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## **Cognitive deficits associated with maltreatment in Brazilian adolescents**

### **Déficits cognitivos associados a maus-tratos em adolescentes Brasileiros**

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## **Abstract**

There are evidences about the impact of child maltreatment (CM) on cognition but few Brazilian studies have examined this topic. This study aimed to investigate the association between CM and intelligence, visuoconstructive ability, visual memory, working memory and arithmetic skills. The sample was composed by Maltreated adolescents (MA, N=28) and Comparison adolescents (CA, N=30). Results indicated a negative correlation between CM and neuropsychological measures and the impact of lowered IQ in MA on visuoconstructive performance and arithmetic skills.

**Keywords:** child psychiatry, adolescents, maltreatment, neuropsychology, cognition

## **Resumo**

Evidências apontam o impacto dos maus-tratos infantis (MTI) na cognição, mas poucos estudos brasileiros investigaram esse tema. O objetivo do estudo foi investigar a associação entre MTI e inteligência, habilidades visuo-constructivas, memória visual, memória de trabalho e habilidades aritméticas. A amostra foi composta por adolescentes maltratados (MA, N = 28) e grupo de comparação (CA, N = 30). Foi encontrada uma correlação negativa entre MTI e medidas neuropsicológicas e impacto negativo do menor QI do MA no desempenho visuo-constructivo e habilidades aritméticas.

**Palavras chave:** Psiquiatria Infantil, adolescentes, maus-tratos, neuropsicologia, cognição.

## **Cognitive deficits associated with maltreatment in Brazilian adolescents**

According to the World Health Organization, child maltreatment (CM) – defined as all forms of neglect, physical, sexual and emotional abuse - is a worldwide public health issue, affecting millions of people every year and it is a major risk factor for psychiatric disorders and aggressive behaviors towards others (WHO, 2012). CM has negative impacts on brain development and functioning, leading to several cognitive impairments (Porter, Lawson, & Bigler, 2005), once the brain is under a complex process of neurobiological maturation (McEwen, 2008).

The aim of this article was to investigate the association between child maltreatment and cognitive performance through neuropsychological tests assessing several cognitive domains such as: intelligence, visuoconstructive ability, memory, working memory and arithmetic

skills. Although recent studies has focused on the relationship between child maltreatment and some cognitive abilities, to our knowledge, there were few attempts, if any, in measuring the association between this specific cognitive functions and diverse types of maltreatment experiences (Oliveira, Scivoletto, & Cunha, 2010), which are extremely important to leaning process and social adaptation (Lezak et al., 2004). It is particularly essential to investigate the cognitive profile of maltreated adolescents, once it can contributes to the development of specific strategies for treatment and inclusion in school and society. Different kinds of maltreatment with functions such as intelligence, visuoconstructive ability, memory, and arithmetic skills

### **Method**

The total sample was composed of 58 adolescents between 12 and 16 years divided in two groups: the Maltreated Group (MG) and Comparison Group (CG).

Participants of the MG (N=28) were recruited from The Equilibrium Program (TEP), a multidisciplinary mental health community service specialized in the outpatient treatment of children and adolescents with a history of maltreatment and social deprivation (Scivoletto, Silva, & Rosenheck, 2011). Adolescents who are enrolled in TEP have all suffered some kind of maltreatment and are living either with their families or in group shelters (Scivoletto et al., 2011). The CG (N = 30) was those subjects with no history of CM, selected from an educational and social program composed by children and adolescents of low socioeconomic status (SES). They were matched by age and sex to the MG. None of the control group subjects had a history of maltreatment.

In both groups, we excluded adolescents with any of the following criteria of the 4<sup>th</sup> Edition of Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association [APA], 1994) diagnoses: substance abuse and/or

dependence; mental retardation; pervasive developmental disorders; acute and transient psychotic disorders; and severe depressive episode with or without psychotic symptoms. We also excluded those with a history of perinatal brain damage, traumatic brain injury with loss of consciousness for more than an hour, or other neurological disorders. The exclusion criteria were applied in order to avoid any condition that would lead to significant neuropsychological changes.

Vocabulary and Block-Design subtests from the Wechsler Intelligence Scale for Children – Third Edition (WISC-III) were used to assess Estimated Intelligence Quotient (EIQ) (Lezak, Howieson, & Loring, 2004; Wechsler, 2002). The Rey-Osterrieth Complex Figure Test (ROCFT) was used to assess visuoconstructive ability (ability that combines visuoperception, planning and motor response) and visual memory (Rey, 1999). The Arithmetic subtest (WISC-III) was used to measure working memory (the

ability to handle arithmetic problems mentally) and the ability to perform mathematical operations (Wechsler, 2002).

All participants were interviewed with the Kiddie-Sads-Present and Lifetime (K-SADS-PL) version in order to investigate psychiatric diagnoses and to exclude those patients meeting the exclusion criteria (Kaufman et al., 1996). The Childhood Trauma Questionnaire (CTQ), a 28-item self-report inventory was administered to investigate maltreatment history and its five subtypes: emotional, physical and sexual abuse; emotional and physical neglect (Bernstein et al., 2003; Grassi-Oliveira, Stein, & Pezzi, 2006).

The research project was approved by the ethics committee from University of São Paulo School of Medicine. All subjects and their legal guardians signed a consent form.

### **Statistical Analysis**

Data distributions were examined for normality. The Kolmogorov-Smirnov

test was performed on continuous variables. Student's t-test or Mann-Whitney test yielded comparisons between groups. Specific comparisons (inventories) were evaluated through analysis of covariance or Poisson regression (depending on the assumed adequacy of each variable).

Data analyses were controlled by IQ, education, presence of psychiatric diagnoses, use of psychiatric medication, and socioeconomic status (SES- "problems related to housing and economic circumstances", ICD-10, Z59). The variables were controlled because it is expected intellectual deficit in victims of maltreatment (Oliveira et al., 2012), as well as psychiatric disorders and socioeconomic difficulties (Scivoletto et al., 2011); and all these aspects can influence the neuropsychological performance (Hackman et al., 2010).

Fisher's exact test was applied in categorical data and correlations between the total CTQ score and

neuropsychological tests were measured by Spearman's correlation coefficient. The correlation was performed with the entire sample, because CG could report situations of maltreatment not significant according to the cutoff scores (Bernstein et al., 2003). Type I error rate was set at 5%, and all tests were two-tailed. All analyses were performed with the Statistical Package for the Social Sciences, version 19.0.

## Results

There were no differences between groups in variables such as age, ethnicity, and handedness (table 1). In the MG, only 5 patients were living with their families (the great majority was living in group shelters). The educational level was significantly lower in MG and also, this group showed lower EIQ and higher CTQ scores in all subscales.

**Table 1**

*Sociodemographic variables, Estimated Intelligence Quotient (EIQ) and CTQ Scores of Maltreated Group (MG) and Comparison Group (CG)*

Variable	Maltreated N = 28	Comparison N = 30	p value (MGxCG)
Age <sup>a</sup> , M (SD)	13.71 (1.32)	13.73 (1.31)	0.95
Education (years) <sup>a</sup> , M (SD)	6.39 (1.93)	8,00 (1.50)	<0.01
Sex (male/female) <sup>b</sup> , N/N	14/14	15/15	1.00
Ethnicity (White/Black) <sup>b</sup> , N/N	13/15	12/18	0.87
Handedness (right-handed/left-handed) <sup>b</sup> , N/N	26/2	29/1	0.61
Place of residence (family home/shelter) <sup>b</sup> , N/N	5/23	30/0	< 0.01
Estimated Intelligence Quotient, M (SD)	90.39 (10.93)	112.40 (9.70)	<0.01
CTQ scores, M (SD)			
Sexual abuse domain	7.21 (4.15)	5.03 (0.18)	< 0.01
Physical abuse domain	9.93 (4.71)	5.83 (1.23)	<0.01
Emotional abuse domain	11.43 (5.69)	7.10 (2.60)	< 0.01
Emotional neglect domain	12.93 (6.77)	7.73 (2.84)	< 0.01
Physical neglect domain	9.46 (3.65)	5.50 (0.77)	<0.01
Total	51.29 (18.16)	31.20 (5.90)	<0.01
Denial subscale	1.79 (1.10)	2.87 (0.43)	<0.01

<sup>a</sup>Student's *t*-test for independent samples; <sup>b</sup>Fisher's exact test; <sup>c</sup>Mann-Whitney test, CTQ: Childhood Trauma Questionnaire

None of the CG adolescents presented psychiatric diagnoses. On the other hand, the MG group 43% (N=12) fulfilled one diagnosis criteria and 39% (N=11) presented two or more diagnoses. The most common were: Major Depressive Episode (MDE) (12%; N=7), and Attention-Deficit/Hyperactivity Disorder (ADHD) (10%; N=6). Moreover, 24% (N=14) of the MG participants were using some type of psychiatric medication. The most frequent were selective serotonin reuptake inhibitors (12%) and antipsychotics (10%).

Table 2 presents the scores of the groups on neuropsychological tests. The *p values* mentioned in the GROUP line indicates if the difference between groups was significant because the CTQ score. The others subsequent rows indicate whether scores of the groups were influenced by the controlled variables mentioned before.

As showed, the EIQ measure influenced performance on Arithmetic and ROCFT (copy) tests (table 2). Moreover, performance on Arithmetic test was influenced by educational level.

**Table 2**

*Neuropsychological Performance of Maltreated Group (MG) and Comparison Group (CG)*

		WISC-III- Arithmetic <sup>1</sup>	ROCFT Copy <sup>2</sup>	ROCFT Recall <sup>1</sup>
<b>MG</b>	Mean	14.64	28.09	15.32
	SD	2.78	7.67	9.02
<b>CG</b>	Mean	17.93	34.48	22.37
	SD	2.27	2.58	7.56
<b>Group</b>	p-value	0.93	0.16	0.19
<b>EIQ</b>	p-value	<b>0.01</b>	<b>0.01</b>	0.06
<b>Education</b>	p-value	<b>0.00</b>	0.15	0.93
<b>Z59</b>	p-value	0.32	0.70	0.98
<b>Psychiatric Diagnoses</b>	p-value	0.63	0.09	0.38
<b>Medication</b>	p-value	0.77	0.26	0.69

MG= maltreated group, CG= Comparison Group, WISC-III= Wechsler Intelligence Scale for Children, third edition, ROCFT= Rey-Osterrieth, Complex Figure Test, Group= indicates whether there is significance in difference between groups without interference from the controlled variables, Z59=Problems related to housing and economic circumstances, <sup>1</sup>ANCOVA; <sup>2</sup>Poisson Regression Model

Psychiatric diagnoses, use of psychiatric medication and socioeconomic status (SES) did not influence the results.

Finally, it was found a moderate significant negative correlation between the CTQ and neuropsychological measures: EIQ ( $\rho = -0.55$ ,  $p < 0.01$ ); ROCFT Copy ( $\rho = -0.31$ ,  $p=0.01$ ), ROCFT Recall ( $\rho = -0.32$ ,  $p=0.01$ ) and Arithmetic ( $\rho = -0.37$ ,  $p < 0.01$ ).

### **Discussion**

Overall, the main result of this study is that the higher levels of maltreatment self-reports were negatively associated with cognitive performance, result that support a possible association between history of maltreatment and neuropsychological deficits described in the literature (Oliveira et al., 2010). In addition, intellectual deficits may represent a risk factor for exposure to other kinds of maltreatment, such as bullying (Kelly & Norwich, 2007).

Besides that, the lower IQ negatively influenced visuoconstructive functions and arithmetic performance, which is an unpublished result with this population. It is important to consider that the impairment on these functions may impact on the daily activities of adolescents who need basic working memory, arithmetic skills, and visuoconstructive abilities required to adapt to the world (Lezak et al., 2004). These findings gain more importance to current studies, which emphasize the importance of working memory and planning skills for the regulation of behavior and adaptation in various social contexts, including school (McClelland & Cameron, 2011).

Another relevant result is that MG sample showed a high prevalence of mental disorders as well as other samples of children and adolescents with maltreatment history (Scivoletto et al., 2011). This result is alarming since childhood exposure to maltreatment is

associated to a higher risk for school dropout, especially when psychiatric diagnoses are present (Porche, Fortuna, Lin, & Alegria, 2011). Moreover, MDE and ADHD (most common disorders in MG) can damage self-esteem, academic performance and social relationships (Klassen, Miller, & Fine, 2004).

Some limitations should be considered. The cognitive difficulties related to each psychiatric disorder were not analyzed because the sample was relatively small considering the diversity of diagnoses. Also, it was not possible to detect the precise age of the occurrence of maltreatment. TEP patients frequently have been shuttled between different shelters and there are communication difficulties among these institutions (Scivoletto et al., 2011).

### **Conclusion**

The current study demonstrated the negative correlation between child maltreatment, neuropsychological functioning and

mental health. These findings reinforce the need for violence prevention programs and multidisciplinary treatment interventions specifically designed for children and adolescents victims of maltreatment.

- Maltreated adolescents showed lower IQ compared with nonmaltreated adolescents;
- Lower IQ in maltreated adolescents negatively influenced visuoconstructive functions and arithmetic performance;
- We found negative correlation between CM and neuropsychological functioning;
- Maltreated adolescents showed a high prevalence of mental disorders;
- Our findings reinforce the need for multidisciplinary treatment interventions specifically designed for victims of maltreatment.

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