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Summary

Background Maternal postnatal depression occurs following 10–15% of births and is associated with a range of negative child outcomes. Risks to children are particularly increased when postnatal depression is persistent. We aimed to examine whether a parenting video-feedback therapy (VFT) intervention versus a control treatment of progressive muscle relaxation (PMR), both added to cognitive behavioural therapy (CBT) for persistent postnatal depression, would lead to improved child outcomes at age 2 years.

Methods In this two-arm, parallel-design, individually randomised controlled trial, we recruited a community sample of women aged 18 years or older living within 50 miles of Oxford, UK, between 4·5 and 9·0 months post partum. All participants met diagnostic criteria for current major depressive disorder that had persisted for at least 3 months and had infants at 35 or more weeks of gestation, with a birthweight of 2000 g or greater, and without serious neonatal complications. Through a centralised service, women were randomly assigned by use of a minimisation algorithm, to receive either VFT or PMR, balanced for child sex, temperament, age, socioeconomic status, and severity of depression. Both groups also received CBT for depression. Primary outcomes were child cognitive development, language development, behaviour problems, and attachment security at age 2 years. There were 11 home-based treatment sessions before child age 1 year, followed by two booster sessions in the second year. Assessors were masked to treatment group allocation. All analyses were done according to the intention-to-treat principle. This trial is registered with the ISRCTN registry, number ISRCTN07336477.

Findings Between March 18, 2011, and Dec 9, 2013, we randomly assigned 144 women, 72 to each group. Primary outcome data were available for 62–64 (86–89%) VFT and 67–68 (93–94%) PMR participants. There were no group differences in child outcome (cognitive development, adjusted difference –1·01 [95% CI –5·11 to 3·09], p=0·63; language development, 1·33 [–4·16 to 6·82], p=0·63; behaviour problems, –1·77 [–4·39 to 0·85], p=0·19; attachment security, 0·02 [–0·06 to 0·10], p=0·58), with both groups achieving scores similar to non-clinical norms on all outcomes. There were six serious adverse events: five in the VFT group (in two participants) and one in the PMR group. None was treatment-related.

Interpretation The effect of persistent postnatal depression on children is a major public health issue. For both treatment groups there was sustained remission from depression, and child development outcomes were in the normal range. The precise mechanisms accounting for the observed positive child outcomes cannot be ascertained from this study.

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Introduction

Maternal postnatal depression affects 10–15% of women in high-income countries,[1] with substantially higher rates in low-income and middle-income countries. Symptoms of postnatal depression are the same as those for depression in other contexts and significantly affect functioning. Indeed, suicide, which commonly has its origins in depression, is the second most frequent cause of maternal mortality in high-income countries.[2]

Postnatal depression can have wide-ranging negative effects on child development. In early childhood, these effects include impairments in cognitive performance, behaviour disturbance, and insecurity of attachment; these problems can persist into late childhood and adolescence.[3,4] The economic costs associated with the effects of perinatal mental disorders on child development are substantial—estimated at £8·1 billion per year in the UK alone.[5]

The negative effects of postnatal depression on child development are particularly marked when the depression persists beyond the first few months post partum[6,7] and when the mood disturbance tends to be severe. Yet, treatment trials aiming to improve maternal and child outcomes have rarely targeted such prolonged

Research in context

Evidence before this study

Postnatal depression has long-term adverse effects on child development, with risks being particularly increased for children exposed to persistent postnatal depression. Since parenting is a mediator of the association between postnatal depression and child outcomes, a specific intervention component might be required to address parenting in the context of treating maternal depression. We searched MEDLINE, PsycINFO, and the Cochrane library using search terms for maternal depression, randomised controlled trial, or treatment and child outcomes (for full details of search terms see the appendix) from inception to Dec 8, 2017. We identified ten relevant reviews and 34 randomised controlled trials or quasi-experimental studies that examined the effects of interventions for women with postnatal depression on parenting or child development, or both. Overall, results suggest that treatment of the depression alone might not be sufficient to significantly benefit child outcomes. No randomised controlled trial to date has examined whether a parenting intervention, added to a standardised evidence-based treatment for depression, improves child outcomes.

Added value of this study

This randomised controlled trial sought to address a gap in the literature for women with persistent postnatal depression. We examined whether video-feedback therapy (VFT), when compared with progressive muscle relaxation (PMR; the control treatment), led to improved cognitive, language, behaviour, and attachment outcomes in children of women receiving cognitive behavioural therapy (CBT) for postnatal depression. At child age of 2 years we found no significant differences between VFT and PMR, with child development outcomes for both groups of children being similar to the norms for non-clinical populations. Levels of maternal depression fell markedly across both groups by the end of treatment (at 1 year) and improvements were sustained at 2 years. Most children were therefore not exposed to significant maternal depression from the latter part of their first year through to the entire second year of life, suggesting that treating the mother's depression effectively and maintaining remission could mitigate longer-term negative effects of persistent postnatal depression on the child.

Implications of all the available evidence

Since the risk of negative child outcomes is particularly elevated in the context of persistent and severe maternal depression, and since brief interventions for postnatal depression are unlikely to lead to long-term maternal remission and improved child development, effective treatments for mothers are crucial in this context. Treatments are more likely to be effective when intensive and extended by boosters, and are likely to be particularly acceptable when delivered in mothers' homes. Such treatments have substantial implementation costs, but in the long term they are likely to yield important benefits to both maternal mental health and child development, and will reduce costs to society.

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postnatal depression. Instead, they have typically evaluated relatively brief interventions delivered in the early postnatal months. These interventions have not shown long-term benefits in either maternal mood or child outcomes.[8–11] There is, therefore, a need to evaluate interventions that target more persistent forms of postnatal depression.

The possibility that child outcomes will improve with more intensive interventions derives from studies of depressed parents of older children, where remission of parental depression was associated with marked improvements in child outcomes.[12–14] However, it is not known whether this observation also holds true for children in their first 2 years of life, when they are maximally dependent on their parents and the foundations of key developmental achievements are laid.

There is substantial evidence that parenting difficulties mediate, at least in part, the negative effect of postnatal depression on child development,[15,16] with low maternal contingent responsiveness leading to poor cognitive development,[3,4] low sensitivity leading to insecure attachment,[7] and poor support for infant emotion regulation leading to child behaviour problems.[3] These observations have led to the view that treatments for postnatal depression might require a specific parenting component to benefit child outcomes.[17,18] Indeed, some studies have reported that interventions designed specifically to enhance the mother–infant relationship in the context of postnatal depression benefit the mother–child relationship and reduce the negative effect of maternal depression on child outcomes when measured in the shorter term.[19,20] However, these studies have been limited by comparisons with controls involving either no or minimal treatment and by small sample sizes. Furthermore, the scant evidence available on child outcomes beyond late infancy has been negative.[9,10,21]

An important unaddressed question is whether a specific parenting intervention improves child outcomes when compared with an intervention not focused on parenting, in a setting where both groups also receive treatment for persistent postnatal depression.

We therefore did a randomised controlled trial in which all participants received intensive treatment for persistent postnatal depression, and investigated whether an additional specific parenting intervention would be more effective in preventing adverse outcomes in children than an additional control intervention not focused specifically on parenting.

The specific intervention to address the mother–infant relationship was video-feedback therapy (VFT),[22] an intervention shown to be effective in a range of contexts.[19,22] The aim of the intervention was to target

those parenting behaviours affected by postnatal depression that are associated with adverse child outcomes.[3,4] We used an active control treatment, progressive muscle relaxation (PMR), which is commonly used for stress management,[23] but which does not target parenting practices or the mother–child interaction. The intervention for treatment of maternal depression, provided to all participants, was cognitive behavioural therapy (CBT)[24] with a principal focus on behavioural activation, a form of treatment that produces robust effects on depression.[25]

We aimed to address whether, in the context of providing CBT for persistent postnatal depression, a parenting intervention (VFT) would lead to better child cognitive, language, behavioural, and attachment outcomes than a control treatment (PMR) at age 2 years.

Methods

Study design and participants

We did a two-arm, community-based, parallel group, individually randomised controlled trial. Mothers were recruited from the Oxfordshire, Buckinghamshire, and Berkshire counties in the UK via general practitioners (GPs), health visitors, and other psychological services, and from posters and leaflets displayed in primary care facilities and Children's Centres. GPs and health visitors gave an overview of the study to potential participants and provided a leaflet and contact information. Mothers could telephone or email the study team, or return self-referral forms in the post. Mothers needed to contact the study team directly rather than be referred by a health-care professional. In some instances, a health visitor or GP contacted the team on the mother's behalf, following discussion with the mother. A member of the study team would then contact the mother to assess her eligibility for the study based on the inclusion and exclusion criteria. Women were included if they met full diagnostic criteria for current major depressive disorder and had been depressed for at least the previous 3 months or the first postnatal 3 months (in fact, all women met criteria for persistent depression in the previous 3 months), were 18 years or older, and if their infants were born at 35 or more weeks of gestation, with a birthweight of 2000 g or greater, were aged 4·5–9·0 months, and had no serious medical complications. Women were excluded if they were unable to converse in English, had another severe psychiatric diagnosis or serious physical illness, were not cohabiting with the child, or were receiving psychological therapy. Women on antidepressant medication were not excluded. Recruitment began in March 18, 2011, and ended in Dec 9, 2013. Following an initial telephone screen, a home visit was arranged for full assessment. All participants provided written informed consent. The study received approval from the local National Health Service (NHS) research ethics committee (10/H0505/55). The study protocol is available online.

For the **study protocol** see https://www.psych.ox.ac.uk/research/cap/recent-studies/opt-study

Randomisation and masking

After eligibility was established, consent agreed, and baseline data collected, participants were allocated to the VFT or PMR treatment group through a centralised randomisation service provided through the Oxford Cognitive Health and Neuroscience Clinical Trials Unit. A random-deterministic minimisation algorithm was used to produce treatment groups balanced for child sex (male or female), socioeconomic status of the mother or of the highest earner in the household if the mother was unemployed (defined as non-manual or manual and categorised according to the Office for National Statistics, Standard Occupational Classification 2010, vol 2), infant temperament (not difficult or difficult), severity of postnatal depression (moderately severe or severe on the Structured Clinical Interview for DSM-IV Clinical Severity Rating [SCID-CSR] scale), and age of child (<7 months or ≥7 months). Randomisation was done by the trial coordinator. Assessors were masked to treatment allocation.

Procedures

All participants received CBT plus one of the two other interventions: VFT or PMR. Each participant received therapy from a single therapist, with each session lasting approximately 1·5 h. The first session was CBT, the second was either VFT or PMR, and all subsequent sessions were equally divided between CBT and either VFT or PMR (45 min each). Six weekly sessions were followed by five fortnightly sessions, and two booster sessions between 6 months and 10 months after the end of therapy. Therapists were allocated participants from both groups to maintain a balance between VFT and PMR. Therapy adherence was facilitated by face-to-face weekly 90-min supervision (by AS, LM, PJC, and DAS), and Skype supervision calls (by MGC). Therapists brought audio-recorded excerpts to supervisions, and video recordings for VFT. All sessions were delivered in mothers' homes (or, rarely, at a mother's request, an alternative location such as a Children's Centre).

VFT aimed to improve the quality of the mother–child interaction by enhancing three core parenting skills: maternal attention to infant cues and associated contingent responsiveness; emotional scaffolding (largely comprising warmth and support); and sensitivity and treating the child as a psychological agent, particularly in the context of attachment needs. Additional details of the therapy are provided in the appendix.

PMR involved exercises in tensing and relaxing major muscle groups combined with attention to sensations[26] (see appendix). Participants were given an audio recording of 16 pre-recorded tracks comprising the guided relaxation exercise to enable practice between sessions.

CBT targeted symptoms of depression by use of cognitive and behavioural activation techniques.

Behavioural activation has been shown to be particularly effective in the treatment of depression[25] and this aspect of the CBT model[24] was the principal focus of the intervention. We focused on behavioural activation because this approach allowed us to direct our therapeutic efforts to features common in postnatal depression, including withdrawal from rewarding activities and an absence of routine or structure. For example, the intervention was adapted to the management of sleep routines, self-care activities, and support networks. The intervention included cognitive techniques in the latter sessions. Additional details are provided in the appendix.

The four therapists who delivered the interventions were qualified clinical psychologists, all with specialist CBT training. VFT training included a 1-week course provided by developers of VFT[22] (to three of the therapists, with the fourth, who joined the team later, trained by the principal investigators) and additional 2-day training provided by AS, LM, and PJC. PMR training was provided by MGC over 2 days. Behavioural activation training was provided by Heather O'Mahen over 1 day. Training in CBT (behavioural activation plus cognitive techniques) and PMR was finalised over 4 days by AS, MGC, and DAS.

All therapy sessions were digitally audio-recorded and written records made. Adherence to treatments was assessed by independent masked raters. Good levels of fidelity to each treatment were found (appendix).

Maternal perceptions of the treatment questionnaire were included to ensure treatments were received as intended from the mothers' perspective (appendix).

The Structured Clinical Interview for DSM-IV-R for Axis I disorders (SCID-IV-R) was done at baseline to establish the nature and duration of the mother's depression, as well as comorbid disorders. If the mother was confirmed as eligible following the SCID-IV-R, she was invited to participate. The researcher also collected demographic information. The mother completed the Edinburgh Postnatal Depression Scale (EPDS) and the Infant Behaviour Questionnaire (IBQ).[27] All diagnoses were reviewed by AS, and a Clinical Severity Rating (CSR) was assigned for major depressive disorder and each comorbid disorder (anxiety disorders, phobias, and eating disorders) from the information gathered during the SCID-IV-R.[28] The CSR rating ranged from 0 to 8 and was used to characterise the severity of depression, with a score of 4 or 5 indicating moderately severe clinical depression and a score of 6 or more indicating severe depression. All assessment interviews were audio-recorded. From the IBQ scale of infant temperament, a score of reactivity was calculated. Children were categorised as difficult if they scored above the 80th percentile.

A second assessment was done at the end of therapy when the infants were aged approximately 1 year. Data collected included the SCID, EPDS, and updates on maternal and child health.

Primary outcomes were obtained at the third assessment, when children were aged 2 years, an age at which developmental outcomes show stability and are relatively robust predictors of future development.[29]

At each assessment, mothers were given £20 for participation.

Outcomes

This randomised controlled trial had four primary outcomes: child cognitive development, language development, behaviour problems, and attachment security. Two primary outcomes (attachment security and behaviour problems) were assessed in the home; the other two were assessed in the Department of Psychiatry, University of Oxford, UK. Secondary outcomes were maternal depression, child emotion regulation, sustained attention, and emotion discrimination.

See Online for appendix

Child cognitive and language development were measured with the Bayley Scales of Infant and Toddler Development-Third Edition (BSID-III), a widely used and validated measure of functioning at 1–42 months.[30] The composite score, range 40–160, mean 100 (SD 15), has good reliability and stability[31] and was used for each outcome. All assessments were video-recorded. Behaviour problems were assessed by maternal reports with the Child Behaviour Checklist (CBCL) questionnaire (for ages 1·5–5 years). This widely used measure has good discriminant validity and reliability.[32] The principal outcome was the externalising scale (range 0–48). Attachment security was measured by the Attachment Q-Sort (AQS), comprising 90 items, designed to measure the security of a child's attachment behaviour during a 1·5 h naturalistic observation in the home. The measure is reliable, with good discriminant, convergent, and predictive validity.[33] The 90 items were scored and sorted in order, from the "most characteristic" to the "least characteristic", and a Pearson's correlation was computed for each child with respect to security of attachment. Inter-observer reliability on AQS between trained observers (n=3) was computed on 22 families (16%), each visited by two observers simultaneously. Intra-class correlation coefficients ranged between 0·70 and 0·89.

Maternal depression was measured with the EPDS[34] and the SCID-CSR (completed at baseline, 1 year, and 2 years following birth). For additional details, see the appendix.

Child attention was assessed with the effortful control factor of the parent report early childhood behaviour questionnaire (ECBQ).[35] Child emotion-regulation was assessed with the barrier paradigm from the Laboratory Temperament Assessment Battery (Lab-TAB).[36] Emotion discrimination was assessed with a visual discrimination task with adult facial expressions of emotion as stimuli.[37] We originally intended to measure both child emotion regulation and child attention using more than one task each. However, because of the need to prioritise the primary outcome assessments, and the fact that children

sometimes became upset after completing the first emotion regulation task (the barrier paradigm), potentially affecting their performance in subsequent tests, we decided to use one test for each outcome only.

Parenting

Parenting was measured by observing mother–infant interactions at baseline, after treatment (child age approximately 1 year), and at the final assessment (child age 2 years). These assessments were done to examine whether there were differences between the groups and whether there were changes in parenting over time. We examined key parenting behaviours that are targeted by VFT: maternal following of child's attention and contingent responsiveness; maternal warmth as a proxy for emotional scaffolding, comprising emotional and physical affection and support for the infant; and sensitivity and treating the child as a psychological agent (as evidenced by mind-mindedness). It was hypothesised that VFT would lead to greater improvements in these capacities, compared with PMR, and these effects would be mediated through to the child outcome.

Statistical analysis

The target number of participants was 144 (72 in each group). The sample size calculation was based on the Bayley Mental Development (MDI) Index by use of the Bayley Scales of Infant and Toddler Development-Second Edition (BSID-II). Cornish and colleagues[38] report Bayley MDI scores for 15-month-old children according to maternal postnatal depression: no history, brief postnatal depression, and chronic postnatal depression. Based on an SD of 10·9, as reported for children of mothers with chronic postnatal depression, a sample size of 57 per group is necessary to detect a difference of 5·8 (as found by Cornish[38]) in the Bayley MDI scale, at the 5% significance level with 80% power. Allowing for 20% of participants to be lost to follow-up, a conservative estimate given the low attrition in our trials to date,[8] 72 participants per group were required. We used the BSID-III to measure the main outcome. This scale gives a score for cognitive and language development separately. With respect to the cognitive and language subscales available in the BSID-III, the proposed sample size had 80% power to detect a standardised treatment difference of 0·53. Piteo and colleagues[39] subsequently reported BSID-III cognitive and language subscale scores at 18 months in 69 children of mothers with maternal depression in the first 6 months post partum. The SD was 11·9 for the cognitive subscale and 13·5 for the language subscale. Assuming these SDs for our trial, 57 participants per group had 80% power to detect a minimum difference of 6·3 in the cognitive scale and 7·2 in the language scale of BSID-III. There was no formal adjustment for multiple testing, since it would have severely over-corrected as the outcomes were associated.[40] All primary outcomes were reported and interpreted together as specified in the primary hypothesis.

All outcome analyses were done according to the intention-to-treat principle. Missing data were assumed to be missing completely at random (MCAR). Departure from the MCAR assumption was considered in a separate sensitivity analysis of the primary outcomes. A pattern mixture model was applied to the data, allowing informative missing parameters to express the magnitude of departure from MCAR. The analysis for each primary outcome utilised an ANCOVA model with therapy group and the covariates of child sex, infant temperament, age of child (in months), socioeconomic status, and severity of postnatal depression (as assessed by the baseline SCID-CSR).

The SCID-CSR and EPDS were analysed by use of a linear mixed-effects model to account for repeated measurements on the same participant, including the same covariates as for the primary analysis, as well as a fixed effect for month of assessment (12 months and 24 months) and interaction between month and treatment. This analysis allows us to estimate the difference between treatment groups at 1 year and 2 years after birth. The secondary outcomes of child emotion regulation, child attention, and emotion discrimination were analysed by means of an ANCOVA model in the same way as the primary outcomes. Parenting behaviours were compared between groups with Mann-Whitney *U* tests, and tests within treatment groups to measure changes from baseline were done with paired Wilcoxon signed rank tests.

Sensitivity analyses were done to assess the effect of compliance on the treatment difference by means of a complier average casual effect (CACE) analysis, to assess whether covariates predictive of missing data affected the treatment difference, and to assess whether including a therapist random effect changed the treatment difference. We tested for the moderation effects of antidepressant usage and presence of comorbid generalised anxiety disorder (GAD) and post-traumatic stress disorder (PTSD) at baseline, for the primary outcomes, by including an interaction term in the ANCOVA model between treatment group and the moderator variable. Each moderator was considered separately.

Analyses were done with Stata, version 13. All adverse and serious adverse events were reported to an independent data monitoring and ethics committee and to the research ethics committee.

This trial is registered with the ISRCTN registry, number ISRCTN07336477.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. AS, EN, LM, PJC, MGC, AN, and JM had full access to all the data in the study and AS, LM, and PJC had final responsibility for the decision to submit for publication.

Results

The number of participants screened and randomised to receive either VFT or PMR is shown in the figure. Eligibility was assessed in 271 referrals, of whom 31 declined to participate and 96 were ineligible: 144 women were randomly assigned (n=72 in each group). Data on primary outcomes were available as follows: cognitive and language development (n=129); behaviour problems (n=132); and attachment security (n=132). Cognitive and language development were measured on average at age 25·6 months (SD 1·44), and behaviour problems and attachment security at age 24·0 months (1·18). Secondary outcomes at 2 years were available for 131 participants on the SCID-CSR and the EPDS. For the child secondary outcomes, data were available for 123 children for emotion regulation, 131 for child attention, and 78 on the child emotion discrimination task. The figure also shows the number of participants who completed an adequate number of interventions (ie, completed at least nine sessions).

The main reasons for loss to follow-up were home circumstances (three participants in the VFT group, one in PMR) and not wishing to continue with the therapy (four participants in the VFT group, two in PMR). Other reasons included parent–child separation (one participant in the PMR group) and preferring to speak to a health visitor (one participant in the VFT group).

The demographic and clinical characteristics of the women are shown in table 1. The covariates used for minimisation and additional covariates (ethnicity, educational qualifications, previous counselling or psychotherapy, antidepressant usage, mother's age, number of children living at home, and whether the child was living with the father) were generally well balanced between the two groups. Both groups had high rates of a history of previous depression, and moderately high rates of comorbid GAD. The number of participants taking antidepressant medication was 18 [25%] in the VFT group and 11 [15%] in the PMR group.

There was no evidence of treatment difference between the two groups for any of the primary outcomes: child cognitive development, language development, behaviour problems, or attachment security (table 2).

There were missing data for the BSID-III for ten (13·9%) of 72 participants in the VFT group and five (6·9%) of 72 in the PMR group. The risk difference for missing data between the two therapies for cognitive and language development is 0·07 (95% CI –0·03 to 0·17). There were missing data for the CBCL and AQS security outcomes for eight (11·1%) participants in the VFT group and four (5·6%) in the PMR group. The risk difference for missing data between the two therapies for behavioural problems and for attachment security is 0·06 (95% CI –0·03 to 0·15). The pattern mixture model showed no changes to the conclusions under the missing not at random assumption; sensitivity analyses including variables associated with missing data resulted in no changes to the conclusions. The CACE sensitivity analysis showed no significant treatment effect, although compliance was high for both therapies (130 [90·3%] of 144 participants attended nine or more sessions; 66 [91·7%] in the PMR group and 64 [88·9%] in the VFT group).

There were no significant moderation effects by antidepressant usage or by presence of comorbid GAD and PTSD at baseline for any of the primary outcomes (appendix).

At baseline, the mean depression score, as assessed by the EPDS, was 19·8 (SD 3·7) for the VFT group and 19·4 (3·80) for the PMR group, which is indicative of

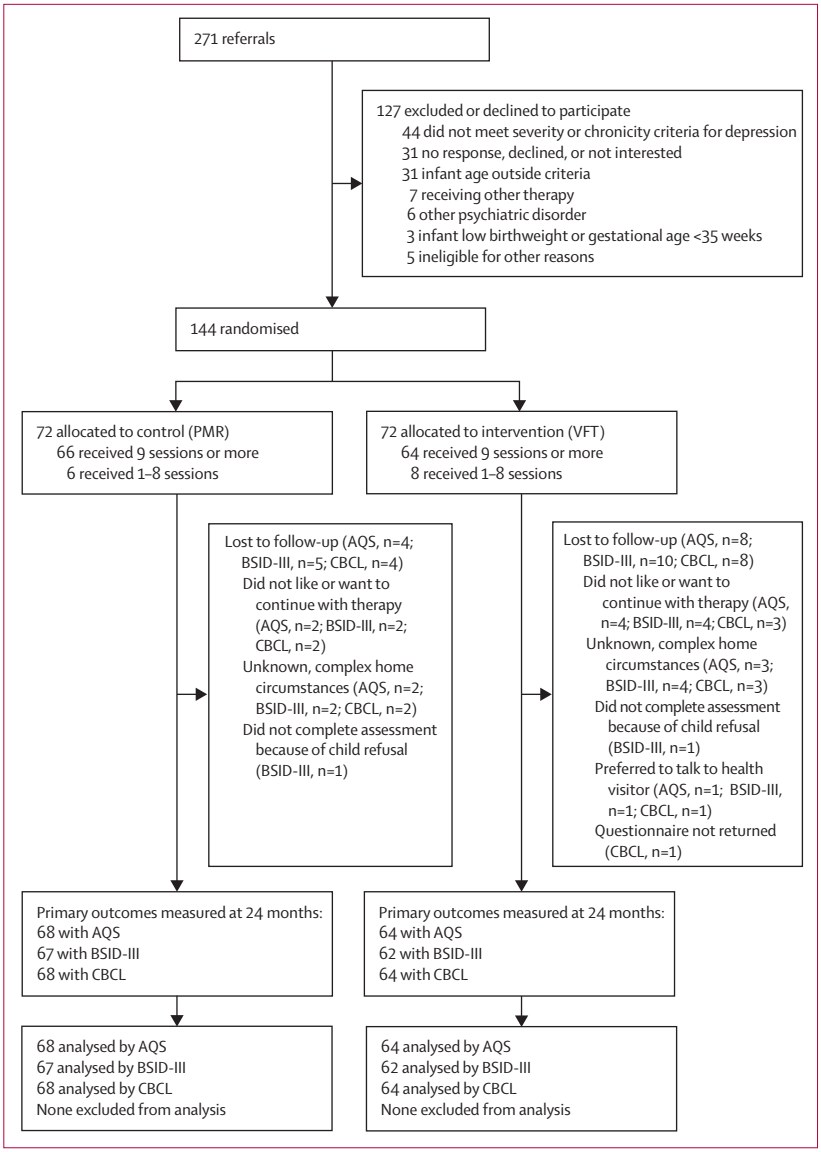

Figure: **Trial profile**

PMR=progressive muscle relaxation. VFT=video-feedback therapy. AQS=Attachment Q-Sort. BSID-III=Bayley Scales of Infant and Toddler Development-Third Edition. CBCL=Child Behaviour Checklist.

	PMR (control); n=72	VFT (intervention); n=72
Mother's age, years	32·2 (5·3)	31·7 (5·7)
Mother's ethnicity		
White British	58 (80·6%)	61 (84·7%)
Ethnicity other	14 (19·4%)	11 (15·3%)
Socioeconomic status		
Manual	19 (26·4%)	19 (26·4%)
Non-manual	53 (73·6%)	53 (73·6%)
Mother's educational qualifications		
No qualifications	3 (4·2%)	1 (1·4%)
School level education	23 (31·9%)	32 (44·5%)
Certificate or diploma of higher education	9 (12·5%)	7 (9·7%)
University degree	37 (51·4%)	32 (44·5%)
Severity of postnatal depression		
Severe	30 (41·7%)	30 (41·7%)
Moderately severe	42 (58·3%)	42 (58·3%)
Generalised anxiety disorder		
Yes	19 (26·4%)	29 (40·3%)
No	53 (73·6%)	43 (59·7%)
Post-traumatic stress disorder		
Yes	4 (5·6%)	6 (8·3%)
No	68 (94·4%)	66 (91·7%)
History of depression		
Yes: 1 episode	16 (22·2%)	27 (37·5%)
Yes: 2 or more episodes	30 (41·7%)	27 (37·5%)
No	26 (36·1%)	18 (25·0%)
Previous counselling or psychotherapy		
Yes	45 (62·5%)	51 (70·8%)
No	27 (37·5%)	21 (29·2%)
Current antidepressant use		
Yes	11 (15·3%)	18 (25·0%)
No	61 (84·7%)	54 (75·0%)
Infant's age, months	6·8 (1·9)	6·8 (2·0)
<7 months	43 (59·7%)	41 (56·9%)
≥7 months	29 (40·3%)	31 (43·1%)
Infant sex		
Male	37 (51·4%)	33 (45·8%)
Female	35 (48·6%)	39 (54·2%)
Infant temperament		
Difficult	15 (20·8%)	16 (22·2%)
Not difficult	57 (79·2%)	56 (77·8%)
Number of children	1·6 (0·6)	1·7 (0·6)
1	34 (47·2%)	31 (43·1%)
2	35 (48·6%)	35 (48·6%)
3 or more	3 (4·2%)	6 (8·3%)
Living with father		
Yes	64 (88·9%)	62 (86·1%)
No	8 (11·1%)	10 (13·9%)

Data are n (%) or mean (SD). PMR=progressive muscle relaxation. VFT=video-feedback therapy.

Table 1: **Baseline demographic and clinical characteristics**

severe depression (table 3). At the 2-year assessment, the mean depression score was 9·5 (SD 6·2) for the VFT group and 7·7 (4·5) for the PMR group. At both the 1-year and 2-year assessments, the EPDS scores for both treatment groups showed improvement, with significant changes from baseline within each group ($p<0·0001$) tested through a linear mixed-effects model. The results of the primary analysis, which assessed the mothers' EPDS scores at 1-year and 2-year assessments, indicated no significant difference at 1 year ($p=0·68$), but a significant, albeit small, difference at 2 years, with the PMR group scoring significantly lower than the VFT group (table 3). The mean scores at both 1-year and 2-year assessments were well below the screening threshold for depression (≥13).

A linear mixed-effects model was used to account for the repeated measures of the SCID-CSR. Baseline SCID-CSR severity means were 5·3 (SD 0·7) for the VFT group and 5·4 (0·6) for the PMR group (table 3). At 1 year, the mean SCID-CSR severity had decreased in both groups, and further decreased at 2 years, with significant decreases from baseline ($p<0·0001$) within each group; there were no significant differences between the groups (table 3). At 1 year, 55 (82·1%) of 67 VFT participants and 57 (83·8%) of 68 PMR participants no longer met the criteria for major depressive disorder. By 2 years the remission rates increased slightly, with 56 (88·9%) of 63 VFT and 58 (85·3%) of 68 PMR participants no longer meeting criteria for depression.

There were no differences between the groups on the other secondary outcomes (tables 4 and 5).

Parenting behaviour did not differ significantly between treatment groups (tables 6, 7). Following child's attention and contingent responsiveness improved in both groups from baseline to 1 year, and then again from 1 year to 2 years. Maternal warmth towards the child improved from baseline to 2 years in the VFT group but not in the PMR group. Sensitivity improved from baseline to 1 year and from baseline to 2 years in both groups, but an ongoing improvement from 1 year to 2 years was observed only in the VFT group (table 6). There were no differences between baseline and 1 year in the mind-mindedness ratings in either group (table 7). Since there was no effect of treatment group on the outcomes, analysis examining whether parenting behaviours mediated child outcome was not relevant.

There were five serious adverse events in the VFT group (in two participants). There was one serious adverse event in the PMR group. There were six adverse events in the VFT group (in four participants). There were four adverse events in the PMR group (in four participants). None was treatment related. Since the numbers were very small, we have not provided a detailed breakdown to prevent possible identification of participants. Details are available from AS if required.

Information on the data monitoring and ethics committee's review of efficacy and safety data are reported in the appendix. Results on maternal perceptions of treatment are also reported in the appendix.

Discussion

Postnatal depression is associated with a range of negative child outcomes, especially when it is persistent, mediated by parenting difficulties associated with the disorder. Our randomised controlled trial targeted this high-risk group by recruiting mothers with persistent postnatal depression. In the context of providing all women with a psychological treatment for depression (CBT), we compared a treatment focusing on mother–child interactions (VFT) with an active control treatment (PMR). At 2 years of age, we observed no significant differences between groups on any of the child outcomes, with these outcomes being similar to the norms for non-clinical populations.[30,33,41] Levels of maternal depression fell markedly across both groups by the end of treatment, with at least 80% of mothers no longer meeting diagnostic criteria. This improvement was sustained at 2 years post partum, with remission rates reaching 85%. There was a drop from baseline of almost 3 SD in depressive symptoms (EPDS) in both groups (with somewhat lower scores in the PMR group *vs* the VFT group). Thus, the majority of children were not exposed to maternal depression from the latter part of their first year through to the entire second year of life.

The key findings from this study are that, in a persistently depressed group of mothers who received an intensive home-based treatment, rates of remission were high and sustained and child development outcomes for both groups were close to the normative means.[30,32,33,41] These findings raise the possibility that treating maternal depression effectively and maintaining remission could be key to mitigating the longer-term negative effects of persistent postnatal depression on children.

Our findings raise two important questions. First, how were the high remission rates of maternal depression achieved? Second, given the commonly held view that providing treatment for the mother's depression alone is insufficient to lead to improvements in child outcomes,[17,18] how should this study's contrary findings be understood?

As noted by a US Preventive Services Taskforce paper in 2016, women with persistent and severe postnatal depression in the postnatal year have generally not been included in treatment studies, because of difficulties with recruitment and retention, as well as their complex therapeutic needs.[42] Furthermore, most treatment studies have targeted postnatal depression in the early postnatal months, rather than depression that persists beyond the first 3 months. The absence of intervention research on persistent postnatal depression is a notable gap in the literature, given the strong evidence for its association with both maternal depression continuing in the longer term and negative effects on the child.[6,43]

	PMR (control)	VFT (intervention)	Treatment difference (95% CI)	p value
Cognitive development (BSID-III)	n=67; 99·9 (12·9)	n=62; 99·2 (12·0)	–1·01 (–5·11 to 3·09)	0·63
Language development (BSID-III)	n=67; 102·0 (16·3)	n=62; 103·5 (17·2)	1·33 (–4·16 to 6·82)	0·63
Behaviour problems, externalising scale (CBCL)	n=68; 14·1 (7·2)	n=64; 12·5 (8·8)	–1·77 (–4·39 to 0·86)	0·19
Attachment security (AQS)	n=68; 0·35 (0·25)	n=64; 0·37 (0·20)	0·02 (–0·06 to 0·10)	0·58

Data are mean (SD) or adjusted treatment difference (95% CI). Linear mixed-effects model adjusting for infant age and sex, infant temperament, postnatal depression severity, and socioeconomic status. PMR=progressive muscle relaxation. VFT=video-feedback therapy. BSID-III=Bayley Scales of Infant and Toddler Development-Third Edition. CBCL=Child Behaviour Checklist. AQS=Attachment Q-Sort.

Table 2: **Primary outcomes at child age 2 years**

	PMR (control)	VFT (intervention)	Treatment difference (95% CI)	p value
EPDS				
Baseline	n=69; 19·4 (3·8)	n=66; 19·8 (3·7)	..	..
1 year	n=68; 9·3 (5·6)	n=67; 9·5 (4·9)	0·37 (–1·67 to 2·11)	0·68
2 years	n=68; 7·7 (4·5)	n=63; 9·5 (6·2)	1·93 (0·17 to 3·70)	0·032
SCID-CSR				
Baseline	n=72; 5·4 (0·6)	n=72; 5·3 (0·7)	..	..
1 year	n=65; 2·3 (1·7)	n=65; 2·4 (1·8)	0·11 (–0·46 to 0·68)	0·71
2 years	n=68; 1·8 (1·5)	n=63; 2·1 (1·8)	0·31 (–0·26 to 0·88)	0·29

Data are mean (SD) or treatment difference (95% CI). PMR=progressive muscle relaxation. VFT=video-feedback therapy. EPDS=Edinburgh Postnatal Depression Scale. SCID-CSR=Structured Clinical Interview for DSM IV Clinical Severity Rating.

Table 3: **Secondary outcomes of maternal depression**

	PMR (control)	VFT (intervention)	Treatment difference (95% CI)	p value
Barrier paradigm*				
Child emotion regulation	n=62; 2·0 (1·1)	n=61; 1·7 (0·97)	–0·32 (–0·70 to 0·07)	0·11
Attention*				
Attentional focusing	n=68; 4·3 (0·7)	n=63; 4·4 (0·8)	0·04 (–0·22 to 0·31)	0·74
Attentional shifting	n=68; 4·6 (0·6)	n=63; 4·7 (0·6)	0·16 (–0·03 to 0·36)	0·10
Inhibitory control	n=68; 4·0 (0·9)	n=63; 4·1 (0·9)	0·07 (–0·24 to 0·38)	0·65

Data are mean (SD) or treatment difference (95% CI). PMR=progressive muscle relaxation. VFT=video-feedback therapy. *ANCOVA model adjusting for infant age and sex, infant temperament, postnatal depression severity, and socioeconomic status.

Table 4: **Secondary outcomes at child age 2 years**

Our finding of sustained remission is particularly striking since this was a sample of women with persistent postnatal depression and high levels of severity, making spontaneous remission unlikely. Indeed, in the only postnatal depression intervention study in mothers with depression of equivalent duration and severity to those of our study population, the remission rate following a course of interpersonal psychotherapy was only 37·5%.[11]

We believe there were four major contributors to the high rates of remission observed in the present study.

	Sad			Neutral			Happy		
	PMR (n=34)	VFT (n=44)	Treatment difference*	PMR (n=34)	VFT (n=44)	Treatment difference*	PMR (n=34)	VFT (n=44)	Treatment difference*
Eyes	1·32 (1·14)	0·98 (0·70)	−0·34 (−0·74 to 0·06; p=0·10)	1·43 (1·20)	1·23 (0·89)	−0·19 (−0·65 to 0·27; p=0·42)	1·15 (0·98)	0·94 (0·75)	−0·15 (−0·52 to 0·23; p=0·43)
Face	3·44 (1·14)	3·47 (1·26)	−0·62 (−0·41 to 0·64; p=0·66)	3·32 (1·14)	3·26 (1·24)	0·00 (−0·53 to 0·52; p=0·99)	3·42 (1·14)	3·36 (1·25)	0·03 (−0·50 to 0·56; p=0·91)
Face scene	3·51 (1·16)	3·54 (1·21)	0·13 (−0·39 to 0·65; p=0·62)	3·40 (1·18)	3·37 (1·18)	0·03 (−0·49 to 0·55; p=0·91)	3·51 (1·18)	3·46 (1·17)	0·07 (−0·44 to 0·58; p=0·79)
Mouth	1·05 (0·94)	1·07 (0·82)	0·07 (−0·32 to 0·46; p=0·72)	0·92 (1·01)	0·82 (0·72)	−0·05 (−0·43 to 0·33; p=0·79)	1·04 (1·10)	1·03 (0·91)	0·02 (−0·43 to 0·47; p=0·92)

Data are mean (SD) or adjusted treatment difference (95% CI) on fixation duration to different facial features where faces are classified as sad, neutral, or happy. PMR=progressive muscle relaxation. VFT=video-feedback therapy. *Linear regression model adjusting for infant age and sex, infant temperament, postnatal depression severity, and socioeconomic status.

Table 5: **Secondary outcome of emotion discrimination task at 2 years of age**

	1 year			Change between 1 year and baseline			Change between 2 years and 1 year			Change between 2 years and baseline		
	PMR (n=68)	VFT (n=67)	p value*	PMR† (n=68)	VFT† (n=67)	p value*	PMR† (n=68)	VFT† (n=64)	p value*	PMR† (n=68)	VFT† (n=63)	p value*
Following child's attention	4·00 (3·42–4·58)	4·00 (3·33–4·00)	0·18	0·67 (0·33–1·17) p<0·0001	0·67 (0·00–1·17); p<0·0001	0·29	0·75 (0·33–1·67); p<0·0001	1·00 (0·50–1·42); p<0·0001	0·14	1·5 (1·08–1·75); p<0·0001	1·42 (1·13–1·96); p<0·0001	0·87
Contingent responsiveness	4·00 (3·33–4·33)	3·67 (3·33–4·00)	0·46	0·33 (0·00–1·00); p<0·0001	0·67 (0·00–1·00); p<0·0001	0·80	0·79 (0·21–1·25); p<0·0001	0·83 (0·50–1·33); p<0·0001	0·48	1·33 (0·96–1·67); p<0·0001	1·33 (0·88–1·79); p<0·0001	0·79
Sensitivity	4·00 (3·33–4·33)	4·00 (3·33–4·33)	0·45	0·33 (0·00–1·00); p<0·0001	0·67 (0·00–1·00); p<0·0001	0·81	−0·08 (−0·33 to 0·42); p=0·37	0·17 (−0·25 to 0·58); p=0·053	0·078	0·50 (0·08–0·88); p<0·0001	0·71 (0·21–1·25); p<0·0001	0·076
Warmth	4·00 (3·42–4·33)	4·00 (3·33–4·00)	0·43	0·00 (−0·33 to 0·67); p=0·26	0·00 (−0·67 to 0·33); p=0·67	0·098	−0·04 (−0·50 to 0·33); p=0·30	0·17 (−0·25 to 0·67); p=0·070	0·10	0·00 (−0·33 to 0·54); p=1·00	0·21 (−0·21 to 0·58); p=0·030	0·25

Data are median (IQR). PMR=progressive muscle relaxation. VFT=video-feedback therapy. *Mann-Whitney *U* test. †p value for paired Wilcoxon signed rank test.

Table 6: **Parenting variables across treatment groups and change from baseline to 2 years**

	PMR (control)	VFT (intervention)	Treatment difference (95% CI)*	p value
1 year	n=65; 0·73 (0·47)	n=65; 0·73 (0·45)	−0·01 (−0·17 to 0·15)	p=0·91
Change between 1 year and baseline	n=64; 0·14 (0·68)	n=65; 0·09 (0·61)	−0·07 (−0·30 to 0·16)	p=0·53

Data are mean (SD) or treatment difference (95% CI). Outcomes are expressed as a proportion where the total count of appropriate mind-minded comments is divided by the maternal vocalisation rating score. PMR=progressive muscle relaxation. VFT=video-feedback therapy. *Linear regression model adjusting for infant age and sex, infant temperament, postnatal depression severity, and socioeconomic status.

Table 7: **Maternal parenting variable of mind-mindedness across treatment groups and change from baseline to 1 year**

The first concerns the intensive nature of the treatment, with the majority of participants receiving almost all of the 11 treatment sessions. The second concerns the content of the CBT treatment, which was tailored to the postnatal period and focused on issues facing a mother with a young infant. Third, two booster sessions in the second year were included to reinforce the benefits of treatment and address relapse prevention. Boosters have been shown to be important in maintaining and enhancing positive treatment effects in primary care settings.[44] Finally, the treatment was home-based. This was positively received, and many mothers said they felt more comfortable receiving help in their own homes than in a clinic.

The second issue to be addressed is that child outcomes did not appear to be compromised at 2 years in either of the two treatment groups, despite the fact that one of the groups did not directly address the mother–child relationship. Indeed, for both treatment groups, scores were similar to the norms of non-clinical populations on all child outcomes. This finding is at variance with the view that treating maternal depression alone is not sufficient to mitigate the effects of maternal depression on the child.[9,17,18] However, some distinctive features of our study could have accounted for these results: the completion rate of treatments was high, and treatment was delivered over a prolonged period. Perhaps most notably, we found a marked and sustained improvement in maternal mood in both groups. This observation suggests that the favourable child outcome achieved in both groups was because the majority of children were not exposed to significant maternal depression from the end of their first year up to the age of 2 years. This view is consistent with evidence that children exposed to adverse caregiving environments that persist through their second year of life are particularly at risk of poor developmental outcomes, whereas those exposed only in their first year largely escape this risk.[45] This explanation is likely because the second year is a period when several key developmental capacities (eg, language and emotion regulation) are becoming consolidated. Furthermore,

developmental outcomes at this stage show stability and are relatively robust predictors of future development.[29]

It is possible that VFT and PMR might each have had additional positive effects on child outcome, over and above the benefit to maternal depression, albeit through different mechanisms. VFT is a specific parenting intervention, whereas PMR might have influenced parenting indirectly by reducing stress, and thereby helping mothers respond to their infants.

A remaining issue is whether there are specific subgroups that might benefit from a parenting intervention in addition to treatment for depression. One important example is socioeconomic disadvantage, as observational studies have shown that the risk of adverse effects of postnatal depression on child outcomes is especially raised in this context. However, to our knowledge, no intervention study to date has targeted persistent postnatal depression in socioeconomically disadvantaged populations. Thus, it is difficult to speculate as to whether child outcomes might be different in this context, and therefore this is an important area for future research. An additional group of interest is women with comorbidities such as GAD and PTSD. In our sample, however, neither disorder, nor the use of antidepressants at baseline, moderated child outcomes.

A key strength of the present study is that the group studied was a high-risk sample of mothers recruited because of persistent depression that placed their children's development at particular risk. There was high acceptability of treatments and low loss to follow-up. Home-based treatment meant that a high proportion of sessions were completed and there was low attrition, with 90% of participants judged to have received an adequate exposure to the intervention.

Limitations of the study included a relatively high education level of the sample as a whole; the CBCL being mother-rated, rather than being rated by an independent assessor; and the home-based setting of the treatment: it is not routine practice to have trained clinical psychologists provide intensive home-based treatment. However, given the need to provide effective treatments for mothers and infants at high risk[46] and the acceptability and uptake of home-based treatments for women with a young infant, policies might need to incorporate this option. The fact that PMR is an effective treatment for anxiety is another limitation given the high rates of anxiety in both groups. Nonetheless, rates of remission from GAD did not differ between the groups (appendix) and baseline GAD did not moderate the outcome.

Recent research has emphasised the economic costs of perinatal mental illness, especially because of the effects on the child. Thus, addressing the needs of women with postnatal depression and their children is crucial and likely to yield important benefits to child development and to reduce costs to society. The results of this trial, done on a high-risk group of mothers with persistent postnatal depression, whereby risks to the child are especially elevated, suggest that if treatment for maternal depression successfully leads to remission, and the improvements in maternal mood are sustained, the adverse effects on children's development can be largely mitigated. Our findings indicate that it is possible to achieve high rates of remission, even for persistent and severe postnatal depression, with intensive home-based psychological treatments tailored to the postnatal period. If these findings are replicated, they suggest that policy should focus on identifying women with persistent postnatal depression and providing them with accessible and effective treatment for their depression to both help the mothers and improve their children's life chances.

Contributors

AS, LM, and PJC designed the study and were responsible for its conduct. MGC provided input on the design of the PMR and CBT interventions and supported the supervision and management of these interventions. PJL, CG, and CK provided the treatment and contributed to the development of all the treatment manuals. DAS was responsible for the development of the CBT treatment and its supervision, and development of manuals. EN, ER, and VW were responsible for the collection and management of study data. GS was responsible for the measures of child attention, emotion discrimination tasks, and eye tracking data processing and extraction. JM, AN, AS, and EN drafted the analysis plan, AN did the statistical analysis. AS, LM, PJC, EN, MGC, JM, and AN interpreted the data. AS, EN, LM, and PJC drafted the manuscript. All authors were involved in critically revising the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

Declaration of interests

We declare no competing interests.

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For more information about the **MacBrain Face Stimulus Set** contact Nim Tottenham at tott0006@tc.umn.edu

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