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Emotion recognition and executive functions in school children born term and preterm

Dos Santos Telaska, Tatiele* [a]; Jaworski de Sá Riechi, Tatiana Izabele [a]; Mota de Oliveira, Tiago [b]; Tiago Silva, Luciano [b] y Pereira Bellon, Olga Regina [b]

Artículo Original

Absract

This study aimed to analyze the association between emotion recognition and executive functions in preterm birth and term born schoolchildren. The methodology consisted of a cross-sectional and correlational study, with a sample of 82 participants aged 8 to 12 years, divided into control and clinical groups. Socioeconomic questionnaire, Computerized Emotion Recognition Assessment Battery, Five-Digit Test, Wisconsin Card Sorting Test, and Wechsler Intelligence Scale for Children were used. The results showed differences between groups in the recognition of emotions, in addition to correlations between preterm birth, recognition of emotions, inhibitory control and cognitive flexibility and gaze fixation. It is concluded that the data obtained demonstrated the importance of evaluation and interventions aimed at preterm birth and of studies on this theme.

Keywords:
preterm birth, emotions, executive functions, inhibition.

Resumen

Reconocimiento de emociones y funciones ejecutivas en estudiantes nacidos a término y prematuros. Este estudio tuvo como objetivo analizar la asociación entre el reconocimiento de emociones y las funciones ejecutivas en escolares prematuros y nacidos a término. La metodología consistió en un estudio transversal y correlacional, con una muestra de 82 participantes de 8 a 12 años, divididos en grupos control y clínico. Se utilizaron el Cuestionario Socioeconómico, la Batería Computarizada de Evaluación de Reconocimiento de Emociones, el Test de los Cinco Dígitos, el Test de Clasificación de Cartas de Wisconsin y La Escala Wechsler de Inteligencia para Niños. Los resultados mostraron diferencias entre grupos en el reconocimiento de emociones, además de correlaciones entre parto prematuro, reconocimiento de emociones, control inhibitorio y flexibilidad cognitiva y fijación de la mirada. Se concluye que los datos obtenidos demostraron la importancia de la evaluación y las intervenciones dirigidas al parto prematuro y de los estudios sobre este tema.

Palabras clave:
prematuro, emociones, funciones ejecutivas, inhibición

Tabla de Contenido

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Each year about 15 million preterm births (PB) take place, that is, one in every 10 births. PB is the main cause of death of children under five years of age (World Health Organization [WHO] 2022), responsible for 35% of the 3.1 million deaths globally each year (Blencowe et al., 2013). When birth occurs before 37 weeks, it is considered preterm. It can still be classified as extremely preterm (less than 28 weeks), very preterm (28 to 32 weeks), and moderate (32 to 37 weeks; WHO, 2022).

It is possible to identify which stages of brain

[a] Federal University of Paraná, Psychology Department, Curitiba-PR, Brazil
[b] Federal University of Paraná, TI Department, Curitiba-PR, Brazil
*Enviar correspondencia a: Dos Santos Telaska, T. E-mail: tatieletelaska@gmail.com

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development have been completed or are in progress through the gestational age. In this sense, preterm leads to anatomical and structural alterations of the brain due to the interruption of prenatal development stages with damage to brain maturation (Peterson Zomignani et al., 2009). For example, it is a predictor of the following factors: (1) motor impairment (Oliveira et al., 2011; Synnes & Hicks, 2018), (2) worse cognitive scores in early childhood (Beauregard et al., 2018), (3) damages in social and discipline issues (Guardiano et al., 2017), (4) increased difficulty in early childhood social communication, development and implementation of social cognition (Scott et al., 2012), (5) impact on the understanding of decision-making activities by emotional ambivalence (Wong et al., 2014), (6) presence of deficits in emotion recognition, cognitive control (Twilhaar et al., 2019) problems of socialization in adolescence, problems associated with changes in the brain network of emotional processing, with greater vulnerability to psychiatric disorders (Healy et al., 2013), and (7) deficit in executive functions (EFs; Brydges et al., 2018; Lowe et al., 2019).

In this sense, EFs refers to the skills that assist in reasoning, planning, problem-solving and managing the individual's life. It covers cognitive skills that allow one to store information, inhibit responses, and change the focus of attention on a given task or problem (Blair, 2017). For Diamond (2013), EFs also includes working memory, inhibition, and cognitive flexibility. Inhibitory control involves the ability to control one's attention, behavior, thought, and emotions to counteract a strong internal predisposition or external attraction and do what is appropriate or necessary. Cognitive flexibility includes being flexible to adjust to altered demands or priorities, admitting errors, and taking advantage of unexpected opportunities. Working memory refers to being able to keep information in mind and manipulate it.

The EFs plays a fundamental role in the self-regulation capacity of the individual (Correia & Navarrete, 2017). Its different components affect the processing of social and emotional information (Van Nieuwenhuijzen et al., 2017). EFs, like inhibitory control, are needed in social activities to perceive the environment, people and emotions. That said, the study involving visual tracking tasks can be developed for evaluation, identifying the way the individual extracts information from the environment, which in turn influences the way they act on this context (Orsati et al., 2008).

Recognizing emotions with precision is an essential aspect of social functioning, bearing in mind that facial expressions are an important indication of emotional state (Orgeta & Phillips, 2007). According to Mancini et al. (2013), the ability to distinguish and interpret emotions from facial expressions is a major component of the nonverbal communication system and a crucial skill for human relationships.

The research found on the subject involves the emotion recognition and inhibitory control in people with Huntington's disease (Hünefeldt et al., 2020), emotion recognition and EFs in bipolar patients (David et al., 2014), emotion recognition, and cognitive flexibility after brain injury (Milders et al., 2008), EFs and emotion recognition in young people as challenging opposition and conduct disorder (Kleine Deters et al., 2020), EFs and emotion recognition in borderline personality disorder (Baez et al., 2015), working memory and recognition of facial expression in patients with Parkinson's disease (Alonso-Recio et al., 2014).

Augusti et al. (2014) evaluated how emotional facial expressions affected working memory in children from 9 to 12 years old. The study revealed that by using the task of operational memory with facial expressions, expressions with negative valence related to negative emotions such as sadness, anger, fear, and disgust do more harm to the working memory than emotions like joy. Morra et al. (2011) investigated the relationship between emotional comprehension, grammatical comprehension, and operational memory capacity in children between 5 and 11 years old, testing the hypothesis that working memory has a role in developing emotional comprehension. The results indicated that working memory capacity plays a decisive role in the transition of understanding emotions. Thus, the development of working memory has a considerable impact on the development of emotional understanding. Rosenqvist et al. (2014) addressed the ability to recognize emotions correlated with all other neurocognitive abilities, such as EFs in children aged 3 to 6. The results indicated that neurocognitive language skills, attention and EFs, and mind theory were significant predictors of emotion recognition ability.

For Rosenqvist et al. (2014), studies that investigate the relationship between emotion recognition and EFs, among them, language, memory, theory of mind or visuomotor functions are still very limited.

Furthermore, no published papers were found that correlate recognition of emotions and PB in the age group of this study, the relationships between these variables are still not well characterized. It is understood that evaluating the difficulties can lead to more adequate clinical evaluations and to an understanding of the recognition of emotion.

Thus, the study has the objective of analyzing the association between the recognition of emotions and the EFs, among them, working memory, inhibitory control and cognitive flexibility in preterm birth and term born (TB) schoolchildren.

Methods

This research was characterized as an exploratory and cross-sectional study to explore the descriptive/correlational the performances between the control group (TB) and the clinical group (PB). The hypotheses are that there are differences in EFs and emotion recognition between the groups and association between EFs and emotion recognition.

The call for participation was made utilizing a report in the school agenda. All members of the sample were regularly enrolled in the public-school network. The sample did not include schoolchildren whose parents did not authorize participation or who could not take the tests because of the compromised oral language, speech comprehension, visual acuity, and motor and hearing alterations. All participants presented normal or corrected vision.

Participants

The sample (N = 82) was divided into two groups, clinical and control, aged 8 to 12 years. The criterion for defining the samples was convenience, seeking to obtain similar and paired groups.

The clinical group (*n* = 32) with a mean age of 9.5 years (*SD* = 1.2), 19 females, with PB below 37 weeks and/or less than 259 days of gestation proven by the health booklet of the participating child (*SD* = 2.25). The schooling varied between 2nd and 7th grade, with the majority enrolled in 3rd grade (25%) and 5th grade (28.1%) of elementary school. The maternal age was 25 to 52 years, with an average of 35.5, while the paternal age was 30 to 49 years, with an average of 37.8.

The sample of the control group (*n* = 50) had a mean age of 8.9 years (*SD* = 1.02), with TB distributed in 25 females and 25 males. Regarding schooling, 34% of participants enrolled in the 3rd grade, 36% in the 4th grade, 22% in the 5th grade, 2% in the 6th grade, and 6% in the 7th grade. The maternal age was 26 to 53 years, with an average of 36.06, while the paternal age was 27 to 53 years, with 38.34 of average. The distribution of the economic classes was characterized from A to D/E, with the predominance of B2 (44%) in the control group, C1 (34.4%), and B2 (34.4%) in the clinical group. Regarding parents' schooling, the majority, both maternal and paternal, of both groups had complete/incomplete high school.

Instruments

The instruments were applied individually, in three sessions of approximately two hours each, in a room free of auditory and visual stimuli inappropriate for research, with protocols and response sheets as required in the application manuals.

To characterize the studied sample, a questionnaire was used to collect information regarding the identification of the participant, clinical data on the development, and economic data based on the criteria of Economic Classification of the Brazilian Association of Research Companies (Associação Brasileira De Empresas De Pesquisa, 2019) of which classifies six socioeconomic strata: A, B1, B2, C1, C2 and D-E based on some variables (quantity of: bathrooms, employees, cars, microcomputer, dishwasher, refrigerator, freezer, washing machine, digital video disc, microwave oven, motorcycle, and dryer), education level of the head of the household and public services (piped water and paved streets). A1 is the highest class, and D-E is the lowest class.

The Wechsler Intelligence Scale for Children (WISC-IV) Working Memory Index was used to evaluate operating memory. WISC-IV is an individual application tool to evaluate the intellectual capacity and problem-solving process of children between 6 years and 0 months to 16 years and 11 months (Weschler, 2013).

The Wisconsin Card Sorting Test (WCST) was used to evaluate cognitive flexibility utilizing the variables number of categories and perseverations. This standardized test consists of four stimulus cards and 128 answer cards that represent figures of various shapes, colors, and numbers. There is no time limit for execution, and it can be used from 6 and a half years to 89 years of age (Heaton et al., 2019).

The Five Digits Test (FDT) evaluated inhibitory control and cognitive flexibility, using the inhibition percentile and flexibility percentile. It has four visually presented parts in the form of a page of 50 items within small squares (five per line) that form a matrix of ten successive lines (Sedó et al., 2015).

For emotion recognition was used the Battery for Computerized Assessment of Emotion Recognition (BACRE-I; Oliveira, 2021; Telaska, 2020). For this research, we used indices of errors, hits and time for each phase, total time, total hits, total errors and total fixations in eye tracking. The BACRE-I was applied to children from 8 to 12 years old, was composed of 6 phases and training: Phase 1- twelve still images, Phase 2- eighteen dynamic videos, Phase 3- six emotional sounds, Phase 4- thirteen dynamic movie clips, Phase 5- generation of seven three-dimensional avatars (virtual representation) with captured facial traits similar to the participant, Phase 6- eleven stimuli containing images, videos, and visual tracking. All the stimuli used in these phases are colorful and include the faces of children, adults, and the elderly. In order to perform it, it was necessary an adapted numeric keyboard, a notebook with a camera for eye tracking coupled, and a headset. Instructions were informed before each phase, there was no time limit, and no-hit or error feedback was provided.

Analysis of results

For the analysis of data in quantitative variables (performance in instruments and sociodemographic data), the measures of central tendency (mean, minimum/maximum) and variability (standard deviation and standard error) were used. The frequency measures were used for the descriptive analysis of the categorical variables (gender, class, education). To compare the performance of the samples, we used Mann-Whitney tests, chi-square test of independence, and Cohen's index. The level of significance adopted for the statistical tests was $p \leq .05$. In BACRE-I, the analysis was also performed on the visual tracking records, which is the total number of fixations that the eye remained examining an area of the stimulus (forehead, eyes, nose, mouth, right and left sides of the face and the defocusing of interest).

Spearman's correlation analysis and Pearson's coefficient were performed to verify the correlation of the groups (PB and TB, and the variables).

Ethical aspects

The Research Ethics Committee approved the study of the Federal University of Paraná SCS/UFPR under the number 09255519.8.0000.0102 and of the Municipal Health Secretariat of Curitiba under the number 09255519.8.3002.0101. The participating children gave their agreement by signing the Informed Consent Form, and their guardians signed the Informed Consent Form and received information about the research.

Results

In order to analyze the performance of the two groups (clinical and experimental) in the EFs, the number of categories and perseverative responses of the WCST, WISC-IV (Working Memory Index) and the percentages of inhibitory control and flexibility obtained in the FDT test (Table 1), have been utilized.

No significant differences were found among the means. The effect size was considered small or very small, demonstrating that no significant differences between the analyzed groups regarding operational memory, inhibition, and cognitive flexibility were presented.

Regarding the measures of emotion recognition, the clinical group presented a significant difference in the execution time of Phase 4 (p = .028), in which the identification of emotions occurred through excerpts of films (Table 2). PB students had a lower performance in time for the emotion recognition, in which, when compared to the other group, it took longer to finish the phase. Regardless of the absence of statistical significance between the groups in the phases, it is relevant to consider that the averages obtained indicated that the clinical group had a lower performance because they got fewer items right, made more mistakes, and took longer to complete the phases.

Table 1.
Comparison of Groups in the Executive Functions indexes

Domain	Control Group		Clinical Group		*p*	*d*
	Average	*SD*	Average	*SD*		
Working Memory Index - WISC-IV	100.7	11.5	95.8	14.0	.105	.381
Percentile Inhibition- FDT	42.7	14.8	39.9	16.9	.334	.174
Flexibility Percentile-FDT	52.6	18.6	50.0	21.7	.494	.129
Number of categories- WSCT	5.4	1.1	5.4	1.3	.820	.032
Perseverations – WCST	14.9	15.0	11.3	8.7	.335	.297

Note. p = significance; *SD* = standard deviation; *d* = Cohen's D

Table 2.
Averages, standard deviation, minimum/maximum, and number of responses in the phases of BACRE-I

	Control Group (*n* = 50)		Clinical Group (*n* = 32)		*p*
	Average	*SD*	Average	*SD*	
Phase 1 – Time	115.2	37.0	116.7	52.3	.648
Phase 1 – Total Hits	9.0	1.7	8.9	1.9	.869
Phase 1 – Total Errors	2.9	1.7	3.0	1.9	.869
Phase 2 – Time	146	32.1	145.2	48.0	.248
Phase 2 – Total Hits	14.6	2.3	15.0	1.2	.509
Phase 2 – Total Errors	3.3	2.3	2.9	1.2	.515
Phase 3 – Time	85.5	14.0	91.6	16.3	.071
Phase 3 – Total Hits	5.5	0.9	5.4	.8	.668
Phase 3 – Total Errors	0.5	0.9	.5	.8	.648
Phase 4 – Time	488.0	31.9	504.3	36.4	**.028**
Phase 4 – Total Hits	10.1	1.3	9.6	1.6	.222
Phase 4 – Total Errors	2.9	1.3	3.3	1.6	.246
Phase 5 – Time	65.5	24.3	65.9	27.8	.872
Phase 5 – Total Hits	2.8	.7	2.6	.7	.348
Phase 5 – Total Errors	3.1	.7	3.3	.7	.348
Phase 6 – Time	149.0	21.3	150.9	29.2	.989
Phase 6 - Total Hits	8.0	1.3	7.8	0.9	.500
Phase 6 - Total Errors	2.9	1.3	3.1	0.9	.500
Total Time	1049.4	115.3	1074.8	152.2	.594
Total Hits	50.1	5.8	49.6	3.5	.262
Total Errors	15.8	5.8	16.3	3.6	.289

Note. p = significance; *SD* = standard deviation

In the analysis of eye tracking during the emotion recognition, the comparison between the groups showed a significant difference in defocusing (p = .002). The clinical group, that is, PB schoolchildren, performed more deviations in eye movement away from the stimulus face while performing emotion recognition.

About the emotion recognition, in the clinical group, the cognitive flexibility had correlation with the execution time in Phase 1 (p = .030, r = .384), Phase 2 (p = .026, r = .0392), Phase 5 (p = .016, r = .422) and with the total time (p = .023, r = .0401). The inhibitory control correlated with Phase 5 in time (p = .027, r = .391), hits (p = .043, r = .360) and total errors (p = .043, r = .360). The operating memory was correlated with the total errors of Phase 2 (p = .037, r = .0370). In the control group the perseverations were related to time (p = .17, r = -.340) and hits (p = .17, r = .340) of Phase 1 (Table 3).

Based on the objectives proposed in this research, the results showed correlations between emotion recognition, operational memory, cognitive flexibility, and inhibitory control in the analyzed groups. However, the correlations are weak, and the more significant correlation found was between cognitive flexibility and Phase 5 (r = .422). Besides that, it is necessary to consider that the sample size is small.

Table 3.
Correlation between the groups in the phases of BACRE-I and executive functions

Phase		Control Group (*n* = 50)					Clinical Group (*n* = 32)				
		WMI	IC	CF	NC	P	WMI	IC	CF	NC	P
Phase 1 Time	*r*	.1	-.2	-.2	.1	**-.3**	-.0	.2	**.3**	-.2	.0
	p	.4	.0	.1	.2	**.0**	.7	.0	**.0**	.1	.7
Phase 1 Hits	*r*	-.1	.2	.2	-.1	**.3**	.0	.1	.0	.0	-.0
	p	.4	.0	.1	.2	**.0**	.7	.4	.8	.9	.8
Phase 1 Errors	*r*	.0	.1	.0	.0	.0	-.0	-.1	-.0	-.0	.0
	p	.6	.2	.5	.8	.9	.7	.4	.8	.9	.8
Phase 2 Time	*r*	-.0	-.2	.1	-.2	.2	.0	.2	**.3**	-.3	.2
	p	.8	.0	.3	.0	.0	.6	.1	**.0**	.0	.2
Phase 2 Hits	*r*	.0	.2	-.1	.2	-.2	-.3	.0	-.0	.1	-.0
	p	.8	.0	.4	.0	.0	.0	.9	.9	.3	.9
Phase 2 Errors	*r*	-.0	.0	.0	-.1	.0	**.3**	-.0	-.0	-.1	-.0
	p	.8	.7	.7	.3	.5	**.0**	.8	.9	.5	.9
Phase 3 Time	*r*	.3	.2	.1	-.0	.0	-.0	.0	.0	.0	.5
	p	.0	.1	.2	.6	.9	.5	.5	.8	.7	.6
Phase 3 Hits	*r*	-.0	.0	.1	.1	-.1	.0	-.1	.1	-.2	.4
	p	.7	.6	.2	.4	.4	.8	.2	.2	.1	.7
Phase 3 Errors	*r*	.0	-.0	-.1	-.1	.1	-.0	.1	-.1	.2	-.0
	p	.7	.6	.2	.4	.3	.8	.2	.2	.1	.7
Phase 4 Time	*r*	.2	-.0	-.0	.2	-.1	.1	.2	.3	-.1	.0
	p	.0	.7	.9	.1	.2	.5	.1	.0	.4	.7
Phase 4 Hits	*r*	-.2	.0	.0	-.2	.2	.2	.1	.0	.3	-.2
	p	.0	.6	.7	.1	.1	.2	.4	.9	.0	.1
Phase 4 Errors	*r*	-.0	.1	.2	.0	-.0	-.2	-.1	-.0	-.3	.2
	p	.6	.2	.1	.8	.9	.2	.4	.9	.0	.1
Phase 5 Time	*r*	-.0	.1	-.0	.1	-.0	.0	**.3**	**.4**	-.1	.1
	p	.8	.2	.8	.4	.8	.8	.0	**.0**	.3	.5
Phase 5 Hits	*r*	.0	.0	.1	-.0	-.1	.1	**.3**	.3	-.2	.0
	p	.7	.5	.3	.6	.2	.4	**.0**	.0	.2	.8
Phase 5 Errors	*r*	-.0	-.0	-.1	.0	.1	-.1	**-.3**	-.3	.2	.2
	p	.7	.5	.3	.6	.2	.4	.0	.0	.2	.2
Phase 6 Time	*r*	-.0	.2	.2	-.1	.0	-.0	-.0	.1	.0	.0
	p	.7	.0	.1	.3	.9	.8	.9	.4	.8	.7
Phase 6 Hits	*r*	.1	-.2	-.1	.0	-.2	-.2	-.0	.0	.2	-.0
	p	.4	.1	.2	.7	.1	.2	.9	.9	.2	.9
Phase 6 Errors	*r*	-.1	.2	.1	-.0	.2	.2	.0	-.0	-.2	.0
	p	.4	.1	.2	.7	.1	.2	.9	.9	.2	.9
Total Time	*r*	-.0	.1	.0	.0	-.0	.0	.3	**.4**	-.2	.0
	p	.5	.2	.8	.9	.7	.6	.0	**.0**	.1	.7
Total Hits	*r*	.1	-.2	.0	.0	-.1	-.0	.1	.0	.1	-.1
	p	.2	.0	.9	.9	.2	.9	.4	.9	.4	.4
Total Errors	*r*	-.1	.2	.0	-.0	.1	.0	-.1	-.0	-.1	.1
	p	.2	.0	.9	.9	.2	.8	.4	.9	.5	.4

Note. *p* = significance; *r* = correlation coefficient; *SD* = standard deviation; WMI = Working Memory Index; IC = Inhibitory control; CF = Cognitive flexibility; NC = Number of categories; P = Perseverations

Discussion

The main objective of this study was to analyze the association between emotions recognition and EFs, specifically the operational memory, cognitive flexibility, and inhibitory control in PB and TB students.

In the field of EFs, no significant differences were found between the groups, corroborating a study by Loe et al. (2012) and Tavares (2019), in which the performance in EFs was the same both in PB and in the TB. For instance, Jaekel et al., (2016), Aviles et al., (2018), and Basso (2014) found differences in EFs between the groups, in which PB negatively affected inhibitory control skills. In addition, they found that the lower the gestational age of the child, the lower inhibitory control, due to interruption of gestational development. It is believed that the fact that the clinical group sample consisted mostly of moderate to late preterm was related to the fact that the performance of the two groups was similar, with no statistically significant differences, differing two results from other studies. Moreover, to Everts et al. (2019), in PB, the development of EFs occurs in a prolonged way throughout childhood until adolescence, when they reach at least the same level of performance and may improve beyond TB in inhibition and cognitive flexibility.

The performance of the groups in the recognition of emotions obtained in this research corroborated the research by Williamson and Jakobson (2014), pointing out that preterm children had more difficulty identifying emotions correctly. However, Ríos-Flórez and Flóres Barco (2017) found no relation between recognition of basic emotions and PB. However, assessments mainly use two-dimensional facial stimuli, but Wang et al. (2017) indicate that the use of three-dimensional stimuli favors recognition more efficiently and quickly. Bernstein and Yovel (2015) claimed that research should expand to study dynamic stimuli, considering that facial motion rather than static images convey most real-life social interactions. Dynamic displays improve decoding accuracy, have greater ecological validity, and are more suitable for research (Slepian & Carr, 2019).

In eye tracking, preterm students had less focus on recognizing emotions. Loe et al. (2012) obtained the same results in research on EFs, in which the PB showed an impaired capacity to retain fixation during the evaluation. Research by Yaari et al. (2018) indicated that premature newborns looked away to better process emotional information and regulate arousal levels. This same pattern of look deviation in the identification of emotions was evidenced in Fuentes et al. (2018), who sustained that it impacts emotion recognition, considering that the understanding of emotions in the social context provides clues about the present conditions, indicating the directions that the behavior must follow to be socially adequate and have adaptive value. In this way, they convey the emotional state, and the ability to produce and recognize it is an important component of interpersonal communication.

The mentioned data on the correlation between inhibitory control and recognition of facial expressions of emotions agreed with the study by van Rijn et al. (2011). This study correlated the assignment of emotions with inhibitory control, where the difficulty in identifying emotions was related to inhibitory control problems, which influenced the performance of the selection of appropriate social significance, being a possible marker of vulnerability for psychosis. According to Diamond (2013), inhibitory control allows selective participation, focusing on what the individual chooses, and suppressing attention to other stimuli, involving control over behavior and emotions. The lack of inhibitory control leaves the individual at the mercy of impulses, habits of thought or action, and/or stimuli in the environment. Thus, the development of inhibitory control skills is vital for children living in the social environment.

Early identification of inhibitory control difficulties and emotion recognition can be beneficial in targeting children at risk of maladaptive development, and there are many opportunities for intervention during early childhood (Rhoades et al., 2009). Therefore, it is important to identify interventions (Hüning et al., 2017).

The emotion recognition requires operational memory, and these requirements are greater as the number of options to choose from increases. Difficulties in working memory are likely to cause specific problems in tasks of labeling facial expressions of emotion, where participants are asked to make a decision (Phillips et al., 2008). People with greater operational memory capacity are more adept at controlling emotions than others (Schmeichel et al., 2008). Thus, in general, the relevance of EFs is understood, which enables the individual to adapt quickly and flexibly to changed circumstances, maintain focus and face new unforeseen challenges (Diamond, 2013).

The study tried to identify if there was an association between EFs and emotions recognition in the preterm and full-term groups. However, when EFs were associated with emotion recognition, correlations were found, with the highest correlation between cognitive flexibility and Phase 5. The results identified in the study by Erfanian et al. (2018) indicated the relationship between components of EFs and emotion recognition. In other words, working memory is enhanced by improving emotion control, initiating, planning, organizing, and monitoring the amount of emotional recognition. Thus, difficulties in EFs negatively influence the emotion recognition.

The data obtained in the research are important for the planning of interventions and prognosis, considering that it is essential to understand the pattern of preterm child development, considering the results throughout the development so that the use of data with different gestational ages are vital to building this understanding (Silveira & Procianoy, 2019). Understanding the consequences of prematurity and ways to minimize the effects is urgent to promote each individual's quality of life and the repercussions it causes (von Doellinger et al., 2017).

Although the objectives of this study were met, there are some limitations, such as the sample size and the weak correlations found. However, even with the limitations inherent to this research, it is believed that it made it possible to understand the association between EFs and emotion recognition in schoolchildren TB and PB. In future studies, larger and more representative samples are recommended to minimize or even eliminate these limitations.

Conclusions

This study allowed us to understand the EFs and emotion recognition of schoolchildren PB and TB from 8 to 12 years of age.

The results obtained indicate that the main findings of the study refer to the fact that no significant differences were found in the EFs between the groups, refuting the hypothesis that there was a difference between the groups; furthermore, the PB schoolchildren showed a significant difference in the execution time in one of the phases and a lower performance in the emotion recognition time. In the eye-tracking analysis, the comparison between the groups showed a significant difference in defocusing, that is, the preterm birth schoolchildren made more deviations in eye movement away from the stimulus face. As for the association between EFs and emotion recognition, correlations were found between the EFs assessed and emotion recognition.

It is understood that this study is considered relevant because it makes it possible to understand the relationship between EFs and emotion recognition in schoolchildren born at term and preterm so that the results of the study demonstrate the importance of assessment and interventions directed at PB and emotion recognition and EFs, and the need for further studies that address this public. In future studies, it is proposed to use longitudinal studies to portray the developmental profile.

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