Peer Reviewed

Lessons Learned from Remote Assessment of Mother-Infant Interactions Among Women with Postpartum Depression

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Abstract:

Purpose: *The COVID-19 pandemic posed challenges to measuring mother-infant interactions, a critical outcome for many interventions to support mothers with postpartum depression symptoms and their new infants. The current study describes the process and lessons learned from implementing a remote assessment of mother-infant interactions during the pandemic.*

Description: *At the onset of the COVID-19 pandemic, we pivoted from in person to using two different strategies to assess mother-infant interactions remotely: (1) participants independently recorded and uploaded videos of free play with their child, and (2) the research team conducted a live-video recording of the free play.*

"The COVID-19 pandemic posed challenges to measuring mother-infant interactions, a critical outcome for many interventions to support mothers with postpartum depression symptoms and their new infants. The current study describes the process and lessons learned from implementing a remote assessment of mother-infant interactions during the pandemic."

Assessment: *We found initial barriers, including technical and video quality issues, but overall, a remote option could increase enrollment and retention rates in a sample of postpartum women across various racial/ethnic groups and economic levels.*

Conclusion: *Our experiences conducting remote assessments with postpartum women add to growing evidence for the feasibility and validity of remote visits. This showed how our methods can be implemented in future research and practice with postpartum mothers and their infants.*

Introduction:

Mother-infant interactions are critical to a child's development, particularly in the first years of life (1). Secure parent-child relationships help children regulate their emotions in stressful situations, explore their environment, and foster development (2). Substantial research finds associations between maternal sensitivity and positive child outcomes, including secure attachment, cognitive and language growth, and social and emotional competence (3, 4). A mother's positive affect may enhance problem-solving, promote intrinsic motivation, facilitate self-regulation in young children (4), and improve mother-infant interaction quality that can be impaired by maternal depression.

Postpartum depression (PPD) is common, occurring in 12–24% of women following the birth of a child (5–7). PPD symptoms negatively affect responsive parenting, i.e., a mother's ability to nurture and care for her children (8, 9). Mothers with depression are less likely to engage in healthy feeding, eating, and safety practices (10–11). These mothers are less likely to display positive parenting behaviors (e.g., providing praise) and more likely to endorse negative parenting behaviors (e.g., yelling) than mothers who are not depressed (11–12). The literature suggests that depression may adversely affect the mother-infant relationship, leading to less responsive parenting and contributing to impaired infant attachment with mothers (13–14).

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Effective parent-infant interaction requires that both the infant and parent send clear cues and respond to each other, thus facilitating the development of an

interactive environment that supports continued interaction. A range of observational systems have been used to assess mother-infant interactions. Some of these systems include CARE-Index, Parent-Child Early Relational Assessment (PCERA), Parent-Infant Interaction Observation Scale (PIIOS), and Parent-Infant Relational Assessment Tool (PIRAT) (15). These systems capture and rate parent behaviors such as responsiveness to their child, infant developmentally appropriate behaviors, and quality of the dyadic interactions.

"This paper discusses the methods and lessons learned from transitioning from in-person assessment of mother-infant interaction to remote assessment due to the COVID-19 pandemic. In our randomized controlled trial (RCT) that enrolled mothers exhibiting elevated PPD symptoms."

This paper discusses the methods and lessons learned from transitioning from in-person assessment of mother-infant interaction to remote assessment due to the COVID-19 pandemic. In our randomized controlled trial (RCT) that enrolled mothers exhibiting elevated PPD symptoms, mother-infant interaction quality was the primary outcome; thus, its collection was vital for the study. In the current study, we used the PCERA to assess mother-infant interaction quality, as it has sound psychometric qualities and included tasks appropriate for mothers and their infants 12 months and younger (16, 17). Collecting video-recorded mother-infant interactions required addressing barriers remotely that would be common among postpartum women across various racial/ethnic groups and economic levels.

"We conducted an RCT to determine whether a social media-based parenting program improves responsive parenting among women with PPD symptoms. Mothers with infants ages one month to eight months and who scored above 9 on the Edinburgh Postnatal Depression Scale (EPDS) when screened at urban pediatric practices were recruited to the study. Participants were randomized to a parenting program + online depression treatment or online depression treatment alone. Mother-infant interactions were assessed at baseline and post-intervention."

Description:

Randomized Trial/PCERA

We conducted an RCT (NCT 04045132)(18) to determine whether a social media-based parenting program improves responsive parenting among women with PPD symptoms. Mothers with infants ages one month to eight months and who scored above 9 on the Edinburgh Postnatal Depression Scale (EPDS)(19) when screened at urban pediatric practices were recruited to the study. Participants were randomized to a parenting program + online depression treatment or online depression treatment alone. Mother-infant interactions were assessed at baseline and post-intervention (3 months after the start of intervention); thus, each participant potentially had two assessments.

Our sample comprised 75 mother-infant dyads. The adult sample was predominantly Black (69.3%) with at least a high school diploma or GED (94.7%). Household yearly income levels varied, with the majority representing lower income levels: 41.3% reported less than $25,000, and 32% reported $55,000 or greater. The infant sample was also predominantly Black (64%), with an average age of 3.7 months at enrollment. Participants were compensated for completing study activities and assessments and received monthly compensation for cellular data charges.

"... we used the PCERA, a validated 65-item (29 parental, 28 child, and 8 dyadic items) videotape assessment designed to measure the quality of affect and behavior in parent-child interactions to serve as the primary outcome measure. The PCERA uses ratings based on observations of 5-minute videotaped interactions with parent-infant dyads engaged in feeding, structured tasks, and free play. For this study, we coded the free play episode. The PCERA has good interrater reliability, internal consistency, discriminant and concurrent validity, and sensitivity to change."

In the current investigation, we used the PCERA, a validated 65-item (29 parental, 28 child, and 8 dyadic items) videotape assessment designed to measure the quality of affect and behavior in parent-child interactions to serve as the primary outcome measure (20). The PCERA uses ratings based on observations of 5-minute videotaped interactions with parent-infant dyads engaged in feeding, structured tasks, and free play. For this study, we coded the free play episode. The PCERA has good interrater reliability, internal consistency, discriminant and concurrent validity, and sensitivity to change (16, 17). Mothers

were instructed to play with their infants as usual, using a standard set of age-appropriate toys provided for free play. As a result of the COVID-19 pandemic and institutional restrictions on in-person research engagement, it was necessary to transition the PCERA administration from in-person to virtual.

Phase I. Pre-COVID In-Person Enrollment

Prior to COVID-19, we conducted in-person enrollment visits. As part of the baseline assessment, we collected written informed consent, measures of demographic characteristics, family income, social support, depressive symptoms, parenting competence, and parenting stress, as well as a five-minute video-recorded free play session of the parent-infant dyad using the PCERA. These study visits took place in a research lab. Each family was offered the option of transportation through a ride-share service or mileage reimbursement if they chose to travel in their vehicles or through public transportation.

The assessment rooms were a neutral space with three cameras in different positions around the room. The study staff explained the assessment methods and provided each participating dyad with the same set of toys for free play. Research staff then filmed from a separate viewing room where we could alter the camera angles and shift positions if the mother or child moved around the room. Before the onset of the pandemic, 15 participants were enrolled in the study and completed baseline PCERA assessments in this in-person format, which is the typical administration format.

"The first virtual method we employed for the PCERA involved the participants filming the 5-minute free play videos themselves in their homes. Participants uploaded the videos to a secure cloud-based service available through a free mobile application... Some of the significant barriers we encountered early on were internet bandwidth and technical difficulties while filming... we also encountered video quality issues."

Phase II. Initial Virtual Interaction Strategy—Mother Recording Independently

The first virtual method we employed for the PCERA involved the participants filming the 5-minute free play videos themselves in their homes. Participants uploaded the videos to a secure cloud-based service available through a free mobile application that our institution uses to store files securely. We created an instructional guide on downloading the app on a smartphone, recording the video, addressing video logistics, and uploading the videos to the app to be reviewed by the research team. The participants were sent the instructional guide and then given access to a secure participant-specific folder on the app to upload their videos. The videos were then reviewed for quality and stored securely by the research team. Once we established our virtual methods, we obtained additional Institutional Review Board (IRB) approval. The IRB suggested that we expand the language in our protocol and informed consent to maintain that all study activities could be conducted remotely or in person. Although the research team was not required to re-consent participants who were already enrolled in the study, we verbally informed our participants of the changes.

Some of the significant barriers we encountered early on were internet bandwidth and technical difficulties while filming. Due to the large size of the video files, sometimes it took upwards of 30 minutes for a participant to upload their videos to the cloud-based service app. Several participants encountered internet issues and had to travel to a family member's home to upload the PCERA video to the app. With this method, we also encountered video quality issues. There were instances where the lighting or sound quality was distorted, making it difficult for the coders to review the mother's or infant's facial expressions or sounds. Finally, this method also placed a greater burden on the participants to find time to film and upload the videos in addition to their day-to-day activities in the postpartum period. In order to address some of the initial barriers, we explored an alternative method for completing the PCERA videos.

Phase III. Second Virtual Interaction Strategy—Live Video Recording

Considering the initial obstacles, we identified a filming method that reduced the instances of poor video quality and allowed for real-time, personalized instructional feedback from the research team. We decided that a live video recording would be an alternative strategy. We sought to use video conferencing applications to collect data and conduct follow-up procedures remotely that were HIPAA-compliant and offered at and licensed by our institution. We also had to consider if the applications were user-friendly.

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For the live video recording, the research team gave instructions to participants on how to download an app and do a live recording of playtime with their infants. On the day of the visit, participants received a meeting ID that they would use to join the call with a research team member. From there, the research team member would instruct the participant on where and how to position their device so that the picture and audio were validated. The team member then saved and securely stored the recording. If the participant was uncomfortable with a live recording, they could film the video at home and upload it to the secure cloud-based service.

The revised virtual enrollment strategy using a live video recording

through a video conferencing app addressed some of the initial barriers we faced with the participant-initiated recording strategy. While still present, internet issues and technical difficulties were minimal, and the live recording eliminated the time-consuming video upload process. Additionally, video quality improved with this method because study team members could instruct participants in real-time and direct them on adjusting the camera so that the audio and video were clear. While the research team widely used this method, we encountered several barriers, including multiple visit attempts and participant discomfort. There were some instances where the live recording was rescheduled several times due to interruptions, the child falling asleep, or scheduling conflicts.

Assessment:

Throughout the study, we completed 139 PCERA videos. Of the 139, 15 were conducted in person, with the remaining 124 videos conducted virtually, either through independent recording from the participant (n=26) or recorded live using a video conferencing platform (n=98). Two videos were omitted from later analyses due to a high number of missing ratings from poor video quality. Our initial remote strategy involved participants filming the 5-minute free play videos in their homes. After evaluating the initial barriers associated with this strategy, we implemented an additional live video recording option. The live video recording was implemented at the start of Group 2 of 5 (Table 1). Over time, more participants opted to complete the PCERA through the research staff's live video recording compared to filming the video themselves at home.

Before the COVID-19 pandemic, there was a 31% non-attendance rate, compared to 17% once virtual study visits were implemented. In these instances, a visit was scheduled with a potential participant, but they did not attend the scheduled visit. The time and location flexibility associated with virtual visits allowed us to consider mothers' and infants' schedules at home, suggesting that a remote option can potentially increase enrollment and retention rates in a sample of postpartum women across various racial/ethnic groups and economic levels.

"Before the COVID-19 pandemic, there was a 31% non-attendance rate, compared to 17% once virtual study visits were implemented. The time and location flexibility associated with virtual visits allowed us to consider mothers' and infants' schedules at home, suggesting that a remote option can potentially increase enrollment and retention rates in a sample of postpartum women across various racial/ethnic groups and economic levels."

Conclusions for Practice:

The COVID-19 pandemic has required researchers to alter their study designs and data collection methods to align with health and safety protocols, and such adaptations are paving the way

Table 1. *PCERA videos completed at baseline and 3-month follow-up by recording method*

Baseline				
Group (n)	In-Person	At home re-cording	Live video recording	Missing
1 (n=15)	15	0	0	0
2 (n=15)	0	8	5	2
3 (n=17)	0	1	16	0
4 (n=15)	0	0	15	0
5 (n=13)	0	1	12	0
Totals (%)	15 (20%)	10 (13%)	48 (64%)	2 (3%)
Three-month follow-up				
Group (n)	In-Person	At home re-cording	Live video recording	Missing
1 (n=15)	0	11	0	4
2 (n=15)	0	3	9	3
3 (n=17)	0	1	16	0
4 (n=15)	0	0	15	0
5 (n=13)	0	1	10	2
Totals	0 (0%)	16 (21%)	50 (67%)	9 (12%)

for innovative research methods that will continue to be used and developed. Our experiences conducting remote assessments with postpartum women add to growing evidence for the feasibility and validity of remote video visits (21, 22). We found that it was feasible to conduct mother-infant interactions remotely with racially/ethnically and economically diverse mothers with postpartum depression symptoms. We retained 88% of enrolled participants, suggesting that remote collection has advantages over live, in-person observation.

It is crucial to consider the limitations and variability of video quality when conducting assessments remotely. Although the remote visits still allowed for consistent coding, there were instances where the lighting or sound quality was distorted, making it difficult for the coders to view facial expressions or sounds coming from the mother or infant, ultimately impacting their ability to code the videos using the PCERA properly. Nonetheless, two videos were excluded due to missing ratings. This variability in video quality is minimized with in-person study visits and staff-assisted remote recording. Other potential limitations include differences in participant experiences and costs of maintenance of cell phone plans so that mother-infant interactions can be collected. None of the interactions were collected in person or remotely so that a comparison of differences in the quality of interactions could be determined, which can be tested in future research.

"Conducting assessments can help home visiting programs reduce geographic barriers to service delivery virtually, along with issues related to transportation, scheduling, and family engagement preferences. Similarly, virtual assessments of mother and infant interactions can be beneficial in perinatology or neonatology practices for the same reasons. Our experiences conducting mother-infant interaction assessments as part of an RCT with diverse postpartum samples show how support and technology can be leveraged to gather this vital data for research and intervention purposes."

Finally, our study demonstrated that measures of mother-infant interactions can be collected virtually with useful recordings that can be coded. Methods such as those described can be implemented in future research and practice with postpartum mothers and their infants. For example, home visiting programs continue to play a vital role in addressing the needs of pregnant and postpartum women, young children, and families, in person or remotely. Conducting assessments can help home visiting programs reduce geographic barriers to service delivery virtually, along with issues related to transportation, scheduling, and family engagement preferences. Similarly, virtual assessments of mother and infant interactions can be beneficial in perinatology or neonatology practices for the same reasons. Our experiences conducting mother-infant interaction assessments as part of an RCT with diverse postpartum samples show how support and technology can be leveraged to gather this vital data for research and intervention purposes.

References:

1. Rocha NACF, dos Santos Silva FP, dos Santos MM, Dusing SC. Impact of mother-infant interaction on development during the first year of life: A systematic review. *J Child Health Care*, 2020:24(3):365–385. doi.org/10.1177/1367493519864742
2. Frankel LA, Hughes SO, O'Connor TM, Power TG, Fisher JO, Hazen NL. Parental influences on children's self-regulation of energy intake: Insights from developmental literature on emotion regulation. *J Obes*. *2012*; 2012:327259. doi: 10.1155/2012/327259
3. Fenning RM, Baker JK. Mother-child interaction and resilience in children with early developmental risk. *J Fam Psychol*. 2012;26(3):411-420. doi: 10.1037/a0028287
4. NICHD Early Child Care Research Network. Child care and mother-child interaction in the first 3 years of life. *Dev Psychol*. 1999;35(6):1399–1413. https://psycnet.apa.org/doi/10.1037/0012-1649.35.6.1399.
5. Pearlstein T, Howard M, Salisbury A, Zlotnick C. Postpartum depression. *Am J Obstet Gynecol*. 2009;200(4):357-364. https://doi: 10.1016/j.ajog.2008.11.033
6. Horowitz JA, Goodman JH. Identifying and treating postpartum depression. *J Obstet Gynecol Neonatal Nurs*. 2005; 34(2):264–273. https://doi.org/10.1177/0884217505274583
7. Vesga-Lopez O, Blanco C, Keyes K, Olfson M, Grant BF, Hasin DS. Psychiatric disorders in pregnant and postpartum women in the United States. *Arch Gen Psychiatry*. 2008;65(7):805–815. https://doi.org/10.1001/archpsyc.65.7.805
8. Field TM. Prenatal effects of maternal depression. In: Goodman SH, Gotlib IH, eds., Children of depressed parents: Mechanisms of risk and implications for treatment. American Psychological Association, 2002:59–88. https://doi.org/10.1037/10449-003
9. Jones NA, Field T, Fox NA, Lundy B, Davalos M. Infants of intrusive and withdrawn mothers. *Infant Behav Dev*. 1997;20(2):175–186. https://doi.org/10.1016/s0163-6383(97)90020-5
10. Paulson JF, Dauber S, Leiferman JA. Individual and combined effects of postpartum depression in mothers and fathers on parenting behavior. *Pediatrics*. 2006;118(2), 659–668. https://doi.org/10.1542/peds.2005-2948
11. Chung EK, McCollum KF, Elo IT, Lee HJ, Culhane JF. Maternal depressive symptoms and infant health practices among low-income women. *Pediatrics*. 2004 Jun 1;113(6):e523–529. https://doi.org/10.1542/peds.113.6.e523
12. Silverstein M, Augustyn M, Young R, Zuckerman B. The

relationship between maternal depression, in-home violence and use of physical punishment: What is the role of child behaviour? *Arch Dis Child*, 2009; 94(2):138–143. https://doi.org/10.1136/adc.2007.128595

13. Lyons-Ruth K, Lyubchik A, Wolfe R, Bronfman E. Parental depression and child attachment: hostile and helpless profiles of parent and child behavior among families at risk. In: Goodman SH, Gotlib IH, eds. Children of Depressed Parents: Mechanisms of Risk and Implications for Treatment. Washington, DC: American Psychological Association; 2002:89–210. https://doi.org/10.1037/10449-004
14. NICHD Early Child Care Research Network. Chronicity of maternal depressive symptoms, maternal sensitivity, and child functioning at 36 months. *Dev Psychol*. 1999;35(5):1297–1310. https://doi.org/10.1037//0012-1649.35.5.1297
15. Glatigny Dallay E, Guedeney A. Parent-infant interaction assessment. In: Sutter-Dallay, AL., Glangeaud-Freudenthal, NC., Guedeney, A., Riecher-Rössler, A, eds. Joint Care of Parents and Infants in Perinatal Psychiatry. Springer International Publishing, 2016: 93-108. https://doi.org/10.1007/978-3-319-21557-0_6
16. Clark R. The Parent–Child Early Relational Assessment: A factorial validity study. *Educ Psychol Meas*. 1999;59(5):821–846. https://doi.org/10.1177/00131649921970161
17. Clark R, Tluczek A, Moore EC, Evenson AL. Assessment of early parent–child relationships. In: R. DelCarmen-Wiggins R, Carter AS, eds. The Oxford Handbook of Infant, Toddler, and Preschool Mental Health Assessment. Oxford University Press; 2019:45–77. https://doi.org/10.1093/oxfordhb/9780199837182.013.3
18. Guevara JP, Morales K, Mandell D, et al. Social media-based parenting program for women with postpartum depressive symptoms: An RCT. *Pediatrics*. 2023;151(3):e2022058719. https://doi.org/10.1542/peds.2022-058719
19. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry*.1987;150:782–786. https://doi.org/10.1192/bjp.150.6.782
20. Clark R. Parent-Child Early Relational Assessment [Data set]. *PsycTESTS Dataset*. American Psychological Association; 1985. https://doi.org/10.1037/t07207-000
21. Gustafsson HC, Young AS, Stamos G, et al. Innovative methods for remote assessment of neurobehavioral development. *Dev Cogn Neurosci*. 2021:52:101015. https://doi.org/10.1016/j.dcn.2021.101015
22. Shin E, Smith CL, Howell BR. (2021). Advances in behavioral remote data collection in the home setting: Assessing the mother-infant relationship and infant's adaptive behavior via virtual visits. *Front Psychol*. 12:703822. https://doi.org/10.3389/fpsyg.2021.703822

Declarations: *Funding: The National Institutes of Health (Award Number 5 R61 MH118405 02). Conflicts of interest/Competing interests: Roseanne Clark is the developer of the Parent-Child Early Relational Assessment.*

Acknowledgments: *The authors would like to thank the partner institutions and study participants for dedicating their time to this study and Erica Anderson and Alison Fries for their contributions to the coding of the PCERA measure. This project was supported by Award Number 5 R61 MH118405 from the National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.*

Disclosure: *The authors have no conflicts of interests to disclose.*

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