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PECULIARITIES OF THE HESTATION PROCESS COURSE OF PREGNANT WOMEN CONSUMED LOW-ALCOHOLIC BEVERAGES AND THE MEDICAL CONDITION OF THEIR NEWBORNS

[1,2] Marianian A.Yu., Kolesnikova L.I. [1], Protopopova N.V. [2]

[1] Federal State Public Scientific Institution «Scientific Centre for Family Health and Human Reproduction Problems» Irkutsk, Russia

[3] Irkutsk State Medical Academy of Postgraduate Education – Branch Campus of the Federal State Medical Academy of Continuous Professional Education of the Ministry of Healthcare of the Russian Federation

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ABSTRACT

Maternal alcohol consumption during pregnancy and its effects on the developing fetus are a serious public health problem worldwide. Current article describes the course of pregnancy, childbirth and the postpartum period of 545 pregnant women. There were two groups: pregnant women who consumed low-alcohol drinks from 1 to 11 doses (n=261) (Group 2), compared with women who had never used alcohol in the prenatal period (n=284) (Group 1).

Pregnant women observed and gave birth in the Irkutsk Regional Perinatal Center (IRPC), Irkutsk, Russia between June 2012 and June 2014. We described methods of mathematical analysis of the influence of alcoholic beverages on pregnancy, childbirth, the postpartum period and the condition of newborns. Using a discriminant analysis, informative diagnostic signs were obtained to determine the effect of alcohol on pregnancy, childbirth, the postpartum period, and the condition of newborns. The diagnostic accuracy according to the decisive rules on average turned out to be quite high - 76.69 (for the first group - 75.7%, the second - 77.6%). According to the results of the analysis - pregnant women in the control and main groups did not differ in somatic pathology. Women who drank alcohol during pregnancy, medical abortions were more common, and the course of pregnancy was statistically significantly more often complicated by anemia of pregnant women, congenital malformations (CHD) of the fetus, and the formation of congenital heart defects (CHD).

Of the complications of childbirth, in the group of women drinking, dystocia, discoordinated contractions of the myometrium muscle (DCMM) were more often diagnosed. In the postpartum period, uterine subinvolution was more often diagnosed in a group of women who drank alcohol during pregnancy. An interesting result was revealed that girls predominated in the control group, and boys in the main group. Premature by gestational age, more often children were born from drinking mothers, and a serious condition of the newborn at birth was more often diagnosed in children born to women who drank alcohol in the prenatal period. In the postnatal period, hypoxic-ischemic damage to the central nervous system in the fetus was diagnosed. Thus, we can conclude that even small doses of weak alcohol can lead to a complicated course of pregnancy, childbirth and the postpartum period, as well as adversely affect the developing fetus and the state of health of a newborn.

Keywords: alcohol, low-alcohol drinks, pregnancy, act of delivery, postnatal period, fetus, newborn.

Correspondance:
Marianian A.Yu
Federal state public scientific institution
Irkutsk, Russia
Email: anait_24@mail.ru; iphr@sbamsr.irk.ru

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INTRODUCTION

Nowadays, the problem of alcohol consumption by women at procreative age is particular important for public healthcare, while the health of future generations depends on it (Goodlett Ch.R., Horn K.H., Zhou F.C. , 2005; Balachova T., Bonner B., Chaffin M. et al., 2012; Popova S., Lange S., Probst C. Et al., 2017). Regular and occasional alcohol consumption during pregnancy is dangerous not only for the mother, but also for the fetus (Malakhova Z.L., Shilko V.I., Bubnov A.A., 2012; Mamluk L, et al., 2017; Wubetu A.D., Habte S., Dagne K., 2019; Marianian A., Atalyan A., Bohora S. et al., 2019)

According to authors, women who consumed alcohol, pregnancy and childbirth proceed against the background of extragenital pathology (66.6%), complicated obstetric and gynecological history (83.3%), complicated pregnancy (63.3%,), premature (16.6%) and rapid birth (23.3%), with amniotic fluid pathology (83.3%), abnormal fetus presentation (11.6%) (Albertsen K, Andersen AM, Olsen J, et al.,2004; Robinson M, Oddy W.H, McLean N.J., et al. 2010; Rychkova L., Marianian, A., Darenskaya M., Grebenkina L., Bonner B., Balachova T., Protopopova N., Kolesnikova L, 2017; Wubetu A.D., Habte S., Dagne K..2019).

The effect of alcohol on the fetus has been studied in details by K.L. Jones et and D.W. Smith (1973), who gave it the name "alcoholic (fetal) embryopathy" (AE).

Analyzing the current studies on this problem in Russia and the whole World, it was found that children born by mothers who consumed alcohol during pregnancy are susceptible to a number of nervous and mental disorders, worse develop and are ill more often (CDC, 2004) (Kolesnikova L.I, Grebenkina L.A, ; Darenskaya, M.A., Vlasov B.J., 2012; Malachova, J., Shilko, V., & Bubnov, A., 2012). The mental and physical defects occur at the childbirth and remain for the whole life, do not secede with time and are the main cause of mental development disorders (Olson H.C., Feldman J.J., Streissguth A.P. et al., 1998; Kosyh E.A., Balashova T.N. et al., 2010; Пальчик А.Б. и соавт., 2011; Popova S., Yaltonskaya A., Yaltonsky V., Kolpakov Y., 2014; Popova S., Lange S., Probst C. et al., 2017; Wubetu A.D., Habte S., Dagne K..2019). The **goal** of the research was to determine the characteristics of the gestational process of pregnant women who consumed low-alcohol drinks and the condition of their newborns.

METHODS

STUDY PARTICIPANTS

Pregnant women consecutively enrolled in prenatal care between June 2012 and June 2014 was recruited to the study at the Irkutsk Regional Perinatal Center (IRPC), Irkutsk, Russia. The women who initiated prenatal care at ≤10 weeks of gestation were accepted to participate.

A total number of pregnant women were 548 to participate in the research. Two of them refused to participate, resulting in a number of 546 pregnant women. All participants were admitted for delivery to IRPC. One delivery resulted in the neonate's death due to severe fetal distress and hypoxia within 24 hours of delivery.

The research was approved by the ethics committees of the Federal State Public Scientific Institution «Scientific Centre for Family Health and Human Reproduction Problems», Irkutsk, Russia.

PROCEDURES AND DATA COLLECTION

The women completed standard medical procedures at the first prenatal visit, including a prenatal care medical exam; were prescribed folic acid, and were provided with information about a healthy lifestyle during pregnancy (risks of alcohol use, tobacco use, and secondhand smoke). All participants completed face-to-face interview with a study investigator (Dr. Anait Marianian), as well as a brief intervention recommended for alcohol consumption (Balachova, Bonner, Shapkaitz et al., 2012). At delivery, a neonatologist examined neonates. One-to-three days after delivery, mothers completed a face-to-face interview with the research manager. Follow-up data on infant development were obtained from the child's medical records.

Collected data included maternal medical history and childbirth outcomes. Information included social and demographic characteristics obtained from maternal and child medical records, such as - maternal age at time of the birth and marital status, maternal medical history including number of previous deliveries (parity), chronic conditions, infectious diseases, such as HIV/AIDS, pregnancy complications and mode of delivery (vaginal delivery or caesarean section); sex of the neonate, and the neonate's birth weight, gestational age at birth, and evaluation by a neonatologist at birth (APGAR Score).

Two face-to-face structured interviews utilized measures of alcohol consumption and tobacco smoking developed or adapted by the Prevent FAS Research Group (Balachova, Bonner, & Isurina, 2012). The first 20-to-30-minute interview was conducted at the time of the first prenatal visit to collect socio-demographic information, and obtain women's self-reports about their alcohol use, including interviewed about drinking alcohol before pregnancy, use of other substances, and other risk factors prior to the visit and pregnancy recognition. The second interview considered self-reports about alcohol consumption and smoking during the remaining pregnancy period, and took approximately 20 minutes to complete. Although self-reports about alcohol consumption may be affected by desirability bias. It is considered to be reasonably accurate among volunteers recruited in health care settings when confidentiality is protected (Babor, Steinberg, Anton, & Del Boca, 2000; Linda C. Sobell& Mark B. Sobell, 2004; Maisto S.A. & Connors G.J., 1992). The postnatal timing of reports was selected due to research data suggesting that pregnant women's reports about their consumption during pregnancy are more affected by biases than are their retrospective, after-pregnancy reports about drinking during pregnancy (Alvik, Haldorsen, Groholt and Lindemann, 2006; Hannigan et al., 2010). Several additional measures were implemented to improve further accuracy and elicit truthful self-reports. It included completing research informed consent procedures and reassuring participants about confidentiality, conducting interviews in private, ensuring that participants were alcohol-free when interviewed, wording questions clearly, and administering interviews by a female study investigator who was the same age group as the participants.

ALCOHOL EXPOSURE

Detailed reports were obtained during the interviews on maternal alcohol consumption during 40 weeks of pregnancy. Following guidance of Sobell & Sobell (2004), the participants were provided with a calendar and asked to memorize personal events, such as holidays and birthdays, that might be associated with alcohol consumption. The concept of "one drink" as a unit of consumption was not familiar for women in Siberia. Nevertheless, similar to beverage- and container-specific approaches that have been used in Russia and other countries (Russell M., 1994; Chang G., Wilkins–Haug L., Berman S.et al. 1999; Balachova, Bonner, Chaffin et al., 2012; Kesmodel, Kesmodel, Larsen, &Secher, 2003; Kristjanson, Wilsnack, Zvartau, Tsoy, & Novikov, 2007) a beverage-specific approach was utilized to determine standardized alcohol content and volume of alcohol consumption. Participants were provided with a card that showed pictures of alcoholic beverages and containers that are common in Russia, and were asked about the type of beverage, type of container, and number of containers consumed during each month of pregnancy. The information was transformed into ethanol volume.

For each participant, the amount of consumed alcohol since the estimated time of conception until the first prenatal visit reported at first interview was summed with the amount of alcohol consumed during the remaining period of pregnancy reported at second interview to calculate the total amount of alcohol consumed during the pregnancy. The total amount of alcohol consumed during pregnancy was calculated for each participant and utilized in data analysis. For reporting clarity, ethanol/pure alcohol data were then transformed to U.S. standard drink units (i.e., 14 grams of pure alcohol) (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2007). If a participant reported any alcohol consumption during pregnancy, she was categorized as having any alcohol consumption during pregnancy (Group 2; n=284). The maximum amount of alcohol consumption reached 11 doses. The control group (Group 1; n=261) included women who reported never consuming alcohol during pregnancy.

CHILD DEVELOPMENT

Child development and clinical data, including infant height, weight, head and chest circumferences, congenital malformations, rickets, and developmental milestones, were extracted from the children's medical records. Following routine medical procedures and standard protocols, neonates were evaluated at birth (n=545) by their clinic's neonatologists. Information about congenital malformations, including congenital heart disease, retroperitoneal tumor, adrenal gland tumor, malformations, fetal alcohol syndrome, and cerebral palsy diagnoses recorded in medical charts by the pediatrician and/or pediatric neurologist was extracted from the charts.

STATISTICAL ANALYSIS

Statistical analysis was performed using STATISTICA 10 software (Stat-Soft Inc., USA). The initial analysis of the source data was aimed at identifying intergroup differences for each characteristic using the criteria of comparative statistics, mainly nonparametric. At this stage, we used comparative statistics of the Mann-Whitney criterion to reduce the set of features and highlight the most informative.

At the second stage, after removing features that have no differences according to the Mann-Whitney criteria, we performed a dimensionality reduction using the module for reducing the dimensionality of a neural network program (V.I. Yunkerov, S. G. Grigoriev, M. V. Rezvantsev., 2011).

At the next stage, using a genetic dimensional reduction algorithm implemented in the STATISTICA 10 software (Stat-Soft Inc., USA), a set of informative features was identified that were analyzed by discriminant analysis of neural networks (Yunkerov V.I., S.G. Grigoriev, M.V. Rezvantsev., 2011).

The discriminant analysis (DA) provides the selection of informative features and obtaining decision rules in the form of linear classification functions (LCF) and canonical linear discriminant functions (CLDF). The quality of the developed rules is assessed by comparing the classification results with the initial classification of objects in the training matrix (I. Mikhalevich, 2014).

With the help of discriminant analysis was determined:

- informational content of signs included in linear discriminant functions;
- coefficients of linear classification functions and a classification matrix with assessments of the sensitivity of diagnostics of groups of educational information by LCF;
- coefficients of canonical LDF, canonical values by CLDF and as a result, we plotted the canonical variable for the analyzed groups.

The informational content of the following features included in LDF was evaluated (n=545): before pregnancy, alcohol was consumed 1 time per month (p=0.000001); before pregnancy, alcohol was consumed 2-4 times a month (p=0.000001); smoking during pregnancy (p = 0.000001); history of abortion (p=0.000007); anemia during pregnancy (p=0.032496); Ultrasound 3 of CHD (congenital heart defect) (p=0,000389); dystocia (p=0.000015); uterine subinvolution in the postpartum period (p=0.000045); gender of the newborn (p=0.022681); prematurity of gestational age (p=0.035808); the general condition of the newborn is severe (p=0,000406).

Using the obtained coefficients, linear classification formulas are as follows (F1, F2):

F1 = -0,992 + 0,396×X1+ 0,468×X2 + 0,541×X3 + 0,256×X4 + 0,108×X5 + 0,194×X6 + 0,243×X7 – 0,239×X8 – 0,129×X9 – 0,119×X10 – 0,200×X11

F2 = -0,850 – 0,424×X1 – 0,472 ×X2 – 0,486 ×X3 – 0,233 ×X4 – 0,126 ×X5 – 0,184×X6 – 0,235×X7 + 0,214×X8 +0,117×X9 + 0,117×X10 + 0,190×X11

where: X1 - before pregnancy, alcohol was consumed 1 time per month; X2 - before pregnancy, alcohol was consumed 2-4 times a month; X3 - smoking during pregnancy; X4 - a history of abortion; X5 - anemia during pregnancy; X6 - ultrasound 3 CHD (congenital heart disease); X7 - dystocia; X8 - subinvolution of the uterus in the postpartum period; X9 - gender of the newborn; X10 - prematurity of gestational age; X11 - the general condition of the newborn is severe

We found out that comparing the results of classification according to LCF with the initial classification by groups in the sample, the accuracy of diagnosis by decision rules is on average quite high - 76.69% (for the first group - 75.7%, the second - 77.6%).

Using the equation of the canonical linear discriminant function, the canonical values were calculated for each pregnant woman of the 1st and 2nd groups (formula 3):

K = 0,016 + 0,609×X1 + 0,699×X2 + 0,764×X3 + 0,364×X4 + 0,174×X5 + 0,281×X6 + 0,355×X7 – 0,336×X8 – 0,183×X9 – 0,175×X10 – 0,291×X11

The obtained results of the CLDF analysis for the 1st and 2nd groups are more clearly demonstrated in the form of a linear graph (Fig. 1) and the Mahalonobis distance with the p-level determination by the Mahalonobis distance (Table 1).

Table 1

Mahalanobis distances for the 1st and 2nd groups		
Group	Squares of Mahalanobis distance	
	G_1:1	G_2:2
G_ 1:1	1,810691	0,000000
G_ 2:2	0,000000	1,810691
p – level for 1st and 2nd groups		
G_ 1:1		0,01
G_ 2:2	0,01	

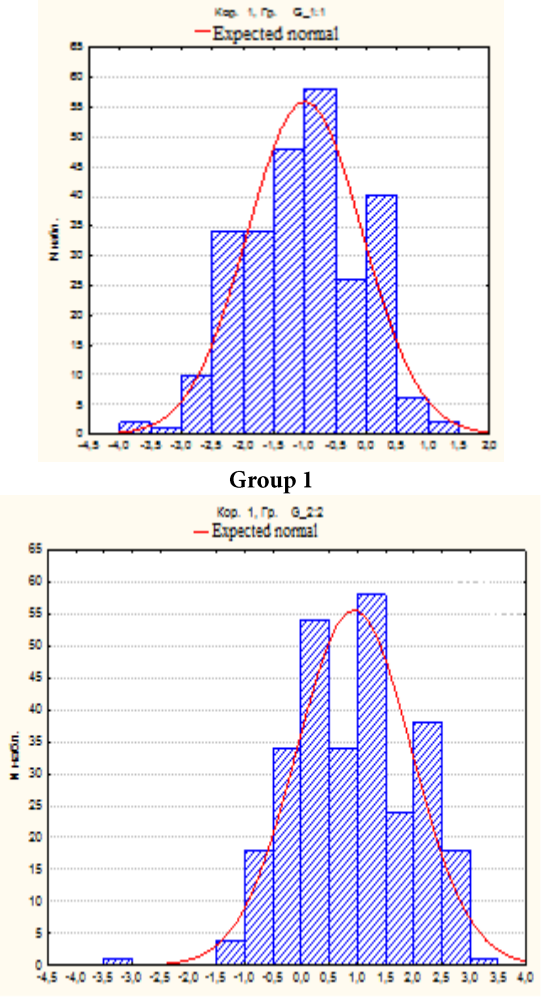

Fig. 1. The graph on the canonical variable for the 1st and 2nd groups

RESULTS

According to the results of the survey, using the AUDIT questionnaire (Russell M., 1994), which occurred before pregnancy, we found that the first question of the AUDIT questionnaire: "How often do you drink alcoholic drinks?" Women answered as follows: alcohol 1 time 71.6% of women of the 1st group and 75.70% of the 2nd group consumed per month; alcohol was consumed 2–4 times a month before pregnancy by 9.96% of women in the control group and 20.42% of women in the 2nd group.

When comparing the results of drinking women with control, statistically significant differences were obtained ($p < 0.05$).

According to statistical analysis, it was found that more than every second pregnant woman smoked while drank alcohol (51.76%). For comparison, 18.39% of pregnant women smoked in the control group. In the statistical analysis of indicators, significant differences were obtained ($p < 0.05$).

It was found that medical abortion was most common in the group of women who consumed alcohol in the prenatal period, which amounted to 48.94% in contrast to the control group, where this indicator was 26.82% ($p < 0.05$).

Quite a lot of women during pregnancy suffered from anemia, but statistically significantly more this indicator was in the group of pregnant women drinking. So, in the control group, this indicator amounted to 40.23% and in the group of women who drink alcohol during pregnancy - 48.24% ($p < 0.05$).

CHD was significant of the congenital malformations of the fetus. Ultrasound in the third trimester of pregnancy was diagnosed with 9.96% of pregnant women of the 2nd group. For comparison, this indicator in the control group was 1.41%. This is evidence that pregnant women who drank alcohol during pregnancy were more likely to be diagnosed with CHD compared with the control group ($p < 0.05$).

The most significant and informative signs were dystocia, discoordinated contractions of the myometrium muscle (DCMM). In the group of non-drinking women, these signs were 3.07% and in the group of drinkers, 6.34% ($p < 0.05$).

Analyzing complications in the postpartum period, we found that uterine subinvolution was an informative and significant sign, which was 11.6% in the control group and 19.54% in the 2nd group ($p < 0.05$).

As for the gender of the newborn, girls predominated in the control group (46.74%), and boys in the main group (58.87%) ($p < 0.05$).

The diagnosis of preterm gestational age was made by 4.78% of newborns of the control group, 10.95% of the group of children born to drinking women. Statistically significant differences were obtained when comparing the indicators of the 1st and 2nd groups, which proves the effect of alcohol on the degree of maturity and development of the fetus ($p < 0.05$).

Severe condition of the newborn was diagnosed in 0.8% of children in the control group and 8.48% of children born to women who consumed alcohol in the prenatal period. This could be due to hypoxic manifestations, which in turn may be associated with anemia, dystocia, prematurity ($p < 0.05$).

DISCUSSION

The potential harm to the fetus caused by drinking during pregnancy is a public health concern worldwide, particularly as almost half of all pregnancies are unplanned and are, therefore, at higher risk from inadvertent alcohol exposure (WHO. Global status report on alcohol and health, 2018).

Mention of the dangers of drinking alcohol during pregnancy can be traced back to the 18th century in religious sources, literary works, paintings, and reports from doctors and public figures.

In general, the toxic effect of ethanol aggravates the already existing somatic pathology of the parents, creates even more unfavorable conditions for intrauterine development of the fetus, and increases the risk of

complications during pregnancy and childbirth (Sofronova, G.I., A.B. Palchik,2012; Yaltonskaya, A., Yaltonsky, V., Kolpakov, Y., 2014; Popova S., Lange S., Probst C. Et al., 2017). It contributes to the emergence of pathological conditions in the neonatal period, and subsequently leads to frequent loss of normal life activity by the child, its disability and social maladaptation (Thomas S.E. et al., 1998; Zhang F.X. et al., 2005; Popova S., Lange S., Probst C. et al., 2017). Analyzing the data of our study, it was found that among Group 2 women who drank alcohol during pregnancy, medical abortions were significantly more likely in the history and pregnancy was also statistically significantly more often complicated by anemia of pregnant women, congenital malformations (CM) of fetuses diagnosed by ultrasound screening in the third trimester of pregnancy, the formation of congenital heart defects (CHD) during pregnancy.

The article describes the methods of mathematical analysis of the influence of alcoholic beverages on pregnancy, childbirth, the postpartum period and the condition of newborns. Using a discriminant analysis, informative diagnostic signs were obtained to determine the effect of alcohol on pregnancy, childbirth, the postpartum period, and the condition of newborns. The diagnostic accuracy according to the decisive rules was on average quite high - 76.69, for the first group - 75.7%, the second - 77.6%.

According to studies of authors, pregnancy and childbirth in women who drink alcohol can occur against the background of premature birth and other complications of pregnancy, childbirth and the postpartum period (Albertsen K, Andersen AM, Olsen J, et al.,2004; Robinson M, Oddy W.H, McLean N.J., et al. 2010; Marianian, A., Protopopova, N., & Kolesnikova, L., 2015; Wubetu A.D., Habte S., Dagne K..2019). In our research, we showed that even small doses, from 1 to 11 doses over the entire pregnancy, with slightly alcoholic beverages, in the form of beer, wine and champagne, statistically significantly more often complicated the course of the delivery of dystocia and DCMM. Also in the postpartum period, uterine subinvolution was more often diagnosed in a group of women who drank alcohol during pregnancy.

An interesting fact was obtained that girls predominated in the control group, and boys in the main group of drinking women.

When analyzing literature data, it was found that a significant increase in the risk of the formation of congenital malformations of the fetus is possible even with a single intake of pregnant alcohol. Moreover, it is emphasized that congenital malformations may initially be invisible and the opinion is presented that the harmful effects of alcohol on the fetus are not the same in different periods of pregnancy: the first trimester is most dangerous (Wong E.V. et al., 1995). The results of our study show that babies born to drinking mothers were more likely to be born prematurely to gestational age, and a severe condition of the newborn at birth was more often diagnosed in children born to women who drank alcohol in the prenatal period.

CONCLUSIONS

We must conclude that even small doses of low alcohol drunk throughout pregnancy can lead to a complicated course of pregnancy, childbirth and the postpartum period, as well as adversely affect the developing fetus and the state of health of the newborn.

In conclusion, I would like to point out that it is necessary to attract the attention of specialists and researchers of different medical and social profiles to a problem so important for the well-being of future generations of our country and the whole world.

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Conflicts of Interest: The authors declare no conflict of interest.

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AUTHOR CREDENTIALS:

Marianian Anait Yuryevna – MD, PhD, Head of the Laboratory of Socially Important Problems of Reproductology, Leading Researcher; Associate Professor of the Department of Obstetrics and Gynecology of the ISMAPGE - Branch of the FSBEI FPE RMACPE MOH Russian. Address: 664003, Russia, Irkutsk, Timiryazev str. 16. Tel.: +7 (3952)207636; +79140147065. E-mail: anait_24@mail.ru; iphr@sbamsr.irk.ru; ORCID: 0000-0002-9544-2172

Kolesnikova Lyubov Iljinichna – academician of RAS, Scientific Supervisor, Scientific Centre for Family Health and Human Reproduction Problems. Address: 664003, Russia, Irkutsk, Timiryazeva str. 16. Tel.: +7 (3952)207636. E-mail: iphr@sbamsr.irk.ru; ORCID: 0000-0003-3354-2992;

Protopopova Natalia Vladimirovna - MD, PhD, Professor, Head of the Department of Obstetrics and Gynecology of the ISMAPGE - Branch of the FSBEI FPE RMACPE MOH Russian. Address: 664079, Russia, Irkutsk, microdistrict Yubileiny, 100. Tel.: +7 (3952)46-53-26; E-mail: doc_protopopova@mail.ru; E-mail: igiuvpress@yande.ru; ORCID: 0000-0002-1740-228X