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B.M. Gasanova, N. S-M. Omarov, M.L. Polina, N.I. Douglas, T.E. Burtseva, S. S. Sleptsova, P.N. Zakharova **FEATURES OF ANEMIA IN PREGNANT**

WOMEN OF VARIOUS GENESIS IN ETHNIC SAMPLES

Objective of the Study: to determine in different ethnic samples of pregnant women with anemia of various genesis the factors influencing on its development; perinatal outcomes in anemia of various genesis; features of the production of pro- and antioxidant blood factors.

Material and methods

A prospective cohort study of pregnant women with IDA and ACD was carried out in various ethnic samples. In the Republic of Dagestan, the sample with anemia consisted of 470 women: with IDA (n = 286) and ACD (n = 184). In the sample of pregnant women with anemia in the Republic of Sakha (Yakutia) (n = 284) we also distinguished groups with IDA (n = 186) and ACD (n=98). The control group - 34 healthy pregnant women in the Dagestan population and 42 - in the Yakut one was introduced into the study to compare the indicators in the study of pro- and antioxidant factors.

Research methods included the assessment of a general blood test, serum iron (SI), C-reactive protein (CRP), ferritin, total protein, pro- and antioxidant factors (erythrocyte and blood serum catalase, sulfhydryl groups (SH-groups), ceruloplasmin (CP) and malondialdehyde (MDA) in blood serum), the level of IgG to parasitic infections.

Results

The study showed a variety of risk factors and conditions contributing to the development of anemia on the background of lower iron and lower hemoglobin concentration in various ethnic samples (ecological, biological and social biotopes). True ID was confirmed at low levels of ferritin (100.0%) and serum iron.

Inflammatory diseases of the pelvic organs were twice as common in women with ACD than IDA (p < 0.05).

Iron limiting participation for erythropoiesis in ACD was accompanied by an increase (85.6%) or normal serum ferritin level (14.4%), increase in the level of CRP (100,0%), lymphocytes (29.3%), monocytes (22.8%), blood sedimentation rate (ESR)(14.7%).

Pregnant women with true ID were characterized by a balanced increase in the level of proand antioxidant factors.

Iron metabolism violations in ACD were accompanied by a pronounced imbalance in the production of hydroperoxides and antioxidant protection factors.

The effect of excess lipid peroxidation products on the placenta in ACD in the Yakut population was accompanied by an evolutionarily accumulated level of endogenous antioxidants (blood plasma and erythrocyte catalase, sulfhydryl groups). A decrease in the compensatory mechanisms of the placenta of pregnant Dagestan women with ACD influenced the higher frequency of morphological and functional immaturity of newborns due to the moderate antioxidant potential. Morphofunctional immaturity of newborns (MFI) in the group with ACD was detected one and a half times more often in the Dagestan population (p = 0.0005) than in the Yakut population (p = 0.04). Cerebral ischemia was more common among newborns from mothers with ACD – 1.8 times (p = 0.002) and 1.7 times (p = 0.04) than those with IDA in the sample of Dagestan and Yakut women, respectively.

Conclusion. It is shown necessity of correction of risk factors of anemia of different genesis at the preconception stage (replenishment of ID, essential micronutrients, treatment of infections and inflammatory diseases) to improve the hematological status of the mother and pregnancy outcomes.

The nature of placental dysfunction in anaemia of pregnant women is explained by the degree of severity of oxidative stress and the activity of compensatory-adaptive mechanisms. Iron metabolism violation in ACD is accompanied by excessive production of hydroperoxides, a certain decrease in the antioxidant potential in the Dagestan population in comparison with the Yakut population.

Anemia in the population of the Far North proceeds on the background of evolutionary adaptive and homeostatic physiological characteristics of the organism. The increased risk of adverse pregnancy outcomes (low birth weight, cerebral ischemia) was more common in women with ACD. **Key words:** iron deficiency, anemia of chronic diseases, ferritin, oxidative cell stress, antioxidant activity

Introduction. According to the WHO, anemia affects about a third of the world's population and more than 800 million women and children, including 38% of all pregnant women [22]. Reducing anemia in women of reproductive age by 50% by 2025 is one of the global nutrition goals [24].

It is reported that the peculiarities of iron metabolism in pregnant women may be due to ethnic and ecological disunity, genetic characteristics of ethnic groups, place of residence and socio-economic factors [17].

The combination of maladaptive reactions from various body systems results in the development of the polar stress syndrome in conditions of the Far North [11].

The development of IDA in the regions of our country is associated with the deterioration of the socio-economic situation, national habits of the population in nutrition, the provision of essential micronutrients, including iron [9].

The study confirms the role of environmental factors in the genesis of IDA, which determine the level of iron in the composition of soil, drinking water, plant and animal products [2,9,10].

The role of social factors in the genesis of IDA is performed by the nutritional traditions of national groups (isomerism, deficiency of protein, iron and other microelements in the diet, mainly carbohydrate foods) [9]. The modern population of Yakutia is distinguished by a carbohydrate-lipid diet (excessive consumption of bread, sugar, confectionery), an excess of protein and fatty foods in the diet was found only in distant uluses [5].

The consequences of maternal anemia (low birth weight, premature birth, unfavorable perinatal outcomes), proved in studies, negatively affect the gene pool of small ethnic groups [21].

The concept of complex iron homeostasis allows us to distinguish anemia of chronic diseases (ACD) associated with impaired proliferation of erythroid precursors on the background of an infectious, inflammatory or autoimmune process

and urogenital diseases [16,17]. The development of anemia on the parasitic invasions background is explained by the fact that the republics of Sakha (Yakutia) and Dagestan belong to the zones of natural focal biohelminthiasis [20]. Exceeding the average rate of parasitic diseases, among which the most common are opisthorchiasis, diphyllobothriasis, echinococcosis, was registered in 17 territories of the Republic of Sakha (Yakutia). Parasitoses transmitted through fish, crustaceans, molluscs, amphibians, reptiles and their products remain an important problem. The social prerequisites for the incidence of parasitosis in the population are the hygienic skills of the population (household and behavioral), an increase in the amount of fish and homemade fish products in the diet of the population of coastal cities and villages [8]. Due to the favorable natural and climatic conditions of the lowland and foothill zones, the Republic of Dagestan belongs to the regions with a high incidence of ascariasis (in some areas the indicators exceed the national average by several times) and trichocephalosis [1].

The mechanisms of the ID influence on the body of a pregnant woman and a fetus are different depending on the genesis of anemia. ACD is associated with oxidative stress in erythrocytes, damage to the structure of proteins, carbohydrates, fats, and DNA [12].

The study of the features of iron homeostasis and factors influencing the development of anemia in ethnically different samples is promising from the standpoint of understanding the relationship between perinatal risks and the activity of compensatory-adaptive mechanisms of the pregnant organism.

The objective of the study: to determine in different ethnic samples of pregnant women with anemia of various genesis the factors influencing on its development; perinatal outcomes in anemia of various genesis; features of the production of pro- and antioxidant blood factors.

Material and methods. A prospective cohort study of pregnant women with IDA

and ACD was carried out in various ethnic samples. In the Republic of Dagestan, the sample with anemia consisted of 470 women (avarkas, kumychkas, darginkas, lezginkas, lachkas): with IDA (n = 286) and ACD (n = 184). In the sample of pregnant women (vakuts, evenks) with anemia in the Republic of Sakha (Yakutia) (n = 284) we also distinguished groups with IDA (n = 186) and ACD (n=98). The control group - 34 healthy pregnant women in the Dagestan population and 42 - in the Yakut one was introduced into the study to compare the indicators in the study of pro- and antioxidant factors (146 women with IDA and 82 - ACD in each sample).

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Inclusion criteria: pregnant women with anemia confirmed by specialists before pregnancy (IDA and ACD), singleton progressive pregnancy. Exclusion criteria: anemia of other types.

The study was conducted with the voluntary informed consent of the participants. The study took into account the provisions of the Helsinki Declaration of the World Medical Association (revised 2008) and the document "International Ethical Guidelines for Biomedical Research with human participation".

Research methods included the assessment of a general blood test, serum iron (SI), C-reactive protein (CRP), ferritin, total protein, pro- and antioxidant factors (erythrocyte and blood serum catalase, sulfhydryl groups (SH-groups), ceruloplasmin (CP) and malondialdehyde (MDA) in blood serum), the level of IgG to zoonotic infections.

The diagnosis of anemia was made on the basis of hemogram indicators (decrease in Hb <110 g/l), iron status (decrease in serum ferritin less than 15 mcg/l among IDA patients). ACD was diagnosed with an increase in C-reactive protein (CRP)) on the background of normal or increased ferritin levels.

In pregnant women with ACD, the level of IgG to echinococcus, trichinella, toxocara and ascaris was determined using test systems by the enzyme-linked immunosorbent assay (ELISA) with the help of standard kits from "DRG diagnostics" (Germany). Laboratory tests were carried out at 16-20 weeks of pregnancy.

All pregnant women with anemia were recommended to take preparations containing iron, folic acid (400-800 mg per day), macro- and micronutrients.

Statistical data was processed using the Statistica 10 software package (manufactured by StatSoft Inc., USA), SPSS 12.0. The Mann-Whitney test was used to compare the two independent variables. Significance level (p) when testing statistical hypotheses was taken (p≤0.05). The data in the text is partially presented as the arithmetic mean and its standard deviation (M ± σ). Student's and Kruskal-Wallis tests were applied. The analysis of intergroup differences in terms of qualitative characteristics was carried out using the χ 2 test (chi-square), less than five – the exact two-sided Fisher test.

Results and discussion. The average age of pregnant women with ACD was 26.8 ± 3.2 years, IDA – 27.3 ± 4.1 years, without significant intergroup differences.

The geographical distribution of pregnant women in different zones influenced the nature of anemia. The number of Dagestani women living on the flat territory of the republic was 68.0% (40.6% with IDA and 59.4% with ACD), on the foothills – 32.0% (65.3% with IDA, 34.7% with ACD) (p = 0.00, χ^2 = 24.1).

The study of the premorbid background showed a higher incidence of chronic infectious and inflammatory diseases in both samples in comparison with IDA (Table 1).

Respiratory diseases were noted three times more often in the Dagestan sample (p = 0.0005, χ 2= 25.8), twice more often in the Yakut sample (p = 0.007, χ 2= 7.9), kidney disease – two and a half times (p = 0.0005, χ 2 = 29.6) and twice (p = 0.0003, χ 2 = 14.2), respectively, sinusitis - 2.6 times (p = 0.002, χ 2= 10.0) and twice (p = 0.02, χ^2 = 5.5), respectively, diseases of the upper respiratory tract (pharyngitis, rhinitis) – three times (p = 0.0005, χ^2 = 38.4) and two and a half times (p = 0.00, χ^2 = 22.4), respectively. More than half of pregnant women with anemia had inflammatory diseases of the female pelvic organs - twice more often in the group with ACD than IDA (p <0.05). When diagnosing parasitic invasions in ACD, enzyme-linked immunosorbent markers were detected in 5.9% of Dagestani women and 9.2% of Yakutia residents.

The diet of the indigenous inhabi-

tants of Yakutia with antibodies to zoonotic infections (echinococcus - 2.0%, Trichinella - 2.0%, toxocara - 2.0%, ascaris - 3.1%) included the consumption of raw meat and fish, the presence of domestic animals and cattle. Pregnant women who were seropositive for parasitic infestations were more common among the rural population, and there were more Yakuts than Dagestanis. The reasons for the infection are non-compliance with the keeping of domestic animals, the consumption of raw meat and fish by the local population of Yakutia, and unsatisfactory processing of vegetables and fruits. The consumption of raw fish remains highly frequent despite the awareness of personal and community prevention measures for helminthiasis. Seropositive reactions for ascariasis are associated with the use of fruits and vegetables contaminated with helminth eggs.

The consumption of macronutrients in the recommended amount for pregnant women was the following: protein - in 19.6% of Dagestani women and 22.9% of Yakut women, fats - 33.8% and 35.6%, respectively, carbohydrates - 34.2% and 38.4%, respectively. Unbalanced nutrition (preference for pasta and bakery products on the background of a deficiency of animal protein, vegetables, fruits and dairy products) forms an insufficient energy value of the diet, vitamins and microelements. The diet of the inhabitants of the northern uluses consists mainly of fishing and hunting products, with a significant shortage of fruits, vegetables and greens.

The delivery time of pregnant women with anemia (17.8% in the Dagestan population and 25.9% in the Yakut population) and the frequency of caesarean section (12.8% and 14.1%, respectively) did not differ between groups. The weight of newborns was lower in the group with ACD than IDA (2850 \pm 140 g/l vs 2970 \pm 280 g/l in Dagestani women), however, ethnic features of the skeletal structure explain the smaller parameters of children in the Yakut population (2760 \pm 160 g/l vs 2850 \pm 130 g/l (p = 0.0005).

The nature of chronic hypoxia (hemic, circulatory and tissue) and the degree of compensatory-adaptive mechanisms in pregnant women with anemia influenced the adaptation of the newborn to extrauterine conditions of existence (Table 2).

8.6% of children in the Dagestan and 12.9% in the Yakut population had a short gestational period at birth, mal-

nutrition was detected in the group with ACD (p <0.05). Infectious and inflammatory diseases of newborns (omphalitis, conjunctivitis, dacryocystitis, vesiculopustulosis) in the groups with ACD were determined by the high infectious potential of mothers. Signs of morphological and functional immaturity of newborns (MFI) in the group with ACD were detected one and a half times more often in the Dagestan population (p = 0.0005, χ 2 = 18.8) than in the Yakut population (p = 0.04, $\chi 2$ = 4.2). Cerebral ischemia was more common among newborns from mothers with ACD - 1.8 times (p = 0.002, χ 2 = 11.0) and 1.7 times (p = 0.04, χ 2 = 4.9) than those with IDA in the sample of Dagestan and Yakut women, respectively.

Features of iron metabolism and hemograms of pregnant women with anemia are presented in Table 3.

True ID was confirmed at low levels of ferritin (100.0%) and serum iron ($8.2 \pm 2.6 \text{ mmol/I}$). Iron sequestration in macrophages in chronic infectious and inflammatory diseases was accompanied by an increase in CRP and / or a shift in the leukocyte formula, an increase in ferritin (85.6%) or its normative values (14.4%). Pregnant women with ACD had a more pronounced total protein deficiency.

The results of the study of the oxidant blood profile of pregnant women with anemia of various origins are presented in Table 4.

A decrease in erythropoiesis in ACD was accompanied by a pronounced imbalance in the production of hydroperoxides and antioxidant protection factors (catalase of blood plasma, erythrocytes, sulfhydryl groups). Pregnant women with true ID were distinguished by a balanced increase in the level of pro- and antioxidant factors. The content of ceruloplasmin turned out to be statistically significantly higher in ACD than in the group with IDA only in women from Yakutia (p = 0.01). The concept of severe damage to placental tissues in pregnant women with ACD in the Dagestan sample was based on excessive MDA (malondialdehyde) production with a moderate antioxidant potential of blood serum (catalase of plasma, erythrocytes, sulfhydryl groups).

Our research has shown the influence of a combination of factors on the development of anemia in pregnant women – the environment (ecological biotope), biological and social [18].

The impact of low temperatures in the Republic of Sakha determines the great need of the body for iron due to



Table 1

Chronic diseases of pregnant women with anemia of various origins

Parameters	Iron- deficiency anemia (IDA) (n=286)	deficiency iia (IDA)Anemia of chronic diseases (ACD)=286)(n=184)		Iron- deficiency anemia (IDA) (n=186)	Anemia of chronic diseases (ACD) (n=98)	p, χ ²		
		Dagestani women		Yakut women				
Sinusitis	16 (5.6)	27 (14.7)	0.002 (10.0)	22 (11.8)	22 (22.4)	0.02 (5.5)		
Rhinitis, nasopharyngitis and pharyngitis	33 (11.5)	66(35.9)	0.0005 (38.4)	33 (17.7)	43 (43.9)	0.00 (22.4)		
Respiratory diseases	21 (7.3)	45 (24.4)	0.0005 (25.8) 23 (12.4)		25 (25.5)	0.007 (7.9)		
Kidney diseases	41 (14.3)	67 (36.4)	0.0005 (29.6)	40 (21.5)	42 (42.9)	0.0003 (14.2)		
Inflammatory diseases of the female pelvic organs	78 (27.4)	99 (53.8)	0.0005 (32.4)	61 (32.8)	64 (65.3)	0.00 (27.5)		
Parasitic invasions (total)	-	11 (5.9)		-	9 (9.2)			
Trichinosis	-	-		-	2 (2.0)			
Toxocariasis	-	3 (1.6)		-	2 (2.0)			
Echinococcosis	-	-		-	2 (2.0)			
Ascariasis	-	8 (4.3)		-	3 (3.1)			

Table 2

Morbidity of newborn in groups of women with anemia of various origins

Parameters	Iron-deficiency anemia (IDA) (n=286)	Anemia of chronic diseases (ACD) (n=184)	p, χ ²	Iron-deficiency anemia (IDA) (n=186)	Anemia of chronic diseases (ACD) (n=98)	p, χ²		
	I	Dagestani women		Yakut women				
Hypotrophy of newborn	59 (20.6)	49 (26.6)	0.2	30 (30.6)	23 (23.5)	0.15		
Infectious and inflammatory diseases	14 (4.9)	27 (14.7)	0.001 (12.2)	7 (3.8)	13 (13.3)	0.006 (8.8)		
Morphofunctional dismaturity of newborn	47 (16.4) 63 (34.2)		0.0005 (18.8)	36 (19.4)	22 (22.4)	0.54 for ACD – 0.04 (4.2)		
Cerebral ischemia of newborn	51 (17.8)	58 (31.5)	0.002 (11.0)	29 (15.6)	26 (26.5)	0.04 (4.9)		
Premature newborns	18 (6.3)	20 (10.9)	0.1	16 (8.6)	17 (17.3)	0.03 (4.8)		

Table 3

Laboratory parameters of pregnant women with anemia of various origins

Parameters	Iron-deficiency anemia (IDA) (n=286) Anemia of chronic diseases (ACD) (n=184)		p, χ ²	Iron-deficiency anemia (IDA) (n=186)	Anemia of chronic diseases (ACD) (n=98)	p, χ ²		
		Dagestani women		Yakut women				
Decrease in ferritin, mcg/l	286 (100)	0	-	186 (100)	0	-		
Normal ferritin level, mcg/l	0	34 (18.5)	-	0	10 (10.2)	-		
Increase in ferritin level, mcg/l	0	150 (81.5)	-	0	88 (89.8)	-		
C-reactive protein, mg/l	0 184 (100.0)		-	0	87 (88.8)	-		
Lymphocytosis, %	28 (9.8)	54 (29.3)	0.0005 (28.4)	12 (6.5)	33 (33.7)	0.00 (35.7)		
Monocytosis, %	23 (8.0)	42 (22.8)	0.0005 (19.3)	11 (5.9)	11 (11.2)	0.16		
Increase in ESR, mm/h	13 (4.5)	27 (14.7)	0.0009 (13.5)	12 (6.5)	22 (22.4)	0.00 (15.6)		
Serum iron, mmol/l	7.8±2.6	8.1±2.3	0.9	6.8±1.7	9.4±1.2	0.2		
Total protein, g/l	74.6±4.2	69.4±5.3	0.44	70.6±3.8	65.4±4.2	0.35		

Healthy Healthy Iron-deficiency Anemia of Iron-deficiency Anemia of pregnant pregnant p₁₋₂ anemia (IDA) chronic diseases p₁₋₂ anemia (IDA) chronic diseases women women Parameters (n=146) (ACD) (n=82) (n=146)(ACD) (n=82) (n=42) (n=34) Dagestani women Yakut women Malon dialdehyde, 1.3 ± 0.1 1.7 ± 0.1 1.2 ± 0.4 0.005 1.5 ± 0.1 2.0 ± 0.1 1.4 ± 0.6 0.00 mmol/l 87.4±2.7 74.9±1.4 74.7 ± 0.9 0.001 $1.4{\pm}0.6$ 87,4±2,7 Erythrocyte catalase, mcat/l $72,4\pm1,1$ 0,00 24,2±1,7 Serum catalase, mcat/l 0.001 0.001 29.6±2.4 14.8 ± 1.5 15.7±0.5 $17,5\pm0,3$ 0,01 Ceruloplasmin, mg/l 369.8±12.5 406.3±14.1 366.9 ± 13.5 p>0.05 388.5±10.6 414.3±10.6 356.4±9.2 0.01 13.3±0.4 17.2 ± 1.3 16.5±0.5 14.4±0.4 0.00 SH-groups, mmol /l 12.4 ± 0.4 0.01 19.2 ± 1.3

Pro-	and	antio	kidant	factors	in sa	amples	of	pregnant	t women	with	anemia	of	various	origin	ns
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the adaptive activation of the basal metabolism, revealed in the Eskimos, Yakuts, Evens and Chukchi [3]. Probably, the imbalance of the processes of anabolism and catabolism in the indigenous population of Yakutia is the reason for the development of acclimatization ID.

Climatic and geographic conditions of Dagestani women with low oxygen content in the air (in the mountains) are accompanied by a compensatory increase in the number of erythrocytes. Physiological needs for hemoglobin in people living at high altitudes increase on the background of low oxygen concentration in the atmosphere [13]. A study in Myanmar showed a lower possibility of anemia among women living in hilly areas compared to other areas of the country [23].

The effect of the environmental factor was found by us in the Dagestan population: the severity of anemia prevailed in urban women in comparison with rural ones, in residents of flat areas in comparison with those living in mountain villages.

It seems that the influence of environmental factors on microelement disorders and the functional activity of the erythroid blood germ is integral.

We have confirmed the connection between the mother's unsatisfactory nutrition and the formation of antenatal and perinatal risk factors. The lack of animal protein, vegetables, fruits and berries in the diet of pregnant women is associated with a low educational level of mothers who are not sufficiently informed about the needs of expectant mothers.

The development of anemia in pregnant women of the Far North was facilitated by an unbalanced diet, with an increase in the proportion of carbohydrates (refined sugar and starch) and a decrease in animal protein. The development of ACD on the parasitic invasions background determined the living conditions and eating habits of women of various ethnic groups [17].

The reasons for the infection are non-compliance with the keeping of domestic animals, the consumption of raw meat and fish by the local population of Yakutia, and unsatisfactory processing of vegetables and fruits.

The study of the premorbid background of pregnant women with anemia confirms the need to identify and eliminate controllable risk factors for pregnancy complications.

Identification of biomarkers of inflammation in pregnant women with anemia (acute phase reactions of inflammation, increased C-reactive protein (CRP)) on the background of normal or increased ferritin levels allows to diagnose the development of ACD [15]. The effect of inflammatory processes on the reduction of hemoglobin concentration was noted in a recent BRIN-DA study [16].

The high perinatal morbidity in women with anemia should be considered as a consequence of the angiopathy of the uterine vessels formed before pregnancy [14].

The consequences of chronic hypoxia were more pronounced in pregnant women with ACD, more significant violations of the molecular mechanisms of protein biosynthesis in whom, in comparison with IDA, determined a more frequent morbidity in newborns [19]. The anthropometric characteristics of the children of the indigenous population of Yakutia, corresponding to the lower centile boundaries of the standards, explain their low weight in the presence of ACD in mothers [4].

A number of physiological changes, called an adaptive shift, in the indigenous inhabitants of Yakutia is accompanied by the activation of peroxide processes in conditions of increased consumption of energy reserves and an increase in the rate of basal metabolism [3]. The excessive LPO activity in the indigenous and newcomer population of the Far North in comparison with the middle latitudes is compensated by a sufficient level of endogenous antioxidants developed by generations of aborigines [6]. The nature of biochemical changes in all pregnant women with ACD exceeds the "adaptive Arctic norm," however, the degree of reduction in reserve and compensatory capacities turned out to be higher in the Dagestan population [7].

The damaging effect of hydroperoxides in Dagestani women with ACD led to a more significant destabilization of cell membranes, disruption of cell division and growth, depletion of the erythroid germ because of the deficiency of SH-groups, catalase in blood serum and erythrocytes.

Conclusion. The study showed a variety of risk factors and conditions that contribute to the development of anemia against the background of limited iron stores and lower hemoglobin concentrations in various ethnic samples.

The concepts of the adaptive and homeostatic mechanisms of pregnant women with anemia on the background of chronic infectious and inflammatory diseases are formed when studying proteins of the acute phase of inflammation, the ratio of oxidative stress factors and antioxidant activity.

Violation of the regulation of iron metabolism in ACD is accompanied by excessive production of hydroperoxides, a pronounced decrease in the antioxidant potential in the Dagestan population in comparison with the Yakut one. The development of anemia in the population of the Far North proceeds against the background of the



evolutionarily established adaptive-homeostatic physiological characteristics of the organism.

An increased risk of adverse pregnancy outcomes (low birth weight, low body weight for gestational age, cerebral ischemia) was more common in women with ACD.

The reduction of pregnancy complications and newborns' morbidity in women with anemia is possible with the replenishment of ID, essential micronutrients and the treatment of chronic infectious and inflammatory diseases at the preconception stage.

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