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The Relationship between screen time and expressive language (active vocabulary and narrative production skills) in preschoolers

E.S. Oshchepkova[1] ✉**, A.N. Shatskaya**[1]**, Yu.E. Makarevskaya**[2]**,
A.A. Tvardovskaya**[3]
[1] Federal Scientific Center for Psychological and Interdisciplinary Research, Moscow, Russian Federation
[2] Sochi State University, Sochi, Russian Federation
[3] Federal Scientific Center for Psychological and Interdisciplinary Research (Kazan Branch of FSC PMI), Kazan, Russian Federation
✉ maposte06@yandex.ru

Abstract

Context and relevance. The study of the impact of electronic devices, particularly screen time (ST), on children's cognitive, emotional, and language development has become increasingly relevant in recent years, especially after the transition to fully or partially electronic forms of education. The influence of ST on language development is only beginning to be explored and shows contradictory results. **Objective.** To identify the relationship between a child's ST and the characteristics of their language development. **Hypothesis.** The negative impact of ST on language development would only be observed when ST exceeds the duration recommended by the WHO. **Methods and Materials.** The study involved 652 preschoolers (M = 70,4 months, SD = 4,53; 51% boys). Participants attended kindergartens in Moscow (74%), Kazan (13.5%), and Sochi (12,5%). Children were asked to "play with words" (i.e., complete a verbal and semantic fluency test) and then view a series of pictures and tell a story based on them. Parents completed a questionnaire indicating their child's ST duration on weekdays and weekends. **Results.** It was shown that ST duration is not significantly associated with the size of children's vocabulary but is associated with their ability to construct coherent narratives. **Conclusions.** The negative impact of ST is indeed observed only when it is excessive and, according to our study, affects more complex forms of speech (narratives). In the future, we consider it necessary to determine at what age these differences begin to manifest, as it can be assumed that by 70 months, lexical and grammatical skills are generally formed, and the negative impact primarily affects parameters that are actively developing at this age, namely, the construction of coherent narratives, their coherence, integrity, and structure.

Keywords: preschool age, language development, active vocabulary, coherent speech, macro- and microstructure, screen time, gadgets

Связь экранного времени дошкольников и их экспрессивной речи (на материале активного словарного запаса и навыков составления рассказа)

Е.С. Ощепкова[1] ✉**, А.Н. Шатская**[1]**, Ю.Э. Макаревская**[2]**, А.А. Твардовская**[3]
[1] Федеральный научный центр психологических и междисциплинарных исследований (ФГБНУ ФНЦ ПМИ), Москва, Российская Федерация
[2] Сочинский государственный университет (ФГБОУ ВО «Сочинский государственный университет»), Сочи, Российская Федерация
[3] Федеральный научный центр психологических и междисциплинарных исследований (ФГБНУ ФНЦ ПМИ) (Казанский филиал), Казань, Российская Федерация
✉ maposte06@yandex.ru

Резюме

Контекст и актуальность. Изучение влияния электронных устройств, гаджетов, в частности, продолжительности экранного времени (ЭВ) ребенка на особенности его когнитивного, эмоционального и речевого развития становится в последние годы все более актуальным, особенно после перехода детей полностью или частично на электронные формы обучения. Влияние ЭВ на речевое развитие только начинает изучаться и показывает противоречивые результаты. **Цель**. Выявить взаимосвязь ЭВ ребенка и особенностей его речевого развития. **Гипотеза**. Негативное влияние ЭВ на речевое развитие будет отмечаться только при чрезмерной длительности (более ЭВ, рекомендованного ВОЗ). **Методы и материалы**. В исследовании приняли участие 652 дошкольника (М = 70,4 месяца, SD = 4,53; 51% мальчиков). Участники являлись воспитанниками детских садов городов Москвы (74%), Казани (13,5%) и Сочи (12,5%). Детям предлагалось «поиграть в слова» (то есть пройти тест на вербальную и семантическую беглость), а затем посмотреть серию картинок и рассказать историю по этим картинкам. Родители детей заполняли анкету, где указывали продолжительность ЭВ ребенка в будни и выходные дни. **Результаты.** Было показано, что длительность ЭВ значимо не связана с объемом словарного запаса детей, однако связана с навыками построения связной речи. **Выводы**. Негативное влияние ЭВ действительно проявляется только при чрезмерной длительности и, судя по нашему исследованию, при оценке более сложных форм речи (нарративов). В даль-

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нейшем мы считаем необходимым узнать, с какого возраста начинают проявляться эти различия, поскольку можно допустить, что в 70 месяцев лексико-грамматические навыки уже в целом сформированы и негативное влияние оказывается прежде всего на те параметры, которые особенно активно развиваются в этом возрасте, а именно — на построение связного рассказа, на его связность, цельность и структурированность.

Ключевые слова: дошкольный возраст, речевое развитие, активный словарный запас, связная речь, макро- и микроструктура, экранное время, гаджеты

Introduction

The study of language development has a long history; however, modern technologies have introduced new research trends and challenges. One of the increasingly relevant issues is the impact of children's screen time (ST) on their language and speech development (Bukhalenkova et al., 2021; Zinchenko, 2022; Duch et al., 2013; Karani, Sher, Mophosho, 2022). Currently, there is a lack of data on this issue in the context of the Russian language, despite its growing significance. Addressing this challenge requires the development of new psychological approaches and methods to mitigate the negative effects of digital technologies on both oral and written speech, particularly in older preschool and early school-age children (Kortava, 2024).

The main stages of language development in children under five years old have been extensively studied, including in the Russian language (Veraksa et al., 2024). However, the 5–7 age range in typically developing children remains insufficiently explored, particularly concerning the formation of discourse and narratives and the influence of ST on its development.

In recent years, particularly due to the COVID-19 pandemic, the issue of ST's impact on child development has gained even more prominence (Gomes, Souza, 2023; Zinchenko, 2022; Qi, Yan, Yin, 2023). Screen time is generally defined as the duration a child spends using digital devices, such as smartphones, televisions, computers, and tablets (Ponti et al., 2017).

The Impact of Screen Time (ST) on Children's Cognitive Development

The study of screen time (ST) and its effects on child development has been gaining increasing attention in recent years (Veraksa et al., 2024). Researchers are not only accumulating data but also conducting reviews and meta-analyses to account for various variables and determine the extent to which ST has a definitive impact on child development.

It is important to note that many studies focus specifically on excessive ST. Excessive ST is generally defined as screen exposure exceeding two hours per day (Whiting et al., 2021). Research has identified negative effects of prolonged ST on children's physical and mental health, as

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well as their emotional development (Kurgansky et al., 2023; Kerai et al., 2022). Specifically, excessive ST has been linked to behavioral and cognitive problems (McArthur, Tough, Madigan, 2022), obesity, anxiety, sleep disturbances (Muppalla, Vuppalapati, Reddy Pulliahgaru, 2023), memory impairments, learning difficulties, and even neurodegeneration (Neophytou, Manwell, Eikelboom, 2021).

However, a considerable number of publications report no negative impact of ST on various psychological phenomena in children. For instance, a study by Bukhalenkova and Almazova (2023) found no correlation between ST duration and different aspects of children's imagination. It is worth noting that in this study, prolonged ST was defined as more than 80 minutes per day—less than 1.5 hours—which, as previously discussed, does not qualify as excessive ST in most countries.

It is suggested that the varying data on the effects of screen time (ST) on children's psychological development may be linked to differences in the types of digital games children engage with (Plotnikova, Bukhalenkova, Chichinina, 2023) and the distinction between active and passive ST (Sweetser et al., 2012). Passive ST refers to screen exposure in which the child does not interact with the digital device, such as watching videos, whereas active ST involves interaction, including playing games and using educational programs (Sweetser et al., 2012).

Studies indicate that a predominance of passive ST negatively affects children's cognitive and social skills development (Hu et al., 2020). In contrast, no such association has been found with active ST (Hu et al., 2020), even when it exceeds pediatric recommendations. Moreover, the negative effects of ST can be mitigated by sufficient outdoor time, with a favorable screen time-to-green time ratio (Oswald et al., 2020).

A recent review (Panjeti-Madan, Ranganathan, 2023) concluded that ST may have adverse effects on motor development, physical activity, sleep, nutrition, socio-emotional skills, and self-regulation. However, based on their analysis, the authors suggest that acceptable ST limits should be as follows: no screen exposure for children under two years, less than 60 minutes per day for children aged 3–5 years, and 60 minutes per day for those aged 6–8 years.

Similar recommendations exist in various countries. For preschoolers, the WHO Guidelines on Physical Activity, Sedentary Behavior, and Sleep for Children under 5 Years of Age (2019) advise limiting ST to 60 minutes per day for children aged two and older. In the Russian Federation, the Methodological Recommendations on Daily Screen Time Duration for Children (MR 2.4.0330-23) were developed by Rospotrebnadzor and approved by the Chief State Sanitary Doctor of the Russian Federation, A.Yu. Popova, on August 29, 2023, for school-age children. According to these guidelines, daily ST should not exceed two hours for children from early school age onward.

The Relationship between Screen Time Duration and Children's Language Development

The study of the relationship between screen time (ST) and language development has been widely explored. A relatively recent meta-analysis (Madigan et al., 2020) identified 26,751 studies on this topic from 1960 to 2019 during the selection phase alone. It is important to note that most of these studies focus on language development in children under 36 months. Additionally, many studies assess language development solely based on passive vocabulary size.

For example, the study that found a negative effect of ST on language development (Beatty, Egan, 2018) reported that prolonged ST negatively impacts the vocabulary size of 5-year-old children. A longitudinal cross-sectional study of Latin American children

(Duch et al., 2013) also indicated that ST has adverse effects on both communicative and linguistic skills. However, in this study, the average ST for 2-year-old children was 2 hours per day, and the negative effect was observed in those who spent more than 2 hours per day watching television.

Some review papers (e.g., Watt, 2010) suggest a positive impact of digital devices on language development, particularly in increasing vocabulary size and promoting literacy. However, it is essential to note that these studies focus not on ST duration but rather on the mere fact of gadget use by children.

Another research direction in studying the effects of screen time (ST) on children's language development is considering additional family and social factors. A longitudinal study (Blankson et al., 2015) demonstrated that ST duration at ages 3–4 negatively affects vocabulary and self-regulation skills at age 5. However, this negative impact was mitigated when parents engaged actively with their children, providing support in language acquisition and self-regulation

Recent analytical reviews (Bhutani et al., 2023; Karani, Sher, & Mophosho, 2022) suggest that ST can have positive, negative, or neutral effects, depending on three key factors: 1) ST duration; 2) content type (educational vs. passive consumption); 3) parental involvement during screen interaction.

Our analysis of existing literature, including meta-analyses and critical reviews, indicates that excessive ST (over 2,5 hours/day) negatively affects language development—particularly in children under 4–5 years old engaged in passive ST (e.g., watching videos without interaction). However, results are less conclusive under other conditions.

Research Objectives and Hypothesis

The goal of our study was to investigate the relationship between children's ST and their language development. The research question was formulated as follows: How does ST duration on weekdays and weekends correlate with the development of children's narrative skills and the size of their active vocabulary?

In our empirical study, we tested the hypothesis that a negative effect of ST on language development would only be observed when ST exceeds the WHO-recommended limits.

Materials and methods

To verify the formulated hypothesis, we conducted a comprehensive assessment of children's language development levels. Language skills assessment included diagnostics of active vocabulary and narrative skills.

Active vocabulary assessment was performed using:

Verbal fluency test — children were asked to name as many different words as possible within one minute; Semantic fluency test — children named as many different actions as possible in one minute (Methods of Neuropsychological Examination..., 2016). Responses were evaluated based on productivity metrics.

Narrative skills assessment employed the "Storytelling based on a Series of pictures" method (Methods of Neuropsychological Examination..., 2016), using the "Nest" sequence from the Multilingual Assessment Instrument for Narratives (MAIN) (Gagarina et al., 2019).

Two experts evaluated the children's narratives based on two scales:

1) Macrostructure (10 points total) — assessed for semantic completeness, adequacy, coherence, and adherence to the narrative structure (goal — attempt — outcome). Scores ranged from 1 (no coherent story) to 10 (a complete, well-structured narrative with an introduction, all episodes, and a conclusion).

2) Microstructure (10 points total) — assessed for lexical (accurate word choice)

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and grammatical (correct use of grammar, syntax, and agreement) accuracy (Oshchepkova, Shatskaya, 2023).

Screen Time Measurement

ST duration was assessed via a parent questionnaire. Parents provided information on:

— ST duration on weekdays and weekends,

— Child's age and gender, and

— City of residence, which was encoded in the study.

The study involved 870 preschoolers (Mean age = 70.4 months, SD = 4,53; 51% boys) and their parents from: Moscow (74%), Kazan (13,5%), Sochi (12,5%)

All assessments were conducted individually in quiet kindergarten rooms during morning hours to ensure optimal testing conditions. This methodological approach allowed for standardized evaluation while accounting for individual differences in children's language development patterns.

Results

Children's Screen Time Data. Preliminary Data Analysis

In the initial stage of data analysis, we calculated descriptive statistics for the key study variables. The Shapiro-Wilk test indicated that the data distribution was not normal. However, given that the total sample included over 650 children, we supplemented this analysis with the Skewness criterion, which also revealed a significant deviation from normality. As a result, we used non-parametric methods for further analysis of ST differences.

First, we examined the duration of ST on weekdays and weekends (Table 1). The analysis revealed that:

— Mean daily ST on weekends (M = 49,6 minutes; SD = 58,7) was almost twice as high as

— Mean daily ST on weekdays (M = 25,6 minutes; SD = 36,8).

A Wilcoxon signed-rank test confirmed that these differences were statistically significant (W = 1731; p < 0,001), with a biserial rank correlation coefficient of 0,946, indicating a strong effect size.

Additionally, Table 1 presents frequency distribution data, and we conducted a percentile-based classification of the sample. This allowed us to divide the children into groups based on ST duration, which facilitated further analysis.

Since the Shapiro-Wilk test (p < 0,001) and Skewness values (2,0 and 1,89) indicated a non-normal frequency distribution, we employed non-parametric statistical methods for further analysis.

Table 1

Descriptive statistics of screen time (ST), normality test, percentile groups (N = 652)

	ST (weekdays)	ST (weekends)
M (SD)	25,6 (36,8)	49,6 (58,7)
Min	0	0
Max	240	360
Skewness criteria	2.20	1.89
Shapiro-Wilk criteria W (p)	0,711 (<0,001)	0,784 (<0,001)
25%	0.00	0.00
50%	10,0	30,0
75%	30,0	60,0

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Using percentile-based classification, we divided children into four groups based on their screen time (ST) duration:

— Weekdays: 1) no screen time (as reported by parents); 2) 10 minutes or less; 3) 11 to 30 minutes; 4) more than 30 minutes

— Weekends: 1) no screen time; 2) 30 minutes or less; 3) 31 to 60 minutes; 4) more than 60 minutes

A Kruskal-Wallis test comparing ST across different regions showed that weekday ST was significantly lower in Moscow than in Kazan (W = 3,49, p = 0,036) and Sochi (W = 4,06, p = 0,011). However, there were no significant differences between Kazan and Sochi. Weekend ST did not differ significantly across regions.

Additionally, gender differences in ST were analyzed. Results showed that boys spent significantly more time using gadgets than girls, both on weekdays (W = –3,02; p = 0,033) and weekends (W = –3,55; p = 0,012).

The Relationship Between Screen Time (ST) and Language Skills

Inter-Rater Reliability. Expert evaluations of narrative macrostructure (coherence, completeness) and microstructure (lexical-grammatical accuracy) showed high consistency (Spearman's r = 0,61, $p < ,001$), ensuring measurement validity.

ST Duration and Language Development. We compared the four ST exposure groups (see previous classification) across the parameters: verbal fluency, semantic fluency, narrative macrostructure, narrative microstructure (Table 2). The Kruskal-Wallis statistics showed significant differences between groups with different ST in weekdays only for narrative skills (macro— and microstructural aspects).

The results of the statistical analysis show the relationship between the duration of screen time (ST) in children and their language development.

Additional comparison of region groups with Kruskal-Wallis criteria showed no significant difference except for verbal fluency (Moscow children outperformed Sochi (W = –3,40, p = 0,043)) and lexical-grammatical skills (Moscow children outperformed Kazan (W = –6.92, p < 0,001)).

Supplementary pairwise comparisons using the Dwass-Steel-Critchlow-Fligner (DSCF) test revealed significant differences in narrative macrostructure between:

• Group 1 and Group 4 (W = –5,302, p = 0,001) (i.e., children with no weekday device use versus those using devices for more than 30 minutes)

• Group 3 and Group 4 (W = –4,403, p = 0,010) (i.e., children using devices for less than 30 minutes versus more than 30 minutes on weekdays)

For narrative microstructure, significant differences were found only between Group 1 and Group 4 (W = –4,298, p = 0,013).

No significant differences in any parameter (verbal and semantic fluency, nar-

Table 2

Differences in language skills between children groups with different ST in weekdays (Kruskal-Wallis)

	χ^2	df	p	ε^2
Verbal fluency	3,819	3	0,282	0,006
Semantic fluency	0,179	3	0,981	0,000
Narrative macrostructure	15,716	3	0,001	0,025
Narrative microstructure	9,606	3	0,022	0,015

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rative macro-/microstructure) were found between Weekend ST groups.

Discussion

The results of the statistical analysis show the relationship between the duration of screen time (ST) in children and their language development.

The non-normal distribution of the data can be explained by the fact that most parents restrict the use of gadgets for preschool-aged children, particularly during weekdays, with three-quarters of children spending less than half an hour on gadgets during these days. However, in cases where children are not limited in screen time, they can spend up to 4 hours on weekdays and up to 6 hours on weekends.

Descriptive statistics reveal differences in gadget use across Moscow, Kazan, and Sochi. A trend can be observed, where the size of the city is inversely related to screen time duration. At the same time, no significant differences were found for screen time during weekends. This aligns with a study by Nigg et al. (2022), which showed that in recent years, the frequency of gadget use has significantly increased among children and adolescents in rural areas. However, in some studies (e.g., Dollman et al., 2012), longer screen times were noted among adolescents in large cities. In this case, the study refers specifically to adolescents aged 9–16, who choose the duration of their screen time themselves. We hypothesize that this is because the larger the city, the more opportunities children have for extracurricular activities and leisure during the weekdays, which consequently reduces their screen time. On weekends, however, parents are more lenient about gadget use, leading to a significant increase in screen time across all regions. This result is consistent with other studies, such as (Sigmundová and Sigmund, 2021), which

found that screen time increases significantly on weekends, not only for children but also for their parents.

Regarding differences in language development indicators across regions, we found that only lexical-grammatical accuracy significantly differed in Kazan. We attribute this to Kazan being a bilingual region, where bilingual children, as shown in several studies, may lag behind their monolingual peers in terms of lexical and grammatical accuracy (e.g., Boese et al., 2023; Kovyazina et al., 2021; Nicoladis & Genesse, 1997).

The gender differences observed in screen time usage also align with findings from other studies. For instance, a large-scale international project examining physical activity and screen time in over 150,000 children across 25 countries found that the percentage of boys spending more than 3 hours per day on gadgets was significantly higher than that of girls (Whiting et al., 2021). However, it is important to note that some studies, such as one on Australian children aged 3–5 years (Downing, Hinkley, Salmon, 2017), did not find gender differences in screen time. In our view, the data on gender differences in screen time requires further verification using other methods of data collection, not only parental surveys.

As for the interaction between screen time and children's language development, our findings indicate that significant differences are found only at the level of narratives. The vocabulary of children with different screen time usage did not differ. As discussed earlier, the relationship between language development and screen time varies across studies. The lack of significant correlation between weekend screen time and language development in our study can mainly be explained by the fact that screen time is not a constant interaction with the device but rather is limited to one or two days a week.

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However, when considering weekdays, no differences in vocabulary were observed, likely because the average screen time does not exceed the WHO's recommended limit of 2 hours per day. Therefore, no drastic reduction in vocabulary was observed. On the other hand, macrostucture of the narrative is the parameter that develops most actively in older preschool children (Kartushina et al., 2022), making it more susceptible to the effects of excessive screen time.

It is also important to note the variation in all language parameters in Group 2. These are children whose parents reported that the child uses a gadget on weekdays, but for less than 10 minutes. It is likely that this reflects a socially desirable response, rather than objective data. Moreover, as studies have shown (Fotekova, 2003), children often use various strategies to bypass parental restrictions on screen time.

It should be noted that this study only addresses the correlation between parameters, not a causal relationship. A common predictor for both the uneven development of macrostructure in narratives and the duration of screen time could be, for example, the family's socio-economic status, the number of siblings, family interaction patterns, or other external factors, which require further investigation, as indicated in studies (Veraksa et al., 2024; Gavrilova, Chichinina, 2023).

Conclusions

The results of the literature analysis show that the duration of screen time (ST) affects the cognitive and emotional development of children. In our study, we focused on the relationship between ST and language development in 5-6-year-old children. It was found that a significant interaction between ST and language development occurs only with daily prolonged ST (more than 30 minutes on weekdays) in relation to the development of narrative skills, especially the narrative macrostructure. The volume of active vocabulary was not related to the child's ST. Furthermore, the duration of ST on weekends was also found to have no significant relationship with language development.

In general, we can conclude that prolonged ST, especially on a daily basis, is particularly concerning.

Limitations. Social desirability, recall inaccuracy, or underestimation of actual screen time in parents' responses.

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Information about the authors

Ekaterina S. Oshchepkova, PhD in Philology, Leading Research Associate, Laboratory of the Psychology of Childhood and Digital Socialization, Federal Scientific Center for Psychological and Interdisciplinary Research (FSC PMI), Moscow, Russia, ORCID: https://orcid.org/0000-0002-6199-4649, e-mail: oshchepkova_es@iling-ran.ru

Arina N. Shatskaya, Research Associate, Laboratory of the Psychology of Childhood and Digital Socialization, Federal Scientific Center for Psychological and Interdisciplinary Research, Moscow, Russia, ORCID: https://orcid.org/0000-0001-7283-8011, e-mail: arina.shatskaya@mail.ru

Yuliya E. Makarevskaya, PhD in Psychology, Associate Professor, Chair of the general psychology and social communications, Federal state budgetary educational institution of the higher vocational training «Sochi state university», Sochi, Russia, ORCID: https://orcid.org/0000-0001-6937-6784, e-mail: yuliya-sochi@mail.ru

Alla A. Tvardovskaya, PhD in Psychology, Leading Research Associate, Federal Scientific Center for Psychological and Interdisciplinary Research (Kazan Branch of FSC PMI), Kazan, Russia, ORCID: https://orcid.org/0000-0002-2402-0669, e-mail: taa.80@ya.ru

Информация об авторах

Ощепкова Екатерина Сергеевна, кандидат филологических наук, ведущий научный сотрудник лаборатории психологии детства и цифровой социализации Федерального научного центра психологических и междисциплинарных исследований (ФГБНУ ФНЦ ПМИ), Москва, Российская Федерация, ORCID: https://orcid.org/0000-0002-6199-4649, e-mail: oshchepkova_es@iling-ran.ru

Шатская Арина Николаевна, научный сотрудник лаборатории психологии детства и цифровой социализации Федерального научного центра психологических и междисциплинарных исследований (ФГБНУ ФНЦ ПМИ), Москва, Российская Федерация, ORCID: https://orcid.org/0000-0001-7283-8011, e-mail: arina.shatskaya@mail.ru

Макаревская Юлия Эдуардовна, кандидат психологических наук, доцент, доцент кафедры психологии и дефектологии ФГБОУ ВО «Сочинский государственный университет», Сочи, Российская Федерация, ORCID: https://orcid.org/0000-0001-6937-6784, e-mail: yuliya-sochi@mail.ru

Твардовская Алла Александровна, кандидат психологических наук, доцент, ведущий научный сотрудник, Казанский филиал Федерального научного центра психологических и междисциплинарных исследований (Казанский филиал ФНЦ ПМИ), Казань, Российская Федерация, ORCID: https://orcid.org/0000-0002-2402-0669, e-mail: taa.80@ya.ru

Contribution of the Authors

Ekaterina S. Oshchepkova — ideas; planning of the research; writing of the manuscript; control over the research.

Arina N. Shatskaya — application of statistical methods for data analysis; visualization of research results.

Yuliya E. Makarevskaya — conducting the experiment; data collection and analysis; writing of the manuscript.

Alla A. Tvardovskaya — literature review; conducting the experiment; data collection and analysis; design of the manuscript.

All authors participated in the discussion of the results and approved the final text of the manuscript.

Вклад авторов

Ощепкова Е.С. — идея исследования; разработка дизайна исследования; написание текста; редактирование текста.

Шатская А.Н. — применение статистических методов для анализа данных; визуализация результатов исследования.

Макаревская Ю.Э. — проведение эксперимента; сбор и анализ данных; написание текста статьи.

Твардовская А.А. — сбор и анализ данных; обзор библиографических источников; оформление текста статьи.

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The authors declare no conflict of interest.

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