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Development of infants born to mothers with normal and impaired reproductive function in the context of the social situation of development

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Abstract

Context and relevance. For children in the first months of life, the basis of the social situation of development (SSD) is their involvement in the mother – child relationship. Conception and pregnancy achieved through assisted reproductive technologies (ART) often result in a chronic stressful situation for the woman, which can negatively affect the development of her maternal attitude. Communication with a close adult is the leading activity of a child in the first six months of life, and its disruption affects the overall development of children from these dyads. **Objective.** To compare the indicators of motor and emotional development in three-month-old children conceived with and without the use of reproductive technologies. **Hypothesis.** The social situation of development (SSD) in children born to mothers who used assisted reproductive technologies (ART) differs significantly from that in children born to mothers who did not, which is reflected in indicators of motor and emotional development as early as three months of age. **Methods and materials.** The study included 83 mother–child dyads with infants aged 3 to 3,8 months. In 20,5% of cases, the children were conceived using assisted reproductive technologies (ART). The research methods employed were clinical, experimental-psychological, and statistical. **Results.** The hypothesis was confirmed: children born with the use of assisted reproductive technologies (ART) differed from their peers with statistical significance in the level of motor skills development, despite approximately comparable indicators of physical health. **Conclusions.** The conditions of conception, pregnancy, and the postpartum period create a high risk of emotional disturbances and a shift in priorities in interaction with children for women who conceived through assisted reproductive technologies (ART). The social situation of development (SSD) for children is determined by these factors and may, in some cases, be considered emotionally deficient. Minimal differences in the level of physical health indicate that features of social interaction are the primary causes of delays in motor skills.

Keywords: assisted reproductive technologies, social situation of development, infancy, mother-child relationships, motor development, social-emotional development

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Развитие младенцев от матерей с сохранной и нарушенной репродуктивной функцией в контексте социальной ситуации развития

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Резюме

Контекст и актуальность. Для детей первых месяцев жизни основной социальной ситуации развития выступает включенность в материнско-детские отношения. Зачатие и вынашивание ребенка при помощи вспомогательных репродуктивных технологий нередко оборачивается для женщины хронической стрессовой ситуацией, что может негативно сказываться на становлении ее материнского отношения. Общение с близким взрослым является ведущей деятельностью ребенка в первом полугодии жизни, и его нарушение сказывается на общем развитии детей из этих диад. **Цель:** сравнить показатели двигательного и эмоционального развития у детей в возрасте трех месяцев, зачатых с применением репродуктивных технологий и без них. **Гипотеза:** социальная ситуация развития у детей, рожденных матерями с применением вспомогательных репродуктивных технологий и без них, имеет существенные различия, что отражается на показателях двигательного и эмоционального развития уже к трехмесячному возрасту. **Методы и материалы.** 83 материнско-детские диады, возраст детей от 3 до 3,8 мес., в 20,5% случаев были зачаты искусственным путем. Методы исследования: клинический, экспериментально-психологический, статистический. **Результаты.** Гипотеза подтвердилась: дети, рожденные с применением вспомогательных репродуктивных технологий, статистически достоверно отличались от сверстников по уровню развития двигательных навыков при приблизительно равных показателях физического здоровья. **Выводы.** Условия зачатия, протекания беременности и послеродового периода создают для женщин с искусственным зачатием высокий риск эмоциональных нарушений и смещения приоритетов во взаимодействии с детьми. Социальная ситуация развития для детей определяется этими факторами и может в ряде случаев рассматриваться как эмоционально дефицитная. Минимальные различия в уровне физического здоровья указывают на особенности социального взаимодействия как основные причины задержек двигательных навыков.

Ключевые слова: вспомогательные репродуктивные технологии, социальная ситуация развития, младенческий возраст, материнско-детские отношения, двигательное развитие, социально-эмоциональное развитие

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Introduction

The concept of “social situation of development” (SSD) was introduced into scientific circulation by L.S. Vygotsky, who defined it as a system of significant connections and relationships in a child that guide the course of their development at a given age. For infancy, he described SSD as the child's maximum dependence on an adult, combined with minimal means of communication for communicating their needs (Vygotsky, 1984). According to this logic, the dialectical contradiction inherent within the situation was viewed as the driving force behind the infant's development, primarily in the direction of speech development as a means of communication with an adult. However, modern knowledge

of infant development indicates the existence of broad pre-verbal communicative capabilities, which in reality alleviates the severity of this contradiction and, therefore, necessitates a new approach to the problem of SSD for this age. For children in the first months of life, it is determined, first of all, by inclusion in mother-child relationships and the experience of deep community with a close adult (Lisina, 2009; Smirnova, 2024).

The foundations of a dyadic approach to understanding infant mental development were laid a century ago by classic psychoanalytic scholars. These ideas gained widespread currency throughout the twentieth century. Despite the differences in interpretations of early childhood development, the recognition that its normal course is impossible without close interaction with a close adult

remains a fundamental feature of classical psychoanalysis, neo-Freudianism, cultural-historical psychology, the activity approach, attachment theory, perinatal psychology, the concepts of Daniel Stern and Stanley Greenspan, and others (Mukhamedrakhimov, 2003). A modern scientific approach to the social development of children in the first year of life must inevitably be based on concepts of dyadic mother-child relationships.

The specific content of an infant's social connections directly depends on the mother's parenting position—her value orientations, the educational strategies and tactics of routine care and interaction with the infant based on them, as well as on the gender-role structure of the family and the intra-family situation as a whole. In the modern world, these characteristics exhibit a very wide variability. Thus, within the framework of attachment theory (without using the term “social situation of development”, of course), extensive experimental material has been used to demonstrate how the characteristics of interpersonal interactions within the mother-child dyad shape various types of behavioral and emotional responses, goal-directed activity, and mental representations in children, and also influence the child's overall development and level of mental health. In the works of E.O. Smirnova, the concept of a “deficient sociocultural situation of development” was developed, leading to disturbances in the development of fine and gross motor skills, speech, and spatial representations in young and preschool children (Karabanova, 2022). In a psychological and sociological study by V.S. Sobkin and his co-authors demonstrated that young children from two-parent and single-parent families experience different maternal influences, which impacts their personal development. The authors of the study advance the idea that, in today's social order, we should not focus on a single, universal SSD within a given age range, but rather on a set of typical social developmental situations (Sobkin, Marich, 2002).

In light of the above, the specifics of raising a child conceived through modern conception technologies deserve special attention. Assisted reproductive technologies (ART) are a range of medical procedures aimed at assisting in the conception and birth of a child in cases of infertility. These technologies involve manipulation of sperm, eggs, or embryos to help a couple conceive, carry, and deliver a child. Despite its widespread use, having a child through ART is not a common occurrence in the life of a modern family and has significant differences from natural childbirth. These differences can be summarized as follows.

A diagnosis of female infertility can itself be a factor in a woman's emotional instability, contributing to the development of so-called “reproductive inferiority syndrome”. A prolonged, unsuccessful wait for pregnancy, the resulting exacerbation of family problems, unsuccessful attempts at ART accompanied by intense disappoint-

ment and emotional pain, and a high risk of complications during pregnancy and childbirth—all of this often leads to persistent emotional disturbances and neurotic states that persist into the postpartum period (Golyshkina et al., 2021; Zolotova, Malafeevskaya, 2023). Furthermore, an “obsession” with the idea of motherhood can have a paradoxical consequence, when a woman's primary interest is focused on the pregnancy and birth of a child, without recognizing the need for further deep involvement in the processes of care and upbringing. The listed factors can contribute to the formation of dysfunctional relationships in the mother-child system and affect the mental health and development of the child (Zolotova, Khazova, 2025).

According to several studies, children conceived through ART are more likely than other children in the general population to experience increased sensitivity and excitability, unstable autonomic responses, sleep and appetite disturbances, general motor disinhibition, and delayed speech development (Solovyeva, 2014). However, the impact of ART conception on children's subsequent development has been insufficiently studied. Most studies, both in Russia and abroad, focus on the physical health rather than the mental development of these children, and the results obtained have been highly contradictory. Furthermore, children are examined primarily in preschool or school age, less frequently in early childhood, and very rarely in the first months after birth (Solovyeva, 2014; Bokhan et al., 2024), which is partly due to the difficulty of accessing groups of children of this age for research and a number of ethical issues.

Purpose of the study: to compare the indicators of motor and emotional development in children aged three months, conceived naturally and using ART.

Hypothesis: The social developmental situation of children born to mothers using assisted reproductive technologies and without them has significant differences, which is reflected in their motor and emotional development indicators by the age of three months.

Materials and methods

The study involved 83 mother-child dyads (166 people in total).

Sample of children

The average age of the children at the time of the examination was 3,3 months, including 37 boys (44%) and 46 girls (56%). All children were born full-term at 37–41 weeks of gestation.

Inclusion criteria were children aged 3 to 3,8 months; exclusion criteria included the presence of serious physical health conditions that could negatively impact psychophysiological development.

Sample of mothers

The mothers ranged in age from 21 to 45 years (average age 34 years). Of these, 17 women (20,5%) conceived using ART, while 66 (79,5%) conceived naturally. The overall sample of mothers was matched for family social adaptability and socially acceptable attitudes toward children. Clinical interviews determined whether the mothers desired a child, and 100% of them responded affirmatively to the question about the conscious decision to conceive. All women signed a voluntary informed consent form to participate in the scientific study.

Inclusion criteria included consent to have their child examined by a clinical psychologist; exclusion criteria included family social distress, undesirability of the child, and dysfunctional parental attitudes.

Research methods

1. Clinical method: a medical examination of the child to determine their current somatic condition and health status at the time of the examination.

2. Experimental psychological method, including:

— a clinical interview with women in the form of a semi-structured interview to obtain anamnestic data on conception, pregnancy, and childbirth, to identify the desire for childbirth, the specifics of planning for both the most recent and previous pregnancies on the part of both the mother and the father, and the presence of difficulties in caring for and interacting with the infant;

— an empirical assessment of the development of motor, emotional, and social skills in three-month-old children by conducting diagnostic tests to determine the development of the relevant skills. I.A. Zolotova's original methodology, developed in accordance with the objectives of the study, was used.

3. A statistical processing method including descriptive statistics and comparative analysis using Fisher's * angular transformation and Pearson's 2.

The developed methodology utilized the most representative criteria for normative psychosocial development of infants (Griffiths R, 1996; Kustova et al., 2018; Keshishyan, 2020; Trushkina, 2021). The degree of development of motor skills, emotional development, and social skills was assessed on a scale from 0 to 2 points: 0 points—skill not developed; 1 point—skill in the developmental stage; 2 points—skill fully developed.

Contents of experimental tests

Development of motor skills.

1. While lying on the stomach, briefly lifts the head, holding it for at least 3 seconds.

2. While lying on the stomach, lifts the head 45 degrees and holds it for several minutes.

3. Straightens the legs from a flexed position.

4. Opens and closes the hand.

5. Turns the head toward a sound while lying on the back.

6. While lying on the stomach, supports the forearms bent at an acute angle.

7. Supports the head well in an upright position.

8. While lying on the stomach, lifts the head 90 degrees and holds it for several minutes.

9. While lying on the back, keeps the head in the midline.

10. Folds the hands together.

11. Moves the half-open palm toward the offered object. Attempts to touch the object, swinging it.

12. Tries to roll from back to side.

13. Lying on stomach, supports himself on forearms bent at a right angle.

14. Lying on back, lifts head when traction is applied to arms.

15. Rolls from back to stomach or from stomach to back.

16. Keeps their palm open.

17. Examines, feels, grasps and holds rattles, and puts them in their mouth.

Development of the emotional sphere and social skills.

1. The child notices the adult's address and attempts to establish eye contact.

2. Fixes gaze.

3. Social smile (communication smile, in response to an adult's address).

4. Reacts to sound with concentration (fixed gaze or cessation of movements).

5. Turns head toward sound.

6. A special smile addressed to a close, significant adult.

7. Full animation complex (a special emotional-motor response to an adult's address, including concentration, smiling, vocalizations, and motor animation).

8. Emotions of joy in the form of squeals or laughter.

9. Begins to transmit negative emotions (displeased when a toy is taken away).

10. Protests when losing an adult's gaze or when the adult is about to leave.

11. Turns toward a voice upon hearing their name.

Progress of the study

The study was conducted at a regional children's clinical hospital in the Central Region over the course of one year. In the first stage of the study, a representative sample of 83 mother-child dyads was recruited through clinical interviews. Respondents were divided into two groups based on their method of conception: the ART group (using assisted reproductive technologies) and the NC group (using natural conception). The ART group included 17 dyads, while the NC group included 66 dyads. The interviews were conducted by a clinical (perinatal) psychologist.

In the second stage, 83 apparently healthy children with no clinical signs of infection or somatic, neurologi-

cal, or mental disorders were examined. These children were classified into the “ART” and “NC” groups. The study plan included: 1) an assessment of their somatic status and confirmation of their health status at the time of the study (conducted by a pediatrician); 2) an assessment of their motor and emotional development (conducted by a clinical psychologist).

The examination of each dyad lasted approximately 40 minutes.

In the third stage, the results were analyzed using statistical methods.

Results

Results of clinical interviews with mothers

Clinical interviews with mothers, in addition to the aforementioned data on the unconditional desire for a child, yielded a number of qualitative findings. For example, the narratives of 87% of mothers who conceived through ART indicated they experienced severe anxiety about motherhood. They typically stated: “Anxiety never leaves me”, “I’m constantly afraid of something, worried that something will go wrong with the baby”, and “I’m afraid I won’t be able to cope, so I trust my mother to raise me”. Frequently, stories were told of the fears that accompanied the months of pregnancy and motherhood: fear of revealing the secret of artificial conception, fear of misunderstanding and judgment from friends and family, fear of losing the child. In some cases, low self-esteem or lingering feelings of guilt, for example, over the loss of the ability to conceive naturally, were present. In the NC group, signs of anxiety-phobic disorders were observed significantly less frequently, occurring only in isolated cases, and their overall emotional state was noticeably more stable. Furthermore, a striking difference in preferred conversation topics was observed between the ART and NC groups: women with natural conception were more likely to discuss their child with the specialist (their health, behavioral characteristics, joys and difficulties interacting with them, etc.), while mothers with artificial conception were more willing to engage in conversations about themselves or their family situation.

Results of the examination of children

The results are presented as follows:

1. The child’s health status (as an indicator of physical health);
2. The level of motor skill development;
3. The level of emotional development and communication skills.

Children’s physical health level

Based on the pediatric examination results, 82% of children in the overall sample were classified in health group 2 and 18% in health group 3. Health group 2 is the most common among children of this age in the region. It allows for minor functional deviations in children’s physical health and is considered favorable for subsequent successful psychophysical development. Health group 3 also does not limit children’s normal development during infancy; however, it requires monitoring by specialists: pediatricians, neurologists, cardiologists, and perinatal (clinical) psychologists. In the sample examined, children with health group 3 had low birth weight (40%), neonatal jaundice (40%), and congenital heart disease without circulatory impairment (20%).

The distribution of children by physical health groups in the ART and NC groups is reflected in Table 1.

As Table 1 shows, the distribution of children across health groups, although minor, differs between the ART and NC groups. Using Fisher’s exact coefficient, the difference between groups was determined to be $p \leq 0,1$, which corresponds to a trend.

The level of psychophysiological development of children.

To analyze differences in children’s development across areas (motor, emotional, and communication skills), this study adopted quantitative criteria for “optimal development” and “obvious developmental delay”. Development in a given area was considered optimal if a child scored between 90% and 100% of the maximum score on all tests. Cases with a score of 70 percent or less of the maximum score were considered overt developmental delay. The authors emphasize that these criteria were used solely as a basis for group comparison in this study and cannot be recommended for clinical use until they are statistically validated in larger child samples.

Differences in physical health groups in three-month-old children conceived through ART and naturally

Table 1

Group	The proportion of children classified as health group 2, %	The proportion of children classified as health group 3, %
ART (Assisted reproductive technologies)	76,5	23,5
NC (Natural conception)	83,5	16,5
Overall for the sample	82,0	18,0

The percentages of children with optimal and delayed development in the areas studied are given in Table 2.

As follows from Table 2, in the ART and NC groups the number of children with both the most and the least successful development differs.

Differences in cases with “optimal development” were assessed using Fisher’s angular transformation coefficient. Differences in motor development were statistically significant at $p \leq 0,05$, and in socio-emotional development at $p \leq 0,1$.

Differences in cases of “obvious delay” were analyzed using the Pearson chi-squared test, as the Fisher angular transformation is inapplicable to proportions with a zero value. Differences in motor development were statistically significant at $p \leq 0,01$, and in socio-emotional development at $p \leq 0,1$ (with 1 degree of freedom).

Table 3 shows the levels of statistical differences in the state of physical health and psychophysiological development of children from the ART and NC groups.

Thus, the study confirmed the hypothesis: children born to mothers who used assisted reproductive technologies and those who conceived naturally show statistically significant differences by the age of three months in the level of motor (to a greater extent) and socio-emotional (to a lesser extent) development, with minor differences in physical health indicators.

Discussion

First, the study showed that three-month-old infants conceived through ART and naturally have some differences in their physical health, but statistical methods only confirm these differences at the trend level. Similar conclusions were reached in previous studies by international psychologists and clinicians (Kelly-Vance, 2004; Klemetti, 2006; Djuwantono et al., 2020; Lo, Weng, Tsai, 2022; Pinborg, Wennerhol, Bergh, 2023; Angel et al., 2025). Russian researchers are divided on the likelihood of reduced physical health in children conceived through ART. Some authors point to the frequency of physical health problems in these children (Zyuzikova et al., 2018), while the opposing view is as follows: “The in vitro fertilization procedure does not negatively impact the health of children born from singletons and multiple pregnancies” (Malyskina et al., 2019, p. 44).

Furthermore, the study revealed statistically significant differences in psychophysiological development indicators between children conceived naturally and via ART. The aforementioned insignificance of differences in physical health suggests that their cause lies in the specifics of maternal influences. Thus, 87% of women in the ART group reported a markedly unstable emotional state, lasting from the moment they entered the in vitro fertilization protocol until the interview, i.e., until the baby reached three

Table 2

Indicators of development of motor and emotional-social skills in three-month-old children conceived with the help of ART and naturally

Group	Motor sphere		Social-emotional sphere	
	Proportion of children with optimal level of development, %	The proportion of children who are clearly lagging behind in their development, %	Proportion of children with optimal level of development, %	The proportion of children who are clearly lagging behind in their development, %
(Assisted reproductive technologies)	66	17	68	5
NC (Natural conception)	87	0	85	0

Table 3

Statistical analysis of differences between groups

Indicator	Name of the statistical criterion	The meaning of the statistical criterion	Level of significance of differences between groups
Physical health level	Fisher angular transform	0,65	0,1
Optimal development of the motor sphere	Fisher angular transform	1,86	0,05
Optimal development of the emotional-social sphere	Fisher angular transform	1,50	0,1
Obvious delay in motor development	X ² Pearson	12,15	0,01
Obvious lag in the development of the emotional and social sphere	X ² Pearson	1,01	Not significant

months of age. On average, the period of chronic stress among the study participants lasted from one and a half to three years. Its intensity varied depending on the course of the *in vitro* fertilization process, the woman's personal characteristics, the level of family support, and other circumstances. The problem of affective distress in women with a history of impaired reproductive function is recognized by many domestic and foreign authors and is widely discussed (Osipenko, 2020; Golyshkina, 2021; Solovieva, 2021; Zolotova, Malafeevskaya, 2023). It is reasonable to conclude that these particular characteristics of mothers in the ART group (likely in combination with other factors) could have had a negative impact on the mental development of their children. The scientific literature documents two main pathways for such influences. The first is the course of pregnancy under unfavorable emotional conditions. A link has been established between prenatal depression and chronic anxiety in mothers and subsequent impaired the mental development in children. Long-term developmental consequences have been observed in children conceived through ART, including a noted decline in cortical function at ages 5-8 (Surkova et al., 2025). The second way in which the mother's emotional state negatively impacts the child's development during the perinatal period is through disruption of the mother-child relationship (Zolotova, Khazova, 2025). Numerous studies in perinatal psychology, the systemic family approach, psychoanalysis, attachment theory, and other fields have devoted detailed discussions to this issue.

This study noted an interesting phenomenon: the mother's immediate value of the child (as an object of love and care, as a developing individual) is replaced by the value of the mere fact of the child's birth and existence. In routine childcare practices, this could lead to the mother's desire to limit her involvement with the child, reduce or even delegate her responsibilities for the child's upbringing. Thus, statements like this were heard in the conversations: "I've already accomplished the task—I became a mother, now I want to relax". Similar distortions in the need-motivational structure of the maternal sphere were previously noted in a study of the attitudes toward young children in women with deviant maternal behavior (Trushkina, 2025). The theoretical developments of G.G. Filippova allow us to regard these phenomena as "inculcating values" that hinder the formation of optimal mother-child relationships and dyadic interaction (Filippova, 2002).

Finally, the high incidence of motor developmental disorders in children in the ART group appears unexpected at first glance. It would seem that interaction with an anxious or under-engaged mother would have a greater impact on the child's emotional and communication skills. However, the obtained

result is entirely consistent with the position of the founders of the cultural-historical and activity-based approaches — L.S. Vygotsky, A.V. Zaporozhets, D.B. Elkonin, V.V. Davydov, M.I. Lisina and others, who argued that it is communication with an adult that is the leading activity in the first half of life, and it determines the development of other types of activity. Experiments by the Lisina school (Meshcheryakova, 1975) demonstrated that increasing the duration and intensity of emotionally charged interactions with adults resulted in children "... mastering grasping sooner, engaging in longer and more varied activities with toys they came across, freeing themselves earlier from impulsive, unproductive methods of examining objects, and mastering more precise and better-controlled actions involving the combined use of the eyes, hands, and mouth" (Lisina, 2009, p. 170). A lack of interaction with an interested and supportive close adult is a significant factor in delayed motor development in three-month-old infants.

Conclusion

1. The study shows that the specific conditions of conception, pregnancy, and the postpartum period when using ART create a high risk for women to develop chronic stress, emotional disturbances, and a shift in priorities in the formation of their maternal motivational sphere.

2. The social developmental situation for her child is largely determined by these factors and can in most cases be considered emotionally deficient.

3. The results obtained in the study indicate that the development of basic motor skills in children conceived through ART is delayed by three months of age compared to children conceived naturally.

4. In terms of physical health, all the children examined differed only slightly, which allows us to see the main reasons for the differences in the characteristics of social influences.

5. This interpretation of the results obtained in the study is entirely consistent with the postulates of the cultural-historical and activity-based approaches, but has scientific novelty in understanding the characteristics of the development of children conceived using ART.

6. A more complete understanding of the picture of the influence of the characteristics of the social situation of development on the development of children conceived artificially requires additional research.

Limitations. We concede that an increase in the sample size may lead to changes in the observed level of differences in the formation of motor and emotional-communicative skills between three-month-old infants conceived naturally and those conceived via ART.

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