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ORIGINAL ARTICLE

The positive impact of an intervention for maternal depression on child emotional and behavioral symptoms in a low-resource setting

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Objectives: Children of depressed mothers are at risk of developing mental health problems. We sought to determine whether treatment for maternal depression by community-based health workers would decrease behavioral/emotional symptoms in their children. Interventions for maternal depressive symptoms in a low/middle-income country can have a high global impact.
Methods: Community-based health workers were trained to deliver a psychosocial intervention for mothers with depression in a primary care setting. A total of 49 mothers and 60 children were assessed pre-intervention, post-intervention, and at 6 months follow-up. Child behavioral/emotional symptoms were evaluated according to type of change in maternal depressive symptoms: response or remission.
Results: An overall decrease in maternal depressive symptoms from baseline to post-intervention and 6 months follow-up were found. Response or remission was associated with better outcomes in child behavioral/emotional symptoms at 6 months follow-up ($p = 0.0247$, Cohen's d: 0.76; $p = 0.0224$, Cohen's f: 0.44) but not at post-intervention ($p = 0.1636$, Cohen's d: 0.48; $p = 0.0720$, Cohen's f: 0.33).
Conclusions: Improvement in maternal depression was related to decreased behavioral/emotional symptoms in their children. Our results suggest that providing interventions for maternal depression in primary care is a viable strategy to prevent behavioral/emotional symptoms in the next generation.
Clinical Trial registration: Brazilian Clinical Trials, number RBR-5qhmb5.

Keywords: Depressive disorder; mother; child; mental health; developing countries

Introduction

Depression in women of child-bearing age is highly prevalent in both low/middle-income countries (LMIC) and high-income countries.[1-3] A mother's depression can interfere with parent-child bonding, which is critical for healthy child development and can prevent mothers from establishing nurturing, consistent, and empathic relationships with their children.

Maternal depressive symptoms are among the most well-replicated risk factors for child development. Studies in LMIC have shown strong associations between maternal depressive symptoms and child psychopathology,[4-6] as well as infant undernutrition,[7-9] low birth weight,[7] impaired infant cognitive and motor development,[10] disrupted emotion regulation,[11] and child mortality.[12]

According to one longitudinal study,[13] psychiatric disorders in the children of depressed mothers may vary by age, with disruptive behavior and anxiety disorders commonly occurring in school-age children, depression in adolescents, and substance abuse in young adults. Problems often begin before puberty and persist into adulthood. The morbidity can last for an extended period, impairing social and occupational functioning and increasing the risk of medical problems.[14] Evidence also suggests that there is an earlier onset of depressive disorder in the children of depressed parents, and this effect might be transmissible to the next generation.[13]

Importantly, studies have also found that successfully treating depressed mothers (whether with psychological therapy or medication) has a positive effect on their children's mental health.[15-24] A meta-analysis[6] about the

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impact of psychological treatment for depressed mothers on their children found that a decrease in maternal depression levels reduced their children's psychiatric symptoms. A significant limitation of this meta-analysis was that none of the studies included families from LMIC. The small number of studies conducted in LMIC is a large research gap, since LMICs represent more than 80% of the global population but have less than 20% of its mental health resources.[25]

Maternal depression in LMIC is a public health concern. Access to care is an essential issue since any intervention used to improve maternal mental health must be integrated into existing services, preferably in primary care settings to more effectively reach populations in need. A trial[26] found that trained community-based health workers (CHWs) and facility-based primary health care workers could efficiently deliver specific maternal mental health care components in a LMIC setting.[27] In Brazil, where community-based health programs are widely available to low-income mothers,[28] relying on CHWs appears to be the most feasible way to improve coverage and reduce the mental health treatment gap.

According to the World Health Organization's Mental Health Gap Action Program guidelines for treating depression in primary healthcare settings in LMIC,[29] psychosocial approaches, such as brief structured psychological therapies are viable methods for enhancing both the mental health of women in LMIC and public health.[30] Among such interventions, interpersonal psychotherapy (IPT)[31] has been used in these populations and has shown promise. Evidence indicates that women prefer psychotherapy over psychopharmacology to treat mental disorders.[32]

The present study is part of a randomized clinical trial (RCT) to evaluate the efficacy of interpersonal counseling (IPC), an evidence-based intervention[33,34] to treat depression utilizing a task-shifting approach,[35] in which IPC was provided by lay professionals (CHWs) trained to treat depressive symptoms in primary care.[36] In this RCT, 86 patients (94.2% women or n=81) diagnosed with current major depressive disorder (MDD) or dysthymia (according to DSM-IV criteria) who were recruited from a Family Health Strategy (Estratégia Saúde da Família) clinic were randomized to IPC (n=43) or enhanced treatment as usual (E-TAU) (n=43). E-TAU facilitated patient referral to specialized mental health care within the public health system. In this RCT, although the groups did not differ in the intention to treat analysis, the per-protocol analysis showed significantly better outcomes (lower Hamilton Rating Scale for Depression [HRSD-17] scores) in the IPC group than the E-TAU group.[37] Intention-to-treat analysis showed significant improvement in symptoms over 2 months with no significant differences between groups.

Rather than comparing interventions, our study assessed the effects of treating maternal depression in a primary care setting on children's emotional and behavioral health. Few studies have been conducted on this topic in LMIC settings. To fill this gap, we built on the RCT described above, restricting the sample to mothers (or grandmothers) responsible for child care and support, focusing on the child's emotional and behavioral symptomatology before and after the maternal depression intervention. We hypothesized that remission of depression or substantial symptom reduction following intervention among depressed mothers would improve their children's emotional and behavioral symptoms.

Methods

The sample for present study was derived from the above-described RCT conducted in a Brazilian primary care setting in São Paulo, Brazil (Unidade Básica de Saúde Iaçapé in the district of Sapopemba). This RCT sought to treat depressive disorders and evaluate whether IPC and E-TAU would be effective interventions in a primary care setting. The detailed methodology and the results for this RCT have been described elsewhere.[36]

Eligible participants included all mothers or grandmothers involved in the RCT aged 18 to 70 years with non-psychotic MDD, whose HRSD-17 score at baseline was $>$ 7. Maternal exclusion criteria were ongoing treatment with antidepressants or psychotherapy, suicide risk, current or past episodes of mania or hypomania, existing psychotic symptoms, borderline or antisocial personality disorder, and substance use disorder. All eligible mothers/grandmothers were randomly assigned to IPC or E-TAU treatment, and our analyses focused on the outcomes for each dyad, assessing depression in mothers and emotional and behavioral symptoms in their children over time. We did not evaluate the clinical trial's results regarding IPC effectiveness.

Interpersonal counseling

IPC is derived from IPT, an evidence-based psychotherapy developed by Klerman & Weissman.[31] It is a briefer, structured version of IPT primarily for use in non-mental health settings, such as primary care clinics with CHWs, for patients with depressive symptoms.[37] CHWs are agents of the Brazilian public health system responsible for visiting assigned households at least once per month to collect data and promote health primary care, irrespective of demand.[38] Forty-two CHWs employed at the primary care clinic with no formal experience in psychotherapy or counseling were trained, of whom 20 were selected after a 3-day training session with the IPC Manual[35] based on the trainers' observation of their motivation and skills. They were supervised weekly throughout the trial by the same trainers, who were also available for the entire study period. IPC included a 3 to 4 1-hour weekly sessions, provided either at the clinic or during household visits.

Enhanced treatment as usual

Designed by the research team, E-TAU aimed to facilitate the mothers' referral to specialized mental health care, increasing access to treatment. Since primary care clinics usually employ only non-mental health professionals, referrals are required. Mothers randomized to E-TAU were followed by off-site research psychologists funded by the study. These psychologists contacted patients and

facilitated their referral to specialized mental health care professionals for pharmacological or psychological treatment, increasing the attention lacking in routine clinical care. This was carried out by calling the mother at least once per week to confirm the referral and ensure follow-up.

Sample

Of the initial sample of 81 women recruited between September 2013 and November 2014 for the initial trial, 49 (40 mothers and nine grandmothers who were primary caregivers, hereafter called mothers) had between 1 and 4 children aged 6 to 15 years (mean age: 10.4, SD: 2.29) who screened positive for emotional and behavioral symptoms on the Child Behavior Checklist (CBCL). Sixty children were enrolled in the study, all presenting CBCL scores indicating borderline/clinical impairment ($\geqslant$ 63). The exclusion criteria for children were ongoing psychiatric treatment or psychotherapy, previous psychosis, autism spectrum disorder, or intellectual disabilities. The sample selection is described in detail in Figure 1.

Measures

The mothers were assessed with a battery of instruments that included baseline sociodemographic data and a psychiatric diagnosis and, at all-time points, depressive symptoms (baseline, post-intervention, and 6 months follow-up). The mothers and children were assessed at three different points: baseline, 2-months post-intervention, and 6 months after the beginning of the intervention. The children's behavioral/emotional symptoms were assessed at baseline, post-intervention, and 6 months follow-up. Trained mental health professionals, blinded to maternal treatment group status (IPC or E-TAU), collected standard demographic information and administered all instruments.

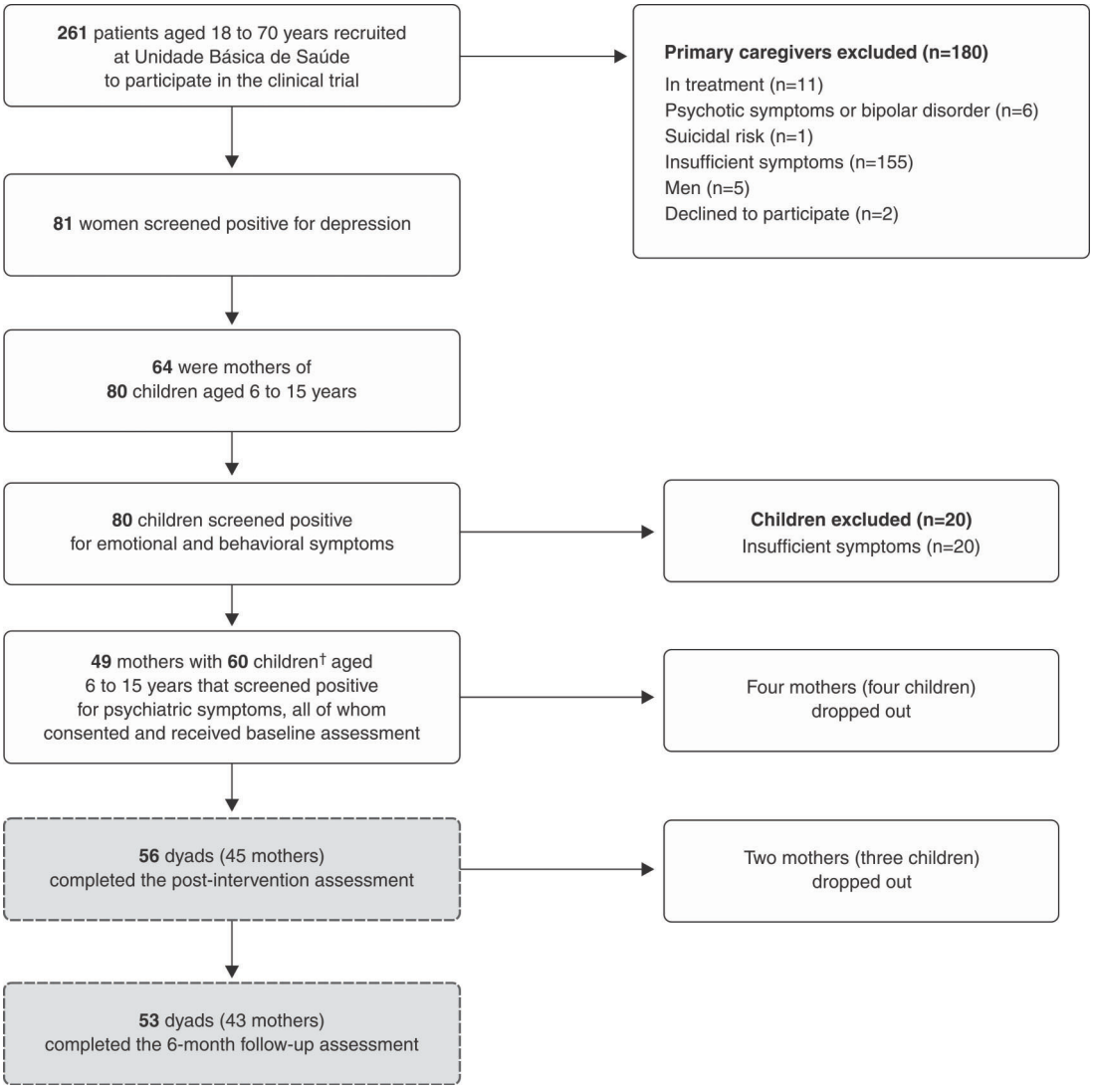

Figure 1 Study flow diagram. † Six mothers had two children, one mother had four children, and one mother had three children.

Sociodemographic inventory

An instrument designed for this study assessed the mothers' and children's demographic and social data (Tables 1 and 2).

Maternal assessments

Maternal depression: the Hamilton Rating Scale for Depression[39]

The validated Brazilian version of the HRSD-17 was used to assess the presence and severity of maternal depressive symptoms.[40] It has excellent reliability and good correlation with the other included instruments. Total scores range from 0 to 52, and the American Psychiatric Association's Handbook of Psychiatric Measures[41] defines its grades of severity as mild depression (8-13), moderate depression (14-18), severe depression (19-22), and very severe depression ($\geqslant$ 23). HRSD-17 scores[42] were used as the primary outcome for the symptom presence and severity. We defined ''remission'' as scores $\leqslant$ 7 for depressive symptoms and ''response'' as a $\geqslant$ 50% reduction from baseline scores.[4,43,44] For the analyses, maternal remission was divided into two levels: remission ($\leqslant$ 7) or no remission ($>$ 7). Maternal response was categorized into three levels based on the reduction in baseline HRSD-17 scores: $<$ 0% (symptom worsening), 0 to 50% symptom reduction, and $>$ 50% symptom reduction, the latter being the standard and most widely used cut-off point for determining response with the HRSD-17.

Maternal mental health: the Mini International Neuropsychiatric Interview (MINI)[45]

The MINI is a brief standardized diagnostic interview, consistent with DSM-III-R/IV and ICD-10 criteria, intended for clinical practice and primary care research after a brief training period. The MINI has the same psychometric properties of a more complex structured diagnostic interview,[46,47] allowing a $\geqslant$ 50% reduction in assessment time. We used the Brazilian Portuguese version[45] of the MINI to diagnose depression and possible comorbidities. All interviewers were trained before administering the MINI.

Child assessment

Child behavioral/emotional symptoms: Child Behavior Checklist (CBCL)[48,49]

The CBCL parent version was used as the primary child mental health outcome. It provides a behavioral profile of the child/adolescent in three scales: overall mental health and behavior problems, internalizing problems (anxiety/depression), and externalizing problems (aggressive, impulsive, opposing, and challenging). The Brazilian version was used in this study.[50]

The instrument consists of 138 items divided into two blocks. The first block includes 20 questions related to social competence. These questions require the parents/primary caregivers to compare their child's behavior with that of other children of the same age, defining them as above, below, or within the mean. Comparisons are based on relative time spent in various activities, the degree of group participation, the quality of family relationships, independence in play or work, and school performance. The second block consists of eight different scales, totaling 118 items about emotional and behavioral symptoms, to which the parents/primary caregivers respond with three possible alternatives: false or absent behavior (score = 0); partially true or occasional behavior (score = 1); completely true or frequent behavior (score = 2). T scores range from 0 to 100 for total externalizing a nd internalizing problems; patients who score $\geqslant$ 63 are considered clinically impaired. In our analysis, total CBCL scores were used to determine the presence of behavioral/emotional symptoms.

Statistical analyses

Categorical variables were analyzed using frequencies and percentages. Continuous variables were analyzed using means and standard deviations. Mothers who experienced remission were compared to those who did not with the chi-square, Mann-Whitney, and Kruskal-Wallis tests. Cohen's *d* was determined to measure the effect size between two means in the maternal remission groups. Cohen's *f* was also used to compare the three means for the maternal response groups, with the effect size reported where appropriate. Change in child psychopathology from baseline to 6 months follow-up was evaluated in association with maternal remission (HRSD-17 score $\leqslant$ 7, yes or no) and maternal response level (percent reduction in baseline HRSD-17 scores: $<$ 0, 0 to 50, and $>$ 50%).

The analyses were adjusted according to child age and sex and the following control variables: race, religion, household income, socioeconomic status, and the mother's age, educational level, treatment type (IPC or E-TAU), and psychiatric comorbidities. To avoid Simpson's paradox, all sociodemographic variables were included in multiple linear regression models, with the child's improvement as a dependent variable.

Ethics statement

Participation in the study was voluntary and participants received no financial compensation. The study protocol was approved by the Universidade Federal de São Paulo research ethics committee and the Conselho Municipal da Secretaria Municipal da Saúde da Prefeitura da Cidade de São Paulo. The trial was registered in Brazilian Clinical Trials (number RBR-5qhmb5: http://www.ensaiosclinicos.gov.br/rg/RBR-5qhmb5/).

Results

The study included 60 dyads: 49 mothers (mean age: 40.4, SD:10.5; mean HRSD-17 score: 17.2, SD: 5.8), all of whom met diagnostic criteria for depressive disorder according to the MINI, and 60 children (mean age: 10.4

Table 1 Baseline characteristics of depressed mothers and their children according to remission status

	Post-intervention assessment (n=45)			6-month follow-up assessment (n=43)		
Maternal characteristics (n=49)	Remission (n=9)	No remission (n=36)	p-value	Remission (n=13)	No remission (n=30)	p-value
Age, mean (SD), years	39.00 (9.27)	41.36 (10.75)	0.5892	41.85 (13.43)	41.47 (9.21)	0.7404
Race			0.7231			> 0.999
White	5 (56)	17 (47)		6 (46)	13 (43)	
Non-white	4 (44)	19 (53)		7 (54)	17 (57)	
Marital status			0.1040			0.4771
Married	8 (89)	19 (53)		8 (62)	17 (57)	
Single	0 (0)	10 (28)		2 (15)	9 (30)	
Separated/divorced/widowed	1 (11)	7 (19)		3 (23)	4 (13)	
Household monthly income (BRL)			0.2579			0.2873
⩽ 1449.99	1 (11)	15 (42)		3 (23)	13 (43)	
1450.00-2899.99	4 (44)	9 (25)		3 (23)	8 (27)	
⩾ 2900.00	4 (44)	12 (33)		7 (54)	9 (30)	
Education			0.7103			0.5031
< High school degree	6 (67)	19 (53)		7 (54)	20 (67)	
⩾ High school degree	3 (33)	17 (47)		6 (46)	10 (33)	
Religion			0.0129			0.5758
Catholic	6 (67)	7 (19)		5 (38)	8 (27)	
Protestant	3 (33)	19 (53)		6 (46)	14 (47)	
Other/none	0 (0)	10 (28)		2 (15)	8 (27)	
Socioeconomic class (ABIPEME)			0.8989			0.4171
B1/B2	3 (33)	11 (31)		5 (38)	7 (23)	
C1/C2	5 (56)	18 (50)		7 (54)	16 (53)	
D/E	1 (11)	7 (19)		1 (8)	7 (23)	
Treatment received in primary care			0.4177			> 0.999
IPC	5 (56)	17 (47)		6 (46)	15 (50)	
IPC/TAU	0 (0)	7 (19)		2 (15)	5 (17)	
TAU	4 (44)	12 (33)		5 (38)	10 (33)	
Comorbid axis I diagnoses			0.6636			0.2431
0	6 (67)	20 (56)		10 (77)	15 (50)	
1	3 (33)	12 (33)		2 (15)	13 (43)	
2 or 3	0 (0)	4 (11)		1 (8)	2 (7)	
Comorbid axis I diagnoses			0.7127			0.1772
No	6 (67)	20 (56)		10 (77)	15 (50)	
Yes	3 (33)	16 (44)		3 (23)	15 (50)	
Baseline HRSD-17 score	16.00 (5.07)	17.39 (5.91)	0.8089	16.85 (4.24)	17.10 (5.97)	0.7503
	Post-intervention assessment (n=56)			6-month follow-up assessment (n=53)		
Child characteristics (n=60)	Remission (n=10)	No remission (n=46)	p-value	Remission (n=16)	No remission (n=37)	p-value
Age, mean (SD), years	10.60 (1.51)	10.37 (2.47)	0.8629	10.75 (1.91)	10.32 (2.50)	0.5908
Sex			0.3111			0.5568
Female	7 (70)	23 (50)		7 (44)	20 (54)	
Male	3 (30)	23 (50)		9 (56)	17 (46)	
Race			> 0.999			> 0.999
White	5 (50)	22 (48)		7 (44)	17 (46)	
Non white	5 (50)	24 (52)		9 (56)	20 (54)	

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Table 1 (*continued*)

Maternal characteristics (n=49)	Post-intervention assessment (n=45)			6-month follow-up assessment (n=43)		
	Remission (n=9)	No remission (n=36)	p-value	Remission (n=13)	No remission (n=30)	p-value
Education[†]			0.7766			0.3748
Grades 1-4	4 (40)	23 (50)		6 (38)	19 (51)	
Grades 5-9	6 (60)	22 (48)		10 (63)	17 (46)	
Not attending school[‡]	0 (0)	1 (2)		0 (0)	1 (3)	
Living with			0.0332			0.5568
Biological mother/other	4 (40)	25 (54)		10 (63)	19 (51)	
Both biological parents	6 (60)	21 (46)		6 (38)	18 (49)	

Data presented as n (%), unless otherwise specified.
Diagnoses were based on the Mini International Neuropsychiatric Interview, and p-values were based on χ^2 tests for categorical variables and the nonparametric Mann-Whitney test for continuous variables.
ABIPEME = Associação Brasileira dos Institutos de Mercado (Brazilian Association of Market Institutes); HRSD-17: Hamilton Rating Scale for Depression; IPC = interpersonal counseling; SD = standard deviation; TAU = treatment as usual.
[†] Numbers may vary in each category due to missing data.
[‡] Children not attending school were excluded from p-value calculation.

Table 2 Baseline characteristics of depressed mothers and their children according to maternal response level

Maternal characteristics (n=49)	Post-intervention assessment (n=45)				6-month follow-up assessment (n=43)			
	Worse (n=14)	0-50% (n=21)	> 50% (n=10)	p-value	Worse (n=15)	0-50% (n=13)	> 50% (n=15)	p-value
Age, mean (SD), years	42.29 (10.24)	41.57 (11.46)	37.50 (8.40)	0.3913	44.60 (9.69)	39.77 (8.48)	40.13 (12.63)	0.1921
Race				0.7450				> 0.999
White	6 (43)	10 (48)	6 (60)		6 (40)	6 (46)	7 (47)	
Non-white	8 (57)	11 (52)	4 (40)		9 (60)	7 (54)	8 (53)	
Marital status				0.0339				0.4855
Married	5 (36)	12 (57)	10 (100)		7 (47)	7 (54)	11 (73)	
Single	5 (36)	5 (24)	0 (0)		6 (40)	3 (23)	2 (13)	
Separated/divorced/ widowed	4 (29)	4 (19)	0 (0)		2 (13)	3 (23)	2 (13)	
Household monthly income (BRL)				0.7124				0.7627
⩽ 1449.99	5 (36)	9 (43)	2 (20)		5 (33)	6 (46)	5 (33)	
1450.00-2899.99	3 (21)	6 (29)	4 (40)		4 (27)	4 (31)	3 (20)	
⩾ 2900.00	6 (43)	6 (29)	4 (40)		6 (40)	3 (23)	7 (47)	
Education				0.6811				>0.999
< High school degree	9 (64)	10 (48)	6 (60)		10 (67)	8 (62)	9 (60)	
⩾ High school degree	5 (36)	11 (52)	4 (40)		5 (33)	5 (38)	6 (40)	
Religion				0.0044				0.8661
Catholic	4 (29)	2 (10)	7 (70)		4 (27)	4 (31)	5 (33)	
Protestant	5 (36)	14 (67)	3 (30)		6 (40)	7 (54)	7 (47)	
Other/none	5 (36)	5 (24)	0 (0)		5 (33)	2 (15)	3 (20)	
Socioeconomic class (ABIPEME)				0.8720				0.3319
B1/B2	3 (21)	7 (33)	4 (40)		4 (27)	2 (15)	6 (40)	
C1/C2	8 (57)	11 (52)	4 (40)		7 (47)	10 (77)	6 (40)	
D/E	3 (21)	3 (14)	2 (20)		4 (27)	1 (8)	3 (20)	
Treatment received in primary care				0.0700				0.4551
IPC	6 (43)	9 (43)	7 (70)		9 (60)	4 (31)	8 (53)	
IPC/TAU	5 (36)	2 (10)	0 (0)		3 (20)	2 (15)	2 (13)	
TAU	3 (21)	10 (48)	3 (30)		3 (20)	7 (54)	5 (33)	

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Table 2 (*continued*)

Maternal characteristics (n=49)	Post-intervention assessment (n=45)				6-month follow-up assessment (n=43)			
	Worse (n=14)	0-50% (n=21)	> 50% (n=10)	p-value	Worse (n=15)	0-50% (n=13)	> 50% (n=15)	p-value
Comorbid axis I diagnoses				0.4062				0.1544
0	6 (43)	13 (62)	7 (70)		6 (40)	8 (62)	11 (73)	
1	7 (50)	5 (24)	3 (30)		8 (53)	5 (38)	2 (13)	
2 or 3	1 (7)	3 (14)	0 (0)		1 (7)	0 (0)	2 (13)	
Comorbid axis I diagnoses				0.3397				0.2006
No	6 (43)	13 (62)	7 (70)		6 (40)	8 (62)	11 (73)	
Yes	8 (57)	8 (38)	3 (30)		9 (60)	5 (38)	4 (27)	
Baseline HRSD-17 score	13.7 (4.5)	18.6 (5.7)	18.7 (5.9)	0.0227	16.0 (5.5)	15.4(5.1)	19.5 (5.1)	0.0715

Child characteristics (n=60)	Post-intervention assessment (n=56)				6-month follow-up assessment (n=53)			
	Worse (n=17)	0-50% (n=28)	> 50% (n=11)	p-value	Worse (n=17)	0-50% (n=18)	> 50% (n=18)	p-value
Age, mean (SD), years	9.88 (2.06)	10.68 (2.72)	10.55 (1.44)	0.4800	10.71 (2.31)	9.83 (2.71)	10.83 (1.89)	0.5239
Sex				0.5999				0.6158
Female	10 (59)	13 (46)	7 (64)		8 (47)	11 (61)	8 (44)	
Male	7 (41)	15 (54)	4 (36)		9 (53)	7 (39)	10 (56)	
Race				0.8246				0.9404
White	7 (41)	14 (50)	6 (55)		7 (41)	9 (50)	8 (44)	
Non-white	10 (59)	14 (50)	5 (45)		10 (59)	9 (50)	10 (56)	
School[†]				0.5349				0.2197
Grades 1-4	11 (65)	11 (39)	5 (45)		11 (65)	6 (33)	8 (44)	
Grades 5-9	6 (35)	16 (57)	6 (55)		6 (35)	11 (61)	10 (56)	
Not attending school[‡]	0 (0)	1 (4)	0 (0)		0 (0)	1 (6)	0 (0)	
Living with				0.2264				0.9401
Biological mother/other	10 (59)	16 (57)	3 (27)		10 (59)	10 (56)	9 (50)	
Both biological parents	7 (41)	12 (43)	8 (73)		7 (41)	8 (44)	9 (50)	

Data presented as n (%), unless otherwise specified.
Diagnoses were based on the Mini International Neuropsychiatric Interview and p-values were based on χ^2 tests for categorical variables and nonparametric Mann-Whitney test for continuous variables.
ABIPEME = Associação Brasileira dos Institutos de Mercado (Brazilian Association of Market Institutes); HRSD-17: Hamilton Rating Scale for Depression; IPC = interpersonal counseling; TAU = treatment as usual.
[†] Numbers may vary in each category due to missing data.
[‡] Children not attending school were excluded from the p-value calculation.

years, SD: 2.3; 51.7% girls; mean baseline CBCL score: 69, SD: 7.0). A total of 56 children (93.3%, mean post-intervention CBCL score: 64.9, SD: 11.5) were evaluated post-intervention, and 53 (88.3% of the initial sample, 6-month follow-up mean CBCL score: 63.8, SD: 9.9) remained in the study for the 6-month follow-up assessment. The characteristics children whose mothers dropped out did not differ significantly from those whose mothers did not. Mothers who dropped out before the 6-month follow-up assessment were younger than those that did not (mean age: 32.2 years, SD: 5.6 vs. 41.6 years, SD: 10.5; p = 0.0228). There were no significant differences in sociodemographic or clinical variables between mothers who did and did not drop out of the study. There were no differences in HRSD-17 scores between these groups, indicating that baseline depression severity did not explain dropouts 6 months post-intervention.

All mothers in the IPC and E-TAU groups were considered to have received an active intervention. We were not informed which type of intervention the patients from this group had after referral or even if they received complete treatment, but we considered the E-TAU group to have received active emotional support and care through the research psychologists' phone calls, which had a psychological impact.

Maternal remission and changes in child behavioral/emotional symptoms

Table 1 summarizes the baseline characteristics of mothers and their children according to maternal depression remission at post-intervention and 6 months follow-up. Among mothers who underwent follow-up assessments, 9 of 45 (20%) and 13 of 43 (30%) remitted from depression (HRSD-17 score $\leqslant$ 7) at post-intervention and

at 6 months follow-up, respectively. Of the 13 mothers with continued remission 6 months after treatment, 6 (46%) received IPC treatment only. Mothers in remission at the post-intervention assessment were more likely to be Catholic (67 vs. 19%; p = 0.0129) (Table 1) than Protestant or other religions, and whose children lived with both biological parents at the time of evaluation (54 vs. 46%; p = 0.0332) (Table 1), compared to those living only with their biological mother or others.

At the 6-month follow-up assessment, the mean HRSD-17 score decreased from 16.8 (SD, 4.2) to 3.5 (SD, 1.9) among mothers who achieved remission. Sociodemographic characteristics did not differ between remitted and non-remitted mothers. Mean child CBCL scores according to maternal remission at both evaluation times (post-intervention and 6 months follow-up) are described in Table 3. Asymptomatic mean CBCL ($\leqslant$ 60) scores only occurred at 6 months follow-up among children of remitted mothers (mean CBCL score: 58.43; SD, 10.08).

There was no evidence that maternal remission was related to lower behavioral/emotional symptoms in their children at the post-intervention assessment (p = 0.1636, Cohen's *d*: 0.48). However, there was a significant time and group effect (p = 0.0247, Cohen's *d*: 0.76), i.e., reductions in child behavioral/emotional symptoms were higher at 6 months follow-up among the children of mothers in remission.

Maternal response level and changes in child behavioral/emotional symptoms

To better understand maternal improvement, we examined changes in baseline HRSD-17 scores according to maternal response to treatment, which, as previously described, was classified into three levels based on baseline, post-intervention (n=45), and 6-month follow-up (n=43) scores. Table 2 summarizes the baseline characteristics of mothers and their children according to maternal response level at post-intervention and 6-months follow-up.

Among mothers who underwent follow-up assessments, 10 of 45 (22.2%) and 15 of 43 (34.9%) presented a response $>$ 50% at post-intervention and at 6 months follow-up, respectively. Of the 15 mothers whose treatment response was a $>$ 50% reduction in depressive symptoms according to HRSD-17 scores at 6 months after treatment, 8 (53%) received IPC treatment only. Those with a $>$ 50% reduction in symptoms at post-intervention assessment were all married (p = 0.0339) (Table 2) and were more likely to be Catholic (70%) than Protestant or other religions (p = 0.0044) (Table 2). Mean child CBCL scores at both evaluation times (post-intervention and 6 months follow-up) according to maternal response are shown in Table 4. The only group who achieved asymptomatic CBCL scores at ($\leqslant$ 60) at both times is children whose mothers had a $>$ 50% reduction in depressive symptoms (mean score: 57.82, SD: 13.81 and 59.65, SD: 10.17, respectively). Therefore, according to CBCL criteria, only children whose mothers had more remarkable improvement showed clinical progress.

Although children achieved asymptomatic CBCL scores at both post-intervention and 6 months follow-up, there was no evidence that maternal response to treatment was related to lower behavioral/emotional symptoms (p = 0.0720, Cohen's *f*: 0.33). However, there was a significant difference (p = 0.0224, Cohen's *f*: 0.44) at 6 months follow-up among the children of mothers who had a better post-intervention treatment response.

There were no significant differences in maternal response or remission according to treatment type (IPC or E-TAU), either at post-intervention (response: p = 0.0695; remission: p = 0.6295 or 6 months follow-up (response: p = 0.4563; remission: p $>$ 0.999), compared with baseline HRSD-17 scores.

Table 3 Child CBCL scores according to maternal remission at post-intervention and 6 months follow-up

	Mother not remitted			Mother remitted			
	n	Mean	SD	n	Mean	SD	p-value
Mean CBCL psychopathology score[†] post-intervention (n=56)	46	65.87	10.96	10	60.40	13.66	0.1636
Mean CBCL psychopathology score[†] follow-up (n=53)[‡]	37	65.65	9.16	15	58.53	10.08	0.0247

CBCL = Child Behavior Checklist.
[†] The scoring range is from 0 to 100. Scores $\geqslant$ 63 indicate clinical impairment.
[‡] The numbers may vary in each category due to missing data.

Table 4 Child CBCL scores according to maternal response at post-intervention and 6 months follow-up

	Maternal response level (%)									
	Worse $\leqslant$ 0%			0-50%			$>$ 50%			
	n	Mean	SD	n	Mean	SD	n	Mean	SD	p-value
Mean CBCL psychopathology score,[†] post-intervention (n=56)	17	67.88	9.03	28	65.86	11.20	11	57.82	13.81	0.0720
Mean CBCL psychopathology score,[†] follow-up (n=53)[‡]	17	69.00	8.87	18	62.22	8.66	17	59.65	10.17	0.0224

p-values are based on nonparametric Kruskal-Wallis tests.
CBCL = Child Behavior Checklist.
[†] The scoring range is from 0 to 100. Scores $\geqslant$ 63 indicate clinical impairment.
[‡] Numbers may vary in each category due to missing data.

Discussion

There is strong evidence that maternal remission of depressive symptoms positively affects their children.[51-53] This study determined whether a brief intervention for maternal depression administered by CHWs in a primary care setting improved child behavioral/emotional symptoms. After following up dyads for up to 6 months after treatment, we found that remission of maternal depression (HRSD-17 scores $\leqslant$ 7) was associated with improved child behavioral/emotional symptoms (CBCL scores below clinical level). We also found that child symptoms improved when their mothers responded to treatment (particularly a $\geqslant$ 50% change in HRSD-17 score) at the post-intervention and 6-month follow-up assessments.

In our study, maternal response and remission after depression treatment were associated with lower child behavioral/emotional symptoms at 6 months follow-up. Using the percentage of reduction in maternal depression as a continuous variable, we also conducted a multiple linear regression, adjusted for possible confounders, such as child sex and age, race, religion, household income, socioeconomic class, maternal age, educational level, treatment type, and comorbidities. As a result, only reduced maternal depression scores were significantly associated with lower child CBCL scores (coefficient: 0.040; SD: 1.797; p = 0.0301). These analyses suggest that the more significant the improvement in maternal depression, the greater the improvement in child psychopathology (for each point decrease in HRSD-17 score, there was a 0.04 point decreased in CBCL score). Maternal remission was also the only significant (coefficient: 6.420, SD: 2.286; p = 0.0071) variable related to the child improvement at 6 months follow-up. These regressions corroborate the previous analyses, so we presented the results with the previous analyses, facilitating data interpretation.

In a study on child outcomes after pharmacological treatment for maternal depression, child psychopathology only improved in the first 3 to 6 months after maternal treatment.[54] Another study evaluating a psychological treatment found that child improvement according to positive maternal response to treatment only reached significance 3 months post-treatment, and the association was strengthened at 6 months.[55]

In our sample, child improvement in post-intervention CBCL scores (vs. baseline) was associated with maternal response to depression treatment (p = 0.0441, Cohen's *f*: 0.38), but not with maternal remission (p = 0.2099, Cohen's *d*: 0.59). However, at 6 months follow-up, child symptom levels decreased compared to baseline with maternal response (p = 0.0229, Cohen's *f*: 0.40) and maternal remission (p = 0.0169, Cohen's *d*: 0.86). Later changes in children (after 6 months) could be explained by the fact that the effectiveness of psychotherapy, especially when compared to medication, is frequently observed in the long term as a continuous and persistent effect, suggesting that interventions may have downstream effects, particularly on child functioning. Furthermore, positive subsequent effects on child behavioral/emotional symptoms could be explained by the correlation between improved maternal depression and changes in parenting style, as well as family functioning (maternal warmth and acceptance, positive maternal behavior, and family functioning), which can affect the mother-child relationship and affect the child's symptoms. This result is consistent with previous findings,[52,56] indicating that child behavioral/emotional symptoms frequently decrease over time with decreased maternal depression, mediated by parenting changes. The mothers in this study were treated with IPC or E-TAU, but the findings could likely apply to any effective treatment for depression, and further studies with a time-varying effects model could clarify the nature of these associations.

Even considering previously reported findings and associations, the reason remitted maternal depression has a positive impact on children over time is still unclear. In other studies,[57,58] multiple contextual risks relevant to child psychopathology could be positively impacted by decreased maternal depression, including family conflict, perceived stress, parenting hassles, social support, and family organization. Furthermore, child improvement can positively impact mothers in a reverse causation relationship.

From this perspective, lack of improvement or deterioration after treatment (in our study, the 'worsening' response group) could indicate more severe maternal depression, which could also be reflected in more severe symptoms in the child. From another perspective, child severity could also be explained by prior causes, such as genetics or earlier environmental elements.

The children of depressed mothers are exposed to cumulative risks that could increase the impact of depression on their outcomes. Epidemiological data[59] suggests that addressing maternal depression and associated risk factors may be the most effective way to prevent adverse outcomes in children. Studies on the effects of maternal depression may also benefit from considering other risk factors associated with maternal mental health.

Robust evidence shows that maternal depression is highly prevalent and could harm the child's mental health. Although genetic components have a high impact on child psychopathology,[60] our study found that an environmental factor, remission and response in maternal depression, had a strong influence. It is crucial to find feasible and well-disseminated therapeutic tools for public use, mainly in LMIC.

A recently published trial[55] comparing 9 weekly brief IPT sessions of for mothers) and brief supportive psychotherapy showed improvement over time in the depressive symptoms of mothers and the psychiatric symptoms of children, with no significant differences between treatment groups. However, the children were also receiving treatment in mental health clinics, which could have masked the benefits and association between maternal depression improvement and child outcomes. Our study did not focus on the differences or efficacy of maternal treatment type, and in our analyses IPC and E-TAU did not differ in maternal treatment outcomes. As described above, both interventions were considered

maternal support care, since both addressed depression management in primary care. A previous study[61] reported that the type of treatment offered in primary care settings matters when the approach involves building a close relationship, including empathic listening, patient community engagement, and other resources.

Our study is the first to assess school-aged children in an LMIC as their depressed but treatment-seeking mothers underwent non-pharmaceutical treatment. Mothers tend to seek treatment for their school-age children with symptoms rather than for themselves, which might impede them from engaging in treatment if it were proposed.[29] The mothers in our study sought treatment for themselves, which facilitated engagement.

Our study has certain limitations. Although the instrument we used to identify symptoms in children and evaluate outcomes is widely applied in pediatric mental assessment, a diagnostic assessment of the children might have helped us better understand the children's disorders. Moreover, best practice for assessing psychiatric disorders in children requires reports from both the mother and child. In our study, we relied only on maternal reports (assessed through the CBCL), which is an essential limitation. It must be considered that maternal depression can negatively affect child behavior. However, if depression-related bias influenced the children's scores, we would expect an association between maternal depression severity and maternal reports of child symptoms. Such an association was not found. To address this point, future studies should include child and, if possible, teacher reports across behavioral assessments, in addition to assessing outcome biomarkers in the children.

Other limitations were that a single primary health unit handled all cases of depressed mothers. Furthermore, the sample was restricted to the mothers of children with initially high symptom levels, excluding 20 children without clinical symptoms for behavioral/emotional problems according to the CBCL.

Even considering that the symptoms of some mothers increased after 6 months of treatment, most achieved a good response (n=26 vs. 17), and mean HRSD-17 scores decreased at post-intervention and 6 month follow-up assessments. These results clarified the association between maternal and child outcomes. Among our sample, when the mothers improved, the children improved, as well as the opposite: when the mother worsened, so did the child.

Public health systems must be prepared to address the issue of maternal depression so that treatment benefits may be fully realized. The burden of depression on economic and social spheres and its consequences on future generations is enormous. Improving child mental health by treating mothers could buffer this impact. The strength of our findings is that it is possible to improve maternal and child mental health by training and enabling CHWs and by scaling up care for mental health disorders, especially in low-resource settings.

Although we did not gather enough evidence to predict worse outcomes in later life, a Ugandan study with qualitative follow-up data[62] found that treating depression in communities with low resources may lead to positive changes in global health and development years later.

According to prospective studies, task sharing[63] in primary care is a promising strategy for addressing the mental health treatment gap, especially in LMIC, and for diminishing the burden of depression worldwide.[3]

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Disclosure

The authors report no conflicts of interest.

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