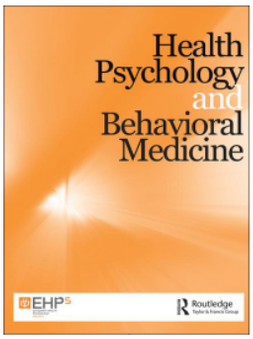

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RESEARCH ARTICLE

Promoting breastfeeding through digital communication: a longitudinal randomized controlled trial

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ABSTRACT

Introduction: Breastfeeding is a key early-life primary prevention behavior; yet, despite consistent recommendations and recent improvements, exclusive breastfeeding rates remain well below target levels. This preregistered longitudinal randomized controlled trial (RCT) tested the effectiveness of two resource-efficient digital communication interventions.

Methods: Women in the 36th week of pregnancy ($N = 467$) were randomly assigned to one of six conditions in a 2×3 between-participants design. The first intervention consisted of informational messages targeting components of the extended Theory of Planned Behavior (TPB). The second intervention was a drip communication campaign delivered via mobile phone messages: participants in the *tips* condition received messages aimed at increasing practical breastfeeding knowledge and skills, whereas participants in the *implementation intentions* condition were additionally prompted to formulate specific if-then plans. Control groups received messages related to healthy eating and physical activity. Participants were followed up until 5 months postpartum.

Results: The TPB-based intervention exerted indirect effects on both full and any breastfeeding duration by increasing breastfeeding self-efficacy and perceived behavioral control, which in turn enhanced exclusive breastfeeding intentions. For full breastfeeding only, the intention-behavior relationship—and thus the indirect effect of the TPB intervention—was strengthened by both the tips and implementation intentions interventions. Higher levels of self-objectification indirectly reduced breastfeeding duration through weaker identification as a breastfeeding mother and lower intentions.

Discussion: Delivering simple, resource-efficient digital communication interventions that empower mothers and support the translation of intentions into sustained behavior represents a scalable strategy to promote exclusive breastfeeding.

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KEYWORDS
Breastfeeding promotion; digital health communication; theory of planned behavior; self-efficacy; implementation intentions

Introduction

Breastfeeding is widely recognised as a key early-life primary prevention behaviour, and major international health organisations consistently emphasise its importance. The World Health Organisation & UNICEF, (2003, 2013), together with leading professional associations such as the American Academy of Paediatrics (Meek & Noble, 2022), recommend exclusive breastfeeding for the first six months of life. Reflecting the global relevance of this practice, the fifth target of the Global Nutrition Monitoring Framework (GNMF) aims to increase the proportion of infants under six months who are exclusively breastfed to 60% by 2030 (World Health Organisation & UNICEF, 2025).

Despite these consistent recommendations, exclusive breastfeeding rates remain far below target levels. Although modest improvements have been documented in recent years (World Health Organisation, 2024), substantial cross-country variability persists (North et al., 2022), and only about one quarter of infants in Europe and the United States are exclusively breastfed for the recommended six months (Centers for Disease

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Control and Prevention, 2024; Theurich et al., 2019). This persistent gap between guidelines and real-world practices underscores the need to better understand the psychosocial factors shaping infant feeding decisions and to identify effective, economical, and scalable strategies to promote exclusive breastfeeding. This preregistered longitudinal randomised controlled trial (RCT) tested the effectiveness of two resource-efficient digital communication interventions delivered in two sequential steps. The first intervention was grounded in the Theory of Planned Behaviour (TPB), whereas the second focused on enhancing preparedness by providing practical tips, either alone or combined with implementation intentions.

Fostering breastfeeding intentions

The TPB (Ajzen, 1991) has been extensively used to explain a wide range of health behaviours (Conner & Sparks, 2005). According to the TPB, behaviour is directly determined by behavioural intention, which in turn depends on attitudes toward the behaviour, subjective norms, and perceived behavioural control (PBC). The extended TPB (Ajzen & Fishbein, 2005) and the Reasoned Action Approach (RAA; Fishbein & Ajzen, 2010) further distinguish affective/experiential and cognitive/instrumental attitudes, injunctive and descriptive norms, self-efficacy (capacity) and control (autonomy) components of PBC, and includes additional predictors such as past behaviour, self-identity, anticipated emotions, and moral norms (Conner & Sparks, 2005).

The TPB has proven useful in explaining breastfeeding choice. Several studies indicate that TPB components, together with socio-demographic variables such as educational level and socioeconomic status, account for a substantial proportion of variance in breastfeeding initiation and duration (Lau et al., 2018). A meta-analysis by Guo et al. (2016) estimated that attitudes, subjective norms, and PBC explain 41% of the variance in breastfeeding intentions, which in turn—along with PBC—explains 30% of the variance in breastfeeding behaviour. However, important issues remain unresolved.

TPB-based research has frequently informed interventions aimed at changing health-related intentions and behaviours, typically producing medium-to-large effects on intentions ($d = .58$) and small-to-medium effects on behaviour ($d = .40$; Webb & Sheeran, 2006). However, most TPB-based breastfeeding studies have been correlational, limiting causal inference. Only a small number of experimental studies have tested TPB-informed educational interventions targeting breastfeeding intentions and behaviour. Among these, two were quasi-experiments (Jeihooni et al., 2019; Rahmanian et al., 2022) and seven were RCTs (Giles et al., 2014; Gu et al., 2016; Wambach et al., 2011; Wan et al., 2016; Wen et al., 2021; Yazdanpanah et al., 2024; Zhang et al., 2009).

Most of these interventions were conducted in China and, except for Giles et al. (2014), involving secondary school students in Northern Ireland, and Wambach et al. (2011), focusing on predominantly African American adolescent mothers, none were carried out in Western countries. Moreover, these interventions typically combined multiple components (e.g. group classes, individual instruction, counselling, face-to-face and telephone support), making them costly, demanding, and difficult to scale. The complexity of these interventions also hampers the identification of which elements are responsible for the observed effects.

Accordingly, the first aim of the present study was to test a simple and cost-effective TPB-based digital intervention suitable for large-scale implementation. This intervention, delivered as a self-paced informational video, was designed to foster expectant mothers' breastfeeding intentions and thus behaviour by targeting cognitive, affective, motivational, and social components of the extended TPB.

As a secondary purpose, we further tested whether the effectiveness of this intervention would vary across individuals, focusing on self-objectification as a potential moderator. Self-objectification has been negatively associated with breastfeeding attitudes and intentions and positively related to perceived barriers, concerns about public breastfeeding, and about the impact of breastfeeding on body shape and sexuality (Al-Ali et al., 2013; Johnston-Robledo & Fred, 2008; Johnston-Robledo et al., 2007; Rodgers et al., 2018). However, no prior research has examined whether self-objectification predicts actual breastfeeding behaviour or moderates the effectiveness of breastfeeding promotion interventions. Addressing this gap constituted the second aim of the study.

Reducing the intention-behaviour gap

Although intentions explain a substantial portion of variance in breastfeeding initiation and duration (Guo et al., 2016), an intention-behaviour gap remains evident, as is common across health behaviours (Sheeran

& Webb, 2016). Breastfeeding often requires learning through practice and may be challenging, particularly in the early postpartum period. Expectant mothers intending to breastfeed are not always sufficiently prepared for potential difficulties, which may hinder the translation of intentions into actual behaviour. Preparation involves both practical knowledge and planning. According to Gollwitzer's (1993, 1999) distinction between goal intentions and implementation intentions, forming specific if-then plans can facilitate goal attainment.

Meta-analytic evidence (Sheeran et al., 2025) indicates that implementation intentions effectively reduce the intention-behaviour gap, exerting on average a small-to-medium effect on health behaviour ($d = .26$). Two cognitive processes are involved: first, implementation intentions make goal-relevant opportunities and obstacles highly accessible and thus detectable; second, by creating a strong link between those situations and the goal-directed response, they make this response automatic (Bieleke et al., 2021).

These mechanisms are particularly relevant to breastfeeding, where early recognition and management of difficulties are crucial (Feenstra et al., 2018; Gianni et al., 2019). However, no studies have experimentally assessed the effect of implementation intentions on breastfeeding outcomes. The third aim of the study was therefore to test and compare the effectiveness of a tips provision intervention, alone or combined with implementation intentions, in translating intentions into behaviour. These interventions were delivered via mobile phone text messages, a cost-saving and accessible solution. A meta-analysis supports the effectiveness of text-message interventions for preventive health behaviours (Armanasco et al., 2017), and some studies have reported positive effects on breastfeeding outcomes (Gallegos et al., 2014; Hmone et al., 2017; Jiang et al., 2014; Kellams et al., 2022; Mehrabi et al., 2021), although none were based on implementation intentions or conducted in Europe.

The present study

We conducted an RCT using a 2 (TPB intervention vs. control) × 3 (tips vs. implementation intentions vs. control) full-factorial, between-participants longitudinal design (see Figure 1). The hypothesised model is reported in Figure 2. For the analyses, the design was represented using dummy-coded variables to test the moderating role of the second intervention on the intention-behaviour link.

As for the first aim—fostering expectant mothers' exclusive breastfeeding intentions and, in turn, behaviour—we hypothesised that participants randomly assigned to the TPB intervention, compared with those in the control condition, would score higher on the TPB first level components, namely cognitive and affective attitudes (H1a1), perceived behavioural control and self-efficacy (H1a2), descriptive, injunctive, and moral norms (H1a3), anticipated emotions (H1a4), and personal identity (H1a5), and on exclusive breastfeeding intentions (H1b); and that the effect of the intervention on intentions would be mediated by the TPB first level components (H1c). We further expected that the TPB intervention would increase actual breastfeeding outcomes (H1d), namely any breastfeeding initiation (H1d1), any breastfeeding duration (H1d2), and full breastfeeding duration (H1d3)[1], and that these effects would be mediated by the TPB components and intentions (H1e)[2].

A secondary aim of the study was to examine the role of self-objectification. We hypothesised that higher levels of self-objectification would be associated with less favourable cognitive and affective attitudes (H2a), PBC and self-efficacy (H2b), self-identity (H2c), and anticipated emotions (H2d), and, in turn, with lower exclusive breastfeeding intentions (H2e) and poorer breastfeeding outcomes (H2f; i.e. any breastfeeding initiation, any breastfeeding duration, and full breastfeeding duration), with these negative effects being at least partially mediated by the extended TPB components (H2g). We further hypothesised that self-objectification would moderate the effects of the TPB intervention, such that the intervention would be less effective among women reporting higher levels of self-objectification (H2h).

The third aim was to test and compare the effectiveness of a tips intervention, either alone or combined with an implementation intentions intervention, in translating breastfeeding intentions into behaviour. We hypothesised that participants assigned to the tips intervention, compared with those in the control condition, would show a stronger association between breastfeeding intentions, on the one hand, and any breastfeeding initiation (H3a1), any breastfeeding duration (H3a2), and full breastfeeding duration (H3a3), on the other. We further hypothesised that participants assigned to the implementation intentions intervention (which also included tips) would show an even stronger association between breastfeeding

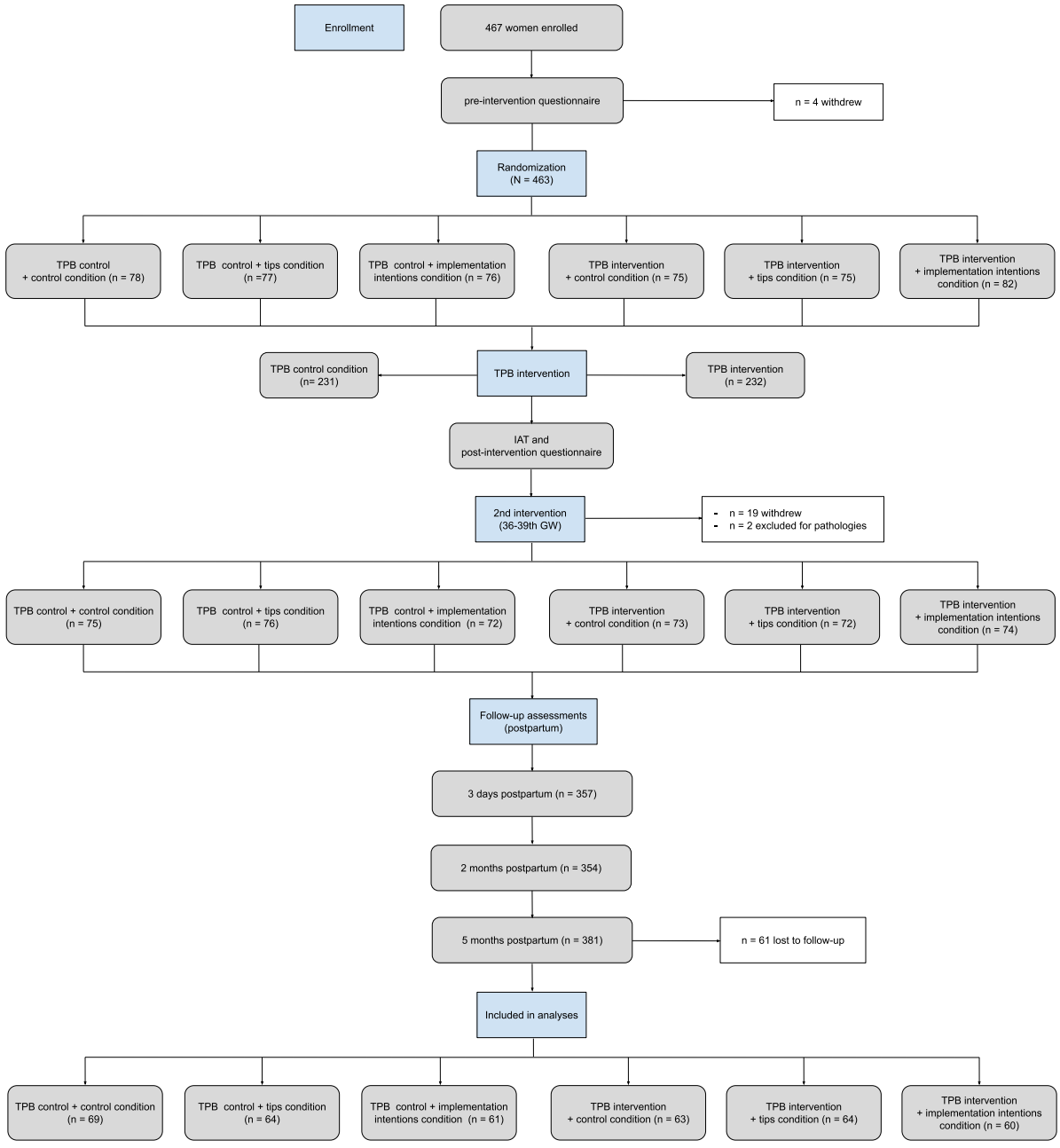

Figure 1. CONSORT flow diagram of participant allocation and follow-up.
Note: In contrast to preregistered exclusion criteria, participants who failed the attention check ($n = 21$), showed insufficient effort responding ($n = 1$), or were identified as outliers based on Cook's distance ($16 \leq n \leq 28$) were retained, as their exclusion did not substantively alter results and retention maximised statistical power.

intentions and any breastfeeding initiation (H3b1), any breastfeeding duration (H3b2), and full breastfeeding duration (H3b3).

Method

Participants and procedure

Based on an a priori power analysis, a sample of $N = 251$ was sufficient to detect a medium effect size ($f = .25$) with $\alpha = .05$ and power = .95 in a 2×3 between-participants design. This calculation was intended to support the detection of overall group differences on continuous follow-up outcomes (breastfeeding

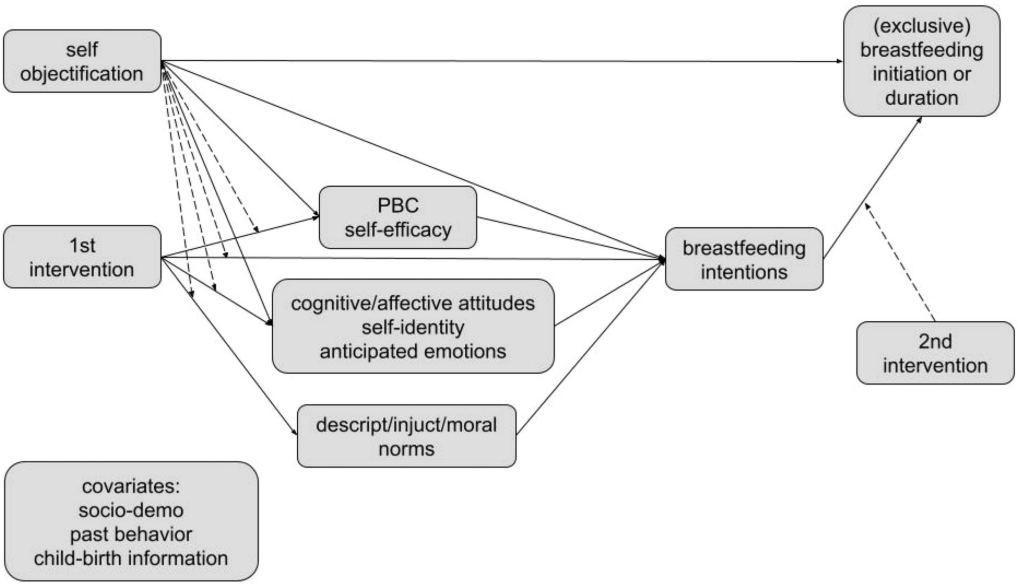

Figure 2. The hypothesised moderated mediation model.

duration), rather than specific paths or conditional indirect effects. In addition, a sample of approximately 200 participants was sufficient to detect a medium effect size ($f^2 = .15$) in multiple linear regressions with up to 15 predictors and 10 covariates. To account for potential attrition across intervention phases and follow-ups, we set a recruitment target of at least 360 participants, assuming a loss of approximately 25–30% of the initial sample.

A convenience sample of 467 expectant women was recruited during the 36th week of pregnancy at the Obstetrics Department of the Policlinic of Modena (acceptance rate = 75%). Eligibility criteria included being of legal age, healthy, proficient in Italian, and willing to participate voluntarily. After providing informed consent, participants received an anonymous identification code and completed a pre-intervention questionnaire assessing socio-demographic characteristics, breastfeeding experience as infants, past infant feeding behaviour, and self-objectification.

Participants were then randomly assigned to one of the six experimental conditions and received either the TPB-based intervention or the control condition. Randomisation was performed automatically by Inquisit Web, the software used in this part of the study. Given the nature of the interventions, full blinding was not feasible. Participants were unaware of other experimental conditions. The experimenter was initially blind to condition assignment, with occasional unblinding during the first phase if assistance was required; no face-to-face interaction occurred during the second intervention.

Following this first intervention, all participants completed a post-intervention questionnaire assessing the extended TPB components. Participants also provided their mobile phone numbers to receive the second intervention and follow-up assessments.

The second intervention began the day after recruitment (see Figure 1). Over the subsequent 23 days, participants received 16 WhatsApp messages (including opening and closing messages), depending on condition: one third were assigned to a control condition, one third to a tips condition, and one third to an implementation intentions condition. Less than half of the participants gave birth before the end of the second intervention (43%). After giving birth, they continued to receive messages. Among women who gave birth during the second intervention, nearly half (48%; i.e. 21% of the full sample) delivered between 1 and 5 days before the intervention ended (i.e. with a maximum of three experimental messages remaining), nearly one third (32%; i.e. 14% of the full sample) delivered between 6 to 10 days before the intervention ended (i.e. with less than half experimental messages remaining), and the remaining 20% (8% of the full sample) delivered during the first half of the second intervention.

Three days postpartum, the remaining 442 participants (93.3% Italians; 62.3% first-time mothers) were invited to complete a short online questionnaire assessing current infant feeding practices and birth-

related information. Follow-up questionnaires were administered again when infants were 3 and 5 months old[3]. A total of 381 participants completed the final follow-up (attrition rate = 14%). At the end of the study, participants were fully debriefed and confirmed their informed consent.

Experimental materials

During the first intervention, participants viewed a 41-slide self-paced video containing 26 informational messages. Texts were read aloud by a female voice and displayed on a sky-blue background, interspersed with pictures and accompanied by relaxing background music. Participants randomised to the TPB experimental condition received theory-informed messages designed to enhance key components of the extended TPB. Content was drawn from the Italian Ministry of Health (2019) brochure for mothers, Krol and Grossmann (2018), and the World Health Organisation & UNICEF (1993).

Eighteen of the messages focused on the benefits of breastfeeding for both infants (e.g. reduces the risk of allergies and asthma) and mothers (e.g. reduces the risk of anaemia), and were intended to reinforce positive evaluations of breastfeeding, addressing attitudes as well as injunctive and moral norms. These messages had previously been shown to improve breastfeeding attitudes among pregnant women (Guidetti et al., 2026). The remaining eight messages explicitly emphasised women's breastfeeding competence (e.g. 'Even if it is your first experience, you and your baby have the innate skills to initiate and continue breastfeeding') and were designed to directly strengthen breastfeeding self-efficacy and PBC, while also conveying descriptive normative cues. Visual and auditory elements were used to support engagement, positive emotions, and identification with breastfeeding. In the control condition, participants received messages on healthy eating and physical activity during pregnancy, based on Ministry of Health guidelines. After each message, participants indicated whether they were already aware of the information by pressing one of two keys ('I already knew' vs. 'I didn't know'), both to maintain engagement and to derive a prior knowledge index to be used as a potential moderator[4].

The second intervention (pre-tested with five pregnant women and two peer-counsellors) consisted of a drip communication campaign delivered via WhatsApp. Participants in the tips condition received brief informational messages (including images and one video link) and replied 'ok' to confirm they had read, whereas participants in the implementation intentions condition were additionally instructed to reply with specific if-then plans based on the information provided. Messages were sent at approximately 8:00 a.m.; participants in the implementation intentions condition received a reminder at around 4:00 p.m., prompting them to re-read their plan or write it if not done yet. The control group received information on healthy eating and exercise during pregnancy and were asked to reply 'ok' after reading. The number of correct implementation intentions or feedback messages provided by each participant was recorded.

Measures

Potential moderators of the first intervention effects

Self-objectification. At baseline, participants completed the Italian version (Puvia & Vaes, 2013) of the Self-Objectification Questionnaire (SOQ; Noll & Fredrickson, 1998). Scores were computed following the authors' instructions (range: −25 to 25).

Hypothesised mediators of the first intervention effects

TPB factors. Intentions to exclusively breastfeed for up to six months[5], self-efficacy and PBC[6], affective and cognitive attitudes, descriptive, injunctive, and moral norms, self-identity, and anticipated emotions were assessed using items adapted from previous TPB studies on breastfeeding (Grano et al., 2023; Lawton et al., 2012; Richetin et al., 2011). Responses were given on 5-point Likert scales. Exploratory factor analyses supported the computation of composite scores both for affective and cognitive attitudes, and for self-efficacy and perceived behavioural control ('SE-PBC' from here onwards). Reliability estimates for each variable are reported in Table 1.

These psychological measures focused on exclusive breastfeeding for the first six months, as this is likely to provide greater variability and aligns with the dose-dependent benefits of this practice, as well as current health recommendations. At the same time, the TPB-based intervention adopted a broader framing of

Table 1. Reliability, descriptive statistics, and correlations for the study measures.

	α	*M* (*SD*)	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Exclusive bf intention[t]	.88	4.16 (.84)	.42***	.37***	.39***	.47***	.40***	.27***	.38***	.62***	.55***	−.12*	.22***	.04	.10
2. Any bf duration[t]		124.75 (32.98)	–	.68***	.26***	.25***	.13*	.10	.17**	.32***	.34***	−.09	.25***	.12*	.14**
3. Full bf duration[t]		94.39 (51.02)		–	.18***	.16**	.14**	.11*	.08	.21***	.28***	−.02	.26***	.17**	.11*
4. SE-PBC	.75	3.41 (.70)			–	.47**	.34***	.28***	.42***	.59***	.43***	−.05	.22***	−.07	.08
5. Bf attitude[t]	.71	4.25 (.59)				–	.24***	.16**	.27***	.43***	.53***	−.15**	.22***	−.02	.07
6. Injunctive norms	.94	3.22 (1.18)					–	.48***	.35***	.45***	.20***	.00	.03	.07	.02
7. Descriptive norms	.69	2.84 (1.07)						–	.30***	.32***	.12*	.07	−.06	.03	.02
8. Moral norms[r]	.47	3.78 (.90)							–	.56***	.37***	−.02	.10*	.01	−.02
9. Identity as a bf mom[r]	.61	3.79 (.95)								–	.48***	−.13*	.22***	−.02	.01
10. Anticipat. emotions	.85	4.13 (.48)									–	−.09	.09	−.16**	.05
11. Self-Object[t]		−13.85 (8.98)										–	−.07	−.03	−.12*
12. Past bf (months)[t]		5.77 (11.69)											–	.03	.13**
13. Years of education		15.69 (3.25)												–	.07
14. Infant birth weight (gr)		3357.32 (404.48)													–

Notes: Pearson's correlation coefficients are reported. Correlations were computed using pairwise deletion of missing data.
[t] RIN transformed variable (means and standard deviation are reported for the raw variables, though they were almost identical for the transformed ones; transformed variables were used in correlations).
[r] These scores are based on two items; therefore, inter-item correlations (Pearson's r) are reported instead of Cronbach's α.
*$p < .05$.
**$p < .01$.
***$p < .001$.

breastfeeding to avoid overly prescriptive messaging and to reflect that any breastfeeding is preferable to none, while greater exclusivity is associated with increased health benefits.

Dependent variables

Participants completed brief follow-up assessments at 3 days, 3 months, and 5 months postpartum. The first follow-up assessed initial infant feeding practices and repeated measures of exclusive breastfeeding intentions, self-efficacy, and PBC. At the 3- and 5-month follow-ups, participants reported current feeding practices and, when applicable, the timing of breastfeeding cessation or formula introduction. Responses were used to compute a dichotomous indicator of *any breastfeeding initiation* and two continuous outcomes, namely *any and full breastfeeding duration* (in days).

The study was approved by the Ethics Committee of the Emilia Nord Wide Area (CE AVEN approval reference number: AOU0015527/23). Method and hypotheses were preregistered before data collection on the Open Science Framework: https://doi.org/10.17605/OSF.IO/YS8D5. Our preregistration included the study design, materials and measures, planned sample size, and planned primary analyses. The materials, data, and syntax of analyses supporting our findings are openly available at https://doi.org/10.17605/OSF.IO/JXGH4. We report all manipulations, measures, and exclusions.

Results

Preliminary and descriptive analyses

The analyses were conducted using SPSS and PROCESS (version 4.3; Hayes, 2018) with 5,000 bootstrap resamples and 95% confidence intervals.

Of the 357 mothers who completed the 3-day questionnaire, 91.9% initiated breastfeeding, and 72.5% were fully breastfeeding. Most respondents were still breastfeeding at both the 3-month (81.6%) and the 5-month follow-up (77.4%). Overall, the sample showed particularly positive breastfeeding outcomes. Accordingly, several variables displayed skewed distributions, including attitudes, intentions, past breastfeeding duration, any breastfeeding duration, full breastfeeding duration, and self-objectification. To meet the assumptions of inferential analyses, these variables were transformed using a rank-based inverse normal transformation (Blom method; Bishara & Hittner, 2012; Blom, 1958). This approach ensures that the distribution is approximately normal for inferential analyses, while the transformed scores remain on a scale comparable to the original data. Descriptive statistics are reported for the raw variables, whereas transformed scores were used in correlations, analyses of variance, and PROCESS analyses.

A Multivariate Analysis of Variance (MANOVA) and subsequent univariate tests, with the two interventions as factors, indicated that participants assigned to the six conditions did not differ in maternal age, educational level, self-objectification, past breastfeeding duration, gestational age at birth, or infant birth weight (multivariate $ps > .341$; univariate $ps > .074$). Baseline characteristics by conditions are displayed in Supplementary Table S1. Means, standard deviations, and correlations among study variables are reported in Table 1.

Hypotheses test

First, a MANOVA was conducted to examine the effect of the TPB intervention on the set of TPB variables. The multivariate effect was significant, Pillai's Trace = .07, $F(8, 376) = 3.39$, $p < .001$, $\eta_p^2 = .07$. Independent-samples *t*-tests (reported in Table S2) showed that the TPB intervention significantly affected SE–PBC (supporting H1a2) and moral norms (partially supporting H1a3). No total effects emerged for exclusive breastfeeding intention (contrary to H1b), nor for other TPB components (contrary to H1a1, H1a4, and H1a5).

To make the behavioural total effects of the interventions more explicit, a 2×3 MANOVA was conducted on breastfeeding duration outcomes. No significant main or interaction effects emerged (see Table 2). Although contradicting H1d (which predicted total effects on behavioural outcomes), this may be consistent with the other preregistered hypotheses, which propose that the first intervention operates

Table 2. Breastfeeding duration outcomes across the 2 × 3 intervention conditions.

	Any BF duration - *M (SD)*		Full BF duration - *M (SD)*	
	TPB Control	TPB intervention	TPB Control	TPB intervention
Control condition	123.17 (47.23)	130.21 (45.45)	90.41 (68.86)	102.48 (64.90)
Tips intervention	126.61 (51.03)	129.31 (44.74)	109.03 (63.67)	91.91 (66.07)
Implementation intentions	127.98 (44.70)	128.49 (44.90)	96.29 (66.61)	94.13 (65.85)
Multivariate tests				
TPB intervention	Pillai's Trace = .005, $F(2,368) = 0.91$, $p = .403$			
Second intervention	Pillai's Trace = .001, $F(4,738) = 0.12$, $p = .975$			
TPB × second intervention	Pillai's Trace = .007, $F(4,738) = 0.69$, $p = .598$			
Univariate tests				
TPB intervention	$F(1,369) = 0.56$, $p = .456$		$F(1,369) = 0.10$, $p = .750$	
Second intervention	$F(2,369) = 0.05$, $p = .951$		$F(2,369) = 0.04$, $p = .960$	
TPB × second intervention	$F(2,369) = 0.18$, $p = .836$		$F(2,369) = 1.11$, $p = .331$	

Note: Descriptive statistics are reported for the raw (non-transformed) variables. Multivariate and univariate tests were conducted on RIN-transformed variables.

through TPB-related psychological mechanisms, and the second acts as a moderator of the intention-behaviour link. To directly test these hypotheses, we therefore proceeded to the preregistered conditional process analyses.

A PROCESS Model 7 (Hayes, 2018) showed that self-objectification did not moderate the effects of the TPB intervention on intention, $p > .206$; Thus, H2h was not supported, and this variable was not included as a moderator in the final model. Nonetheless, higher self-objectification was associated with less favourable attitudes toward breastfeeding (supporting H2a), weaker identification as a breastfeeding mother (supporting H2c), and lower exclusive breastfeeding intentions (supporting H2e; see Table 1). Therefore, self-objectification was entered into the final model as a predictor to explore its potential indirect effects on breastfeeding behavioural outcomes.

A subsequent PROCESS Model 4 on intention revealed a significant indirect effect of the TPB intervention mediated by SE–PBC only (partially supporting H1c). Anticipated emotions, injunctive norms, and self-identity were also significantly associated with exclusive breastfeeding intention and were therefore retained in the final model (whereas TPB components not predicting intention were removed to ensure parsimony).

Three customised PROCESS models were then estimated, one predicting any breastfeeding initiation (at three days) and two predicting full and any breastfeeding duration[7]. In these models, the TPB intervention (dummy coded: 0 = control, 1 = intervention) and self-objectification were entered as independent variables, SE–PBC and self-identity were specified as parallel mediators, with anticipated emotions and injunctive norms included as covariates at the same level[8], followed by exclusive breastfeeding intention as a serial mediator. Breastfeeding initiation or duration served as the dependent variable. The tips and implementation intentions interventions (dummy coded: tips vs. control; implementation intentions vs. control) were included as moderators of the intention-behaviour link. Past any breastfeeding duration (coded as 0 for women without previous children) was included as a covariate on intention and initiation measures; maternal educational level and the number of feedback messages or implementation intentions were included as covariates on all outcomes; and infant birth weight was included as a covariate on any breastfeeding duration[9]. Because results were substantively unchanged when covariates were either included or excluded, models are reported without covariates for clarity (covariate-adjusted models are displayed in Table S3).

Results for the duration outcomes are illustrated in Figures 3 and 4. Each figure represents a single fitted model, in which all paths were estimated simultaneously. Because the same analytical specification was applied across outcomes, results up to the prediction of intentions were identical across all models. The TPB intervention significantly increased SE–PBC (supporting H1a2), which in turn predicted stronger exclusive breastfeeding intentions (supporting H1c). In addition, self-objectification negatively predicted identification as a breastfeeding mother (supporting H2c), which in turn was positively associated with exclusive breastfeeding intentions (supporting H2e).

Turning to the second portion of the model, exclusive breastfeeding intentions predicted both full and any breastfeeding duration (supporting H1e). This association was moderated by the second intervention, as expected, only for full breastfeeding duration: both the tips and implementation

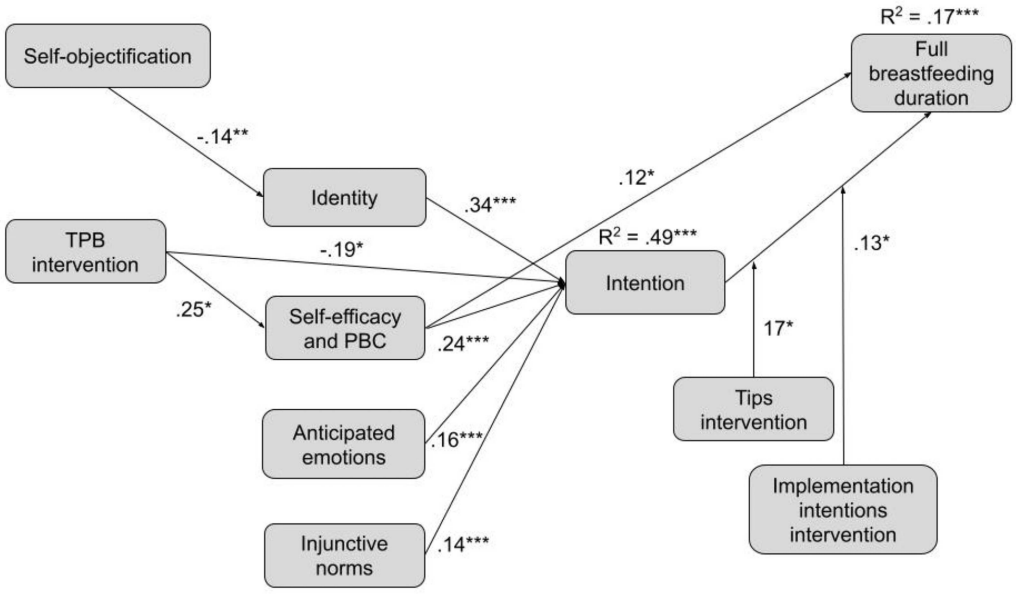

Figure 3. The moderated mediation model predicting full breastfeeding duration.

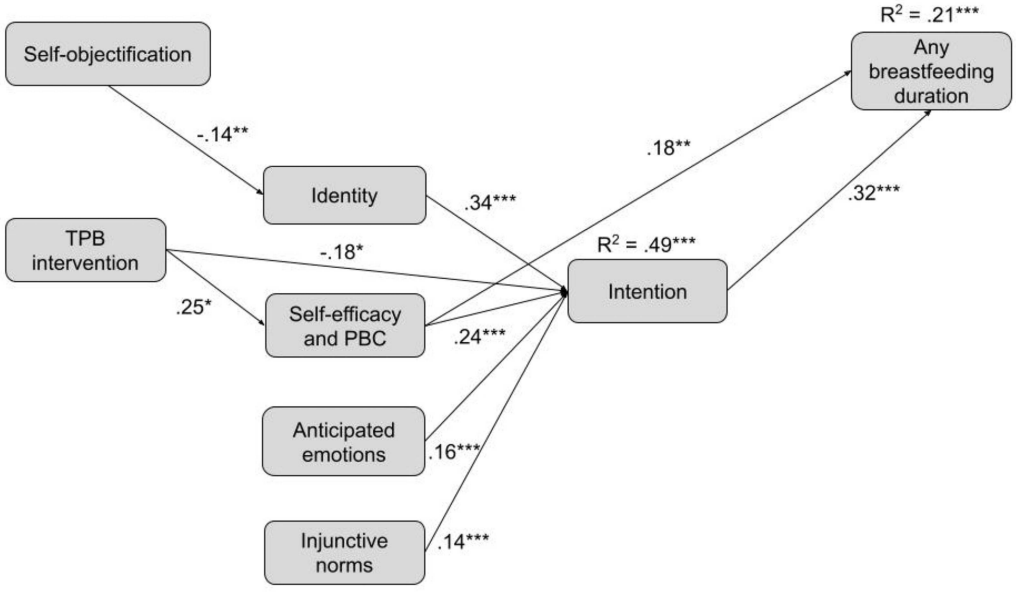

Figure 4. The moderated mediation model predicting any breastfeeding duration.

intentions conditions strengthened the intention-behaviour link (supporting H3a3 and H3b3)[10]. However, as shown in Figure 5, the implementation intentions condition was not more effective than the tips condition. Accordingly, the indirect effect of the TPB intervention on full breastfeeding duration varied as a function of the second intervention, being significant and positive in both the tips condition (IE = 1.29, SE = .75, 95% CI [.17, 3.07]) and the implementation intentions condition (IE = 1.20, SE = .69, 95% CI [.14, 2.86]).

For any breastfeeding duration, the moderating effects of the second intervention were weaker and did not reach conventional levels of significance (p = .051 for tips and p = .094 for implementation intentions), thus providing no clear support for H3a2 or H3b2, although the pattern remained consistent with the hypothesised interactions (see Figure S1).

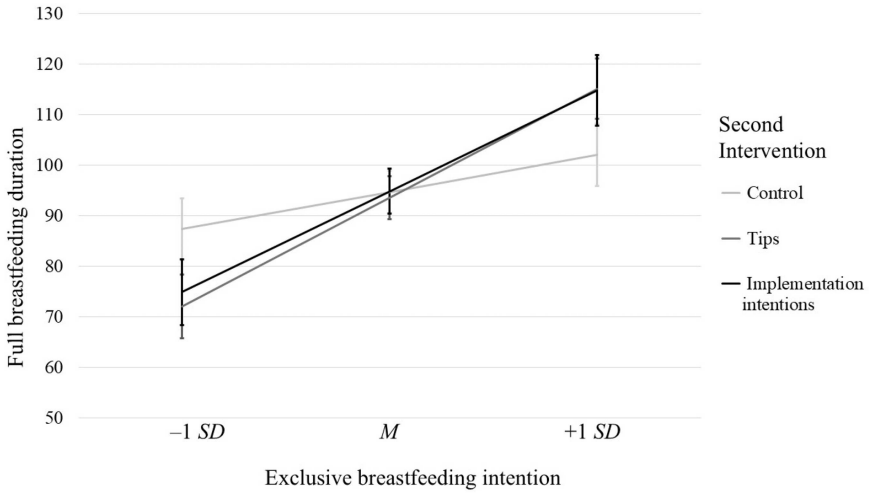

Figure 5. The moderating role of 'tips' and 'implementation intentions' interventions on the intention-behaviour link (full breastfeeding duration).

The logistic regression model predicting any breastfeeding at 3 days was significant, $\chi^2(7) = 36.85$, $p < .001$, Nagelkerke $R^2 = .24$: SE–PBC was positively associated with the outcome (OR = 2.85, $p = .007$, 95% CI [1.34, 6.06]), whereas intention, intervention conditions, and their interactions were not significant ($ps > .06$). Therefore, H3a1 and H3b1 were not supported for any breastfeeding initiation.

Given the lack of significant interactions across these outcomes (i.e. any breastfeeding duration and initiation), additional models without interaction terms were estimated to examine indirect effects of the TPB intervention. In these models, SE–PBC was positively associated with any breastfeeding initiation (OR = 3.00, $p = .005$, 95% CI [1.40, 6.43]) and duration (see Figure 3). In addition, intention significantly predicted any breastfeeding duration (see Figure 3). For any breastfeeding initiation and duration, the indirect effect of the TPB intervention operated through SE–PBC alone (IE = .20, SE = .12, 95% CI [0.02, 0.49], and IE = 1.50, SE = .84, 95% CI [0.16, 3.42], respectively), supporting H1e. The full serial pathway through SE–PBC and intention was significant for any breastfeeding duration (IE = .03, SE = .02, 95% CI [.004, .08], and IE = .65, SE = .35, 95% CI [.10, 1.96]), further supporting H1e.

As a robustness check, we conducted Cox regression analyses for time-to-event outcomes. Results are reported in Supplementary Materials and Table S4 and were broadly consistent with the main analyses: higher SE–PBC and intention were associated with a lower risk of breastfeeding cessation. For full breastfeeding duration, the association between intention and cessation risk was moderated by the tips condition (HR = 0.60, $p = .038$), providing further support to H3a3, whereas the interaction with the implementation intentions condition was not significant (not confirming H3b3). For any breastfeeding duration, although consistent with the expected pattern (H3a2-H3b2) and in line with the PROCESS model, interaction effects were weaker and did not reach conventional statistical significance ($.053 \leq p \leq .085$).

Notably, the TPB intervention also exerted a negative direct effect on exclusive breastfeeding intention, resulting in negative indirect effects via intention on any breastfeeding duration (IE = −1.88, SE = .90, 95% CI [−3.83, −.24]) and full breastfeeding duration. The latter indirect effect was conditioned by the second intervention, emerging only in both the tips condition (IE = −4.04, SE = 1.97, 95% CI [−8.42, −.79]) and the implementation intentions condition (IE = −3.75, SE = 1.83, 95% CI [−7.77, −.73]).

Finally, self-objectification showed indirect associations with breastfeeding duration (but not initiation) outcomes via identity and intention. Specifically, it negatively predicted identification as a breastfeeding mother, which in turn predicted intention, resulting in a negative indirect effect on any breastfeeding duration (supporting H2g), IE = −.06, SE = .03, 95% CI [−.12, −.01]. For full breastfeeding duration, this indirect effect was again moderated by the second intervention, being significant only in the tips condition (IE = −.11, SE = .05, 95% CI [−.23, −.03]) and in the implementation intentions condition (IE = −.10, SE = .05, 95% CI [−.22, −.02]).

Discussion

Several insights can be drawn from the present findings. With respect to the first aim, despite the absence of total effects on behavioural outcomes, the TPB-based intervention indirectly increased both full and any breastfeeding duration by enhancing breastfeeding SE–PBC, which in turn strengthened exclusive breastfeeding intentions. The same indirect pathways, though weaker, were observed for any breastfeeding at three days. No effects were observed for the other TPB components. The lack of effects on anticipated emotions, self-identity, and normative components is reasonable, as these constructs were not directly targeted by the informational content of the intervention. However, the absence of effects on explicit attitudes is more surprising, given that most of the messages were specifically designed to promote favourable evaluations of breastfeeding and had proven effective in a previous study (Guidetti et al., 2026).

This discrepancy is likely attributable to ceiling effects: All participants reported highly positive attitudes toward breastfeeding, with 94.9% scoring above the scale midpoint, and the distribution of this variable was markedly left-skewed. The absence of differences between conditions may indicate that participants already held very favourable attitudes at baseline—either genuinely or due to social desirability. In addition, the assessment of breastfeeding beliefs may have contributed to reinforcing favourable evaluations, consistent with a question–behaviour effect (Wilding et al., 2016). Under these conditions, the intervention had little room to further improve attitudes. However, the positive impact on SE–PBC is particularly relevant as, in line with previous research (Golnam et al., 2025; Lau et al., 2018), this construct emerged as a key predictor of breastfeeding intentions and behaviour. Prior findings also highlighted the need to empower women's breastfeeding self-efficacy as it can moderate the affective and cognitive reactions to promotion interventions, and their effectiveness (Guidetti et al., 2026).

Notably, the present findings suggest that the TPB intervention exerted qualitatively different effects on distinct psychological processes. On the one hand, the intervention increased breastfeeding self-efficacy, which in turn strengthened breastfeeding intention and behaviour. On the other hand, once these positive indirect pathways were statistically controlled, a negative direct effect of the intervention on intention emerged. This pattern explains the absence of total effects on breastfeeding outcomes, in line with what has been described as inconsistent mediation or suppression effects in mediation models, where positive and negative pathways coexist and partially counterbalance each other. In such cases, the total effect may provide a misleading summary of the overall influence of X on Y (Hayes, 2018). In practical terms, these findings suggest that the intervention was beneficial when it successfully enhanced women's confidence in their breastfeeding ability, while if it failed to do so, its informational content alone may have had a counterproductive impact, potentially eliciting discomfort or resistance among participants. This interpretation warrants further investigation. Indeed, a previous experiment showed that largely the same informational messages—when framed in terms of gains, as in the present study—elicited positive affective reactions and promoted favourable attitudes (Guidetti et al., 2026).

To our knowledge, this is the first RCT to show that a very simple and cost-effective intervention can enhance breastfeeding SE–PBC and, through this pathway, increase breastfeeding intentions and duration. As reviewed in the Introduction, most previous TPB-based experiments and quasi-experiments relied on complex, multi-component interventions. Similarly, among studies specifically targeting breastfeeding self-efficacy (Brockway et al., 2017), the majority combined multiple actions and required direct involvement of health personnel, although some exceptions exist (Nichols et al., 2009; Otsuka et al., 2014; Sousa et al., 2025).

Another important predictor of exclusive breastfeeding intention was identification as a breastfeeding mother. The present findings extend previous research by showing, for the first time, that self-objectification was negatively associated with breastfeeding identity, which in turn indirectly reduced breastfeeding duration through lower intentions. In other words, the more women tended to objectify themselves, the less they identified as breastfeeding mothers, and this weakened both their motivation and subsequent behaviour. This result is consistent with prior evidence linking self-objectification to less favourable breastfeeding attitudes and greater perceived barriers (e.g. Rodgers et al., 2018), and highlights identity processes as a potentially important target for future interventions.

Contrary to expectations, self-objectification did not moderate the effectiveness of the TPB intervention. This null finding should be interpreted cautiously, given the particularly low mean level of self-

objectification in the present sample and the strongly right-skewed distribution of this variable. Indeed, 90.6% of participants reported negative SOQ scores, indicating a stronger valuation of physical competence (e.g. health) than appearance (e.g. measurements). While this pattern is partially consistent with evidence suggesting that mothers report lower self-objectification than non-mothers (Yager et al., 2022), it remains possible that breastfeeding promotion interventions may be less effective among highly self-objectifying women, a hypothesis that should be tested in more diverse samples and using different self-objectification measures.

The present findings also support the effectiveness of preparation-based interventions in reducing the intention-behaviour gap for full breastfeeding. Conceptually, implementation intentions are not expected to increase breastfeeding behaviour uniformly across participants. Rather, according to Gollwitzer (1999), these interventions should primarily facilitate the translation of pre-existing intentions into action by helping individuals anticipate opportunities and obstacles and automatise goal-directed responses. Accordingly, the critical test of the second intervention was whether it strengthened the intention-behaviour association, rather than whether it exerted total or direct main effects on breastfeeding outcomes.

Both the tips intervention and the implementation intentions intervention strengthened the association between breastfeeding intentions and full breastfeeding duration in the PROCESS models, regardless of the number of feedback messages or implementation intentions actually provided. However, only the tips intervention's moderating effect was confirmed in the Cox regression, which appropriately accounts for the high proportion of censored cases in the present sample. This differential robustness suggests that the moderating role of the implementation intentions intervention may have been partially inflated by censoring and should be interpreted with caution. Taken together, these findings suggest that participants in the tips condition may have spontaneously formed implementation intentions and that interventions which nudge individuals toward self-generated planning, rather than prescribing explicit if-then formats, may prove more effective. We acknowledge that this interpretation is highly speculative and should be tested in future studies. In contrast, preparation-based intervention did not moderate the intention-behaviour link for any breastfeeding initiation, while the interaction did not reach conventional statistical significance for any breastfeeding duration, indicating that self-efficacy and motivation may be sufficient to initiate and maintain partial breastfeeding. Maintaining full breastfeeding, instead, appears to require additional preparation to prevent or manage difficulties that lead to formula supplementation.

Limitations and strengths

Some limitations should be acknowledged. First, participants were recruited from a single maternity ward in Italy, which limits the generalisability of the findings to other regions and cultural contexts. Second, for practical and economic reasons, women with limited proficiency in Italian could not be included. Additionally, self-selection bias could not be ruled out. Although acceptance rates were high, the 25% of women who declined participation may differ systematically in their breastfeeding beliefs and intentions. This bias, along with the question-behaviour effect, likely contributed to the skewed distributions observed for some variables and may partly explain the null effects of the TPB intervention on them. Attrition across follow-ups, although limited, may have further amplified this issue. Notably, if women who did not complete the final follow-up were classified as not fully breastfeeding, full breastfeeding rates aligned with those observed in the broader provincial population (Di Mario et al., 2025).

Third, the a priori power analyses used to determine the sample size were intended to ensure adequate power for the primary associations of interest rather than for the full moderated mediation models ultimately tested. Accordingly, these calculations should be considered an approximation, and the sample size may not be sufficient to detect small effects in more complex conditional process models.

Another limitation concerns the absence of baseline measures for the hypothesised mediators. Although collecting such measures would have allowed for stronger causal inference, this choice was necessary to minimise response bias and participants' burden. The randomised design nevertheless allows for valid tests of intervention effects. Finally, participants were recruited late in pregnancy, when concerns about labour and delivery may overshadow attention to breastfeeding information. Future research should examine whether similar interventions are more effective when delivered earlier in pregnancy.

Despite these limitations, the present study has several strengths. A comprehensive set of psychosocial predictors of breastfeeding was assessed, and participants were followed longitudinally for up to five months postpartum, allowing for the examination of self-reported behaviour over time. Most importantly, the study tested a simple, resource-efficient, two-step digital intervention with high potential for scalability. The TPB-based intervention effectively enhanced breastfeeding SE–PBC and could be implemented through in-loop delivery in maternity ward waiting rooms. The second intervention (particularly tips provision) proved useful in helping mothers translate intentions into sustained full breastfeeding and could be easily deployed through automated messaging systems. By demonstrating the effectiveness of scalable digital communication strategies, this study contributes to efforts aimed at increasing exclusive breastfeeding and supporting women in achieving their breastfeeding goals.

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Author contributions

CRediT: **Margherita Guidetti:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **Giulia Scaglioni:** Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – review & editing; **Nicoletta Cavazza:** Funding acquisition, Writing – review & editing; **Rossana Reggiani:** Investigation; **Ramona Infante:** Funding acquisition, Investigation; **Maria Teresa Molinazzi:** Funding acquisition, Investigation; **Isabella Neri:** Funding acquisition, Investigation, Supervision.

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Data availability statement

The materials, data, and syntax of analyses supporting our findings are openly available at https://doi.org/10.17605/OSF.IO/YS8D5.

Ethics approval statement

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and was approved by an Institutional Review Board/Ethics committee. See details under Methods.

Informed consent declaration

All participants received full information about the study and provided informed consent prior to participation.

AI disclosure statement

The authors used ChatGPT 5.2 (OpenAI) to assist with English language editing and stylistic revisions of text originally drafted by the authors. The tool was used solely for language refinement and did not generate any original content, nor contribute to the study design, data analysis, interpretation of results, or scientific conclusions. The authors take full responsibility for the manuscript.

Open scholarship

This article has earned the Center for Open Science badges for Open Data, Open Materials and Preregistered+. The data are openly accessible at https://doi.org/10.17605/OSF.IO/JXGH4; materials are openly accessible at https://doi.org/10.17605/OSF.IO/JXGH4; registration of study design and sampling plan of the larger project are openly accessible at https://doi.org/10.17605/OSF.IO/YS8D5; registration of the hypotheses and analysis plan are openly accessible at https://doi.org/10.17605/OSF.IO/YS8D5.

Endnotes

1. Exclusive breastfeeding refers to feeding infants only breast milk, with no other foods or liquids. Predominant breastfeeding refers to breast milk as the main source of nutrition, allowing the intake of other liquids (e.g., water) but excluding infant formula. Full breastfeeding includes both exclusive and predominant breastfeeding, whereas any breastfeeding encompasses all forms of breastfeeding, including partial breastfeeding with formula supplementation.
2. Preregistered hypotheses H1f1–H1f5 and H2b are not reported, as they were not supported by the data. Implicit attitudes (assessed soon after the TPB intervention) were neither affected by the TPB intervention nor by self-objectification and did not predict breastfeeding behaviour. The remaining hypotheses were renumbered accordingly.
3. Our choice of follow-up timing aligns with regional and national breastfeeding reports (Di Mario et al., 2025; Pizzi et al., 2026) and reduced potential overlap with complementary feeding practices, which were beyond the scope of the present study. Indeed, although WHO recommends exclusive breastfeeding for the first 6 months, complementary feeding is commonly introduced earlier in Italy: 95% of Italian primary care paediatricians recommend introducing solid foods between 4 and 6 months of age (Capra et al., 2024), and 85.5% of Italian infants begin complementary feeding at or before 5 months (Caroli et al., 2012).
4. As this variable did not moderate the intervention effectiveness, it is not reported in the paper.
5. When "Exclusive breastfeeding" was mentioned for the first time, an explanation of its meaning was included for participants.
6. In line with TPB-based applications in the breastfeeding domain (e.g. Lawton et al., 2012), PBC was operationalized through self-efficacy and perceived control components. Although these constructs closely correspond to the capacity and autonomy dimensions proposed in the RAA (Fishbein & Ajzen, 2010), we retain the TPB terminology for consistency with preregistration and prior work.
7. The 2×3 design was represented using contrast variables, as the second intervention was modelled as a moderator of the intention-behaviour path rather than as a factor in a traditional factorial ANOVA. PROCESS uses logistic regression for the final equation on binary outcomes.
8. Because they were not affected by the TPB intervention but predicted breastfeeding intention.
9. Several socio-demographic and childbirth variables (epidural analgesia, infant birth weight, past any and exclusive breastfeeding duration, mothers' evaluation of the birth experience, and maternal educational level) were initially considered as potential covariates, as they showed bivariate associations with breastfeeding outcomes. To reduce redundancy due to intercorrelations among these variables, all candidates were entered simultaneously into preliminary regression models: significant predictors were retained as covariates in the final models.
10. This second intervention did not exert significant direct effects on any breastfeeding outcomes, consistent with its hypothesised role as a moderator of the intention-behaviour link.

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