

Recognition of dynamic and static facial expressions of emotion among older adults with major depression

Reconhecimento de expressões faciais estáticas e dinâmicas das emoções em idosos com depressão maior

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Abstract

Introduction: The recognition of facial expressions of emotion is essential to living in society. However, individuals with major depression tend to interpret information considered imprecise in a negative light, which can exert a direct effect on their capacity to decode social stimuli.

Objective: To compare basic facial expression recognition skills during tasks with static and dynamic stimuli in older adults with and without major depression.

Methods: Older adults were selected through a screening process for psychiatric disorders at a primary care service. Psychiatric evaluations were performed using criteria from the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5). Twenty-three adults with a diagnosis of depression and 23 older adults without a psychiatric diagnosis were asked to perform two facial emotion recognition tasks using static and dynamic stimuli.

Results: Individuals with major depression demonstrated greater accuracy in recognizing sadness ($p=0.023$) and anger ($p=0.024$) during the task with static stimuli and less accuracy in recognizing happiness during the task with dynamic stimuli ($p=0.020$). The impairment was mainly related to the recognition of emotions of lower intensity.

Conclusions: The performance of older adults with depression in facial expression recognition tasks with static and dynamic stimuli differs from that of older adults without depression, with greater accuracy regarding negative emotions (sadness and anger) and lower accuracy regarding the recognition of happiness.

Keywords: Aging, mood disorders, emotion, social cognition.

Resumo

Introdução: O reconhecimento de expressões faciais das emoções é essencial para a convivência em sociedade. Entretanto, indivíduos com depressão maior apresentam uma tendência a interpretar de forma negativa informações consideradas imprecisas, o que pode afetar diretamente sua capacidade de decodificação de estímulos sociais.

Objetivo: Comparar a habilidade de reconhecimento de expressões faciais das emoções básicas em tarefas com estímulos estáticos e dinâmicos em idosos com e sem depressão maior.

Métodos: Os idosos foram selecionados a partir de um rastreamento de transtornos psiquiátricos na atenção básica, realizada por meio de avaliação psiquiátrica de acordo com os critérios da 5ª edição do Manual Diagnóstico e Estatístico de Transtornos Mentais (DSM-5). Vinte e três idosos com diagnóstico de depressão e um grupo de 23 idosos sem diagnóstico psiquiátrico atual foram convidados a realizar duas tarefas de reconhecimento de emoções faciais, utilizando estímulos estáticos e dinâmicos.

Resultados: Os idosos com depressão maior apresentaram maior acurácia no reconhecimento da emoção tristeza ($p=0,023$) e da emoção raiva ($p=0,024$) na tarefa com estímulos estáticos, e menor acurácia para a emoção alegria na tarefa com estímulos dinâmicos ($p=0,020$). O prejuízo está relacionado principalmente ao reconhecimento de emoções de menores intensidades.

Conclusões: O desempenho de idosos com depressão maior em tarefas com estímulos estáticos e dinâmicos é diferente quando comparados com idosos sem depressão. A acurácia de emoções negativas (tristeza e raiva) é maior, enquanto que a acurácia para alegria é menor.

Descritores: Envelhecimento, transtornos de humor, emoção, cognição social.

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Introduction

Major depression can affect up to 7% of the population of older adults.¹ This chronic, recurring condition is associated with functional incapacity and a reduction in quality of life.² Depression often leads to social isolation due to difficulties in maintaining social interactions.³

Basic emotions are involuntary physiological responses that are universally shared by our species, visually distinguishable and pre-established by stimuli that have influenced our evolution and can also be molded by life experiences.⁴ Most studies establish emotions like happiness, sadness, anger, disgust, surprise and fear as basic or primary, however the conceptualization of basic emotion as well as which emotions would be part of this set are still much debated and controversial.⁵

The recognition of facial expressions of basic emotions is an extremely important skill in society, as it is related to the capacity to interpret the feelings and emotions of others. Facial emotion recognition is associated with emotional regulation, enabling individuals to use emotions adaptively.⁵ However, the decoding of these stimuli may be altered in individuals with depression, who tend to interpret information considered imprecise in a negative light, which can affect their capacity to decode some social stimuli.^{6,7}

A recent meta-analysis has found that individuals with depression have impaired facial expression recognition for all basic emotions, except sadness.⁸ Moreover, such individuals seem to exhibit an increase in vigilance and selective attention for faces with sad expressions compared to other emotions.⁹ However, a limitation that should be considered in studies involving facial expression recognition regards the use of different tasks and procedures employed in investigations addressing depression⁹ and other mental disorders,¹⁰ which can lead to divergent results. An important methodological difference among studies is the use of static vs. dynamic stimuli, as the use of these different types of stimuli may be related to greater accuracy and shorter reaction time for reading facial expressions of emotion.¹¹

Among studies involving older adults, Mah & Pollock¹² found a correlation between depressive symptoms and impairment in the perception of faces with a neutral expression. Orgeta¹³ evaluated older adults with mild depressive symptoms and found a reduction in accuracy regarding the recognition of expressions of fear and anger. Another recent study demonstrated that the recognition of happiness was similar between older adults with current depression and those with a

previous episode in remission.¹⁴ All tasks used in those studies with older adults involved static stimuli.

The aim of the present study was to compare the ability to recognize basic facial emotions in older adults with and without major unipolar depression using static and dynamic stimuli.

Method

Participants

Participants were selected from a screening study for psychiatric disorders within the area of coverage of a primary care service in a municipality in the state of São Paulo, Brazil, in which 267 older adults (aged 60 years or older) were evaluated. Of that initial sample, 28 individuals had a diagnosis of major depression and were therefore asked to participate in the present investigation, five of whom declined, resulting in a final sample of 23 participants. A convenience sample composed of 23 older adults without a diagnosis of psychiatric disorder was then selected to comprise the control group, which was matched for age, sex, and schooling. Close neighbors to the participants in the group with depression were preferably selected for the control group. Figure 1 displays the flowchart of the selection process.

In the group of 23 older adults with depression, only three made use of antidepressants (nortriptyline [5 mg/day], paroxetine [10 mg/day] and fluoxetine [40 mg/day]). In this group, 14 patients had no other psychiatric disorder, whereas nine had comorbid anxiety disorders, such as generalized anxiety (n=7), a specific phobia (n=4) or social anxiety disorder (n=2). In the control group, no individuals had a diagnosis of a psychiatric disorder or made use of psychotropic medication.

Differences in the number of participants who performed the tasks within each group were due to the fact that some older adults did not complete all tasks. Individuals with severe vision or hearing impairment that could hinder their comprehension during the interview and tests and those with severe clinical comorbidity, major neurocognitive disorder or psychotic disorder were excluded from the study.

Measures

Patient Health Questionnaire-2 (PHQ-2)

The PHQ-2 is used to screen and quantify depression and is composed of two items referring to the previous two weeks.¹⁵ Response options range from 0 (not at all) to 3 (nearly every day) for each item. The total score is determined from the sum of the points and may range from 0 to 6. The PHQ-2 has been validated for the Brazilian population.^{16,17}

Mini Mental State Examination (MMSE)

The MMSE is the test most widely employed to screen for cognitive decline. It has the following domains: recall (registration and evocation), temporal and spatial orientation, attention and calculation, language (naming, repetition, reading and writing, comprehension and praxis) and visuoconstructive capacity. The total MMSE score may range from 0 to 30, and the cutoff point depends on the individual's level of schooling, regardless of age, with lower scores denoting greater cognitive decline.¹⁸

Task with dynamic stimuli

The emotion recognition task normalized by Kessels et al.¹⁹ was used for the facial emotion recognition test. On this task, basic emotions (happiness, sadness, disgust, anger, fear and surprise) are evaluated in a dynamic fashion. Each individual is presented short videos with faces of male and female actors going from neutral to a basic emotion, the intensity of which could be 40, 60, 80 or 100%. The number of frames in each video clip varies according to the intensity of the emotion: 0-40% (eight frames), 0-60% (12 frames), 0-80% (16 frames) and 0-100% (20 frames). Likewise, the duration of each video ranges from one

second (0-40%) to three seconds (0-100%). In this experiment, 99 video clips were presented, the first three of which were used for training only. The total score may range from 0 to 96. The score for each emotion may range from 0 to 16 and for each intensity from 0 to 24. The maximum estimated duration of the test is 20 minutes.¹⁹

Task with static stimuli

The Penn Emotion Recognition Test comprises 96 color photographs of facial expressions of basic emotions (happiness, sadness, anger, fear and disgust), as well as faces showing no emotion (neutral) in static stimulus.¹⁹ Sixteen photographs of each expression were presented: eight demonstrated the emotion with low intensity and eight with high intensity. The participants were asked to choose the emotional valence of each expression. No restrictions were imposed with regard to the response time. As soon as one response was given, the next image was presented. The total score was recorded, along with the subscores of each expression, number of correct responses per intensity and response time. The total score of the Penn Emotion Recognition Test may range from 0 to 96. The score for each emotion may range from 0 to 16 and for each intensity from 0 to 48.²⁰

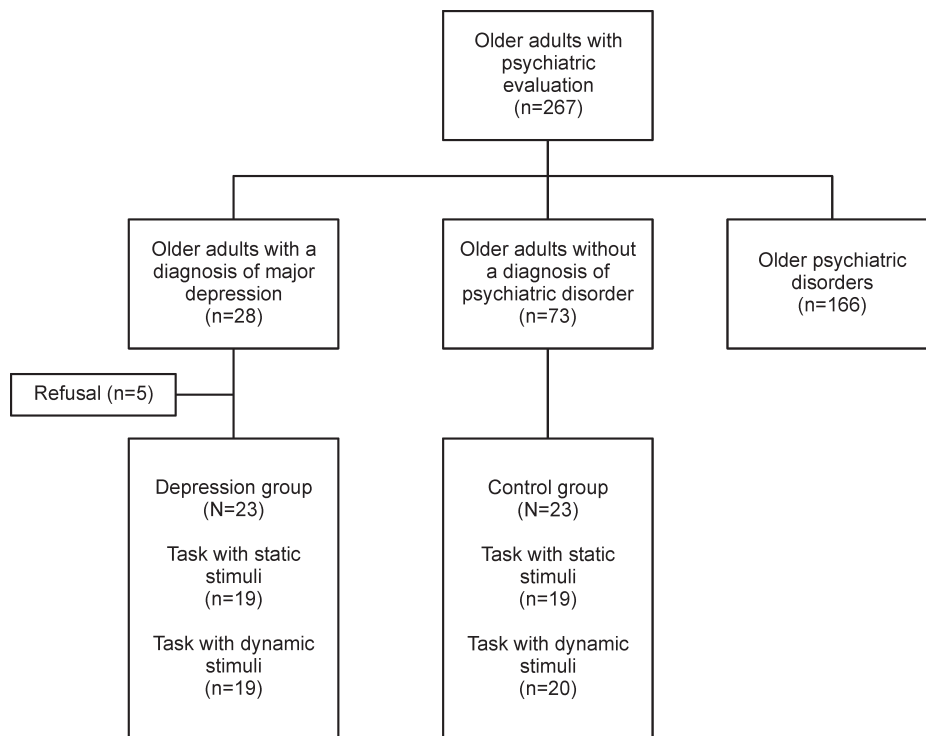


Figure 1 - Flowchart of the selection process

Procedures

All participants were first evaluated through a detailed clinical interview conducted by a psychiatrist based on diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), published by the American Psychiatric Association,²¹ which offers a structure for the diagnostic investigation and screening questions for different mental disorders.²²

In a second stage, participants were evaluated within a maximum of 30 days using the PHQ-2, MMSE, and the tasks with static and dynamic stimuli of facial expressions of emotions. Some participants needed more time and required two sessions to complete this stage. Therefore, some older adults refused to continue with the facial emotion recognition tasks. Facial expression recognition tasks were performed on a computer with a 13-inch screen (Dell®, model 7348, Eldorado do Sul, Brazil).

All volunteers agreed to participate by signing a statement of informed consent. The study protocol was approved by the human research ethics committee of Universidade Federal de São Carlos (protocol 51376515.7.0000.5504).

Data analysis

Descriptive analysis was performed to characterize the social-demographic profile of the groups. The Shapiro-Wilk test was used to determine the normality of the data. Differences in the response pattern between the groups were determined using the chi-square test. Either the Student's *t*-test or the Kolmogorov-Smirnov *Z* test was used to determine differences between groups regarding the number of correct responses, emotion intensity and reaction time, depending on the distribution of the data. Cohen's *d* effect sizes were used to estimate differences between groups and were defined as the difference between the mean obtained in the depression and control groups divided by a standard deviation of the full sample. The statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) version 23.0. The level of significance was set to 5% ($p < 0.05$).

Results

The clinical-demographic data of the two groups are displayed in Table 1. No significant differences were found regarding age ($p = 0.649$), sex ($p = 1.000$), schooling ($p = 1.000$) or cognitive status based on the MMSE ($p = 0.275$). In contrast, a statistically significant difference was found between the groups regarding the PHQ-2 score ($p < 0.001$), with a higher mean score found in the group with depression compared to the control group.

Regarding the number of correct responses per emotion on the task with dynamic stimuli, a significant difference between the groups was found for the recognition of happiness ($p = 0.020$), with a higher mean number of correct answers in the control group compared to the group with depression. No other significant differences between the groups were found in the number of correct responses per intensity or at total in the same task (Table 2).

Regarding the number of correct responses per emotion on the task with static stimuli, statistically significant differences between the groups were found for the recognition of sadness ($p = 0.023$) and anger ($p = 0.024$), with higher means of correct answers in the group with depression compared to the control group (Table 3).

On the task with dynamic stimuli, the individuals in both groups had difficulty discriminating fear and happiness from surprise. The chi-square test demonstrated differences in the response pattern given by the two groups on the dynamic task ($\chi^2 = 25.81$; $p < 0.001$). The control group mistook surprise for happiness in 57.5% of the trials (Figure 2).

On the task with static stimuli, both groups had difficulty discriminating negative emotions, such as disgust, sadness and anger. The control group also demonstrated difficulty discriminating anger from fear and from neutral expressions. The response pattern also differed significantly between the groups on the static task ($\chi^2 = 22.89$; $p < 0.001$) (Figure 3).

Table 1 - Clinical and demographic characteristics of the groups

	Depression group	Control group	<i>t</i> or <i>Z</i>	<i>p</i>
Sex, n male/n female	8/15	8/15	-	1.000
Age (years)	70.30 (± 9.76)	69.13 (± 7.54)	$Z = 0.737$	0.649
Schooling (years)	3.09 (± 3.17)	2.70 (± 2.09)	$Z = 0.295$	1.000
MMSE	23.95 (± 3.84)	22.78 (± 3.34)	$t_{44} = 1.105$	0.275
PHQ-2	4.21 (± 2.04)	0.91 (± 1.38)	$Z = 2.064$	< 0.001

Data presented as mean (\pm standard deviation), unless otherwise specified. MMSE = Mini Mental State Examination; PHQ-2 = Patient Health Questionnaire-2.

Discussion

The present results indicate greater accuracy among older adults with major depression in recognizing sadness and anger on the task with static stimuli and less accuracy in recognizing happiness on the task with dynamic stimuli compared to the control group without depression. Moreover, differences in response bias were found between the two groups. The data indicate differences in the recognition pattern depending on the task performed.

The major difficulty found in generalizing the results of comparative studies on the recognition of facial expressions of emotion is the lack of standardization in the tasks and procedures employed. The stimuli

used in facial expression recognition tasks constitute an important aspect to explore. Dynamic and static facial expressions of emotions evoke distinct emotion processing neural networks.^{11,23} The processing of dynamic facial expressions of emotions seems to recruit the neural networks responsible for this process more reliably, such as the amygdala, fusiform gyrus and inferior occipital lobe.²⁴

Dynamic facial expressions are more associated with the social context. Therefore, the use of tasks with dynamic stimuli assists in the understanding of the mechanisms involved in the recognition of expressions¹¹ and could contribute to quicker, more precise identification. Moreover, the use of such tasks enhances recognition, as the presentation of the stimuli consists

Table 2 - Number of correct responses per emotion, per intensity and total on the task with dynamic stimuli

	Depression group	Control group	t or Z	p	Cohen's d
Emotion					
Happiness	13.00 (±2.78)	14.95 (±1.23)	Z=1.520	0.020*	-0.840
Sadness	5.84 (±4.41)	7.40 (±4.48)	Z=0.674	0.755	-0.349
Anger	11.10 (±2.02)	11.85 (±3.49)	Z=0.904	0.388	-0.262
Disgust	10.73 (±2.51)	10.60 (±3.28)	Z=0.468	0.981	0.044
Fear	6.47 (±3.07)	6.85 (±4.45)	t ₃₇ =0.305	0.762	-0.100
Surprise	6.31 (±2.60)	4.90 (±2.93)	t ₃₇ =1.590	0.120	0.498
Intensity					
40%	10.00 (±3.48)	12.65 (±4.61)	t ₃₇ =2.017	0.051	-0.622
60%	13.15 (±3.18)	14.25 (±3.79)	t ₃₇ =0.971	0.338	-0.314
80%	14.52 (±3.38)	14.50 (±3.05)	Z=0.559	0.914	0.006
100%	15.79 (±2.07)	15.15 (±2.70)	t ₃₇ =0.827	0.414	0.266
Total	53.47 (±9.92)	56.55 (±12.58)	t ₃₇ =0.845	0.404	-0.272

Data presented as mean (± standard deviation).

* Statistically significant result.

Table 3 - Number of correct responses per emotion, per intensity and total on the task with static stimuli

	Depression group	Control group	t or Z	p	Cohen's d
Emotion					
Happiness	14.05 (±3.20)	14.31 (±2.05)	Z=0.487	0.972	-0.098
Sadness	8.94 (±2.99)	6.84 (±2.45)	t ₃₆ =2.372	0.023*	0.724
Anger	6.68 (±2.72)	4.52 (±2.89)	t ₃₆ =2.365	0.024*	0.724
Disgust	4.31 (±2.33)	5.47 (±2.58)	t ₃₆ =1.447	0.156	-0.464
Fear	9.73 (±3.28)	9.10 (±3.75)	Z=0.811	0.526	0.180
Neutral	9.89 (±4.17)	10.21 (±4.19)	t ₃₆ =0.232	0.817	-0.077
Intensity					
Low	24.42 (±5.33)	22.94 (±6.18)	t ₃₆ =0.786	0.437	0.257
High	29.47 (±4.61)	27.68 (±6.72)	t ₃₆ =0.957	0.348	0.309
Total	53.63 (±9.03)	50.47 (±12.24)	t ₃₆ =0.904	0.372	0.294

Data presented as mean (± standard deviation).

* Statistically significant result.

of the progression from a neutral facial expression to the complete apex of an emotion²⁵; consequently, one's attention is directed to the changes in the facial expression, facilitating perception.¹⁰

However, Bould & Morris²⁶ found that the advantage of dynamic stimuli is lower for facial expressions of greater intensity, as more intense static expressions have strong emotional signals.²⁷ In the present study, no statistically significant differences were found between groups regarding the number of correct responses per intensity.

In the task with dynamic stimuli, the individuals with depression demonstrated less accuracy in recognizing happiness compared to the healthy controls. Zwick & Wolkeinstein²⁸ also found that individuals with depression had more difficulty recognizing the facial expression of happiness using the same dynamic task. Likewise, Shiroma et al.¹⁴ found that the recognition of happiness was similar between older adults with current depression and those with a past episode currently in remission, but the individuals with depression demonstrated less sensitivity to the emotion

of happiness compared to a control group. This less accurate recognition of happiness among individuals with depression may represent a vulnerability factor and contribute to the exacerbation or maintenance of depressive episodes,^{29,30} which is extremely worrisome in older adults, considering the greater severity of depression in this age group.³¹

In a meta-analysis, Dalili et al.⁸ found that accurate recognition is impaired among individuals with depression for all emotions, except sadness, but these findings depend on the methodological aspects of each study. On the two tasks used in the present investigation, the recognition of sadness was not impaired and the individuals with depression even demonstrated greater accuracy in recognizing this emotion during the static task. These individuals also demonstrated greater accuracy in recognizing anger during the static task, indicating greater recognition of emotions with a negative valence.

Studying perception in facial emotion recognition, Liu et al.³² found that individuals with depression exhibit

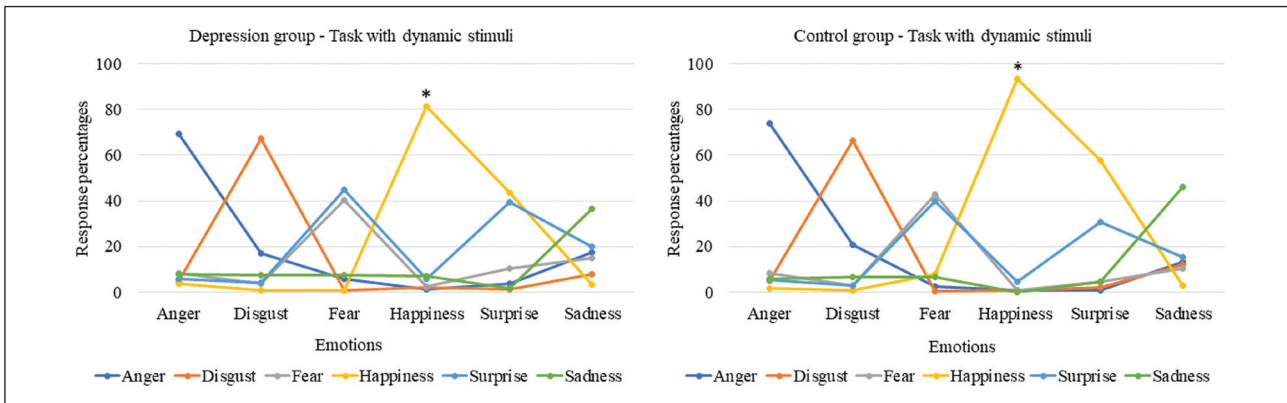


Figure 2 - Response percentages for each emotion in the task with dynamic stimuli

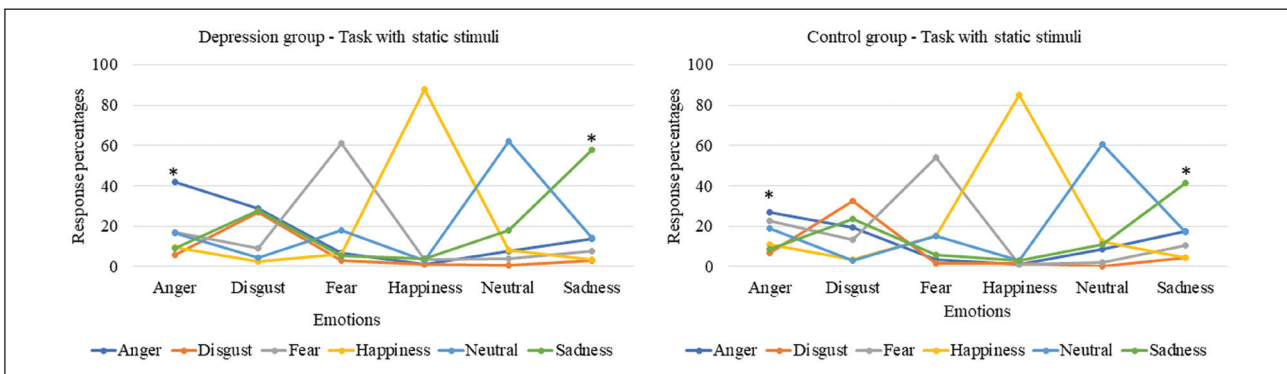


Figure 3 - Response percentages for each emotion in the task with static stimuli

a perceptual bias toward unpleasant emotions, such as sadness and anger. Wright et al.³³ found that women with depression were more likely to choose anger incorrectly compared to women without depression. In contrast, Orgeta et al.¹³ found a reduction in accuracy regarding the recognition of the facial expression of anger among older adults with depression. These divergences in the findings may be attributed to the different types of tasks employed, the age group of the populations and the use of antidepressants.

The response bias results point to an interesting finding during the task with dynamic stimuli. Surprise was mistaken for happiness a greater number of times in the control group compared to the group with depression. Some studies report difficulty in discriminating surprise from fear and happiness.^{34,35} This seems to be an important aspect of facial expression recognition tasks, as characteristics of emotions that can be considered in an ambiguous manner could help better discriminate between different study groups.³⁶

Problems among individuals with major depression in recognizing facial expressions of emotion are associated with dysfunctions in the limbic system, paralimbic cortex and prefrontal areas of the brain, which are associated with altered functioning in emotional processing.³⁷ Some authors propose that antidepressants normalize the processing of emotions and constitute an initial step toward the treatment of depression.^{38,39} Other characteristics of depression, such as slower cognitive processing and difficulty making decisions, which are often found in older adults, are also associated with a worse performance in the recognition of facial expressions of emotion.⁴⁰ Therefore, individuals with major depression are expected to have a longer response time compared to individuals without depression. However, no significant differences in reaction time were found between the two groups in the present investigation.

This study has some limitations that should be considered. The low level of schooling among the participants renders the generalization of the results impossible. Moreover, the older adults' inability to handle digital equipment made the self-administration of the facial expression recognition tasks impossible, which may have exerted an influence on reaction time. Regarding the measures employed, the lack of a more reliable measure for quantifying depression may be considered a weakness of this study, as the PHQ-2 is a brief assessment tool. Also, despite using standardized images, the facial emotion recognition tasks have not been adapted to the Brazilian culture. The sample size may be considered another limitation, but we invited all individuals with a diagnosis of major depression

in the area of coverage of the study and the sample was similar to that found in other studies involving older adults with depression.¹¹⁻¹³ Finally, the presence of individuals with comorbid anxiety disorders in the group with depression may have exerted an influence on the results.

In contrast, despite evidence of the relationship between one's performance on facial emotion recognition tasks and depression, few studies have evaluated this relationship in older adults.¹¹⁻¹³ Moreover, all studies on facial emotion recognition in older adults with depression published to date have used tasks with static stimuli only. Therefore, this study is the first to use tasks with dynamic stimuli to evaluate facial emotion recognition in older adults with depression, and the findings may have implications for clinical practice, as the ability of facial emotion recognition is a possible predictor of response to antidepressants in older adults with depression.³⁷ Further studies should be conducted to evaluate the influence of facial emotion recognition training on depressive symptoms in older adults.

Conclusions

Major depression in older adults may be related to the performance of these individuals on facial emotion recognition tasks, with differences depending on the task and stimuli used. In general, older adults with depression seem to recognize the emotions of sadness and anger with more and of happiness with less accuracy. Emotion variables, response bias, type of stimuli (static or dynamic) and emotion intensity may exert an influence on the results and should, therefore, be considered.

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Disclosure

No conflicts of interest declared concerning the publication of this article.

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