

Mom-Net: Evaluation of an Internet-Facilitated Cognitive Behavioral Intervention for Low-Income Depressed Mothers

Lisa B. Sheeber, Edward G. Feil, John R. Seeley,
Craig Leve, Jeff M. Gau, and Betsy Davis
Oregon Research Institute

Erik Sorensen
Eugene, Oregon

Steve Allan
Options Counseling, Eugene, Oregon

Objective: Evaluate an Internet-facilitated cognitive-behavioral treatment intervention for depression, tailored to economically disadvantaged mothers of young children. **Method:** Economically disadvantaged mothers ($N = 266$) of preschool aged children, who reported elevated levels of depressive symptoms, were randomized to either the 8-session, Internet-facilitated intervention (Mom-Net) or to Motivational Interviewing and Referral to Services (MIRS). Outcomes were measured using the Patient Health Questionnaire 9 (PHQ-9; Spitzer et al., 1999), the Structured Clinical Interview for *Diagnostic and Statistical Manual for Mental Disorders-Fourth Edition-Text Revised (DSM-IV-TR)* Axis I Disorders (SCID; First, Spitzer, Gibbon, & Williams, 2002), and the Hamilton Depression Rating Scale (HDRS; Hamilton, 1960). **Results:** Relative to participants in the MIRS condition, participants in Mom-Net demonstrated significantly greater reduction in depression as indexed by self-report questionnaire (primary outcome), interviewer-rated symptoms, and diagnostic outcomes. **Conclusions:** Results suggest that the Mom-Net intervention is effective as a remotely delivered intervention for economically disadvantaged mothers.

What is the public health significance of this article?

This study suggests that cognitive-behavioral therapy delivered remotely over the Internet will help mothers suffering from depression.

Keywords: depression, mothers, internet intervention, cognitive behavioral treatment

Socioeconomically disadvantaged mothers of young children are at particular risk for unipolar depressive symptoms and disorder (Malik et al., 2007; McLennan, Kotelchuck, & Cho, 2001; Weissman & Jensen, 2002). Though the disability associated with depression is well documented (McQuaid, Stein, Laffaye, & McCahill, 1999; Moussavi et al., 2007), some of the greatest costs of depressive conditions are those borne by the children of depressed mothers. Children of women with depressive syndromes are at increased risk for both internalizing and externalizing difficulties (Goodman, Lamping, & Ploubidis, 2010) as well as for impairments in cognitive and language development (Chapin & Altenhofen, 2010; Cycyk, Bitetti, & Hammer, 2015). The intergenera-

tional transmission of psychopathology appears to be attributable, in part, to environmental influences associated with depressive symptomatology (Hummel & Kiel, 2015; Natsuaki et al., 2014; Radke-Yarrow & Klimes-Dougan, 2002). Depressed women evidence adverse parenting behavior characterized by less positive, less engaged, and more critical/harsh parenting than do nondepressed women (Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Wang & Dix, 2013). Significantly, mounting evidence indicates that improvement in maternal depression is associated with gains in positive parenting behavior, parenting efficacy, parent-child interactions, and child symptoms (Cuijpers, Weitz, Karyotaki, Garber, & Andersson, 2015; Ewell, Foster, Weissman, & Durlak, 2008; Garber, Ciesla, McCauley, Diamond, & Schloedt, 2011; Goodman, Broth, Hall, & Stowe, 2008; Shaw, Dishion, Connell, Wilson, & Gardner, 2009; Weissman et al., 2006), and suggests the potential benefits of intervention for depressed mothers.

A wealth of research supports the effectiveness of cognitive-behavioral therapy (CBT) interventions for depression (Cuijpers, Muñoz, Clarke, & Lewinsohn, 2009; Gloaguen, Cottraux, Cucherat, & Blackburn, 1998; National Institute of Mental Health [NIMH], 2003) in general and maternal depression, in particular (Ammerman et al., 2013; Chronis-Tuscano et al., 2013; Milgrom, Negri, Gemmill, McNeil, & Martin, 2005; Milgrom, Schembri,

Lisa B. Sheeber, Edward G. Feil, John R. Seeley, Craig Leve, Jeff M. Gau, and Betsy Davis, Oregon Research Institute; Erik Sorensen, Independent Practice, Eugene, Oregon; Steve Allan, Options Counseling, Eugene, Oregon.

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Correspondence concerning this article should be addressed to Lisa B. Sheeber, Oregon Research Institute, 1776 Millrace Drive, Eugene, OR 97403. E-mail: lsheeber@ori.org

Ericksen, Ross, & Gemmill, 2011; cf. Verduyn, Barrowclough, Roberts, Tarrrier, & Harrington, 2003). In each of these studies of maternal depression, the interventions have been tailored to address issues related to parenting and family relationships.

Despite the availability of efficacious interventions, however, most depressed persons do not access treatment readily (NIMH, 2003; Wang et al., 2005; Weissman & Jensen, 2002), and this treatment gap is exacerbated among low-income persons (Wang et al., 2005). Among the many potential barriers, several of the most substantial, including lack of mental health coverage, childcare, and transportation, differentially affect women of low socioeconomic status (NIMH, 2003; Weissman & Jensen, 2002). Thus, it is of critical importance to develop nontraditional service delivery systems to overcome barriers to treatment utilization. One approach to overcome barriers has been to integrate CBT into in-home visitation programs for at-risk mothers (Ammerman et al., 2013). Another approach has been through the use of Internet-delivered CBT. Because online interventions allow greater flexibility to access services at times and places convenient to the user, and reduce costs associated with travel and therapist time, there is potential for them to overcome many of the barriers facing underserved populations. Moreover, because this approach enables remote delivery, it has particular promise for addressing the challenge posed by the scarcity of providers in rural areas (Gale & Deprez, 2003). It is notable in this regard that among Americans living in rural areas, as well as those living in poverty, approximately two-thirds report Internet use (Horrigan, 2009).

Internet-based CBT programs for depression have shown significant promise (i.e., Andersson & Cuijpers, 2009; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Hedman, Ljótsson, & Lindfors, 2012), including interventions targeting new mothers (Danaher et al., 2013; Milgrom et al., 2016; O'Mahen et al., 2014). Meta-analytic data indicate that effects obtained by supported-Internet interventions (i.e., those including modest interaction with a coach or therapist) are comparable with those obtained in face-to-face therapy (Cuijpers, Donker, van Straten, Li, & Andersson, 2010). Supported interventions, moreover, evidence both better program adherence (Mohr, Burns, Schueller, Clarke, & Klinkman, 2013) and stronger effects than nonsupported interventions (Andersson, Bergström, Carlbring, & Lindfors, 2005; Andersson & Cuijpers, 2009; Kleiboer et al., 2015; Spek et al., 2007).

Mom-Net

In prior work, we developed and piloted Mom-Net, an Internet-facilitated, cognitive-behavioral treatment for depression, tailored to mothers of young children (Sheeber et al., 2012). The content foundation for the program was the Coping with Depression Course (CWDC; Lewinsohn, Antonuccio, Breckenridge, & Teri, 1984; Lewinsohn, Clarke, Rohde, Hops, & Seeley, 1996). We chose the CWDC because its extensive history of successful adaptation suggested both that it is amenable to diverse delivery modalities and that core content could be tailored to suit disparate populations (Cuijpers et al., 2009), including depressed and at-risk mothers (Chronis, Gamble, Roberts, & Pelham, 2006; Milgrom et al., 2005) and low-income individuals (Miranda et al., 2003). Mom-Net was designed as an integrated program consisting of both coach support and online materials. Core content is presented via online tutorials. Coaches use session-specific phone calls to assist mothers in understanding and

applying the CBT strategies as well as to address barriers to implementation and engagement.

Content adaptations were based on research indicating that material perceived to be of high personal relevance is learned more easily (Knowles & Associates, 1984) and translated more effectively into behavioral change (Kreuter & Holt, 2001). To this end, the rationale for the intervention was expanded to cover the relations between depressive symptoms and parenting. Moreover, the teaching of each skill included a discussion of its relevance for improving both mood and parenting behavior. These adaptations were informed by the work of Milgrom, Martin, and Negri, (1999), who adapted the CWDC for treatment of postpartum depression. As well, participants were taught to implement the strategies in the context of parent-child interactions. The intervention was shortened to eight from 12 sessions because of the difficulty of maintaining engagement over longer periods (Christensen, Griffiths, & Farrer, 2009).

In our administration of Mom-Net, initiation of the intervention is preceded by a brief motivational interview (MI; Miller & Rollnick, 2002). The MI is intended to address motivational deficits that can be a barrier to participation in depressed populations, resulting in pervasive problems with attendance, homework completion, and ultimately, drop out (Weissman & Jensen, 2002). Brief preintervention MI is effective in promoting participation across a range of interventions and populations (e.g., Nock & Kazdin, 2005; Walitzer, Dermen, & Connors, 1999).

In an initial, tightly controlled efficacy trial (Sheeber et al., 2012), 70 women with elevated depressive symptoms were randomized to either the Mom-Net intervention or a delayed intervention/facilitated treatment as usual condition (DI/TAU). Participants in both conditions were provided with a computer, printer, and Internet access. Participants in both conditions participated in a preintervention, in-home motivational interview. Sixty-nine of 70 participants completed posttest assessments. Participants assigned to the Mom-Net condition were highly engaged, completing an average of 6.37 out of 8 sessions ($SD = 2.56$, median = 8.00) with 63% completing the entire intervention. They participated in an average of 6.70 coach calls ($SD = 2.11$). Self-reported satisfaction with Mom-Net, as assessed with an adaptation of the Therapy Attitude Inventory (Brestan, Jacobs, Rayfield, & Eyberg, 1999) was high, averaging over 4 on each 5-point scale. Results indicated a large and significant effect of the Mom-Net intervention over the control condition on the primary treatment outcome measure of maternal depression as assessed by the BDI (Beck, Steer, & Brown, 1996). Results were maintained at 12 week follow up and replicated when participants in the DI/TAU condition subsequently received the intervention.

The Present Study

Though the efficacy trial demonstrated high levels of engagement, satisfaction, and efficacy, it was conducted with a small sample and under the tightly controlled conditions typical of initial efficacy tests. In particular, to provide equal access to the technology, computers and Internet connections were supplied to all participants, the coaches who provided phone support were research staff, and initial recruitment and MI sessions were conducted via home visits to participants. These conditions likely facilitated recruitment and retention of participants, as well as ease and fidelity of treatment delivery. Additionally, as only one-third of the DI/TAU participants accessed services in the community, the control condition was less rigorous than desired.

The goal of the current project, therefore, was to evaluate Mom-Net intervention effects within a larger trial under conditions that were more rigorous and closer (though not identical) to those of real-world service providers and recipients. As well, because one of the advantages of Internet delivery is to overcome access barriers, participant recruitment included rural areas. To this end, the current investigation is different in several ways from the initial trial. First, in the initial trial, coach contact was not provided for participants in the DI/TAU condition, and hence, we could not rule out the possibility that greater improvement for those in the Mom-Net condition was because of the effect of supportive attention from research staff. Thus, in the current investigation, participants in the comparison condition received bi-weekly calls from research staff who used an MI approach to facilitate engagement in services or other behavioral change activities. Second, to approximate real-world conditions, (a) coaching sessions for those in the Mom-Net condition were conducted by therapists employed by a not-for-profit agency providing community mental health services; (b) participants were not provided Internet access or gifted computers, though a small number ($n = 6$) accessed the program through laptops borrowed from the mental health agency; and (c) the MI preceding the intervention for both conditions was conducted by phone rather than in a home visit.

Method

Trial Design

Participants were individually randomized (allocation ratio of 1:1) into two parallel intervention groups: Internet-facilitated CBT intervention (Mom-Net) or Motivational Interview and Referral to Services (MIRS). Research staff was blind to randomization sequence until allocation was revealed during the MI that preceded the intervention. The trial was conducted with approval of an appropriate institutional review board and registered with [ClinicalTrials.gov](http://www.clinicaltrials.gov).

Participants and Inclusion Criteria

Participants were 266 low-income mothers (aged 17.7 to 59.8) of preschool aged children. Inclusion criteria were major or minor depressive disorder as reported on a screening assessment with the Patient Health Questionnaire-8 (PHQ-8; Kroenke & Spitzer, 2002), the ability to comprehend spoken English, and living at or below 185% of the federal poverty level. To be screened in as meeting criteria for major or minor depression, participants had to endorse either the depressed mood or anhedonia symptoms at the level of at least "more than half the days," report impairment in social functioning, and endorse a total of five symptoms (for major depressive disorder) or two symptoms (for minor depressive disorder) at the level of at least "more than half the days" on the PHQ-8. Presence of a full scale diagnosed maternal depressive disorder was not a prerequisite for inclusion given evidence that elevated maternal depressive symptoms are associated with parenting difficulties and higher risk for adverse child outcomes regardless of diagnostic status (Lovejoy et al., 2000). Based on subsequent responses to the Structured Clinical Interview for *Diagnostic and Statistical Manual for Mental Disorders-Fourth Edition (DSM-IV; SCID; First, Spitzer, Gibbon, & Williams, 1997)*, 59.8% of the sample met *DSM-IV* criteria for Major Depressive Disorder, 2.6% for Dysthymia, 2.3% for Minor Depres-

sive Disorder (American Psychiatric Association, 2000) and 5.3% met criteria for Bipolar conditions. Outreach to communities with less access to resources was prioritized such that 37% of residents lived in communities that were micropolitan or more rural as defined by Rural-Urban Commuting Area Codes (RUCA2; Hart, Larson, & Lishner, 2005; <http://depts.washington.edu/uwruca/ruca-data.php>). Participants were enrolled regardless of whether they were involved in community-based treatments. Demographic data are presented in Table 1.

Recruitment and Assessment Procedures

Screening. Head Start centers in micropolitan and smaller communities in Oregon were our primary point of contact, but to bolster recruitment and increase the diversity of the sample, we also invited women receiving services in two midsize cities through both Head Start and a local department of human services, and posted ads in a local circular targeted toward families. Potential participants received an invitation letter and the PHQ-8 (Kroenke & Spitzer, 2002). The letter provided the informed consent information for the screening. The questionnaire was printed such that the answers (but not the questions) were recorded on a \$20 check.¹ This methodology allowed for convenient completion and compensation, and was used in previous research (Feil et al., 2007; Sheeber et al., 2012). The invitation letter explained that if they completed the questionnaire, provided contact information on the check, and cashed the check, this would indicate consent to the screening and to being contacted by research staff if they were selected for possible further participation.

Assessment and assignment. Informed consent information and questionnaires were collected by mail. Diagnostic interviews and motivational interviews were completed by phone by research staff. Randomization was accomplished by placing allocations in sealed envelopes that were shuffled before assignment. Research staff was blind to condition during the diagnostic interview and up until the point in the MI in which treatment options were discussed, at which point, staff opened the envelope containing the condition assignment. Postassessments were conducted after the intervention period (T2; 26.2 weeks after T1); interviewers conducting the diagnostic interviews were blind to condition. Participants were compensated for each assessment. Figure 1 presents the participant flow diagram, utilizing Journal Article Reporting Standards (JARS).

Measures

Maternal depression. The PHQ-8 was administered as a screening instrument to determine study eligibility (Cronbach's $\alpha = .89$ for current sample). Subsequently, the PHQ-9 was administered as an index of depressive symptoms at each full assessment point (Cronbach's $\alpha = .85$). The reliability and diagnostic accuracy of both versions of the PHQ are well established (Kroenke & Spitzer, 2002; Kroenke, Spitzer, & Williams, 2001; Kroenke et al., 2009; Spitzer, Kroenke, & Williams, 1999). The Structured Clinical Interview for *DSM-IV-TR* Axis I Disorders (First et al., 2002) was administered by trained interviewers by

¹ Questions were not printed on the check so that responses were not interpretable by bank staff.

Table 1
Baseline Demographics, Outcomes, and Treatment Utilization by Condition

Demographics	Mom-Net (<i>n</i> = 134)	MIRS (<i>n</i> = 132)	Test statistic
Latino/Hispanic/Spanish <i>n</i> (%)			
Mother	17 (12.7)	14 (10.6)	.28
Racial category <i>n</i> (%)			2.54 ^a
White	106 (79.1)	105 (79.5)	
Non-Caucasian	4 (3.0)	9 (6.8)	
More than one race	15 (11.2)	11 (8.3)	
Not reported	9 (6.7)	7 (5.3)	
Education <i>n</i> (%)			1.18
Less than high school	21 (15.7)	19 (14.4)	
High school	24 (17.9)	28 (21.2)	
Vocational	8 (6.0)	11 (8.3)	
Some college	68 (50.7)	62 (47.0)	
Bachelor's degree or higher	13 (9.7)	12 (9.1)	
Marital status <i>n</i> (%)			11.09
Married	55 (41.0)	52 (39.4)	
Living together	30 (22.4)	23 (17.4)	
Divorced/separated	14 (10.4)	32 (24.2)	
Widowed	0 (0)	1 (0.8)	
Single	35 (26.1)	24 (18.2)	
Mother's age <i>M</i> (<i>SD</i>)	31.4 (7.0)	32.2 (7.5)	-.90

Note. MIRS = Motivational Interviewing and Referral to Services.

^a Because of low frequencies, we tested Caucasian vs. Non-Caucasian; "not reported" cases were excluded from the analysis (*n* = 16). All Bonferroni-corrected test statistics were nonsignificant.

phone to obtain affective diagnoses; to minimize respondent burden, only those modules relevant to diagnosis of depressive disorders were included. Interrater reliability on the SCID was excellent ($\kappa = .89$). Finally, the 17-item Hamilton Depression Rating Scale (HDRS; Hamilton, 1960) was collected as part of the diagnostic interview to assess interviewer-rated depression severity (Cronbach's $\alpha = .82$). Each of these measures has been shown to be sensitive to change (e.g., Danaher et al., 2013; Titov et al., 2011).

Potential moderators. Several indices were used to assess potential moderators of treatment effects. A demographic form queried marital status and income. Recruitment source was tracked at screening. Economic stress was assessed with Conger and Elder's (1994) measure of financial strain. Anxiety was measured with the Generalized Anxiety Disorder 7-item scale (Spitzer, Kroenke, Williams, & Lowe, 2006) a widely used index of anxiety symptoms. Substance use was indexed as frequency of use of licit and illicit substances as assessed with the Monitoring the Future Survey (O'Malley, Johnston, Bachman, Schulenberg, & Kumar, 2006). Depression severity, as assessed by the PHQ-9, and presence of Bipolar Disorder, as assessed by the SCID, were also included as potential moderators.

Treatment process. To assess treatment engagement in the Mom-Net condition we used computer-generated data, captured in real time, with regard to modules and coach calls completed, time spent online on Mom-Net program pages (page timeout was 5 min of inactivity), and number of program visits (i.e., number times Mom-Net website was accessed). These variables are well-established as indicants of treatment usage (Christensen et al., 2009; Donkin et al., 2011, 2013). Number of coach calls was also documented for the MIRS condition. Usability and satisfaction

with the Mom-Net intervention was assessed at postintervention with an adapted version of the System Usability Scale (Sauro, 2011) and a series of 5-point Likert rating scales regarding the helpfulness of Mom-Net content and activities and the acceptability of characteristics of the coach calls. These items were modeled after the Therapy Attitude Inventory (Brestan et al., 1999) and used in our previous trial of the Mom-Net program (Sheeber et al., 2012). Coach fidelity with call scripts was assessed via session specific content adherence during coach calls for participant completed sessions.

Community-service utilization. Participants' report of community-based service utilization for behavioral or mental health difficulties was documented at each assessment. With written consent, we contacted providers to obtain verification of service provided.

Interventions

A motivational interview was conducted before intervention with participants in *both conditions*. During the interview, staff provided feedback from the initial depression screener and explored how depressive symptoms impacted the participants' life, the participants' desire for change, prior change efforts, and impediments or ambivalence about addressing depressive symptoms. The interviewer then encouraged the participant to make a decision as to whether participating in the project as a way to address depressive symptoms was desirable to them at current time. For participants in the Mom-Net condition, the MI ended with a brief *role induction* that outlined what to expect from the intervention and the behaviors on the part of the client that were recommended for a successful experience. Role induction has been found to improve participation in treatment (Walitzer et al., 1999). The interview took 60–90 min.

Mom-Net intervention. Mom-Net consists of eight sessions focused on CBT skills for the treatment of depression. Participants were permitted 4 months to complete the intervention (*Ms* duration 70 days). Session content, outlined in Table 2, includes both core CBT skills (left column), and adaptations relevant to mothers of young children (right column). Relative to the original CWDC, Mom-Net had a greater emphasis on positive affect and behavioral activation (Hopko, Lejuez, Ruggiero, & Eifert, 2003; McMakin, Siegle, & Shirk, 2011), and lesser focus on cognitive restructuring.

We designed the program in accordance with principles of quality instructional design (Kameenui & Carnine, 2001), with a particular focus on design principles relevant to promoting self-regulated learning. Effective instructional design facilitates learning by reducing the cognitive load so as to not tax the learner's working memory (Kirschner, 2002). This focus is particularly important in an intervention for individuals with depressive symptoms given their difficulties with cognitive processes and vulnerability to depressogenic thoughts under conditions of stress (Wenzlaff & Bates, 1998). Key structural elements, consistent with these principles included: (a) *judicious review*, wherein earlier concepts are revisited in subsequent sessions, varied examples are used to promote generalization, and homework is used to provide practice; (b) *conspicuous and integrated strategies*, in which the component steps of each skill are taught to mastery before they are integrated; and (c) *mediated scaffolding*, such that models and feedback are provided to the learner

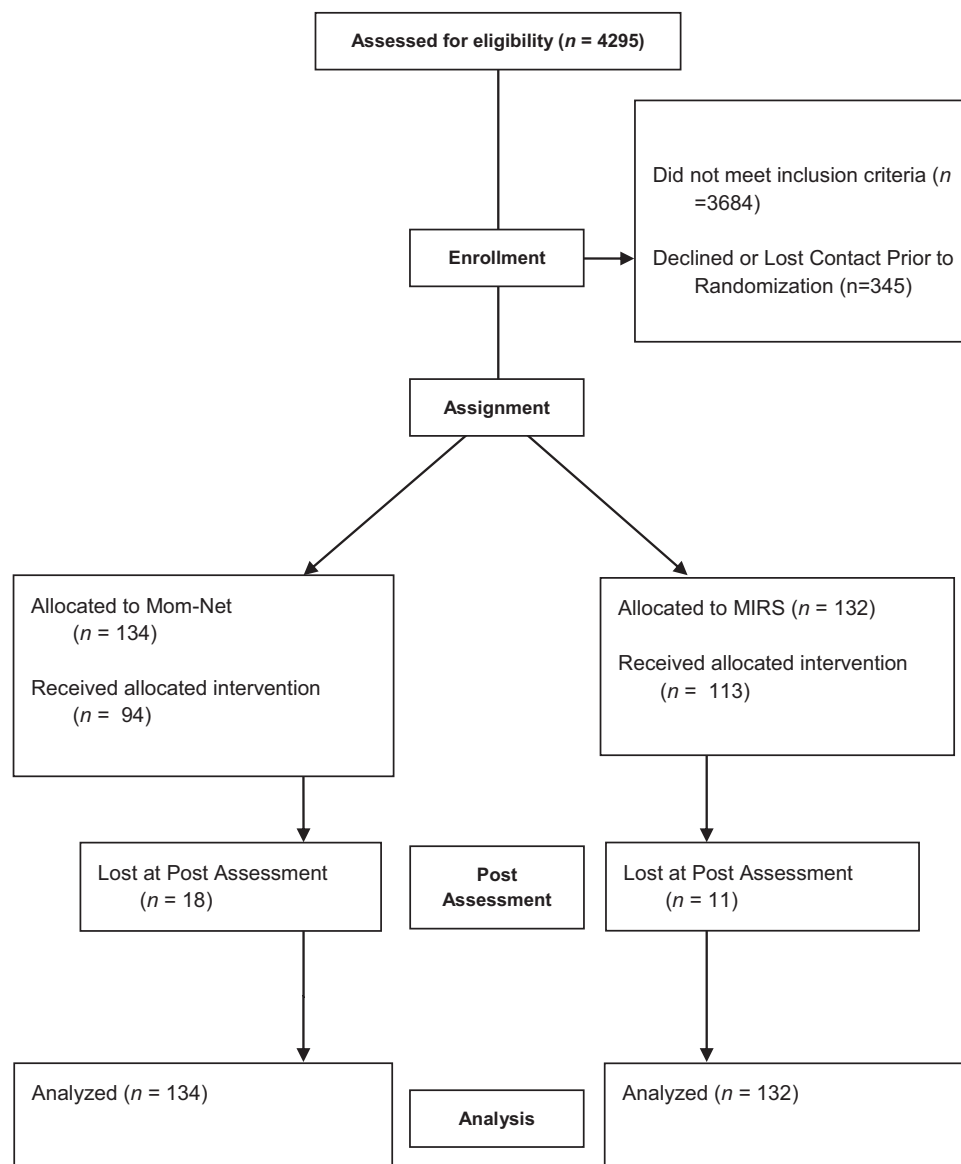


Figure 1. This flow diagram, utilizing Journal Article Reporting Standards (JARS) guidelines, depicts the numbers of participants at each assessment, and allocation to study conditions.

and faded as mastery is achieved (Kameenui & Carnine, 2001). In Mom-Net, the scaffolding was provided via immediate feedback from the computer program as well as by the coach. Another key structural feature was the use of varied multimedia materials and interactive elements to maintain participant engagement. We developed a competency-based approach in which knowledge acquisition was examined at the completion of each session. The goal was to achieve mastery (i.e., 80% correct responses) before the user proceeded to the next module. The program identifies incorrect responses, reviews related content, and retests the material, as needed. Most text elements are accompanied by corresponding audio and the remaining elements have optional narration to reduce literacy requirements. Participants were prompted to complete a PHQ-9 biweekly for safety monitoring.

Coaches were staff at the community mental health agency implementing the program. Of 7 coaches, 5 were masters level therapists and 2 were bachelor level paraprofessionals. Before initiating the trial, coaches participated in 2 days of training conducted by one of the intervention developers (ES), who served as one of the clinical supervisors. Training included didactic presentations and practice in MI and CBT skills as well as in protocols for responding to clinical emergencies. During the trial, coaches participated in weekly supervision with the trainer and a clinical supervisor at the agency.

Coaches scheduled phone conferences with participants to correspond with each Mom-Net session. The average duration of calls was 33.5 min. Coaches assisted mothers in understanding and applying the CBT strategies. They recognized participants' accomplishments, reviewed content that the participant had not yet "mastered," and

Table 2
Mom-Net Content

Sessions	Core CBT	Parenting focus
1	<ul style="list-style-type: none"> • Understanding depression • Intervention description 	Intervention rationale <ul style="list-style-type: none"> • Prevalence of maternal depression • Influence of depression on parenting and child well-being
2–3	<ul style="list-style-type: none"> • Mood monitoring • Increasing adult-focused pleasant events • Self-assessment 	Behavioral activation <ul style="list-style-type: none"> • Increasing positive parent–child activities • Overcoming barriers: Time, money, mood, child fussiness
4–5	<ul style="list-style-type: none"> • Importance of social support • Building a healthy support network 	Interpersonal skills <ul style="list-style-type: none"> • Importance of playing with children • Play skills • Barriers to enjoying play
6	<ul style="list-style-type: none"> • Savoring positive events • Anticipating positive events 	Cognitive skills: Positive thoughts <ul style="list-style-type: none"> • Savoring parent–child time • Anticipating positive parent–child time
7	<ul style="list-style-type: none"> • Identifying negative thoughts • Responding to negative thoughts 	Cognitive skills: Negative thoughts <ul style="list-style-type: none"> • Identifying and responding to negative thoughts regarding your child and your parenting
8	<ul style="list-style-type: none"> • Skill integration • Anticipating problems • Developing a response plan 	Planning for the future <ul style="list-style-type: none"> • Skill integration and planning regarding parenting

Note. CBT = cognitive–behavioral therapy.

answered questions. Reluctance or barriers to engaging in the intervention were addressed within the MI framework, with coaches making reflective statements, emphasizing positive statements, helping mothers to identify if goals had changed, and problem-solving ways to meet their goals.

Coaching was facilitated by an online infrastructure that provided coaches and supervisors with tools for monitoring client progress and participation. An administrative web page enabled coaches to: (a) monitor participation, understanding, and clinical progress (i.e., program utilization, homework completion, mood/activity ratings, content mastery, and biweekly depression ratings); and (b) tailor content of coach calls based on the information provided. The infrastructure also allowed mothers to connect with coaches in crisis situations via an online crisis link, which alerted coaches and supervisors via an immediate text message.

Motivational interviewing and referral to services. The MIRS condition included several features consistent with patient navigation strategies developed for chronic conditions (Dohan & Schrag, 2005; Freeman & Rodriguez, 2011; Natale-Pereira, Enard, Nevarez, & Jones, 2011) including depression (Diaz-Linhart et al., 2016), such as an MI engagement interview, referral to community services, and ongoing monitoring and support. As noted earlier, participants in the MIRS condition participated in the MI engagement interview at the conclusion of the preintervention assessment. Research staff then provided mothers with information about, and referrals to, community providers who serve low-income individuals. Research staff offered to initiate contact with the treatment provider to make an initial appointment. Participants also received biweekly motivational calls from a research staff who served as a coach during

the 4-month intervention period. These calls lasted an average of 20.4 min. Working within an MI framework, the coach: (a) checked in with mothers about the concerns they had raised in the initial motivational interview; (b) queried as to what mothers were doing to seek/engage in mental health services and to otherwise improve their mood; and (c) used reflective statements to emphasize mothers' change statements. They also administered the PHQ-9 for safety monitoring. Research staff doing the MIRS coaching consisted of two bachelors level and one doctoral level nonclinical staff, trained in the use of MI skills. Training and ongoing supervision was provided by a research supervisor who was a masters level clinician.

Provision of MI calls to mothers was intended to have two effects. First, it was an effort to actively engage mothers in intervention to render the MIRS condition as robust as possible, and akin to a comparative intervention. Second, given the strong associations between social support and depression (Santini, Koyanagi, Tyrovolas, Mason, & Haro, 2015) the MI calls were designed to provide some control for the support provided by Mom-Net coaches; that is, to rule out the possibility that Mom-Net benefits accrue primarily as a function of supportive contact.

Sample Size Determination and Statistical Methods

Sample size. Estimates of effect sizes were based on a meta-analysis of the CWDC (average $ES = .65$ for controlled trials; Cuijpers, 1998) as well as on a trial of an Internet-based cognitive intervention ($ES = .54$ for participants with elevated CES-D scores; Clarke et al., 2005). We selected a sample size ($n =$

130/group) that would provide adequate power (estimate = .80) to detect a small-to-medium effect size (Cohen's $d = .38$).

Missing data. Rates of missing data for study outcomes was <1% at baseline and 13–18% at posttest. Multiple imputation was used to replace missing values following best-practice recommendations (Graham, 2009). Missing data were imputed using the IVEWare program (Raghunathan, Solenberger, & Van Hoewyk, 2002), which uses all available data to impute missing data via a sequential regression approach. The observed and imputed data were compared to ensure they showed similar distributions (Abayomi, Gelman, & Levy, 2008). Missing data points were replaced with imputed data in 20 data sets, which were analyzed separately. Model parameters and standard errors, which incorporate within and between model parameter variability, were combined following Rubin (1987) as implemented in SAS PROC MIANALYZE (SAS Institute Inc., 2011).

Analytic models. Group differences in continuous posttest depression scores (PHQ-9 and HDRS) were examined separately with mixed effects regression models estimated with SAS PROC MIXED using restricted maximum likelihood with intercepts allowed to vary randomly. Group differences in the dichotomous posttest depression diagnosis were estimated with SAS PROC LOGISTIC. All models included the pretest score as a covariate and study condition as a two-level predictor with Mom-Net as the reference group. Next, we tested moderation of the main effects of condition, separately for each hypothesized moderator, by adding the moderator and its interaction with condition to the main effects models. Effect sizes were summarized as Cohen's d -statistic for continuous outcomes (.2 small, .5 medium, and .8 large effect; Cohen, 1988) and odds ratios (OR) for the dichotomous depression diagnosis (1.48 small, 2.48 medium, and 4.28 large; Lipsey & Wilson, 2001).

Results

Preliminary Analyses

All 266 participants completed the pretest assessment and 89% completed the posttest assessment. Number of completed assessments was not related to study condition, $\chi^2(1, 266) = 1.78, p = .182$ or any pretest measure. Demographic and pretest variables were examined for baseline equivalence, with a Bonferroni correction applied to multiple tests. No significant differences were found as a function of condition on pretest values or demographic variables. No between group differences emerged between participants who initiated participation in one of the two conditions and those who did not. Demographic data are presented in Table 1.

Program Utilization, Satisfaction, and Usability

Table 3 presents the descriptive statistics for the measures of program utilization, satisfaction, and usability. Of the 134 Mom-Net participants, 67.8% initiated program usage, with 56.7% completing four or more sessions. Participants who initiated the program completed on average 6.6 of the eight modules (70% completed all modules). Among participants who initiated use, the website was used extensively as indicated by the mean number of program visits and the average total hours of use. With respect to program satisfaction, the mean ratings were above 4 on a 5-point

Table 3
Program Utilization, Satisfaction, and Usability by Condition

Measure	Mom-Net <i>M (SD)</i>	MIRS <i>M (SD)</i>
Computer-generated indices		
Number of modules completed	6.6 (2.4)	N/A
Number of program visits	19.6 (15.7)	N/A
Hours on program	5.5 (3.2)	N/A
Participant-rated satisfaction (5-point scale)		
Skills and materials	4.2 (.8)	N/A
Website	4.2 (.7)	N/A
Coach assistance	4.3 (.7)	4.4 (.8)
Coach calls		
Number of coach calls	6.9 (4.8)	5.2 (2.0)*
Duration of calls in minutes	33.50 (20.21)	20.36 (5.53)**

Note. This data reflects indices for participants who initiated the program. MIRS = Motivational Interview and Referral to Services.

* $t(245) = 3.527, p < .001$. ** $t(245) = 6.677, p < .0001$.

Likert-type scale for skills and website usability, indicating that the participants were highly satisfied with the Mom-Net intervention. In the MIRS condition, 85% of participants engaged in at least one coach call. Participants in both conditions also rated the coach support highly, with mean ratings above 4.3 on a 5-point Likert-type scale. Across all completed sessions, Mom-Net coaches covered 78.0% of relevant content.

With regard to community service utilization, 37% of participants in the MIRS condition and 31% of participants in the Mom-Net condition received mental health services during the interval between pretest and posttest, $\chi^2(232) = 0.93, p = .41$. In the MIRS condition, 30.3% received pharmacotherapy intervention and 21% received counseling, while in the Mom-Net condition 26.5% received pharmacotherapy and 14.2% participated in counseling, $\chi^2(232) = 0.39, p = .56$ and $\chi^2(232) = 1.87, p = .23$, respectively.

Between-Group Intervention Effects

Descriptive statistics for the study outcomes at pre- and posttest are shown in Table 4. Mixed effects regression models showed the Mom-Net group had significantly lower posttest adjusted PHQ-9 (estimate = $-1.51, t = -2.44, p = .015, d = .27$) and HDRS (estimate = $-1.85, t = -2.35, p = .019, d = .24$) scores compared with MIRS participants (Bonferroni-corrected $p = .05/2 = .025$). Within group effects in the Mom-Net condition (Cohen's $d = 1.31$) were consistent with effects obtained in an earlier small-scale trial (Cohen's $d = 1.11$; Sheeber et al., 2012). Effects for the MIRS condition were Cohen's $d = 1.08$.

Logistic regression analysis showed that the Mom-Net group had significantly lower odds of meeting *DSM-IV* criteria for a depression diagnosis at posttest compared with MIRS participants (adjusted $OR = 0.53, 95\% CI [0.29-0.98]$). Remission rates, as defined by *DSM-IV* criteria, were 39.7% in the Mom-Net condition and 28.18% in the MIRS condition. Stated differently, by taking the reciprocal of the adjusted $OR (1/0.53 = 1.89)$ the MIRS participants had approximately 89% greater odds of meeting criteria for a current diagnosis of depression at posttest compared with Mom-Net participants.

Table 4
Descriptive Statistics for Study Outcomes

Depression measures	Mom-Net		MIRS	
	Pretest Mean (SD)	Posttest Mean (SD)	Pretest Mean (SD)	Posttest Mean (SD)
PHQ-9	14.03 (4.98)	6.27 (5.00)	14.43 (5.95)	7.90 (5.37)
Hamilton	13.31 (7.60)	7.48 (5.89)	13.71 (7.95)	9.41 (6.58)
Current depression ^a	68.6% (4.84)	47.9% (6.23)	64.4% (5.19)	59.5% (5.54)

^a The average percentage and *SE* of participants with a current depression diagnosis. MIRS = Motivational Interview and Referral to Services; PHQ = Patient Health Questionnaire-9. Means and *SDs* averaged across 20 imputed data sets.

Moderation of Condition Effects

Several moderators were evaluated, including recruitment source, depression severity, self-reported anxiety level, substance use, marital status, family income, and economic stress, as well as presence of bipolar disorder. Bonferroni corrections were applied to the evaluation of significance, to maintain familywise $\alpha = .05$. None of the Condition \times Moderator effects were statistically significant for PHQ-9, HDRS, and current depression diagnosis at posttest.

Discussion

Mom-Net is coach-facilitated, Internet-delivered CBT intervention comprised of both online tutorials and coach phone calls corresponding to each session. It was developed for and targeted to low-income mothers of young children, as a population at greatly increased vulnerability to depressive conditions. In this RCT, the Mom-Net intervention was administered in a community mental health center by community-based bachelor- and masters-level clinicians. Because motivational deficits can be a barrier to participation in depressed populations, participation in both conditions was preceded by a brief motivational interview aimed at promoting community-based resources as well as engagement and active participation in the Mom-Net intervention. It was compared with an alternative intervention condition that received facilitated referrals to community treatment providers as well as biweekly phone contact with a coach. As discussed, phone calls in the control conditions used an MI framework and were intended to facilitate engagement in community mental health services and provide social support as a control for that provided by the Mom-Net coaches.

With regard to engagement and participation, it is important to note that 30% of participants never initiated program use. It is possible that as the sample was recruited, which is to say, not treatment seeking, that motivation to participate in research may have exceeded motivation for treatment engagement. It is also likely that there are barriers to engagement that were not sufficiently addressed by either our initial motivational interview or ongoing coach support. Nonetheless, these rates are similar to others reported in the literature for both online and in person interventions (Kaltenthaler et al., 2008). Identifying factors associated with nonengagement is an important focus of ongoing research.

Notably, however, among participants who initiated use, participation in the program was high. On average, participants

who initiated the program (70% of Mom-Net participants) completed 80% of sessions, with more than 70% completing all sessions. Additionally, they completed more than 85% of expected coach calls. As well, participants reported high levels of satisfaction with the program, indicating that they found the intervention helpful, the website easy to use, and the coaches to be supportive. Overall these indices of engagement and satisfaction are comparable with those of other Internet interventions (Christensen et al., 2009; Kaltenthaler et al., 2008; Waller & Gilbody, 2009). By means of comparison, Waller and Gilbody (2009) have reported in a systematic review of computerized CBT that on average 56% of participants complete the full course of intervention.

Turning to effectiveness, the results were very promising. Participants in the Mom-Net condition demonstrated significantly greater reduction in depression as indexed by self-report questionnaire (primary outcome), interviewer-rated symptoms, and diagnostic outcomes. The effect sizes obtained in the current study are comparable with the overall effect size of $d = .28$ for the 18 CWDC treatment studies included in the meta-analytic review conducted by Cuijpers and colleagues (2009). Moreover, the within group effects for the Mom-Net condition were large, mirroring those obtained in our earlier tightly controlled pilot trial (Sheeber et al., 2012). These effects are notable for a number of reasons. As described, economically disadvantaged mothers of young children experience depressive conditions at high rates (Malik et al., 2007; McLennan et al., 2001; Weissman & Jensen, 2002), resulting in suffering and impairment for themselves and their children. Moreover, evidence suggests that they are unlikely to access traditionally offered services (Wang et al., 2005; Weissman & Jensen, 2002). The current project is important in that it speaks to the feasibility of remotely delivered interventions, which have the potential to overcome barriers to access for this at-risk population. In particular, it speaks to the plausibility of using Internet technology in low income and rural households. The replication of our earlier findings is also significant. This study improved on the initial pilot work (Sheeber et al., 2012) by providing a more robust control condition, eliminating research-specific supports (e.g., provision of computer and Internet), and shifting the coaching to community-based therapists, rather than research staff. The significant effects, in this context, suggest the potential disseminability of the intervention for community-based delivery. This will be an important direction for future research.

It is worth noting, as well, that the effect size for between-groups comparisons was modest, reflecting the beneficial impact

of the alternative intervention comparison condition, which also demonstrated a large within-group effect. The large effect may be attributable, in part, to the fact that a sizable percentage of participants accessed services in the community. It may also reveal the beneficial impact of the support provided by the coaches. These effects are notable as the intervention was less intensive than the Mom-Net condition, including fewer and shorter coach calls and no structured intervention. As noted earlier, the MIRS condition shared features consistent with emerging patient navigation strategies for chronic conditions, whose goals are to reduce health disparities experienced by vulnerable populations (Natale-Pereira et al., 2011). The combination of MI, referrals, and ongoing monitoring and support, appears to have been highly beneficial to participants.

A question could be raised regarding the extent to which coach support is necessary for treatment effects. As described earlier, existing research suggests that treatment effects are typically stronger for Internet interventions supplemented by human support. Supported interventions, moreover, evidence both better program adherence (Mohr et al., 2013) and stronger effects than nonsupported interventions (Andersson et al., 2005; Andersson & Cuijpers, 2009; Cuijpers et al., 2010; Kleiboer et al., 2015; Spek et al., 2007). Nonetheless, one limitation of our design is that because the two components of the intervention were highly integrated (e.g., “Try this strategy and then discuss how it went with your coach”; “Make a plan and send it to your coach for review”), with both aspects designed to facilitate engagement and skill acquisition, the unique effects of each component cannot be determined. The extent of the integration reflects our conceptualization of the intervention as facilitating remote delivery of services rather than as a stand-alone intervention. That said, revising the tutorials so as to enable self-administration without coach support may be a useful direction for future research. Though effect sizes would likely be significantly lower (Andersson & Cuijpers, 2009), the public health benefit could be large given the potentially greater reach (Glasgow, 2007), if attention to instructional design is successful in overcoming barriers to engagement and retention evident in unsupported programs (Christensen et al., 2009).

There are, of course, limitations to discuss. First, these effects reflect the initial prepost outcomes, and do not speak to the extent to which effects are maintained over time. Subsequent analyses will address maintenance of treatment effects as the long-term follow-up data become available. As well, we will examine the extent to which results are mediated by hypothesized changes in cognitive-behavioral mechanisms. Second, because the sample was relatively homogeneous with regard to demographic characteristics and included a large percentage who had attended some college, we do not know how the intervention would have fared in a more diverse sample, though meta-analyses on the CWDC indicate that its effectiveness is robust across diverse populations (Cuijpers et al., 2009). Third, to minimize participant burden, we limited the number of outcomes and did not assess comorbid psychopathology. Hence, the effect of comorbid psychopathology on the effectiveness of the Mom-Net intervention awaits future research. As well, our focus here was on diagnostic outcomes, and we did not include broader indices of well-being such as quality of life measures. Fourth, mothers were included based on the PHQ-9 screener and approximately one-third of the sample did not meet

DSM-IV criteria for a depressive diagnosis at pretest based on the SCID interview. However, the CWDC has been shown to be effective for preventing escalation to full syndrome among individuals with subthreshold depression (Cuijpers et al., 2009).

Additional directions for future work are also worth noting. At this stage in the program of research, it makes sense to turn our attention to questions of implementation and sustainability (Curran, Bauer, Mittman, Pyne, & Stetler, 2012). Reach is also important: are there nonclinical community sites serving low income families, such as Head Start programs, who would be natural partners for the delivery of the Mom-Net intervention? Moreover, given that younger and lower income persons differentially access the Internet through mobile devices, it will be critical to adapt the intervention for these delivery systems (Pew Research Center, 2015).

In closing, the Mom-Net intervention appears to be feasible and effective, as a remotely delivered treatment for economically disadvantaged mothers. Relative to coach-supported, facilitated usual care, it demonstrated significant effects on multiple indices of depressive outcomes.

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