# EARLY PROGNOSIS OF HYPOGALACTIA IN BREASTFEEDING MOTHERS: NEW OPPORTUNITIES FOR PRIMARY PREVENTION

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**Abstract.** An increase in the hypogalactia frequency diagnosis in breastfeeding mothers is one of the world-spread medical and social problems and is especially high in women with risk factors of lactation disorders. Early estimation of risk factors creates opportunities for physicians to diagnose the lactation problem that mothers face and solve it.

**Aim.** To identify and calculate prognostic criteria for determining the risk of hypogalactia in breastfeeding mothers and strategies to help women overcome them.

**Materials and methods.** Twenty-two factors that cause the most significant impact on the development of hypogalactia were selected, and their frequency was determined in 208 mothers with hypogalactia (group 1) and 388 mothers with normal lactation (group 2). The sequential Wald analysis, which compares the frequencies of distribution of traits in the study groups and determines their informativeness by calculating prognostic coefficients (PC) for different risk factors and estimating the individual risk of hypogalactia was used.

**Results.** The elder age of the breastfeeding mother (36 years and older) and its lower educational level promoted hypogalactia. Low security of the mother was associated with hypogalactia (PC -1,4). It was also found that mothers engaged in heavy physical labor suffer from hypogalactia more often than employees. Mothers' return to work, have been reported as factors that influence breastfeeding. Occupational hazards (noise, dyes, vibration, lead soldering, dust factors) and bad habits caused hypogalactia (PC -5,4). Prenatal breastfeeding education has been shown to prevent hypogalactia. A burdensome obstetric history (PC -3,9), habitual miscarriage (PC-1,4), and female genital diseases worsen the prognosis of lactation. Extragenital pathology was characterized by negative PC of hypogalactia, especially rheumatic fever, compensated heart defect (PC -3,2), chronic cardiovascular insufficiency (PC -11,4), congenital heart disease (PC -11,4), obesity (PC -4,8), diabetes mellitus (PC -5,8). The time of the first application to the breast affected the mothers' milk production.

**Summary.** The mathematical model of the individual prognosis of lactation in mothers contributes to the early detection of hypogalactia and the corresponding correction.

**Key words.** Prognosis, hypogalactia, mathematical model, prevention.

Раннее индивидуальное прогнозирование гипогалактии: новые возможности первичной профилактики

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Рост частоты гипогалактии у матерей является одной

из актуальных медико-социальных проблем, особенно у женщин с факторами риска нарушения лактации. Ранняя оценка факторов риска дает возможность составить индивидуальный прогноз лактации, диагностировать и профилактировать ее нарушения.

**Цель.** Определить и расчитать прогностические критерии для раннего прогнозирования и выявления гипогалактии у кормящих матерей для дальнейшей профилактики.

Материалы и методы. В результате математического анализа отобрано 22 фактора, имевших наибольшее влияние на снижение лактации, и определена их частота у 208 матерей с гипогалактией (группа 1) и 388 матерей с полноценной лактацией (группа 2). Методом последовательного анализа Вальда, в основе которого лежит сравнение частот распределения признаков в исследуемых группах, определена их информативность с подсчетом прогностических коэффициентов (ПК) и оценки индивидуального суммарного риска гипогалактии.

Результаты. Старший возраст (более 36 лет) и низкий образовательный и материальный уровень матери способствуют развитию гипогалактии. Матери, занятые тяжелым физическим трудом, страдают гипогалактией чаще. Возвращение матери к профессиональной деятельности негативно влияет на лактацию. профессиональные и бытовые вредности (шум, краски, вибрация, свинцовая пайка, пылевые факторы) способствут гипогалактии (ПК -5,4). Пренатальное обучение вопросам грудного вскармливания матери и ее семьи, формируют мотивацию и предупреждют развитие гипогалактии. Отягощенный акушерский анамнез ſПК -3,9), невынашивание беременности в анамнезе (ПК -1,4), хронические генитальные заболевания ухудшают прогноз лактации. Екстрагенитальная патология матери характеризутся отрицательными прогностическими коэффициентами, в особенности порок сердца вследствие ревматической лихорадки (ПК -3,2), врожденные пороки сердца (ПК -11,4), хроническая сердечно-сосудистая недостаточность (ПК -11,4), ожирение (ПК - 4,8), сахарный диабет (ПК-5,8). Выводы. Математическая модель индивидуального прогноза лактации у матерей способствует раннему

выявлению гипогалактии и соответствующей ее коррекции. Ключевые слова: прогноз, гипогалактия, математическая модель, профилактика.

**Introduction.** An important area of modern pediatrics is the study of hypogalactia, which is defined as inability to synthesize enough milk for infant growth requirements due to its rather high frequency of diagnosis and early cessation of breastfeeding [1].

Breastfeeding is the nourishment created by nature for newborns and infants. The benefits of human milk are well known. Breastfeeding is the optimal way of feeding neonates and infants and has vital importance for the child's development and health [2]. Breastfeeding is a protective factor for several infectious, atopic, and cardiovascular diseases. It also has a positive impact on immune development, microbiome, and health system factors [3], improves neurodevelopment and IQ and reduces the risk of attention deficit and behavioral disorders in children. Insufficient nutrition in the early periods of life places the infant at risk for disturbance of growth as well as serious and life-threatening complications of the diseases [4]. Lactation decreases the risk of sudden infant death syndrome by 36% and prevents 13% of infant mortality worldwide [5].

The World Health Organization (WHO), the Centers for Disease Control and Prevention, and the American Academy of Pediatrics recommend exclusive breastfeeding for 6 months after a child's birth [6]. The Baby-Friendly Hospital Initiative (BFHI) proposed by the United Nations Children's Fund (UNICEF) was introduced in 1993 to promote breastfeeding nationwide. The influence of compliance with UNICEF guidelines on breastfeeding duration is visible [7]. Research and clinical practice aimed to improve breastfeeding outcomes is focused on prehospital and hospital lactation support and education of mothers [1].

Many mothers give up breastfeeding earlier than recommended [2]. More than 68% of mothers were breastfeeding till the end of the third month, 31,5 - 34,4%, till the end of the sixth month, and only 2% continued to breastfeed for one year and longer [2,8].

So, the prevalence of breastfeeding nowadays is not optimal, and one of the main reasons is lactation insufficiency [1]. It has been estimated to affect 38-44% of newly postpartum women, and 29,3% of breastfeeding women at all, contributing to the nearly 60% of infants that are not breastfed according to the WHO guidelines [1]. It is known that 1 in 20 women worldwide are unable to successfully breastfeed and provide adequate nutrition for their infant through their breast milk exclusively [4].

The most spread reasons for never breastfeeding and for breastfeeding less than 6 months are insufficient milk and breastfeeding difficulties [8,9]. Hypogalactia is a complex phenomenon and a major reason in mothers worldwide for early termination of breastfeeding. Management of insufficient milk syndrome is an important part of encouraging breastfeeding success.

The increase of the hypogalactia frequency diagnosis in breastfed mothers is one of the widespread medical and social problems, its solving depends on the estimation of mothers' lactation possibility. However, researchers report that lactation insufficiency may be more often than is diagnosed [4].

According to modern research, the frequency of hypogalactia diagnosis is high in women with risk factors of lactation disorders [4].

Early estimation of risk factors creates opportunities for physicians to diagnose the problems that mothers face and solve [6]. According to the risk strategy, it is optimal to identify and estimate risk factors and determine their impact on the pathological process and the formation on the basis of risk groups for the development of hypogalactia. Delayed or failed achievement of lactogenesis occurs as factors result of various maternal and/or infant interactions. Early recognition of these risk factors is critical for clinicians who interact with breastfeeding women so that intervention and achievement of full or partial breastfeeding can be preserved [10]. This article describes the maternal and infant conditions that contribute to unsuccessful lactation.

Health professionals need to have adequate knowledge about improving lactation methods, and the reasons for inducing lactation. However, the lack of information on the individual prognosis of lactation insufficiency makes it difficult [11].

**Aim.** To identify and calculate prognostic criteria (PC) for determining the risk of hypogalactia in breastfeeding mothers as well as strategies to help women overcome them.

**Materials and methods.** We predicted hypogalactia to determine the likelihood of lactation pathology. Biological, economical, medical and motivation factors which have influence on lactation were determined in 208 mothers and their children with hypogalactia (group 1) and 388 mothers with normal lactation and their children (group 2). Twenty-two factors that cause the most significant impact on the development of hypogalactia were selected. Hypogalactia in mothers was diagnosed according to clinical signs: insufficient weight gain of the child, control feeding at least three times, and control pumping of milk at intervals corresponding to the regime method of childs' feeding.

Mathematical criteria for determining the individual risk of hypogalactia were developed. The sequential Wald analysis, which is based on comparing the frequencies of distribution of traits in the study groups and determining their informativeness by calculating a prognostic value for different risk factors was used. The calculation of the frequency of symptoms in alternative conditions was performed according to formula 1.

PC= 10lg [P1 (xi / A1) / P2 (xj / A2)]

- P1 the probability of hypogalactia.
- P2 the probability of normal lactation.
- X i,j criteria of hypogalactia.

A1, A2 - group of states, respectively, hypogalactia and normal lactation.

Formula (2) was used to determine the threshold of diagnostic coefficients (TC)

$$TC A_1 = 10 lg \qquad \frac{100-\alpha}{\beta} \qquad TC A_2 = 10 lg \qquad \frac{\alpha}{100-\beta}$$

 $\alpha$  and  $\beta$  are permissible errors of series 1 and 2, conditionally taken for 5%, the reliability of the results obtained should be 95% sensitivity. TC was ±13.

For calculation of the individual prognosis, PC values were added, and the amount obtained was estimated as follows: if a threshold of -13 was reached when adding PC, the development of hypogalactia can be expected with 95% sensitivity.

**Ethical considerations.** When the health examination of the patients was performed, the written informed consent forms from of every recipient for study purposes were obtained. This study was approved by the ethics review board of the Danylo Halytsky Lviv National Medical University with which the researchers were affiliated. The authors declare that there is no duality of interest associated with this manuscript.

## GEORGIAN MEDICAL NEWS No 7 (328) 2022

## Table 1. Prognostic coefficients of hypogalactia in breastfeeding mothers.

Prognostic criteria		Frequency of prognostic criteria				
		Hypogalactia, n=208		Normal lactation n=388		DC
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		n, abs	%	n, abs	%	
Mother's age (years)	17-25	100	48,1	238	61,3	+0,1
	26-30	48	23,1	81	20,9	-0,5
	31-35	35	16,8	53	13,7	-0,8
	36-40	17	8,2	13	3,4	-3,8
	more than 40	8	3,8	3	0,7	-7,3
Elderly firstborn		26	12,5	23	5,9	-3,3
Season of childbirth	winter	63	30,4	62	15,9	-0,8
	spring	64	30,9	92	23,6	-1,1
	summer	38	18,3	112	28,9	+2,0
	autumn	42	20,2	122	31,6	+1,9
Mother's marital status	married	200	96,3	381	98,2	+0,1
	single	8	3,7	7	1,8	-3,1
Education	average	97	46,6	135	34,8	-1,1
	secondary special	52	25,0	127	32,7	+1,2
	high	46	22,2	102	26,3	+0,7
Social and professional group	workers	101	48,6	149	38,4	-1,0
	employees	88	42,3	167	43,0	+0,1
	agricultural workers	48	2,3	17	4,4	+2,8
	housewife	12	5,8	20	5,2	- 0,4
	mental	56	26,9	112	28,8	+0,3
	physical	92	44,2	150	38,7	-0,6
The nature of employment	business area	40	19,2	78	20,1	+0,2
	service sector	100	4,8	38	9,7	+3,0
	unemployed	100	4,8	10	2,5	-4,0
Material security	law	80	38,5	109	28,0	-1,4
	middle	119	57,2	275	70,8	+0,9
	high	9	4,3	7	1,7	-4,0
Occupational hazards		6	2,8	3	0,8	-5,4
	smoking	5	2,4	4	1,0	-3,8
Bad habits	alcohol abuse	2	1,0	-	-	-9,8
Serial number of pregnancies	1	112	53,9	227	58,5	+0,4
	2-3	69	33,2	131	33,8	+0,5
	4 and more	27	13,0	30	7,7	-2,3
Serial number of deliveries	1	115	55,7	245	63,1	+0,5
	2-3	84	40,4	139	35,9	+0,5
	4 and more	7	3,3	4	1,0	-4,8
Time of registration of the pregnant woman in the women's clinic and	before 12 weeks of gestation	132	63,5	270	69,6	+0,4
	after 12 weeks of gestation	67	32,2	112	28,9	-0,4
	we're not registered	89	4,3	6	1,5	-4,6
Targeting mothers and their families in breast-feeding promotion programs		185	88,9	368	94,9	+3,2
Complications of pregnancy	burdened obstetric history	39	18,8	29	7,5	-3,9
	gestosis of the first half of pregnancy	45	21,6	70	18,0	-0,8
	gestosis of the second half of pregnancy	43	20,7	29	7,5	-4,4
	edema of pregnant women	100	4,8	15	3,9	-0,9
	iron-deficiency anemia in pregnancy	41	19,7	13	3,4	-7,6
	risk of miscarriage	40	19,2	53	13,7	-1,4

#### GEORGIAN MEDICAL NEWS No 7 (328) 2022

Mother's disease	hypertension	11	5,2	2	1,8	-4,6
	rheumatic fever, compensated heart defect	8	3,8	2	1,8	-3,2
	chronic cardiovascular insufficiency	3	1,4	-	-	-11,4
	congenital heart disease	3	1,4	-	-	-11,4
	acute and chronic pyelonephritis	29	13,9	17	4,4	-4,9
	obesity 2-3 degree	15	7,2	4	0,96	-4,8
	diabetes mellitus	2	0,96	1	0,3	-5,8
	acute viral respiratory disease	23	11,1	35	9,0	-0,1
	Staphylococcal aureus carrier	1	0,5	7	1,8	-5,3
	urgent delivery	168	80,7	331	85,3	+0,3
	late delivery	27	12,9	43	11,1	-0,6
	premature birth	13	6,3	11	2,8	-3,5
Complications of delivery and the postpartum period	rapid delivery	9	4,3	10	2,6	-2,2
	weakness of labor	43	20,7	38	9,8	-3,2
	premature discharge of amniotic fluid	60	28,8	80	20,6	-1,4
	cesarean section	28	13,5	11	2,8	-6,8
	rupture of the section and vagina	20	9,6	16	4,1	-3,6
	use of obstetric forceps	11	5,2	6	1,5	-5,4
	revision of the urine cavity	42	20,2	70	18,0	-0,5
	bleeding in the natal and postnatal period	11	5,3	3	0,8	-8,2
Drugs that affect the contractile activity and tone of the myometrium (drugs based on horns (Claviceps Purpurea)		<sup>8</sup> 23	11,1	20	5,2	-3,3
Combination of risk factors complicating the course of pregnancy and delivery	0	20	9,6	156	40,2	+6,2
	1	66	31,7	122	31,4	-0,4
	2	85	40,9	77	19,8	-3,2
	3	29	13,9	30	7,8	-2,5
	4-5 and more	8	3,9	3	0,8	-6,9
Assessment of the newborn on the Apgar scale	8-10 points	12	57,6	286	73,7	+1,0
	6-7 points	82	39,5	101	26,0	-1,8
	5 points and less	6	2,9	1	0,3	-9,8
Diseases of the neonatal period	hypoxic and traumatic lesions of the central nervous system	72	34,8	74	19,1	-2,6
	asphyxia	12	5,8	9	2,3	-4,0
	respiratory disorders syndrome	5	2,4	3	0,8	-4,8
	prematurity	13	6,2	11	2,8	-3,4
	postmaturity	27	12,9	42	11,0	-0,6
Time of the first application to the	first 2 hours	142	68,2	364	94,0	+1,3
breastfeeding	second day and later	66	31,8	24	6,0	-1,5

**Results.** Twenty-two factors that cause the most significant impact on the development of hypogalactia were selected and their frequency was determined in 208 mothers with hypogalactia and 388 mothers with normal lactation (table 1).

**Discussion.** New evidence indicates that nutrition in the early life of the child seriously influences neurous and motor development, and affect later-life health outcomes, and disease risks. Noncorrect early life nutrition is associated with different pathology. Children who are adequately nourished are more likely to reach their developmental potential in cognitive, motor, and socioemotional abilities, with positive social interactions [12].

The percentage of interruption of breastfeeding in children at the 6th month is 45%. Such maternal factor, like insufficient milk is the most frequent reason that led to an early cessation [13].

In the article possible explanations for insufficient milk are analyzed, and new evidence of the influence of different biological, social, and medical factors on the development of hypogalactia in breastfeeding mothers and the algorithm for the calculation of individual prognosis for the hypogalactia development in every other mother is provided.

Although there is no clear way to predict who will experience impaired lactation, knowledge about the risk factors can enable health care professionals to better identify risk mother-infant dyads. Early intervention may help prevent infant complications associated with inadequate nutritional intake [4].

In the study, the elder age of breastfeeding mothers was a serious risk factor for lactation insufficiency. While at the mother's aged 18-25 years PC was (+0,1), it decreased up to (-3,8) at the age 36-40 years. Age had a serious bearing on the occurrence of lactation failure [14].

The higher educational level of the mother promoted full lactation. Thus, in mothers with secondary special education PC was (+1,0), and in mothers with secondary general education PC (-1,1). That is similar to Moss KM, et al. [8] that mothers of children who received human milk for less than 6 months were more likely to have a lower education compared to mothers of children exclusively breastfed. Low education had a serious influence on the occurrence of lactation failure.

The best for lactation was the middle security of the mother (PC  $\pm$ 0,9), the same data were received by Mathur N.B., et al. [14] that socio-economic status, influenced the occurrence of lactation failure. There is a possibility that lactating mothers practicing exclusive breastfeeding and living under harsh conditions may experience periods of low breast milk volume, indicate dietary inadequacies, and require nutritional intervention [15].

It was also found that mothers engaged in heavy physical labor suffer from hypogalactia more often than employees. Mothers' return to work, have been reported as factors that influence breastfeeding [6] and the most frequent reasons (43,4%) for giving up breastfeeding [2].

Occupational hazards (noise, dyes, vibration, lead soldering, dust factors) and bad habits along with the negative impact on the pregnancy caused hypogalactia (PC -5,4). That was similar to Moss KM, et al. [8] that mothers of children who received human milk for less than 6 months were more likely to smoke. Exposure of lactating women to environmental cigarette smoke may increase nicotine in breast milk, which in turn may reduce the volume of milk and the duration of breastfeeding [16].

Increasing the serial number of pregnancies from the first to fourth and more decreased PC from +0.4 to -2.3; while increasing the serial number of deliveries from the first to fourth and more decreased PC from +0.5 to -4.8.

Early time registration of the pregnant mother in women's clinics and targeting mothers and fathers in breastfeeding promotion programs in medical institutions had a positive influence on lactation (PC +0,4). Prenatal breastfeeding education has been reported as a factor that influences breastfeeding [6].

Targeting mothers and their family in breastfeeding promotion programs are recommended. The research found that the father's support positively impacts breastfeeding duration and exclusivity in the form of father's/partner's parental-child interactions [17]. Prenatal breastfeeding education has been shown to prevent hypogalactia [6,18]. Family-centered models for breastfeeding, peer support groups, and technology have been studied as potential ways to help women meet their breastfeeding goals [6]. Professional and non-professional support plays a great role in motivation to start and continue breastfeeding [13]. A system of professional lactation support for breastfeeding mothers must work, and include visitations to the outpatient breastfeeding service, and contact with breastfeeding mothers' support groups [2]. Though, it is determined that impaired lactation can occur despite maternal motivation, knowledge, support, and appropriate breastfeeding technique [4].

A burdensome obstetric history (PC -3,9), habitual miscarriage (PC -1,4), and female genital diseases worsen the prognosis of lactation. It was reported a new autoimmune etiology for isolated prolactin deficiency and puerperal hypogalactia in mothers [19]. Early hypogalactia was shown to be a neuroendocrine pathology affecting the central links of regulation of lactation as well as the function of the peripheral endocrine glands [20].

All extragenital pathology was characterized by negative PC of hypogalactia. Particularly high levels of lactation disorders were characteristic of cardiovascular pathology (hypertension, rheumatic and congenital heart disease, chronic circulatory failure) in the range of PC (-3,2) and (-11,4), which is similar to Yu X, et al. [21] that pregnancy-induced hypertension syndrome was found to be the risk factors for delayed lactogenesis. Emotional stress, anxiety, pain and maternal illness are the various psychosomatic factors that influence the production of milk and can reduce milk supply [22]. Obesity in breastfeeding mothers, especially 2-3 degrees caused a high risk of hypogalactia. That is similar to Moss KM, et al. [8] that mothers of children who received human milk for less than 6 months were more likely to be overweight/obese. Lactation insufficiency in obese breastfeeding mothers has an endocrine explanation as to the result of the failure of prolactin secretion, and inhibition of secretion by progesterone and estrogens through sequestration of progesterone and aromatization of estrogen in mammary adipose tissue [23].

Factors of high risk of hypogalactia in the mother were gestosis (preeclampsia) of 1-3 degrees (PC -4,4) and iron deficiency anemia (PC -7,6), so treatment for women with postpartum iron-deficient anemia increases the likelihood of lactation.

The use of drugs based on horns (Claviceps Purpurea) negatively influences lactation (PC -3,3). Also, the adverse effects of metoclopramide, bromocriptine, and domperidone must be weighed against the benefits of breastfeeding [24].

Hypogalactia developed during surgery: cesarean section, vacuum extraction, the use of obstetric forceps, as well as bleeding in the natal and early neonatal period (PC -5,4; -6,8; -8,2; respectively). The method of delivery has been reported as a factor that seriously influences breastfeeding [6]. The volume of milk transferred to infants born by cesarean section was significantly less than that transferred to infants born by normal vaginal delivery.

Unsatisfactory lactation of the previous child may determine the nature of lactation in subsequent pregnancies and births (PC -7,1).

Shorter postpartum excessive breast engorgement [25] was found to be the risk factor for delayed lactogenesis, but it was not analyzed in our study.

Newborn diseases were characterized by a high risk of developing hypogalactia: hypoxic-traumatic lesions of the central nervous system (PC -2,6), internal asphyxia (PC -4,0), partly as the result of the negative effect of the weakness of the

#### GEORGIAN MEDICAL NEWS No 7 (328) 2022

sucking reflex (PC-5,3). Prematurity (PC -3,4) was a serious risk factor for hypogalactia. It is evident, that perceived breast milk insufficiency was present in mothers of preterm babies [14].

Assessment of the newborn on the Apgar scale 5 points and less is the risk factor for hypogalactia (PC- 9,8). Lactation is negatively affected by the application of the child to the breast after the second day and even more after the fourth. Delayed expression initiation was found to be the risk factor for delayed lactogenesis [21].

Physicians must continue to improve their knowledge regarding lactation and risk factors of hypogalactia. Father education will allow for alterations in standard practices and improve breastfeeding. More research into this problem is necessary for early diagnosing and treating lactation insufficiency [21]. Influences on unsuccessful breastfeeding should direct changes in prenatal, intrapartum, and postpartum practices [26-30].

**Conclusion.** Risk factors for impaired lactogenesis are identifiable and possible to diagnose using prognostic coefficients of a mathematical model of individual prognosis of hypogalactia. Clinicians must be able to predict and recognize hypogalactia during pregnancy. Women who are at risk for delayed lactogenesis need targeted interventions and additional support during pregnancy and postpartum. Universal and individual strategies are required to increase rates of exclusive breastfeeding.

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