HHS Public Access

Author manuscript

Child Maltreat. Author manuscript; available in PMC 2018 November 01.

Published in final edited form as:

Child Maltreat. 2017 November ; 22(4): 334–343. doi:10.1177/1077559517729890.

Technology to Augment Early Home Visitation for Child Maltreatment Prevention: A Pragmatic Randomized Trial

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Abstract

Early home visitation (EHV) for child maltreatment prevention is widely adopted but has received inconsistent empirical support. Supplementation with interactive software may facilitate attention to major risk factors and use of evidence-based approaches. We developed eight 20-min computer-delivered modules for use by mothers during the course of EHV. These modules were tested in a randomized trial in which 413 mothers were assigned to software-supplemented *e*-Parenting Program (*e*PP), services as usual (SAU), or community referral conditions, with evaluation at 6 and 12 months. Outcomes included satisfaction, working alliance, EHV retention, child maltreatment, and child maltreatment risk factors. The software was well-received overall. At the 6-month follow-up, working alliance ratings were higher in the *e*PP condition relative to the SAU condition (Cohen's $d = .36$, $p < .01$), with no differences at 12 months. There were no between-group differences in maltreatment or major risk factors at either time point. Despite good acceptability and feasibility, these findings provide limited support for use of this software within EHV. These findings contribute to the mixed results seen across different models of EHV for child maltreatment prevention.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Keywords

child maltreatment; clinical trials; community samples; home visiting; substance abuse

Rates of child maltreatment in the United States remain high (Finkelhor, Turner, Shattuck, & Hamby, 2015), despite encouraging downward trends since 1992 (Finkelhor, Saito, & Jones, 2015). Among current prevention efforts, Early Childhood Home Visiting (early home visitation [EHV]) programs have been by far the most widely adopted; nationwide, the last known estimate suggested that up to 550,000 families per year receive EHV services in the United States (Gomby, Culross, & Behrman, 1999). The successful dissemination of such programs has been facilitated by reports of their success in preventing child abuse and neglect (Donelan-McCall, Eckenrode, & Olds, 2009). However, not all controlled clinical trials have shown program-related effects on child maltreatment, particularly when maltreatment is measured via child protection system reports (Chaffin, 2005; Duggan et al., 2007; Filene, Kaminski, Valle, & Cachat, 2013).

Possible explanations for variability in EHV effects on maltreatment include restrictions of positive effects to certain subgroups of parents (e.g., low-income, unmarried first-time mothers; Gomby, 2000) and fidelity to treatment models (Casillas, Fauchier, Derkash, & Garrido, 2016). Retention has also proven to be a major challenge: Overall attrition in EHV programs averages approximately 50% at 1 year (Duggan, McFarlane, et al., 2004; Gomby et al., 1999); families who do remain involved at 1 year receive, on average, only 38–56% of intended visits (Gomby et al., 1999). Further, attrition appears higher in replication trials than in original efficacy trials (O'Brien, Moritz, Luckey, McClatchey, Ingoldsby, & Olds, 2012). Finally, research has suggested that home visitor recognition of key maltreatment risk factors such as substance use, mental illness, and partner violence may be limited; for example, home visitor recognition of these risks, when present, ranged between 11% and 29% in one large outcome study (Duggan, Fuddy, et al., 2004). Home visitors rank substance abuse, mental illness, and intimate partner violence (IPV) as areas in which they feel least competent (Duggan, Fuddy, et al., 2004; Lecroy & Whitaker, 2005).

Technology may offer a way to increase attention to these key risk factors as well as to enhance the overall capacity of home visitors to provide evidence-based services, without requiring extensive additional training or modification of ongoing services. That is, rather than attempting to build capacity in home visitors who already are expected to master a great deal of content regarding relationship-building, fostering attachment, and infant and child development, interactive technology could directly extend the repertoire of intervention expertise offered. If effective, these approaches could (1) assist in addressing key child maltreatment risk factors at relatively low cost, (2) be amenable to ongoing large-scale trials in which a range of technology-delivered elements could be compared and improved on an ongoing basis, and (3) easily incorporate new research findings. Further, evidence that stigmatizing information is often revealed more readily to a computer than to a person suggests that a higher proportion of at-risk parents could receive at least some assistance in this way (Newman et al., 2002). Reviews of technology-delivered interventions overall suggest positive effects for a range of problem behaviors, including for substance use

(Khadjesari, Murray, Hewitt, Hartley,& Godfrey, 2011; Moore, Fazzino, Garnet, Cutter, & Barry, 2011; Portnoy, Scott-Sheldon, Johnson, & Carey, 2008; Riper et al., 2009; Rooke, Thorsteinsson, Karpin, Copeland, & Allsop, 2010). In addition, even small effects can have large public health consequences, particularly when the cost and simplicity of a given intervention are low enough to give it substantial reach (Riper et al., 2009).

This study was a test of the effectiveness of a multicomponent computer-based supplement, the *e*-Parenting Program (*e*PP), designed to augment the ability of ongoing EHV to prevent child maltreatment directly either via effects on risk factors for child maltreatment (e.g., substance abuse) or via increased retention in EHV. We developed eight 20-min computer-delivered modules for use by mothers during the course of a home visiting program (Healthy Families). These modules were tested in a pragmatic randomized trial (placing greater emphasis on external vs. internal validity; e.g., Patsopoulous, 2011), in which mothers were assigned to software-supplemented services (*e*PP; software + Healthy Families), services as usual (SAU or standard Healthy Families), or community referral conditions, with evaluation at 6 and 12 months. Outcomes included satisfaction, working alliance, child maltreatment, and child maltreatment risk factors. We predicted that *e*PP supplementation would be well-accepted by participants, with mean participant satisfaction ratings of at least 4 on a 1–5 scale and no adverse effect on working alliance; that participants receiving *e*PP supplementation would show higher retention in home visiting services; that participants receiving *e*PP supplementation would exhibit lower levels of harsh parenting; and that participants receiving *e*PP supplementation would exhibit lower levels of maltreatment risk factors.

Method

Study Design

The present study was a within-site randomized trial comparing home visiting plus software supplementation to home visiting as usual and to a community referral control condition. Home visitors were randomly assigned to condition with stratification on years of experience, race, and historical retention rate (all home visitors were female). Designed as a pragmatic trial, this study recruited from an ongoing community-based home visiting program, used existing home visitors, had minimally restrictive inclusion and exclusion criteria, and intentionally kept training and supervision of community staff to a minimum; it was designed to reflect likely capacity for additional training in any future implementation efforts.

Participants and Settings

Participants were recruited from two sites within Healthy Families Indiana (HFI). HFI is a statewide Healthy Families America initiative designed to prevent maltreatment among at-risk families who were not yet part of the child welfare system. To be considered for the study, parents needed to be women scoring between 25 and 85 on the Kempe Family Stress Checklist (Gray, Cutler, Dean, & Kempe, 1979; Korfmacher, 2000), a measure of overall maltreatment risk that evaluates factors such as substance abuse, prior maltreatment, and IPV. Participants also had to be at least 18 years old, able to communicate in English, and

recruited no more than 45 days before the expected date of delivery. Participants additionally needed to complete the baseline research assessment within 11 weeks after the baby's date of birth to be eligible for the study. Participants received gift cards for either Target or Walmart in the amount of US$30 for the baseline assessment, US$50 for the 6-month assessment, and US$75 for the 12-month assessment. Participants also had the opportunity to voluntarily provide a hair sample at the 6-month follow-up; they received an additional gift card worth US$20 if they chose to provide that sample. Participants were not incentivized for receipt of treatment in any condition. Baseline data collection took place between June 2008 and June 2010, ending when recruitment goals were met. All study procedures were approved by the institutional review boards of Wayne State University and Indiana University.

Procedures

Intake staff from the two sites in Indiana introduced the study after recruiting women into HFI; those who were interested in participating in the study provided written informed consent. Participants who provided written consent were allocated to condition using a randomization table generated via www.randomization.com. Participants were evaluated by blinded research assistants at baseline and at 6- and 12-months post baseline. All self-report measures were obtained via audio computer-assisted self-interviewing technology, in which participants answered questions directly using a touch-screen computer.

Intervention Conditions

e-Parenting program (software-supplemented EHV; ePP)—This condition consisted of HFI SAU plus technology designed to augment ongoing home visiting. The Internet-based software used in the software-supplemented condition (the *e*PP) consisted of eight separate sessions, most of which were approximately 20 min in duration. *e*PP sessions were designed to begin as soon as possible after childbirth and to continue until either all sessions were completed or until the infant was 6 months of age (whichever came first). This software was designed for deployment on tablet PCs, using headphones for privacy; each home visitor had her own tablet PC and mobile Wi-Fi device for wireless Internet access. Participants used the tablet computers in their homes during regularly scheduled home visits. By design, and consistent with the pragmatic nature of this trial, home visitors were welcome to discuss participants' reactions to the software as part of their home visit, or to structure that day's visit around the software's content, but were also free to focus on any other content. Home visitors were provided with infant choke tester devices, thermometers, and an infant health manual that were distributed to *e*PP parents during the appropriate session (6 and 7, respectively).

Training for home visitors was limited to assistance in using the tablet PC and software. We began with an overall orientation at each site in which the study and its rationale were introduced and questions were answered. Home visitors later received one formal training of 2 hr's duration in the use of the software, including a review of the topics covered in each session. (In addition, the software required the home visitor to select the topic for that day, so that they always knew the topic of each session before giving the tablet PC to the parent.) Subsequent visits at each site took place approximately once per year and were focused on

thanking home visitors for their participation but also served to monitor implementation and address any obstacles. In addition, study staff maintained contact with leadership at each site in order to address any implementation issues that arose. Finally, leadership at each site monitored the use of the software and contacted study staff if any questions or concerns arose.

These sessions with home visitors and agency leadership provided training as well as an opportunity for feedback regarding the intervention. This led to one significant change in the original *e*PP design. The original plan called for the initial *e*PP session to be administered at the first home visit. However, given home visitor concerns regarding the need to complete paperwork during early sessions, as well as the frequent need to respond to crises or other pressing issues, home visitors requested and were given flexibility with respect to how soon and when software modules were administered. Other requests for changes were minor in nature and had primarily to do with simplifying the process of logging participants in to each session.

The *e*PP intervention was designed to focus on key maltreatment risk factors using evidence-based intervention approaches. The Internet-based software used in this study was an adaptation and extension of software evaluated in previous studies with high-risk postpartum women (Ondersma, Chase, Svikis, & Schuster, 2005; Ondersma, Svikis, & Schuster, 2007). It featured an animated talking narrator, full audio support using headphones, a high degree of synchronous interactivity, and videos.

As seen in Table 1, the software incorporated elements of three evidence-based interventions: motivational interviewing (Miller & Rollnick, 2002), cognitive retraining (CR; Bugental et al., 2002), and SafeCare (Edwards & Lutzker, 2008; Gershater-Molko, Lutzker, & Wesch, 2002; Lutzker & Bigelow, 2002). Each of these approaches has shown efficacy in reducing maltreatment and/or major risk factors for maltreatment. As also seen in Table 1, content was modeled after these approaches as closely as possible. For example, the motivational sessions were nonjudgmental, provided normed feedback, and helped participants to identify their own reasons for participating in home visiting or making change in a key risk factor. CR sessions provided video from actors portraying a pediatrician, grandmother, and young mothers, all teaching/modeling benign attributions for difficult infant behaviors as well as instruction in key soothing techniques (emphasizing parental efficacy and problem-solving ability). SafeCare sessions also involved video-based instruction and modeling. All sessions elicited and incorporated participant preferences, reactions, and evaluations of the content.

EHV SAU—HFI implements the Healthy Families America model and is accredited by Prevent Child Abuse America. For the first 6–9 months, visits are scheduled each week. Depending on the family's level of functioning, home visits are then scheduled every other week and eventually taper off to once a month or quarterly. Home visitors seek to promote positive outcomes by enhancing family function, promoting parent–child relationships, and supporting healthy child growth and development. Most home visits last about 1 hr, and each home visitor has a caseload of 15–25 families. Home visitors are required to have 1–1.5 hr of reflective supervision each week and ongoing continuing education and training,

including 4–5 days of Healthy Families America–specific training prior to providing home visits and 90–100 hr of general home visiting topics in the first 6 months of their date of hire.

Community referral (control)—Participants randomized to the community referral control condition were given a referral to other available services in the community. The proportion of participants assigned to this condition never exceeded the proportion that otherwise would have been denied HFI services because of limited program capacity.

Measures

Outcomes related to feasibility and acceptability were measured in three primary domains. First, we measured the proportion of participants assigned to the software-supplemented condition who received at least one *e*PP session. Second, we measured participant-rated satisfaction with the software using the subjective satisfaction ratings (SSRs), a brief measure of reactions to the software (Ondersma et al., 2005). αs for the SSR in our sample were .83 for the 6-month items and .84 for the 12-month items. Third, we measured possible effects on working alliance with the home visitor (available only for the *e*PP and SAU conditions) using the Working Alliance Inventory— Short Form, Client version (WAI-SC), a 12-item measure of the extent to which clients perceive their therapist as worthy of trust and feeling positively toward the client, agreeing with them on the goals of treatment, and agreeing on the tasks to be used in treatment (Hatcher & Gillaspy, 2006). αs for the WAI-SC in this sample were .85 for the 6-month time point and .90 for the 12-month time point. Overall program retention was measured as mean number of completed home visits for each of the two home visiting conditions (*e*PP and SAU) and whether or not participants in each condition were still active within the home visiting program at 6- and 12-months post baseline.

Harsh parenting was measured using items from the Conflict Tactics Scales—Parent–Child version (CTS-PC), a brief and face-valid measure of parental behaviors including harsh or abusive parenting and neglect (Straus, Hamby, Finkelhor, Moore, & Runyan, 1998). Seven items from the CTS-PC indicating harsh parenting and potentially relevant to parenting of infants (i.e., hit on bottom with a brush or other object, pinched, shouted, or screamed at) were used for analyses (αs for the 7 items were .71 at baseline, .70 at 6 months, and .62 at 12 months).

Major maltreatment risk factors were measured primarily via self-report. Depression was measured via the Edinburgh Postnatal Depression Scale (EPDS), a 10-item scale designed to measure depression in the postnatal period without being confounded by typical levels of tiredness, and so on, seen during this period (Cox, Holden, & Sagovsky, 1987). EPDS αs for this sample ranged from .88 to .90 for the three time points. Substance use was measured via the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST), a World Health Organization–sponsored measure of substance use and related consequences in all substance abuse categories and found to have αs ranging from .77 for hallucinogens to. 94 for opioids (Newcombe, Humeniuk, Hallet, & Ali, 2003) and also by hair analysis at the 6-month follow-up. Hair analysis was provided by Psychemedics, Inc., and provides a 90-day

window of detection. IPV was measured using the CTS II, a measure of received and committed relationship violence (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). Items from the physical assault (α = .86) and injury (α = .95) subscales were used. Finally, overall quality of home environment was measured using the observer-rated HOME scale plus the Supplement to the Home for Impoverished Families (SHIFs) supplement (Ertem, Forsyth, Avni-Singer, Damour, and Cicchetti, 1997). The HOME was completed by research assistants during the in-home follow-up evaluations. αs for the HOME ranged from .81 to .84 and for the SHIF αs ranged from .57 to .71 for the three time points.

Statistical Analyses

Descriptive means and standard deviations were estimated for all feasibility, acceptability, and retention outcomes, and general linear model *F* tests were used to assess between-group differences. All longitudinally collected maltreatment risk factor outcomes were analyzed using generalized linear mixed model (GLMM) growth curve analyses (Breslow & Clayton, 1993) as described below. Outcome measures were transformed as needed in order to meet assumptions of normality, using the transformation that yielded the best result. Variables were dichotomized in cases where skew was too severe for successful transformation.

Analyses tested four hypotheses: (a) *e*PP supplementation will be well-accepted by participants, with mean participant satisfaction ratings of at least 4 on a 1–5 scale and no adverse effect on working alliance; (b) participants receiving *e*PP supplementation will show higher retention in home visiting services than participants in the control or SAU conditions; (c) participants receiving *e*PP supplementation will exhibit lower levels of harsh parenting than participants in the control or SAU conditions; and (d) participants receiving *e*PP supplementation will exhibit lower levels on risk factors including depression, IPV, substance use, or home quality than those in the control or SAU conditions. All difference-in-differences tests for these hypotheses were constructed within a multigroup, structural equation modeling (MG SEM) framework. These tests were conducted in a sequence using separate two-group MG SEM models: first, testing the control group change versus SAU change; then control versus *e*PP change; and finally, SAU versus *e*PP change. Random (for first piece-wise segment) and fixed (for second piece-wise segment) interaction terms were constructed to determine whether average growth (decline) among the second group is significantly larger than the first group. We also evaluated within-group change using single-group, piece-wise latent growth curve structural equation models. Piece-wise growth segments were fit to the data to account for change over time. The Akaike information criterion, the Bayesian information criterion, and graphical visual inspection of marginal mean predictions were used to select the “best-fitting” trajectory model. For identification purposes, if a second piecewise component was indicated, this term was modeled as a fixed (as opposed to random) effect.

For all models, years was used as the initial timing metric for the piecewise covariates. When convergence problems existed and the random effect variance for the first piecewise component appeared to approach 0, the variance of this random effect was constrained to 0 (this constraint was implemented for all binary outcome models). If a postservice or follow-up interview was not obtained, the postservice and follow-up piecewise covariates were set

to their respective sample averages, so that the modeling procedure included all study participants via a multivariate, full-information maximum likelihood estimator. All data analyses were conducted based on the intent-to-treat protocol. All participants who were randomly assigned to one of the three conditions were included in analyses except when scales required the individual to be in a recent relationship (e.g., IPV) or when only a single assessment was planned (e.g., retention). The GLMM models attempted to adjust for missing data bias under the assumption that data were missing at random (Rubin, 1976).

Results

Participant Flow and Attrition

As seen in Figure 1, a total of 799 participants were assessed for willingness to participate, 227 refused, and another 166 failed to complete the baseline assessment within the specified time frame after consenting to the study. There was no difference in baseline Kempe risk score between women who chose to participate (mean = 48.8) and those who did not, mean = 46.9; $t(357.8) = 1.4$, $p = .16$; equal variances not assumed because of positive Levene's test for equality of variances, $F = 12.2$, $p < .001$. In terms of attrition, as seen in Figure 1, a total of 322 participants (78.7%) completed 6-month follow-up and 301 participants (73.6%) completed 12-month follow-up. There were no group differences in follow-up completion at either the 6-month follow-up, $\chi^2(2) = 0.08$, $p = .96$, or the 12-month follow-up, $\chi^2(2) = 0.83$, $p = .66$.

Baseline Characteristics and Randomization Success

The final study sample included 413 women, 155 (37.5%) of whom were African American. Consistent with their recruitment from a program focused on at-risk mothers, participants in this study showed evidence of multiple challenges. As seen in Table 2, most women (over 90%) were receiving some form of public assistance, over 40% reported a history of some level of IPV, and over 40% met ASSIST criteria for problem alcohol use. As also seen in Table 2, randomization resulted in largely equivalent groups.

Feasibility, Acceptability, and Retention

Of the 142 participants assigned to the *e*PP condition, 117 (82%) completed at least one *e*PP software session. A total of 74 (52%) completed the first seven primary sessions, and a total of 70 (49%) completed all eight sessions, including the final review/booster session. On average, the delay between enrollment in HFI and completion of the first *e*PP session was 9.2 weeks (range = 1–26 weeks; $SD = 4.5$). Among participants using the software, mean ratings for helpfulness, respectfulness, perceived positive regard, and likelihood of recommending the software to other parents were all in the 4.2–4.4 range (on a 1–5 scale, where 5 was the strongest positive score); scores were lowest for perceived relevance (mean = 3.7). There were between-group differences in participant ratings of working alliance with their home visitor at the 6-month follow up, such that participants in the *e*PP condition reported stronger working alliances with their home visitors, 69.5 for SAU versus 74.3 for *e*PP, $t(207) = 2.7$, $p < .01$. At the 12-month follow-up, however, there were no between-group differences in working alliance, 69.1 for SAU versus 72.0 for *e*PP, $t(189) = -1.4$, $p = .15$.

With respect to retention, the mean number of visits for the SAU and *e*PP conditions did not differ at either 6 months postbaseline, mean visits = 12.4 for SAU versus 13.1 for *e*PP, $t(281) = -0.68$, $p = .497$; or 12 months, mean 20.3 for SAU versus 21.1 for *e*PP, $t(281) = -0.453$, $p = .651$. Similarly, the proportion of participants still active with the home visiting program did not differ at either 6 months postbaseline, 72.5% for *e*PP versus 66% for SAU, odds ratio (*OR*) = 1.36, $\chi^2(1) = 1.4$, $p = .23$; or 12 months, 56.3% for *e*PP versus 51.1% for SAU, *OR* = 1.24, $\chi^2(1) = 0.79$, $p = .37$.

Child Maltreatment Outcomes

As seen in Table 3, all conditions reported significantly higher mean levels of harsh parenting over time (i.e., post-/preestimates for control, SAU, and intervention rows all greater than 0). There were no between-group differences in harsh parenting.

Intervention Effects on Major Maltreatment Risk Factors

Results regarding self-reported depression, IPV (victimization and perpetration), and substance abuse (alcohol and drug), as well as observer-rated home quality, are also seen in Table 3. Scores on many of these measures showed evidence of a significant improvement over time. In addition, the reduction in depression scores (Becker $g = .22$, $p < .01$) and self-reported drug use (absolute risk reduction = .05, $p = .03$) was significant from baseline to the 6-month follow-up for the *e*PP condition but not for SAU or control, and change in depression between 6 and 12 months showed a significant advantage for the *e*PP condition versus control ($p = .01$). However, total change in depression from baseline to the 12-month follow-up did not show an advantage for *e*PP (estimate = 0.18, $p > .47$). Similarly, although between-group differences approached significance for drug use, there were also significantly greater rates of use at baseline in the *e*PP condition (0.13 vs. 0.07 for control and 0.06 for SAU).

A total of 263 of the 322 participants who completed the 6-month follow-up (81.7%) also provided usable hair samples. However, hair samples were at times insufficient for mass spectrometry validation for any particular drug of abuse, so the total *N* of usable samples varied from 249 to 263. Unadjusted group differences in any drug use, marijuana use, and drug use other than marijuana can be found in Table 4. Overall evidence of any drug use in the past 90 days was present in approximately 21% of participants who completed 6-month follow-up and chose to provide a hair sample. Marijuana was the most commonly used illicit drug (16.7%); drugs other than marijuana were present in 4.2% of samples. There were no significant between-group differences in drug use, with or without controlling for covariates.

Discussion

The present findings suggest that the addition of computer-delivered content to ongoing EHV, with minimal training or oversight, is feasible. Home visitors assigned to the software-supplemented conditions were able to incorporate the computers into their ongoing practice, such that 82% of participants in the *e*PP condition received at least one computer-delivered session. This was true in spite of the provision of only minimal training and oversight in

order to maximize external validity, a decision consistent with this study's pragmatic trial approach (Patsopoulos, 2011; Tosh, Soares-Weiser, & Adams, 2011).

Further, the software appears to have been integrated well into EHV. Working alliance with the home visitor was unaffected (or even enhanced), and overall satisfaction and acceptability of the software were good. Between 72% and 82% of participants gave the software positive ratings on most elements, with the exception of the item measuring perceived relevance (56%). The relatively low rating for relevance is notable: Despite efforts to target content to the individual user, it appears that more effort in this regard is necessary. More choice of content/focus, rather than a preset series of steps, may have improved ratings in this area.

There was no compelling evidence that the supplementation of EHV with interactive software that was conducted for this study enhanced outcomes in any area. This finding is contrary to our expectations and is inconsistent with other research regarding the efficacy of computer-delivered and/or video-based interventions (Bigelow & Lutzker, 1998; Moore et al., 2011; Ondersma et al., 2005, 2007; Rooke et al., 2010). Despite being carefully developed, it is possible that the software was not well-designed for this context; a great deal is still unknown regarding the ideal content and delivery of intervention software. Alternate technologies may also have been preferable. For example, our model of having the home visitor provide a computer to be used in the home, during sessions, is but one possible approach. Mobile apps are an alternate possibility; this approach could be used during home visits, outside of those structured sessions, or both and could take advantage of high-quality recording features, messaging, and so on. Additionally, tailored text messaging has shown promise in addressing a range of health-related behaviors.

It is also possible that brief technology-delivered interventions are less efficacious in the context of ongoing treatment. For example, there is evidence that interventions with multiple goals can be less efficacious than those with a single goal (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003) and that the introduction of multiple treatment elements can reduce rather than enhance effects (Chaffin et al., 2004). EHV is a complex, intensive, and long-term endeavor with multiple treatment goals; the software may have added even more potential behavioral targets and approaches, thus counteracting any positive effects that might otherwise have been present. Software that focused on a single goal, rather than multiple goals, may have led to better results. Similarly, software designed to serve as a booster following delivery of more intensive interventions, thus using a sequential rather than a simultaneous approach, should also be considered.

Although the literature includes examples of positive results for some EHV programs on child maltreatment outcomes (Avellar & Supplee, 2013; Chaffin, Hecht, Bard, Silovsky, & Beasley, 2012; Donelan-McCall et al., 2009; Olds et al., 1997), our failure to find between-group differences is also not without precedent (e.g., Duggan et al., 2007; Filene et al., 2013). Alternate models of home-based prevention might be worth considering when child maltreatment prevention is the primary goal.

A number of limitations must be considered. For example, despite overall feasibility, the software was not used with the consistency or timing that was originally intended. The original intent was for the initial motivational sessions to be administered very quickly after enrollment in order to maximize initial motivation (and based on evidence that motivational approaches used before initiation of standard services can facilitate change and/or retention; Burke, Arkowitz, & Menchola, 2003). However, it took an average of 2 months after enrollment for participants to complete the first *e*PP session. This delay may have substantially limited the ability of the motivational intervention to affect participants' initial approach to home visiting. More training and oversight may have affected the speed in which the software was integrated into the home visiting process, which in turn may have resulted in better outcomes. Similarly, detailed measurement of the manner in which home visitors integrated the software into their work (e.g., how it was introduced, whether and how it was synchronized with their other activities, or the extent to which home visitors communicated positive or negative views of the software) might have shed light on possible reasons for the present findings. However, this trial's design does not allow determination of whether additional training or different integration of the software by home visitors would have led to better outcomes.

Further, this aspect—changing the study plan to accommodate program preferences—was just one of the several other pragmatic elements of this trial; other pragmatic elements include its recruitment of participants from within an existing program with minimal inclusion or exclusion criteria, strict restriction on study-related training of home visitors, and not first conducting more internally valid formative research of our technology-delivered CR and SafeCare adaptations. These and other steps in clinical trials increase the external validity of any positive findings (Patsopoulos, 2011), for example, by testing levels of training and agency investment that better reflect what is realistic in community implementations. However, these elements also prevent determination of whether negative findings may have been different under more strictly controlled conditions (e.g., more training for home visitors; only working with EHV sites that are willing to substantially change procedures to accommodate the research, etc.). Like all research designs, pragmatic trials have pros and cons. The current infrequency with which evidence-based approaches become widespread, in part because of limited applicability of explanatory trials to clinical practice, has led to calls for greater use of pragmatic approaches (e.g., Tunis, Stryer, & Clancy, 2003).

A second limitation of this study is its reliance on maternal self-report for the primary outcome of harsh parenting. Self-report of stigmatized behaviors has well-known limitations. Although these may have been partly mitigated by the use of computer-based self-report and separation of assessment from clinical care, the finding that harsh parenting increased over time in all conditions suggests that self-presentation strategies may still have suppressed reports of these behaviors. (Alternately, this observed increase in self-report of harsh parenting could also reflect the increasing age of the participant's child or children.) Finally, this outcome is also limited in that it does not capture neglect, which represents the majority of child maltreatment.

In summary, these results suggest that the technology tested in this study—and the way it was deployed—did not act as an efficacious supplement to ongoing, intensive, and multifocal EHV. There remains a need to evaluate whether alternate, more focused, and/or differently timed approaches (e.g., with use of technology as a booster following traditional interventions) would be more successful. These results also suggest that the EHV model deployed in this study did not lead to the desired reductions in child maltreatment as measured by self-reported harsh parenting and major maltreatment risk factors. At the same time, however, this study clearly serves as proof of concept that technology can be embedded within EHV with minimal training or oversight. This bodes well for implementation of any efficacious technology-delivered supplements that are identified in the future. There is a clear need for further research evaluating moderators and key components of EHV, including those related to implementation fidelity, that could lead to more efficacious approaches.

Acknowledgments

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. Dr. Ondersma is part owner of a company that markets the intervention authoring software that was used to develop the interventions for this study.

The authors wish to acknowledge the tremendous intellectual and personal contributions of Dr. Mark Chaffin (1952–2015).

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was funded by the National Center for Injury Prevention and Control of the Centers for Disease Control and Prevention (Grant U49-CE001078), with support from the CDC Foundation and the Doris Duke Charitable Trust.

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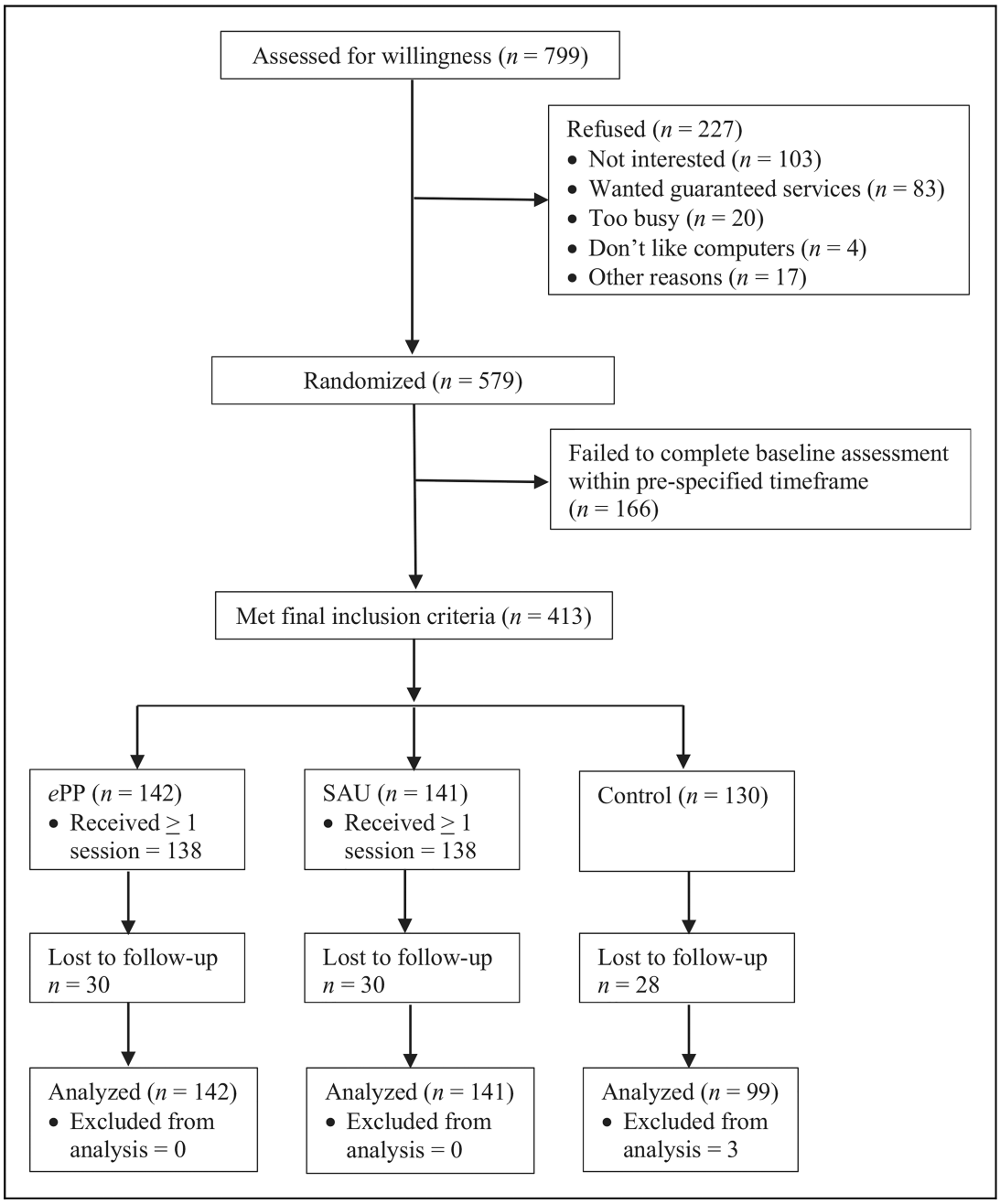

Figure 1.

Participant flow for the three conditions in the randomized trial. Three control group participants were excluded from analysis for having received early home visitation services.

Table 1

Outline and Content of the e-Parenting Program Software Supplement.

Session	Duration (min)	Evidence-Based Model	Content
Session 1	20	MI	Engagement in home visiting and goals
Session 2	20	MI	Key maltreatment risk factors (substance use, partner violence, and depression)
Session 3	20	CR	Causes of infant crying and fussiness (facilitating nonpejorative attributions)
Session 4	20	CR	Ways to soothe infant crying and fussiness (building efficacy) also shaking prevention
Session 5	20	SafeCare	Infant play/cognitive stimulation
Session 6	40	SafeCare	Home safety and accident prevention
Session 7	20	SafeCare	Appropriate medical decision-making
Session 8	20	SafeCare	Booster (choice of content from above)/wrap-up

Note. All sessions were delivered via touch-screen tablet PC, with full audio enhancement and earphones for privacy, as part of regular home visits.

MI = motivational interviewing; CR = cognitive retraining.

Table 2

Participant Characteristics at Baseline.

Characteristic	Total RCT *N* = 413	ePP *n* = 142	SAU *n* = 141	Control *n* = 130
Continuous measures				
Age in years (*SD*)	23.6 (4.8)	23.8 (4.8)	23.3 (4.2)	23.6 (5.0)
Baseline risk—Kempe (*SD*)	48.8 (13.3)	48.6 (13.7)	48.6 (13.3)	49.4 (12.9)
Frequencies				
Unemployed, past 6 months (%)	203 (49.3)	68 (47.9)	77 (54.6)	58 (45)
Black/African American (%)	155 (37.5)	51 (35.9)	41 (29.1)	63 (48.5)
Not high school/GED (%)	95 (23.1)	32 (22.5)	36 (25.5)	27 (20.9)
Married (%)	80 (19.4)	27 (19)	25 (17.7)	28 (21.7)
Public assistance use (%)	384 (93.2)	133 (93.7)	132 (93.6)	119 (92.2)
Depression over past week (%)	84 (20.5)	31 (22.0)	28 (19.9)	25 (19.5)
Intimate partner violence, any (%)	170 (41.2)	57 (40.1)	57 (40.4)	56 (43.1)
Risky alcohol use (%)	168 (41.1)	55 (39.9)	58 (41.1)	55 (42.3)
Risky marijuana use (%)	94 (23.2)	33 (24.3)	36 (25.5)	25 (19.4)

Note. “Public assistance” refers to receipt of food stamps: Women, Infants, and Children food supplements; Temporary Assistance for Needy Families; or housing assistance. “Intimate partner violence” refers to any report of any receipt of violence or victimization by a partner in the past year. Risky alcohol and marijuana use are based on the Alcohol, Smoking, and Substance Involvement Screening Test and its associated criteria for when a brief intervention is merited.

ePP = e-Parenting Program; GED = Graduate Equivalent Diploma; SAU = services as usual; *SD* = standard deviation; RCT = randomized controlled trial.

Table 3

Results of GLMM Analyses of Maltreatment and Maltreatment Risk Factors.

		Post- and Prepiece-Wise Segment				Follow-Up—Postpiece-Wise Segment			
Outcome	**Model Tests**	**Estimate**	***SE***	***z* Value**	***p* Value**	**Estimate**	***SE***	***z* Value**	***p* Value**
Harsh parenting from CTS-PC (any report of harsh actions; dichotomous)	Control	1.52	0.35	4.41	.00	—	—	—	—
	SAU	0.89	0.38	2.34	.02	—	—	—	—
	ePP	1.42	0.36	3.98	.00	—	—	—	—
	SAU—Control	−0.75	0.49	−1.54	.13	—	—	—	—
	ePP—Control	−0.03	0.45	−0.07	.94	—	—	—	—
	ePP—SAU	0.70	0.49	1.44	.15	—	—	—	—
Self-reported alcohol use: ASSIST_alc score (quantity + consequences) recoded as binary (no use, some use)	Control	−1.74	0.39	−4.52	.00	—	—	—	—
	SAU	−1.32	0.42	−3.12	.00	—	—	—	—
	ePP	−1.72	0.37	−4.60	.00	—	—	—	—
	SAU—Control	0.74	0.52	1.42	.16	—	—	—	—
	ePP—Control	−0.03	0.48	−0.07	.95	—	—	—	—
	ePP—SAU	−0.76	0.51	−1.49	.14	—	—	—	—
Self-reported drug use: ASSIST_drg score (quantity + consequences) recoded as binary (no use, some use)	Control	−0.55	0.92	−0.60	.55	—	—	—	—
	SAU	0.48	0.71	0.67	.50	—	—	—	—
	ePP	−1.14	0.53	−2.13	.03	—	—	—	—
	SAU—Control	1.02	1.16	0.89	.38	—	—	—	—
	ePP—Control	−0.77	0.94	−0.82	.41	—	—	—	—
	ePP—SAU	−1.65	0.85	−1.93	.05	—	—	—	—
Self-report depression: EDS total recoded by Ln(score + 1) transform	Control	−0.07	0.19	−0.34	.73	−.43	.18	−2.37	.02
	SAU	−0.24	0.19	−1.29	.20	.05	.18	0.26	.80
	ePP	−0.52	0.18	−2.92	.00	.22	.16	1.37	.17
	SAU—Control	−0.18	0.27	−0.66	.51	.48	.26	1.88	.06
	ePP—Control	−0.46	0.26	−1.75	.08	.64	.24	2.64	.01
	ePP—SAU	−0.29	0.26	−1.11	.27	.16	.24	0.67	.50
Observed home quality: HOME + SHIF score recoded by square root transform	Control	1.27	0.11	11.07	.00	.21	.10	2.12	.03
	SAU	1.27	0.10	12.51	.00	.30	.09	3.58	.00

Outcome	Model Tests	Post- and Prepiece-Wise Segment				Follow-Up—Postpiece-Wise Segment			
		Estimate	*SE*	*z* Value	*p* Value	Estimate	*SE*	*z* Value	*p* Value
	ePP	1.40	0.10	13.53	.00	.13	.08	1.58	.11
	SAU—Control	0.01	0.15	0.05	.96	.09	.13	0.70	.48
	ePP—Control	0.11	0.15	0.71	.48	−.08	.13	−0.60	.55
	ePP—SAU	0.10	0.14	0.71	.48	−.18	.12	−1.49	.14
Self-report IPV: CTS-victimization binary prevalence score	Control	−2.83	0.76	−3.74	.00	—	—	—	—
	SAU	−2.84	0.74	−3.85	.00	—	—	—	—
	ePP	−1.72	0.67	−2.58	.01	—	—	—	—
	SAU—Control	−2.45	0.72	−3.43	.00	—	—	—	—
	ePP—Control	1.14	0.94	1.21	.23	—	—	—	—
	ePP—SAU	0.53	0.97	0.54	.59	—	—	—	—
Self-report IPV: CTS-perpetration binary prevalence score	Control	−1.70	0.63	−2.69	.01	—	—	—	—
	SAU	−2.13	0.64	−3.34	.00	—	—	—	—
	ePP	−2.70	0.68	−3.98	.00	—	—	—	—
	SAU—Control	−0.29	0.87	−0.34	.74	—	—	—	—
	ePP—Control	−0.87	0.89	−0.98	.33	—	—	—	—
	ePP—SAU	0.59	0.89	0.66	.51	—	—	—	—

Note. All models were estimated using either a logistic (for binary outcomes) or normal (for depression and HOME outcomes) generalized linear mixed model (GLMM). Estimates of model tests labeled control, SAU, and ePP reflect the linear piece-wise coefficients from single-group GLMMs, where the first piece-wise segment captures twice the expected logit (for binary outcomes) or mean change 6-months after treatment began and the second piece-wise segment captures expected change per year occurring thereafter. Estimates of model tests labeled SAU—Control, ePP—Control, and ePP—SAU reflect difference of differences tests for each piece-wise coefficient. A "—" indicates that these estimates were not applicable, since the model did not include a second piece-wise component, that is, a simple generalized linear change from pre to post that plateaued at the follow-up visit fit these data best.

SE = standard error; SAU = services as usual; ePP = e-Parenting Program, software supplemented condition; CTS-PC = Conflict Tactics Scales—Parent Child; ASSIST_alc = Alcohol, Smoking, and Substance Involvement Screening Test, alcohol. ASSIST_drug = Alcohol, Smoking, and Substance Involvement Screening Test, drug; EDS = Edinburgh Postnatal Depression Scale; HOME = HOME measure plus SHIF supplement; IPV = intimate partner violence.

Table 4

Hair Test Results by Study Condition.

Hair test outcome	Total RCT *N* = 413	ePP *n* = 142	SAU n = 141	Control *n* = 130	χ^2
Any drug use (%)	55 (20.8)	19 (21.3)	23 (24.5)	13 (16.1)	1.9
Marijuana use (%)	44 (16.7)	17 (19.8)	18 (20.7)	9 (11.8)	2.6
Use of drugs other than marijuana (%)	11 (4.2)	2 (2.2)	5 (5.3)	4 (4.9)	1.0

Note. All results are from 1.5-inch hair samples, providing an approximate 90-day window of detection. “Drugs other than marijuana” include cocaine, opiates, methamphetamines, and phencyclidine (PCP). All comparisons are *df* = 2, *ns*.

RCT = randomized controlled trial.