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Major Depressive Disorder: A Comparative Study on Social-Emotional Cognition and Executive Functions

Bruna Gomes Mônego[1,*], Rochele Paz Fonseca[2], Antônio Lúcio Teixeira[3], Izabela Guimarães Barbosa[4], Leonardo Cruz de Souza[4], & Denise Ruschel Bandeira[1]

[1]*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil*

[2]*Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil*

[3]*The University of Texas, Health Science Center at Houston, Houston, TX, United States*

[4]*Universidade Federal de Minas Gerais, Faculdade de Medicina, Belo Horizonte, MG, Brazil*

ABSTRACT – The present study aimed to assess socioemotional cognition and executive functions in patients with unipolar Major Depressive Disorder. The sample included 22 patients between 36 and 93 years of age (M = 59.32; SD = 12.89) and 23 patients between 30 and 81 years of age (M = 63.00; SD = 13.56) controls. In addition to demographic data, symptoms of anxiety and depression, empathy, theory of mind, recognition of emotions, inhibitory control, cognitive flexibility and phonemic verbal fluency were obtained. There was no statistical difference between the groups regarding age and education. Patients had significantly more anxiety, depression and personal distress than controls. Individuals with more severe depressive symptoms had a lower processing speed than the others.

KEYWORDS: Major Depressive Disorder, executive functions, socio-emotional cognition, empathy

Transtorno Depressivo Maior: Um Estudo Comparativo sobre Cognição Socioemocional e Funções Executivas

RESUMO – O objetivo deste estudo foi avaliar a cognição socioemocional e as funções executivas em pacientes com Transtorno Depressivo Maior unipolar. A amostra incluiu 22 pacientes entre 36 e 93 anos de idade (M = 59,32; DP = 12,89) e 23 indivíduos controles entre 30 e 81 anos de idade (M = 63,00; DP = 13,56). Além de dados demográficos, foram avaliados sintomas de ansiedade e de depressão, empatia, teoria da mente, reconhecimento de emoções, controle inibitório, flexibilidade cognitiva e fluência verbal. Não houve diferença estatística significativa entre os grupos quanto à idade e à escolaridade. Os pacientes apresentaram significativamente mais ansiedade, depressão e angústia pessoal do que os controles. Indivíduos com sintomas depressivos mais graves apresentaram menor velocidade de processamento.

PALAVRAS-CHAVE: Transtorno Depressivo Maior, funções executivas, cognição socioemocional, empatia

Major Depressive Disorder (MDD) is a condition that leads to intense suffering and considerable functional impairment. MDD is characterized by depressed mood and/or loss of interest or pleasure, along with other symptoms, such as alterations in psychomotricity, appetite, sleep, and fatigue, as well as recurrent thoughts about excessive guilt, worthlessness, death, and cognitive impairments related to attention and decision-making skills. Because these symptoms occur nearly every day, they lead to intense suffering that affects all contexts of people's lives (American Psychiatric Association [APA], 2014).

Cognitive symptoms are currently included among the central aspects of MDD (Millan et al., 2012; Roca, Vives, Lopez-Navarro, Garcia-Campayo, & Gili, 2015; Zuckerman et al., 2018). According to a review (Millan et al., 2012), the most common cognitive alterations documented in MDD include deficits in working memory, episodic memory, processing speed, and executive functions. In particular, a

* E-mail: brunamonego@hotmail.com

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meta-analysis showed that MDD patients were impaired in several measures of executive functions, with similar effect sizes for all subcomponents assessed: inhibition, shifting, updating, verbal and visuospatial working memory, planning, and verbal fluency. However, inhibition might be impaired to a greater extent than the others (Snyder, 2013).

Even though several studies have investigated cognitive impairment in MDD, they do not reveal a homogeneous impairment profile. The diversity of symptoms present in MDD and of instruments used to measure those symptoms might be (partially) responsible for the conflicting results reported across studies (Roca et al., 2015). Research on socioemotional cognition, on the other hand, is a much more recent but growing field. Studies on this topic have found that deficits in socioemotional cognition may explain, at least in part, the impairments in social functioning observed in MDD (Wolkenstein, Schönenberg, Schirm, & Hautzinger, 2011).

The term social-emotional cognition (or social cognition) describes the adequacy of an individual's behavior to their environment and includes cognitive processes that allow them to perceive, understand, and think about themselves and others (Beer & Ochsner, 2006) by creating and manipulating mental representations of social relationships (Adolphs, 2003). Empirical studies and meta-analyses with MDD patients have reported alterations in skills such as theory of mind ([TOM] Bora & Berk, 2016), recognition of emotional facial expressions (Cusi et al. 2013; Dalili, Penton-Voak, Harmer, & Munafo, 2015), and empathy (Cusi et al., 2011; Inoue, Tonooka, & Yamada, 2004; Lee, Harkness, Sabbagh, & Jacobson, 2005; Uekermann, Channon, Lehmkämper, Abdel-Hamid, Vollmoeller, & Daum, 2008; Wang, Wang, Chen, Zhu, & Wang, 2008). However, there is considerable discrepancy among the results of those studies (Hoertnagl & Hofer, 2014). An aspect that may underlie this discrepancy is the clinical and pathophysiological heterogeneity of MDD (Arnow et al., 2015; Bora & Berk, 2016).

It is also noteworthy that social-emotional impairments are a transdiagnostic issue that may constitute a clinical marker. This was suggested by Cotter et al. (2018) in a systematic review of 31 meta-analyses investigating TOM and recognition of emotional facial expressions in individuals with psychiatric, neurological, or developmental disorders. Consistent impairments in those skills were found in almost all of the 30 clinical conditions investigated, with magnitudes similar to those found in more frequently investigated skills, such as memory and processing speed.

Considering components of social-emotional cognition and executive functions are related (Devine & Hughes, 2014; Santamaría-García et al., 2020; Shahaeian, Henry, Razmjoee, Teymoori, & Wang, 2014), it is important to investigate these constructs concomitantly in patients with MDD (Cusi et al., 2011). The present study aims to (a) compare individuals with unipolar MDD and a control group in tasks of social-emotional cognition (recognition of emotional facial expressions, TOM, and empathy) and executive functions (inhibitory control, cognitive flexibility, and phonemic verbal fluency); (b) investigate associations between test performance and diagnosis-related variables (time since diagnosis, age at first episode, and duration of treatment); and, (c) create subgroups according to severity of depressive symptoms and compare the performance of both groups on tests of social-emotional cognition and executive functions.

Considering the literature reviewed above, we expected lower performance in the MDD group compared to the control group in measures of both social-emotional cognition and executive functions. We expected to a similar result in the comparison between groups defined by severity of depressive symptoms, with the highest severity group showing lowest performance.

METHOD

Because the goal of this study was to describe characteristics of a group of patients with MDD and compare them to a healthy control group, a descriptive-correlational design was adopted.

Participants

The sampling process was non-probabilistic. Participants from the Brazilian states of Minas Gerais and Rio Grande do Sul were invited to participate in the study through the Municipal Health Department of Osório (in Rio Grande do Sul), seniors' groups, health institutions, and researchers' acquaintances. Figure 1 shows participants invited at each institution and the absolute frequency of invitations, inclusions, and exclusions of participants.

As shown in Figure 1, a total of 131 individuals were invited to participate in the study and 45 comprised the final sample. All participants met the inclusion criteria (Figure 2).

As shown in Figure 2, the Mini-Mental State Examination ([MMSE] Folstein, Folstein, & McHugh, 1975; Kochhann, Varela, Lisboa, & Chaves, 2010) and the Mini-International Neuropsychiatric Interview ([MINI-PLUS] Amorim, 2000; Sheehan et al., 1998) were employed as screening instruments, the latter being administered only to the control group. The MINI-PLUS diagnostic modules were used whenever screening questions were answered affirmatively, following the instructions of the instrument. Individuals who met criteria for current or past Major Depressive Episode, Manic Episode, Psychotic Disorders, or Anxiety Disorders were excluded from the sample.

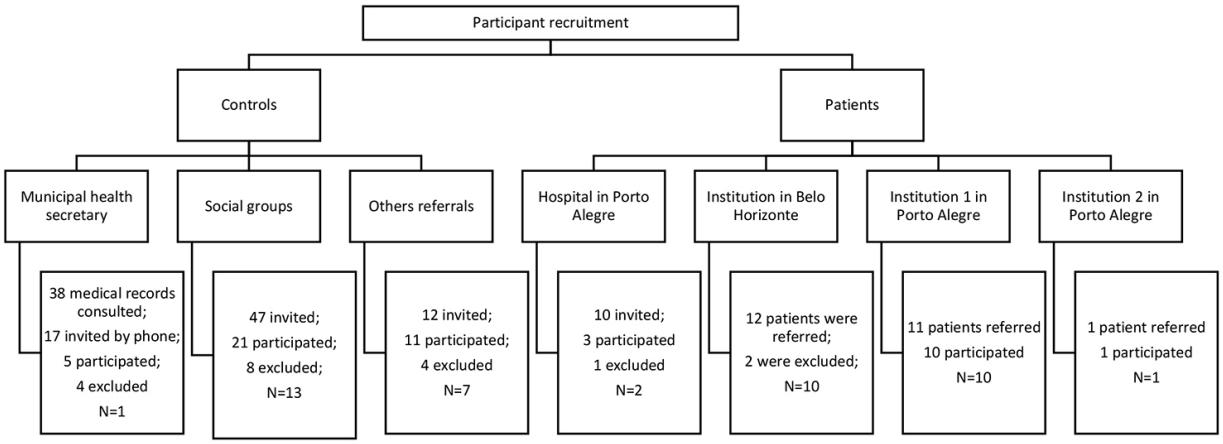

Figure 1. Flowchart of participant selection procedure.

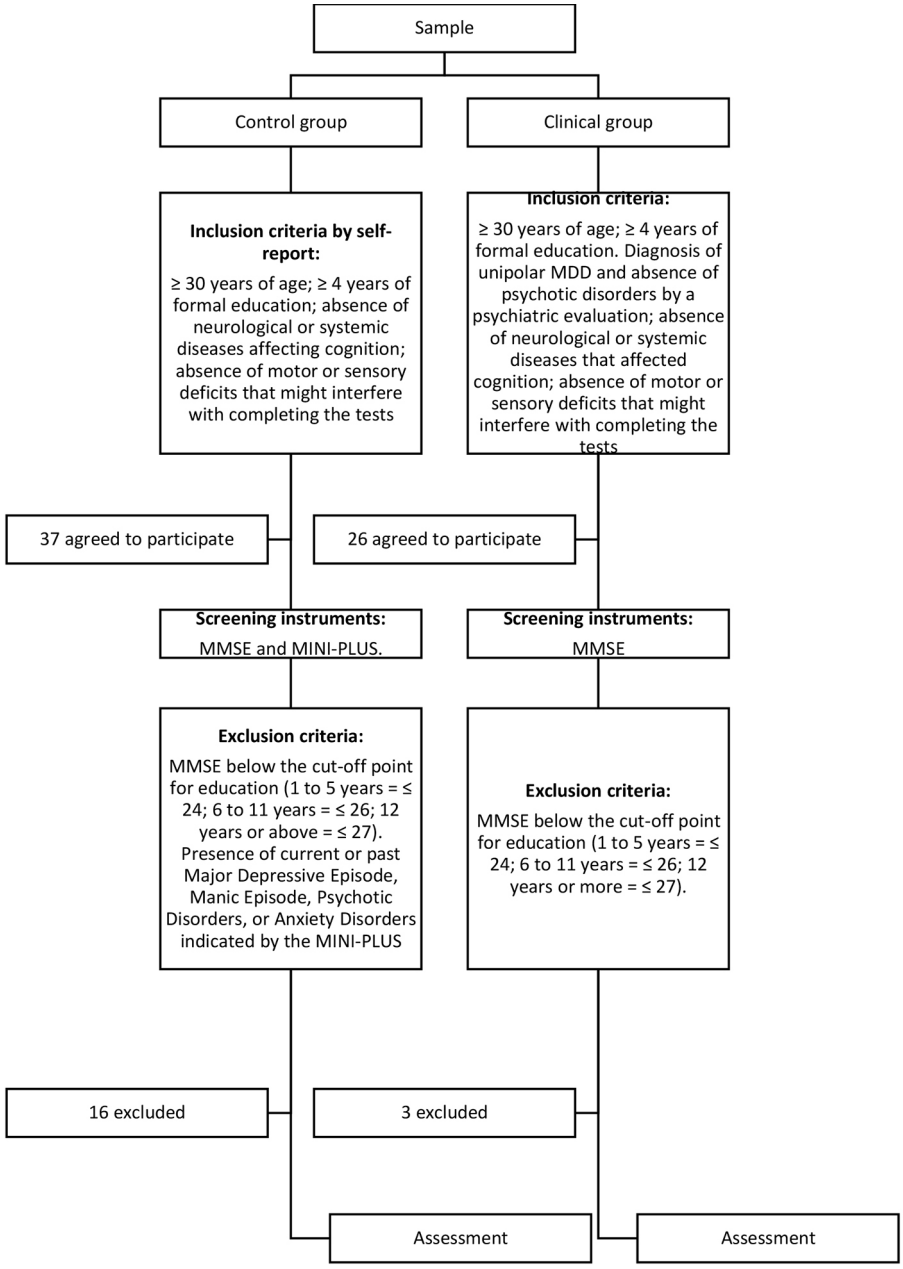

Figure 2. Flowchart of data collection procedures and instruments. MDD = Major Depressive Disorder; MMSE = Mini-Mental State Examination; FAB = Frontal Assessment Battery; IRI = Interpersonal Reactivity Index; MINI-SEA = Social Cognition and Emotional Assessment, abbreviated version.

The final sample consisted of male and female individuals between 30–93 years of age, with 4–29 years of formal education. Participants lived in the metropolitan region of Porto Alegre, in the city of Taquari, coastal region of the state of Rio Grande do Sul, and in the city of Belo Horizonte, state of Minas Gerais. They were split into two groups according to presence or absence of MDD. The control group comprised 23 participants between 30 and 81 years of age (M = 63.00; SD = 13.56) and 4–29 years of formal education (M = 12.74; SD = 8.18). The clinical group included 22 individuals between 36 and 93 years of age (M = 59.32; SD = 12.89) 4–27 years of formal education (M = 13.73; SD = 6.24). Table 1 presents descriptive data for the sample.

Table 1 shows that some participants in the control group took medication, but none had been diagnosed with any psychiatric disorder; this was confirmed by the MINI-PLUS. No participants took antipsychotics. The line "other medication" in Table 1 includes diuretics and drugs for hypertension and diabetes.

Instruments

The following instruments were employed: Demographic data and health conditions questionnaires (Fonseca et al., 2012), the Hospital Anxiety and Depression Scale ([HADS]; Botega, Bio, Zomignani, Garcia, & Pereira, 1995; Zigmond & Snaith, 1983), the Hayling Test (Burgess & Shallice, 1997; Zimmerman, Cardoso, Kristensen, & Fonseca, 2017), a Phonemic Verbal Fluency Task (f/a/s) (Steiner, Mansur, Brucki, & Nitrini, 2008), the Frontal Assessment Battery ([FAB]; Beato et al., 2012; Beato, Nitrini, Formigoni, & Caramelli, 2007; Dubois, Slachevsky, Litvan, & Pillon, 2000), the *Interpersonal Reactivity Index* ([IRI]; Davis, 1980; 1983; Sampaio et al., 2011), and the *Social Cognition and Emotional Assessment*, abbreviated version ([MINI-SEA] Bertoux et al., 2012; Funkiewiez, Bertoux, de Souza, Lévy, & Dubois, 2012).

Procedures

A pilot study was conducted with six individuals to estimate the time required for data collection and to evaluate the understandability of instruction-items (or instructions-stimuli) sets, as well as the adequacy of the instruments. After this step, some changes were made to the order and structure of the protocols. Participants in the pilot study did not enter the final sample. Instruments were administered at the participant's own home, in educational institutions or in hospitals, between the years of 2015 and 2016.

Ethical considerations

This project was approved by the Research Ethics Committee of the Psychology Institute at UFRGS (Approval number: 1.099.551; CAAE 34753614.1.3002.5327) and by the Hospital de Clinicas de Porto Alegre (Approval number: 1.117.465; CAAE 34753614.1.0000.5334) and was financially supported by CNPq (Process number: 471755/2014-1). The study was carried out in collaboration with [information omitted to avoid identification of authors]. The project, entitled "Social-emotional cognition: clinical, neuroimaging, and biomarker study" was approved by the Research Ethics Committee of UFMG (Approval number: 17850513.2.0000.5149) and received financial support from CNPq (Process number: 402853/2012-1). An Informed Consent Form was read and signed by all individuals prior to participating in the study.

Table 1
Sample characteristics and analysis of diferences between groups

Variables	CG	MDD	Chi-square /t/F	p
Female *n* (%)	18 (78.30%)	18 (81.80)	16.20	.001
Age (*M* and *SD*)	63 (13.56)	59.32 (12.89)	-0.83	.412
Years of formal education (*M* and *SD*)	12.74 (8.18)	13.73 (6.24)	0.22	.828
MMSE (*M* and *SD*)	28.43 (1.75)	27.18 (2.09)	6.34	.016
Antidepressants *n* (%)				
SSRI	0	15 (68.20)	-	-
Tricyclic	1 (4.5)	4 (18.20)	-	-
Other	0	7 (31.80)	-	-
Neuroleptics *n* (%)	0	2 (9.10)	-	-
Lithium *n* (%)	0	2 (9.10)	-	-
Anticonvulsants *n* (%)	1 (4.5)	2 (9.10)	-	-
Benzodiazepines *n* (%)	2 (9.10)	5 (22.70)	-	-
Other medications *n* (%)	16 (72.70)	18 (81.08)	-	-

Note: CG = control group; MDD = clinical group with major depressive disorder; SSRI = selective serotonin reuptake inhibitor; MMSE = Mini-mental state examination.

Data analysis

Initially, descriptive statistics of central tendency and dispersion were computed to characterize the sample. Kolmogorov-Smirnov tests were performed to assess the distribution of continuous variables; these tests indicated that the variables were normally distributed. ANCOVA and t-tests were used to compare scores between groups. To assess whether controlling for the effects of years of formal education and age was necessary, partial correlation analyzes were carried out: (a) between age and other variables, for each group; (b) between years of formal education and other variables, for each group. Whenever significant partial correlations were obtained for a variable in any of the groups, an ANCOVA was performed with years of formal education and/or age as control variables. Other variables were analyzed using t-tests.

The variables analyzed using ANCOVA, controlling for years of formal education, were: overall MMSE score; overall verbal fluency with letters F, A, and S; total hits on expression of anger; scores on the faux pas task (with gaffes, without gaffes, control questions, and overall score); total hits on recognition and emotional expression; overall score on the MINI-SEA; and the following scores on the Hayling Test: time in part A, time in part B, accuracy in part A, accuracy in part B, qualitative score in part B, and overall score. The variable age was controlled for only when analyzing our anxiety measure. Finally, t-tests were used to analyze the following variables: age, years of formal education, personal distress, empathic concern, fantasy, perspective taking, depression, and overall FAB score. Additionally, coefficients of variation for each group were calculated.

Pearson's correlation analyzes were performed to investigate associations between diagnostic variables (symptoms, time since diagnosis, age at first episode, and duration of treatment) and test performance. Finally, for the third objective, the sample was split into groups according to severity of depressive symptoms, as measured by the HADS. Kruskal-Wallis tests with Bonferroni's post hoc test were performed to compare performance on tasks of social-emotional cognition and executive functions. A 95% confidence level was adopted.

RESULTS

Results did not show any statistically significant differences between groups for age (t = -0.83; p = .41) or education (t = 0.22; p = .83). Regarding depressive and anxiety symptoms at the time of assessment, as measured by the HADS, the clinical group had a significantly higher mean score than the control group. Table 2 displays the results of this analysis.

Table 2 also shows some heterogeneity between participants' responses, as well as a small effect size for anxiety, and a large effect size for depression. To interpret effect sizes, the following cut-off values were adopted: insignificant (≤ 0.19), small (0.20–0.49), medium (0.50–0.79), and large (≥ 0.80; Cohen, 1988).

The HADS also provides a categorization of symptomatology into severity levels: normal (0-7), mild (8-10), moderate (11-14), and severe (15-21). Regarding anxiety in the clinical group, 18.20% of the participants were categorized as normal, 27.30% as mild, 36.40% as moderate and 18.20% as severe. In the control group, 95.20% were categorized as normal and 4.80% as mild. For depression in the clinical group, 22.70% of participants were categorized as normal; 27.30% as mild, 22.70% as moderate, and 27.30% as severe. In the control group, 85.70% were categorized as normal and 14.30% as mild.

In the clinical group, 15 of the 22 patients were able to report the time since diagnosis, which ranged from 11 to 396 months, with a mean of 85.20 months (SD = 102.88, median = 36). Eighteen patients reported a duration for their current treatment between one and 144 months (M = 31.39, median = 20, SD = 35.42) and 14 reported that the first episode occurred between 17 and 71 years of age (M = 41.57, median = 41.50, SD = 18.55). The majority found it considerably difficult to report the number of depressive episodes they experienced throughout their lives, stating that there had been several of them. For the six patients who were able to answer, the mean was 1.83 episodes (median = 1, SD = 1.33).

Table 2
Comparison of HADS mean scores between groups

HADS	CG M (SD)	CV (%)	MDD M (SD)	CV (%)	t/F	d/Eta	p
Anxiety	4.43 (2.34)	0.53	11.14 (4.95)	0.44	28.86	0.42	.001
Depression	3.76 (2.91)	0.77	10.95 (5.16)	0.47	5.66	-1.71	.001

Note: CG = control group; MDD = clinical group with major depressive disorder; CV = coefficient of variation; HADS = Hospital Anxiety and Depression Scale.

Comparison between groups in tasks of social-emotional cognition and executive functions

Participants in the MDD and control groups performed similarly on all measures of social-emotional cognition, except for the personal distress dimension of the IRI. Group differences between mean scores in the IRI and in the MINI-SEA are shown in Table 3.

Table 3 shows results obtained by t-tests and ANCOVAs, controlling for the effect of either age or years of formal education, as explained above. We see that coefficients of variation are higher for emotion recognition measures and that, despite a lack of statistical significance, there is a small effect size for some of them. Likewise, comparisons of performance on executive functions tests did not reveal any significant differences between the groups. Results for the Hayling Test and the verbal fluency task are presented in Table 4.

Table 4 shows higher coefficients of variation for most measures and small effect sizes for some scores in the Hayling Test. Finally, there were no differences in mean scores obtained in the FAB (t = -0.28; p = .78) between groups (MDD: M = 15.27; SD = 2.19; CV = 0.14. CG: M = 15.43; SD = 1.40; CV = 0.09).

Relationship between MDD characteristics and performance in tasks of social-emotional cognition and executive functions

Our second goal was to further investigate the performance of the clinical group using Pearson correlation analysis between diagnosis-related variables – time since diagnosis, age at first episode, and duration of treatment – and other variables of social-emotional cognition and executive functions. Results were not statistically significant.

Table 3
Comparison between mean scores on social-emotional cognition tests using t-tests or ANCOVA and coefficients of variation

Variables	CG M (SD)	CV (%)	MDD M (SD)	CV (%)	t/F	d/Eta	Observed power
IRI							
Personal distress	20.05 (3.92)	20	23.59 (5.01)	21	2.61*	0.79	-
Perspective taking	24.68 (3.98)	16	24.32 (3.70)	15	-0.31	0.10	-
Empathic concern	31.14 (3.99)	13	31.91 (4.57)	14	0.60	0.18	-
Fantasy	23.00 (5.32)	23	22.82 (7.12)	31	-0.10	0.03	-
Emotions							
Happiness	5 (0)	0	4.95 (0.21)	04	-1.00	0.33	-
Disgust	4.05 (0.95)	23	4.18 (1.05)	25	0.45	0.14	-
Surprise	4.05 (1.05)	26	4.36 (1.09)	25	0.99	0.29	-
Sadness	3.86 (1.08)	28	3.55 (1.26)	36	-0.90	0.27	-
Neutral	4.50 (0.86)	19	4.05 (1.21)	30	-1.43	0.43	-
Fear	2.09 (1.34)	64	2.14 (1.36)	63	0.13	0.00	.06
Anger	2.86 (1.39)	49	3.36 (1.26)	37	1.35	0.03	.21
Overall score in emotions	26.55 (3.71)	14	26.91 (4.15)	16	0.02	0.00	.05
MINI-SEA	23.91 (2.88)	12	23.27 (4.25)	18	0.96	0.02	.16
Emotion recognition	11.38 (1.59)	14	11.53 (1.78)	16	0.02	0.00	.05
Faux Pas	12.53 (2.21)	18	11.70 (2.76)	24	1.99	0.05	.28
Control questions	19.23 (1.34)	7	19.48 (0.98)	5	0.28	0.01	.08
Faux-pas stories	24.05 (5.53)	23	21.38 (7.15)	33	2.83	0.07	.38
Non-Faux-pas stories	9.36 (1.29)	14	9.81 (0.60)	6	1.78	0.04	.26

Note: CG = control group; MDD = clinical group with major depressive disorder; CV = coefficient of variation; IRI = *Interpersonal Reactivity Index*; MINI-SEA = *Social Cognition and Emotional Assessment*, abbreviated version.
*$p \leq .05$.

Table 4
Comparison between mean scores in the Hayling test and verbal fluency using ANCOVA, controlling for years of study

Variables	CG M (SD)	CV (%)	MDD M (SD)	CV (%)	F	ETA	Observed power
Hayling test							
Parte A – time	23.31 (12.67)	54	18.00 (7.21)	40	3.62	0.08	.46
Parte A – hits	14.38 (0.59)	4	14.55 (0.51)	4	1.07	0.03	.17
Parte B – time	64.69 (40.06)	62	62.68 (32.07)	51	0.08	0.00	.06
Parte B – hits	11 (3.18)	29	9.09 (3.84)	42	2.84	0.07	.38
Qualitative	8.95 (7.09)	79	13.45 (9.08)	67	2.96	0.07	.39
Overall score	41. 38 (38.98)	94	44.69 (30.66)	69	0.06	0.00	.06
Verbal fluency							
F	13.10 (4.85)	33	13.10 (4.86)	37	0.01	0.00	.05
A	11.95 (5.42)	52	12.20 (4.15)	34	0.00	0.00	.05
S	10.73 (4.03)	40	11.57 (3.41)	30	0.13	0.01	.06

Note: CG = control group; MDD = clinical group with major depressive disorder; CV = coefficient of variation.

Comparison between groups defined by severity of depressive symptoms in tasks of social-emotional cognition and executive functions

For our third goal, we split the sample into groups according to severity of depressive symptoms, as measured by the HADS. A little over half of the sample (53.50%) was categorized as normal, 20.90% as mild, 11.60% as moderate, and 14% as severe. Then, we tested for differences between these groups in performance on tasks of social-emotional cognition and executive functions. A Kruskal-Wallis test employing Bonferroni's post-hoc test showed that the group with severe symptoms took significantly longer to perform part A of the Hayling test, compared to the group categorized as normal ($\chi^2(3) = 8.56$, $p < .05$). Other comparisons were not statistically significant.

DISCUSSION

The goal of this study was to compare the performance of individuals with and without MDD on measures of social-emotional cognition and executive functions. We expected the clinical group to show significantly lower scores than the control group. In addition, we investigated whether social-emotional cognition and executive functions were related to clinical variables of MDD and whether there was a difference in performance between individuals with different levels of severity of symptoms.

Patients in our sample were diagnosed by psychiatrists with adequate training and experience, whereas the control group was recruited through careful screening. As expected, individuals with MDD reported more depressive and anxiety symptoms than controls. An examination of symptom severity levels revealed that a few patients did not report substantial depressive symptoms in HADS. Since all patients were undergoing pharmacological treatment at the time of evaluation, they were assumed to be in remission. In the control group, a few participants reported mild symptoms, but did not meet criteria for any mood or anxiety disorder as assessed by the MINI-PLUS.

Comparison between groups in tasks of social-emotional cognition and executive functions

We hypothesized that the MDD group would exhibit lower scores, compared to the control group, on measures of social-emotional cognition and executive functions. The results obtained partially corroborated this hypothesis. Patients scored higher on the personal distress dimension of the IRI, a result that has been reported in previous studies (Derntl et al., 2012; Domes, Spenthof, Radtke, Isaksson, Normann, & Heinrichs, 2016; Schreiter et al., 2013; O'Connor et al., 2002; Schneider et al., 2012; Thoma et al., 2011; Wilbertz et al., 2010). Additionally, a meta-analysis (Schreiter et al., 2013) showed a difference between groups with an effect size of 0.86, which can be considered large. In our study, we found a similarly large value, 0.79.

Personal distress consists in an analysis and search for relief in another person's misfortune from a self-centered perspective (Davis, 1980). Patients with MDD exhibit a cognitive attentional bias towards their own negative aspects

(Mor & Winquist, 2002), which may increase personal distress. Thus, when witnessing or listening to another person's suffering, individuals with MDD may tend to imagine themselves experiencing the situation, resulting in an affective response that is related to their own reactions/emotions to a greater degree than to the other person's emotional state (Schreiter et al., 2013). Other aspects of empathy did not differ between the groups investigated here, although other studies have reported low cognitive empathy (Schreiter et al., 2013) and deficits in empathic concern and perspective taking (Cusi et al., 2011).

Cognitive empathy is related to the concept of TOM, since the ability to infer and understand feelings and thoughts of others is essential for empathic processing (Schreiter et al., 2013). The present study also investigated TOM skills, specifically, perception of gaffes (faux pas) and recognition of emotional facial expressions, using the MINI-SEA. This battery has the benefit of providing an overall score that includes both tasks.

The MINI-SEA was developed to assist in differential diagnosis of the behavioral variant of frontotemporal dementia (Bertoux et al., 2012). Therefore, we did not expect MDD patients to exhibit low performance in the battery, or at least not as low as patients with frontotemporal dementia. However, studies on recognition of facial emotional expressions and TOM in MDD patients report divergent results. Some studies have shown significant differences between patients and healthy controls (Leppänen, Milders, Bell, Terriere, & Hietanen, 2004; Weightman, Air, & Baune, 2014), whereas others have not (Bediou et al., 2012; Gollan, McCloskey, Hoxha, & Coccaro, 2010; Gollan, Pane, McCloskey, & Coccaro, 2008; Matthews, Strigo, Simmons, Yang, & Paulus, 2008; Suslow et al., 2010). In our study, patients and controls showed similar performance on all MINI-SEA tasks, in line with Bertoux et al. (2012), who also employed this battery to evaluate MDD patients

For the Faux Pas task, some studies have reported differences between MDD patients and controls (Cusi et al., 2013; Wang et al., 2008), whereas here we observed that patients tended to perform worse in recognition of gaffes. It is possible that our small sample size influenced the results, but it should be mentioned that most studies employed similarly sizes samples.

A comparison between clinical groups evaluated in other studies reveals differences between them, such as disease duration, type of medication being used, presence of psychotic symptoms, age of onset of symptoms, among others. There is no homogeneous profile of MDD patient groups that shows poor performance on TOM tasks. Each study includes distinct control variables. Wang et al. (2008), for example, evaluated patients who experienced their first severe depressive episode, with and without psychotic symptoms, and without medication. Cusi et al. (2013), on the other hand, included only patients with mild MDD. Yamada, Inoue, and Kanba (2015) assessed individuals in remission. Our study investigated patients with multiple depressive episodes and who underwent pharmacological treatment. Considering that difficulties in TOM have multiple causes, including social isolation, history of trauma and abuse, low socioeconomic status, and problems related to attachment (Kanba, Yamada, & Inoue, 2010; Liotti & Prunetti, 2010), it is possible that these factors explain, at least partially, the conflicting results regarding patients with MDD.

Some stories used in the faux-pas task may also have contributed to bias the results reported here, even in the control group, as in the case of the story in which a customer mistakes another customer for the waiter. Some participants mentioned this happening quite often to them, and did not find such situations embarassing, or found them more embarrassing for the person mistaken for the waiter than for the person who made the mistake; others explained that some people might get angry in this situation, but that they did not. In another story, in which a man comforts his girlfriend for not getting the part she wanted, some individuals responded that he should have cheered her up, rather than remarking that she must be disappointed. Different views on the same stories may have contributed to a higher coefficient of variation, particularly for the stories used in recognition of faux pas. It is possible that adapting these stories to Brazilian cultural standards will improve the task.

Regarding recognition of emotional facial expressions, a meta-analysis concluded that patients with MDD have impairments in recognition of all basic emotions (anger, disgust, fear, joy, and surprise) except for sadness (Dalili, Penton-Voak, Harmer, & Munafo, 2015). Since the effect size found was small, the authors noted that a sample of approximately 615 cases and 615 controls would be needed to detect it, considering 80% statistical power at an alpha of .05. On average, the studies included in the meta-analysis used samples of 21 patients and 25 controls.

Social-emotional skills in general, and empathy in particular, appear to depend on preserved executive control, more specifically on cognitive flexibility and inhibition. (Thoma et al., 2011), both of which were also assessed in this study. Although most studies indicated that cognitive deficits in MDD occur regardless of age, test difficulty, motivation, symptom severity, depression subtype, and response bias (Austin, Mitchell, & Goodwin, 2001), the hypothesis of a difference in performance on tasks of executive functions was not corroborated by our results.

There is a consensus that executive functions are a multidimensional construct. Thus, patients with MDD may have difficulties in some, but not all subcomponents of executive functions (Knight & Baune, 2018). The instruments used in this study assessed inhibitory control, cognitive flexibility, and phonemic verbal fluency. These

subcomponents were also investigated in other studies that did not report significant differences between MDD patients and healthy controls. For example, Thoma et al. (2011) observed similar performance for both groups on measures of cognitive flexibility, response inhibition, and working memory; Wagner et al. (2018) reported similar results using the Trail Making Test and tasks of phonemic and semantic verbal fluency, as did Aker et al. (2014) using tasks of hot and cold executive functions.

Aker et al. (2014) highlighted that most previous studies included samples with highly impaired patients, either with severe comorbidities, alcohol or drug abuse, somatic problems, or low levels of formal educational. The sample studied by Aker et al. (2014), on the other hand, had low comorbidity, no substance abuse, high levels of formal education or high intelligence quotient and no use of psychotropic medication (excluded from the analysis of executive functions). The points raised by Aker et al. may also be relevant for our study, since patients did not report issues related to use of alcohol or other drugs; their average level of formal education was 13.73 years; and none had severe comorbidities.

Another explanation for the lack of performance differences on tasks of executive functions and social-emotional cognition might be that the instruments used here were not sensitive enough to detect the deficits in the clinical group. Indeed, the conflicting results reported by other studies might be explained by: differences between the instruments employed, some of which may be more sensitive to impairments in MDD than others; differences in methods; or differences in scores or versions of the same test used. Furthermore, the clinical groups in those studies showed a wide range of clinical and demographic characteristics (Snyder, 2013).

We argue, however, that this is less likely, since tasks such as the Hayling Test and the phonemic verbal fluency used here are able to detect performance differences in other samples of MDD patients. Similarly, recognition of emotional facial expression using images from Ekman and Friesen's Pictures of Facial Affect and faux pas tasks have also detected differences in some studies (Cusi et al., 2013; Leppänen et al., 2004; Wang et al., 2008; Weightman et al., 2014), though not in others (Bertoux et al., 2012; Gollan et al., 2010, 2008; Matthews et al., 2008; Suslow et al., 2010). Thus, it is plausible that other characteristics of the participants or their clinical condition, rather than the tests, are responsible for the discrepancy between the results of different studies. In this regard, it is worth noting how heterogeneous the performance of each group was on most tasks, as indicated by the coefficients of variation.

Relationships between MDD and performance in social-emotional cognition and executive functions tasks

The literature on MDD lists some variables that are related to more severe cognitive symptoms, such as recurrent episodes, late onset of the disorder, and presence of melancholic or psychotic symptoms (Bora, Harrison, Yücel, & Pantelis, 2013). However, our correlation analyses indicated that time since diagnosis, age at first episode and duration of treatment had no relationship with the performance of this clinical group in tests of social-emotional cognition and executive functions. We were interested in relating the number of depressive episodes to the tasks, but the vast majority of participants were unable to inform the number of episodes they experienced, instead stating that there had been several of them.

Comparison between groups defined by severity of depressive symptoms in social-emotional cognition and executive functions tasks

The hypothesis that individuals with more severe depressive symptoms would show worse performance was partially corroborated. Although no significant differences were found between MDD patients and controls in most measures, when the whole sample was split by levels of depressive symptom severity, a difference was detected. Patients with severe symptoms took longer to perform part A of the Hayling test, compared to symptom-free individuals (i.e., those in the "normal" category), which indicates reduced processing speed. This result is in line with a previous study showing that depressive patients had lower processing speed than healthy controls, while patients in remission did not (Zaremba et al., 2019). It has also been reported that patients with greater severity of depressive symptoms had larger deficits in TOM tasks (Bora & Berk, 2016), but such a difference was not found in our sample.

Even in sublinical MDD patients or those in remission, cognitive (Darcet, Gardier, Gaillard, David, & Guilloux, 2016; Zuckerman et al., 2018) and social-cognitive (Kessler, Zhao, Blazer, & Swartz, 1997) impairments occur. It is important to evaluate clinical samples with distinct levels of depressive symptomatology (Schreiter, Pijnenborg, & Aan Het Rot, 2013), event though the current study did not support such findings.

CONCLUSION

MDD is a diagnosis with heterogeneous manifestations (Darcet et al., 2016) and this may partly explain the conflicting results reported in the literature (Bediou et al., 2012). Studies with this population generally report this heterogeneity as a limitation; however, this might actually be a characteristic instrinsic to the disorder and responsible for its complexity. In this study, we measured that heterogeneity using standard deviation measures, clinical information, and coefficients of variation. Although there is a growing tendency to carry out studies with more homogeneous groups, recruiting such samples is in practice rather complex. For this reason, most researchers try to report the characteristics of their samples in detail.

In the sample assessed here, MDD did not influence performance on tasks of recognition of emotional facial expressions, faux pas, phonemic verbal fluency, and the Hayling Test. The high score we found for the personal distress dimension seems to be a robust result, with an effect size of 0.79.

In specific cases, empathy is disrupted by impaired emotional self-regulation and may become an aversive experience in the absence of accurate cognitive processing of the perception of other persons' situation (Decety & Jackson, 2004). Studies on social-emotional cognition in MDD may wish to focus on aspects related to emotional regulation, self-focus, and rumination. Patients with MDD exhibit a maladaptive tendency to focus on negative aspects of a situation (Boyraz & Waits, 2015), which increases rumination (APA, 2014) and significantly interferes with patients' interpersonal relationships and their interpretations of social situations.

Limitations of this study include sample size, which, although similar to that of similar studies, is nevertheless small; intragroup heterogeneity in terms of age range and years of formal education; and use of the MINI-SEA, which is still being validated in Brazil. Some individuals in the control group took medications, which can be considered a limitation. However, none did so to treat psychiatric disorders, as informed by participants and their results in the MINI-PLUS.

Additionally, measures of functionality may provide useful information to interpret results, since many patients do not achieve functional recovery even after mood improvement (Millan et al., 2012 Fiorillo et al., 2018; Hammer-Helmich et al., 2018; Hammer-Helmich et al. al., 2018; Zuckerman, et al., 2018). Intelligence quotient (IQ) measures were not obtained either, but the cognitive screening tool employed here, MMSE, has been widely employed, including by the publications discussed in the current study.

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