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Original article

Inclusive games in the development of gross motor skills in children with autism spectrum disorder

[*Los juegos inclusivos en el desarrollo de la motricidad gruesa en niños con trastorno del espectro autista*]

[*Jogos inclusivos no desenvolvimento de habilidades motoras brutas em crianças com transtorno do espectro autista*]

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ABSTRACT

Introduction: Autism Spectrum Disorder (ASD) is a special educational need, which is characterized by limitation in the movements of the lower and upper body, and also involves certain repetitive actions affecting motor skills.

Objective: To determine whether the application of an inclusive game design improves gross motor skills in 9th grade children with ASD.

Materials and methods: For the purposes of the study, theoretical methods such as analytical-synthetic and bibliographical methods were taken into account to support the theory, while the empirical methods used were observation and measurement through the application of the KTK test.

Results: The significance of the normality of the data was 0.00, that is, >0.05, after the analysis of the Student 's T test for related samples, the significance was 0.00, being <0.05, showing the effectiveness of the application of inclusive games in the development of gross motor skills. Similarly, the analysis of the general motor coefficient showed that children with ASD in the pre-test were on a weak scale and in the post-test it rose to normal.

Conclusions: In this way, it is concluded that the appropriate application of an inclusive game design, respecting the characteristics of this group of children with adaptations and without using excessive colors and excessive noise, in order not to distract the students' attention, significantly improves the elements of gross motor skills.

Keywords: autism; physical education; inclusive play; gross motor skills.

RESUMEN

Introducción: el trastorno de Espectro Autista TEA es una necesidad educativa especial, la cual se caracteriza por limitación en los movimientos del tren inferior y tren superior, también conlleva ciertas acciones repetitivas afectando su motricidad.

Objetivo: determinar si la aplicación de un diseño de juegos inclusivos mejora la motricidad gruesa de los niños de 9no. año de educación básica detectados con TEA.

Materiales y métodos: para efectos del estudio se tomaron en cuenta los métodos teóricos como el analítico-sintético y bibliográfico para la sustentación de la teoría, en cuanto que la utilización de los métodos empíricos fueron la observación y la medición a través de la aplicación del test KTK

Resultados: la significancia de la normalidad de los datos fue 0,00 es decir >0,05, después del análisis de la prueba T de Student para muestras relacionadas la significancia evidenciada fue de 0,00 siendo <0,05 mostrando una efectividad de la aplicación de los juegos inclusivos en el desarrollo de la motricidad gruesa, de igual manera en el análisis del coeficiente motor general mostró que los niños con TEA en el pre-test se encontraban en una escala de débil y en el post-test se elevó a normal.

Conclusiones: de esta manera se concluye que la aplicación adecuada de un diseño juegos inclusivos, respetando las características de este grupo de niños con las adaptaciones y sin usar colores excesivos y ruidos excesivos, con la finalidad de no aturdir la atención de los estudiantes, mejora de forma significativa los elementos de la motricidad gruesa.

Palabras clave*:* autismo; educación física; juegos inclusivos; motricidad gruesa.

RESUMO

Introdução: O Transtorno do Espectro Autista (TEA) é uma necessidade educacional especial caracterizada por movimentos limitados da parte inferior e superior do corpo. Também envolve certas ações repetitivas que afetam as habilidades motoras.

Objetivo: Determinar se a implementação de design de jogos inclusivos melhora as habilidades motoras brutas em crianças do nono ano diagnosticadas com TEA.

Materiais e métodos: Para os propósitos deste estudo, métodos teóricos como o analítico-sintético e o bibliográfico foram utilizados para fundamentar a teoria. Os métodos empíricos utilizados foram a observação e a mensuração por meio da aplicação do teste KTK.

Resultados: A significância da normalidade dos dados foi de 0,00, ou seja, >0,05. Após a análise do teste t de Student para amostras relacionadas, a significância foi de 0,00, ou seja, <0,05, demonstrando a eficácia da aplicação de jogos inclusivos no desenvolvimento das habilidades motoras brutas. Da mesma forma, a análise do coeficiente motor geral mostrou que as crianças com TEA apresentaram uma escala fraca no pré-teste e aumentaram para normal no pós-teste.

Conclusões: Conclui-se que a aplicação adequada do design de jogos inclusivos, respeitando as características desse grupo de crianças com adaptações e sem uso excessivo de cores e ruídos, de modo a não distrair a atenção dos alunos, melhora significativamente os elementos da motricidade grossa.

Palavras-chave: autismo; educação física; brincadeira inclusiva; habilidades motoras brutas.

INTRODUCTION

Autism Spectrum Disorder (ASD) is a condition that affects brain development, affecting communication and social interaction and causing repetitive behaviors. It is considered a spectrum due to the variability in the type and severity of symptoms. People with ASD may have limited interests and experience difficulties with motor function, including gross motor skills in movements of the arms, legs, trunk, and feet, and impairments in the coordination of different muscles and joints (López-Ruiz *et al.,* 2023).

For Alas *et al.* (2022) and Jaramillo *et al.* (2022) mention that autism encompasses diverse conditions with symptoms that vary in severity. It is classified into several types according to the DSM-5 (American Psychiatric Association book), the most common types are:

Classic Autism: With delays in language and social skills.

Asperger's Syndrome: Where language is normal, but there are problems with social interaction.

TGD-NE: Diagnosed when some symptoms of autism are present.

ASD can affect cognitive and motor skills, and in some children, IQ is also affected. Hence the importance of individualized inclusive processes to stimulate their motor development (García *et al.,* 2019).

Physical Education is essentially where the practice of all activities allows the proper use of strategies that create an inclusive and integrative environment and, above all, where recreational activities adapted to the reality of this group of children are used, since in many cases colors, noise and some external factors make it difficult to receive different instructions, for this reason children with ASD show poor development of gross motor skills determined by repetitive movement patterns (Murillo *et al.,* 2023). Curricular adaptations with inclusive game activities allow stimulating the gross and fine motor development of students with or without ASD.

An inclusive methodology allows for adequate and interdisciplinary insertion of these children. Games, by fulfilling the conditions of simple rules, fun and cooperation, stimulate mental development, motivate and facilitate the area of language and communication in children with ASD and are especially considered an important first tool for the motor development of these children. Games are a stimulant for the development of gross motor skills, since these children have movement problems and simple games with basic rules will allow children to achieve harmonious cognitive and motor development (Unir, 2025).

The development of fine and gross motor skills is crucial from childhood, to stimulate the consolidation of basic motor skills such as: walking, running, jumping and throwing (Guerrero *et al.,* 2024). Children with ASD may face challenges in their motor development, which affects their interaction with the environment. Motor difficulties in children with ASD affect their mobility, coordination, balance and agility, hence the importance of incorporating inclusive games with simple rules into the curriculum, so that they can assimilate basic and complex movements, thus strengthening their motor skills (Sánchez, 2025).

Inclusive games are effective in encouraging the participation of children with ASD in physical education classes. These games promote exercise, inclusion, and integration for all children, regardless of their limited abilities. Inclusion allows children with ASD to interact physically and socially, improving their self-esteem. Inclusive games offer a safe and stimulating space for children to learn through action and interaction in different activities (Ávila *et al.,* 2024).

Play is key to the motor development of children with ASD. Games that integrate elements of gross motor skills, such as running, jumping, throwing, and catching, help children improve their coordination, agility, flexibility, and balance. These games improve attention and emotional regulation, essential skills for learning. Activities should be designed with students in mind and integrated into the curricular framework of games and play, so that they can be developed within Physical Education classes to stimulate both body and mind (García, 2022).

Inclusive games allow children with and without ASD to participate in activities that prioritize gross motor skills. This interaction benefits children with ASD and fosters empathy and respect among their peers. Teamwork helps children develop key skills such as cooperation, communication, and problem-solving. These games are adapted to each child's needs, ensuring that everyone enjoys the experience (Ávila. *et al.,* 2024).

Celis and Ochoa (2022) and Montañez (2019) point out that, in this inclusive area, insufficient information for Physical Education teachers, as well as the lack of strategies to address curricular adaptations for children with ASD, has motivated the authorities to include in the (Physical Education Curriculum, 2016) some activities for the inclusion of children with and without this disorder, thus stimulating the development of motor coordination.

This study aims to determine whether inclusive games improve gross motor development in ninth-grade children with autism. It proposes inclusive games with simple rules and specific instructions that can stimulate gross motor development through the benefits of inclusive play.

MATERIALS AND METHODS

The present study aims to determine whether inclusive games improve the development of gross motor skills in children with autism in 9th grade. The research was approached from a quantitative point of view, with a pre- experimental design with a longitudinal section, an initial evaluation (pre-test) and a final evaluation (post-test) were used (Ramos, 2021). The game design was applied for eight weeks, inserted within the Physical Education curriculum in the games and playing block, the characteristics of students with ASD were taken into account, adapting the games without violating the excessive use of color, the inappropriate use of whistle, which affect the attention and interrelation of children, the theoretical methods used for the foundation of the theory of inclusive games and gross motor skills were analytical and synthetic, as for the

empirical methods used were observation and measurement to be able to evaluate gross motor skills, for this purpose the KTK test was used with the tests (Backward balance, single-leg jumps , lateral jumps and lateral transportation) a tool validated by (Vecino *et al.,* 2020). As for the statistical method used, it was through descriptive and inferential analysis, with the computer program SPSS v.25 and Microsoft Excel.

Population and sample

The population used for the research was the 101 students of basic general education, within the 2023 - 2024 school year, the sample that was selected was 9 students from 9th grade parallel basic "A", who have a diagnosis of Autism Spectrum Disorder ASD, in an age range of 11 and 12 years, it should be noted that these students were evidenced by the vocational guidance department of the institution, the sampling criterion was intentional non-probabilistic, the study was applied in Physical Education classes, the characteristics of the sample are shown below (Table 1).

Table 1. - *Characterization of the Study Sample*

	11 years		**12 years**		**Total**	
Variable	(n=5 - 55.56%)		(n=4 - 44.44%)		(n=9 - 100%)	
	M	**±DS**	**M**	**±DS**	**M**	**±DS**
Age (years)	11	0.00	12	0.00	11.42	0.53
Size (meters)	138.19	1.10	142.25	0.50	1.39	2.29
Weight (kg)	37.35	1.52	40.23	0.96	38.58	1.94
BMI	19.56	0.62	19.88	0.60	19.7	0.60

Note: Analysis of the Study Sample of Children with ASD

Within the characterization of students with autism spectrum syndrome ASD, it can be mentioned that within the study group of nine students, five are in a range of 11 years, being 55.56% while in the group of 12 years there were four boys representing 44.44% the total characteristics of the age was an average of 11.42 ± 0.53 years, with an average

height of 1.39 ± 2.29 meters, the recorded weight had an average of 38.58 ± 1.24 kg and the BMI had an average of 19.88 ± 0.60,

Measuring instrument

The instrument that was considered for the evaluation of gross motor skills in children with ASD was the KTK test, a test validated by (Vecino et al., 2020), it is highly recommended for an age range between 8 to 12 years, with a standardization of four tests, the first being balance, the second single-leg jumps , the third lateral jumps and the fourth transportation of place, this test within its characteristics has the use of simple material and its application is very easy for children, the following table shows the main characteristics of the KTK test tests (Table 2).

Table 2. - *KTK test standardization*

1. Backward balance	**Monopodal jumps**	**3. Lateral jumps**	**4. Lateral transportation**
Walk backwards, on 3 3-meter beams.	Jumps over the 35cm plates, on a total of 7 plates	Jumps on a 100cm x 60cm board and a 60cm x 4cm x 2cm midline.	Crossing from one plate to the other plate of 25 cm x 25 cm x 1.5 cm.
The student must pass 9 times	The student must take 12 passes with the left foot and 12 passes with the right foot.	The student must jump from side to side for 15 seconds.	The student must move from one plate to the other in 20 seconds.
8 points each pass	3 points per pass	the jumps of the 2 attempts are added together	2 attempts
Total 72 points	**Total 72 points**	**Total 72 points**	**Total 72 points**

Note: *KTK Test Protocol*

In the case of the evaluation of gross motor skills of children with Autism Spectrum Disorder ASD, the teacher must take into account avoiding the use of strong colors, loud sounds such as those of the whistle, this helps to generate a balanced classroom

environment, above all a clear explanation must be taken into account, the support of other teachers or students to be able to apply the protocol of this test is very important for the adequate perception of each activity.

Inclusive game design

For the design of inclusive games, some characteristics were taken into account such as: games that are suitable for children with ASD or that are not very difficult, that have simple instructions, that the material is adequate and easy to manipulate, that the activities are sensitive and adapted to children with Autism Spectrum Disorder, in such a way that these factors do not cause alterations in the children's behavior and that these recreational activities are inserted into physical education classes, based on what was reported by (Flores *et al.*, 2024).

Aim

To achieve the intervention, the following objective was proposed: to structure an inclusive game design for students with autism spectrum disorder (ASD) over eight weeks and implement them in physical education classes, thereby demonstrating whether these games stimulate the development of students' gross motor skills.

Insertion into the Curricular Block

The adaptation was carried out in the curricular block of games and playing, within the 9th year Physical Education curriculum (Ministerio de Educación, 2016), during the second quarter of the 2023-2024 school year, with a duration of eight weeks (Table 3).

Table 3. - *Inclusive Game Design for Students with ASD*

Game	Description	Adaptation for children with ASD
Catch the opponent	A chase game in which one child must catch another and switch roles.	Reduce the number of participants to avoid overstimulation and establish a safe space with clear rules. Vests or colors can be used to differentiate roles.
Going rabbit hunting	One child (the hunter) tries to catch another (the rabbit) while the others form a protective circle.	Use visual or auditory cues to mark role changes. Allow the child with ASD to observe first before participating.
Mouse, take care of your tail.	A child has a handkerchief as a "tail" and must prevent another child from taking it away while running.	Use soft materials for the "glue" and allow the child with ASD to practice before playing. Reduce playtime to avoid anxiety.
Policeman and thief	One group of children plays the role of "police officers" and another plays the role of "thieves." The police officers must catch the thieves and take them to a detention center.	Explain the rules of the game with pictograms or visual stories. Allow for rest periods and safe spaces to reduce sensory overload.
Hopscotch	Game in which children throw a stone into numbered squares and must jump in order.	Use bright colors to mark the squares and allow the child to practice the movements without pressure. Individual turns can be used to avoid crowding.
Kick the ball	Game in which children must kick a ball to make passes or score in a goal.	Use a larger or softer ball. Allow the child to practice in a quiet space before playing in a group.
Balance game	Activity in which children must walk on a narrow line or surface without losing their balance.	Use colored lines or textures on the floor for added safety. Allow the child to use support if needed.

Throw and catch game	The children throw a ball and another person must catch it to continue the game.	Use lightweight, brightly colored balls. Allow the child to practice with an adult first before playing in a group.

Note: *Description and Adaptation of Inclusive Games.*

As can be seen in the table above, the eight games used in the intervention are described, along with their respective descriptions for their implementation and specific methodological adaptations for children with autism spectrum disorder.

RESULTS

The results obtained during the research are presented below, taking into account that a diagnostic evaluation (pre-test), the application of the design of inclusive games and a final evaluation (post-test) were applied; Within the research process, the data normality test was applied, under the consideration that if the sample is ≥30, the Shapiro Wilk test should be used. (Luzuriaga *et al.*, 2023). Considering that there were 9 students with ASD and under this analysis procedure, an average significance of the KTK test with a value of 0.15 is evident, in this way it is verified that $p>0.05$, in this way it is verified that the data are not normal, in this way the parametric Student T test for related samples was applied.

Within the process of tabulation and descriptive analysis of the means of the KTK test, the general motor coefficient and the Student T test for related samples, it is presented in the following table with a statistical analysis to verify if the improvement of gross motor skills is evident (Table 4).

Table 4. - *Means Initial and Final Evaluation Student T Test*

KTK Test	Pre-test		Post-test		T- Student
	M	DS	M	DS	
Backward balance	16.67	6.18	24.11	6.74	0.00
Monopodal jumps	17.56	3.00	25.00	4.95	0.00
Lateral jumps	23.44	2.24	28.67	4.24	0.00
Lateral transportation	25.33	3.64	34.11	4.73	0.00
General motor coefficient	**83.00**	**9.89**	**111.89**	**14.78**	**0.00**

Note. *Descriptive Analysis M (Mean); (SD) Standard Deviation.*

The table above shows the results of the 4 tests and the motor coefficient per test, where in the pre-test the average was 83.00 ± 9.89 and in the post-test an average of 111.89 ± 14.78, these data confirm that in the pre-test the problem of poor gross motor skills was detected, being one of the characteristics of these students with ASD, since after the application of inclusive games, a significant improvement in gross motor skills is seen, then the inclusive game stimulates balance, jumping, grip and transportation, whereas the results of the Student 's t test for related samples shows a significance of 0.00 being P <0.05 verifying the effectiveness of the intervention during the eight weeks, in other words, students with Autism Spectrum Disorder were stimulated the patterns of gross motor skills through inclusive play.

Motor Coefficient per Test KTK Test

One of the results of the KTK test is the estimation of the motor coefficient with a scale of 1 to 5, intervals and indicators, which allow the analysis of the behavior and development of gross motor skills for each test of the KTK test. To calculate this coefficient, the values of each test must be added separately and for the respective attempts, the total sum is 72 points per test (Table 5).

Table 5. - *Motor Coefficient per KTK Test*

Motor Coefficient				**1. Backward balance**		**Monopodal jumps**		**3. Lateral jumps**		**4. Lateral transportation**	
				Pre-test	**Post-test**	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**	**Pre-test**	**Post-test**
1	Very weak	1 - 14	Insufficiency in motor development	44.4		22.2					
2	Weak	15 - 29		44.4	77.8	77.8	66.7	66.7	44.4	77.8	22.2
3	Regular	30 - 43	Normal	11.2	22.2		33.3	33.3	55.6	22.2	77.8
4	Well	44 - 58	Great motor development								
5	Very good	58 - 72									
Total				100	100	100	100	100	100	100	100

Note. *Analysis by Percentage of the Motor Coefficient*

The motor coefficient is an indicator that allows to identify the state and evolution of gross motor skills, in the pre-test it can be identified that in balance, jumping, gripping and transportation, they are on the very weak and weak scale evidencing insufficient motor development; While in the post-test balance, jumping, gripping and transportation coincide on the weak and regular scale, they coincide on the normal indicator, this shows a progressive motor development and adequate to their special educational need ASD, to complement the analysis, children with Autism Spectrum Disorder ASD despite having problems within their locomotion, inclusive games stimulate the elements of gross motor skills, such as balance, jumping, gripping and transportation, being main skills within gross motor skills.

General Motor Coefficient KTK test

This general coefficient of the KTK test allows us to demonstrate, through the sum of all the tests in this test, the development of gross motor skills, this General Motor Coefficient (CMG) presents some data as a qualitative scale, CMG score, % and the presentation of the respective frequencies with the percentage of the pre-test and post-test (Table 6).

Table 6. - *General Motor Coefficient (CMG) KTK Test*

General Motor Coefficient KTK Test	CMG Score	%	Pre-test		Post-test	
			F	%	F	%
High	131 - 145	99-100				
Well	116 - 130	85 - 98			3	33.3
Normal	86 - 115	17 - 84	2	22.2	6	66.7
Symptomatic	71 - 85	03 – 16	6	66.7		
Problematic	56 - 70	0 - 02	1	11.1		
Total			9	100	9	100

Note: *CMG Frequency and Percentage Analysis*

It is evident that in the pre-test , on the problematic scale a value of 1 = (11.1%), on the symptomatic scale 6 = (66.7%) and on the normal scale a value of 2 = (22.2%) that is, it is a group that shows gross motor problems before starting the intervention of inclusive games, while in the post-test on the normal scale a value of 6 = (66.7%) and on the good scale a value of 3 = (33.3%), it is verified that inclusive games managed to improve gross motor skills, which in the case of children with Autism Spectrum Disorder ASD under their condition and limitation of some movements, they managed to significantly improve gross motor skills, this clearly shows that the proper application of game design, within Physical Education classes progressively, respecting the characteristics of children with ASD.

DISCUSSION

The development of gross motor skills is a crucial pillar in childhood, as it facilitates the acquisition of skills such as balance, coordination, and muscle strength. The results obtained in the four motor tests and the analysis of the motor quotient reflect a significant improvement in the gross motor skills of students with ASD after the intervention. The pre-test showed a mean of 83.00 ± 9.89, confirming the presence of low motor performance, a common characteristic in this population. However, the increase observed in the post-test, with a mean of 111.89 ± 14.78, ratifies the effectiveness of the applied program, demonstrating notable progress in the development of motor skills. These findings support the importance of implementing interventions with inclusive games that stimulate gross motor skills in students with ASD, contributing to their comprehensive development and functionality in school and social contexts.

In relation to the above, Vecino *et al.* (2020) propose that inclusive games promote the development of gross motor skills through playful activities and adapted to the specific needs of students with ASD, in this way it is agreed that inclusive games facilitate the active participation of children with autism spectrum disorder (ASD) in activities planned by the teacher within the Physical Education curriculum, thus promoting their motor and social development.

According to the analysis carried out by Murillo *et al.* (2023), children diagnosed with ASD show delays in the development of gross motor skills, which can negatively influence their autonomy and their ability to participate in group recreational activities. The development of adapted games, which incorporate explicit instructions and visual supports, favors the inclusion and the progressive process of the elements of gross motor skills. In this way, it is agreed with the present study that activities should be planned with simple activities to achieve the inclusion of these children within Physical Education classes.

On the other hand, Ávila *et al.* (2024) propose that games can be adapted to encourage the inclusion of children with autism spectrum disorder (ASD). They suggest starting with simple skills such as walking, balancing, jumping, grabbing, and moving, and incorporating visual indicators and instructions appropriate to this educational need. These modifications facilitate the reduction of anxiety and optimize the understanding of the game rules, thus encouraging participation. For this reason, there is a direct relationship with the research where inclusive games were planned and developed in Physical Education classes within the games block, which allowed for the improvement of coordination, balance, agility, and movement.

García (2022) suggests that inclusive games are presented as an effective instrument to develop stimulation levels in children diagnosed with autism spectrum disorder (ASD). The practice of activities such as running, jumping and moving have proven to be effective in improving self-regulation and reducing repetitive or avoidant behaviors. Games require specific motor control, help children direct their energy effectively and promote their emotional well-being. This evidence is concatenated with the results obtained within the research where the activities carried out are related to running, jumping and moving, these skills are immersed in the games.

Flores *et al.* (2024) propose that inclusive play not only contributes to the development of gross motor skills, but also promotes social interaction in children with autism spectrum disorder (ASD). According to the game interactions with neurotypical peers contribute to the improvement of communication skills, teamwork and understanding of decision-making. The implementation of cooperative games facilitates the inclusion of children with autism spectrum disorder (ASD) in group settings, thus promoting the development and strengthening of their social skills. These results are consistent with the development of gross motor skills, children with ASD who were subjected to the application of inclusive games also managed to improve their inclusion and integration process in them.

Llacza and Quispe (2023); Hortal and Sanchis (2022) mention that educators play a crucial role in the implementation of inclusive games for the development of gross motor skills. It is essential to understand the particular needs of children with autism spectrum disorder (ASD) and to make the necessary adaptations to the dynamics to ensure an enriching experience. Training in inclusion strategies and facilitating an accessible play environment enhance the participation of all students. In relation to the role of the teacher, the study allowed Physical Education teachers to propose the respective adaptations to inclusive games, allowing for the creation of a playful and inclusive environment.

CONCLUSIONS

The findings from the implementation of the KTK test indicate that the integration of inclusive games for children diagnosed with autism spectrum disorder (ASD) leads to a significant improvement in their gross motor skills. The pre-test analysis showed that most participants showed levels of motor development classified within the very weak and weak categories, indicating a deficiency in their coordination and fundamental motor skills. However, after the implementation of the inclusive games intervention, the results obtained in the post-assessment indicate positive progress. The scores fall within the regular and good development scales, demonstrating a beneficial impact on balance, jumping, grasping, and carrying skills.

Furthermore, the estimation of the general motor quotient (GMC) reveals a significant change in the distribution of scores in the pre-test, characterized by a decrease in the instances classified as problematic and symptomatic, while the post-test shows a significant increase in the levels classified as normal and good after the intervention. These results support the evidence that the implementation of inclusive games favors the development of gross motor skills in children diagnosed with autism spectrum disorder (ASD), despite the difficulties they present in their locomotor skills. The gradual and meticulous implementation of recreational activities in the field of Physical

Education is shown to be an effective strategy to enhance the development of gross motor skills in this population.

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***Conflict of interest*:**

The authors declare no conflicts of interest.

***Authors' contributions*:**

The authors have participated in the writing of the work and analysis of the documents.