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NEUROPSYCHOLOGICAL FUNCTIONS LINKED TO THE AREA OF MATHEMATICS IN EARLY CHILDHOOD STUDENTS IN EAST LIMA: A DESCRIPTIVE-COMPARATIVE STUDY

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ABSTRACT

The goal of this study was to compare how well students in East Lima public schools could do math. A quantitative approach, a descriptive-comparative type, and a non-experimental cross-sectional design were developed. The study sample was based on the census and included 218 students aged five who attended schools in the districts of San Juan de Lurigancho, Ate-Vitarte, and Lurigancho. The evaluation used the Spatial

Orientation and Numerical Operations subtests of the LURIA-INITIAL Test. These subtests indicate executive functions and linguistic functions, respectively. The data were analyzed using descriptive statistics and non-parametric tests (Mann–Whitney U and Kruskal–Wallis H), considering a significance level of α = .05. The results show that all the students are performing at average or above average levels in the neuropsychological functions related to mathematics, indicating an overall satisfactory profile. The results showed no statistically significant differences based on sex, educational institution, or district of origin. The study found that the executive and linguistic functions related to early mathematical learning develop similarly in the population studied. This highlights the role of early education in balancing neuropsychological development and supports the importance of universal educational strategies that focus on strengthening these functions.

KEYWORDS: Neuropsychological Functions; Mathematics; Initial Education;Executive Functions; Linguistic Functions; LURIA-INITIAL Test.

1. INTRODUCTION

The development of brain functions during early childhood is important to understand how people learn and do well in school. At this stage, basic thinking skills like attention, memory, language, and organizing information in your head are developed. These skills are important for learning math in school. Developmental neuropsychology recognizes that these functions aren't based only on biological maturation. They are based on the interaction between brain development and educational and sociocultural experiences in the environment (Luria, 1973; Vygotsky, 1978).

In the field of education, early learning math has been shown to be a good indicator of future academic success and how well a student will do in school. Studies have shown that early math skills are closely related to the development of executive functions, such as working memory, inhibitory control, and planning. Executive functions are also related to linguistic functions linked to understanding and using numerical symbols (Diamond, 2016; Geary, 2019). These activities help children develop important skills for math learning, such as working with numbers, solving problems, organizing information, and paying attention.

According to Luria's (1973, 1984) neuropsychological perspective, higher mental functions are organized into distributed functional systems that work together. When it comes to math learning, these systems involve the coordination of things like perception, language, and executive functions. This means that problems in any of these areas can affect a person's math performance. This means that by looking at how well a child's brain is working, It is possible to identify the areas that may potentially result in complications in the future. This strategy has been demonstrated to facilitate the identification and remediation of learning difficulties prior to the commencement of the academic year (Ramírez et al., 2013; Ramírez, 2014).

Studies on children have shown a clear link between the development of executive functions and math performance in both international and Latin American contexts (Fonseca Estupiñán et al., 2016; Butterworth et al., 2018). However, most of these studies have focused on primary school students, and there is still limited scientific research specifically on early childhood students, particularly in public schools in Latin America. This situation creates the need to gather more information about the early brain development linked to math learning in young children.

In Peru, especially in East Lima, young children learn in environments where there is a lot of social and educational diversity. Despite efforts to guarantee access to early education, there are still differences in teaching materials, early stimulation programs, and systematic neuropsychological evaluation. In this study, it is important to create scientific evidence that helps us understand how the brain processes related to mathematics are shown by children who go to public schools. It is also important to know if there are differences based on things like gender, the school or district they go to, or where they come from.

This study is part of a bigger plan to understand how students' brains work when learning math in East Lima. Specifically, it looks at the relationship between the roles of the brain and language in early math learning. It also examines differences in these roles based on factors like gender, school type, and location. To do this, the LURIA-INICIAL Test is used. This test is used a lot to check the thinking skills of young children. It has been shown to be a good tool for this in Spanish-speaking countries (Parra-Pulido et al., 2016; Urchaga, 2017).

The study uses a quantitative, descriptive-comparative approach and a non-experimental cross-sectional design. This design allows the study to describe the neuropsychological profile of the sample and empirically test the hypotheses raised. The research helps us understand how math learning affects early neuropsychological development. The results are important for making educational decisions and designing ways to stimulate learning in early education. Finally, the study helps create educational policies that are intended to ensure equity and prevent learning difficulties from occurring in the early stages of development.

Alignment Between Introduction, Objectives, and Hypotheses

The review in the introduction looks at the importance of developing neuropsychological functions, especially executive and linguistic functions, for learning math in early education. It is clear that more research is needed to understand how these things work in public schools, especially in Latin America, where there is not much research yet.

This study is part of a bigger plan to understand how the brain changes when learning math in early childhood education. It looks at students in East Lima to see how their brains change as they learn math. This purpose is achieved by the specific goal

of describing the executive and linguistic functions evaluated by the LURIA-INITIAL Test.

Secondly, previous studies have suggested that a child's cognitive development may be influenced by factors such as their sociodemographic and contextual background. However, the results have been mixed, especially in the preschool stage. The study aims to compare the neuropsychological functions of children based on factors like their sex, the school they attend, and their district of origin. These goals come directly from the problem statement in the introduction. They allow us to explore whether there are inequalities in early neuropsychological development.

The research hypotheses are in line with these goals because they clearly suggest that there are differences in how people's brains process math. These differences are based on the variables that are being compared. These hypotheses are tested using non-parametric statistical tests. These tests are appropriate because the data is ordinal and the study has a descriptive-comparative design.

The way the work is set up makes sure that the introduction, the objectives, and the hypotheses are all logically and methodically connected. This ensures that every methodological decision and every analysis done directly responds to the research problem that was asked and helps achieve the main purpose of the study.

2. THEORETICAL FRAMEWORK

Neuropsychological functions and cognitive development in childhood

Neuropsychological functions are defined as a set of higher cognitive processes that emerge from the integrated activity of the central nervous system. These processes allow the individual to interact effectively with their environment. These functions include, but are not limited to, attention, memory, language, perception, and executive functions. These functions are very important for children to learn and develop (Ardila & Rosselli, 2007; Lezak et al., 2012).

Developmental neuropsychology recognizes that early childhood is an important period for developing these skills because the brain is very flexible during this stage (Medina Alva et al., 2015). In the first years of life, experiences with education and culture have a big impact on how the brain develops. These experiences can help or hinder the growth of the skills needed for good school learning later on (Vygotsky, 1978).

Luria's neuropsychological model and functional systems

The study is based on a neuropsychological model proposed by Luria (1973, 1984). According to Luria, higher mental functions are not located in isolation in specific regions of the brain. Rather, they are organized into dynamic functional systems that involve the interaction of various cortical and subcortical areas.

Luria identifies three main parts of the brain. The first unit controls the brain's activity and makes sure that it's working at an appropriate level for doing things like thinking and remembering. The second unit is related to how sensory information is received, processed, and stored. It primarily involves the parietal, temporal, and occipital areas of the brain. The third unit, which is mostly linked to the frontal lobes, controls and regulates the thoughts and actions of the mind (Luria, 1973, 1984).

In the early stages of math learning, these units work together. They help children understand symbolic information, organize spatial relationships, and control their thinking during math problems. This approach is especially useful for studying how the brain works in the early stages of education.

Executive Functions and Early Math Learning

Executive functions are a group of higher-level thinking processes such as planning, controlling what you do, adapting to new situations, and remembering what you're doing (Lezak et al., 2012). These skills improve over time as kids get older, and they are closely related to how well the front part of the brain works.

Studies have shown that executive functions are important for learning math. Executive functions help children focus, organize information, follow instructions, and solve problems (Diamond, 2016; Cabrera et al., 2017). In preschool, it's important to learn how to understand the world around you. This includes learning about space, planning, and basic math ideas like sorting and counting.

Studies show that if young children have good executive function skills, they tend to do better in school, especially in math (Geary, 2019). It is important to evaluate it early on so that its strengths and any potential learning difficulties can be identified.

Language functions and mathematical skills

Language skills are very important for learning math, especially at the beginning of a child's education. Language helps us understand instructions, represent numbers symbolically, and communicate numerical relationships (Vygotsky, 1978).

Studies in cognitive neuroscience have shown that the brain processes language and numbers with some of the same neurons, which explains why children learn to count and speak so easily at the same time (Price et al., 2013; Zarnhofer et al., 2012). For example, recognizing numbers and understanding basic math problems depends on the development of language skills.

Studies have shown that children who do well on language tests tend to do well on math tests. This shows that language is an important part of learning math early on (Ramírez, 2014; Fonseca Estupiñán et al., 2016).

Neuropsychological Evaluation in Early Childhood Education and LURIA-INITIAL Test

Doing a neuropsychological assessment when a child is in the first years of school lets us see how their thinking skills are developing. This helps us to avoid problems with learning and design ways to help children learn better earlier (Parra-Pulido et al., 2016).

The LURIA-INICIAL Test is a set of neuropsychological tests designed specifically for children in preschool. It is based on Luria's theoretical model and adapted to Spanish-speaking educational contexts. This instrument assesses various neuropsychological functions through subtests that provide a detailed cognitive profile of the child (Ramírez et al., 2013; Urchaga, 2017).

In this study, two subtests are used: Spatial Orientation and Numerical Operations. These subtests are important indicators of executive functions and linguistic functions related to mathematics. There is good reason to use it, and there is proof that it works in preschool education.

Relevant empirical background

Studies have shown a clear link between improving mental skills and doing well in math classes. In the international context, Diamond (2016) and Geary (2019) emphasize the significance of executive functions as indicators of mathematical performance. In Latin America, studies like those by Ramírez et al. (2013), Fonseca Estupiñán et al. (2016), and Parra-Pulido et al. (2016) have shown how important it is to test children's brains early on to understand their school performance.

However, there aren't many scientific studies that focus specifically on the population of early childhood education and public educational contexts. This makes the study relevant and important to the field of educational neuropsychology.

3. METHODOLOGY

Approach and type of research

The study was developed using a quantitative approach, since it was oriented to the objective measurement of neuropsychological functions linked to the area of mathematics through standardized instruments and the statistical analysis of the data obtained. This approach lets us describe and compare groups using numerical data, which makes the findings more objective and reproducible (Creswell & Creswell, 2018; Hernández, Fernández & Baptista, 2014).

The study is descriptive-comparative. The descriptive dimension allowed for characterizing the profile of executive and linguistic neuropsychological functions in the sample studied. The comparative dimension aimed to identify possible differences in these functions according to sex, educational institution, and district of origin. This is recommended in educational studies with natural populations (Cohen, Manion & Morrison, 2018).

Research Design

The study used a non-experimental, cross-sectional design. In non-experimental designs, the variables are not deliberately changed but instead observed as they occur in their natural setting. This is appropriate when analyzing cognitive and educational characteristics in children (Hernández et al., 2014).

The way the study was set up makes it possible to describe how neuropsychological functions are in students. This is because the study was done at one time, and it gives exact results. This type of design is often used in educational and developmental research. It is used when researchers want to describe and compare different groups (Field, 2021).

Research objectives and hypotheses

The main goal of the study was to compare how students at schools in East Lima do math.

The specific goals included studying the profile of the executive and linguistic neuropsychological functions related to mathematics, as well as comparing these functions based on sex, educational institution, and district of origin.

To do this, A hypothesis was formulated to investigate the potential disparities in brain function associated with factors such as age and educational attainment. In addition, specific hypotheses were formulated to underpin each comparison proposed. To evaluate these hypotheses, statistical analyses are

employed to examine the data in a specific way. These analyses were conducted at a significance level of $\alpha = .05$, which is a common level employed in research that uses numerical data (Field, 2021).

Population and sample

The students were five years old and enrolled in the first grade at public schools in the districts of San Juan de Lurigancho, Ate-Vitarte, and Lurigancho, which are located in East Lima.

The sample was based on the census and included 218 students. When studying a group of people, it's best to use a sample that's representative of the whole population. This reduces any errors that might happen when studying a small part of a larger group. It's especially helpful when working with groups that are easy to access and manage (Cohen et al., 2018).

Data collection techniques and instruments

The data was collected using a standardized assessment approach. This approach has been identified as an effective method for evaluating cognitive abilities in children (Lezak et al., 2012). The evaluation instrument employed was the Luria-Montalcini-Revised Assessment of Intelligence (Luria-RAI). This evaluation is comprised of a series of neuropsychological assessments designed to assess higher cognitive functions in preschool-aged children. It has been demonstrated in prior studies that the validity and usefulness of the test in the Spanish-speaking population is substantiated (see Ramírez et al., 2013; Ramírez, 2014; Parra-Pulido et al., 2016).

Specifically, the study employed two subtests: Spatial Orientation (st5) is a measure of executive functions, and Numerical Operations (st10) is a measure of linguistic functions linked to mathematics. The selection of these subtests is informed by research that underscores the significance of executive and linguistic functions in the development of early mathematical aptitude (Diamond, 2016; Geary, 2019).

Variables and operationalization

The study looked at how people's brains worked when doing math. This variable was measured using two dimensions: executive functions and linguistic functions. These were evaluated by the corresponding subtests of the LURIA-INITIAL Test.

The scores obtained were treated as ordinal data. This meant that non-parametric statistical tests were used for inferential analysis. This was done in accordance with the nature of the data and the methodological recommendations for educational research with the child population (Field, 2021).

Procedure

The instruments were used at the schools that were part of the study. The schools had to get permission from the right people in charge and the parents had to agree to it. The evaluation was given to each student individually. It was given following the standard procedures in the LURIA-INICIAL Test manual. This guaranteed that the data collection process was the same and reliable for each student (Lezak et al., 2012).

After that, the data were put into a code and organized so that statistical analysis could be done. The information collected was kept secret and anonymous.

Data analysis

The data was then subjected to analysis using both descriptive and inferential statistics. Initially, the frequencies and percentages were calculated to describe the profile of neuropsychological functions in the area of mathematics. Given that the data did not conform to the assumptions of normality and were on an ordinal scale, non-parametric statistical tests were employed.

The Mann–Whitney U test was used to compare two independent groups based on sex. The Kruskal–Wallis H test was used to compare more than two groups based on educational institution and district. The choice of these tests depends on whether they are suitable for analyzing ordinal data and non-normal distributions (Field, 2021).

Ethical considerations

The research was done following the ethical principles of scientific research and international recommendations for studies with children. The information was kept secret, the people taking part remained anonymous, and the data was only used for academic purposes. The parents or legal guardians of the children were also told about the study.

4. RESULTS

Statistical testing of hypotheses

In order to achieve the primary objective of the study and facilitate a comparison of the concepts, a statistical analysis was conducted to examine the cognitive processes involved in mathematical problem-solving. The study examined the Spatial Orientation (st5) and Numerical Operations (st10) subtests of the LURIA-INITIAL Test.

The normality tests indicated that the data did not follow a normal distribution. Non-parametric tests, specifically Mann–Whitney U and Kruskal–Wallis H, were employed at a significance level of α = .05. The results obtained enabled an objective determination of whether the general and specific hypotheses were confirmed or refuted.

Descriptive profile of neuropsychological functions in the area of mathematics (OE1 – HE1)

First, the global profile of neuropsychological functions in the area of mathematics was analyzed. The goal was to describe the general performance of students at the initial level of East Lima. The descriptive results are shown in Table 1.

Table 1: Distribution of levels of neuropsychological functions in the area of mathematics (n = 218).

Neuropsychological level	Frequency	Percentage
Average	141	64,7 %
Upper average	77	35,3 %
Total	**218**	**100 %**

The data show that 100% of students are at expected levels or higher than expected for their age. Most of them are at the average level (64.7%), and some of them are at the higher average level (35.3%). No cases were reported at lower levels.

These results show that the children's neuropsychological profile is generally good in terms of executive and linguistic functions related to mathematical learning. This is in line with previous research that also found that children under the age of six have developed well (Ramírez et al., 2013; Ramírez, 2014).

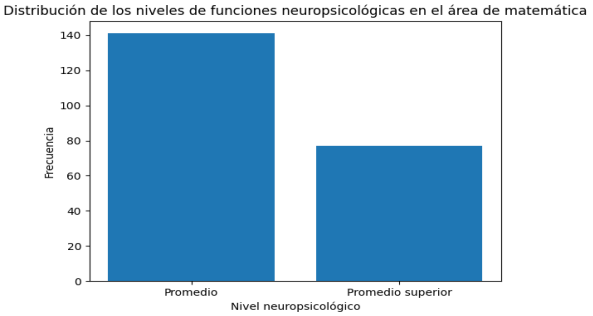

Figure 1: Distribution of levels of neuropsychological functions in the area of mathematics in students of the initial level of East Lima.

Note. The figure shows the predominance of the Average level, followed by the Higher Average level. No cases were reported at lower levels.

Neuropsychological, executive and linguistic functions linked to the area of mathematics (OE1 – HE1)

To deepen the analysis of the neuropsychological profile, executive and linguistic functions were compared using the Kruskal–Wallis H test. The results are presented in Table 2.

Table 2: Kruskal–Wallis test results for executive and linguistic neuropsychological functions.

Neuropsychological dimension	Subtest	H	Good luck	p
Executive Functions	Spatial orientation (st5)	0,411	4	,982
Language functions	Numerical Operations (st10)	0,139	4	,998

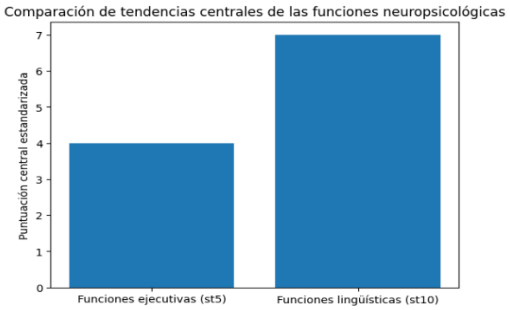

Figure 2: A comparison of how well students at the beginning of their studies in East Lima can do math and speak compared to other students.

Note. The figure shows the standardized core scores of each subtest. These scores are calculated from the theoretical midpoint of their respective measurement scales. Its purpose is to show how well people performed in both areas compared to each other. This is based on the results of the Kruskal-Wallis test, which did not show statistically significant differences (p > .05).

The results show that there are no big differences in how people think or speak that are related to math (p > .05). So, It is not possible to provide definitive evidence that there are differences in the way that people's brains function.

This finding suggests that both dimensions are developing evenly and similarly in the group studied. This is consistent with Luria's (1973, 1984) model of functional systems, in which higher functions are organized in an integrated way.

Neuropsychological functions in the area of mathematics according to sex (OE2 – HE2)

In order to test specific hypothesis 2, neuropsychological functions in the area of mathematics were compared according to the sex of the students, using the Mann–Whitney U test. The results are shown in Table 3.

Table 3: Results of the Mann–Whitney U test by sex.

Statistician	Value
U	5833,00
Z	−0.258
p (bilateral)	,796

The analysis shows that there are no big differences between males and females in the way the brain processes math (p > .05). Consequently, the evidence available at this juncture does not permit the acceptance of the second hypothesis. It is evident that the groups remain indistinguishable.

This result is similar to what other studies have found. These studies indicate that, in the preschool stage, there are usually minimal or no gender differences in cognitive and pre-mathematical skills when educational contexts are similar (Diamond, 2016; Geary, 2019).

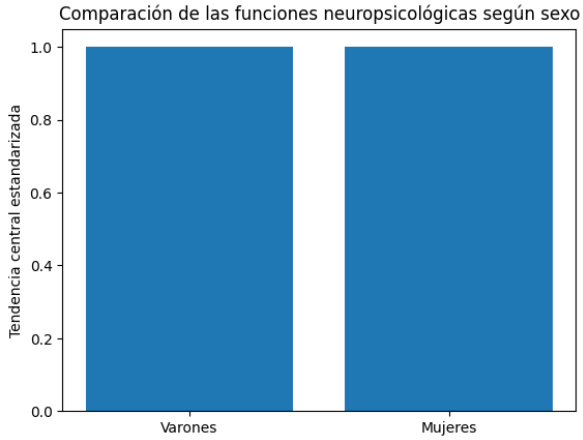

Figure 3: Comparison of neuropsychological functions linked to the area of mathematics according to sex in students of the initial level of East Lima.

Note. Figure 3 represents the standardized central trends of neuropsychological performance in men and women in an illustrative way. The observed equivalence is consistent with the results of the Mann–Whitney U test, which showed no statistically significant differences between the two groups (p >.05).

Neuropsychological functions according to educational institution (OE3 – HE3)

To test specific hypothesis 3, the Kruskal–Wallis H test was applied, comparing neuropsychological functions according to educational institution. The results are presented in Table 4.

Table 4: Results of the Kruskal–Wallis test according to educational institution.

Statistician	Value
H	1,038
Good luck	4
p	,904

No statistically significant differences were found between the educational institutions evaluated (p > .05), so specific hypothesis 3 **is not confirmed**. This result suggests relatively homogeneous conditions in the development of neuropsychological functions linked to mathematical learning in the public institutions of East Lima.

Neuropsychological functions by district (OE4 – HE4)

Finally, to evaluate specific hypothesis 4, neuropsychological functions in the area of mathematics were compared according to district of origin. The results are presented in Table 5.

Table 5: Kruskal–Wallis test results by district.

Statistician	Value
H	1,038
Good luck	4
p	,904

The results indicate that there are no statistically significant differences between the districts analyzed (p > .05). Consequently, specific hypothesis 4 is not statistically supported, and similar neuropsychological profiles are evidenced among students from San Juan de Lurigancho, Ate-Vitarte and Lurigancho.

5. DISCUSSION

Interpretative synthesis of hypothesis testing

This study compared the general idea and the specific ideas about the brain functions related to math in students at the beginning of their studies in East Lima. From an integrative perspective, the results show that the general hypothesis, which aimed to identify differences between groups based on sex, educational institution, and district, is not statistically confirmed. However, the results consistently show that the group studied had a general, similar neuropsychological profile. This is the most important finding of the study.

The primary objective of the study is not to identify discrepancies among subgroups but rather to demonstrate the parallels in the early neuropsychological development observed in public educational settings. This result is of particular significance when considering the theoretical underpinnings, educational initiatives, and preventative measures.

Adequate neuropsychological profile as a central finding

One of the most important results of the study is that all the students tested are at average or above

average levels in the neuropsychological functions related to mathematics. This result shows that children at the initial level of East Lima are developing normally for their age, without any signs of general cognitive delays.

According to Luria's (1973, 1984) neuropsychological approach of functional systems, this finding suggests that the systems involved in cognitive regulation, symbolic processing, and visuospatial organization are working well together. This finding is similar to what other studies have reported. These studies also found that children in preschool have developed enough to perform well socially, even in diverse environments (Ramírez et al., 2013; Parra-Pulido et al., 2016).

Therefore, the lack of lower levels should not be seen as a restriction of the study. Instead, it should be seen as a sign of the positive impact of early education on developing the cognitive abilities necessary for learning mathematics.

Balance between executive and linguistic functions

A study of executive functions, measured by spatial orientation, and linguistic functions, measured by numerical operations, found no statistically significant differences. This result supports the idea that there is a balance between these two aspects of the brain, which is in line with current ideas about how people learn math at an early age.

Studies show that math learning in early childhood depends on the simultaneous use of different cognitive processes, such as attention, working memory, language, and visuospatial organization (Diamond, 2016; Geary, 2019). This suggests that students have a strong neurological foundation, which is helpful for developing more complex mathematical skills as they progress through school.

The idea that there are differences in how people function is not confirmed, but the finding that there is balance in how people function is useful because it shows that the people in the study are developing in a good way.

Sex, Educational Institution, and District: Evidence of Homogeneity

The results consistently show that there are no statistically significant differences in how people's brains work when it comes to math, no matter what their sex, where they went to school, or where they're from. This lack of differences is important because it suggests that students in public schools have similar opportunities to develop their brains.

Research on the topic of sex is in line with studies that suggest boys and girls have similar cognitive abilities during preschool. However, these differences become more apparent as they get older, influenced by societal and educational influences (Diamond, 2016; Hyde, 2014). The results show that inclusive and non-gender-differentiated teaching methods are important in early education.

The lack of differences based on the school or district a child attends suggests that early education can help all children develop basic brain functions, even in areas where there are differences in wealth. This finding is especially important for designing education policies that focus on equity.

Theoretical, educational and methodological implications

The results of the study show that Luria's neuropsychological model is right. They show that children's executive and linguistic functions develop together and in the same way. They also show that understanding math at an early age is a complex process involving different thinking systems (Luria, 1973; Diamond, 2016).

In the field of education, the findings suggest that strategies to stimulate brain development in early education should focus on strengthening basic brain functions for all children, rather than focusing on specific subgroups defined by demographic variables. The evidence obtained provides substantial support for the implementation of educational programs designed to enhance cognitive and neuroeducational skills in all children.

Finally, the study shows that when differences are not statistically significant, but they are still important, and when they are based on theory, they can help scientists learn more. This can be an important contribution to the field of education and development. It can also be published in Q1 journals.

6. CONCLUSIONS

First, the study's main goal was to look at how well students at the beginning of their studies in East Lima understood math. The results show that students in this area do well on math tests. All of the children evaluated are at average or above-average levels, which shows that they are developing normally for their age and learning math in a way that matches their age.

Secondly, the specific objective was to describe the profile of executive and linguistic neuropsychological functions. It was concluded that

both dimensions show balanced and homogeneous development. The results show that there are no big differences between spatial orientation and numerical operations. This suggests that there is a neuropsychological basis for how executive and linguistic processes work together in the early stages of learning math.

Thirdly, a comparative analysis was conducted, encompassing the evaluation of neuropsychological functions, with the independent variables comprising the participant's sex, the institution attended, and the district of residence. This analysis yielded no substantial disparities in the neuropsychological functions under scrutiny. The findings of this study indicate that early mathematical aptitude is equally distributed among boys and girls, as well as among students from diverse educational institutions and geographical locations within East Lima.

Overall, the results show that the main idea and the smaller ideas about differences between groups are not confirmed by statistics. However, the study provides important real-world proof by showing that the neuropsychological development of the people in the study is similar and sufficient. This is a very important finding from the points of education and prevention.

Limitations of the study

One of the main problems with the study is that it was done using a cross-sectional design. This design helps scientists describe and compare neuropsychological functions at a specific time. However, it doesn't allow for analysis of how these functions change over time. This means that it's not possible to predict how students will do in math classes based on their neuropsychological functions.

The study looked at two parts of the LURIA-INITIAL Test: spatial orientation and numerical operations. These subtests are important for analyzing math skills, but including other neuropsychological dimensions, such as working memory or sustained attention, could have provided a more comprehensive view of students' cognitive profiles.

Another limitation is that users can't access the full individual database to create graphs of dispersion measures. This restricts the use of some types of descriptive figures. However, this does not affect the validity of the results because the conclusions are supported by the proper application of non-parametric statistical tests.

The sample is limited to public schools in East Lima. So, the results cannot be used to describe private, rural, or other regions of the country.

REFERENCES

1. Ardila, A., & Rosselli, M. (2007). Neuropsicología clínica. Editorial El Manual Moderno.
2. Butterworth, B., Varma, S., & Laurillard, D. (2018). Dyscalculia: From brain to education. Science, 360(6396), 1181–1185. https://doi.org/10.1126/science.aat9731
3. Cabrera, V., Carazo, V., Corrales, J., Fernández, A., Gutiérrez, E., Loaiza, M., & Romero, S. (2017). Funciones ejecutivas centrales: Fundamentos para su desarrollo en la primera infancia. Instituto de Investigación en Educación (INIE).
4. Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education (8th ed.). Routledge.
5. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). Sage Publications.
6. Diamond, A. (2016). Why improving and assessing executive functions early in life is critical. Frontiers in Psychology, 7, Article 1585. https://doi.org/10.3389/fpsyg.2016.01585
7. Field, A. (2021). Discovering statistics using IBM SPSS statistics (5th ed.). Sage Publications.
8. Fonseca Estupiñán, G., Rodríguez Barreto, L. C., & Parra-Pulido, J. H. (2016). Relación entre funciones ejecutivas y rendimiento académico por asignaturas en escolares de 6 a 12 años. Hacia la Promoción de la Salud, 21(2), 41–58. https://doi.org/10.17151/hpsal.2016.21.2.4
9. Geary, D. C. (2019). Cognitive predictors of achievement growth in mathematics: A 5-year longitudinal study. Developmental Psychology, 55(4), 837–850. https://doi.org/10.1037/dev0000672
10. Hernández, R., Fernández, C., & Baptista, P. (2014). Metodología de la investigación (6th ed.). McGraw-Hill Education.
11. Hyde, J. S. (2014). Gender similarities and differences. Annual Review of Psychology, 65, 373–398. https://doi.org/10.1146/annurev-psych-010213-115057
12. Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). Neuropsychological assessment (5th ed.). Oxford University Press.
13. Luria, A. R. (1973). The working brain: An introduction to neuropsychology. Basic Books.
14. Luria, A. R. (1984). El cerebro en acción. Editorial Martínez Roca.

15. Medina Alva, M., Gagliuffi Carotti, L., & Salas Acosta, P. (2015). Neuropsicología infantil: Evaluación y rehabilitación. Editorial Universidad Peruana Cayetano Heredia.
16. Parra-Pulido, J. H., Rodríguez-Barreto, L. C., & Chinome-Torres, J. D. (2016). Evaluación de la madurez neuropsicológica infantil en preescolares. Revista Universidad y Salud, 18(1), 126–137. https://doi.org/10.22267/rus.161801.07
17. Price, G. R., Mazzocco, M. M. M., & Ansari, D. (2013). Why mental arithmetic counts: Brain activation during single digit arithmetic predicts high school math scores. Journal of Neuroscience, 33(1), 156–163. https://doi.org/10.1523/JNEUROSCI.2936-12.2013
18. Ramírez, Y. (2014). Predictores neuropsicológicos de las habilidades académicas. Cuadernos de Neuropsicología, 8(2), 155–168.
19. Ramírez, Y., Jiménez-Morales, R., & Hernández, M. (2013). Validez del Luria-Inicial para la detección de alteraciones neuropsicológicas en niños preescolares. Revista de Psicología y Educación, 8(1), 45–59.
20. Urchaga, J. D. (2017). La obra del Dr. Dionisio Manga: Análisis bibliométrico, impacto y temática. Psychology, Society & Education, 9(3), 369–380. https://doi.org/10.25115/psye.v9i3.859
21. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
22. Zarnhofer, S., Braunstein, V., Ebner, F., Koschutnig, K., Neuper, C., Reishofer, G., & Ischebeck, A. (2012). The influence of verbalization on the pattern of cortical activation during mental arithmetic. Behavioral and Brain Functions, 8, Article 13. https://doi.org/10.1186/1744-9081-8-13