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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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EFFECT OF THE CORRECTIONAL APPROACH ON THE REGULATION OF NEURAL FUNCTIONS IN CHILDREN WITH MENTAL DISABILITIES WITH INTERHEMISPHERIC BRAIN ASYMMETRY

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Abstract.

The degree of asymmetry in humans and the complication of mechanisms of interhemispheric interaction are formed mainly in the process of learning, but the impact of developmental teaching methods on the regulation of nervous functions in children with intellectual disability has been little developed. The aim of the work is to study the influence of developmental teaching methods on the regulation of nervous functions in children with mental development disorders and interhemispheric asymmetry of the brain.

Findings: The information obtained in the data must be taken into account when organizing the learning process in the elementary school when working with mentally retarded children, when forming classes, when choosing programs, methods of teaching, when organizing psychological and pedagogical support.

The age features of the brain associated with advanced development of right hemispheric functions are almost not used in it. Meanwhile, the active use of opportunities of the right hemispheric way of processing information, especially in elementary school, promotes the development of the child's abilities, allows to predict and increase the efficiency of school training.

Conclusion: The functional contributions of the right and left hemispheres to the formation of the human psyche are assumed to be different because the hemispheres in their paired work function differently in time. The paired work is carried out in the present tense, so that the right hemisphere relies on the past, the left on the future tense. Therefore, the preservation of paired hemispheric functioning and structural integrity of the brain is the main condition, without which full-fledged mental activity cannot be formed.

Key words. Interhemispheric asymmetry, regulation of nervous processes, children with mental disabilities, brain structure and functions, developmental teaching, interhemispheric interaction.

Introduction.

The modern system of education is focused on the development of the symbolic and sign function of thinking. The age features of the brain associated with advanced development of right hemispheric functions are almost not used in it. Meanwhile, the active use of opportunities of the right hemispheric way of processing information, especially in elementary school, promotes the development of the child's abilities, allows to predict and increase the efficiency of school training [1-18,3,5,10,13]. The goal of developmental learning according to Zankov's system is integrity and maximum efficiency. Zankov identified four basic didactic principles in his system: teaching at a high level of difficulty; the leading role of theoretical knowledge; progression at a brisk pace; and students' awareness of the learning process [1,3,12]. It is more difficult to deal with children with mental development disorders as their play activity is leading for a long time already at school age. Considering this, the process of developmental training has a number of features.

The results of the research have shown that we have determined the level of mental development in mentally retarded children 8-11 years old caused by features of interhemispheric brain organization. We have conducted research of interhemispheric functional asymmetry and interhemispheric interaction in students studying according to different developmental programs, studied dynamics of regulation of nervous functions in students 8-11 years old with impaired mental development and interhemispheric asymmetry. On the basis of the conducted research and work experience, the results of some aspects of the problem are presented and a number of recommendations are offered.

The modern system of education is focused on the development of the symbolic and sign function of thinking. The age features of the brain associated with advanced development of right hemispheric functions are almost not used in it. Meanwhile, the active use of opportunities of the right hemispheric way of processing information, especially in elementary school, promotes the development of the child's abilities, allows to predict and increase the efficiency of school training [3,5,10,13]. It is necessary to note insufficient attention of researchers to the problem of functional asymmetry of the brain hemispheres in connection with education of children of primary school age (from 8 to 11 years) when educational activity of the child is formed as the leading one. At this age the structure and functions of the brain undergo essential changes [2,4,15]. To provide for harmonization of brain functioning, it is necessary to have a differentiated system of selection of techniques for training and development according to the psychophysiological profile of the child, the individual rate of maturation of the nervous system and formation of intra- and interhemispheric connections.

Scientific research on the features of interhemispheric cerebral organization in children aged 8-11 is currently conducted in several directions. First of all, it is the study of functional asymmetry of hemispheres in preschool children in connection with the diagnosis of their readiness for school education. In recent years, the number of studies of interhemispheric brain organization in children with learning difficulties and, in particular, in children with mental development disorders, has been growing [6,7,11,17]. The study of the relationship

between the features of interhemispheric brain organization in mentally retarded elementary school students and their level of development of intellectual and creative abilities and school performance is intensively developing. The essence of developmental learning consists in the fact that its contents, methods and the form of its organization are focused on patterns of child development Currently, the best-known systems of developmental learning are the system of J.B. Zankov and the system of D.B. Elkonin-V.V. Davydov [10].

The goal of developmental learning according to Zankov's system is integrity and maximum efficiency. Zankov identified four basic didactic principles in his system: teaching at a high level of difficulty; the leading role of theoretical knowledge; progression at a brisk pace; and students' awareness of the learning process [1,3,12]. It is more difficult to deal with children with mental development disorders as their play activity is leading for a long time already at school age. Considering this, the process of developmental training has a number of features.

The focus of developmental education according to the system of D.B. Elkonin-V.V. D.B. Elkonin-V.Davydov system, is restructuring of the learning activity of the child at the level of the contents and forms of its organization in order to provide emergence of new psychological qualities - theoretical thinking, reflection, independency in the solution of various educational tasks, etc. [10]. The development of the problem of functional asymmetry of the cerebral hemispheres and interhemispheric interaction in younger students with mental developmental disabilities aged 8-11 studying according to different developmental programs is just beginning. Meanwhile, consideration of the dynamics of interhemispheric asymmetry of the brain and interhemispheric interaction during the period of school education under different developmental programs will make it possible to identify the most preferred strategies of perception and processing of information in students of different age and typological groups, optimize the learning process, develop the intellectual and creative abilities of a child. Based on this, we determined the need to study interhemispheric asymmetry of the brain in children with intellectual disability of 8-11 years old in the conditions of developmental learning. Considering the above, our aim was to study functional asymmetry of the cerebral hemispheres and peculiarities of mental development of 8–11-year-old students under different developmental programs.

Methods.

The methodological basis was the work of a number of authors devoted to the study of nervous functions in children with mental development disorders and interhemispheric asymmetry of the brain, regulation of these functions, identifying difficulties, and modeling the system of work with these children. (Boguslavskaya, Miroshnichenko, 2019, Maryutina, Yermolaev 2001, Reuter-Lorenz and others, 2000).

From the above, it follows that teaching children with mental development disabilities of 8-11 years under the developmental program of D.B. Elkonin-V.V. Davydov activates to a greater extent right hemispheric brain systems. Education of children with mental development disorders of 8-11 years old according to the developmental program of J.B. Zankov activates left hemispheric brain systems to a greater extent. Further it follows that the correlation between the type of functional asymmetry of the cerebral hemispheres and the features of the training program will determine the level of mental development in these children studying in different developmental programs. Children with mental development disorders of 8-11 years old with a right hemispheric thinking style who study according to the developmental program of D.B. Elkonin-V.V. Davydov, and with the left hemispheric style, studying according to the developmental program of J.B. Zankov, will have a relatively higher level of intellectual development as compared to other types of functional asymmetry of the cerebral hemispheres. And also, it is necessary to note individual features of functional asymmetry of cerebral hemispheres in younger schoolchildren, caused by features of interhemispheric interaction at the differences in the structure of mental development in them will be formed by teaching them different developmental programs.

The above determined the following research objectives:

- To compare the dynamics of hemispheric activity in children with intellectual developmental disabilities of 8-11 years studying according to the developmental programs of D.B. Elkonin-V.V. Davydov, J.B. Zankov and the general education program, in the process of learning.
- To investigate interrelation of features of interhemispheric cerebral organization with the general level of intellectual development in children studying according to different educational programs.
- To reveal typological features of brain functional asymmetry in children with intellectual development disorders of 8-11 years old studying according to different educational programs and their correlation with the structure of intellectual development.

The object of the study was the pupils of the junior classes of special auxiliary schools No. 6 and 12 and of the main school No. 57 at the ASPU. In general, the sample of respondents was divided into two groups.

To solve the tasks set, we conducted a study of the features of interhemispheric interaction and the level of intelligence in mentally retarded children aged 8-11 who study according to the developmental programs of L.V. Zankov and D.B. Elkonin-V.V. Davydov, by the traditional program in the process of teaching children from grades I to III.

The study was conducted with the help of approved test methods.

To determine the functional state in the study was used M. Lusher color test; to diagnose the level of intelligence - Wechsler test (children's version); to diagnose the individual structure of mental development of younger students as an indicator of learning efficiency in the study was used group intellectual test consisting of seven subtests (execution of instructions, arithmetic tasks, addition of sentences, determination of similarity and difference of concepts, number series, establishment of analogies, symbols).

It is shown that in 8-9 years old there is a decrease in the intensity of blood filling and an increase in the elastic properties of arterial vessels of distribution and resistance in the carotid region, an increase in the elastic properties of arterial vessels in the vertebrobasilar region on the left. Obviously, changes

in cerebral blood flow reflect the specific features of cerebral circulation in children with this pathology. In children of 10-11, there is an increase in the intensity of blood flow, the tone of large arteries and the elastic properties of arterial vessels of distribution and resistance in both the carotid and vertebrobasilar regions on the left, which corresponds to existing ideas about the organization of hemodynamic processes of the brain and the role of left-hemisphere dominance in children in ontogenesis. Therefore, we found it necessary to select a range of children in the age group from 8-11 years in our research.

A total of 131 children aged between 8 and 11 years participated in the study, including 73 healthy schoolchildren and 58 children with mild mental retardation.

The degree of mental retardation was assessed on the basis of medical indications, degree of social adaptation, degree of intellectual functioning and mastery of the school programme while studying in a special educational institution.

Each category of examinees was divided into 2 age groups: 8-9 years old and 10-11 years old.

Control group of healthy schoolchildren:

- 8-9 years old 38 children, including 20 girls and 18 boys.
- 10-11 years old 35 children including 17 girls and 18 boys.

Experimental group of children with mental retardation:

- 8-9 years - 31 children, including 11 girls and 17 boys.
- 10-11 years - 27 children, including 12 girls and 13 boys.

Children in the experimental group were selected on the basis of accompanying documents with an approved diagnosis of mild mental retardation. After reviewing the results of clinical, laboratory, pedagogical and psychological examinations, a voluntary agreement was signed with family members and caregivers for the child's participation in the research.

Experimental-psychological methods aimed at analysing preferences (motor and sensory) for performing certain behavioral acts, which allow determining not only the degree of interhemispheric asymmetry, but also using, for the first time, our proposed modification to determine interhemispheric interaction. Techniques for assessing interhemispheric interaction are considerably less developed than those aimed at determining interhemispheric asymmetry.

The functional studies were conducted in the morning, under conditions that comply with the hygiene requirements for educational institutions (SanPiN 2.4.2.2821-10, 2013). The ethical requirements outlined in the Declaration of Helsinki were observed during the study.

Since the aim of our study was to make a comparative analysis of the functional asymmetry of normal school children and children of the same age with mild mental retardation, we developed our original test questionnaire adapted for our study based on the well-known tests - the Edinburgh test and the Bragina and Dobrohotova (1988) method. In our test questionnaire we kept the first 10 questions of the Edinburgh test which we added to the 4 questions of the Bragina and Dobrohotova (1988) test. Thus, our test-questionnaire consists of fourteen questions about the preference for using the right or left hand when performing certain actions, such as writing, drawing, sewing, brushing hair, brushing teeth, using a spoon or fork, etc. (Table 1).

Table 1. *Student questionnaire.*

	Action to be performed	**Left hand**	**Right hand**
1	Which hand do you write with?		
2	Which hand do you draw with?		
3	Which hand do you throw a ball with?		
4	Which hand do you use to catch a ball?		
5	Which hand do you hold scissors with?		
6	Which hand do you hold your toothbrush in?		
7	Which hand do you hold the dinner spoon in?		
8	Which hand do you hold the comb?		
9	With which hand do you open the lid of a box (box of chocolates)?		
10	Which hand do you hold the hammer with when you hammer a nail?		
11	The finger of the leading hand rests on top when the fingers are intertwined (lock)		
12	"Napoleon's pose (the hand that goes first to the forearm of the other hand and rests on top of it is considered the leading hand)		
13	Applause test (the leading hand is more active and mobile; it makes striking movements against the palm of the nonleading hand)		
14	Which hand you pick up an object from the floor		

Based on the results of the presented test-questionnaire, the coefficient of functional asymmetry (CFA), the coefficient of manual (motor) asymmetry (CMA) and the coefficient of general asymmetry (CGA) are calculated according to the following formulas:

$$CFA = \frac{N(right) - N(left)}{N\,m}$$

Where CFA is the coefficient of functional asymmetry, N(right) and N(left) the number of "+" signs in the "Right hand" and "Left hand" columns respectively, Nm is the number of tests offered.

$$CMA = \frac{N(right)}{N(left)}$$

$$CGA = \frac{CFA+CMA}{2}$$

Where CGA is the coefficient of overall asymmetry, the arithmetic mean of the CFA and CMA coefficients.

Statistical processing of the results of the study was carried out using the Spearman correlation coefficient.

Results.

The frequency of response options to the test-questionnaire to determine motor (manual) asymmetry in the group of healthy children is presented in Table 2.

As we can see from the data in Table 2, pupils perform most of the actions with the right hand. In the first test (writing) children's right hand was dominant in 83.8% of cases and left

Table 2. *The results of a test questionnaire to determine motor (manual) asymmetry in a group of healthy children.*

N test question	Leading hand (%)		
	Right	Left	Both hands
1	83,8	16,2	0
2	83,8	16,2	0
3	73	10,8	16,2
4	75,7	16,2	8,1
5	75,7	16,2	8,1
6	83,8	13,5	2,7
7	75,7	13,5	10,8
8	75,7	18,9	5,4
9	82,8	14,3	2,9
10	85,3	11,8	2,9
11	56,8	43,2	0
12	54,1	45,9	0
13	86,5	13,5	0
14	85,3	14,7	0

Table 3. *The results of motor (manual) asymmetry in the group of children with mental retardation.*

N test question	Leading hand (%)		
	Right	Left	Both hands
1	73,2	26,8	0
2	68,9	25,9	5,2
3	74,4	18,9	6,4
4	73,8	23,1	3,1
5	91,8	8,2	0
6	76.8	18,6	4,6
7	88,9	6,3	4,8
8	93,6	6,4	0
9	38,6	36,8	24,6
10	86,6	13,7	0
11	65,8	34,2	0
12	56,6	43,4	0
13	43,8	56,2	0
14	40,9	44,8	14,3

Table 4. *Asymmetry coefficients in the control and experimental group.*

Asymmetry coefficients	Control	Experiment
CFA	41,7	25
CMA	55,8	40
CGA	48,75	32.8

hand in 16.2%. In the second test the number of children who preferred to draw with the right hand was 83.8%, the left hand 16.2%, the same as in the first test. We obtained some variety from the results of the third test. When throwing the ball 73% of children had the right hand and 10.8% the left hand; we also found a small number of children using both hands (16.2%). Analysis of answers to the fourth and fifth questions has revealed that 75.7% of children prefer to hold scissors and toothbrush in the right hand, 16.2% - in the left hand, and the number of children able to perform this action with both hands made 8.1%. When asked about the use of a spoon the majority of children answered that they hold it in their right hand (83.8%), 13.5% in the left hand and 2.7% of children are able to hold a spoon in both their right and left hand. A slightly different picture was obtained for the seventh test. The number of children able to hold a comb in both right- and left-hand increases (up to 10.8 %) as compared to previous tests, although the majority of children are right-handed - 75.7 %, 13.5 % are left-handed. In the next test, the number of children using their left hand to open the lid of the box increased to 18.9%, which exceeds the number of left-handed children in the previous tests. The right hand is dominant in 75.7% of cases, and a small number of children using both hands was found - 5.4%. For the hammer, the right hand is dominant in 82.8% of cases and the left hand in 14.33% of cases; there are also children able to hold the hammer in both hands - 2.9%. In the "lock" test, the right hand was dominant in 56.8% of cases and the left hand in 43.2%. In the "Napoleon Pose" test, the right hand was dominant in 54.1% of children and the left hand in 45.9%. In the clap test, in which students were asked to clap their hands, the right hand was dominant in 86.5% of children and the left hand in only 13.5%. The right hand raises an object from the floor with 85.3% of students, while 14.7% do it with the left hand.

The following table shows the results of motor (manual) asymmetry in the group of children with mental retardation (Table 3).

As we can see from the data in Table 3, as in the previous study, students perform most of the actions with the right hand (tests 1-10). In the first test (writing), children's right hand was

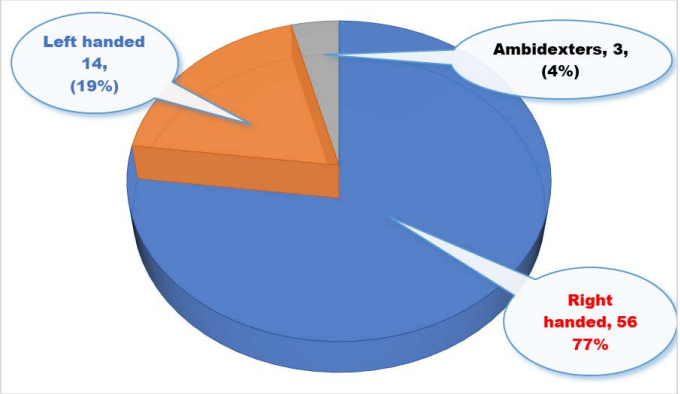

Figure 1. *Distribution of children in the control group by manual preference.*

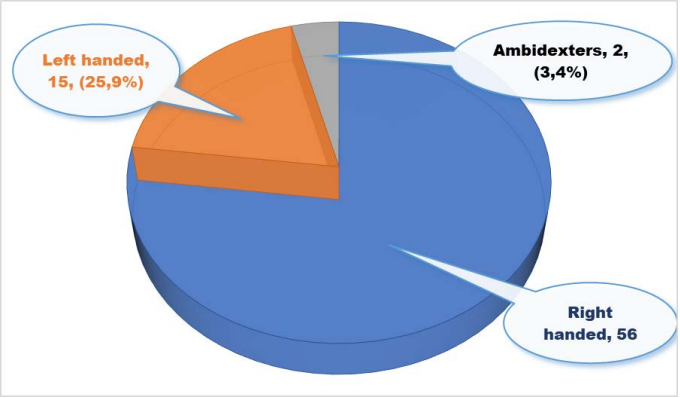

Figure 2. *Distribution of children in the experimental group by manual preference.*

dominant in 73.2% of cases and left hand in 26.8%. In the second test, the number of children who preferred to draw with the right hand was 68.9% as in the first case, the left hand was 25.9% and 5.2% of mentally retarded children could draw with both hands. Approximately the same trend holds for the third test. When throwing the ball 74.4% of children had the right hand as the leading hand, 18.9% had the left hand, and a small number of children using both hands, 6.4%, were also detected. Analysis of answers to the fourth question has revealed that 73.8% of children prefer to hold scissors in the right hand, 23.1% of children - in the left hand and 3.1% can use both hands if necessary. 91.8% of children prefer to hold a toothbrush in the right hand and 8.2% in the left hand.

When asked about spoon use, the majority of children answered that they hold a spoon in their right hand (88.9%), 6.3% hold it in their left hand and 4.8% of children can hold a spoon in both right and left hands.

A somewhat different picture was obtained for the eighth test. No children were found able to hold a comb in both right and left hands, although the majority of children are right-handed - 93.6%, 6.4% are left-handed. In the next test, the number of children using the left and right hand to open the lid of the box was approximately equal - 38.6% and 36.8% respectively, with 24.6% of test takers using both hands. When using a hammer, the right hand dominates in 86.6% of cases and the left hand in 13.7%. In the "lock" test, the right hand was dominant in 65.8% of cases and the left hand in 34.2%. In the "Napoleon's Pose" test, the right hand was dominant in 56.6% of children, and the left hand in 43.4%. In the clap test, in which students were asked to clap their hands, the right hand was dominant in 43.8% of children and the left hand in 56.2%. The right hand raises an object from the floor with 40.9% of pupils, 44.8% do it with the left hand and 14.3% perform the action with both hands.

To determine latent signs of left-handedness, which are most often unknown to the subject himself and are not influenced by learning, the tests "intertwining of fingers", "crossing of hands on the chest" and "applauding" were used. According to the data obtained, they supplement the data on the presence of signs of motor asymmetry in the subjects (Bragina N.N, Dobrohotova T.A, 1988).

A study conducted to determine left- and right-handedness yielded the following results: among normally developing children aged 8-11 there were 56 right-handed children (77%), 14 left-handed children (19%), and three ambidextrous children (3) or 4%. Of the 8–9-year-olds, 76.3% or 29 children were right-handed, 18.4% or 7 children were left-handed, and two ambidextrous children were identified, accounting for 5.3%. In the 10–11-year-old group right-handed children accounted for 80% or 28 children, left-handed - 17.1% or 6 children, and one ambidextrous child was detected, accounting for 2.9%.

The same calculations for mentally disabled children revealed the following numbers: right-handed - 41 children or 70.7%, left-handed - 15 children or 25.9%, ambidextrous - two (2) or 3.4%. A breakdown by age group showed that at ages 8-9 years were right-handed - 67.8% or 19 children, left-handed - 25% or 7 children, and 2 ambidextrous children were identified, representing 7.2%. In the 10-11-year-old age group, right-handed children comprised 72% or 18 children and left-handed children comprised 28% or 7 children. There were no ambidextrous children in this group.

The same data is presented more clearly in the form of a diagram.

Familial left-handedness is found in less than a third of the children surveyed.

Responses to questions about manual preferences for various subject activities showed that 38% of children with intellectual disabilities were left-handed or ambidextrous, with a predominance of boys among these children.

For each child, we calculated the CFA (Coefficient of Functional Asymmetry), CMA (Coefficient of Motor Hand Asymmetry) and COA (Coefficient of General Asymmetry) (Table 4).

Averaged results calculated for the groups as a whole showed that in the group of children with mild mental retardation, the different types of asymmetry were less pronounced, which may indicate a weak degree of differentiation of hemispheric functions and their more pronounced equipotentiality.

Discussion.

Our findings suggest left hemispheric dominance in school children, both in the Bragina and Dobrohotova tests, and in the Edinburgh questionnaire. Although manual asymmetry coefficient and handedness coefficient are related to each other, right-handed dominance, as revealed by the results of the answers to the questions, and the nature of sensory asymmetry are not consistent with each other.

The presence of a left-sided profile of individual brain asymmetry in a third of boys and about 40% of girls is caused, as a rule, by impaired left hemisphere functions manifested in a global, undifferentiated left hemisphere response to meaningful and insignificant visual stimuli.

In addition, we noted isolated inconsistencies in the responses to the questionnaire and the actual preference for right and left handedness. On this basis, we considered it necessary to conduct additional research in order to improve the Edinburgh questionnaire and developed an adapted test questionnaire.

Thus, we distinguish between two types of laterality that we encountered in our study: pathological and functional. Pathological laterality, associated with changes in interhemispheric interaction underlying the integration of brain functions, is, in our opinion, compensatory in mental retardation due to organic brain damage. In children with mental retardation, the immaturity of the integrative and trigger structures of the left hemisphere is noted, which also leads to pathological laterality.

Functional laterality is not inherently pathological, it does not contradict the laws of normal mental development, including intellectual development; on the contrary, many researchers believe that right hemisphere dominance promotes creative personal development. We believe that reproductive teaching methods appealing to the left hemisphere can create stereotypical approaches to creativity in children by the age of 9-11. Right-hemisphere functions include precise perception and memory of stimuli that cannot be easily verbalised or are too complex to be labelled with words. Because the right hemisphere is figurative, sensory, information processing is global. We refer to right hemisphere dominance as a functional type of laterality.

Conclusion.

The information obtained in the data must be taken into account when organizing the learning process in the elementary school when working with mentally retarded children, when forming classes, when choosing programs, methods of teaching, when organizing psychological and pedagogical support.

The age features of the brain associated with advanced development of right hemispheric functions are almost not used in it. Meanwhile, the active use of opportunities of the right hemispheric way of processing information, especially in elementary school, promotes the development of the child's abilities, allows to predict and increase the efficiency of school training.

In the course of widespread research on functional asymmetry of the brain, it has become increasingly clear that the notion of autonomy of each hemisphere in providing for different human activities and that the splitting of the brain results in a situation where a person receives two brains instead of one is untenable.

Clinical experience shows that neither the left nor the right hemisphere is at an advantage. Regardless of which side of the brain is affected, patients with focal brain damage show reduced or even impossible social adaptation.

The functional contributions of the right and left hemispheres to the formation of the human psyche are assumed to be different because the hemispheres in their paired work function differently in time. The paired work is carried out in the present tense, so that the right hemisphere relies on the past, the left on the future tense. Therefore, the preservation of paired hemispheric functioning and structural integrity of the brain is the main condition, without which full-fledged mental activity cannot be formed.

Limitations.

Our study has some limitations. The initial number of participants was not very large, due to time constraints. This is a limited study as part of a larger study. At the same time, the participants were not selected randomly, but through an avalanche method, i.e. participants who best met the criteria and requirements for the study were selected. It is important to emphasise that participation in the study was with the consent of parents or guardians of children aged 8-11 years. In order to obtain more objective data, we referred to earlier studies in this area.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Yerevan State Medical University (Approval No. 2 dated 24 October 2019).

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Declaration of interest statement:

The authors declare no conflict of interest.

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