


A WhatsApp-Based Intervention to Improve Maternal Social Support and Maternal–Child Health in Southern Brazil: The Text-Message Intervention to Enhance Social Support (TIES) Feasibility Study

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Abstract

Participatory learning and action cycles with women's groups have been recommended by the WHO to promote maternal and newborn health, but few studies have tested its feasibility and acceptability in mobile health (mHealth) interventions among mothers of toddlers. This was a mixed-method feasibility assessment of an 8-week WhatsApp-based maternal support group for mothers of toddlers (12–18 months of age) enrolled in a birth cohort study in Southern Brazil. Daily messages and weekly activities were sent by moderators to promote maternal–child outcomes: child nutrition, child sleep, nurturing care, and maternal psychosocial well-being (assessed pre- and post-intervention via self-reported questionnaire). The implementation and engagement of the mothers in the program were assessed by message extraction. Acceptability was evaluated through in-depth interviews (n = 5) and open-ended surveys (n = 10). 1481 messages were exchanged in 3 WhatsApp groups (n = 30 mothers). Mothers were most active on weekdays (68.6% of messages sent on Tuesdays and 72.6% on Thursdays), afternoons (2:00–4:00pm), and evenings (9:00–11:00 pm). Engagement was higher at weeks 1–4. Mothers enjoyed and considered topics relevant. Group interaction was perceived as low, which influenced their participation. The prevalence of depression symptoms decreased from pre- to post-intervention (9% to 5%; $P = .04$). A moderated mobile-based support group for mothers of toddlers was feasible. mHealth services to promote maternal support are a promising strategy to improve maternal–child outcomes, but engagement and use of the service remains a challenge. Program managers should work with community members to identify ways to support engagement and participation throughout the intervention.

Keywords

WhatsApp, mHealth, intervention, feasibility, maternal–child health, psychosocial wellbeing, nurturing care, food neophobia

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What do we already know about this topic?

Participatory learning and action cycles with women's groups have been recommended by the WHO to promote maternal and newborn health, but few studies have tested its feasibility and acceptability in mobile health (mHealth) interventions among mothers of toddlers.

How does your research contribute to the field?

A moderated mobile-based (WhatsApp) support group for mothers of toddlers was feasible, had high acceptability among mothers, although engagement of group participants was low and it remains an issue in mHealth interventions.

What are your research's implications toward theory, practice, or policy?

A mobile-based intervention potentially addresses the barriers related to low attendance faced by programs delivered in-person. However, interventionists and program managers should work with community members to identify ways to support engagement and participation throughout the intervention.

Background

Many children in low- and middle-income countries (LMICs) are not achieving optimal growth and development due to poverty and early life adversities.¹ With the success of programs focused on mothers of newborns and progress in child survival rates worldwide,² the WHO-UNICEF advocates that children not only survive in their first year but also thrive.³ Thus, interventions that promote responsive caregiving and learning opportunities in addition to health and nutrition rooted in the Nurturing Care Framework implemented from preconception and beyond the first years of life have been recommended to promote equity and ensure healthy development.⁴

Maternal social support interventions and government-based programs, such as participatory learning and action cycles (PLA), have been instrumental in promoting perinatal and postnatal health and development,⁵ as mothers of young children are at greater risk for poor psychosocial well-being. Mothers who feel supported and have healthy psychosocial well-being are more responsive to their children.⁶ Mobile health (mHealth) support groups may be an alternative to in-person groups during challenging times (such as the COVID-19 pandemic) and beyond, particularly using the WhatsApp text-messaging platform—lower cost than SMS and extensively used service in many LMICs like Brazil, India, and Mexico.

Mobile-based interventions to improve maternal-child outcomes have received considerable attention to improving population access to health information and care.⁷

However, most mHealth interventions are considered as a unidirectional counseling approach, and few studies have tested the effectiveness of interactive media (e.g., mobile apps that converge messages and social media) to promote social support.⁸ Programs using mHealth strategies, particularly WhatsApp, have shown increased health-related knowledge,⁹ although a study comparing a mHealth intervention to face-to-face groups reported no improvements.¹⁰

Purpose

WhatsApp use is prevalent among Brazilians, as the app is the most downloaded in the country.¹¹ Given the widespread use of this platform, and the possibility of social interactions online, this study aimed to test the acceptability and feasibility of a mHealth intervention, titled TIES (text-message intervention to enhance social support), to provide social support for mothers of toddlers aged 12–18 months living in Southern Brazil. The program promoted child and maternal health in 4 areas: child nutrition, child sleep behavior, nurturing care (early learning and responsive caregiving), and maternal psychosocial well-being during the COVID-19 pandemic.

Methods

Study Design

The TIES was a feasibility study that followed a pre-/post-design without a control group. Although the study was not powered to evaluate behavior change, the findings will inform effect size calculations to estimate trial sample size and other relevant information concerning the feasibility of mHealth interventions.

Study Setting and Sample

TIES was nested in the Rio Grande birth cohort study. Rio Grande is a mid-sized city located in Southern Brazil, with an estimated population of 211,000 inhabitants in 2019, and 96% of the population living in urban areas. This study is an ongoing population-based prospective cohort that follows all live births that occurred in the city hospitals in 2019. Mothers and their newborns weighing ≥ 500 grams or at least 20 weeks of gestational age were considered eligible. A total of 2314 mother-child dyads participated in the cohort (99.5% of the total births occurring in Rio Grande).

Mother-child dyads were eligible for this feasibility study if they had (i) children in the 2 oldest age tertiles (12–18 months old) and (ii) complete information for the 6-month assessment for the parent birth cohort study. A total of 89 mothers were eligible and a subsample of 74 mothers were randomly invited to enroll in the program in September 2020. Mothers were contacted until 30 enrolled in the study and

were randomly assigned to one of three WhatsApp groups. The decision to keep 10 participants in each group was informed by a previous WhatsApp maternal group study¹² to allow for personalized interactions. The 3 groups occurred concomitantly and had identical informational and goal-setting messages sent by 2 moderators who were health professionals trained at the graduate level. Additionally, 2 researcher-participants, unknown by mothers, participated in all groups to support the intervention’s messages and to encourage mothers to actively participate. The protocol for researcher-participants was to answer questions posed by the moderators if less than 2 mothers had engaged within 24 hours, and to ask further questions to other mothers, encouraging group sharing.

Ethics

Ethical approval was obtained from the ethics committee of the Federal University of Rio Grande (protocol number 15724819.6.0000.5324). All participants provided digital consent for the quantitative assessments and the intervention, and verbal consent for the qualitative interviews.

Conceptual Framework and Theories Guiding the Intervention

The intervention was guided by the principles of the PLA¹³ and informed by the social cognitive theory,¹⁴ social constructivism learning,¹⁵ and social networks and social support¹⁶ models to help build learning and social support networks for mothers through a digital platform (WhatsApp). The hypothesis was that participation in the WhatsApp group would support mothers in analyzing their own situations and how to best tackle issues related to parenting and maternal-

child outcomes, helping them feel supported by the WhatsApp community and empowered to take action, which in turn would facilitate parenting self-efficacy of healthy behaviors for their children (Figure 1).

Intervention Design

The overall intervention was designed to provide knowledge about maternal-child health, mobilize, and create a social support environment for mothers with young children (12–18 months old). Daily messages and weekly activities were delivered to encourage interaction and role modeling between the mothers. This was an 8-week intervention program composed of 4 main topics (2 weeks duration each): child nutrition (weeks 1–2), child sleep (weeks 3–4), components of nurturing early learning and responsive caregiving (weeks 5–6), and maternal psychosocial well-being (weeks 7–8). Intervention topics and the use of WhatsApp for intervention delivery were chosen based on formative research conducted with a subsample of mothers from the Rio Grande birth cohort (n = 25) in January 2020. The majority had access to the Internet on their phones and reported using WhatsApp every day.

Child Nutrition. Mothers received information and goal setting on children’s eating behavior focused on healthy and diversified eating practices, with strategies for inclusion of new foods in children’s diet. Evidence-based messaging from the Brazilian Dietary Guidelines for children under the age of 2 years was sent daily and encompassed 4 main areas: introduction to new foods; methods of complementary feeding; family mealtime; and weaning from breastmilk. Goal-setting messages included the addition of new foods in the child’s diet: “Choose a food that is not very familiar to your child and offer the new food in different preparations (raw, cooked in

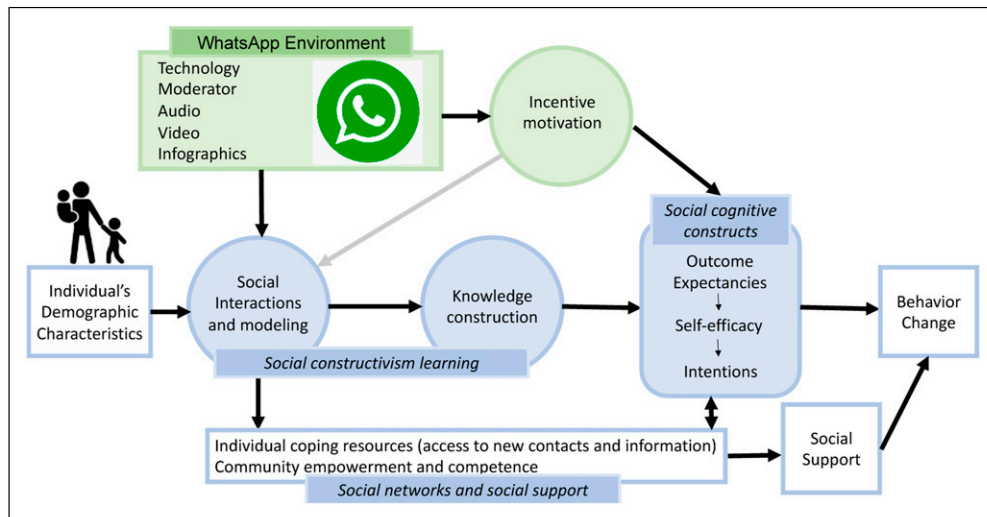


Figure 1. Conceptual framework of the TIES Whatsapp-based intervention to promote maternal-child outcomes through improving maternal social support.

pieces or puree, for example) at least twice this week!" and a family meal where everyone could share the same foods and preparations: "*Choose a day of the week and turn the food served to your child into the food served for the whole family!*" Mothers were encouraged to share photos or videos of each proposed activity and discuss their own experiences.

Child Sleep Behavior. Mothers were encouraged to discuss and share experiences around sleep hygiene, sleep self-regulation, and a healthy sleep environment for their children. Most educational, infographics, and goal-setting messages were previously tested in a randomized controlled trial with a similar population.¹⁷ Intervention activities included the formation of routine practices for sleep and preparation of an environment conducive to sleep (discouraging the use of screens and lights before bedtime), and ways to improve children's night and day sleep.

Nurturing Care (Early Learning and Responsive Caregiving). Interactive infographics about child development were used to generate discussions about milestones and inform mothers of developmental delays. Sensorial activity (i.e., to fill a bowl with water and ice/rice and encourage the child to experience it) and book-sharing were proposed to promote mother-child interactions and early learning. Discussions were focused on the mother-child relationship, bonding, and positive parenting.

Maternal Psychosocial Well-being. Messages and activities focused on maternal social support, self-care, and mother-child relationship were previously tested⁵ and utilized evidence-based cognitive-behavioral techniques. For each topic, mothers were asked a question to promote personal reflective thinking and social interaction followed by activities including a social network support list, a 1-minute meditation session, a ten-minute uninterrupted mother-baby playtime, and a mind map. The Thinking Healthy manual was used as a reference for the activities,⁵ developed by the World Health Organization's mhGAP Intervention Guide.

Data Collection

Mother Engagement. A text mining script was developed using Python programming language to evaluate participant's interaction in each WhatsApp group. The script received as input the raw transcript of all messages sent by moderators, researcher-participants, and participants, and extracted the sender's ID, date, hour, and content of each message. Extracted messages were categorized as text, image, video, sticker, or audio message. As output, the Python script produced a structured Stata 16.1 (StataCorp. LLC, College Station, TX) dataset.

Qualitative Research to Understand Program Implementation.

Qualitative research was conducted at mid- and post-intervention to gather maternal perceptions and lessons

learned from the groups. Methodological triangulation was used to improve accuracy and gather detailed information on the program implementation. At mid-intervention, all mothers were invited to answer an open-ended questionnaire with 4 questions on what worked, what did not work, suggestions to improve their experience in the group, and the best time to receive messages. Immediately after the intervention, all mothers were invited for in-depth interviews (IDIs) conducted by video conference. The IDI lasted between 20 and 40 minutes, were audio-recorded, and transcribed for analysis. Examples of questions asked were "*How did you feel about the level of interaction between mothers in the group?*" and "*How would you encourage more mothers to interact in the group?*" Data collection was intended to inform the dissemination of the program state-wide. The interviewers (TMS and RM) were trained and certified by the principal investigator, who has graduate-level training in qualitative research methods.

Pre- and Post-Evaluations. Pre- and post-intervention online surveys were disseminated using the REDCap software. Pre- and post-surveys were self-reported and were developed using a responsive web design, optimized to work well in various devices and screen sizes. Mothers self-reported on child nutrition in terms of child food neophobia,¹⁸ child sleep behaviors,¹⁹ nurturing care (mother-child interactions and early learning opportunities),²⁰ maternal psychosocial well-being,²¹ parental self-efficacy,²² and maternal social support²³ using validated questionnaires described in the [Supplemental Material 1](#).

Demographics. The following demographic characteristics were reported by mothers in the online survey at the pre-intervention assessment: maternal age (years), child's age (months), child sex (male and female), first child (*Does the child have siblings?* yes, no), child ever breastfeed, maternal marital status, schooling (completed high school of the head of the household), number of rooms in the house (bathrooms were excluded), and family income (in Purchasing Power Parity using Brazil's exchange rate in 2020).

Data Analysis

Engagement Analysis

The total number of messages per topic and frequency of messages sent per week by mothers and moderators were calculated. The frequency of messages according to the day of the week and time of the day was also evaluated to estimate mothers' most active moment in each WhatsApp group.

Qualitative Analysis

After reading all IDI transcripts, the research team identified emergent patterns and used inductive coding to identify key themes and concepts to develop a list of common codes to

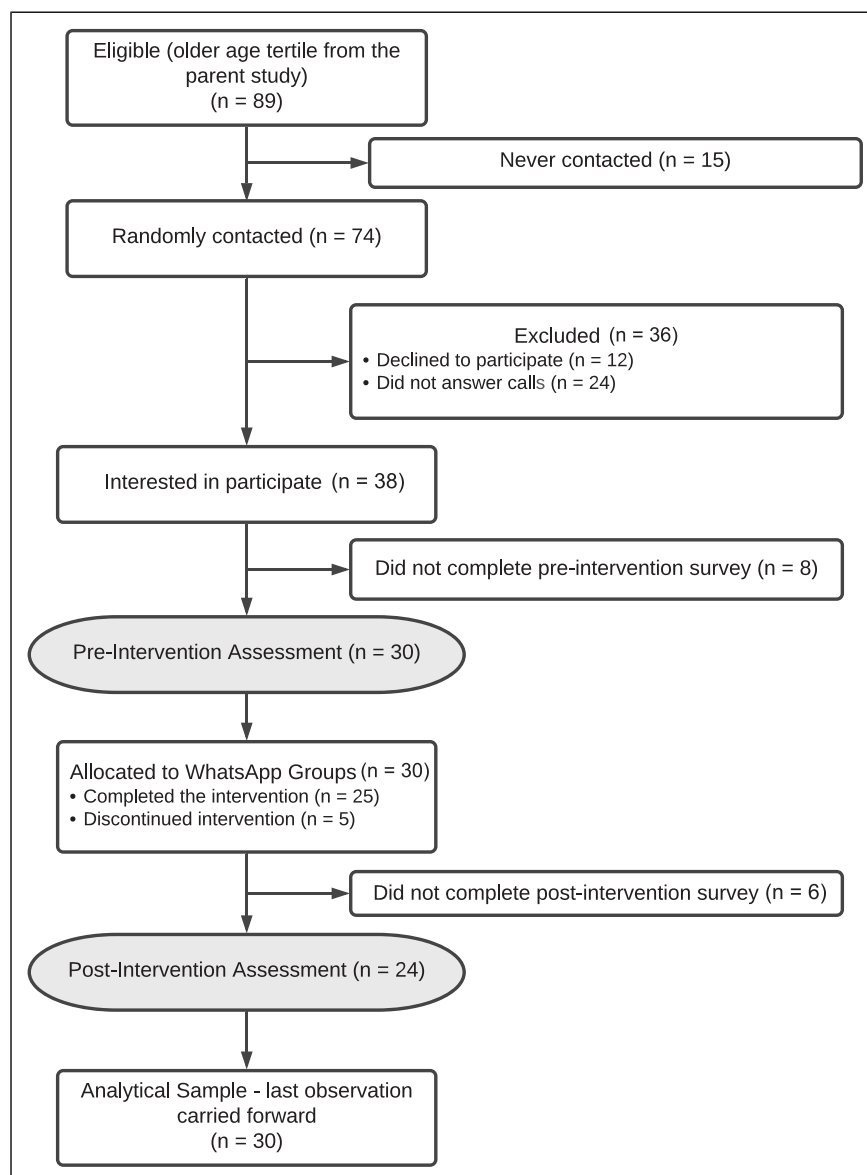


Figure 2. Flow of participants throughout the study.

analyze the data. A grounded theory approach was adopted for the qualitative analysis.²⁴ Seven codes emerged, including reassurance, shared experience, intervention topics, interaction, and suggestions. The text was extracted from transcriptions to generate analysis content, themes, and findings, and then translated to English.

Quantitative Analysis

Last observation carried forward was applied for mothers with missing data for the post-intervention evaluation ($n = 6$). Univariate distributions were examined to identify extreme values (outliers) and asymmetry of distributions; all continuous outcomes were asymmetrically distributed, thus median values were utilized in the analyses. A comparison

between the pre- and post-intervention estimates for maternal-child outcomes was performed. Dichotomous measures were compared using McNemar's chi-squared test, and discrete measures were compared by Wilcoxon matched-pairs signed-rank tests. The Cohen's D effect size for samples with repeated measures was also estimated. All analyses were conducted using Stata 16.1 software (StataCorp, College Station, TX, USA), and a 5% significance level was considered.

Results

Thirty mothers were allocated into a WhatsApp group and received the intervention from October to December 2020. During the intervention, 5 mothers dropped out stating lack of time ($n = 1$), technology burnout during the pandemic ($n = 1$),

Table 1. Descriptive Information on Pre-Intervention Maternal and Child Characteristics and Demographics (n = 30).

Maternal characteristic	Mean (SD)/n (%)
Age (years)	30.0 (6.9)
Family income (PPP)	763.5 (798.0)
Number of rooms in the house ^a	4.8 (1.7)
Completed high school ^b %	22 (75.9)
Marital status (partner)%	25 (83.3)
Child characteristics	
Age (months)	16.4 (2.8)
Sex (female)%	15 (50.0)
First child%	15 (50.0)
Ever breastfed%	29 (96.7)

Note. PPP = Purchasing Power Parities; SD = standard deviation.

^a Bathrooms were excluded.

^b One missing information, n = 29.

Table 2. Absolute and Relative Frequencies of Types of Messages Sent by Mothers (N = 30) Across the 3 WhatsApp Group During the TIES Program.

Types of messages	n (%)
Audio	40 (2.7)
Image	31 (2.1)
Sticker	8 (.5)
Text	1398 (94.4)
Video	4 (.3)
Total	1481 (100.0)

upset no one answered her message (n = 1), not using the WhatsApp group (n = 1), and did not provide a reason (n = 1). The project experienced a retention rate of 83% and 24 mothers completed post-intervention assessment after the 8-week intervention (Figure 2). The main reasons for non-response at follow-up included changes in the phone number (n = 2) and refusals (n = 4). The baseline characteristics of the 30 mother-child dyads are described in Table 1. On average, mothers were 30 years old (SD + 6.9), majority completed high school, and had a partner living with them. Children were on average 16 months old (SD + 2.8) and the majority had ever breastfed.

Text-Message Intervention to Enhance Social Support Program Implementation and Engagement of Mothers

During the study, a total of 2385 messages were sent in all WhatsApp groups, of which 62% (n = 1481) were sent by mothers, 21% (n = 500) by moderators, and 17% (n = 404) by researcher-participants. A list of intervention messages sent by the moderators is displayed in Supplementary Table 1. Text messages were the main type of communication used by mothers (94.4%), followed by audio messages (2.7%) (Table

2). The number of audios and stickers were different between the WhatsApp groups (Supplementary Table 2). Since the design of the intervention was the same across the groups, analyses are presented at the aggregated level with WhatsApp groups combined.

Figure 3 illustrates the frequency of exchanged messages by day of the week and hours of the day. The absolute number of messages sent by moderators ranged from 37 (on Sundays) to 108 (on Mondays), whereas mothers sent between 34 (on Sundays) and 395 messages (on Tuesdays). The number of messages sent by mothers and moderators was low during the weekend. During weekdays, Fridays were the days with the lowest number of messages sent (n = 248). Messages sent by researcher-participants did not seem to influence mothers' participation in the group (Supplementary Figure 2), thus the amount and frequency of messages presented in the results are focused on moderators and mothers. In Figure 4, most messages were sent by mothers around 3:00 pm and 10:00 pm, and sent by moderators at 10:00 am, 4:00 pm, and 6:00 pm. In spite of that, mothers were active during all times of the day, except early in the day from 3:00 am to 6:00 am.

In Figure 5, there was a reduction in the total number of messages sent by mothers in the last 3 intervention topics compared to the first topic. For the first 3 topics covered by the intervention (child nutrition, child sleep behavior, and nurturing care), a steep increase in the number of messages was perceived on the first or second day after the introduction of the topic. It was also possible to note an increase in the middle of each topic window, in response to the activities proposed by the moderators. Mothers' engagement with the last topic (maternal psychosocial well-being) was the lowest and did not vary.

Acceptability of the TIES Intervention and Feedback on Program Materials

Eleven mothers provided qualitative feedback at mid-intervention using Google Forms. For the IDIs conducted post-intervention, 12 mothers agreed to participate, 2 declined, and 16 never responded to the invitation. Of the 12 mothers interested in the IDI, 5 were interviewed using WhatsApp video calls. The remaining mothers could not participate due to schedule conflicts.

Assessment of qualitative data showed that mothers enjoyed knowing that others were going through similar phases or shared similar challenges, which made them feel reassured. They were interested in being part of the program to learn and ask questions about what may come next in their toddler's life. For them, this is a group that they know they can count on to ask questions and share experiences when needed, and these were the main motivators for continuing in the group, even after the intervention ended.

"I stayed in the group because it's a nice group, I don't know what the next (developmental) phase will be like. If all of a

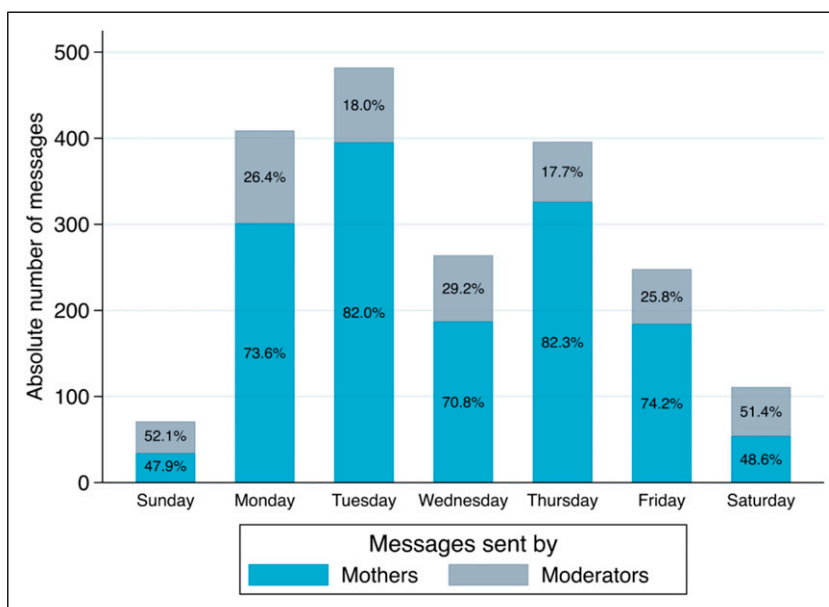


Figure 3. Number of messages sent in each day of the week according to the role of the participant.

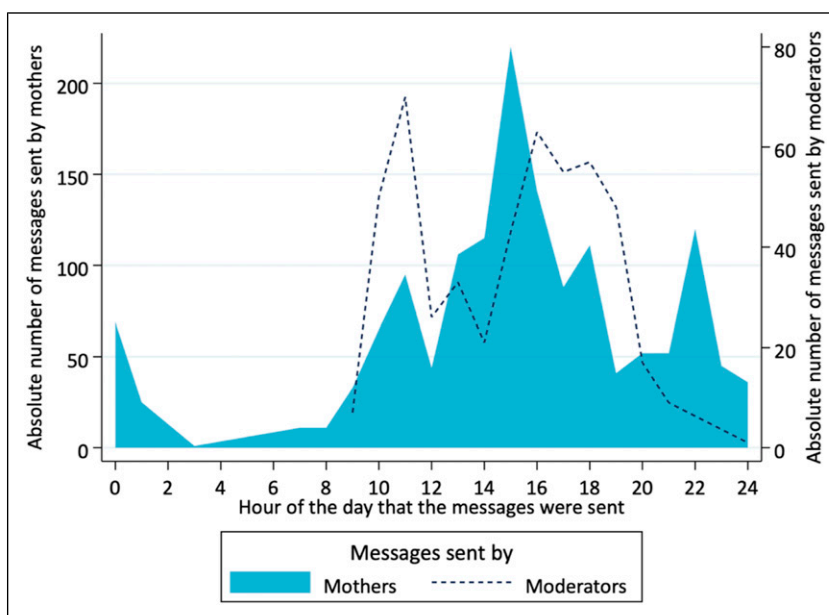


Figure 4. Absolute number of messages sent by mothers and moderators according to the hour of the day.

sudden, I have a question, it’s good to know that I have a group that I can ask questions and sometimes someone else is going through the same thing as me.”

Overall, topics discussed in the WhatsApp group attended mothers’ expectations and needs. Topics that seemed to be more relevant to mothers were related to what they were going through at the time. For example, if sleep was the major issue they perceived, the discussions around child sleep were more relevant to them. Introduction to new foods

seemed to be the behavior that all mothers started doing more because of the intervention. They mentioned having difficulties introducing solids and becoming frustrated with it. For them, the discussion in the group was a good reminder and encouragement to continue to offer different foods and textures:

“I am still trying to offer foods that she no longer wants. The discussion around offering foods various times was a good one because I had already given up. It is important to be persistent.”

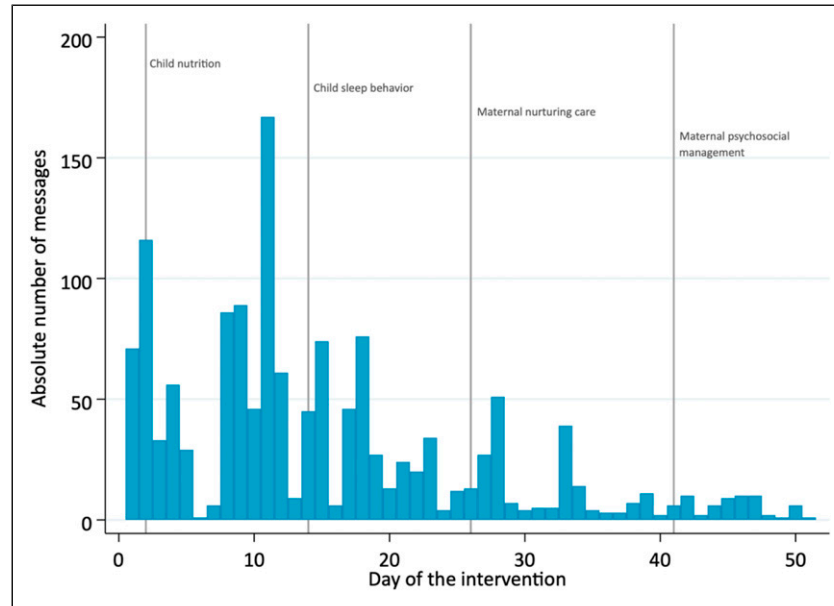


Figure 5. Absolute number of messages sent by mothers according to the day of the intervention. Starting day of each theme is represented by vertical lines.

Another recurring theme was the difficulty in having time for self-care but realizing that when they are well, they can be more present and caring for their babies. However, the activities proposed around the topic of maternal psychosocial well-being during the intervention were the most difficult for them to implement, such as meditation. Mothers mentioned either starting to reflect more on the importance of having more time for themselves or implementing small changes in their lives like stopping for 5 minutes to read books and feeling reinvigorated for the rest of the day. Despite knowing the importance of taking care of themselves, barriers such as not having access to childcare, especially during the pandemic, emerged:

“Having a moment for ourselves (mothers), is very difficult. I had no one to leave her with, but this is still kind of difficult. In the pandemic, there is nowhere to leave the child to have time to take care of myself.”

The interaction between mothers in the group was perceived to be low and to decrease over time. Overall, mothers were excited at the beginning of the intervention but described having other demands throughout the program that influenced their participation to decrease. Other mothers were upset that they were the only ones who seemed to be sharing and talking in the group and decided to send fewer messages as the intervention progressed. They felt that perhaps they would be perceived as annoying to other mothers but did not understand why mothers accepted to be in the group and did not engage. A possible explanation was related to the mother’s schedules and priorities.

Suggestions to improve the interaction and the intervention included having more personalized messages from the

moderators to the group, as at times, topics were already covered in the discussion among mothers and repeated by the moderators. One mother suggested having access to all topics to be discussed beforehand to know what to expect from the discussions and the time to raise a related issue. Another suggestion was to have started the group earlier, when their babies were newborns, as this was a time that they had most questions and fears, and it could have improved the bond between the mothers. Having a group where children are about the same age was helpful, and while a newborn group would have been helpful, they valued this specific group because they know new doubts will emerge.

Maternal and Child Outcomes: Pre- and Post-intervention Assessment Results

In the pre- and post-intervention analysis, there was a 13.3% point decrease in the prevalence of maternal depression symptoms (P -value = .045) and an increase in child’s food neophobia (pre-intervention median score = 13 and post-intervention score = 24, P -value < .001) (Table 3). The median score of maternal social support increased with a moderate Cohen’s D effect (.28), although not statistically significant.

Discussion

Three major findings emerged from this investigation of the feasibility of a WhatsApp-based maternal support intervention to improve maternal–child outcomes in a middle-income country. First, this study showed that adapting programs using PLA groups to mobile-based interventions is feasible

Table 3. Change in Maternal–Child Outcomes from Pre- to Post-Intervention.

Change in study outcomes	Pre-intervention		Post-intervention		Cohen's D effect	P value
	N	% (95% CI)	N	% (95% CI)		
Low quality of sleep						
No	15	57.7 (37.6–75.5)	16	61.5 (41.1–78.6)	.03	.706 ^a
Yes	11	42.3 (24.5–62.4)	10	38.5 (21.4–58.9)		
Maternal psychosocial well-being						
No risk of depression	21	70.0 (50.8–84.1)	25	83.3 (64.7–93.2)	.98	.045 ^a
Risk of depression	9	30.0 (15.9–49.2)	5	16.7 (6.8–35.3)		
		Median (IQR)		Median (IQR)		
Maternal social support	30	43 (36–47)	30	47 (40–48)	.28	.241 ^b
Child food neophobia	30	13 (10–16)	30	24 (19–26)	1.93	<.001 ^b
Maternal nurturing care	30	12 (11–13)	30	12 (11–13)	–.06	.964 ^b
Self-efficacy	30	24 (20–26)	30	23.5 (21–26)	.08	.992 ^b

Note. CI = confidence interval; IQR = interquartile range.

^a McNemar's chi-squared test.

^b Wilcoxon matched-pairs signed-rank test.

for mothers of toddlers. Second, a WhatsApp-based support group for mothers of toddlers was acceptable by mothers, as evidenced by the high retention rate (i.e., 25 mothers completed the program) and feedback from qualitative data. Third, there was an improvement in maternal psychosocial well-being and a trend for increased maternal social support from pre- to post-intervention.

The engagement analysis paired with the qualitative findings demonstrated the initial excitement of the mothers toward the group with a decline in the number of messages exchanged after 4 weeks of the program. Low adherence to intervention protocol is often described as an issue in intervention trials. Participants may lose interest in continued participation or find that ongoing participation is burdensome, increasing their probability of dropping out. A recent WhatsApp-based study implemented among Brazilian women to increase breast cancer awareness also pointed out that the interaction between participants was a challenge.²⁵ The authors noted that women adopted a passive posture for receiving health information, always waiting for the moderator (“expert voice”) to have the final say.²⁵

Future programs should identify ways to increase engagement that reflect the core cultural values and social norms of the community in future WhatsApp-based PLA with women. Training moderators that are familiar with the community (e.g., community health workers) or identifying mothers that are positive-deviants²⁶ could be innovative strategies to be tested in future WhatsApp-based interventions to promote maternal–child health. Although technology-based programs address many of the barriers that influence low attendance such as transportation,²⁷ there is a need to explore strategies to maintain engagement in interventions using interactive media.

Monitoring interaction and engagement of participants is important to inform program implementation (e.g., topics that

generate more interest than others and days of the week that have a higher response rate) and ensure the integrity of data collected (e.g., address the issue of non-participation bias, as individuals who engage in the program may be different than those who do not).²⁸ In this study, there was a greater engagement and exchange of messages among mothers on Mondays and Tuesdays. This is in line with the Healthy Mondays' initiative, which shares the premise that people may be more likely to engage in aspirational behaviors following temporal landmarks, such as the beginning of a new week (also known as the “fresh start effect”).²⁹

There was an improvement in maternal psychosocial well-being and a trend for increased maternal social support from pre- to post-intervention. Findings corroborate other studies conducted during the pandemic. For instance, an intervention study to improve women's mental health conducted in the Dominican Republic during the COVID-19 pandemic showed that an online tool was effective in increasing access to mental health care to assist in anxiety, depression, and insomnia treatments.³⁰ In a recent COVID-19 survey conducted with mothers in the Rio Grande birth cohort, the risk for depressive and anxiety symptoms increased from pre- to post-intervention during pandemic periods.³¹ The finding that the TIES intervention improved maternal psychosocial symptoms is encouraging given the prevalence of depressive and anxiety symptoms increased in the study population amidst the pandemic. mHealth interventions that foster social support could be an alternative to presentational traditional mental health care in the pandemic context³² or a supplement to such services beyond public health emergency situations.

Children's fear to try new foods increased from pre- to post-intervention, despite results from the qualitative interviews indicating that mothers felt more empowered to introduce new foods repeatedly to their toddlers. Toddlers go through a developmental phase where fear of trying new

foods is very prevalent, peaking around 24 and 36 months.³³ Children in this study started to approach this phase, which could explain the increase in rejections of new foods. Another possible explanation is that mothers may have become more aware of food neophobia issues based on the group discussions.

Limitations

First, almost half of the participants contacted did not enroll in the program. Additionally, there was no information collected on Internet access and WhatsApp usage among those who were not contacted or did not agree to participate. Future interventions could provide support for data costs associated with the program to address potential participation bias. Second, there might be systematic differences between non-contacted mothers and those enrolled in the intervention, thus the findings of this study should be interpreted considering this limitation. Third, a control group was not considered because of the feasibility design to investigate intervention implementation and acceptability, thus causality cannot be established. Given the small sample size ($n = 30$), power issues cannot be ruled out in the analyses. Another limitation concerns the qualitative assessment, as mothers' views may differ from those who did not participate in this study based on relevant programming issues. Moreover, only 5 mothers participated in IDIs. Personal and professional schedules and family emergencies precluded participation of other mothers who were willing to share their experiences. All participants knew that the interviewer was affiliated with the program, which may have affected responses due to social desirability bias. However, good rapport with interviewees was established, and trust was built to ensure data accuracy.

Implications for Practice and Research

In summary, a moderated WhatsApp support group for mothers of toddlers was feasible and acceptable in a middle-income country. The TIES intervention was a program implemented with low resources with short duration, testing a strategy to promote maternal-child outcomes and ensure that all children thrive during public health emergencies and beyond. Although mobile-based groups potentially address the barriers related to low attendance faced by programs delivered in-person, engagement of group participants remains an issue. Future research and programs should work with community members to identify ways to support engagement and participation throughout the intervention, and potentially train community members to become group moderators. mHealth services to promote maternal support is warranted to improve the reach of maternal-child program guidelines and empower mothers to take actions for their health and for their child.

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Author Contribution

ACBT and CLdM designed the intervention. ACBT, RCM, TMS, CB, MXC, BDP implemented and evaluated the research study. RCM, TMS, CB, MXC were involved in the curation of the data. ACBT drafted the article. ACBT, RCM, TMS, CB, MXC, BDP, and CLdM interpreted the data and revised sections of the article critically. All authors verified the data, participated in article reviews and approval of the final version.

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Supplemental Material

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