, Ma Y, Yang W, Li Y, Tang X, Wang Z. Vitamin D and dapagliflozin alleviate renal injury and insulin resistance in a diet-induced metabolic syndrome rat model. J Biochem Mol Toxicol. 2025 Mar;39(3):e70185. doi: 10.1002/jbt.70185.
28. Mashayekhi M, Nian H, Mayfield D, Devin JK, Gamboa JL, Yu C, et al. Weight loss-independent effect of liraglutide on insulin sensitivity in individuals with obesity and prediabetes. Diabetes. 2024 Jan 1;73(1):38-50. doi: 10.2337/db23-0356.
29. Alsanea S, Alkofide H, Almadi B, Almohammed O, Alwhaibi A, Alrabiah Z, et al. Liraglutide’s effect on weight management in subjects with pre-diabetes: a systematic review & meta-analysis. Endocr Pract. 2024 Aug;30(8):737-45. doi: 10.1016/j.eprac.2024.05.009.
30. Dobbie LJ, Coelho C, Mgaieth F, Chauhan K, Campbell S, Shuriye S, et al. Liraglutide 3.0 mg in the treatment of adults with obesity and prediabetes using real-world UK data: A clinical evaluation of a multi-ethnic population. Clin Obes. 2024 Jun;14(3):e12649. doi: 10.1111/cob.12649.
31. Lent MR, Atwood M, Bennett WL, Woolf TB, Martin L, Zhao D, et al. Night eating, weight, and health behaviors in adults participating in the Daily24 study. Eat Behav. 2022 Apr;45:101605. doi: 10.1016/j.eatbeh.2022.101605.
32. Sa’ari AS, Hamid MRA, ‘Ain Azizan N, Ismail NH. Examining the evidence between screen time and night eating behaviour with dietary intake related to metabolic syndrome: a narrative review. Physiol Behav. 2024 Jun 1;280:114562. doi: 10.1016/j.physbeh.2024.114562.
33. Burggraaf B, Pouw NMC, Fernández Arroyo S, van Vark-van der Zee LC, van de Geijn GM, Birnie E, et al. Effects of dapagliflozin on postprandial lipid metabolism in type 2 diabetes mellitus. Eur J Endocrinol. 2022 Apr 6;186(5):597-605. doi: 10.1530/EJE-21-1270.
34. Zhaohu H, Xiao H, Hailin S, Feng H. Efficacy and safety of dapagliflozin versus liraglutide in patients with overweight or obesity and type 2 diabetes mellitus: a randomised controlled clinical trial in Tianjin, China. J Diabetes Res. 2022 Aug 13;2022:4126995. doi: 10.1155/2022/4126995.
35. Ma J, Fu J, Guo N, Liu Z. Clinical efficacy and safety of liraglutide and dapagliflozin on glucose and lipid metabolism and insulin function in patients with type 2 diabetes mellitus. Altern Ther Health Med. 2024 Aug;30(8):144-51.

Abbreviations

BMI – body mass index
BDT – basic drug therapy
BFP – body fat percentage
DAPA – dapagliflozin
HOMA-IR – Homeostasis Model Assessment for insulin resistance
IR – insulin resistance
GLP-1RAs – glucagon-like peptide 1 receptor agonists
LIRA – liraglutide
LR – leptin resistance
SGLT2i – sodium-glucose cotransporter 2 inhibitors
T2D – type 2 diabetes
VAI – visceral adiposity index
VBFP – visceral body fat percentage

Сучасні тенденції лікування предіабету в жінок репродуктивного віку

М.М. Іваніщак[1,2], І.О. Костіцька[1], І.О. Басюга[1], О.І. Бабенко[1]

[1]Івано-Франківський національний медичний університет
[2] КНП «Обласна клінічна лікарня Івано-Франківської обласної ради»

Резюме. Вступ. Предіабет залишається актуальною медичною та соціальною проблемою сучасності, оскільки його вважають одним із ключових факторів, що підвищує ризик безпліддя в жінок репродуктивного віку. Цей метаболічний стан спричиняє дисфункцію інсулярного апарату підшлункової залози через прогресування інсуліно- (ІР) та лептинорезистентності (ЛР), які підвищують ризик розвитку цукрового діабету (ЦД) 2 типу. Важливим завданням медичної спільноти є розробка та науково обґрунтоване вдосконалення пацієнт-орієнтованих алгоритмів лікування предіабету зі збереженням фертильності жінки. **Мета:** оцінити ефективність 12-тижневого курсу лікування інгібіторами натрійзалежного котранспортера глюкози 2 типу (іНЗКТГ-2: дапагліфлозин (ДАПА), агоністом рецептора глюкагоноподібного пептиду-1 (арГПП-1: ліраглутид (ЛІРА)) предіабету в жінок репродуктивного віку. **Матеріал і методи.** У дослідженні взяли участь 42 пацієнтки віком від 19 до 45 років із предіабетом, які відповідно до алгоритму лікування були розподілені на три групи: І група (n=14) отримувала базову медикаментозну терапію (БМТ): метформін – 500-2000 мг/добу, альфа-ліпоєва кислота – 600 мг/добу, холекальциферол (вітамін D_3) - 800-10 000 МО/добу; інозитол – 2 000 мг/добу; II група (n=14) застосовували БМТ у поєднанні з іНЗКТГ-2 (ДАПА – 10 мг/добу); III група (n=14) приймали БМТ у комбінації із підшкірними ін'єкціями арГПП-1 (ЛІРА) у добовій дозі 0,6-3,0 мг). Тривалість дослідження становила 12 тижнів. **Результати.** Через 12 тижнів лікування, порівняно з початковими даними, найкращу динаміку компенсації вуглеводного обміну було досягнуто в пацієнток, які в складі БМТ отримували ін'єкції ЛІРА. У III групі дослідження глікований гемоглобін (HbA_1C) знизився на 8,5% (β = –0,085, 95% ДІ [–0,112; –0,058], p<0,001), у жінок II групи цей показник був на 7,0% нижчим (β = –0,070, 95% ДІ [–0,097; –0,043], p<0,001), тоді як у пацієнток, які отримували курс БМТ спостерігався позитивний результат зі зниженням рівня HbA_1C на 3,67% (p<0,05). У жінок II та III груп дослідження було виявлено вірогідне покращення показників як резистентності до інсуліну, так і ЛР. Індекс ІР знизився на 23,8% (β = –0,238, 95% ДІ [–0,360; –0,117], p<0,001) у II групі та на 28,4% (β = –0,284, 95% ДІ [–0,405; –0,162], p<0,001) у III групі. Індекс ЛР зменшився на 18,3% (β = –0,183, 95% ДІ [–0,314; –0,051], p=0,007) та на 30,7% (β = –0,307, 95% ДІ [–0,439; –0,176], p<0,001) відповідно. **Висновки.** Вчасне призначення ДАПА (10 мг/добу)/ЛІРА (0,6-3,0 мг/добу) у складі БМТ жінкам репродуктивного віку з предіабетом слід розглядати як ефективні персоналізовані підходи до лікування, які є превентивними заходами щодо прогресування ІР, ЛР й розвитку ЦД 2 типу.

Ключові слова: предіабет, жінки репродуктивного віку, інгібітори натрійзалежного котранспортера глюкози 2 типу (дапагліфлозин), агоніст рецептора глюкагоноподібного пептиду-1 (ліраглутид).

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Адреса для листування: Іваніщак Мар'яна Мирославівна; ivanishchak_ma@ifnmu.edu.ua; Івано-Франківський національний медичний університет, КНП «Обласна клінічна лікарня Івано-Франківської обласної ради», вул. Федьковича, 91, Івано-Франківськ 76008, Україна.

Відомості про авторів: Іваніщак Мар'яна Мирославівна, аспірантка кафедри ендокринології Івано-Франківського національного медичного університету, лікар-ендокринолог ендокринологічного та поліклінічного відділення КНП «Обласна клінічна лікарня Івано-Франківської обласної ради», ORCID: 0009-0006-4786-7033; Костіцька Ірина Олександрівна, д-рка мед. наук, проф., професор кафедри ендокринології Івано-Франківського національного медичного університету, ORCID: 0000-0003-4319-0986; Басюга Ірина Омелянівна, канд. мед. наук, доцентка, доцентка кафедри акушерства та гінекології ім. професора І.Д. Ланового Івано-Франківського національного медичного університету, ORCID: 0000-0002-4205-386X; Бабенко Олександр Ігорович, канд. мед. наук, доцент, доцент кафедри внутрішньої медицини №1, клінічної імунології та алергології ім. Є.М. Нейка Івано-Франківського національного медичного університету, ORCID: 0000-0002-9924-5870.

Особистий внесок: Іваніщак М.М. – аналіз проблеми, концепція й дизайн дослідження, аналіз та статистична обробка результатів дослідження, написання та оформлення статті; Костіцька І.О. – аналіз літератури, аналіз даних, редагування та консультації під час оформлення статті; Басюга І.О. – редагування тексту, оформлення статті; Бабенко О.І. – аналіз літератури, аналіз статистичних даних.

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Correspondence address: Ivanishchak Mariana Muroslavivna; ivanishchak_ma@ifnmu.edu.ua; Ivano-Frankivsk National Medical University, Communal Non-commercial Enterprise «Regional Clinical Hospital of Ivano-Frankivsk Regional Council», 91 Fedkovich St., Ivano-Frankivsk 76008, Ukraine.

Information about the authors: Ivanishchak Mariana Muroslavivna, Postgraduate Doctor of the Endocrinology Department of Ivano-Frankivsk National Medical University, MD, Endocrinologist of Endocrinology and Policlinic Departments, Communal Non-commercial Enterprise «Regional Clinical Hospital of Ivano-Frankivsk Regional Council», ORCID: 0009-0006-4786-7033; Kostitska Iryna Oleksandrivna, MD, PhD, DMSc, Professor of Endocrinology Department of Ivano-Frankivsk National Medical University, ORCID 0000-0003-4319-0986; Basiuha Iryna Omelyanivna, MD, PhD, Associate Professor of the Department of Obstetrics and Gynecology named after professor I.D. Lanovoy, Ivano-Frankivsk National Medical University, ORCID: 0000-0002-4205-386X; Babenko Olexandr Ihorovych, MD, PhD, Associate Professor of the Department of Internal Medicine No. 1, Clinical Immunology and Allergology named after academician E.M. Neyko, Ivano-Frankivsk National Medical University, ORCID: 0000-0002-9924-5870.

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