



UNIVERSIDADE D
COIMBRA

Fabiana Garcia Monteiro

**PROMOTING POSITIVE MENTAL HEALTH IN THE
POSTPARTUM PERIOD: RANDOMIZED CONTROLLED
TRIAL OF A WEB-BASED CBT INTERVENTION FOR LOW-
RISK POSTPARTUM WOMEN**

**Doctoral thesis in Doctorate in Psychology, Specialty Health Psychology,
supervised by Ana Fonseca, Maria Cristina Canavarro and Marco Pereira and
submitted to the Faculty of Psychology and Educational Sciences of the
University of Coimbra.**

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*We need to stop just pulling people out of the river.
We need to go upstream, and find out why they're falling in.*

Desmond Tutu

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List of Abbreviations and Acronyms

AAQ-II	Acceptance and Action Questionnaire-II
ACT	Acceptance and Commitment Therapy
ANOVA	Analysis of variance
HADS-A	Anxiety Subscale of the Hospital Anxiety and Depression Scale
CBT	Cognitive Behavioral Therapy
CFT	Compassion Focused Therapy
CFA	Confirmatory factor analysis
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CONSORT	Consolidated Standards of Reporting Trials
CEAC	Cost-effectiveness acceptability curve
CEA	Cost-effectiveness analysis
DERS-SF	Difficulties in Emotion Regulation Scale-Short Form
EPDS	Edinburgh Postnatal Depression Scale
ES	Empowerment Scale
EQ-5D-3L	EuroQoL Five-Dimension Three-Level
ICER	Incremental cost-effectiveness ratio
ICTs	Information and Communication Technologies
ITT	Intention to treat
ITP	Interpersonal Therapy
LMM	Linear mixed model
MCQ	Maternal Confidence Questionnaire
MHC-SF	Mental Health Continuum-Short Form
MAR	Missing at random
MCAR	Missing completely at random
NMAR	Not missing at random
PMPS-E	Perceived Maternal Parenting Self-Efficacy
PPD	Postpartum depression
PDPI-R	Postpartum Depression Predictors Inventory – Revised
RCT	Randomized controlled trial
RD&H	Relationships, Development & Health

IMS-S	Satisfaction subscale of the Investment Model Scale
SCS-SF	Self-Compassion Scale-Short Form
T1	Time 1
T2	Time 2
T3	Time 3
T4	Time 4
TiC-P	Trimbos and iMTA questionnaire for costs associated with psychiatric illness
WLC	Waiting-list control
WHO	World Health Organization
SWLS	Satisfaction With Life Scale
QoL	Quality of life
QALYs	Quality-Adjusted Life Years

Abstract

Background

Mental illness during the postpartum period has been associated with several long-term negative consequences for the mother's health and the child's development and has also been linked to a significant economic burden on society. Psychological interventions could play a central role in reducing the human and economic costs associated with mental illness in this period. However, research suggests that focusing solely on treatment and prevention of mental illness may not be enough. A strategy that goes beyond targeting at-risk groups for prevention and treatment could lead to significant mental health benefits in population terms. Research findings suggest that while treatment and prevention have a crucial role to play in the short term, the way to reduce the prevalence of mental disorders in the long term is to intervene seeking to elevate positive mental health levels at the general population level. During the postpartum period, women face several practical and attitudinal barriers that keep them from seeking traditional face-to-face professional help. e-Mental health tools for mental health promotion can be particularly helpful, given their accessibility and flexibility. These interventions can serve as helpful mental health promotion tools that can be delivered to a broad population. In this context, Be a Mom was developed to be a web-based intervention based in cognitive behavioral therapy principles, aiming to promote maternal mental health among postpartum women. The general aims of our study were: 1) to understand the relevance of measuring and addressing positive mental health in the postpartum period; and 2) to test the overall efficacy, acceptability, feasibility and cost-effectiveness of Be a Mom among postpartum women presenting low risk for postpartum depression.

Methods

This research project comprised two phases. Phase I consisted of a cross-sectional study which focused on: 1) the psychometric studies of the Mental Health Continuum-Short Form [MHC-SF]; and, 2) the examination of the factors (sociodemographic, health-related, infant-related, and psychological factors) associated with flourishing and postpartum depressive symptoms among postpartum women. Phase II consisted of a randomized controlled trial evaluating the efficacy of Be a Mom vs. a waiting-list control group among postpartum women presenting low risk for PPD. A total of 367 participants were randomly assigned to the Be a Mom group ($n = 191$) or to the waiting-list control group ($n = 176$) and completed baseline (T1), postintervention (T2), four and 12 months after postintervention assessments (T3 and T4, respectively). Participants completed self-report

questionnaires assessing individual outcomes (e.g., positive mental health, depressive symptoms), maternal outcomes (e.g., maternal self-efficacy), relationship outcomes (e.g., relationship satisfaction), psychological processes (e.g., self-compassion, emotion regulation), QALYs and data related to healthcare and productivity costs.

Results

In phase I, results showed that the MHC-SF is a valid measure for use in the postpartum context. Confirmatory factor analysis showed that the bifactor model yielded a significantly better fit to the data than the original correlated three-factor model. The results also suggested a strong general factor of positive mental health and did not support the use of the subscale scores. Additionally, our results showed that the factors that contribute to flourishing in the postpartum period differed from those associated with not presenting depressive symptoms. In particular, younger infant age, higher levels of maternal confidence, and resilience increased the likelihood of flourishing. In turn, higher income, fewer problems with an infant's sleep, perceiving an infant's temperament as easy, and higher psychological flexibility increased the likelihood of not having depressive symptoms. Appraising the support received by others as good and having higher self-compassion increased the likelihood of both outcomes.

In phase II, our findings showed that, compared to the control group, the intervention group reported significant increases in positive mental health and self-compassion between T1 and T2. Group effects were found for depressive and anxiety symptoms and emotion regulation. Additionally, we found that increases in self-compassion from T1 to T2 significantly contributed to the improvement in positive mental health.

Moreover, results indicated that Be a Mom is a cost-effective intervention. At a €0 willingness to pay threshold, there is a 96% probability that the intervention is cost-effective when compared with the control group. Different sensitivity analysis generally supported the acceptable likelihood of the intervention being more cost-effective than the control group.

Conclusions

The findings of this research project highlight the need of a paradigm shift in current perinatal clinical and research contexts, from a sole focus on mental illness to a more comprehensive approach that includes the assessment and promotion of positive mental health. It also emphasizes the potential of web-based interventions in delivering (cost-)effective mental health interventions.

A pathway which uses eHealth interventions aimed at promoting positive mental health among low-risk postpartum women seems to play a significant role in managing the current high burden of postpartum mental illness.

Keywords

Positive mental health • postpartum period • web-based intervention • randomized controlled trial • be a mom • cost-effectiveness • cognitive behavioral therapy • psychological processes • self-compassion • bifactor model

Resumo

Introdução

A perturbação mental durante o período pós-parto tem sido associada a diversas consequências negativas a longo prazo para a saúde da mãe e para o desenvolvimento da criança, assim como a um encargo económico significativo para a sociedade. As intervenções psicológicas podem desempenhar um papel central na redução dos custos humanos e económicos associados à doença mental neste período. No entanto, a investigação sugere que o foco exclusivo no tratamento e prevenção de doença mental poderá não ser suficiente. Uma estratégia que vá para além de visar grupos de risco para prevenção e tratamento de doença poderá levar a benefícios significativos para a saúde mental em termos populacionais. Os resultados da investigação sugerem que embora o tratamento e a prevenção tenham um papel crucial a desempenhar a curto prazo, a forma de reduzir a prevalência de perturbações mentais a longo prazo é intervir procurando elevar os níveis de saúde mental positiva ao nível da população em geral. Durante o período pós-parto, as mulheres enfrentam várias barreiras práticas e atitudinais que as impedem de procurar ajuda profissional presencial. Ferramentas de *e-mental health* para a promoção da saúde mental podem ser particularmente úteis, dada a sua acessibilidade e flexibilidade. Estas intervenções podem servir como ferramentas úteis de promoção da saúde mental positiva que podem ser disponibilizadas a uma vasta população. Neste contexto, o Be a Mom foi desenvolvido para ser uma intervenção online baseada na terapia cognitiva comportamental, com o objetivo de promover a saúde mental materna em mulheres no pós-parto. Os objetivos gerais do nosso estudo foram: 1) compreender a relevância de medir e abordar a saúde mental positiva nas mulheres no período pós-parto; e 2) testar a eficácia global, aceitabilidade, viabilidade e custo-eficácia do Be a Mom entre mulheres no pós-parto que apresentam baixo risco para depressão pós-parto.

Metodologia

Este projeto de investigação compreendeu duas fases. A Fase I consistiu num estudo transversal que se centrou em: 1) conduzir o estudo psicométrico do *Mental Health Continuum-Short Form*, e, 2) examinar os fatores (sociodemográficos, relacionados com a saúde, infantis e psicológicos) associados com sintomas depressivos e com níveis elevados de saúde mental positiva em mulheres no pós-parto. A Fase II consistiu num *randomized controlled trial* que procurou avaliar a eficácia de Be a Mom vs. um grupo de controlo entre mulheres de baixo risco no período pós-parto. Um total de 367 participantes foi distribuído aleatoriamente pelo grupo de intervenção ($n =$

191) ou pelo grupo de controlo ($n= 176$). Ambos os grupos preencheram um protocolo de avaliação num momento de pré-intervenção (T1), pós-intervenção (T2), quatro e 12 meses após pós-intervenção (T3 e T4, respetivamente). As participantes preencheram questionários de autorresposta avaliando resultados individuais (por ex., saúde mental positiva, sintomas depressivos), maternos (por ex., autoeficácia materna), relacionais (por ex., satisfação relacional), processos psicológicos (por ex., autocompaixão, regulação emocional), QALYs e dados relacionados com custos de cuidados de saúde e de produtividade.

Resultados

Na fase I, os resultados demonstraram que o MHC-SF é uma medida válida para utilização no contexto do pós-parto. A Análise Fatorial Confirmatória mostrou que o modelo bifator demonstrou um ajustamento aos dados significativamente melhor do que o modelo original de três fatores. Os resultados também sugeriram um forte fator geral de saúde mental positiva e não apoiaram a utilização das pontuações das subescalas. Além disso, os nossos resultados mostraram que os fatores que contribuem para o *flourishing* no período pós-parto eram diferentes dos associados a não apresentar sintomas depressivos. Em particular, a menor idade do bebé, níveis mais elevados de confiança materna, e a resiliência aumentaram a probabilidade de apresentar *flourishing*. Por sua vez, rendimentos mais elevados, menos problemas com o sono da criança, a perceção do temperamento da criança como fácil, e uma maior flexibilidade psicológica aumentaram a probabilidade de não apresentar sintomas depressivos. Avaliar o apoio recebido pelos outros como bom e ter maior autocompaixão aumentou a probabilidade de ambos os resultados.

Na fase II, os nossos resultados demonstraram que, em comparação com o grupo de controlo, o grupo de intervenção relatou aumentos significativos na saúde mental positiva e na autocompaixão entre T1 e T2. Foram encontrados efeitos de grupo para sintomas depressivos e de ansiedade e regulação emocional. Além disso, descobriu-se que os aumentos na autocompaixão entre T1 e T2 contribuíram significativamente para a melhoria da saúde mental positiva.

Adicionalmente, os resultados indicaram que o Be a Mom é uma intervenção custo-eficaz. A um limiar de 0 euros, existe uma probabilidade de 96% de que a intervenção seja custo-eficaz quando comparada com o grupo de controlo. Diferentes análises de sensibilidade apoiaram a probabilidade aceitável de a intervenção ser mais custo-eficaz do que o grupo de controlo.

Conclusões

Os resultados deste projeto de investigação sublinham a necessidade de uma mudança de paradigma nos atuais contextos clínicos e de investigação perinatal, de um único enfoque na doença mental para uma abordagem mais abrangente que inclua a avaliação e promoção da saúde mental

positiva. Os resultados enfatizam também o potencial das intervenções baseadas na Internet em disponibilizar intervenções (custo)eficazes para a saúde mental.

Uma opção de cuidados de saúde mental que utiliza intervenções *eHealth* destinadas a promover a saúde mental positiva entre mulheres de baixo-risco no pós-parto parece desempenhar um papel significativo na gestão das consequências da doença mental no pós-parto.

Palavras-chave

Saúde mental positiva • período pós-parto • intervenções *web-based* • *randomized controlled trial* • *be a mom* • custo-eficácia • terapia cognitivo-comportamental • processos psicológicos • autocompaixão • modelo bifator

Introductory Note

The transition to motherhood is usually a demanding period for mothers because it entails an adjustment to lifestyle changes and new responsibilities. Research suggests that this period is a time of increased risk for psychological problems, such as postpartum depression. Even women who are not at an immediate risk of developing postpartum depression face numerous challenges and concerns that may place them in a vulnerable position. In turn, mental illness during this period can lead to several long-term negative consequences for the mother's health and the child's development.

Psychological interventions could play a central role in reducing the human and economic costs associated with mental illness in this period. However, the majority of research has tended to consider women's psychological adjustment to this period only in terms of levels of depression and anxiety, and the promotion of positive mental health has been neglected. Research suggests that focusing solely on treatment and prevention of mental illness may not be enough. A strategy that goes beyond targeting at-risk groups for prevention and treatment could lead to significant mental health benefits in population terms.

In this sense, e-mental health tools for mental health promotion can be delivered at a very low-cost and overcome many of the practical barriers to help-seeking found among postpartum women, such as feelings of guilt, shame and stigma, time constraints or childcare responsibilities. Web-based interventions have been shown to have long-term positive outcomes beyond the reduction of psychopathological symptoms and can contribute to an efficient use of health services, with evidence of reduced waiting lists and needs for formal care. *Be a Mom* is a web-based CBT intervention that was developed to promote maternal mental health among postpartum women. Therefore, the present research project aims to contribute to a shift in perinatal mental healthcare from a sole focus on treating and preventing disease to a more comprehensive approach which also comprises the promotion of positive mental health while taking advantage of the potential of e-mental health tools.

The present dissertation is organized in four chapters, herein succinctly described. **Chapter I | Theoretical Framework** provides an overview of the current state of the art on the topic of the psychological adjustment in the transition to motherhood. This first chapter begins with a description of the multiple challenges faced by women in the transition to motherhood and how they may adversely affect their mental health. Subsequently, we describe the literature on the overall

negative consequences of postpartum mental illness, as well as the treatment and preventive efforts that have been made so far. We continue the chapter focusing on the need to look beyond mental illness, describing the dual-continua model of mental health and its several implications for mental health promotion. Afterwards, we proceed with a review of the already vast evidence on e-mental health tools for mental health, particularly web-based interventions. Here we talk about web-based psychological interventions in the perinatal period and describe Be a Mom in detail. Be a Mom is a web-based CBT intervention for maternal mental health and was one of the main focus of this research project. This introductory section ends with a summary of the research gaps and limitations identified in the current literature, which guided the formulation of specific objectives for our research project.

Chapter II | Objectives and Methods integrates the operational aspects of our research project, by describing the general aims and broad methodological options that interconnect the different empirical studies. Overall, our research project comprised two distinct phases: I) the relevance of measuring and addressing positive mental health in the postpartum period; and II) the overall evaluation of Be a Mom, a web-based CBT intervention for promoting maternal mental health. In this second chapter, the study design, procedures and assessment instruments are presented for each empirical research phase. The statistical methods that allowed us to test our theoretically driven are also commented. A final reflection focused on the ethical principles that guided our research work, since its conception to the implementation of the assessment protocol and dissemination of results.

Chapter III | Empirical Studies includes five original studies presented in the format of scientific papers. Four of them are published in international peer-reviewed journals (empirical studies I, II, III and IV) and one is submitted for review (empirical study V). Note that in this chapter we present the articles according to the standards of each scientific journal, but without the final formatting of each journal's publication.

Empirical studies I and II are part of research phase I. Empirical study I, entitled *Measuring positive mental health in the postpartum period: The bifactor structure of the Mental Health Continuum-Short Form in Portuguese women*, sought to evaluate the psychometric properties of the European Portuguese version of the Mental Health Continuum-Short Form (MHC-SF) and aimed to investigate the factor structure of the MHC-SF in the postpartum context. Empirical study II, entitled *Is positive mental health and the absence of mental illness the same? Factors associated with flourishing and the absence of depressive symptoms in postpartum women*, aimed to explore

a wide range of factors associated with flourishing and with the absence of depressive symptoms among postpartum women.

Empirical studies III, IV and IV are part of research phase II and focused on examining the overall efficacy of Be a Mom. Empirical study III entitled *Be a Mom's efficacy in enhancing positive mental health among postpartum women presenting low risk for postpartum depression: Results from a pilot randomized trial*, reports the results on primary and secondary outcomes of the randomized controlled trial conducted in this research project. Empirical study IV entitled *Be a Mom, a web-based intervention to promote positive mental health among postpartum women with low risk for postpartum depression: Exploring psychological mechanisms of change*, explored the psychological mechanisms of change of the intervention. More specifically, it aimed to examine whether self-compassion, psychological flexibility and emotion regulation skills contributed to the improvements in the primary outcome. Lastly, empirical study V entitled *Cost-effectiveness of a web-based intervention to promote maternal mental health among postpartum women presenting low risk for postpartum depression*, sought to examine the cost-effectiveness of Be a Mom compared to a control group.

Finally, **Chapter IV | General Discussion** offers a brief summary and discussion of the core results derived from our empirical studies. In this chapter, a global critical evaluation of the work is also presented, based on a reflection about its main strengths and limitations. The concluding remarks of the present dissertation are dedicated to the discussion of the theoretical and practical contributions of the present research project and to the outlining of evidence-based guidelines for future research, clinical practice and health policy making in mental health promotion for perinatal women.

Attached to this dissertation, we also present an empirical study entitled *Perceived Maternal Parenting Self-Efficacy scale: Factor structure and psychometric properties among Portuguese postpartum women*. This study aimed to evaluate the psychometric properties of the European Portuguese Version of the Perceived Maternal Parenting Self-Efficacy scale in order to measure maternal self-efficacy as one of the secondary outcomes of the randomized controlled trial conducted in phase II of our research project. This study was published in an international peer-reviewed journal.

Chapter I

Theoretical Framework

1. The transition to motherhood: An appropriate period for public mental health attention

1.1. From increased challenges to increased vulnerability

The birth of a baby is socially represented as a positive event. Indeed, the postpartum period is often depicted with positive images of women immediately able to care for their infants and fulfilled in their mothering roles (Choi et al., 2005). However, because it requires an adjustment to a new role and new responsibilities, the transition to motherhood is also filled with difficult challenges and several reorganizations (Canavarro, 2001; Emmanuel & St John, 2010; Slade et al., 2009). This life transition represents a dynamic process of development and women experience a restructuring of their own identities to integrate the role and meaning of being a mother (Canavarro, 2001).

Postpartum women often experience a wide range of stressors and can find it challenging to balance the various competing demands of the early postpartum period. Several studies have documented the challenges and concerns of women in this life transition (Choi et al., 2005; Kanotra et al., 2007; Sutherland, 2010). Specifically, women may experience physical health difficulties related to physical recovery after childbirth (Woolhouse, Gartland, et al., 2014), difficulties related to breastfeeding (Chaput et al., 2016) and struggle with the demands of infant caretaking (Kanotra et al., 2007). They can also go through changes in the relationship with their partners as well as changes in social relationships (Woolhouse et al., 2012; Woolhouse, McDonald, et al., 2014). Financial strains and difficulties in balancing work and family demands (Grice et al., 2007; Nowak et al., 2013) are also commonly reported. Additionally, women may experience emotional difficulties such as feelings of loss in relation to the previous self (Nicolson, 1999). A few studies also highlight that during the postpartum period women may perceive themselves as failures or 'bad mothers' (particularly when the ideals associated with the myth of perfect motherhood are not achieved) leading to feelings of guilt and shame (Dunford & Granger, 2017; Sonnenburg & Miller, 2021; Sutherland, 2010). It is important to note that these demands and concerns may be experienced by all women in the postpartum period. Even under optimal circumstances, the early postpartum period constitutes a major life transition for all postpartum women.

The array of demanding tasks and stressors may adversely affect women's mental health and it has been suggested that the postpartum period could represent a time of increased vulnerability and risk of developing psychological difficulties (Dennis et al., 2017; Epifanio et al., 2015; Norhayati et al., 2015).

Postpartum depression (PPD) is the most prevalent mental health complication in this period, with global pooled prevalence ranging from 11.9% (Woody et al., 2017) to 17.7% (Hahn-Holbrook et al., 2017). While many symptoms of general depression and PPD are the same (e.g., sadness, crying, low energy, loss of appetite, self-critical thinking), PPD is unique because its onset is associated with childbirth (Gaynes et al., 2005). The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013) does not distinguish mood disorders that occur in the postpartum period from mood disorders that occur in other periods. Nevertheless, it includes the specifier “with peripartum onset” to include depressive disorders that start during pregnancy or in the first four weeks following delivery (American Psychiatric Association, 2013). However, there is a clinical consensus that PPD may be defined as the occurrence of a nonpsychotic depressive episode within 12 months after delivery (Gaynes et al., 2005; O'Hara & McCabe, 2013). Although PPD might develop at any point along the first year after the birth of a child, the first three months postpartum are a particularly vulnerable timeframe (Gavin et al., 2005). If left untreated, PPD can be a lasting condition continuing sometimes months and years after childbirth.

Moreover, it has been suggested that about 35-40% of women with depressive symptoms also report anxiety disorders or symptoms (Farr et al., 2014). Compared to depression, postpartum anxiety has received less attention from researchers and health professionals. In a recent systematic review and meta-analysis with a total of 221,974 women from 34 countries, Dennis et al. (2017) found that the prevalence for anxiety symptoms during the postpartum period ranged from 17.8% in the first four weeks to 15% thereafter. The prevalence for anxiety disorders during the first year ranged from 9.3 to 9.9%.

Some women may present risk factors that make them more vulnerable to mental illness during this period. There is extensive research on the risk factors for PPD (e.g., Leigh & Milgrom, 2008; Milgrom et al., 2008; Norhayati et al., 2015). These include history of depression, low social support, low self-esteem, stressful life events and poor marital relationship (O'Hara & McCabe, 2013). Knowledge on the risk factors for PPD is important to identify and refer women who may be at higher risk and minimize detrimental effects. However, this period constitutes a major life transition for all postpartum women, including low-risk women (i.e., women not presenting risk factors for PPD), who can still experience symptoms of depression and anxiety (Murphey et al., 2017; Weisman et al., 2010), but whose experiences have been less documented by the literature. Indeed, the overwhelming majority of studies have focused on treating psychopathology or reducing risk of developing a psychological disorder, ignoring the importance of the presence of mental health in all women in the postpartum period.

1.2. The negative consequences of untreated postpartum mental illness

When left untreated, postpartum mental illness could have a noticeable negative impact on multiple fronts, including maternal health, maternal caretaking behaviors and parenting, the mother-child relationship and the child's health and development (O'Hara & McCabe, 2013; Slomian et al., 2019).

Mental illness during this period can negatively impact the mother's physical and psychological health and their quality of life (Orsolini et al., 2016; Slomian et al., 2019). For instance, postpartum mental illness has been associated with lower self-esteem, less self-care, and less confidence in the performance of the motherhood role (Denis & Luminet, 2018; O'Hara & McCabe, 2013). Additionally, postpartum mental illness has been associated with a higher likelihood to report thoughts of self-harm and increased prevalence of suicidal ideation (Orsolini et al., 2016; Slomian et al., 2019).

Postpartum mental illness also seems to have an influence on the performance of maternal caretaking behaviors, the parental role and on the mother-child relationship. For instance, postpartum depressive symptoms have been shown to have a negative impact on breastfeeding, with mothers with depressive symptoms being more likely to bottle feed, more unsatisfied with breastfeeding and having experienced significant breastfeeding problems (Dennis & McQueen, 2007; Gagliardi et al., 2012). In the interaction with the child, when compared to non-depressed mothers, those who present postpartum depressive symptoms have shown several patterns of negative interaction (Field, 2010). In a review, Field (2010) synthesized evidence showing that women with postpartum depressive symptoms show less responsiveness and emotional involvement in interactions with the child, greater hostility and irritability, less involvement in enriching activities and less face-to-face interactions with the child. In turn, poorer maternal care and poorer maternal-child interactions can influence bonding difficulties and insecure attachments (Śliwerski et al., 2020; Slomian et al., 2019).

Regarding the consequences of untreated postpartum mental illness in the infant's health and development, there is substantial evidence demonstrating its significant long-term negative impact (e.g., Slomian et al., 2019; Stein et al., 2014). Specifically, research has consistently shown that maternal mental illness can impact the child's physical health (e.g., poor cardiovascular function, high rates of gastrointestinal infection) and compromise their cognitive, psychomotor and language development (Kingston et al., 2012; O'Hara & McCabe, 2013; Slomian et al., 2019). Furthermore, a few studies have emphasized the positive association between postpartum mental

illness and behavioral and emotional problems in children, such as internalizing and externalizing psychopathology (Kingston et al., 2012; O'Donnell et al., 2014; Stein et al., 2014).

Furthermore, a few studies have addressed the social and economic consequences of untreated psychological symptoms and disorders in this period (e.g., Bauer et al., 2016; Ladd et al., 2017). Specifically, postpartum mental illness has been associated with increased use of healthcare services for mother and infant (Dagher et al., 2012; Eilat-Tsanani et al., 2006; McCallum et al., 2011), suggesting that postpartum women presenting psychopathological symptomatology had more health expenditures, and increased work absenteeism (Ammerman et al., 2016; van der Zee-van den Berg et al., 2021). Bauer et al. (2016) emphasized that perinatal mental illness can have a lifetime economic impact as they estimated that the majority of the costs were related to adverse impacts on the child at different life stages, from increased mental and physical health costs to future productivity losses and lower earnings.

The strong societal and economic burden of postpartum mental illness, as well as its long-lasting consequences on infant health and development emphasize how maternal mental health should be a public health priority, suggesting the relevance of global approaches to reduce its impact (Muñoz, 2019).

1.3. Treatment and preventive efforts for postpartum mental illness

Psychological interventions could play a central role in reducing the human and economic costs associated with mental illness in this period and are often recommended as the first line of treatment for moderate PPD (Molenaar et al., 2018). Accordingly, several efforts using psychological interventions have targeted the treatment and prevention of psychological disorders during this period, particularly for PPD (e.g., Branquinho et al., 2021; Sockol et al., 2013).

Randomized controlled trials of psychological interventions for the treatment of PPD started with studies by Meager and Milgrom (1996) and O'Hara et al. (2000). The field continued to grow since and has been covered by several systematic reviews (e.g., Sockol, 2015; Sockol et al., 2011), overviews of the literature (Cuijpers & Karyotaki, 2021; Stuart et al., 2003), and even systematic reviews of systematic reviews (Alderdice et al., 2013; Branquinho et al., 2021). Overall, the results have shown that psychological interventions are effective in the treatment of perinatal depression, particularly when using Cognitive Behavioral Therapy (CBT) and Interpersonal Therapy (IPT; Nillni et al., 2018), but also when using recent developments of CBT (referred as third-wave-CBT), such as Acceptance and Commitment Therapy (ACT; Bonacquisti et al., 2017), mindfulness- (Lever Taylor et al., 2016) and compassion-based interventions (Kelman et al., 2018).

With respect to preventive interventions, a few systematic reviews have shown that they can significantly prevent the onset of depressive episodes in the postpartum period although the effects are more modest when compared to the treatment of PPD (O'Connor et al., 2019; Sockol, 2015; Sockol et al., 2013). In these reviews, a few characteristics associated with the enhanced efficacy of these interventions have been highlighted (O'Connor et al., 2019; Sockol, 2015; Sockol et al., 2013), particularly: interventions developed based on psychotherapeutic models, such as CBT or IPT; interventions delivered during the postpartum period, as opposed to those delivered during pregnancy as women may perceive the information as more immediately relevant and helpful; and interventions delivered individually. Sockol (2015) found that CBT interventions can be equally effective whether they targeted women who endorsed risk factors for depression, or all women in a community, although the effect sizes were more modest among community samples. Nevertheless, the vast majority of the existing empirical evidence has been limited to women presenting high risk for perinatal depression (O'Connor et al., 2019) and information about which interventions characteristics would benefit women with varying risk profiles is lacking.

Although treatment and preventive efforts have shown good efficacy and are critical to address the burden of postpartum mental illness, the increasing prevalence of mental illness cases suggests that more needs to be done (Vigo et al., 2016). Research has shown that mental health involves more than mental illness, but the bulk of interventions studies in the perinatal period use psychopathology as the primary outcome and other outcomes of mental health have rarely been explored (Smith et al., 2014). Indeed, there is a general idea that a reduction in psychopathology will inevitably lead to increased mental health. However, it has been increasingly recognized that approaches focused on treatment and reduction of adverse outcomes alone are not sufficient and that a comprehensive approach to mental health must also include the promotion of positive mental health (Barry et al., 2019; Forsman et al., 2015; Iasiello et al., 2020).

2. Looking beyond mental illness

2.1. The dual-continua model of mental health: Mental illness and positive mental health as two distinct constructs

Traditionally, mental health has been viewed according to either a unipolar model, in which mental health is merely interpreted as referring to mental illness, or to a bipolar model, in which mental health and mental illness are viewed as opposite ends of the same continuum (Herron & Trent, 2000). Accordingly, individuals are not able to 'gain' mental health since the core focus is on mental illness (Herron & Trent, 2000). These models of mental health have received criticism as early as 1958 (Jahoda, 1958), and in recent decades, the view of mental health as the absence of mental illness or as simply a euphemism for mental illness has changed considerably (Diener, 2000; Iasiello et al., 2020; Keyes, 2005).

In 2004, the World Health Organization (WHO) published a historic first report on mental health promotion, conceptualizing mental health as "a state of wellbeing in which every individual realizes their own potential, can cope with the normal stress of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (2004, p. 12). Thus, the WHO's definition of mental health highlights the concepts of wellbeing and positive functioning, going beyond the simple absence of mental illness. While it has relevant consequences, mental illness represents only half of the outcomes that should be of interest; the other equally important half is the study of positive mental health. The emphasis on positive mental health evolved over time as increasing empirical evidence revealed its significance (Iasiello et al., 2020). Although its conceptualization has not always been consensual, as there are several theoretical frameworks that use different terminologies (Huta & Waterman, 2014), it has been widely accepted that positive mental health comprises emotional wellbeing, psychological wellbeing, and social wellbeing (WHO, 2004; Keyes, 2005).

By definition, emotional wellbeing refers to positive feelings, such as happiness, joy, and interest, as well as positive evaluations of one's life and satisfaction with different life domains (e.g., work, personal relationships; Diener, 1984). It comprises an affective component (positive and negative affect) and a cognitive component (subjective interpretation of one's satisfaction with life) (Diener, 1984). Therefore, an individual has high levels of emotional wellbeing when they perceive they are satisfied and happy with their lives and experience many positive emotions and few negative emotions (Diener, 2000).

In the 1980s and 1990s, the field of psychology displayed a growing interest in the concept of wellbeing and psychologists expressed discomfort with the fact that the conceptualization of

wellbeing was not rooted in psychological theories (Ryff, 1989; Waterman, 1993). Ryff (1989) argued that wellbeing was more than feeling well, also encompassing the individual's potential and positive functioning and sought to bring together the contributions of various psychological theories, namely those that focus on positive functioning throughout the life cycle (Erikson, 1980; Jung, 1933), the concept of self-actualization by Maslow (1968) or the representation of the fully functioning person by Rogers (1961). Based on this framework, psychological wellbeing was conceptualized as having six dimensions: self-acceptance, purpose in life, autonomy, positive relationships with others, environmental mastery and personal growth (Keyes & Ryff, 1999).

Although these were important steps in the study of wellbeing, both emotional and psychological wellbeing focused on the individual in isolation, ignoring the community in which the individual belongs and their relationship with it. Based on sociological theories, Keyes (1998) argued that functioning well in life also includes social challenges and tasks that reflect an individual's social wellbeing, highlighting its importance for mental health. He conceptualized social wellbeing in five dimensions: social coherence, social acceptance, social actualization, social contribution and social integration (Keyes, 1998). **Table 1** describes the specific indicators of each dimension of positive mental health.

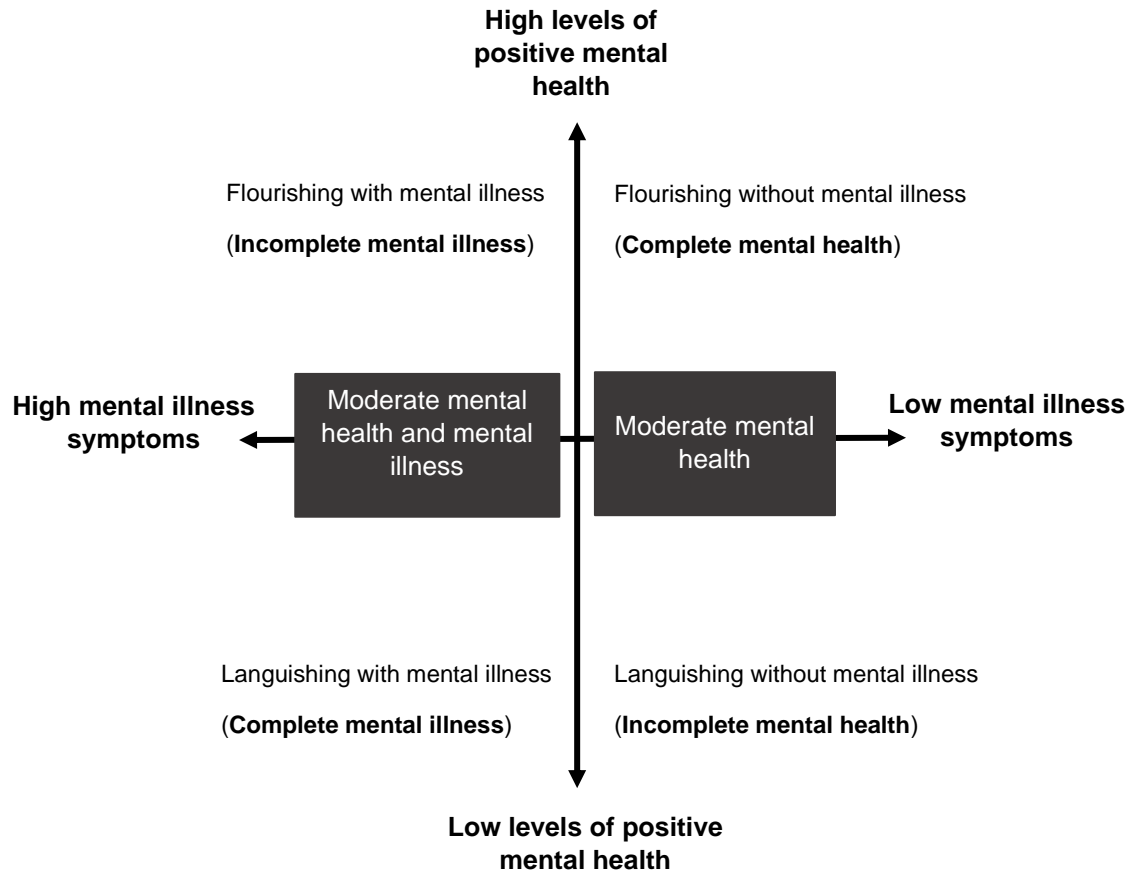
Therefore, mental health can be understood not only as the absence of mental illness, but also as the presence of positive mental health, which encompasses emotional, psychological and social well-being (Keyes, 2005). This is in line with a dual-continua view of mental health, which emerged as an alternative to the unipolar and bipolar models. Despite being related constructs, positive mental health and mental illness belong to two different continuums: one of the continuums indicates the presence/absence of mental illness and the other the presence/absence of positive mental health. Mental health is then seen as a complete state, which does not consist only of the absence of mental illness, but also the presence of "symptoms" of positive mental health (Keyes, 2002, p. 208). Although the dual-continua model of mental health has long been described in the literature (e.g., Fontana et al., 1980; Herron & Trent, 2000; Jahoda, 1958), it was only in recent years that it started to spark more interest through Keyes' dual-continua model of mental health or complete mental health model (Keyes, 2002, 2005; Keyes & Lopez, 2002).

Table 1. The tripartite structure of positive mental health: Description of its dimensions

Emotional wellbeing	Psychological wellbeing	Social wellbeing
<p>Positive affect Positive emotions, interest in life.</p> <p>Life satisfaction Sense of satisfaction with life or with life domains (such as work or personal relationships).</p>	<p>Self-acceptance A positive attitude of acceptance towards all aspects, good and bad, of the self.</p> <p>Purpose in life Believing that one's life has a purpose and meaning.</p> <p>Autonomy Sense of self-determination guided by internally accepted standards and values.</p> <p>Positive relationships with others Presence of loving or friendly relationships, grounded on empathy, trust and intimacy.</p> <p>Environmental mastery Being able to manage the environment according to the one's needs and values.</p> <p>Personal growth Understanding one's potential for growth and development. Seeking challenges and new experiences for continued development.</p>	<p>Social coherence Interest in society and social life and finding them meaningful. Perception of society as logical and predictable.</p> <p>Social acceptance Positive attitude towards others, recognizing their positive aspects as well as their difficulties and complexity.</p> <p>Social actualization The belief in society's potential for growth and confidence in its ability to evolve positively.</p> <p>Social contribution Feeling of usefulness and that one's own activities contribute and are valued by society.</p> <p>Social integration Feeling and perception of belonging to a community with a sense of comfort and support.</p>

According to Keyes' model (2005), individuals can be categorized according to their level of mental illness, as well as their level of positive mental health – flourishing, moderate mental health or languishing (see **Figure 1** for a schematic presentation of this model). Flourishing refers to the presence of optimal levels of emotional, psychological and social wellbeing. In turn, individuals who manifest feeling stuck, stagnant, empty or that life has no interest are classified as languishing. Finally, an individual is considered to have moderate mental health when they are not included in any of the above categories. In conclusion, a state of complete mental health encompasses not only the absence of mental illness, but also the presence of high levels of positive mental health (i.e., flourishing).

Figure 1. The dual-continua model of mental health. Adapted with permission from the University of Manitoba, Healthy Child Manitoba and the Winnipeg Regional Health Authority, n.d. Available in: <https://www.gov.mb.ca/healthychild/towardsflourishing/mentalhealth.html>



The independence of both constructs has been supported by multiple studies (e.g., Iasiello et al., 2020; Trompetter et al., 2017; Westerhof & Keyes, 2010; Xiong et al., 2017). A recent scoping review identified 83 studies conducted in diverse populations, whose results supported the dual-continua model of mental health over the bipolar model (Iasiello et al., 2020). Particularly, these studies provided evidence that mental illness and positive mental health belonged to two different continuums by demonstrating that two-factor models or correlated two-factor models yielded a better fit to the data than a single bipolar continuum (e.g., Franken et al., 2018; Lamers et al., 2011; Petrillo et al., 2015); by showing the reciprocal relations of mental illness and positive mental health over time (e.g., Lamers et al., 2015; Trompetter et al., 2017; Westerhof & Keyes, 2010); or by examining the relations of both positive mental health and mental illness to other aspects of functioning (e.g., Lamers et al., 2012; Teismann, Brailovskaia, Siegmann, et al., 2018; Xiong et al., 2017).

A number of studies have shown that better positive mental health minimizes the risk of developing mental illness later in time and that low levels of positive mental health are a risk factor for mental illness (e.g., Keyes et al., 2010; Lamers et al., 2015; Wood & Joseph, 2010). Furthermore, positive mental health is also proposed as an important predictor of recovery from mental illness (e.g., Lukat et al., 2017; Schotanus-Dijkstra et al., 2019; Trumpf et al., 2009). For instance, Iasiello et al. (2019) found that individuals with diagnosed mental illness who gained or maintained high levels of positive mental health over a 10-year period had much greater odds of recovering than those with low levels of positive mental health. Similar results were observed by Teismann, Brailovskaia, Totzeck, et al. (2018), who found that positive mental health was the most important predictor of recovery from an axis I disorder directly after treatment.

Additionally, a few studies showed that the explicative factors of positive mental health were not the reverse of those associated with mental illness (e.g., Kinderman et al., 2015; Winzer et al., 2014). For instance, positive mental health and mental illness have different and unique associations with personality traits (Lamers et al., 2012) or with sociodemographic variables (Patalay & Fitzsimons, 2016; Westerhof & Keyes, 2010). Moreover, previous research has revealed the existence of distinct subgroups within the two continuums, who presented differences on a range of psychosocial outcomes (e.g., Keyes, 2005; Lamers et al., 2012; Suldo & Shaffer, 2008; Xiong et al., 2017). As displayed in Figure 1, individuals with mental illness can present high levels of positive mental health and individuals without mental illness do not necessarily have high levels of positive mental health (Keyes, 2002). Findings consistently show that, even when experiencing mental illness, the presence of high levels of positive mental health (i.e., flourishing) is related to higher levels of positive functioning. More precisely, Keyes et al. (2012) found that the risk of suicidal behavior among students with mental illness was lower in those who were flourishing. Likewise, Teismann, Brailovskaia, Siegmann, et al. (2018) found that lifetime suicide attempts were less likely in patients who suffered from suicide ideation in the presence of positive mental health. Overall, studies have supported that individuals with mental illness who were also flourishing functioned no worse than individuals who were languishing and did not have psychopathology (Keyes, 2004, 2005), underlining the importance of actively addressing positive mental health in interventions. The presence of flourishing has been linked to several positive outcomes such as better physical health and longevity (Howell et al., 2007; Keyes, 2004; Keyes & Simoes, 2012), fewer health limitations of activities of daily living and fewer missed days of work (Keyes, 2005) as well as overall greater resilience to vulnerabilities and challenges in life (Dyrbye et al., 2012; Keyes, 2007). Even in the postpartum period, higher levels of positive mental health in mothers have been longitudinally associated with better development outcomes in children, specifically cognitive, communication and social development (Phua et al., 2017).

Despite the relevant benefits of positive mental health and flourishing, very few studies have investigated its determinants (e.g., Peter et al., 2011; Schotanus-Dijkstra et al., 2016). In contrast, there is a large body of empirical evidence on the factors associated with mental illness (Hölzel et al., 2011; Köhler et al., 2018; Lopresti et al., 2013; Zimmermann et al., 2020). This disparity is even more indisputable in the perinatal period, as only one study proposed to investigate the factors associated with flourishing during the postpartum period (Johnstone & Mulherin, 2019). This knowledge is essential because to improve overall mental health status it requires a comprehensive knowledge of the factors associated with both mental illness and positive mental health.

2.2. Measuring positive mental health

The results on the independence of the constructs of positive mental health and mental illness were only possible as a consequence of how positive mental health was measured. Indeed, it was only with the growing interest in the positive components of mental health that it was possible to identify different indicators of emotional, psychological and social wellbeing and, consequently, to address and measure positive mental health. In this sense, the Mental Health Continuum-Short Form (MHC-SF; Keyes et al., 2008) stands out as it provides a comprehensive assessment of positive mental health. Other measures have a narrower view of positive mental health as they aim to measure it only as aspects of positive mental health, such as emotional or psychological wellbeing. This happens because for a long time emotional wellbeing was the primary index of positive mental health and several instruments were developed to assess this dimension (e.g., Diener et al., 1985). Therefore, positive mental health is often measured in terms of life satisfaction or happiness (this is the case of measures such as the Satisfaction With Life Scale and the Positive and Negative Affect Scale; Diener et al., 1985; Watson et al., 1988) or in terms of psychological functioning and wellbeing (such is the case with the Psychological General Well-Being Index; Dupuy, 1984). Moreover, other questionnaires measure both emotional and psychological wellbeing (e.g., Warwick-Edinburgh Mental Well-Being Scale; Tennant et al., 2007) or psychological and social wellbeing (e.g., Flourishing Scale; Diener et al., 2010). Nevertheless, these measures do not capture all aspects of positive mental health; just as emotional disturbance does not constitute mental illness, emotional or psychological wellbeing *per se* do not constitute positive mental health.

As there was not a measure in which its underlying theoretical basis was that of a tripartite model of positive mental health, in which emotional, psychological and social wellbeing are included, the MHC-SF was developed (Keyes et al., 2008). The MHC-SF consists of 14 items, each one representing the theoretical indicators of emotional, psychological, and social wellbeing. **Table 2**

shows an overview of the items of the MHC-SF with the underlying theoretical basis of positive mental health.

Table 2. Overview of the items of the Mental Health Continuum-Short Form (Keyes et al., 2008)

Theoretical dimension	Items (In the past month, how often did you feel...)
Emotional wellbeing	
Happiness	1. Happy
Interest	2. Interested in life
Life satisfaction	3. Satisfied with life
Social wellbeing	
Social contribution	4. That you had something important to contribute to society
Social integration	5. That you belonged to a community (like a social group, or your neighborhood)
Social actualization	6. That our society is becoming a better place, for all people
Social acceptance	7. That people are basically good
Social coherence	8. That the way our society works makes sense to you
Psychological wellbeing	
Self-acceptance	9. That you liked most parts of your personality
Mastery	10. Good at managing the responsibilities of your daily life
Positive relations	11. That you had warm and trusting relationships with others
Personal growth	12. That you had experiences that challenged you to grow and become a better person
Autonomy	13. Confident to think or express your own ideas and opinions
Purpose in life	14. That your life has a sense of direction or meaning to it

Besides its continuous scoring, the MHC-SF also provides pre-defined cutoff scores to distinguish the three levels of positive mental health: flourishing, moderately mentally healthy, and languishing. The MHC-SF has been translated into numerous languages and several validation studies across multiple cultural contexts have found evidence supporting its utility, validity and reliability (e.g., Poland: Karaś et al., 2014; Lamers et al., 2011; Netherlands: Lamers et al., 2015; Korea: Lim, 2014; Italy: Petrillo et al., 2015). However, the literature has shown some limitations and inconclusive findings regarding its factor structure.

Keyes et al. (2008) first proposed a correlated three-factor structure of the MHC-SF and several studies supported this structure by using confirmatory factor analysis (CFA) to evaluate the model fit (e.g., Karaś et al., 2014; Lamers et al., 2011; Lupano Perugini et al., 2017). However, previous research works pointed out the high correlations (r above .80) found between the MHC-

SF subscales (Franken et al., 2018) or that the fit indices can be considered only marginally acceptable (Jovanović, 2015). Evaluating the factor structure of measures with multidimensional item responses using only CFA has limitations (Reise, 2012). Specifically, multidimensionality may lead to the interpretation of the total scale score as an indicator of three different constructs. Furthermore, it is unclear to what extent the use of subscale scores is acceptable and how informative they are in addition to the total score. These limitations have been more recently addressed by testing additional methods and competing models and evidence showed that the structure of the MHC-SF was better explained by a bifactor model (e.g., de Bruin & du Plessis, 2015; Echeverría et al., 2017; Hides et al., 2016; Jovanović, 2015). It is thus important to not only examine the validity and reliability of the MHC-SF to establish its psychometric robustness in the postpartum context, but also to examine whether the original correlated three-factor model best represents the structure of the MHC-SF. This information is essential for an adequate use and interpretation of the MHC-SF scores.

To summarize, the development and validity of the dual-continua model of mental health generated significant theoretical and empirical advances, which have important implications for research, practice and policy. Particularly, it allowed mental health and mental illness to be viewed as independent and therefore could be tested and measured independently; in turn, this provided evidence that the absence of mental illness does not imply the presence of mental health nor does the presence of mental illness mean the absence of some level of positive mental health; likewise, it provided evidence that the level of positive mental health differentiates the level of functioning in individuals with and without mental illness, allowing the creation of subgroups that were not possible under the bipolar model. Hence, the dual continua model holds a much richer description of mental health than the traditional view. Altogether, the evidence on the dual-continua model of mental health and the impact of positive mental health suggests that mental health treatment and intervention design should go beyond a focus on psychopathology and urge substantial changes in mental healthcare services.

2.3. Actively addressing positive mental health in interventions: Implications for mental health promotion

There is no doubt that mental disorders represent a significant burden worldwide and must be addressed. However, the focus of mental healthcare services on treatment and risk-reduction prevention has not reduced the burden of psychological disorders nor has it prevented their development (Insel & Scolnick, 2006; Kessler et al., 2005). If mental health is seen as the elimination

of illness, mental health care will always be oriented towards that end, even when considering mental health promotion strategies for the general population. Indeed, there are intervention studies intending to promote mental health that are visibly illness-oriented (e.g., Martin et al., 2009; Puskar et al., 2006; Swannell et al., 2009) as they focus on reduced levels of psychopathological symptoms rather than in mental health “gain”.

Different authors have argued that overlooking the absence of positive mental health in populations means risking failure in tackling the problem of mental illness (Herron & Trent, 2000; Huppert, 2009; Trent, 1992). Huppert (2005) asserts that while treatment and prevention have a crucial role to play in the short term, the way to reduce the prevalence of mental disorders in the long term is to intervene seeking to elevate positive mental health levels at the general population level. Accordingly, in 2015, leading mental health research experts across Europe formulated consensus-based recommendations for future research within the public mental health field (Forsman et al., 2015). Among the 20 priorities for public mental health research that were identified, the number one priority stated that positive mental health should be increasingly addressed in mental health research (Forsman et al., 2015).

As increasing research shows that interventions that are effective in reducing psychopathological symptoms are not necessarily effective in enhancing positive mental health (Newnham et al., 2010; Trompetter et al., 2017), the logic that reduction in psychopathology inevitably leads to higher levels of mental health falls apart. Looking at positive mental health as a separate and different construct than mental illness could enable the focus on strengths rather than vulnerabilities and can prevent people from developing mental illness down the line (Keyes et al., 2010).

Interventions aiming specifically to improve positive mental health have been designed and tested in different settings, including western (Feicht et al., 2013; Schotanus-Dijkstra et al., 2017) and non-western (Hendriks et al., 2020; Ho et al., 2016; Xu et al., 2019) populations, youth (Manicavasagar et al., 2014; Sánchez-Hernández et al., 2019) and adult (Bolier et al., 2014; Sommers-Spijkerman et al., 2018) populations, and clinical (Bohlmeijer et al., 2015; Radstaak et al., 2020; Schrank et al., 2016) and non-clinical (Räsänen et al., 2016; Weber et al., 2019) samples. A recent systematic review and meta-analysis has showed that psychological interventions can significantly improve positive mental health (van Agteren et al., 2021). More specifically, this review found that mindfulness-, CBT- and acceptance and commitment therapy-based interventions, as well as positive psychology interventions demonstrated the greatest efficacy (van Agteren et al., 2021).

In the postpartum period, interventions aiming to increase positive mental health are very scarce. The results of a systematic review of reviews including randomized trials of perinatal

interventions highlighted how interventions in maternity care have largely focused on the reduction of adverse outcomes and how there is an absence of positive-focused outcomes (Smith et al., 2014). These findings emphasize how the effectiveness of interventions during this period has been frequently measured in terms of reduction of adverse outcomes rather than increases in measures of mental health.

To the best of our knowledge, only two randomized controlled trials were conducted in the perinatal period aiming specifically to promote aspects of positive mental health. Gammer et al. (2020) found that an online compassion-based intervention was effective in enhancing psychological wellbeing among a community sample of postpartum women. However, the effects found were small and sensitive to the way missing data were handled (the effects were only significant if missing data were not imputed). Additionally, in a study using a web-based positive psychology intervention, Haga et al. (2020) did not find significant differences between an intervention and a control group of perinatal women on emotional wellbeing. These studies used narrower measures of positive mental health as they only assessed one of its dimensions. Intervention studies using a more comprehensive measure of positive mental health, including its three dimensions of emotional, psychological and social wellbeing, are thus needed.

3. e-mental health

3.1. The emergence of e-mental health tools and current evidence

In the last decades, Internet has become an integral part of people's lives. With the rapid growth of Information and Communication Technologies (ICTs) and the massive societal adoption of these technologies, researchers saw the potential in applying technological advances to health, and specifically to mental health. eHealth is a broad term to describe the use of ICTs in healthcare. It has been defined as "an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies" (Eysenbach, 2001, p. 1).

Mental health researchers showed interest in incorporating ICTs in mental health care around the late 1990s (Barak, 1999). In 1996, Colón was the first to introduce the term "therapy online" to describe a therapeutic online chat group (Colón, 1996). Since then, the field has grown rapidly and generated a large amount of research (Zale et al., 2021). The wide range of formats and methods, the heterogeneity in platforms and the interdisciplinary nature of the field have led researchers to use a variety of terms to name their interventions, which resulted in an inconsistent and chaotic use of terminology (Smoktunowicz et al., 2020). Although there is no clear consensus on how to distinguish the interventions integrating psychotherapy and technology, the terms that are frequently used include e-mental health, web-based intervention, online intervention or internet-delivered therapy (Smoktunowicz et al., 2020). These refer to the use of ICTs to support and improve mental health conditions and mental health care and to promote, empower, and facilitate mental health and wellbeing with individuals (Andersson et al., 2019).

Web-based psychological interventions¹ are structured programs that are based on evidence-based therapeutic protocols (Mohr et al., 2013). The main differences are related to the way information is delivered and in the communication with the therapist (Andersson & Titov, 2014). Moreover, although different models of psychotherapy have been delivered through the Internet, the model of therapy used in Internet-delivered interventions for which there has been most research activity is CBT (Andersson et al., 2019), including third-wave CBT (O'Connor et al., 2017).

Web-based interventions can be guided by a therapist or fully self-guided. Internet interventions that involve therapist contact can be further divided into those that involve real-time (synchronous; such as telephone or video) or delayed (asynchronous; such as e-mail) interaction

¹ There are different types of e-mental health tools such as telepsychology, mobile-based interventions, computerized game-based approaches, or 3D virtual environments. Because they are out of the scope of this work, they will not be discussed in this dissertation.

with patients (Andersson & Titov, 2014). Moreover, self-guided programs may involve a secure asynchronous communication system, such as e-mail and automated reminders.

Internet-delivered psychological interventions have some advantages over the face-to-face format: 1) They can be a useful mean of providing for an 'unmet' need. Indeed, many individuals with psychological difficulties have remained untreated for many years (ten Have et al., 2013; Walker et al., 2015). By allowing self-referral, these interventions can improve access to evidence-based treatments without long waiting-lists. 2) They provide flexibility and reduce time and travel constraints, since they can be available for users at any time of the day from a location of their choice. 3) They can offer privacy and reduce feelings of stigma and shame as they allow users to remain anonymous. 4) In the case of self-guided interventions, they do not require the involvement of a therapist and can therefore be less costly and easily disseminated (Donker et al., 2015).

On the other hand, some issues should be acknowledged. First, there are ethical issues related to patient confidentiality and security issues associated with technology, relevant to data collection and storage (Andersson & Titov, 2014). Additionally, establishing a clinical diagnosis through the Internet has limitations. However, this can be attenuated by conducting structured diagnostic interviews via telephone (Boettcher et al., 2012). Moreover, a major concern is related to the low adherence rates of web-based interventions, particularly with the self-guided formats, which could have an impact on the outcomes of the intervention (Karyotaki et al., 2015).

A few studies have suggested that individuals rate therapy delivered through the internet as acceptable (Arjadi et al., 2018; Gun et al., 2011), and may prefer it over a face-to-face format (Wahbeh et al., 2014). Although individuals can recognize the advantages of e-mental health, a few studies also report negative attitudes towards e-mental health tools (Apolinário-Hagen et al., 2017; Musiat et al., 2014), such as perceiving e-mental health as less helpful and less credible than traditional therapy services.

The number of controlled trials of Internet-delivered psychological treatments has grown at a much faster rate than trials of psychotherapy in general (Andersson et al., 2019). Currently, there is substantial support for the use of psychological web-based interventions for common mental disorders (e.g., Pauley et al., 2021; Rigabert et al., 2020) and some government agencies established mental health policies recommending dissemination of such interventions (e.g., USA's National Institute of Health and UK's National Institute for Health and Care Excellence [NICE]; Ritterband et al., 2006). Several systematic reviews and meta-analysis have shown the efficacy of these interventions in treating anxiety and depressive disorders (e.g., Andrews et al., 2018; Pauley et al., 2021) or in reducing depressive symptoms among individuals with subthreshold depression (Reins et al., 2021).

Moreover, there is empirical evidence showing that web-based interventions can be a promising approach to the prevention of mental disorders, showing efficacy in preventing depression, anxiety and eating disorders (Rigabert et al., 2020; Sander et al., 2016)

Besides the evidence supporting the effectiveness of web-based psychological interventions, findings also suggest that therapist-guided web-based CBT tends to be as effective as face-to-face CBT (Andrews et al., 2018; Carlbring et al., 2018). A meta-analysis on web-based vs. face-to-face CBT found that web-based CBT produced equivalent overall effects to face-to-face treatment for psychiatric and somatic disorders (Carlbring et al., 2018). Similar results were reported in a meta-analysis conducted by Andrews et al. (2018), which found that web-based CBT interventions for anxiety and depression disorders did not produce different effects when compared to face-to-face CBT.

Moreover, results on the effects of guided vs. unguided interventions seem to favor the guided format. Compared with guided web-based interventions, higher dropout rates have been found for the interventions using an unguided format with average levels of adherence estimated at 26% (Richards & Richardson, 2012). In 2014, a systematic review on the impact of guidance on web-based psychological interventions found that guided interventions were superior to unguided interventions (Baumeister et al., 2014). Similar results were reported in a network meta-analysis, which found that guided web-based CBT was associated with more effectiveness than the unguided format among individuals with moderate to severe depression (Karyotaki et al., 2021). However, this meta-analysis also found that unguided web-based CBT was associated with similar effectiveness among individuals with symptoms of mild/subthreshold depression. Similarly, a recent meta-analysis on the effect of web-based interventions for treating anxiety disorders has yielded conclusions supporting that no substantive differences were observed between guided and unguided formats found that the effects of guided and unguided interventions were not significantly different (Pauley et al., 2021). Although guided web-based interventions may result in superior efficacy, the finding that self-guided interventions can still produce clinically significant improvements, particularly among low-risk samples, highlights the public health potential and widespread implementation of these interventions. These interventions can serve as helpful mental health promotion tools that can be delivered to a broad population.

In conclusion, although web-based psychological interventions have only been around for a few decades, the field is developing rapidly and constitutes a new approach to deliver psychological interventions for prevention and treatment of several mental health conditions that can increase population's access to mental health services and contribute to its efficient use.

3.2. e-mental health tools in the postpartum period

Reaching all women in need in the postpartum period through traditional face-to-face psychological interventions is a difficult challenge considering the high amount of human and economic costs involved. Moreover, a number of studies have shown that postpartum women rarely seek for professional help (help-seeking rates range from 15% to 40%; Fonseca et al., 2015; McGarry et al., 2009). A few barriers that prevent women from seeking professional mental health care during the perinatal period have been identified, concretely practical (e.g., demands associated with infant care, work constraints barriers) and attitudinal barriers (e.g., mental illness stigma, feelings of shame and guilt) (Button et al., 2017; Fonseca et al., 2015; Maloni et al., 2013; Sambrook Smith et al., 2019). In addition, barriers to mental health care extend beyond barriers to women's help-seeking and also include inadequate resources. Indeed, even among women who report experiencing mental health problems, there are limitations in the access to treatment (Sambrook Smith et al., 2019). For instance, data from the United Kingdom shows that an estimated 60% of women have no access to perinatal mental health services, that there are long waiting-lists and that most women are not referred to services or given any advice about organizations to contact for further help (Sambrook Smith et al., 2019; Royal College of Obstetricians and Gynecologists, 2017).

These barriers may be effectively managed with e-mental health tools as they can increase women's access and use of mental health resources providing them privacy and convenience. Research has shown that the Internet is already widely used by perinatal women to seek information related to mental health, such as depressive symptoms and to engage in online support groups to obtain health information and emotional support (Evans et al., 2012; Fonseca et al., 2016; Maloni et al., 2013). Moreover, in a recent review, the role of eHealth tools in the perinatal period was highlighted as having the potential to be revolutionary if integrated into standard care (van den Heuvel et al., 2018).

The evidence on web-based interventions in the perinatal period is increasing, though still is in its early stages. Only a few systematic reviews and meta-analyses on this topic have been conducted, which highlight that compared to the general population, much less work on web-based psychological interventions has been done in the perinatal period (Bayrampour et al., 2019; Lee et al., 2016; Loughnan et al., 2019). Indeed, these reviews included between four to seven studies, which limits the strength of their conclusions. Nevertheless, their results suggest the efficacy of web-based interventions in improving perinatal mental health, particularly considering depression and anxiety (Bayrampour et al., 2019; Lau et al., 2017; Lee et al., 2016; Loughnan et al., 2019; Mu et al., 2021). Similar to the research with face-to-face interventions, studies testing internet-

delivered interventions in the perinatal period have largely focused on mental illness as the primary outcome (Ashford et al., 2016).

In Portugal, and to the best of our knowledge, no web-based intervention for maternal mental health has been developed. Regarding this topic, Fonseca et al. (2016) found that Portuguese women were interested in the use of e-mental health tools to promote emotional wellbeing during the perinatal period. Since currently there are no screening procedures in place in Portugal and perinatal mental healthcare is provided only when women self-refer or when health professionals identify symptoms worthy of clinical attention, web-interventions could have a significant role in improving existing mental health practices.

3.3. The case of Be a Mom: A web-based CBT intervention for maternal mental health

In line with this, Be a Mom was developed to be a short-term, fully self-guided web-based intervention for Portuguese postpartum women. It was originally developed to be a preventive intervention for PPD among high-risk postpartum women.

The development and design of Be a Mom involved a rigorous formative evaluation process (Fonseca et al., 2018). Initially, the main characteristics, therapeutic goals, and content of the intervention were identified. For this, a scoping review of existing interventions for PPD was conducted (Fonseca et al., 2018). The results showed that preventive interventions presenting efficacy were grounded on a therapeutic approach, such as CBT, were delivered by mental health specialists, were mostly delivered in the postpartum period with an individual format. Moreover, four distinct categories of therapeutic goals were found: 1) education and skills about the transition to parenthood; 2) education and skills about depression and anxiety symptoms; 3) promotion of social support and of relationship quality; and 4) reducing stigma, promoting help-seeking and helping the family.

To complement the information gathered through the scoping review, a focus group with mental health professionals working with the perinatal population was conducted. Overall, the participants of the focus group highlighted that: CBT should be used as the theoretical background to guide the design of the intervention; the intervention should be organized in different modules, each one addressing one or two thematic contents; each session should address major psychological processes, such as emotion regulation, instead of targeting non-specific contents related to motherhood tasks (e.g., infant care, breastfeeding); the intervention should have some level of tailoring, such as personalized feedback and interactive exercises, as well as some “humanization features” that may promote the user’s engagement with the program. In addition, the

mental health professionals identified six important themes that should guide the development of the intervention's content: Changes and reorganizations, Interpersonal relationships, Stress and depression management, Cognitions, Emotions and Symptoms and help-seeking.

Based on these results, Be a Mom was developed to be a self-guided web-based intervention delivered to women in the postpartum period. It is grounded on CBT principles and includes third wave CBT approaches, such as Compassion Focused Therapy (CFT) and ACT. Because CBT is a structured and time-limited treatment, Be a Mom has five sequential modules addressing specific thematic contents. A description of the content and goals of each module can be found in **Table 3**. The content of the modules is customized to the user's needs (for instance, content related to the promotion of the couple's satisfaction and intimacy is not displayed in case of single mothers).

All modules include the presentation of the module's goals, psychoeducational information about the specific thematic content and practical strategies to be implemented during the week. At the end of the module, a summary of the session is presented as well as a two-minute video in which a mental health professional synthesizes the main content of the module. If women would like to explore more topics, additional information is also provided in a separate Library section. Topics that are addressed include tips for a healthy lifestyle, breastfeeding, sleep hygiene, mindfulness or problem-solving skills.

Table 3. Be a Mom's structure and main content. Adapted with permission from Fonseca et al., 2018, p. 491

Module	Main content	Goals
1. Changes & Emotions	<ul style="list-style-type: none"> ▪ Changes and reorganizations during the transition to motherhood; ▪ The "perfect mother" myth and unrealistic expectations; ▪ Emotions. 	<ul style="list-style-type: none"> ▪ Educate about the changes and reorganizations during the transition to motherhood; ▪ Normalize the common incongruity between expectations and the postpartum reality and promote acceptance and coping with the characteristics of this life period; ▪ Normalize and identify the diversity of emotions and promote their non-judgmental acceptance; ▪ Educate about the cognitive-emotional-behavioral link (understanding the relationship between thoughts, emotions and behaviors).
2. Cognitions	<ul style="list-style-type: none"> ▪ Thoughts: helpful vs. unhelpful/negative thoughts; ▪ The power of thoughts: questioning and defusion; ▪ Self-criticism and self-compassion. 	<ul style="list-style-type: none"> ▪ Normalize and identify negative automatic thoughts in the postpartum period; ▪ Educate about the individual's cognitive functioning (e.g., how cognitive fusion and thought suppression strategies maintain and exacerbate negative thoughts); ▪ Promote cognitive flexibility and self-compassion as ways to deal with internal experiences.

3. Values & Support	<ul style="list-style-type: none"> ▪ Values and committed actions; ▪ Social network: Identifying support needs and asking for help; ▪ Assertive communication. 	<ul style="list-style-type: none"> ▪ Identify, create and clarify parenthood values, and make committed actions in accordance with those values; ▪ Reduce women's social isolation; ▪ Identify support needs, sources of support and activate practical and emotional support from others; ▪ Promote assertive communication skills.
4. Couple Relationship	<ul style="list-style-type: none"> ▪ Changes in the couple relationship during the postpartum period; ▪ Conflict and negotiation; ▪ Sharing parenthood values and commitments. 	<ul style="list-style-type: none"> ▪ Educate about the changes in the couple relationship (e.g., intimacy, sexual relationship) during the transition to parenthood; ▪ Promote effective communication, negotiation and conflict management skills within the couple; ▪ Promote affection and intimacy within the couple; ▪ Normalize and accept differences in parenthood values and negotiate and commit with shared values.
5. Signs of PPD & Help-seeking	<ul style="list-style-type: none"> ▪ Identifying PPD signs and symptoms; ▪ Professional help-seeking: treatment options and how to seek help; ▪ An ongoing journey: Planning for the future. 	<ul style="list-style-type: none"> ▪ Educate about signs and symptoms of PPD, treatment options and its benefits; ▪ Develop a plan for professional help-seeking, in case of need. ▪ Prevent future difficulties and challenges by identifying them and reflecting on how the learned skills may be used in future situations.

Be a Mom was designed to not only address the minimization of risk factors (e.g., lack of social support, poor marital relationship), but particularly to promote CBT-based psychological processes, such as the development of acceptance- and compassionate-focused skills and emotion regulation, which are briefly described below.

Self-compassion refers to the tendency to take a kind, connected and mindful stance towards oneself when confronted with perceived challenges and difficulties, as opposed to being self-judgmental, feeling isolated and overidentifying with personal difficulties (Neff, 2003). Self-compassion has been robustly linked to lower psychopathology (MacBeth & Gumley, 2012) and to positive psychological outcomes (Barnard & Curry, 2011). In the context of the perinatal period, self-compassion may be particularly relevant because it can help guard against the higher levels of self-criticism and guilt that may arise when dealing with the demanding challenges of motherhood (Dunford & Granger, 2017; Sonnenburg & Miller, 2021).

Psychological flexibility is a central therapeutic process in ACT and can be defined as the ability to be aware of the present moment and to willingly accept and experience thoughts and feelings that unfold without trying to control or avoid them and to take action guided by values, even in the presence of life adversities (Hayes et al., 2006).

Emotion regulation is a multidimensional construct that can be broadly defined as an individual's ability to identify, understand and accept emotional experiences, control impulsive behaviors when under stress and flexibly modulate emotional responses appropriate for each situation (Gratz & Roemer, 2004).

Be a Mom relies on different formats to deliver its content, such as text, animations, video and audio files. There are also interactive exercises with personalized feedback based on the user's responses. By using different multimedia tools, there is an increased likelihood of the information being understood by the users, which may translate into a greater ability to put into practice the skills learned. **Table 4** provides a description of a few exercises in each module of Be a Mom.

Table 4. Examples of exercises in each module of Be a Mom

Module	Exercise	Exercise goal
1. Changes & Emotions	<i>Expectations and reality.</i> Participants are encouraged to think about previous expectations about motherhood and their reality now.	To help participants understand that motherhood can bring different changes than were expected, and that they may need more time to adjust.
	<i>The Emotion Thermometer.</i> Participants are asked to measure the intensity of their emotions throughout their day.	To help participants be aware that emotions are transient and not permanent as the intensity of our emotions can change in different days and even in different moments of the same day.
2. Cognitions	<i>Thoughts Journal.</i> Participants are invited to think of a situation in the past weeks when they felt more sad or irritated and write down the situation, their thoughts, emotions and behaviors.	To help participants understand the links between thoughts, emotions and feelings.
	<i>Audio exercise.</i> Participants are invited to listen to the brief audio "Thought suppression" in which they are asked not to think about the image of a yellow car with white spots for two minutes.	To help participants be aware that trying to control our thoughts is an unhelpful strategy.
3. Values & Support	<i>What makes us act?</i> Participants are asked to reflect on the strategies they have been using in their daily lives to deal with negative or unpleasant thoughts and emotions.	To raise participants' awareness about the strategies they normally use to deal with their unpleasant thoughts and behaviors and if they are effective in helping them achieving their goals.
	<i>The Values Compass.</i> Participants are invited to build their own Values Compass. They are also invited to keep track of their commitment with those behaviors during the following weeks.	To help participants expand the identification of their values in Parenthood and other areas of life and think how they can behave accordingly to such values. To encourage participants to keep their actions according to their values, which will increase their satisfaction and sense of meaning.

<p>4. Couple Relationship</p>	<p><i>SOS List – Identifying support needs.</i> Participants are asked to write their needs for each area of social support (practical, emotional and informational support).</p> <p><i>Assertive communication.</i> Participants are invited to help Inês (a fictional character from Be a Mom) in identifying the most useful strategies while talking to her partner about her sexual intimacy difficulties.</p>	<p>To help participants clearly identify areas where they need a helping hand. After completing this exercise, it would be easier for participants to start asking for help in specific situations.</p> <p>To help participants put into practice the strategies for assertive communication with a hypothetical situation.</p>
<p>5. Signs of PPD & Help-seeking</p>	<p><i>The Help-Seeking Plan.</i> Participants are invited to write the name and contact details of people they can turn to if they need professional help.</p> <p><i>What about the future?</i> Participants are asked to write down difficult situations that may arise in the future and the strategies they have learned that they can use to deal with those situations.</p>	<p>To encourage participants to identify who can help them in case they need professional help to address emotional difficulties.</p> <p>To remind participants that problems or difficult situations are inevitable, but that they now have more resources available to deal with difficulties.</p>

To provide humanization features, Be a Mom includes different fictional characters. There is a psychologist who presents the module's goals, suggests strategies and exercises, and outlines important information. There are also three mothers who share their personal experiences throughout the intervention while they are learning and putting into practice the strategies learned (Fonseca et al., 2018).

Asynchronous communication channels (e.g., reminders, email contact for program-related support) are available to enable communication. Moreover, the systems used are continuously updated to meet the latest security requirements.

A pilot trial was conducted to gather evidence of Be a Mom's acceptability and feasibility, as well as preliminary evidence of the program's efficacy among postpartum women presenting high risk for PPD (Fonseca et al., 2020). Overall, the results showed that participants found Be a Mom to be acceptable (e.g., 91.8% reported rated the quality of the intervention as very good and 83.9% would recommend it to a friend). The vast majority of participants reported that the intervention was easy to navigate, and its graphic layout was attractive. Regarding the content of the intervention, most participants agreed that there was an adequate number of modules, that the language was clear, and that the information was presented in an attractive and engaging way. Also, most participants reported that the exercises and homework activities were useful and that the tips provided were clear and helpful. Finally, the results of the pilot trial showed evidence of the

preliminary efficacy of Be a Mom in reducing depressive and anxiety symptoms among high-risk women (Fonseca et al., 2020).

Overall, Be a Mom was originally developed to be a preventive intervention for PPD among high-risk postpartum women. However, considering its format, content and the focus on developing and strengthening psychological resources, it becomes of great importance to extend Be a Mom to the general postpartum population and to understand if this program would also show efficacy in promoting positive mental health.

4. Research gaps and current challenges

The succinct literature review previously presented provides an overview of the current state of the art on the topics of the psychological adjustment in the transition to motherhood, the importance of addressing positive mental health as a separate dimension from mental illness and the potential of e-mental health interventions for mental health promotion. The current review also allows the identification of some research gaps and limitations of existing studies, which will be summarized next.

A major critical issue refers to the scarcity of empirical research addressing positive mental health in the research of women's adjustment in the transition to motherhood. For this purpose, validated measures of positive mental health are needed in the postpartum period as they have not been tested in this context, and the existing psychometric properties may not apply to the unique nature of this period (Meades & Ayers, 2011). Additionally, validated questionnaires that measure positive mental health in the Portuguese population are not available to date. The MHC-SF has been widely used to measure positive mental health but the evidence regarding its dimensionality and factor structure has yielded mixed results. The use of a bifactor model has been recommended to investigate multidimensional constructs which consist of different dimensions that are moderately associated (Reise et al., 2013). This type of measurement model allows us to investigate the relevance and reliability of subscale scores after controlling for the variance of the general factor (Reise et al., 2013). For example, if the emotional wellbeing subscale contributed less to its corresponding items than the general factor (i.e., positive mental health), then using the subscale score to assess emotional wellbeing would be questionable. Due to the inconsistent findings regarding the structure and dimensionality of the MHC-SF, it becomes relevant to extend previous research into the reliability and factor structure of the MHC-SF by using a bifactor model and examine whether the MHC-SF comprises a general factor (i.e., positive mental health) that accounts for the commonality shared by its dimensions or whether it is best represented as domain-specific factors (emotional, social, and psychological wellbeing) that account for the unique influence of the specific dimensions over and above the general factor. This knowledge could be of great practical importance as it provides information on the best practices for using and interpreting the MHC-SF.

Moreover, extensive research exists on the clinical, sociodemographic and psychosocial factors of postpartum mental illness (Milgrom et al., 2008; Norhayati et al., 2015). However, despite being easily identified by practitioners, many of these risk factors have limited practical application because they refer mostly to contextual factors that are not easily modifiable through psychological interventions. In turn, the factors associated with increased positive mental health have rarely been studied. The identification of sociodemographic and clinical characteristic of postpartum women

associated with positive mental health is thus needed. Likewise, a particularly relevant issue is the identification of modifiable psychological variables that can contribute to flourishing mental health. This knowledge can provide essential insights for interventions targeting the improvement of positive mental health in this population. A shift from risk to skills in the research of women's psychological adjustment to the postpartum period can significantly inform mental health promotion practices.

Bearing in mind the adverse impact of mental illness during the postpartum period, particularly how it has been shown to shape children's development and health outcomes (Slomian et al., 2019), the postpartum represents a very fitting period to implement strategies focusing on mental health promotion. The increasing evidence related to the dual-continua model of mental health provides new pathways for a more proactive design in interventions rather than a reactive response to the increasing prevalence of mental disorders during this period (Hahn-Holbrook et al., 2017). Within this framework, an accurate mental health promotion strategy as a complementary approach to treatment and prevention can be employed. A strategy that adopts the dual-continua model could inspire an important transformation in mental health care services and consequently better prepare them for the overwhelming burden of mental illness.

However, positive mental health has rarely been used as a primary outcome in intervention studies in this period. Psychopathological disorders and symptoms, particularly depressive symptoms, have been the greater focus of intervention research during this period (Sockol, 2015). Similarly, the bulk of interventions studies have used either depressed or at-risk samples and current evidence does not allow to understand to what extent can these interventions help or be useful for low-risk samples (O'Connor et al., 2019). Unwell or at-risk populations are likely to differ in terms of motivation or responsiveness to intervention, compared to those presenting low risk. Also, even in the cases where intervention studies used community samples, the primary outcome was still related to mental illness (Sockol, 2015). Therefore, there is a significant lack of knowledge on one of the continuums of mental health and looking specifically at low-risk populations can help to precisely understand effective promotion interventions.

Due to its characteristics (easily accessible, provide flexibility and privacy; Andersson & Titov, 2014), web-based psychological interventions can be an appropriate approach to deliver mental health promotion strategies in the postpartum period. From a public health perspective, these interventions can serve as helpful mental health promotion tools that can be delivered to a broad population and have an important impact on populations' mental health (Huppert, 2005). Previous results have established they can show efficacy in a wide range of contexts (Pauley et al., 2021; Rigabert et al., 2020). However, less is known about their efficacy improving positive mental health among postpartum women, particularly low-risk women.

In addition, although there is increasing research on the efficacy of web-based interventions, the research path of its underlying mechanisms and cost-effectiveness has been less taken. When considering research on internet interventions, and such as it happens with face-to-face interventions, there are no consistent predictors or change mechanisms reported (Andersson et al., 2019). Psychological interventions include learning processes that, together with therapeutic procedures, form the mechanisms of change of a certain treatment (Hofmann et al., 2020). Focusing on mechanisms of change provides a way for evidence-based interventions to be tailored to fit the targeted individuals. Direct empirical evidence to support the mechanisms of change in web-based CBT interventions is lacking, particularly when the primary outcome is positive mental health. Gaining a better understanding of the mechanisms that enable people to develop and maintain positive mental health is essential for improving intervention science in this setting.

Besides examining if an intervention works (i.e., its efficacy) and how it works (i.e., the mechanisms underlying its efficacy), it is also relevant to examine if the intervention is the best use of resources. Cost-effectiveness analysis (CEA) is a form of economic evaluation which compares the costs and health effects of an intervention to assess the extent to which it can be regarded as providing value for money (Gray et al., 2011). The purpose of CEA is to maximize the level of benefits relative to the level of resources available and inform policymakers who have to determine where to allocate limited healthcare resources (Gray et al., 2011). Despite the large costs resulting from postpartum mental illness, cost-effectiveness evidence of psychological interventions in the postpartum period is still scarce (Camacho & Shields, 2018). Current evidence suggests that web-based psychological interventions can be cost-effective (Donker et al., 2015) but to the best of our knowledge, no studies have investigated the cost-effectiveness of web-based or face-to-face interventions aimed at promoting positive mental health in the postpartum period. Bearing in mind that the postpartum represents a crucial period, information on the cost-effectiveness of web-based interventions for low-risk women could inform policy makers in considering mental health promotion strategies in this context.

Chapter II

Objectives and Methods

This research project was carried out within the Relationships, Development & Health (RD&H) research group, of the Center for Research in Neuropsychology and Cognitive Behavioral Intervention (CINEICC), at the Faculty of Psychology and Educational Sciences of the University of Coimbra (FPCE-UC).

The work underlying this dissertation is divided in two phases: I) the relevance of measuring and addressing positive mental health in the postpartum period; II) the overall evaluation of Be a Mom, a web-based CBT intervention for promoting maternal mental health.

This research project, in particular phase II, is nested within a wider research project titled “Be a Mom, a web-based psychological intervention to promote maternal mental health: Results of an efficacy trial and understanding of the treatment response mechanisms among women presenting high-risk and low-risk for postpartum depression”, co-funded by the European Regional Development Fund through the Portugal-2020 program, within the scope of the Regional Operational Program of the Center (CENTRO-01-0145-FEDER-028699) and by the Portuguese Foundation for Science and Technology (FCT) / MCTES technology through national funds². The principal investigator of this project is Ana Fonseca, PhD and the Co-Principal Investigator is Professor Maria Cristina Canavarro, both supervisors of this dissertation. The author of this dissertation collaborated on the wider project since 2015, first through a research grant of the research group RD&H within the scope of the CINEICC’s Strategic Project (UID/PSI/00730/2013), and later with a PhD grant awarded by FCT (SFRH/BD/115585/2016). Thus, while both high-risk and low-risk postpartum women were the target of the wider research project, the assessment of the overall efficacy and acceptability of Be a Mom among low-risk women was carried out specifically within the current PhD project.

The body of this dissertation comprises five empirical studies presented in the format of scientific articles and currently published (four studies) or submitted (one study) for publication in international peer-reviewed journals. The specific objectives and methods (e.g., participants, instruments, statistical analyses) of each study are described in the articles’ appropriate sections (see Chapter III). In this second chapter, we will present an integrative overview of the research project, by describing its objectives, the methodological options interconnecting the different empirical studies and the ethical considerations that guided the conceptualization, implementation and dissemination of this research.

² At the initial stage, the project also received funding from CINEICC and from FCT through the concession of a post-doctoral grant to Ana Fonseca, PhD (SFRH/BPD/93996/2013).

1. Research objectives

The objectives of this research project were outlined in order to fill existing gaps in the scientific literature which were previously described in point 4 of Chapter I. Overall, this project intended to be an innovative contribution to the study of positive mental health in the postpartum period and to the potential of self-guided web-based interventions as mental health promotion tools. Accordingly, a set of objectives were established to enable evidence-based knowledge on the promotion of positive mental health among postpartum women.

Therefore, two general objectives were defined for this research work:

1. To understand women's positive mental in the postpartum period.

- 1.1. To validate the most adequate and widely used measure of positive mental health for Portuguese postpartum women – the MHC-SF;
- 1.2. To contribute to distinguish whether the characteristics of postpartum women who are flourishing are the same of those without clinically relevant postpartum depressive symptoms.

2. To test the overall efficacy, acceptability and feasibility of Be a Mom, a self-guided web-based CBT intervention, among low-risk postpartum women.

- 2.1. To investigate the efficacy of Be a Mom among low-risk postpartum women;
- 2.2. To understand the psychological processes (self-compassion, emotion regulation, psychological flexibility) underlying Be a Mom's treatment response;
- 2.3. To investigate the cost-effectiveness of Be a Mom among low-risk postpartum women.

As outlined in these objectives, this research project first sought to raise awareness to the importance of addressing positive mental in the postpartum period by aiming to validate a widely used measure of positive mental health for the Portuguese context and by aiming to investigate the characteristics that contribute to high levels of positive mental health in postpartum women. The implementation of the first general objective was essential to carry out the second general objective of this research as they provided an adequate and validated questionnaire to measure positive mental health as an outcome of interventions and they informed such interventions by giving insight into which psychological resources should be promoted. Secondly, this research project aimed to examine if Be a Mom, a self-guided web-based CBT intervention, could be useful as a positive mental health promotion tool for low-risk postpartum women. With this general objective we aimed to investigate the relevance of targeting the promotion of positive mental health among low-risk

women as a complementary approach to addressing the burden of mental illness in the postpartum period.

Based on the defined research objectives, five empirical studies were conducted. The first general objective was addressed in two empirical studies and the second was addressed in three empirical studies. **Table 5** displays the specific objectives of each study. Empirical studies I through IV are published in international peer-reviewed journals, while empirical study V is currently under review in an international peer-reviewed journal. Specific details about each study are described in the appropriate section (see Chapter III)³.

Table 5. Specific research objectives for the empirical studies

Research phase	Empirical study	Objectives
I	I	<ul style="list-style-type: none"> - To examine the factor structure and dimensionality of the MHC-SF by examining whether a bifactor model provides a better fit than a single-factor model or a correlated three-factor model. - To examine the reliability of the MHC-SF among postpartum women and to investigate its convergent validity by examining the association of its scores with other measures related to mental health.
	II	<ul style="list-style-type: none"> - To examine the factors (sociodemographic, health-related, infant-related, and psychological factors) associated with increased flourishing among postpartum women. - To examine the factors (sociodemographic, health-related, infant-related, and psychological factors) associated with the absence of postpartum depressive symptoms among postpartum women.
II	III	<ul style="list-style-type: none"> - To examine Be a Mom's effect on low-risk postpartum women from baseline (Time 1 – T1) to postintervention (Time 2 - T2) on the primary outcome (positive mental health) and on secondary outcomes (depressive and anxiety symptoms, empowerment, maternal self-efficacy and relationship satisfaction) compared with a waiting-list control group. - To examine differences in the proportion of patterns of change as a function of group (intervention vs. control group) considering the primary outcome from T1 to T2. - To examine Be a Mom's adherence, acceptability and pattern of usage.
	IV	<ul style="list-style-type: none"> - To examine Be a Mom's efficacy in enhancing psychological processes (self-compassion, psychological flexibility, emotion regulation) among low-risk postpartum women from T1 to T2 and if these effects were maintained at the first follow-up (Time 3 - T3) compared with a waiting-list control group. - To investigate if increased psychological processes (self-compassion, psychological flexibility, emotion regulations skills) at T2 could explain the improvement of positive mental health at T2.
	V	<ul style="list-style-type: none"> - To examine the cost-effectiveness of Be a Mom among low-risk postpartum women compared with a waiting-list control group.

³ Although not directly addressed in the research project objectives, an additional empirical study was conducted which was related to one of the specific objectives of the project. More specifically, this empirical study refers to the psychometric studies of the Portuguese version of the Perceived Maternal Parenting Self-Efficacy questionnaire, which allowed to measure maternal self-efficacy as a secondary outcome in the efficacy study of Be a Mom. This study is presented in the Appendix of this dissertation.

2. Methods

This research project included two different empirical research phases which resulted in the empirical studies I, II, III, IV and V, thus achieving the two general objectives that were proposed. In this section we describe the study design and general procedures for the research phases I and II.

2.1. Research project design

The empirical studies of our research project were quantitative in nature. Phase I of our project had a cross-sectional design, meaning that the data were collected at a single moment. In this phase, we sought to increase the knowledge about positive mental health during the postpartum period and carried out empirical studies I and II.

In phase II, we conducted a two-arm open-label randomized-controlled trial (RCT) of the Be a Mom intervention vs. a waiting-list control (WLC) group. RCTs are recognized as the gold standard for testing treatment efficacy and are considered the highest level of evidence to establish causal associations in clinical research (Zabor et al., 2020). Understanding the principles behind RCTs allows to have a more comprehensive awareness of the reliability and validity of the results. Therefore, next we will describe in detail the principles and general concepts of the design and reporting of an RCT study.

2.1.1. General concepts of designing and reporting an RCT

There are various types of RCT designs but in all the main goal is to test an intervention with respect to an outcome in a target population. In an RCT, two or more groups or “arms” of participants are compared: an experimental group, who receives the intervention and a control group, who receives an alternative intervention, a placebo intervention or no intervention at all. The groups are then measured over a period of time to test the efficacy of the intervention.

The reason why RCTs provide the highest level of evidence in clinical studies is mainly because of aspects of design, particularly randomization, allocation concealment and blinding, which eliminate various types of bias. These procedures allow to provide the most unbiased evidence regarding the impact of the intervention on the desired outcome by minimizing differences in the study group’s characteristics.

The randomization aspect of an RCT ensures that each participant has an equivalent chance of receiving the intervention(s) under study. Randomization also provides a sound statistical basis

for the data analysis relating to the effects of the intervention, preventing an imbalance of baseline characteristics (both assessed and not assessed). In the RCT conducted in phase II of our research project, randomization was conducted using a computerized random number generator (allocation ratio 1:1).

The advantages of randomization in avoiding possible bias are strengthened with blinding. Blinding means that a participant or a researcher do not know which group participants are assigned to. Therefore, it minimizes the influence of that knowledge in the recruitment and assignment of participants, in the attitudes of participants to the intervention, in the assessment of outcomes or in the exclusion of data from analysis. Different types of blinding can be implemented, such as double blinding (in which both participants and researchers are unaware of intervention assignment) and single blinding (in which only participants or only researchers are unaware of intervention assignment).

Blinding can be challenging or not feasible to achieve, particularly in psychological intervention trials (Berger, 2015). In those cases, an open-label trial has to be conducted, in which intervention assignment is known to both researchers and participants. This is the case of the present research project, where only an open-label trial was practically and ethically possible. To minimize the possible bias of the researcher's knowledge of group assignment, allocation concealment was performed.

Allocation concealment occurs when the person who generates the allocation sequence is not the same person determining participant eligibility and actively involved in the trial recruitment. This allows to avoid the possibility that the person responsible for recruitment could direct a person with worse baseline levels to the intervention arm rather than the control, or vice versa. In the present research project, the determination of eligibility of participants and recruitment process was conducted by the author of this dissertation. A code was generated for each participant and this code was provided to one of the supervisors of this dissertation, Ana Fonseca, who performed randomization and allocated each code to one of the two study groups. With this procedure we intended to minimize the potential for conscious or unconscious bias in the allocation of participants thus reinforcing the value of randomization in reducing selection bias.

The stage of reporting the RCT is of central importance. RCT reports should contain complete, clear, and transparent information on its methodology and findings. To provide guidance to authors and help ensure accurate reporting in RCTs, the Consolidated Standards of Reporting Trials (CONSORT) statement was created. The original CONSORT statement was developed in 1996 (Begg et al., 1996) and two revisions followed it, one in 2001 (Moher et al., 2001) and another in 2010 (Schulz et al., 2010). In sum, it consists of a useful tool that allows researchers to design and

report trials and helps peer reviewers and editors to critically evaluate the methodological quality of the trial.

The CONSORT 2010 comprises a 25-item checklist of essential items that should be included in reports of RCTs, which provide standards of how the trial should be designed, analyzed, and interpreted. It also comprises a diagram for documenting the flow of participants throughout the trial (Schulz et al., 2010). The 25-item checklist was divided into six categories according to the different parts of a scientific article (title and abstract, introduction, method, results, discussion and other information). **Table 6** presents an overview of the CONSORT 2010 checklist information.

Table 6. Brief overview of the information in the CONSORT 2010 checklist

Section	Description
Title and abstract	The title should be concise and the word “randomized” should be used. The abstract should be structured and include trial design, methods, main results, and conclusions.
Introduction	The introduction should include a brief scientific background, an explanation of the rationale for the trial and the specific objective or hypothesis.
Method	In the method section, the following information should be reported: the trial design; eligibility criteria for participants; how and where data were collected; thorough description of intervention; description of primary and secondary outcome measures; description of sample size calculation; changes made after beginning the trial; thorough description of methods used for allocation into the trial groups, participants and researchers’ blinding; and methods for statistical analyses.
Results	In the results section, a flowchart with the participants flow throughout the trial is strongly recommended. The following information should be reported: the number of participants who were randomly assigned and analyzed, for each group; losses and exclusions (with reasons), for each group; information on the recruitment period and assessment points; baseline characteristics for each group; primary and secondary outcome results for each group, together with the contrast between the groups (i.e., effect size).
Discussion	In the discussion section, the following information should be presented: limitations, addressing sources of potential bias, imprecision and methodological weaknesses; information on the external validity of the results; applicability and interpretation consistent with results, balancing benefits and harms, considering other published evidence.
Other information	The RCT should be registered, and the registry number presented. Sources of funding of the trial should be reported, as well as the level of involvement by a funder and their influence on the design, conduct, analysis, and reporting of the trial.

Because there are specific designs in RCTs, with different types of interventions and data, different extensions of the CONSORT statement were developed (www.consort-statement.org/extensions). In addition to the CONSORT 2010 statement, the following CONSORT extensions were followed when designing the RCT within the present research project and when

reporting its methodology and results: CONSORT-SPI 2018 (Montgomery et al., 2018), which is specific for RCTs of social and psychological interventions, and CONSORT-EHEALTH (Eysenbach & Group, 2011), which provides guidance for authors of eHealth and mHealth interventions.

Additionally, the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement (Husereau et al., 2013) was followed when designing and reporting the economic evaluation that was conducted alongside the RCT. Similar to the CONSORT 2010, the CHEERS statement comprises a 24-item checklist divided into six main categories (title and abstract, introduction, methods, results, discussion and other information).

2.2. Participants and procedures

2.2.1. Research Phase I

A single cross-sectional study was carried out to address the objectives corresponding to research phase I. The participants were selected in accordance with the non-probabilistic sampling method of convenience. Data were collected through an online survey using the survey platform LimeSurvey, hosted on the website of the host institution (Faculty of Psychology and Educational Sciences of the University of Coimbra). A link to the survey was posted periodically on social media websites (Facebook and Instagram).

In the LimeSurvey link, the study and its objectives were briefly outlined. Subsequently, information was given about the study's goals, the participants' and researchers' roles and the voluntary and anonymous nature of participation. Participants who consented to participate in the study had to click on the option "I understand and accept the conditions of the study" in order to start the assessment protocol. Enrollment in the study occurred between August and November 2018. The ethical committee of the host institution approved all the procedures of sample recruitment and data collection.

To participate in the study, participants had to fulfill the following eligibility criteria: 1) being a woman in the postpartum period (0–12 months after delivery); 2) being 18 years or older; and (3) understanding Portuguese.

Prior to data collection, the translation of the MHC-SF to Portuguese was developed in several steps through a forward-backward translation procedure. First, after obtaining authorization from the authors of the original version to translate and validate the scale, two bilingual Portuguese researchers independently translated the items. The two translated versions were compared, and after discussing and analyzing their similarities/differences, both researchers agreed on a single reconciled version. Second, a third bilingual and independent translator, who was not familiar with

the questionnaire, conducted the back translation of this reconciled version. Finally, the original and the back-translated versions were compared, and translation difficulties were analyzed and resolved between translators to obtain a comprehensible measure that was conceptually consistent with the original.

During the period in which data collection took place, 903 women accessed the online questionnaire and gave their consent to participate in the study. The Limesurvey platform registered that 683 participants completed the assessment protocol and questionnaire completely and 220 only partially completed it. Participants with an incomplete assessment protocol were included in the empirical studies as long as the necessary measures to assess the variables under study had been completed. Moreover, 21 participants were removed from the sample due to having an infant older than 12 months. Accordingly, the final sample of empirical study I consisted of the 882 postpartum women and the final sample of study II consisted of 662 postpartum women. The characteristics of the participants are described in detail in the respective empirical studies in Chapter III.

2.2.2. Research phase II

In order to address the objectives corresponding to research phase II, a two-arm RCT was conducted. During research phase II, participants were recruited online between January 2019 and March 2021. First, a LimeSurvey questionnaire was created to gather informed consent to participate in the study, assess eligibility to participate in the study and collect contact information (email and telephone number). Before providing informed consent, participants were informed about the study's goals and procedures, the participants' and researchers' roles, the voluntary nature of participation, and all aspects related to data protection (anonymity and confidentiality). The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the FPCE-UC. According to the CONSORT 2010 guidelines (Schulz et al., 2010), all RCTs should be registered in a clinical trials database. The RCT of this research project was registered in ClinicalTrials.gov (NCT04055974).

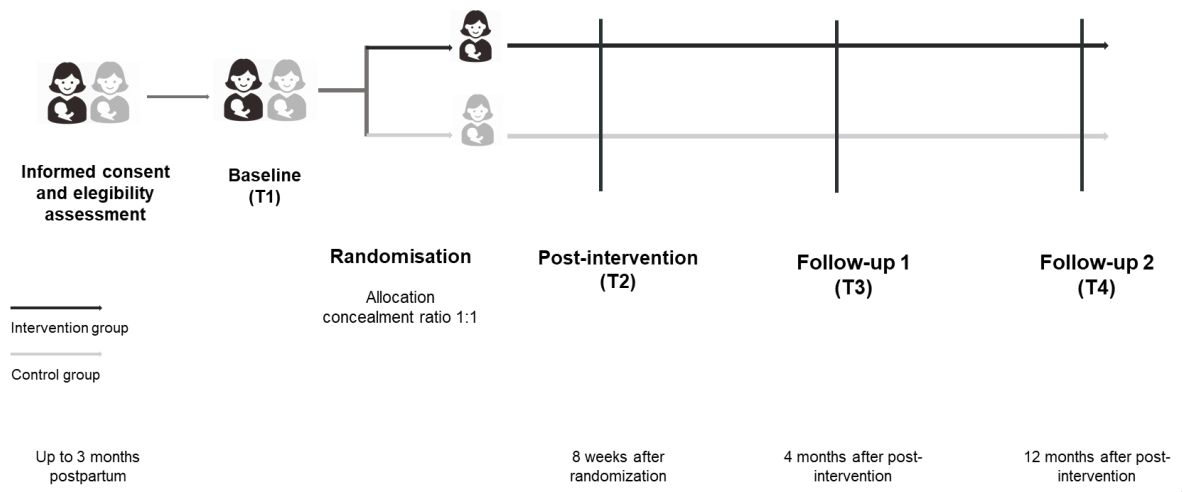
The LimeSurvey link was advertised through paid and unpaid posts on social media websites (particularly Facebook and Instagram). A Facebook page was created for the research project, which contained instructions on how to participate, a summary of the different assessment points of the study, a general description of the intervention and testimonials of previous participants.

Participants were included in the study if they met the following eligibility criteria: 1) to be in the early postpartum period (up to 3 months postpartum); 2) aged ≥ 18 years; 3) to present low

risk for PPD (Postpartum Depression Predictors Inventory-Revised < 5.5); 4) to have internet access at home; 5) to be a resident of Portugal; and 6) to understand Portuguese. Participants were excluded if they had a serious medical condition (physical or psychiatric) or if the infant had a serious health condition (both were self-reported).

Figure 2 schematically presents the design of the data collection of the RCT. The procedure for data collection of the RCT involved several stages, namely:

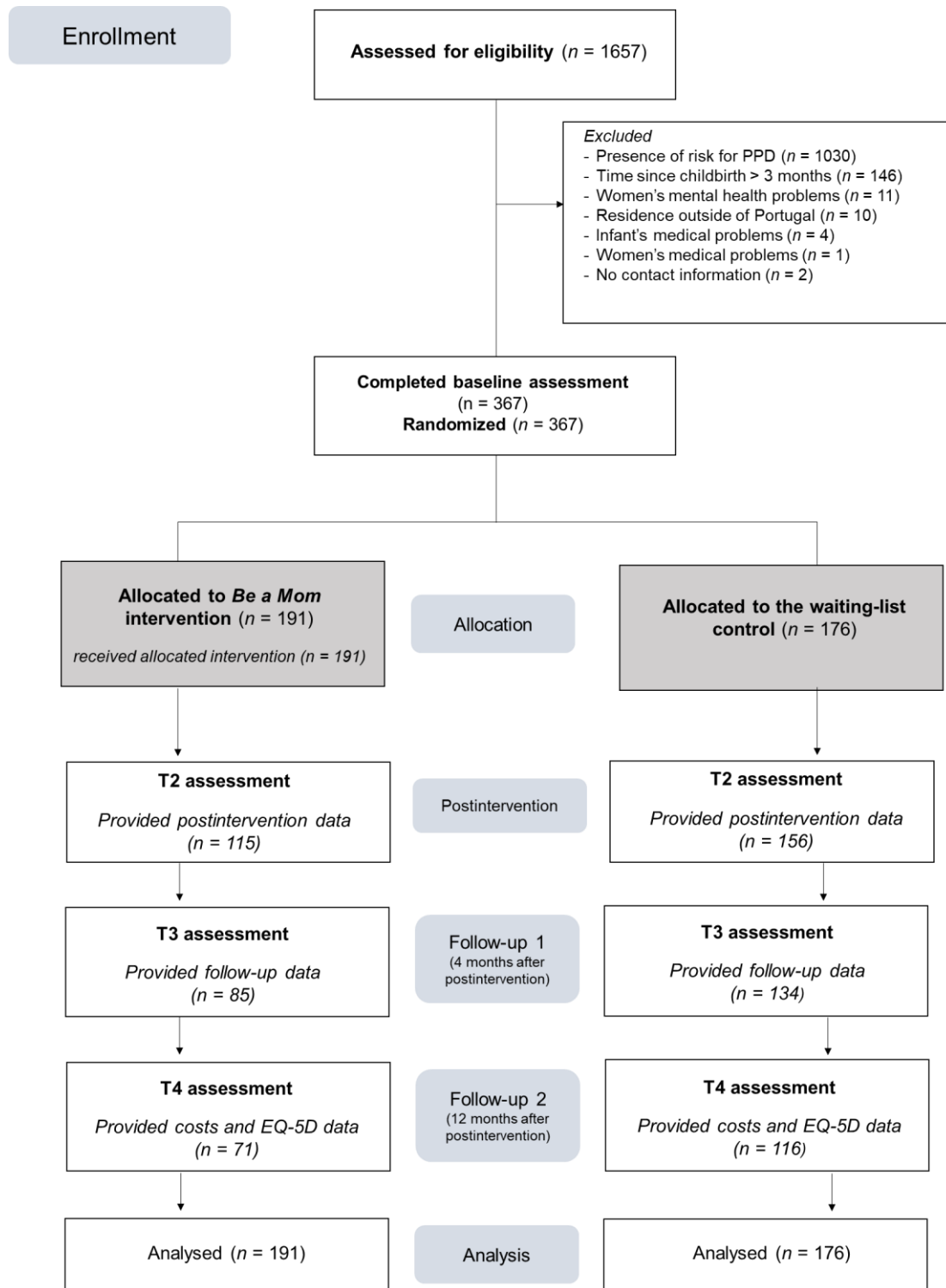
1. Women registered their interest in participating in the study, provided informed consent and were assessed for eligibility.
2. Women were sent an email stating whether they were eligible or not to participate in the study. If women were eligible to participate in the study, a link to the Limesurvey platform with the baseline assessment protocol was sent.
3. Participants who completed the baseline assessment were randomized into two groups: a group of women who had access Be a Mom (intervention group) and a group of women who did not have access to the program immediately (control group).
4. An invitation email to register in the Be a Mom's website was sent to the women in the intervention group. An email was also sent to women in the control group with information that they were selected for the control group and that they would be contacted in 8 weeks to complete the postintervention assessment protocol.
5. A telephone contact was made to the participants of the intervention group who provided a valid telephone number to clarify any questions regarding the flow of the program or help with difficulties accessing the website.
6. Eight weeks after randomization, an email with the postintervention assessment protocol was sent to the participants of both groups.
7. Four months after postintervention, an email with the first follow-up assessment protocol was sent to the participants of both groups.
8. Twelve months after postintervention, an email with the second follow-up assessment protocol was sent to the participants of both groups.
9. Text messages and email reminders were sent on an alternate basis each week for one month to participants in both groups who failed to complete T2, T3 and T4 assessment points, to minimize dropouts.

Figure 2. Flow of the RCT data collection

Of the 1657 women who were assessed for eligibility, 453 were sent the baseline assessment. Most participants were excluded from this study because they presented risk factors for PPD ($n = 1030$). They still participated in the wider research project and were sent a different baseline assessment protocol (the primary outcome in the RCT with high-risk women was depressive symptoms).

In total, 367 participants completed the baseline assessment and were randomly allocated to either the intervention ($n = 191$) or the WLC group ($n = 176$). The flow of participants through the study is presented in **Figure 3**.

Figure 3. Flowchart showing the flow of participants throughout the study



2.2.2.1. Sample size

When designing an RCT, an essential step is the calculation of the sample size, which will allow a reasonable power of detecting a pre-determined difference (i.e., effect size) in the outcome variable, to establish efficacy of the intervention, at a given level of significance. An RCT can be rigorously executed and still fail to answer its research question if the sample size is too small (e.g., clinically meaningful differences could be observed but statistical significance was not achieved) or if the sample size is unnecessarily large (e.g., the importance of small effects could be exaggerated and may not actually be clinically meaningful).

The number of participants needed in an RCT should always be large enough to provide a reliable answer to the questions addressed and should be determined by the primary outcome of the clinical trial, the type of measure, the proposed effect size and the method of calculating the test statistic (Zhong, 2009). Statistically, sample size estimation is typically based on a two-sided test of the primary outcome. To determine the number of participants needed to detect at a pre-specified alpha (often .05, two-sided) and power (often 80% or 90%) levels, a power analysis is conducted.

For the RCT conducted in this research project, a priori calculations indicated that a sample size of at least 200 participants at postintervention assessment was needed to assess evidence of efficacy for the primary outcome (detecting a small effect size [$d = 0.10$] with a statistical power of .80 in a two-tailed test, $p < .05$). Considering that the dropout rate of eHealth interventions is high and that in the pilot study of Be a Mom around 35% of participants dropped out at postintervention (Fonseca et al., 2020), at least 350 participants were needed for randomization.

2.3. Variables and measures

In order to operationalize the variables targeted in the objectives set for this research project, we created assessment protocols consisting of a set of sociodemographic and clinical datasheets and self-report questionnaires assessing different dimensions of the participant's lives. **Table 7** displays the set of questionnaires used for each research phase and assessment times as well as the variables assessed.

Table 7. Variables assessed and measures used for each research phase and assessment time

Variables	Measure	Phase I	Phase II			
			Assessment times			
			T1	T2	T3	T4
Sociodemographic, clinical, and infant-related information		✓	✓	✓	✓	✓
Screening/Eligibility assessment						
PPD risk	Postpartum Depression Predictors Inventory – Revised (PDPI-R)		✓			
Individual outcomes						
Positive mental health	Mental Health Continuum-Short Form (MHC-SF)	✓	✓	✓	✓	✓
Depressive symptoms	Edinburgh Postnatal Depression Scale (EPDS)	✓	✓	✓	✓	✓
Anxiety symptoms	Anxiety Subscale of the Hospital Anxiety and Depression Scale (HADS-A)		✓	✓	✓	✓
Empowerment	Empowerment Scale (ES)		✓	✓	✓	
Satisfaction with life	Satisfaction with Life Scale (SWLS)	✓				
Quality of Life	EUROHIS-QOL	✓				
Parental outcomes						
Maternal self-efficacy	Perceived Maternal Parenting Self-Efficacy (PMPS-E)	✓	✓	✓	✓	✓
Maternal confidence	Maternal Confidence Questionnaire (MCQ)	✓				
Relationship outcomes						
Relationship satisfaction	The Satisfaction Subscale of the Investment Model Scale (IMS-S)		✓	✓	✓	✓
Psychological processes						
Resilience	Resilience Scale-14 (RS-14)	✓				
Psychological flexibility	Acceptance and Action Questionnaire-II (AAQ-II)	✓	✓	✓	✓	✓
Self-compassion	Self-Compassion Scale—Short Form (SCS-SF)	✓	✓	✓	✓	✓
Emotion regulation	Difficulties in Emotion Regulation Scale-Short Form was used (DERS-SR)	✓	✓	✓	✓	✓
Acceptability and feasibility						
Acceptability	Brief acceptability/satisfaction form			✓		
Feasibility	Adherence and dropout Web system data			✓		
Economic evaluation						
Quality-Adjusted Life Years (QALYs)	EQ-5D-3L		✓	✓	✓	✓
Costs	Trimbos and iMTA questionnaire for costs associated with psychiatric illness (TiC-P)		✓	✓	✓	✓

Of the selected set of self-report questionnaires, the MHC-SF and the Perceived Maternal Self-Efficacy Scale were not adapted for the Portuguese population at the beginning of our study; its translation and adaptation were part of the objectives of research phase I. For the remaining self-report questionnaires, the already existing Portuguese validation studies confirmed their adequate psychometric properties. The reliability values (Cronbach's alpha) found in our study samples are described in the method's section of the respective studies (see Chapter III).

Next, a detailed description of each variable and measure used for its assessment included in this research project is presented.

2.3.1. Sociodemographic, clinical, and infant-related data

The participants' sociodemographic, clinical, and infant-related information were collected through datasheets developed by the research team specifically for this research project. Specifically, participants were asked to provide information on their own age, educational level, marital status, employment status, household monthly income and area of residence. Additionally, women were asked to report their gestational weeks at the time of birth, the number of children they had, if they had physical health problems, if they had a previous history of psychiatric/psychological problems and a previous history of psychiatric/psychological treatment. Women were also asked to provide information on their infants, namely their age, their perceived temperament and quality of sleep.

2.3.2. Screening

Risk for postpartum depression

To identify women presenting risk factors for PPD, the Postpartum Depression Predictors Inventory – Revised was used (PDPI-R; Beck, 2002; Portuguese version [PV]: Alves et al., 2018, 2019). The PDPI-R includes 13 risk factors, assessed through 39 items. The factors assessed include: marital status (single, married/cohabitating, separated, divorced, widowed and partnered), socioeconomic status (low, middle, high), self-esteem, prenatal depression, prenatal anxiety, pregnancy intention (unwanted/unplanned), history of depression, social support (from partner, family and friends), marital satisfaction, life stressors, childcare stress, infant temperament and maternity blues. The questionnaire is answered on a dichotomous scale (yes vs. no), except for the first two items (marital status and socioeconomic status). Women's responses are coded with "0" (suggesting absence of risk) or "1" (suggesting presence of risk). A total score can be computed by summing up the respective items, with higher scores indicating greater risk of developing PPD. The psychometric properties of the PDPI-R are well established (Beck, 2002), and it is considered a useful screening tool in both clinical and research contexts. The Portuguese version of the PDPI-R has demonstrated acceptable reliability, and a cut-off score of 5.5 was recommended to indicate the presence of PPD risk (Alves et al., 2019).

2.3.3. Individual outcomes

Positive mental health

Positive mental health was measured using the MHC-SF (Keyes et al., 2008). This questionnaire comprises 14 items measuring positive mental health during the past month. The items of the MHC-SF are divided into three dimensions: 3 items for emotional wellbeing, 5 items for social wellbeing, and 6 items for psychological wellbeing. Women were asked to rate the frequency which they experienced each symptom of positive mental in the past month on a 6-point Likert scale (*never, once or twice, about once a week, about two or three times a week, almost every day, everyday*).

Items are summed, yielding a total score ranging from 0 to 70, with higher scores indicating greater positive mental health. The MHC-SF can be scored continuously or categorically, considering mental health status (flourishing, moderate mental health, languishing). According to the author of the MHC-SF, the items of this measure can be seen as symptoms that may diagnose different categories of positive mental health (Keyes et al., 2008). Flourishing mental health is defined by reporting ≥ 1 of 3 emotional wellbeing signs and ≥ 6 of 11 of social and psychological wellbeing signs experienced “everyday” or “almost every day”. Women who exhibit low levels (i.e., “never” or “once or twice” during the past month) on at least one item of emotional wellbeing and low levels on at least six items of social and psychological wellbeing are defined as having languishing mental health. Women who did not fit the criteria for either flourishing or languishing were considered moderately mentally healthy. In the empirical studies II and III, participants were categorized as flourishing and not flourishing (including both languishers and those with moderate mental health).

The MHC-SF has excellent psychometric properties and has been validated in several countries (e.g., Lim, 2014; Lupano Perugini et al., 2017; Petrillo et al., 2015).

Depressive symptoms

The Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; PV: Areias et al., 1996) was used to assess postpartum depressive symptoms. EPDS is a widely used self-report questionnaire which comprises 10 items that cover different emotions (e.g., sadness, tearfulness, anxiety). Participants are asked to rate the items considering the previous seven days with an individualized four-point response scale (ranging from 0 to 3). The total score ranges between 0 and 30, and higher scores are indicative of more severe depressive symptoms. In the Portuguese validation studies, a score of 10 or higher identifies women who have clinically relevant depressive symptoms (Figueiredo, 1997). Several validation studies have been conducted since the

development of EPDS in 1987 and it has been established as the most frequently used and validated instrument to assess and screen for postpartum depressive symptoms (Gibson et al., 2009).

Anxiety symptoms

The Anxiety Subscale of the Hospital Anxiety and Depression Scale (HADS-A; Zigmond & Snaith, 1983; PV: Pais-Ribeiro et al., 2007) was used to assess anxiety symptoms. The HADS-A is a widely used subscale which is self-administered. It has seven items (e.g., “Worrying thoughts go through my mind”) assessing the presence of anxiety symptoms in the week prior to completion. Each item is answered in a 4-point response scale ranging between 0 and 3. This instrument provides a total sum score for each subscale (range 0 – 21), with higher values denoting higher anxiety symptoms. The Portuguese validation studies of the HADS confirmed that the Portuguese version is reliable and valid for assessing and screening for anxiety symptoms. Accordingly, cut-off score of 11 points or higher is indicative of the presence of clinically relevant anxiety symptoms (Pais-Ribeiro et al., 2007).

Empowerment

The Empowerment Scale (ES; Rogers et al., 1997 PV: Jorge-Monteiro & Ornelas, 2014) was used to assess personal empowerment. The Portuguese version of the ES is a self-reported questionnaire with 20 items, representing five factors: Self-esteem (e.g., “When I make plans, I am almost certain to make them work”), Power-powerlessness (e.g., “Experts are in the best position to decide what people should do or learn”), Community Activism and Autonomy (e.g., “Working with others in my community can help to change things for the better”), Optimism and Control over the Future (e.g., “I am generally optimistic about the future”), and Righteous Anger (e.g., “Getting angry about something never helps”). Each item is rated with a four-point scale with response options ranging from *strongly agree* to *strongly disagree*. Higher scores indicate higher levels of empowerment. Rogers et al. (2010) reported Cronbach's alpha reliability of .82 for the overall empowerment score. In the Portuguese psychometric studies, the ES achieved an overall satisfactory internal consistency level, with a Cronbach's alpha value of .79 (Jorge-Monteiro & Ornelas, 2014).

Satisfaction with life

The Satisfaction With Life Scale (SWLS; Diener et al., 1985; Portuguese Version [PV]: Neto, 1993) was used to measure global life satisfaction. The SWLS is composed of five items (e.g., “So

far I have gotten the important things I want in life.”) rated on a 7-point response scale from 1 (strongly disagree) to 7 (strongly agree), with higher scores denoting a higher satisfaction with life. The results of different psychometric studies among the Portuguese population presented evidence of convergent validity and adequate internal consistency (Reppold et al., 2019; Simões, 1992).

Quality of life

Quality of life (QoL) was measured with the EUROHIS-QOL eight-item index (Power, 2003; PV: Pereira et al., 2011). This is a brief self-report instrument derived from the WHOQOL-100 and WHOQOL-BREF questionnaires (WHOQOL Group, 1994), which operationalize QoL as the individual’s perception of wellbeing in the physical, psychological, social, and environmental life domains. In the EUROHIS-QOL 8-index, these four domains are represented by two items each: Physical domain (e.g., “Do you have enough energy for everyday life?”), Psychological domain (e.g., “How satisfied are you with yourself?”), Social domain (e.g., “How satisfied are you with your personal relationships?”), and Environment domain (e.g., “How satisfied are you with the conditions of your living place?”). Each of the eight items has an individualized 5-point response scale, and scores range between 0 and 100, with higher scores indicating better perception of QoL. The Portuguese version has demonstrated good values of internal consistency ($\alpha = .81$) across different population groups (Pereira & Canavarro, 2015).

2.3.4. Parental outcomes

Maternal self-efficacy

Women’s perception of self-efficacy in the mothering role was assessed using the Perceived Maternal Parenting Self-Efficacy instrument (PMPS-E; Barnes & Adamson-Macedo, 2007). This measure comprises 20 items rated with a four-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate higher levels of perceived self-efficacy.

The results of the Portuguese psychometric study showed that the original four-factor structure did not acceptably fit the data and that a three-factor structure provided a better fit (Monteiro et al., 2022). Accordingly, the 20 items of the PMPS-E are divided into three subscales: Reading behaviors (eight items; mothers’ perceptions of their ability to understand and identify changes in their baby’s behavior; e.g., “I believe that I can tell when my baby is tired and needs to sleep”), Caretaking procedures (seven items; mothers’ perceptions of their ability to perform tasks related to infant care related to physical or emotional needs; e.g., “I am good at bathing my baby”), and Evoking behaviors (five items; mothers’ perceptions of their ability to elicit a change in the

infant's behavior; e.g., "I am good at soothing my baby when they become upset"). High reliability values were found for the total scale ($\alpha = .95$) and for the three factors (α from .88 to .94).

Maternal confidence

Maternal confidence was measured with the Maternal Confidence Questionnaire (MCQ; Parker & Zahr, 1985; PV: Nazaré et al., 2013). The MCQ consists of 13 items answered on a 5-point response scale (from 1 = *never* to 5 = *always*). The items are organized in three subscales: Knowledge of the Infant (e.g., "I know what makes my baby happy"), Caretaking Tasks (e.g., "I can hold my baby properly"), and Evaluation of the Parenting Experience (e.g., "I have all the skills needed to be a good parent"). The computation of a mean score for each subscale as well as a global score of maternal confidence based on the 13 items (range 1 – 5). Higher scores indicate higher perceived maternal competence. Most studies with the original version of the instrument have pointed to satisfactory results in terms of reliability and validity (Badr, 2005; Zahr, 1993). The psychometric studies of the Portuguese version also showed that the MCQ has satisfactory indicators of reliability (Cronbach's alpha values of .88 for the total scale), as well as convergent and discriminant validity (Nazaré et al., 2013).

2.3.5. Relationship outcomes

Relationship satisfaction

The Satisfaction subscale of the Investment Model Scale (IMS-S; Rusbult et al., 1998; PV: Rodrigues & Lopes, 2013) was used to assess women's satisfaction in the relationship with their partner. This subscale assesses the degree that the relationship fulfilled needs for intimacy, sex, companionship, security and emotional involvement. The IMS-S comprises five items (e.g., "Our relationship makes me very happy") answered on nine-point response scale ranging from 0 (*not at all*) to 8 (*completely*). Higher scores indicate higher satisfaction with the relationship. The psychometric studies of the Portuguese version showed that the Satisfaction subscale of the IMS revealed high reliability values ($\alpha = .89$; Rodrigues & Lopes, 2013).

2.3.6. Psychological processes

Resilience

The Resilience Scale (RS-14; Wagnild, 2009; PV: Pinheiro & Matos, 2013) was used to assess resilience. This scale comprises 14 items (e.g., “I feel like that I can handle many things at a time”) scored on a seven-point scale (ranging from 1 = *strongly disagree* to 7 = *strongly agree*). Higher scores indicate a greater ability to respond with resilience. The RS-14 has been shown to be a reliable and valid measure across multiple studies (e.g., Losoi et al., 2013; Nishi et al., 2013), and its Portuguese version has shown a good level of internal consistency (Cronbach’s alphas ranging from .87 to .93; Oliveira et al., 2015; Pinheiro & Matos, 2013).

Self-compassion

The Self-Compassion Scale-Short Form (SCS-SF; Raes et al., 2011; PV: Castilho et al., 2015) was used to assess women's self-compassion levels. The SCS-SF is a self-report measure comprising 12 items (e.g., “When I'm going through a very hard time, I give myself the caring and tenderness I need”), which are answered on a five-point response scale (ranging from 1 = *almost never* to 5 = *almost always*). Despite being a unidimensional measure, it assesses the six components of self-compassion with two items per component: self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification. After negative items are reverse coded, it is possible to obtain a global measure of self-compassion by estimating the mean of the 12 items, with higher scores indicating higher self-compassion.

Its original version has good psychometric characteristics, namely good internal consistency ($\alpha = .86$) and adequate factor validity (Raes et al., 2011). The Portuguese version also had good psychometric characteristics, with good internal consistency ($\alpha = .89$), test-retest stability and adequate convergent validity (Castilho et al., 2015).

Psychological flexibility

Psychological flexibility was assessed with the Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011; PV: Pinto-Gouveia et al., 2012). Participants were asked to rate each of the seven items (e.g., “I worry about not being able to control my worries and feelings”) on a seven-point response scale (1 = *always true*, 7 = *never true*). Higher scores are reflective of greater psychological flexibility. The AAQ-II showed an excellent level of internal consistency in the

Portuguese validation study ($\alpha = .90$) and good convergent and discriminant validities across clinical and nonclinical samples (Pinto-Gouveia et al., 2012).

Emotion regulation

To assess women's emotion regulation skills, the Difficulties in Emotion Regulation Scale-Short Form was used (DERS-SF; Kaufman et al., 2016; PV: Moreira et al., 2020). The DERS-SR comprises 18 items answered on a five-point scale ranging from 1 (*almost never*) to 5 (*almost always*). This instrument consists of six subscales, each with three items, which reflect different difficulties in regulating emotions during periods of stress: Strategies (i.e., limited access to emotion regulation strategies that are perceived to be effective; e.g., "When I'm upset, I take too long time until I feel better"), Non-Acceptance (i.e., non-acceptance of negative emotions; e.g., "When I'm upset, I feel guilty for feeling like this"), Awareness (i.e., lack of emotional awareness; e.g., "I pay attention to how I feel"), Impulses (i.e., difficulties in controlling impulsive behavior in the presence of negative emotions; e.g., "When I'm upset, I get out of control"), Goals (i.e., inability to engage in goal-driven behaviors in the presence of negative emotions; e.g., "When I'm upset, I have difficulty accomplishing tasks") and Clarity (i.e., lack of emotional clarity; e.g., "I have difficulty making sense of my feelings"). The average of the items allows to obtain a total score that can be used as an index of emotion dysregulation or as an indicator of greater difficulties in emotion regulation. The DERS-SF has been considered a valid measure with adequate internal consistency ($\alpha = .89$; Kaufman et al., 2016). The Portuguese version also showed good psychometric characteristics, namely a good internal consistency (Omega index of .82 for the total score; Moreira et al., 2020).

2.3.7. Acceptability and feasibility

Acceptability

During research phase II, participants of the intervention group were asked to answer a data sheet on the acceptability of Be a Mom. Participants were asked to answer questions on a 4-point response scale (0 = *does not apply to me at all*, 3 = *totally applicable to me*) regarding their satisfaction with the help provided by the intervention (e.g., "I am satisfied with the help I received with Be a Mom"), their intentions to use the intervention (e.g., "I would use Be a Mom again, if I were to be in a similar situation), their intentions to recommend it to a friend (e.g., "I would recommend Be a Mom to a friend that was in a similar situation"), usefulness/relevance of the intervention (e.g., "I feel that I learned a lot of important information with Be a Mom"), and the demandingness of the intervention (e.g., "I feel that participating in Be a Mom was very demanding

for me”). In addition, participants were asked to rate the quality of Be a Mom on a 5-point response scale ranging from *very bad* to *excellent*. Additional questions were presented about the participant’s experience using Be a Mom, namely open-ended questions regarding the presence of others when accessing the program and reasons for not completing all modules of Be a Mom, when applicable.

Feasibility

To assess the feasibility of Be a Mom, the participants’ adherence and usage of the intervention were considered. More specifically, data were collected through the Be a Mom website regarding the number of completed modules and pages accessed in each module, number of logins, average minutes spent on the website at each login, number of finished exercises and number of times each audio exercise was played.

2.3.8. Economic evaluation

Cost data

The following costs were considered for the economic evaluation: costs related to healthcare use; costs related to lost productivity; and intervention costs.

To collect data on health care utilization and productivity losses, the Portuguese version of the Trimbos and iMTA questionnaire for costs associated with psychiatric illness (TiC-P; Bouwmans et al., 2013) was used, adapted to the perinatal context. Healthcare use included medical consultations, contacts with a psychologist, psychiatrist, or ambulatory mental health services, contacts with other health professionals (e.g., nursing, physiotherapy, osteopathy, nutrition), hospitalizations, outpatient specialist care, emergency care, and use of medication. Estimations for each cost are detailed in empirical study V.

Data on productivity losses (absenteeism, presenteeism and reduced efficiency during unpaid work) due to health problems were collected. To measure absenteeism, participants were asked to report how many days they had been absent from work.

To measure presenteeism, participants were asked to report the number of days they worked while feeling ill and their personal efficiency score in those days using a rating scale from 0 to 10 (0 reflects total inefficiency and 10 reflects that they were as efficient as when in good health).

Production losses resulting from unpaid work (e.g., domestic tasks, caring for children, running errands) were measured by asking participants the number of days they performed these

tasks while feeling ill. Similar to presenteeism, they were also asked their personal efficiency score in those days through a rating scale from 0 to 10.

Quality-Adjusted Life Years

Quality-Adjusted Life Years (QALYs) were used as the primary outcome of the cost-effectiveness analysis in empirical study V. The QALY is a health measure that combines QoL and the amount of time spent in a health condition, in which one QALY is equal to 1 year lived in perfect health. To compute QALYs, we used the EuroQoL Five-Dimension Three-Level (EQ-5D-3L; EuroQoL Group, 1990; PV: Ferreira et al., 2014) and the validated Portuguese value set (Ferreira et al., 2014). The EQ-5D-3L consists of five items covering five dimensions of health: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Considering a 3-point response scale, participants were asked to indicate their own state of health (from “no problems” to “extreme problems”). The EQ-5D-3L is the most frequently used QoL measure when estimating QALYs (Wisløff et al., 2014), and has been previously used among women in the postpartum period (e.g., Jansen et al., 2007).

2.4. Methodological and statistical options

2.4.1. Data analysis of RCTs

2.4.1.1. Intention-to-treat principle

The intention-to-treat (ITT) principle implies that all randomized participants are included in the primary statistical analysis, regardless of protocol deviations, noncompliance, or dropout (Gupta, 2011). This means that every participant who was randomized is included in the analysis according to the groups to which they were originally assigned.

Excluding participants from an RCT can increase the risk of bias in a study (Abraha et al., 2015). Therefore, this method of analysis preserves the balance given by randomization by preventing bias and providing a secure foundation for statistical tests. A few studies have shown that participants who adhere to the intervention tend to do better than those who do not adhere (e.g., Horwitz et al., 1990). Analysis based on the ITT principle may also provide estimates of intervention effects that are more likely to mirror those observed in practice. If an intervention is found to present efficacy but a substantial number of participants did not adhere to the intervention, the analysis based on the ITT principle will underestimate the magnitude of the intervention effect (McCoy, 2017).

Another approach to analysis that can be followed is the “per protocol”. In this case, only participants who completed the intended intervention are included in the analysis. However, this approach only allows to understand the intervention efficacy among individuals who comply with it and it does not allow an unbiased evaluation of the true intervention effect. Thus, although the ITT approach might result in a more conservative estimate of the intervention effect, this method of analysis results in a more accurate estimate (McCoy, 2017).

2.4.1.2. Handling missing data

To follow the ITT principle, all individuals must be included in the analysis. However, in most RCT studies, missing values and dropouts are very common. This is particularly the case of web-based psychological interventions, where relatively high dropout rates have been consistently reported (Karyotaki et al., 2015). Therefore, it is important to choose the right method of analysis as missing data can reduce the efficiency of the study and lead to an unbalance between the study groups over time.

Missing data are usually grouped into three categories based on the reasons why participants drop out. Little and Rubin (2002) classified the missing value mechanisms as missing completely at random (MCAR; missing values are independent of both unobserved and observed outcomes of the variable being analyzed), missing at random (MAR; missing values depend on the observed data of the variable being analyzed but are independent of the unobserved outcomes of the variable being analyzed), and not missing at random (NMAR; missing values depend on the unobserved outcomes of the variable being analyzed). While MCAR and MAR can be considered “ignorable”, the missing mechanism NMAR is considered as “nonignorable” when analyzing longitudinal data.

When missing data is either MCAR or MAR, several *ad hoc* strategies for dealing with missing values are commonly used. Although there is not a recommended statistical strategy for ITT analyses of RCTs with missing data, linear mixed models (LMMs) have been shown to provide more powerful tests than using other methods, such as analysis of variance (ANOVA) after multiple imputation (Chakraborty & Gu, 2009; Xi et al., 2018).

LMMs are an important class of statistical models that can be used to analyze correlated data, as long as the missing data meets the MCAR or MAR assumptions. Mixed model data have a more complex, multilevel, hierarchical structure than other methods of analyzing longitudinal data, such as ANOVA. They are particularly useful in settings where repeated measurements are taken on the same statistical units and can handle missing and unbalanced data with minimal bias, thus meeting the ITT principle when analyzing the results of an RCT. In LMMs, all available values are

regressed over treatment and timepoint indicators, assuming some variance-covariance structure for the repeated measures. This type of model is becoming the standard analytic approach for examining longitudinal data, particularly RCT data (Mallinckrodt et al., 2008).

The term mixed model refers to the use of both fixed and random effects in the same model, which can be thought of hierarchically. One level for subjects (random effects) and another level for measurements within subjects (fixed effects). In more complex models, there can be more than two levels of the hierarchy. In sum, the fixed effects parameters tell how means differ between the different study groups, while the random effect parameters represent the general variability among subjects or other units.

2.4.2. Economic evaluations alongside RCTs

When an RCT points to the efficacy of an intervention, policy makers must also make the decision whether the intervention offers good value for the additional resources spent. To address this question, an economic evaluation alongside the RCT can be conducted. There are several ways to conduct an economic evaluation but one of the most common is a cost-effectiveness analysis (CEA). Overall, to conduct a CEA, costs and effects of an intervention should be determined and compared with the costs and effects of current practice or with the costs and effects of other interventions (Drummond et al., 2005).

There are no limits to what types of measures of effect can be used when performing a CEA. However, policy makers often have to compare between different interventions targeting different domains to make a decision. Consequently a measure of effect that can be used across different areas is particularly useful, and the measure that has so far gained widest use is the quality-adjusted life-year (QALY) (NICE, 2013). QALYs are an economic outcome that combine survival measured in terms of life-years and quality of life into a single measure. QALYs typically assign to each period of time a weight corresponding to the quality of life during that period. The weight ranges between 0 (death) and 1 (perfect health). Because the weights placed on particular health states are referred to as utilities, CEA which measure outcomes in terms of QALYs are sometimes referred to as cost-utility studies (Drummond et al., 2005).

Another key consideration to be taken in CEA concerns the perspective adopted for the analysis (e.g., societal, payer, government). The perspectives most commonly used are the payer, which is often the public healthcare service, and societal. The identification and valuation of costs will depend on the perspective taken. From a healthcare perspective, it is important to include all healthcare costs within the time horizon adopted for the analysis. The societal perspective involves all costs regardless of who incurs them (e.g., costs related to informal care, opportunity costs

related to time spent in an intervention or costs to employers in the form of productivity losses). Questions related to health care use often include medical consultations, medication use or hospitalizations. Costs stemming from productivity losses often include absenteeism (i.e., absence from work) and presenteeism (i.e., lost productivity occurring when working while not feeling well).

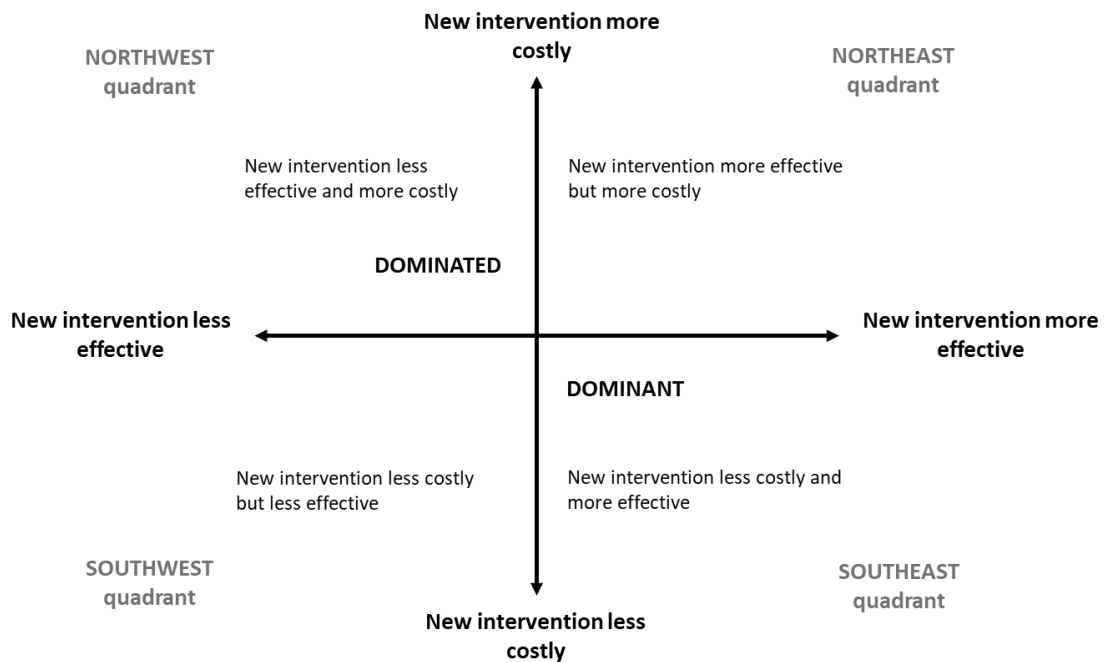
Regarding the statistical analyses for economic evaluations, a probabilistic decision-making approach is often used rather than a hypothesis-testing approach (Briggs & O'Brien, 2001). A greater focus is given to the estimation of the central parameter of interest, the incremental cost-effectiveness ratio (ICER), along with the representation of the uncertainty surrounding that estimate. The ICER indicates the costs required for an additional measure of effect, based on the formula

$$ICER = \frac{Cost_{intervention} - Cost_{control}}{Effect_{intervention} - Effect_{control}}$$

Therefore, in the cases where QALYs are used as the measure of effect, the ICER represents the costs per QALY gained.

To investigate the uncertainty around the ICER, bootstrapping is commonly performed. Bootstrapping is a statistical procedure that resamples a single dataset to create many simulated samples. In CEA studies, this method can be used to create new samples by generating values at random from cost–effect pairs from the original data with replacement (Gray et al., 2011). Once a sufficient number of bootstrap ICERs (e.g., 1000) have been recorded, each cost and effect difference can be plotted on a cost-effectiveness plane to give a non-parametric estimate of the joint density of cost and effect differences. **Figure 4** shows the graphic representation of the cost-effectiveness plane.

Figure 4. The quadrants of the cost-effectiveness plane



If the ICER estimate and associated uncertainty fall in the southeast quadrant, the intervention is considered acceptable (lower costs and higher effects). On the other hand, the intervention is considered unacceptable from a cost-effectiveness perspective if the ICER falls in the northwest quadrant (higher costs and lower effects). In case the intervention is considered to generate superior effects at greater costs (northeast quadrant) or lower effects at lower costs (southwest quadrant), the cost-effectiveness of the intervention depends on how much society is willing to pay for a certain gain in effect. Additionally, to deal with the uncertainty inherent in cost-effectiveness analysis, results are also frequently presented in the form of a cost-effectiveness acceptability curve (CEAC). A CEAC presents the probability that an intervention is cost-effective compared with the alternative for a range of values that a decision-maker might be willing to pay for a particular unit change in outcome.

Finally, sensitivity analysis should be given careful attention as they are an important step in CEA studies to examine the extent to which changes in cost or effect values affect conclusions. The need for sensitivity analysis arises because of a number of factors, such as methodological issues arising from different approaches and methods employed in the evaluation of costs and effects, potential variation in the estimates of costs and effects used in the evaluation, and extrapolation and generalizability from observed events over time to final health outcomes. For

instance, if there is uncertainty regarding the cost of a drug used in a study, sensitivity analysis should recalculate the ICER using high and low values of that drug to examine the extent to which differences in costs affect the conclusions. In another example, if missing data in the study is substantial, different methods of missing data imputation can be tested in sensitivity analysis. In sum, sensitivity analyses can test the assumptions used in the model to reduce the uncertainty and assess how robust the results are.

Overall, CEA provides a method for prioritizing the allocation of limited resources to interventions with potential to yield the greatest improvement in health for the least resources. While CEA may not, by itself, provide sufficient information to inform all policy decisions, it can be a useful starting point.

2.5. Ethical considerations

All ethical requirements were followed to conduct the empirical studies presented in the current dissertation. The procedures adopted during the conception and implementation of the present research project, as well as on the dissemination of the results, were conducted in compliance with important national (Order of Portuguese Psychologists; Regulation number 258/2011, April 20th, 2011, revised in 2016) and international (the American Psychological Association ethical principles regarding research with human participants; American Psychological Association, 2017; and the World Medical Association declaration of Helsinki; 1964, as revised in 2013) ethical principles regarding research with human participants. While these professional associations encourage medical and psychological research with human beings to better understand the causes, development and impact of illness and to improve interventions, they emphasize the importance of any research work to prioritize the rights, dignity and primary interest of the participants over the research objectives. Thus, the following fundamental ethical principles for research with human beings were considered in the conceptualization and implementation of our research project and in the publication and dissemination of results: the general principle of Beneficence and Non-maleficence, which compels researchers to seek to benefit the participants by safeguarding their welfare and ensuring that the research procedures do not cause them any physical or psychological harm; the general principle of Respect for People's Rights and Dignity, which states that researchers must respect the rights of the participants to privacy, confidentiality and self-determination; the general principles of Integrity and Social Responsibility towards the production and reporting of accurate, honest and truthful scientific knowledge that may contribute to the improved health and wellbeing of the targeted populations; and the general principle of Competence, which states that psychologists should only conduct research with populations and

scientific areas within the boundaries of their competence and advises researchers to undertake specialized and constantly updated theoretical and practical training.

During the conception phase of the research project, and following the principle of beneficence and non-maleficence, the research team reflected about the relevance of the objectives of the research, the consistency of the methodological options and the potential risks and benefits for participants. When necessary, specific literature was reviewed and the discussion of these topics was extended with other health professionals involved in the project and with other researchers from the RD&H research group. Accordingly, decisions were made regarding research procedures, namely on the length and burden related to the assessment protocols, given the limited availability of the postpartum period. Therefore, the data sheets and questionnaires included in the research protocol aimed to gather the information strictly necessary to accomplish the research goals and the collection of redundant and superfluous information was avoided. The assessment instruments were carefully selected, favoring, whenever available, their brief versions. After this process, the assessment protocol, together with the detailed research project, was submitted for consideration and was approved by the Ethics Committee of the FPCE-UC.

Ensuring the ethical principle of Competence, it should be noted that all researchers involved in the process were qualified to conduct it, with an academic degree in Clinical Psychology. Additionally, all researchers involved in the research project were competent in the specific scientific area of this study, with previous experience in clinical practice with perinatal women. Moreover, the ethical principle of Competence was accomplished during the conception of the research project through the participation of the researchers in conferences, short-length courses and workshops, the study of relevant literature to improve conceptual and methodological knowledge, and the discussion of the research objectives and procedures with members of the research group RD&H.

After obtaining ethical approval, the data collection phase took place complying with the procedures previously described in the proposal and taking into account the general principle of Respect for People's Rights and Dignity. Participants were provided with information about the research, specifically about: the relevance of the research project and its objectives; inclusion and exclusion criteria; procedures and expected duration of the data collection (specifying the assessment points of the study and the timings they could expect to be contacted by the research team); risks and benefits of the study; voluntary participation without financial compensation; confidentiality of their responses and collective analysis of the data; the right to access, change, delete and limit the processing of their data or revoke their consent by contacting the project researchers; the right to withdraw at any time of the study without penalty; the researchers' role, including their ethical obligations, institutional affiliations and contacts; and the funding sources of the research project. Participants who agreed with these terms, were asked to give their informed

consent to participate in the study. In this research project, the informed consent sought to respect the value of participants' autonomy and comply with the following standards: the disclosure of research information, comprehension of the information (knowledge of study goals, risks, benefits, and requirements), the voluntariness with respect to the decision, free from coercion, and expressed authorization (in the current research project, this was done by clicking on the option "I understand and accept the conditions of the study"). During research phase II, participants were also informed of the randomization procedure and assignment into two different study groups. Randomization was assured by a different researcher from the one responsible for enrollment and assignment of the participants to the study groups. This researcher had no information about the participants except from their code. At the end of the pilot trial, participants in the control group were offered the opportunity to access Be a Mom. Moreover, during the RCT, participants who did not meet inclusion criteria were given feedback to the reasons why they would not be included in the clinical trial. Participants who were excluded from the study for presenting a serious medical condition (physical or psychiatric) were provided with contact information to seek specialized treatment. Throughout the research process, the team of researchers was available (via email or telephone contact) to clarify doubts about general aspects of the research or the intervention.

Finally, the results of the research were disseminated among the scientific community (through the publication of papers in international scientific peer reviewed journals and the presentation of oral and poster communications at national and international scientific meetings) according to the international parameters of scientific dissemination and following the ethical standards of integrity and social responsibility. The data analyses and dissemination of our results were conducted with accuracy, honesty and truthfulness. The results were derived from original and not fabricated data and results not presenting statistical significance were shared with the scientific community. Because the datasets of the empirical studies contained information that could compromise the privacy of research participants, they were not made publicly available. However, in all empirical studies information is given that the datasets are available upon reasonable request. Furthermore, in each empirical study, the limitations that could compromise the results of that particular study were listed in detail.

To comply with the CONSORT 2010 guidelines (Schulz et al., 2010) and prevent from selective reporting of results, the RCT was registered in ClinicalTrials.gov (NCT04055974) prior to its implementation.

In the empirical studies, all third-party ideas that were cited were appropriately attributed to the original authors, in order to avoid plagiarism. The authorships of the empirical studies were defined according to the relative scientific or professional contributions of the researchers involved in any research phase, regardless of their relative status. The sources of funding, institutional

affiliations and conflicts of interest were stated in each empirical study. The main findings of our research are available on the webpage of the Research Centre (<https://cineicc.uc.pt/publications/>) and of the research group RD&H (https://www.fpce.uc.pt/saude/artigos_internacionais.html).

Chapter III

Empirical Studies

EMPIRICAL STUDY I

Measuring positive mental health in the postpartum period: The bifactor structure of the Mental Health Continuum–Short Form in Portuguese women

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Measuring positive mental health in the postpartum period: The bifactor structure of the Mental Health Continuum–Short Form in Portuguese women

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Abstract

This study aimed to investigate the factor structure of the Mental Health Continuum–Short Form (MHC-SF) in the postpartum context using a single-factor model, a correlated three-factor model, and a bifactor model. The reliability and validity of the MHC-SF were also examined. The total sample consisted of 882 postpartum Portuguese women. Confirmatory factor analysis showed that the bifactor model yielded a significantly better fit to the data than the other models. The unidimensionality strength indices (explained common variance = .76, percentage of uncontaminated correlations = .69) and the ω_H values supported the general factor of positive mental health, which accounted for 91.5% of the reliable variance in the total score. Additionally, the MHC-SF showed high reliability ($\omega = .96$), and its total and subscale scores were significantly correlated with other measures related to mental health. The results of this study suggest a strong general factor of positive mental health and support the use of its total score in this context.

Keywords: Mental Health Continuum–Short Form, bifactor model, confirmatory factor analysis, psychometric properties, postpartum period

Background

Although commonly portrayed as happy and joyous, the postpartum period represents a major and challenging transition for most women (Emmanuel & St John, 2010; Winson, 2017). Women in the postpartum period often experience a wide range of stressors, from emotional, physical, and social challenges (e.g., Kanotra et al., 2007; Woolhouse et al., 2012; Woolhouse et al., 2014) to financial strains and difficulties in balancing work and family demands (e.g., Grice et al., 2007; Nowak et al., 2013). This may result in an increased vulnerability to mental illness, even in low-risk women (Murphey et al., 2017). Moreover, there is substantial evidence demonstrating a significant long-term negative impact of perinatal mental illness on the child's cognitive, social, emotional, and physical development (e.g., Kingston et al., 2012; O'Donnell et al., 2014; Stein et al., 2014), with a significant economic burden to society (e.g., Bauer et al., 2016; Ladd et al., 2017).

Accordingly, there has been increasing interest in reducing the human and economic costs associated with perinatal mental illness through its effective treatment and prevention (Sockol, 2015; Sockol et al., 2013). However, the demanding changes experienced by women during this period and their recognized impact are often viewed solely from a mental illness perspective (absence vs. presence of mental illness) rather than from a complete mental health approach (i.e., considering both mental illness and positive mental health), which limits a better understanding of what contributes to and enhances women's mental health. Apart from recent contributions (e.g., Bassi et al., 2017; Corno et al., 2018), the study of positive mental health during this period and the development of interventions focused on the promotion of positive aspects of mental health are still underdeveloped.

In recent decades, the view of mental health as merely the absence of mental illness has changed considerably. The World Health Organization (WHO) has long considered the positive aspects of mental health, stating that mental health is a "state of wellbeing in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (WHO, 2004, p. 12). Integrating the advances made in wellbeing research, Keyes (2002) proposed the two-continua model of mental health. From this perspective, mental health is best viewed as a complete state consisting not only of the absence of mental illness but also of the presence of positive dimensions of mental health, namely, emotional, psychological, and social well-being (Keyes, 2002). This model has been supported by several studies in both general and clinical samples (e.g., Lamers et al., 2015; Trompetter et al., 2017; Westerhof & Keyes, 2010), and the presence of positive mental health has been associated with better psychosocial functioning, better physical health outcomes, less use of health care services, and less missed days of work (e.g., Keyes, 2002, 2005). Considering the

benefits associated with positive mental health, it seems essential to include its assessment when evaluating women's psychological adjustment to the postpartum period.

Assessing positive mental health: The Mental Health Continuum Short-Form

Keyes (2002) created the Mental Health Continuum–Long Form (MHC-LF) as a comprehensive and multidimensional measurement of positive mental health. The MHC-LF comprises 40 items that were developed based on a tripartite conception of positive mental health as emotional, psychological, and social well-being, also reflecting the definition given by the WHO (2004). Subsequently, the MHC–Short Form (SF) was adapted from the long form to create a version that could be more efficiently administered (Keyes et al., 2008), which has been widely used. The MHC-SF consists of 14 items assessing three dimensions: emotional well-being (three items measuring positive affect/satisfaction with life); social well-being (five items comprising social acceptance, social contribution, social coherence, social actualization, and social integration); and psychological well-being (six items comprising purpose in life, positive relations with others, self-acceptance, autonomy, personal growth, and environmental mastery).

The original psychometric study of the MHC-SF was carried out in South Africa and was later expanded in the Netherlands (Keyes et al., 2008; Lamers et al., 2011). Both studies supported a three-factor structure of the MHC-SF and found the instrument to be both reliable and valid. The MHC-SF has been translated into different languages, and several validation studies across multiple cultural contexts have also found evidence supporting its utility, validity, and reliability (e.g., Poland: Karaś et al., 2014; Korea: Lim, 2014; Argentina: Lupano Perugini et al., 2017; Italy: Petrillo et al., 2015). Concerning the MHC-SF factor structure, the majority of studies confirmed its correlated three-factor structure of emotional, social, and psychological well-being (e.g., Franken et al., 2018; Lupano Perugini et al., 2017; Petrillo et al., 2015). However, some of these studies pointed out the high correlations (r above .80) found between the MHC-SF dimensions. Indeed, despite founding evidence of a three-factor structure, Franken et al. (2018) suggest caution in differentiating between the three dimensions of the MHC-SF.

Recently, some studies examined the factor structure of the MHC-SF by investigating competing models and found evidence that the structure of the MHC-SF was better explained by a bifactor model (e.g., de Bruin & du Plessis, 2015; Echeverría et al., 2017; Jovanović, 2015). The use of a bifactor model has been recommended to investigate multidimensional and complex constructs, which comprise different dimensions that are moderately associated (Reise et al., 2013). This type of measurement model allows us to investigate the presence of a general factor and the degree to which each domain-specific factor is significantly distinct from the general factor (Reise et al., 2013). Therefore, it is plausible to consider whether the MHC-SF comprises a general factor

(i.e., positive mental health) that accounts for the commonality shared by its dimensions or whether it is best represented as domain-specific factors (emotional, social, and psychological well-being) that account for the unique influence of the specific dimensions over and above the general factor. Jovanović (2015) found that the MHC-SF was better explained by a bifactor model than by a correlated three-factor model in two samples of Serbian undergraduate students and adults. The same results were found by de Bruin and du Plessis (2015) and Echeverría et al. (2017) in a sample of South African students and Chilean adults, respectively. In these studies, the general factor accounted for a larger proportion of variance in the items, and only the general factor exhibited adequate reliability.

The current study

Due to the inconsistent findings regarding the structure and dimensionality of the MHC-SF, the aim of this study was to extend previous research into the reliability and factor structure of the MHC-SF by using a bifactor model. Specifically, the first goal of this study was to explore whether the bifactor model provides a better fit than a single-factor model or a correlated three-factor model. The second goal was to examine the reliability and validity of the MHC-SF scores to establish the psychometric robustness of the MHC-SF. To the best of our knowledge, this is the first study examining the reliability and validity of the MHC-SF in a sample of postpartum women. The measurement of positive mental health during this period can contribute to a more comprehensive understanding of women's psychological adjustment to this period, and it should better inform the development of more effective interventions in clinical practice.

Methods

Participants and procedure

Women in the postpartum period (0-12 months) aged 18 years or older were invited to participate in the study. Data were collected through an online survey (LimeSurvey®) placed on the website of the Faculty of Psychology and Educational Sciences, University of Coimbra, and a link to the survey was posted on social media websites (Facebook and Instagram). The tagline to advertise the study was the following:

Are you a mother who had a baby in the last 12 months? We would like to ask for your help on this research focused on the psychological well-being of mothers in the postpartum period. Please click on the link below to find more information about this study.

The enrolment in the study occurred between August and November 2018. Informed consent was obtained from all participants (by clicking on the option “I understand and accept the conditions of the study”) after information was given about the study’s goals and the voluntary and anonymous nature of participation. The ethical committee of the Faculty of Psychology and Educational Sciences, University of Coimbra approved all the procedures of sample recruitment and data collection.

In total, 903 women gave their consent to participate in the study. However, 21 women were removed from the sample due to having an infant older than 12 months. The final sample of this cross-sectional study consisted of 882 postpartum Portuguese women with a mean age of 31.97 years ($SD = 4.78$; range 18-45 years). Infants were aged between 0 and 12 months ($M = 5.56$; $SD = 3.32$), and this was the first child for most women ($n = 569$; 64.5%). The majority of women were married/living with a partner ($n = 804$; 91.1%), were employed ($n = 715$; 81.1%), had completed higher education ($n = 555$; 62.9%), and belonged to a medium socioeconomic status ($n = 750$; 85%). In addition, 63.2% ($n = 557$) of women were still on maternity leave and had not returned to work. In our sample, 25.5% ($n = 225$) of women reported having a prior history of psychopathological problems.

Measures

Sociodemographic (e.g., age, marital status, education, and infant’s age) and clinical data (e.g., prior history of psychopathological problems) were collected through a self-report questionnaire developed by the authors.

Positive mental health was measured using the MHC-SF (Keyes et al., 2008). This questionnaire consists of 14 items divided into three dimensions: emotional (three items, e.g., “During the past month, how often did you feel happy?”), social (five items, e.g., “During the past month, how often did you feel that you belonged to a community?”), and psychological well-being (six items, e.g., “During the past month, how often did you feel that you had experiences that challenged you to grow and become a better person?”). Each item is rated on a 6-point response scale from 0 (*never*) to 5 (*every day*) in reference to the last month. The MHC-SF can be scored continuously (scores range from 0 to 70, and higher scores indicate better positive mental health) or categorically considering mental health status (flourishing, moderate mental health, languishing). According to the author of the MHC-SF, the items of this measure can be seen as symptoms that may diagnose different categories of positive mental health (Keyes et al., 2008). Thus, individuals who answered every day or almost every day at least once in the emotional well-being subscale and at least six times in the psychological and social wellbeing subscales were categorized as flourishing;

individuals who answered never or once or twice for at least one item in the emotional well-being subscale and at least six items in the psychological and social well-being subscales were categorized as languishing; and individuals who did not fit the criteria for either flourishing or languishing were considered moderately mentally healthy.

The Satisfaction With Life Scale (SWLS; Diener et al., 1985; Portuguese Version [PV]: Neto, 1993) was used to measure global life satisfaction. The SWLS is composed of five items (e.g., “So far I have gotten the important things I want in life.”) rated on a 7-point response scale from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher scores denoting a higher satisfaction with life. The Portuguese version of the SWLS has demonstrated adequate internal consistency ($\alpha = .78$). In our sample, the Cronbach’s alpha was .89.

Quality of life was measured with the EUROHIS-QOL eight-item index (Schmidt et al., 2006; PV: Pereira et al., 2011). Each of the eight items has an individualized 5-point response scale, and scores range between 0 and 100, with higher scores indicating better quality of life. The Portuguese version has demonstrated good values of internal consistency ($\alpha = .81$) across different population groups (Pereira & Canavarro, 2015). In our sample, the Cronbach’s α was .86.

The Resilience Scale (Wagnild, 2009; PV: Pinheiro & Matos, 2013) was used to assess resilience. This scale comprises 14 items (e.g., “I feel like that I can handle many things at a time.”) scored on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores indicate a greater ability to respond with resilience. The Portuguese version of the RS-14 has been shown to be reliable and valid across multiple studies (e.g., Oliveira et al., 2015; Pinheiro & Matos, 2013). In our sample, the Cronbach’s α was .92.

Maternal confidence was measured with the Maternal Confidence Questionnaire (Parker & Zahr, 1985; PV: Nazaré et al., 2013). The Maternal Confidence Questionnaire comprises 13 items (e.g., “I feel satisfied with my role as mother”) answered on a 5-point response scale ranging from 1 (*never*) to 5 (*always*). Higher scores indicate higher perceived maternal competence. High internal consistency ($\alpha = .88$) has been demonstrated for the Portuguese version. In our sample, the Cronbach’s α was .84.

The Edinburgh Postnatal Depression Scale (PV: Areias et al., 1996; Augusto et al., 1996; Cox et al., 1987) is a 10-item self-report questionnaire of depressive symptoms in the perinatal period. In each item, participants are asked to indicate one of four individualized responses that are rated from 0 to 3. The total score ranges between 0 and 30, and higher scores are indicative of more severe depressive symptoms. In Portuguese validation studies, good internal consistency was found ($\alpha = .85$). In our sample, the Cronbach’s α was .89.

Data analyses

Statistical analyses were performed with the *Statistical Package for the Social Sciences* (IBM SPSS, Version 23.0) and with *Mplus 7.4* (Muthén & Muthén, 2012).

Descriptive statistics were first calculated to explore the sample's sociodemographic and clinical characteristics. Confirmatory factor analyses (CFAs) using the robust maximum likelihood estimation method were performed to examine the best-fitting model for the MHC-SF, because Mardia's test indicated that our data violated the multivariate normality assumption (Mardia's kurtosis = 106.70, $p < .001$). Based on the theoretical background regarding positive mental health and previous research, three models of the MHC-SF were tested: (a) the single-factor model, (b) the correlated three-factor model, and (c) the bifactor model (Figure 1).

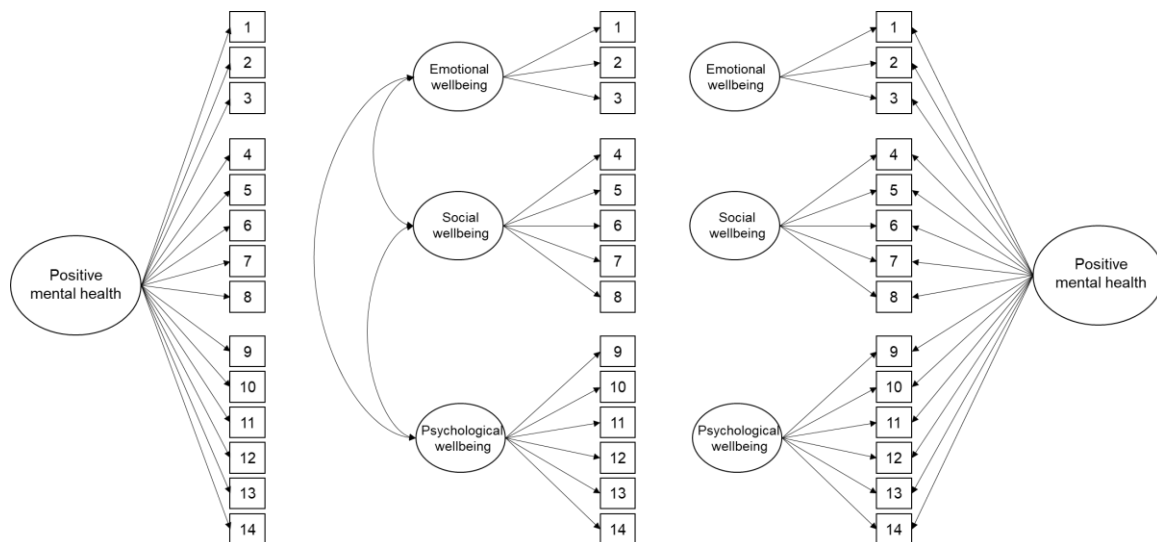


Figure 1. Single-factor, correlated three-factor, and bifactor models of the MHC-SF.

The goodness of fit of the CFA models was assessed using several indices. To indicate a good fit, the chi-square index (χ^2) should be nonsignificant, which is rarely obtained when the sample is large (Van de Schoot et al., 2012). Therefore, other fit indices were considered: a good model fit is also indicated by comparative fit index values above .95, root mean square error of approximation values of .06 or lower, and standardized root mean square residual values of .10 or lower (Hu & Bentler, 1999). To compare the models, $\Delta\chi^2$ (with a significant difference between the χ^2 scores indicating that the model with the lowest χ^2 presents a better fit) and Akaike information criterion values (with the lowest values being indicative of a better fit; Kline, 2011) were used.

Factor loadings for the single-factor model, the correlated three-factor model, and the

bifactor model were examined. Factor loadings of .32 or above were considered meaningful (Tabachnick & Fidell, 2007). Similar factor loadings of the general factor in the bifactor model when compared with the single-factor model and lower factor loadings on the domain-specific dimensions in the bifactor model compared with the correlated factor model suggest a high influence of the general factor and that the specific dimensions have minor influence on the variance in the items (e.g., Zwaanswijk et al., 2017).

Additionally, explained common variance (ECV; i.e., the proportion of all common variance explained by the general factor) and the percentage of uncontaminated correlations (PUC) were computed to investigate the degree of unidimensionality of the total score of the general factor. In conjunction with the ECV, the PUC is useful in determining whether considering a unidimensional model will not lead to biased parameter estimates (Rodriguez et al., 2016b). Higher ECV values indicate little common variance beyond the variance accounted for by the general factor (Reise et al., 2013).

To evaluate reliability, McDonald's (1999) omega coefficients (ω), omega hierarchical (ω_H), and relative omega (ω_H/ω) were calculated. The standardized estimates from the bifactor model were used to compute both coefficients: the ω index reflects an estimate of the amount of variance in total (or domain-specific) scale scores due to all sources of common variance and corresponds to internal consistency, while the ω_H coefficient reflects how precisely the proportion of a total scale score variance is attributed to the general or domain-specific factors. An ω_H value greater than .50 and closer to .75 is suggestive of factor strength (Reise et al., 2013). The relative omega (ω_H/ω) corresponds to the percentage of reliable variance in the multidimensional total score that is due to the general factor and the percentage of reliable variance in the subscale scores that is independent from the general factor.

Factor determinacy (FD) and construct replicability (H index) were calculated to determine the adequacy of the model. High scores of FD (>.90) suggest that individual differences on the factor score estimates are good representations of true individual differences on the factor. The H index refers to how well a set of items represents a latent variable, and high values (>.80) suggest a well-defined latent variable that is more likely to be stable across studies (Rodriguez et al., 2016a).

To provide evidence of the validity of the MHC-SF scores and the categories of positive mental health proposed by Keyes et al. (2008) in relation to other measures, Pearson correlations were examined. Effect sizes were presented for all analyses (small effect: $r = .10$; medium effect: $r = .30$; large effect: $r = .50$; Cohen, 1992).

Results

Confirmatory Factor Analysis

A summary of the three competing models is shown in **Table 1**. The single-factor model presented a poor fit to the data. Although the correlated three-factor model presented an acceptable fit to the data, the bifactor model fit the data noticeably better ($\Delta\chi^2(10) = 147.91, p < .001$).

Table 1. Fit statistics for the confirmatory factor analyses

Model	χ^2 (df)	p	CFI	RMSEA (90% CI)	AIC
Single-factor	1136.956 (77)	<.001	.814	.125 (.119-.131)	34138.708
Correlated three-factor	446.599 (74)	<.001	.935	.076 (.069-.082)	33082.092
Bifactor	298.685 (64)	<.001	.959	.064 (.057-.072)	32875.563

Note. CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; AIC= Akaike Information Criterion

Latent factor intercorrelations

Regarding the correlated three-factor model, significant and high latent factor intercorrelations were found. The highest factor intercorrelation was between emotional and psychological wellbeing ($r = .83, p < .001$), followed by psychological and social wellbeing ($r = .77, p < .001$) and emotional and social wellbeing ($r = .67, p < .001$).

Factor loadings and dimensionality

Table 2 presents the standardized factor loadings of the three models tested. Considering the bifactor model, all items loaded strongly and significantly ($p < .001$) in the general factor, ranging between .635 and .870. These values were similar to those in the single-factor model. On the other hand, loadings on the emotional, social and psychological wellbeing dimensions were significantly lower in the bifactor model than in the correlated three-factor model. In the bifactor model, all factor loadings were higher on the general factor compared with the domain-specific factors. Indeed, regarding the domain-specific factors, several items had nonmeaningful loadings ($< .32$), and in the case of item 14, no significance was found, which suggests that a large proportion of the variance of the items was explained by the general factor.

In addition, the values of the unidimensionality strength indices (ECV = .82, PUC = .69) indicated that the general factor explained a relatively large proportion of the variance of the items (approximately 82% of the common variance). Accordingly, acceptable values of FD and the H-index were only found for the general factor. Taken together with the factor loadings from the tested

models, these results suggest that the MHC-SF has a strong general factor.

Table 2. Factor loadings for the single-factor, correlated three-factor and bifactor models

Item	Single-factor	Three-factor			Bifactor			
	Positive mental health	EWB	SWB	PWB	Positive mental health (general)	EWB	SWB	PWB
1	.739***	.847***			.844***	.361***		
2	.770***	.844***			.848***	.255***		
3	.806***	.902***			.870***	.322***		
4	.775***		.718***		.822***		.143***	
5	.687***		.713***		.718***		.265***	
6	.695***		.867***		.685***		.572***	
7	.683***		.839***		.668***		.572***	
8	.659***		.829***		.635***		.609***	
9	.785***			.799***	.801***			.246***
10	.719***			.755***	.750***			.298***
11	.751***			.777***	.762***			.339***
12	.721***			.747***	.741***			.303***
13	.769***			.805***	.809***			.250***
14	.789***			.806***	.854***			.098
				ECV	.820	.120	.308	.103
				Factor determinancy	.966	.674	.871	.631
				H-index	.960	.251	.624	.319
				ω	.971	.936	.926	.930
				ω_H	.909	.111	.253	.089
				Relative Omega	.937	.118	.273	.096

Note. EWB = emotional well-being; SWB = social well-being; PWB = psychological well-being.

*** $p < .01$.

Reliability

In the present sample, high reliability was found both for the general factor ($\omega = .97$) and for the emotional ($\omega = .94$), social ($\omega = .93$) and psychological wellbeing ($\omega = .93$) dimensions (see Table 2). However, only a small amount of reliable variance was left within the subscales once the general factor was controlled statistically. The ω_H of the domain-specific factors ranged from .09 (psychological wellbeing) to .25 (social wellbeing), while the ω_H of the general factor remained high ($\omega_H = .91$), accounting for 93.7% of the reliable variance in the total score.

Categories of positive mental health and convergent validity

In our sample, and based on the criteria by Keyes et al. (2008), the majority of women were flourishing ($n = 494$; 56%). Moreover, 4.1% ($n = 36$) of women were languishing, and 39.9% ($n = 352$) had moderate mental health. Pearson correlations between MHC-SF total/subscale scores and other measures related to mental health are reported in Table 3. Correlations between the presence of flourishing (vs. not flourishing) and other measures related to mental health are also presented.

Higher scores in the MHC-SF and the presence of flourishing were significantly and largely associated with higher satisfaction with life, higher quality of life and higher resilience. A significant association was also found between lower postpartum depressive symptoms and higher scores on the MHC-SF, as well as the presence of flourishing. Although also significantly associated, higher levels of maternal confidence were only moderately correlated with higher scores on the MHC-SF total/subscales and the presence of flourishing.

Table 3. Pearson's bivariate correlations between the MHC-SF total and subscales scores, presence of flourishing and other variables related to positive mental health and mental ill-health

	MHC-SF total	MHC-SF Emotional wellbeing	MHC-SF Social wellbeing	MHC-SF Psychological wellbeing	Flourishing
Satisfaction with life	.69**	.66**	.59**	.63**	.51**
Quality of life	.70**	.68**	.58**	.67**	.53**
Postpartum depressive symptoms	-.70**	-.74**	-.56**	-.65**	-.51**
Resilience	.65**	.58**	.51**	.68**	.54**
Maternal confidence	.35**	.28**	.25**	.40**	.31**

Note. **p<.01; MHC-SF = Mental Health Continuum-Short Form; Flourishing: [0 = Absence of flourishing, 1 = Flourishing]

Discussion

The main goal of the present study was to examine the factor structure of the MHC-SF in a sample of postpartum women and to determine whether this instrument was best represented by a single-factor, a correlated three-factor or a bifactor model. Confirmatory factor analysis showed that a bifactor model provided a better fit to the data than the competing models. This finding is consistent with the results demonstrated in previous studies in general samples (de Bruin & du Plessis, 2015; Echeverría et al., 2017; Jovanović, 2015), supporting the bifactor structure of the MHC-SF. Moreover, the results of our study support a general positive mental health factor that is reliably measured by the MHC-SF total score, and that separately calculating the subscale scores of the MHC-SF is questionable. This is supported by different results, which will be discussed below.

First, high intercorrelations were found among the latent factors in the correlated three-factor model. This is congruent with previous research using the MHC-SF (e.g., Franken et al., 2018), and highlights the interrelatedness of these dimensions, reinforcing the use of the MHC-SF total score. Moreover, omega indices showed high reliability for both the general factor of the MHC-SF and the dimensions of emotional, social and psychological wellbeing. However, after controlling

for the variance associated with the general factor, the three dimensions explained little variance beyond that explained by the general factor, which is congruent with the results found in previous studies (e.g., Jovanović, 2015). Indeed, values ranged from .09 in the psychological wellbeing dimension to .25 in the social wellbeing dimension, which are below the threshold of .50 recommended by Reise et al. (2013) to consider a subscale a valid representation of a separable dimension. Thus, although the dimensions do explain some variance over and above the general factor, this is not sufficient to warrant the use of the subscale scores.

Additionally, standardized factor loadings were similar between the single-factor model and the general factor from the bifactor model. In turn, there was a noticeable difference between loadings on the specific factors in the bifactor and the correlated three-factor model. Overall, this result is in line with previous research on the bifactor structure of the MHC-SF (e.g., Echeverría et al., 2017; Jovanović, 2015). However, we found differences in the factor loadings from other studies. Specifically, although the overall pattern of the loadings is similar to our findings (e.g., social wellbeing items loaded lower in the general factor), we found generally higher loadings in the general factor and lower loadings in the domain-specific factors when comparing with the results from other studies (de Bruin & du Plessis, 2015; Jovanović, 2015). This suggests that the items of the MHC-SF may function differently in women with infants when comparing to general population samples. Our results also showed a greater percentage of flourishers when comparing to previous findings (Karaš et al., 2014; Keyes et al., 2008; Petrillo et al., 2015). It has been previously suggested that the transition to parenthood is associated with a boost in life satisfaction with relatively higher levels of positive emotions and meaning in life (Dyrdal & Lucas, 2013; Nelson, Kushlev, English, Dunn, & Lyubomirsky, 2013). The higher percentage of flourishers could also be explained by the characteristics of the sample of this study. Most participants were in a relationship, employed and had completed higher education and these sociodemographic characteristics have been suggested as predictors of flourishing (Schotanus-Dijkstra et al., 2016; Westerhof & Keyes, 2010). Moreover, external influences, such as parental leave policy, could have an influence on our results and the majority of the participants of our study were still on maternity leave at the time of data collection. A recent UNICEF report suggests that Portugal is among the countries with friendlier family policies (Chzhen, Rees, & Gromada, 2019), since parents can have up to 180 days of fully paid shared parental leave. It has been suggested that longer parental leaves could facilitate work-family balance and are associated with higher life satisfaction and positive affect (Grice et al., 2007).

Finally, the values of the unidimensionality strength indices indicate that the general factor explains approximately 82% of the common variance. According to Reise et al. (2013), this value suggests that the MHC-SF can be considered as primarily unidimensional. However, stating that the MHC-SF is unidimensional and that it measures a single variable needs further research and

clarification, as the domain-specific factors presented different results. Indeed, the social wellbeing subscale presented a higher ω_H (.25), H-index (.62) and ECV (.31), specifically when compared with the psychological wellbeing subscale ($\omega_H = .09$; H-index = .32; ECV = .10). This indicates that the social wellbeing dimension is the most distinct of the three factors, as it captures a more substantial proportion of specific variance. In contrast, the results of the psychological wellbeing subscale suggest that this dimension almost overlaps with the general factor of positive mental health. Thus, further research is needed to determine the (uni)dimensionality of the MHC-SF.

The convergent validity of the MHC-SF among women in the postpartum period was supported by the results of the correlations between the MHC-SF and other measures. The MHC-SF total and subscale scores were significantly associated with other relevant constructs related to positive aspects of mental health, specifically satisfaction with life, quality of life, resilience and maternal confidence. Additionally, postpartum depressive symptoms were negatively correlated with the MHC-SF total score and with its three dimensions. These findings are congruent with those found in other psychometric studies of the MHC-SF (e.g., Guo et al., 2015; Keyes et al., 2008). Nevertheless, they add to the existing research on the validity of the MHC-SF by including variables more specific to the psychological adjustment to the postpartum period, such as postpartum depressive symptoms and maternal confidence. This supports the use of the MHC-SF as a valid instrument to measure positive mental health among postpartum women. Furthermore, our results also showed that the presence of flourishing (vs. not flourishing) was significantly associated with higher levels of satisfaction with life, quality of life, resilience, maternal confidence and lower levels of postpartum depressive symptoms. This is congruent with findings in general samples (e.g., Petrillo et al., 2015) and suggests that postpartum women who are flourishing function better than those who are not. Although the literature is still scarce, a few studies have shown that flourishing individuals have better psychosocial functioning (i.e., higher resilience, lower perceived helplessness, clearer goals in life; Keyes, 2005), higher levels of conscientiousness and extraversion and lower levels of neuroticism (Schotanus-Dijkstra et al., 2016).

Our study also highlights the relevance of validating positive mental health measures in the postpartum period. Many generic measures have not been tested in this context, and certain psychometric properties may not apply to the unique nature of this period (Meades & Ayers, 2011). Additionally, there is a substantial lack of research concerning positive mental health in perinatal women. Although the measurement of psychopathology in this context is relevant to promptly identifying at-risk women, adding the assessment of positive mental health may provide a more comprehensive knowledge of the psychological adjustment to this period. Indeed, there has been increasing evidence showing that mental illness and mental health, although related, are two different constructs (e.g., Lamers et al., 2015). Thus, the absence of mental illness in postpartum

women does not imply the presence of positive mental health and its associated benefits. Positive mental health has been associated with better physical and mental health, less missed days of work and has a positive influence on the recovery of diagnosed mental disorders (Dyrbye et al., 2012; Keyes, 2007; Schotanus-Dijkstra, Keyes, de Graaf, & Ten Have, 2019). Additionally, positive mental health in the postpartum period could contribute not only to women's overall mental health but also to the child's development, as it has been found that positive mental health in mothers was associated with positive development outcomes in children (Phua et al., 2017). Therefore, the screening and monitoring of positive mental health during this period is as significant as the screening and monitoring of mental illness. Furthermore, the measurement of positive mental health could also benefit research on the effectiveness of psychological interventions in the perinatal period, which focuses mostly on mental illness outcomes (e.g., Sockol, 2015).

Although the present study provides an important step in the shift of postpartum period research from focusing on negative and mental ill-health to a more positive approach, it has several limitations. The cross-sectional design and the self-selected convenience sample of the online recruitment (i.e., women participating in the study could be more interested in the study theme) limit the interpretation and generalizability of these findings to all women in the postpartum period. Additionally, the sample of this study was mainly composed of highly educated and employed mothers. This could explain the high percentage of flourishers in our sample and possibly influenced our results. Future studies could build on current findings by investigating the validity of the MHC-SF in more heterogeneous and representative samples. Furthermore, the test-retest reliability was not determined. Additional test-retest reliability as well as sensitivity to change studies should be also conducted. Finally, it should be noted that it has been advised that the bifactor model has shown tendencies to outperform other models regarding fit statistics (Murray & Johnson, 2013). Therefore, we cannot dismiss the possibility that the bifactor model may have capture unwanted noise and showed a superior fit due to an inbuilt tendency to overfit data. Nonetheless, when understanding the psychometric properties of assessment scales, the bifactor model can provide significant and invaluable information in determining whether a measure's subscale scores are reliable after accounting for the general factor or whether there is only support for the use of a total score (Bonifay, Lane, & Reise, 2017).

Despite these limitations, the present study provides important results that may help to further develop research on positive mental health in the postpartum period. Overall, our findings suggest a general factor of positive mental health and consequently do not provide adequate support for the use of its subscales as measures of distinct dimensions. In addition, our findings suggest that the MHC-SF is a valid instrument to measure positive mental health among postpartum Portuguese women. This may provide a more comprehensive understanding of women's

psychosocial adjustment to this period and be used in the assessment of interventions targeting the prevention and promotion of maternal mental health.

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EMPIRICAL STUDY II

Is positive mental health and the absence of mental illness the same? Factors associated with flourishing and the absence of depressive symptoms in postpartum women

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**Is positive mental health and the absence of mental illness the same?
Factors associated with flourishing and the absence of depressive
symptoms in postpartum women**

Fabiana Monteiro, Ana Fonseca, Marco Pereira, & Maria Cristina Canavarro

Abstract

Objective: Exploring a wide range of factors associated with flourishing and with the absence of depressive symptoms among postpartum women.

Methods: A sample of 661 postpartum women completed a set of questionnaires assessing sociodemographic- and infant-related data, flourishing, psychological flexibility, self-compassion, resilience and maternal confidence.

Results: Younger infant age, higher levels of maternal confidence and resilience increased the likelihood of flourishing. In turn, higher income, fewer problems with infant's sleep, perceiving infant's temperament as easy, and higher psychological flexibility increased the likelihood of not having depressive symptoms. Appraising the support received by others as good and having higher self-compassion increased the likelihood of both outcomes.

Conclusions: Our results support positive mental health and mental illness being related but distinct dimensions. Promoting positive mental health in the postpartum period should be an additional goal in public health care as it may efficiently complement the prevention of psychopathology.

Keywords: positive mental health; flourishing; postpartum period; depressive symptoms

Introduction

Welcoming a new baby represents a demanding transition that can have a significant impact on maternal mental health due to the physical, emotional, social and financial challenges experienced (Jevitt, Groer, Crist, Gonzalez, & Wagner, 2012; Kanotra et al., 2007). For instance, postpartum depression is one of the most prevalent diagnoses of mental illness during this period, with rates ranging from 10% to 15% (O'Hara & McCabe, 2013). The presence of mental illness in the postpartum period also has a significant negative impact on the infant's cognitive, social and physical development (e.g., Slomian, Honvo, Emonts, Reginster, & Bruyere, 2019; Wen et al., 2017). Moreover, a few studies have addressed the social and economic consequences of untreated psychological symptoms and disorders in this period (e.g., Bauer, Knapp, & Parsonage, 2016; Ladd, Rodriguez McCullough, & Carmaciu, 2017), suggesting that maternal mental health should be a health priority.

From mental illness to positive mental health

While the focus on psychopathology during the postpartum period has been important, it has led to a neglect of positive mental health. The bulk of studies on this period have focused on the reduction of mental illness rather than on the promotion of positive mental health outcomes (Smith et al., 2014). There is a general idea that a reduction in psychopathology will inevitably lead to higher levels of positive mental health. However, it has been increasingly recognized that approaches focused on treatment and reduction of adverse outcomes alone are not sufficient and that a comprehensive approach to mental health must also include positive mental health promotion (Barry, Clarke, Petersen, & Jenkins, 2019; WHO, 2005).

A growing body of research has provided empirical evidence that mental health is more than the absence of mental illness. In this context, Keyes' two continua model of mental health (2005) states that mental illness and mental health are two related but distinct constructs. To be categorized as having optimal positive mental health or flourishing, individuals should exhibit high levels of emotional, psychological and social wellbeing (Keyes, 2005). Several studies among general and clinical samples (e.g., de Vos, Radstaak, Bohlmeijer, & Westerhof, 2018; Lamers, Westerhof, Glas, & Bohlmeijer, 2015) have supported the independence of both constructs. For instance, some findings have indicated that interventions that are effective in reducing psychopathological symptoms are not necessarily effective in enhancing positive mental health (Newnham, Hooke, & Page, 2010; Trompetter, Lamers, Westerhof, Fledderus, & Bohlmeijer, 2017), underlining the need to consider positive mental health as a dimension that is separate from psychopathology. Interestingly, the presence of flourishing has been linked to several positive outcomes, including better physical and mental health, fewer missed days of work and greater

resilience to vulnerabilities and challenges in life (Dyrbye et al., 2012; Keyes, 2007). Flourishing has also been found to be an important predictor of remission from mental health disorders, such as mood and anxiety disorders (Lukat, Becker, Lavalley, van der Veld, & Margraf, 2017; Schotanus-Dijkstra, Keyes, de Graaf, & Ten Have, 2019). Regarding the perinatal period, it was recently found that positive mental health in mothers was associated with positive developmental outcomes in children, specifically regarding cognition, communication and social development (Phua et al., 2017).

Factors associated with mental illness and flourishing

Despite the relevant benefits of flourishing, only a few studies have investigated its determinants, especially when compared to the existing empirical evidence on the determinants of mental illness. Commonly reported factors of positive mental health include sociodemographic factors (e.g., higher education, being married, higher income and employment), physical health, social support and positive life events (e.g., Dreger, Buck, & Bolte, 2014; Lehtinen, Sohlman, & Kovess-Masfety, 2005; Schotanus-Dijkstra et al., 2016). In the case of the postpartum period, the gap between the knowledge of the factors associated with mental illness and those associated with flourishing is even more evident. In this context, risk factors for psychopathology have been studied extensively and have included previous history of depression, poor marital relationship and lack of social support as the most frequently reported (Milgrom et al., 2008; Norhayati, Hazlina, Asrenee, & Emilin, 2015). In addition, infant characteristics, such as infant temperament and the quality of infant sleep, have also been linked to maternal psychopathology in the postpartum period (Clout & Brown, 2015; Eastwood, Jalaludin, Kemp, Phung, & Barnett, 2012). However, the association of these factors with flourishing remains mostly unknown. To our knowledge, only one recent study aimed to examine factors associated with flourishing in the postpartum period (Johnstone & Mulherin, 2019). In a sample of young mothers, these authors found that being in a relationship, having higher self-esteem and perceiving to have better social support were significant predictors of flourishing.

Informing mental health promotion practices – Psychological factors

Mental health promotion requires a comprehensive knowledge of the factors associated with both positive mental health and mental illness. Although the knowledge of sociodemographic and situational correlates of flourishing is important to identify individuals who have a lower likelihood of flourishing, if we aim to better inform mental health promotion practices, we should also investigate the psychological factors that are more easily modifiable through psychological interventions. This is the case for psychological resources such as resilience, psychological

flexibility and self-compassion, which have been positively associated with positive mental health (Fledderus, Bohlmeijer, & Pieterse, 2010; Fledderus, Bohlmeijer, Smit, & Westerhof, 2010; Hu, Zhang, & Wang, 2015; Trompetter, de Kleine, & Bohlmeijer, 2017; Zessin, Dickhauser, & Garbade, 2015). Broadly, resilience is considered a dynamic concept capturing positive adaptation and growth in the face of stress (Fletcher & Sarkar, 2013) and has been found to be a protective factor against depression in the perinatal period (Hain, Oddo-Sommerfeld, Bahlmann, Louwen, & Schermelleh-Engel, 2016). Psychological flexibility and self-compassion involve turning toward painful experiences with an accepting and kind attitude as opposed to being self-judgmental or trying to control thoughts and feelings (Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Neff, 2003). Psychological resources focused on the acceptance of negative thoughts and emotions and adaptation in the face of stress may be particularly significant in the postpartum period and were previously shown to be protective factors against the development of depressive and anxiety symptoms among at-risk postpartum women (Monteiro, Fonseca, Pereira, Alves, & Canavarro, 2019).

Additionally, maternal confidence has been identified in the literature as an essential intrapersonal resource in the adjustment to motherhood (Badr, 2005; Kuo, Chen, Lin, Lee, & Hsu, 2009). The transition to motherhood implies learning mothering skills, and successfully adapting to the maternal role involves having confidence in the ability to safeguard the infant's needs and provide nurturing and care. This confidence is related to the women's identity as a mother, influences the affective relationship with her infant (Mercer, 1985) and is negatively associated with maternal parenting stress (Liu, Chen, Yeh, & Hsieh, 2012). It is also likely that greater maternal confidence could be associated with women's positive mental health during this period. However, little is known about the influence of these psychological factors on postpartum women's positive mental health.

The present study

While the research is still limited, other studies have found similarities and differences in the correlates of positive mental health and mental illness (e.g., Van Lente et al., 2012; Westerhof & Keyes, 2010; Winzer, Lindblad, Sorjonen, & Lindberg, 2014). However, the studies have tended to yield mixed results, possibly due to the different measures of positive mental health used and the factors that were investigated. For instance, in some studies, factors associated with income and economic strain were related to both positive mental health and mental illness (Winzer et al., 2014), while in others, a lower income was related to mental illness but not to positive mental health (Van Lente et al., 2012; Westerhof & Keyes, 2010). Therefore, because this is still an unexplored topic in the postpartum period, the present study aimed to investigate the factors

(sociodemographic, health-related, infant-related and psychological factors) associated with flourishing and with the absence of postpartum depressive symptoms in a sample of postpartum women. As the foundations for good mental health lie in the perinatal period and early childhood, these results could inform mental health promotion interventions and consequently have an important impact on public health.

Methods

Participants and procedure

The sample consisted of 661 postpartum women with a mean age of 32.05 years ($SD = 4.69$; range 18-45). At the time of data collection, infants were aged between 0 and 12 months ($M = 5.53$; $SD = 3.34$), and this was the first child for most women ($n = 418$; 63.3%). Most women were married/living with a partner ($n = 602$; 91.1%), were employed ($n = 539$; 81.5%) and had completed higher education ($n = 421$; 63.7%). Additionally, 26.3% ($n = 174$) of participants reported having a history of psychological problems and 27.8% ($n = 184$) reported having attended a psychiatric or a psychologist in the past. **Table 1** summarizes the sociodemographic, health and infant-related characteristics of the participants.

The procedures of sample recruitment and data collection were approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra. A cross-sectional study was conducted in Portugal with the following eligibility criteria: 1) being a woman in the postnatal period (0-12 months after delivery); 2) being 18 years or older; and 3) understanding Portuguese. Enrollment occurred between August and November 2018. Data were collected through an online survey (LimeSurvey) placed on the website of the host institution and the link to the survey was posted periodically on the Facebook page of the research project. The tagline to advertise the study was: "Are you a mother who had a baby in the last 12 months? We would like to ask for your help on this research focused on the psychological wellbeing of mothers in the postpartum period. Please click on the link below to find more information about this study.". Informed consent was obtained electronically from all participants (by clicking on the option "I understand and accept the conditions of the study") after information was given about the study's goals, the participants' and researchers' roles and the voluntary and anonymous nature of participation.

Table 1. Sociodemographic, health and infant-related characteristics of the total sample

	<i>M (SD)/n (%)</i>
Age	32.05 (4.69)
Marital status	
Living with a partner	602 (91.1)
Living alone	59 (8.9)
Employment status	
Employed	539 (81.5)
Not currently working	122 (18.5)
Educational level	
Up to the 9 th grade	39 (5.9)
10 th to 12 th grade	201 (30.4)
University studies	421 (63.7)
Household monthly income	
<500€	8 (1.2)
500€-1000€	117 (17.7)
1000€-2000€	394 (59.6)
2000€-3500€	118 (17.9)
>3500€	24 (3.6)
Physical health problems	
Yes	41 (6.2)
No	620 (93.8)
History of psychological problems	
Yes	174 (26.3)
No	487 (73.7)
Infant's age	5.53 (3.34)
Primiparous	
Yes	418 (63.2)
No	243 (36.8)
Infant's sleep problems	
Yes	92 (13.9)
No	569 (86.1)
Infant's health problems	
Yes	49 (7.4)
No	612 (92.6)

Measures

A self-report questionnaire developed by the researchers was used to assess sociodemographic (e.g., age, marital status, education, household monthly income), health-related (e.g., prior history of psychopathological problems) and infant-related data (e.g., infant's age, infant's sleep problems). In this questionnaire, perceived infant's temperament was assessed through a self-report item, answered in a 4-point scale that ranged from 0 (*very difficult*) to 3 (*very easy*). Women's appraisal of social support received was assessed through a self-report item, answered in a 5-point scale that ranged from 0 (*very insufficient*) to 4 (*very good*).

Positive mental health was assessed using the Mental Health Continuum Short Form (MHC-SF; Keyes et al., 2008; Portuguese Version [PV]: Monteiro, Fonseca, Pereira, & Canavarro, 2020). This questionnaire consists of 14 items divided into three dimensions: emotional (3 items, e.g., “During the past month, how often did you feel happy?”), social (5 items, e.g., “During the past month, how often did you feel that you belonged to a community?”) and psychological wellbeing (6 items, e.g., “During the past month, how often did you feel that you had experiences that challenged you to grow and become a better person?”). Each item is rated on a six-point response scale from 0 (*never*) to 5 (*every day*) in reference to the last month. The MHC-SF can be scored continuously (scores range from 0 to 70, and higher scores indicate better positive mental health) or categorically considering mental health status (flourishing, moderate mental health, languishing). Using Keyes’ criteria (Keyes et al., 2008), women who answered *every day* or *almost every day* at least once on the emotional wellbeing subscale and at least six times on the psychological and social wellbeing subscales were categorized as flourishing. Women who answered *never* or *once or twice* for at least one item on the emotional wellbeing subscale and at least six items on the psychological and social wellbeing subscales were categorized as languishing. Finally, women who did not fit the criteria for either flourishing or languishing were considered moderately mentally healthy. In this study, we were specifically interested in women who were flourishing; therefore, we categorized participants as flourishing and non-flourishing (including both languishers and those with moderate mental health). In our sample, the Cronbach’s alpha of the MHC-SF was .94.

The Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987; PV: Areias, Kumar, Barros, & Figueiredo, 1996) was used to assess the presence of depressive symptoms in the perinatal period (e.g., “I have been so unhappy that I have had difficulty sleeping.”). In each of the 10 items, participants are asked to indicate one of four individualized responses that are rated from 0 to 3. The total score ranges between 0 and 30, and higher scores are indicative of more severe depressive symptoms. A score of 10 or higher identifies women who have clinically relevant depressive symptoms (Figueiredo, 1997). In our sample, the Cronbach’s alpha was .90.

Maternal confidence was measured with the Maternal Confidence Questionnaire (MCQ; Parker & Zahr, 1985; PV: Nazaré, Fonseca, & Canavarro, 2013). The MCQ comprises 13 items (e.g., “I feel satisfied with my role as a mother.”) answered on a five-point response scale ranging from 1 (*never*) to 5 (*always*). Higher scores indicate higher perceived maternal competence. In our sample, the Cronbach’s alpha was .84.

The Self-Compassion Scale – Short Form (SCS-SF; Raes, Pommier, Neff, & Van Gucht, 2011; PV: Castilho, Pinto-Gouveia, & Duarte, 2015) was used to assess women’s self-compassion levels. The SCS-SF is a self-report measure comprising 12 items (e.g., “When I’m going through a very hard time, I give myself the caring and tenderness I need”), answered on a 5-point response

scale (ranging from 1 to 5). After negative items are reverse coded, it is possible to obtain a global measure of self-compassion by estimating the mean of the 12 items, with higher scores indicating higher self-compassion. In our sample, the Cronbach's alpha was .88.

Psychological flexibility was assessed with the Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011; PV: Pinto-Gouveia, Gregório, Dinis, & Xavier, 2012). Women were asked to rate each of the seven items (e.g., "I worry about not being able to control my worries and feelings") on a seven-point response scale (1 = *always true*, 7 = *never true*). Higher scores are reflective of greater psychological flexibility. In our sample, the Cronbach's alpha was .92.

The Resilience Scale (RS14; Wagnild, 2009; PV: Pinheiro & Matos, 2013) was used to assess resilience. This scale comprises 14 items (e.g., "I feel like that I can handle many things at a time.") scored on a seven-point scale (ranging from 1 = *strongly disagree* to 7 = *strongly agree*). Higher scores indicate a greater ability to respond with resilience. In our sample, the Cronbach's alpha was .92.

Data analysis

Data were analyzed using the *Statistical Package for Social Sciences* (IBM SPSS, version 23.0). Descriptive statistics were first computed for sample characterization. Pearson correlations were computed to measure the associations between the psychological variables (small effects: $r \geq .10$; medium effects: $r \geq .30$; large effects: $r \geq .50$; (Cohen, 1992). To investigate the factors related to flourishing and to the absence of postpartum depressive symptoms, the dependent variables were first coded based on the MHC-SF and EPDS cutoff scores (presented in the Measures section). Separate univariate logistic regression analyses were run on the dependent variables. Finally, to examine which factors were independently associated with flourishing and the absence of depressive symptoms, variables in the univariate analysis with a p level $< .10$ were entered into two multivariable logistic regressions. To estimate multicollinearity, the tolerance and VIF values were analyzed; the tolerance values were all higher than 0.1, and the VIF values were lower than 10 (Field, 2009). Therefore, because severe multicollinearity was not present in our model, the predictors were included together. Flourishing (in the model predicting absence of depressive symptoms) and absence of postpartum depressive symptoms (in the model predicting flourishing) were included in the first block of the models as covariates to investigate the unique relation of the factors to each dependent variable. A p-value of .05 was set as the cut-off point for statistical significance. Cox and Snell's R^2 and Nagelkerke's adjusted R^2 were used as indicators of effect sizes, and the statistical significance of individual predictors was evaluated by calculating the odds ratios (ORs) with 95% confidence intervals (CIs).

Results

Overall, 55.2% ($n = 365$) of the participants were flourishing. Of these, 19.5% ($n = 71$) presented depressive symptoms. Our results also demonstrated that 61.7% ($n = 408$) of the total sample presented no clinically relevant postpartum depressive symptoms. Of these, 72.1% ($n = 294$) were flourishing (44.5% of the total sample was both flourishing and presenting no depressive symptoms).

Correlations between the psychological variables

Correlations between the psychological variables are presented in **Table 2**. Significant and positive associations were found between all the psychological variables. Small to medium associations were found between maternal confidence and the remaining variables. Large associations were found between psychological flexibility and self-compassion, between psychological flexibility and resilience and between resilience and self-compassion.

Table 2. Correlations between the psychological factors

Psychological factors	1	2	3	4
1. Maternal confidence	-			
2. Self-compassion	.32**	-		
3. Psychological flexibility	.29**	.73**	-	
4. Resilience	.47**	.62**	.60**	-

Note. ** $p < .01$

Factors associated with flourishing

Table 3 presents the univariate and multivariate logistic regression analyses of the factors associated with flourishing. The univariate analyses revealed that being employed was significantly associated with a higher likelihood of flourishing. Additionally, physical health problems and a previous history of psychopathology were associated with having lower odds of flourishing. Regarding infant-related factors, women with older infants and women who reported that their infants had health and sleep problems had a decreased likelihood of flourishing. Women who perceived their infant's temperament as easy and who appraised the support received by others as good had higher odds of flourishing. Additionally, all of the psychological factors (i.e., maternal confidence, self-compassion, psychological flexibility and resilience) were related to an increased likelihood of flourishing.

The final model was significantly reliable ($\chi^2_{(12)} = 209.68, p < .001$; Cox & Snell $R^2 = 0.40$; Nagelkerke $R^2 = 0.53$) and correctly predicted 81.2% of the cases. After controlling for depressive symptoms, the odds of flourishing were significantly higher for postpartum women with younger infants, who appraised the support received by others as good and who had higher levels of maternal confidence, self-compassion and resilience. None of the sociodemographic variables were significantly associated with an increased likelihood of flourishing.

Table 3. Univariate and multivariate logistic regressions of the factors associated with flourishing

	Univariate analysis		Multivariate analysis $R^2 = .40$ (Cox & Snell); $.53$ (Nagelkerke)		
	OR [95% CI]	p	B (SE)	p	OR [95% IC]
No clinically relevant depressive symptoms	-		-0.63 (0.24)	.008	0.53 [0.33-0.85]
Age (years)	1.02 [0.99-1.06]	.194	-	-	-
Marital status	1.04 [0.61-1.79]	.874	-	-	-
Education	1.10 [0.85-1.41]	.511	-	-	-
Employment status	1.65 [1.11-2.45]	.013	0.08 (0.29)	.781	1.08 [0.62-1.90]
Household monthly income	0.98 [0.79-1.20]	.814	-	-	-
Physical health problems	0.55 [0.29-1.05]	.071	-0.35 (0.44)	.425	0.70 [0.30-1.67]
History of psychological problems	0.42 [0.30-0.60]	<.001	-0.22 (0.26)	.389	0.80 [0.48-1.33]
Primiparous	0.88 [0.64-1.21]	.435	-	-	-
Infant's age	0.94 [0.90-0.98]	.007	-0.07 (0.03)	.046	0.94 [0.88-1.00]
Infant's health problems	0.58 [0.33-1.05]	.073	-0.18 (0.44)	.681	0.83 [0.35-1.98]
Infant's sleep problems	0.40 [0.25-0.63]	<.001	-0.47 (0.33)	.156	0.63 [0.33-1.20]
Perceived infant's temperament	1.78 [1.37-2.30]	<.001	0.01 (0.19)	.984	1.00 [0.69-1.44]
Appraisal of support received	1.50 [1.32-1.71]	<.001	0.24 (0.09)	.005	1.27 [1.08-1.51]
Maternal confidence	9.08 [5.33-15.49]	<.001	1.07 (0.37)	.004	2.91 [1.41-5.99]
Self-compassion	1.20 [1.17-1.24]	<.001	0.09 (0.02)	<.001	1.10 [1.05-1.14]
Psychological flexibility	1.14 [1.12-1.17]	<.001	0.01 (0.02)	.490	1.01 [0.98-1.05]
Resilience	1.13 [1.11-1.16]	<.001	0.07 (0.01)	<.001	1.08 [1.05-1.10]

Note: Dependent variable: 0 = Absence of flourishing, 1 = Flourishing; Marital status [0 = Living with partner; 1 = Living alone]; Employment status [0 = Employed; 1 = Unemployed]; Physical health problems [0 = Yes; 1 = No]; History of psychological problems [0 = Yes; 1 = No]; Primiparous [0 = Yes; 1 = No]; Infant's health problems [0 = Yes; 1 = No]; Infant's sleep problems [0 = Yes; 1 = No].

Abbreviations: 95% CI, 95% confidence interval; OR, odds ratio.

Factors associated with the absence of postpartum depressive symptoms

Table 4 presents the univariate and multivariate logistic regression analyses of the influence of several factors on the absence of postpartum depressive symptoms.

Table 4. Univariate and multivariate logistic regressions of the factors associated with absence of postpartum depressive symptoms

	Univariate analysis		Multivariate analysis <i>R</i> ² = .37 (Cox & Snell); .51 (Nagelkerke)		
	OR [95% CI]	<i>p</i>	B (SE)	<i>p</i>	OR [95% IC]
Flourishing	-		-0.63 (0.25)	.022	0.57 [0.35-0.92]
Age (years)	1.02 [0.99-1.06]	.214	-	-	-
Marital status	1.51 [0.89-2.59]	.130	-	-	-
Education	1.35 [1.04-1.75]	.023	-0.06 (0.13)	.663	0.95 [0.73-1.22]
Employment status	1.96 [1.32-2.92]	.001	-0.01 (0.29)	.980	0.99 [0.56-1.75]
Household monthly income	1.38 [1.11-1.71]	.004	0.42 (0.16)	.009	1.52 [1.11-2.09]
Physical health problems	0.87 [0.46-1.65]	.665	-	-	-
History of psychological problems	0.44 [0.31-0.63]	<.001	0.09 (0.25)	.719	1.10 [0.67-1.80]
Primiparous	1.06 [0.76-1.46]	.741	-	-	-
Infant's age	0.95 [0.90-0.99]	.025	0.01 (0.03)	.886	1.01 [0.94-1.07]
Infant's health problems	0.62 [0.35-1.12]	.112	-	-	-
Infant's sleep problems	0.26 [0.16-0.41]	<.001	-1.27 (0.32)	<.001	0.28 [0.15-0.53]
Perceived infant's temperament	2.13 [1.62-2.80]	<.001	0.39 (0.19)	.040	1.47 [1.02-2.13]
Appraisal of support received	1.52 [1.33-1.74]	<.001	0.22 (0.09)	.011	1.25 [1.05-1.48]
Maternal confidence	3.30 [2.07-5.28]	<.001	-0.28 (0.33)	.390	0.75 [0.39-1.44]
Self-compassion	1.19 [1.16-1.23]	<.001	0.09 (0.02)	<.001	1.10 [1.05-1.14]
Psychological flexibility	1.17 [1.14-1.21]	<.001	0.09 (0.02)	<.001	1.10 [1.06-1.14]
Resilience	1.08 [1.07-1.10]	<.001	0.01 (0.01)	.526	1.00 [0.99-1.03]

Note: Dependent variable: 0 = Presence of depressive symptoms, 1 = Absence of depressive symptoms; Marital status [0 = Living with partner; 1 = Living alone]; Employment status [0 = Employed; 1 = Unemployed]; Physical health problems [0 = Yes; 1 = No]; History of psychological problems [0 = Yes; 1 = No]; Primiparous [0 = Yes; 1 = No]; Infant's health problems [0 = Yes; 1 = No]; Infant's sleep problems [0 = Yes; 1 = No].

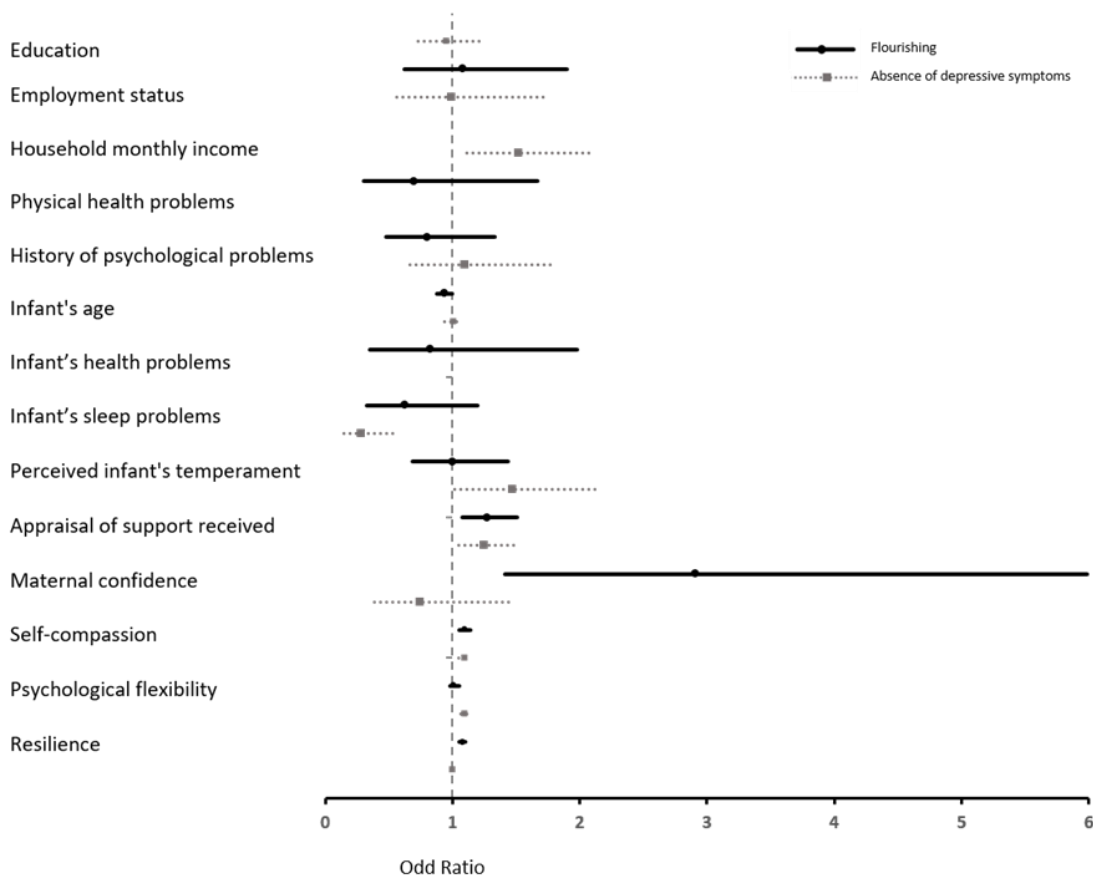
Abbreviations: 95% CI, 95% confidence interval; OR, odds ratio.

Regarding sociodemographic and health-related factors, the results of the univariate analysis showed that higher education, being employed and having higher household monthly income were significantly associated with the absence of depressive symptoms. Additionally, women with a previous history of psychological problems had lower odds of not reporting depressive symptoms. Concerning infant-related factors, women with older infants and those with infants who had difficulties with their sleep had a decreased likelihood of not reporting depressive symptoms. Perceiving their infant's temperament as easy and appraising the support received by others as good were both associated with a higher likelihood of not presenting depressive symptoms. Additionally, all psychological factors (maternal confidence, self-compassion, psychological flexibility and resilience) were associated with not reporting depressive symptoms.

The final multivariate model was significantly reliable ($\chi^2_{(12)} = 184.78, p < .001$; Cox & Snell $R^2 = 0.38$; Nagelkerke $R^2 = 0.51$) and correctly predicted 80.3% of the cases. In the final multivariate model, the odds of not reporting clinically relevant depressive symptoms were significantly higher for women with a higher household monthly income who perceived their infant’s temperament as easy and who appraised the support received by others as good. Women with infants who had problems with their sleep had lower odds of not reporting depressive symptoms. Additionally, women with higher levels of self-compassion and psychological flexibility had higher odds of not reporting depressive symptoms.

Figure 1 displays the odd ratios and confidence intervals for the multivariate models of flourishing and absence of postpartum depressive symptoms.

Figure 1. Graphic representation of the odd ratios and confidence intervals for the multivariate models of flourishing and absence of postpartum depressive symptoms



Discussion

It has been increasingly recognized that mental health is more than the absence of mental illness and that flourishing is an essential part of an individual's emotional, psychological and social functioning (Keyes, 2005, 2007; Trompetter, Lamers, et al., 2017). However, the majority of research on the postpartum period has primarily focused on mental illness, largely overlooking positive mental health. Furthermore, there has been an implicit assumption that the factors associated with positive mental health are the reverse of those associated with mental illness. The results of this study inform not only to a richer understanding of the factors that contribute to flourishing in the postpartum period but also show that they differ from those associated with not presenting depressive symptoms. It should be noted that the association between the absence of depressive symptoms and flourishing was taken into account in our analyses, which allowed us to investigate the unique associations of different factors with both dimensions of mental health. Our main findings indicate that younger infant age and higher levels of maternal confidence and resilience increased the likelihood of flourishing. In turn, higher household income, fewer problems with infant's sleep, perceiving infant's temperament as easy, and higher levels of psychological flexibility increased the likelihood of not reporting depressive symptoms. Appraising the support received by others as good and higher levels of self-compassion increased the likelihood of both outcomes. These findings emphasize that mental health and mental illness are related but distinct dimensions and support the two continua model of mental health (Keyes, 2005).

Sociodemographic and clinical factors

First, our results suggest that sociodemographic factors are not particularly relevant to positive mental health in the postpartum period. Although employment was significantly associated with flourishing in the univariate analysis, after controlling for other variables, this association became nonsignificant. This result is in line with previous studies in general population samples (Schotanus-Dijkstra et al., 2016; Van Lente et al., 2012). In contrast to our findings, Johnstone and Mulherin (2019) found that being in a relationship was significantly associated with flourishing among young postpartum women, even after including social support. It is possible that this difference could be explained by the different characteristics of the sample used by Johnstone and Mulherin (2019), as teenage and young mothers undergo unique personal and social challenges (Kingston, Heaman, Fell, & Chalmers, 2012). Moreover, we found that household monthly income was only significantly associated with not presenting depressive symptoms. This supports previous findings suggesting that income seems to be more related to mental illness and not to positive mental health (Van Lente et al., 2012; Westerhof & Keyes, 2010; Winzer et al., 2014).

Having a previous history of psychological problems is a consistently reported factor

associated with the presence of depressive symptoms in the perinatal literature (e.g., Milgrom et al., 2008). However, after controlling for other variables (e.g., psychological factors, which may also explain the prior occurrence of psychological problems) in the multivariate model, our results showed that reporting a previous history of psychological problems was not significantly associated with either outcome. This is consistent with previous findings (Monteiro et al., 2019) and suggests that other factors should be considered with regard to the psychological adjustment of these women. It is possible that women with a previous history of psychopathology may have previous vulnerabilities (e.g., dysfunctional beliefs, avoidance-based coping strategies, pervasive thinking styles, self-critical thinking), which emphasizes the need to consider psychological factors as important predictors of depressive symptoms in postpartum women.

Infant-related factors

Infant-related factors, specifically fewer problems with their infant's sleep and perceiving their infant's temperament as easy, seem to be particularly important for not presenting depressive symptoms. Poor sleep has been considered a source of considerable stress in postpartum mothers, and it has been associated with depression independently of other risk factors (Dorheim, Bondevik, Eberhard-Gran, & Bjorvatn, 2009). Additionally, perceiving infant's temperament as difficult has also been associated with depressive symptoms (Fernandes, Canavarro, & Moreira, 2020), and it was shown that depressed mothers perceive their infants as having more difficult temperament than non-depressed mothers (Austin, Hadzi-Pavlovic, Leader, Saint, & Parker, 2005; McGrath, Records, & Rice, 2008). Although these factors refer to the women's perceptions, they are indirectly associated with difficult challenges and demands of this period and therefore could be less relevant to experiencing positive mental health in the presence of other factors.

Furthermore, younger infant age was only associated with an increased likelihood of flourishing. This result could be explained by the temporal proximity to birth. Previous studies have suggested that the period after birth is associated with an increase in wellbeing, positive emotions, life satisfaction and meaning in life (Bassi et al., 2017; Brandel, Melchiorri, & Ruini, 2018; Dyrdal & Lucas, 2013; Nelson, Kushlev, English, Dunn, & Lyubomirsky, 2013). This may suggest that becoming a mother is a positive event particularly linked with positive mental health. However, this hypothesis needs to be further tested as this association could be explained by other reasons (e.g., as the infant ages, new difficulties may arise from more demanding developmental tasks that could have an impact on the mother's positive mental health) or it could have a more complex, non-linear relation. Our results also showed that perceiving oneself to have a good level of social support is important to both flourishing and the absence of depressive symptoms. The literature in the postpartum period is rather consistent in showing the protective role of social support in the

development of depressive and anxiety symptoms (e.g., Leahy-Warren, McCarthy, & Corcoran, 2012; Milgrom, Hirshler, Reece, Holt, & Gemmill, 2019). Our results are also in line with those reported more recently by Johnstone and Mulherin (2019), who found that social support significantly predicted flourishing among postpartum women.

Psychological factors

Concerning psychological factors, our results showed that self-compassion was significantly associated with both flourishing and the absence of depressive symptoms. Across multiple studies, self-compassion has been linked to both positive mental health (e.g., Trompetter, de Kleine, et al., 2017) and psychopathology (e.g., Raes, 2011). In the context of the perinatal period, self-compassion may be a particularly pertinent variable, as this period entails learning and adjusting to several new tasks and responsibilities. The prevailing ideology of the perfect motherhood and the failure to meet high-performance standards may lead women to perceive themselves as “bad mothers”, to overly critical self-evaluation, and to a sense of shame and guilt (Gelabert et al., 2012; Sutherland, 2010). A more kind and compassionate tendency to oneself when confronted with parenting-related difficulties seems to be an important protective factor against mental illness as well as a building block for positive mental health. Moreover, our results showed that women reporting higher levels of psychological flexibility were more likely to present absence of depressive symptoms. This result is congruent with a previous study in the postpartum period (Monteiro et al., 2019) and further highlights the significance of engaging in behaviors based on the acceptance of negative thoughts and emotions during this period rather than using control or avoidance strategies. However, in our study, and despite the significant association in the univariate analysis, psychological flexibility was not significantly associated with increased flourishing after controlling for other psychological factors. Research using acceptance and commitment therapy-based interventions has yielded mixed results, with one study reporting that the increase in psychological flexibility during the intervention mediated the effects of the intervention on positive mental health (Fledderus, Bohlmeijer, Smit, et al., 2010), whereas another found that this increase was not related to positive mental health after the intervention (Wersebe, Lieb, Meyer, Hofer, & Gloster, 2018). Further research on the roles of psychological flexibility on positive mental health is needed.

Finally, higher levels of resilience and maternal confidence were associated only with an increased likelihood of flourishing. This result is congruent with several studies focused on resilience and positive aspects of mental health (e.g., Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Haddadi & Besharat, 2010). Our findings suggest that postpartum women with higher levels of resilience may be more likely to effectively meet the challenges and stressors of this period and

successfully adapt to them. To our knowledge, in the postpartum period, resilience was previously only studied as a protective factor for depression (Hain et al., 2016) and not as an important factor for the promotion of positive mental health. Although we initially found a significant association between resilience and absence of depressive symptoms, the results from the final model are not in line with those previously described. Similarly, our results showed that maternal confidence was significantly associated only with higher levels of positive mental health. This finding is consistent with the results of a study among undergraduate students in which self-efficacy did not significantly predict depression when examined together with mindfulness and self-compassion, but it was a significant predictor of psychological wellbeing (Soyso & Wilcomb, 2015). Our results suggest that fostering women's beliefs in their own abilities to care for their infants and increasing their satisfaction in their role as mothers could be significant for the presence of positive mental health.

Limitations

Despite the important and innovative findings of this study, there are some limitations that must be considered. First, the cross-sectional design of this study is one of the main limitations and does not allow us to establish the direction or causality of the associations between the variables. Therefore, the results must be interpreted with caution, and future longitudinal studies are needed to ascertain the direction of these associations. Second, it is important to note that this study used a self-selected sample, and it is possible that women with an interest in the topic were more likely to participate in the study. Additionally, this study sample was mainly composed of highly educated and employed mothers. Future studies could build on current findings by investigating the factors associated with flourishing in more heterogeneous and representative samples. Finally, variables were assessed only with self-reported measures, and the bias associated with this methodology (e.g., social desirability) should also be considered an important limitation. Thus, these results must be viewed as preliminary and in need of replication and extension.

Conclusions

Despite these limitations, this study represents an important contribution to research and clinical practice on the topic of maternal mental health by showing the significance of positive mental health during the postpartum period. Indeed, our study is one of the first to explore factors associated with flourishing among postpartum women. Additionally, we found that the explicative factors of flourishing seem to be different and specific from those that explain the lack of depressive symptoms. This reinforces the argument that positive mental health should be an important outcome to be considered when assessing the adjustment of postpartum women and in the efforts made regarding psychological interventions in this period. There has been increasing interest in

reducing the human and economic costs associated with perinatal mental illness through its effective prevention among at-risk women (Sockol, Epperson, & Barber, 2013). However, mental health programs that are effective in alleviating mental illness do not necessarily promote positive mental health, and our results highlight that a complete mental health approach that targets both the promotion of positive mental health (which implies a population health perspective and not only at-risk individuals) and the prevention of mental illness should be ideal. An understanding of the characteristics of postpartum women presenting positive mental health and absence of depressive symptoms can be useful in informing such programs, and our study provides some insight into this knowledge. Although some of the relevant factors found in our study overlap, others may be specific to each action. In any case, our results suggest that the strengthening of specific psychological skills and resources could result in better mental health and support the need to shift from a risk perspective to one that focuses on competence enhancement. Consequently, this may increase the mothers' positive interactions with their infants and significant others. Therefore, the inclusion of positive mental health in the research and mental health care in the postpartum period could be significantly beneficial for public health, as infancy and early childhood are relevant in shaping lifelong outcomes, which have an impact on social and economic development.

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EMPIRICAL STUDY III

Be a Mom's efficacy in enhancing positive mental health among postpartum women presenting low risk for postpartum depression: Results from a pilot randomized trial

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Abstract

In this study, we conducted a preliminary investigation of the efficacy of Be a Mom, a web-based self-guided intervention, in enhancing positive mental health among postpartum women at low risk for postpartum depression. Additionally, we examined Be a Mom's efficacy regarding secondary outcomes as well as its acceptability and adherence. A total of 367 participants were randomly assigned to the Be a Mom group ($n = 191$) or to the waiting-list control group ($n = 176$) and completed baseline (T1) and postintervention (T2) assessments. The intervention group reported significant increases in positive mental health between T1 and T2 compared to the control group. Additionally, group effects were found for depressive and anxiety symptoms. A significantly higher proportion of participants in the Be a Mom group had an improvement trajectory (from not flourishing at T1 to flourishing at T2). A total of 62 (32.5%) women completed Be a Mom, and most would use it again if needed ($n = 82/113$; 72.6%). This study provides preliminary evidence of Be a Mom's efficacy in increasing positive mental health among low-risk postpartum women. Our findings support mental health promotion strategies in the postpartum period and highlight the important role of web-based CBT interventions.

Keywords: web-based intervention; be a mom; randomized controlled trial; positive mental health; flourishing; postpartum period

Introduction

The transition to motherhood is often depicted as a joyful period filled with excitement, but it also involves demanding adjustments to a new role and new responsibilities [1]. Research in this area has suggested that this is a period of increased mental health vulnerability due to the considerable number of stressors that are often experienced, such as increased physical health needs, adjusting to infant care tasks, changes in marital and social relationships, financial strains or transitioning back to work [2-7]. Even under optimal circumstances, the early postpartum period is full of challenging tasks. Although some women may present risk factors that make them more vulnerable to mental illness, such as postpartum depression (PPD; e.g., history of depression, low social support; [8]), this period constitutes a major life transition for all postpartum women, including low-risk women, who can also experience symptoms of depression and anxiety [9,10].

Mental illness during the postpartum period has increasingly been considered a high-priority public health problem due to the long-term negative implications for maternal health, infant health and development [11,12] and economic costs [13,14]. Even the presence of subclinical symptoms of depression has been associated with increased psychosocial difficulties (poorer maternal self-esteem, more negative and less positive affect) [15]. Several efforts have targeted the treatment and prevention of psychological disorders during this period, particularly PPD [16,17]. With respect to preventive interventions, there is evidence that cognitive behavioral therapy (CBT) is effective in preventing depression both among women who present risk factors for PPD (selective/indicated prevention) and among all women in the community (universal prevention), although the effects of these preventive interventions may be more robust among groups at a higher risk of perinatal depression [16,18].

In addition to prevention, the promotion of positive mental health has been increasingly recognized as a priority [19,20], with research suggesting the need to address positive mental health directly since interventions that are effective in reducing psychopathological symptoms are not necessarily effective in enhancing levels of positive mental health [21,22]. However, previous research has tended to consider women's psychological adjustment to this period in terms of levels of depression and anxiety, and the promotion of positive mental health has been neglected in favor of a greater focus on the prevention and reduction of mental illness [23]. Positive mental health has received growing attention in recent years as research has shown that it is not simply the absence of mental illness [22,24]. Optimal levels of positive mental health involve the experience of high levels of emotional (positive feelings, e.g., feeling happy, satisfaction with life), psychological (optimal functioning in life, e.g., self-acceptance, purpose in life, personal growth) and social wellbeing (optimal social functioning, e.g., social integration and contribution) [24]. Keyes [24] conceptualized those with high levels of emotional, psychological and social wellbeing as flourishing

individuals. Existing studies about the impact of flourishing underline the need for interventions that increase positive mental health. For instance, the presence of flourishing has been associated with better physical health and longevity [25,26], fewer health limitations of activities of daily living and fewer missed days of work [24] and may act as a buffer against future mental illness [27,28]. Although still rarely studied in the postpartum period, higher levels of positive mental health in mothers have been longitudinally associated with better development outcomes in children, specifically cognitive, communication and social development [29]. Thus, proactively addressing and assessing positive mental health in psychological interventions should be a complementary goal of psychological interventions in the postpartum period, including those targeting low-risk women.

Reaching all women in the postpartum period through traditional face-to-face interventions is difficult considering the high number of human and economic costs involved [30]. Additionally, help-seeking rates for postpartum women with depressive symptoms range from 15% to 40% [31,32]. Suggested barriers that contribute to these low rates include feelings of shame, guilt and stigma and demands associated with infant care [33,34]. eHealth interventions have the potential to effectively address these barriers because they provide an opportunity to enhance the capacity and accessibility of mental health care and can be delivered at a very low cost and with privacy and convenience [35,36]. Moreover, these interventions have been shown to have long-term positive outcomes beyond the reduction of psychopathological symptoms, such as improvements in personal empowerment, self-esteem and quality of life [37]. In a recent review, the role of eHealth in the perinatal period was also highlighted as having the potential to be revolutionary if integrated into standard care [38].

In line with this, Be a Mom was developed to be a short-term, fully self-guided web-based intervention for Portuguese postpartum women. It was primarily developed to prevent PPD among at-risk women, and a previous pilot trial demonstrated its efficacy in reducing depressive and anxiety symptoms among a sample at high risk for PPD [39]. Although Be a Mom addresses the minimization of psychosocial risk factors for PPD (e.g., lack of social support, poor marital relationship), it does not focus solely on the minimization of such risk factors. Rather, Be a Mom specifically targets the development and strengthening of psychological competences and resources, namely, acceptance- and compassion-based skills. Be a Mom has already proven its efficacy in promoting self-compassion and emotion regulation skills among a high-risk sample for PPD [40]. Because the enhancement of psychological resources could be useful to all women in the postpartum period, Be a Mom may also be effective in the promotion of mental health among postpartum women presenting low risk for PPD. Be a Mom is grounded in CBT principles applied to the postpartum context and includes content based on the third wave of CBT, namely, acceptance- and compassion-focused approaches. Third-wave CBT approaches aim not only to

reduce psychopathology but also to promote flourishing [41].

There is evidence of web-based CBT interventions as well as acceptance and compassion-based approaches enhancing positive mental health in general population samples [42,43]. However, there is still a lack of studies assessing the efficacy of these interventions in increasing positive mental health in the postpartum period. One study using an eHealth compassion-based intervention found that postpartum women in the intervention group showed an improvement in positive mental health compared to the control group [44], although the effects were small and only significant among participants with lower levels of positive mental health at baseline. Another study using an intervention based on positive psychology and metacognitive therapy only found a significant effect of the intervention with regard to emotional well-being [45]. The majority of web-based intervention studies in the perinatal period focus on the treatment or prevention of psychopathological symptoms using mostly high-risk samples [46]. However, given the characteristics of eHealth interventions and the importance of maternal mental health in influencing lifelong health outcomes, low-risk women may also benefit from these interventions.

Therefore, the present study reports the results of a pilot randomized controlled trial of the Be a Mom web-based intervention compared to a waiting-list control (WLC) group. The aims of this study were 1) to explore the efficacy of Be a Mom in enhancing positive mental health among low-risk postpartum women; 2) to investigate Be a Mom's efficacy considering secondary outcomes (depressive and anxiety symptoms, maternal self-efficacy, empowerment and relationship satisfaction); and 3) to test Be a Mom's acceptability, adherence and pattern of usage.

Methods

Study design

This study was a two-arm, open-label, pilot randomized controlled trial on the efficacy of Be a Mom vs. a WLC for postpartum women presenting low risk for PPD. This study is part of a wider research project assessing Be a Mom's efficacy as a web-based program for the promotion of maternal mental health during the postpartum period. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra and was registered on ClinicalTrials.gov (NCT04055974). The extensions of the CONSORT 2010 checklist for pilot trials [47] and CONSORT-EHEALTH [48] were used for study reporting.

Recruitment procedure and participants

Participants were recruited online between January 2019 and February 2020. In addition to

unpaid cross-posting, paid advertisements were placed on social media websites (Facebook and Instagram) targeting women aged 18–45 years old with interests in maternity topics. The tagline to advertise the study was “Did you have a baby in the last three months? We want to know if Be a Mom is effective in promoting postpartum women’s mental health, and you can help us! To know if you are eligible to participate in the study fill out the following form and we will contact you”. Participants who clicked on the link were then given information about the study’s goals and procedures, the participants’ and researchers’ roles, the voluntary nature of participation, and all aspects related to data protection (anonymity and confidentiality). Participants who gave online informed consent (by clicking the option “I understand and accept the conditions of the study”) answered a set of questions to assess eligibility criteria and provided their contact information (email address and telephone number). The inclusion criteria to participate in this study were a) being in the early postpartum period (up to 3 months postpartum); b) being 18 years or older; c) presenting low risk for PPD (having a score lower than 5.5 on the Postpartum Depression Predictors Inventory-Revised; [49]); d) having internet access at home; e) being a resident of Portugal; and f) understanding Portuguese. Exclusion criteria were the presence of a serious medical condition (physical or psychiatric) in the mother or in the infant (self-reported). Participants who did not meet eligibility criteria were sent an email informing them of the reason they could not participate in this study and advising them to seek professional help if needed. Because this study was part of a wider research project, women who presented risk factors for PPD were contacted by the research team to take part in a separate study to assess Be a Mom’s efficacy in preventing postpartum depressive symptoms (i.e., the primary outcome was depressive symptoms).

A priori calculations indicated that a sample size of at least 200 participants at postintervention assessment was needed to assess preliminary evidence of efficacy for the primary outcome (detecting a small effect size [$d = .10$] with a statistical power of .80 in a two-tailed test, $p < .05$). Considering the dropout rate of approximately 35% in the pilot study of Be a Mom [39], at least 350 participants were needed for randomization.

Randomization

After completing the baseline assessment, eligible participants were randomly assigned (allocation ratio 1:1) to the intervention group (Be a Mom) or to the WLC group. Randomization was performed using a computerized random number generator. After randomization, participants received an email with information about their assigned group. The last author was responsible for randomization, and the first author was responsible for the enrollment and assignment of participants to either the Be a Mom group or the WLC group.

Interventions

Participants in the intervention arm were invited to a password-protected website that contained the Be a Mom intervention (beamom.pt). Access to the program was free of cost, and no compensation was given to participants. Be a Mom has five sequential modules (Changes and Emotional Reactions; Cognitions; Values and Social Support; Couple's Relationship [only presented to women in a relationship]; PPD Alert Signs and Professional Help-seeking). and its contents are presented in an attractive format (simple text, animations, interactive exercises). The modules follow the structured and goal-oriented nature of CBT: first, the module's goals are presented, followed by the thematic content and, finally, a homework activity at the end to guarantee continued therapeutic practice. Each module has an approximate length of 30-45 minutes, and women can interrupt it whenever they need to and resume when they are available. Asynchronous communication channels (e.g., reminders, email contact for program-related support) are available. The formative evaluation process that informed the design and the intervention components of Be a Mom is detailed elsewhere [50].

Participants were given the instructions that they should complete one module per week, but they were allowed to complete the program at their own pace. Those who did not register on Be a Mom were sent two email reminders during the course of the eight weeks given to complete Be a Mom. Participants who registered on the program and who had a valid telephone number were contacted via telephone by the first author approximately two weeks after registration. This contact aimed to clarify any questions regarding the flow of the program or help with difficulties accessing the website. Email reminders were sent automatically by the Be a Mom website to the participants if they went three, seven and 13 days without accessing it. Approximately two days after completing Be a Mom, participants were sent an email with the postintervention assessment. Those who did not complete the program were sent an email with the postintervention assessment eight weeks after randomization.

Participants in the WLC arm were offered no intervention but were informed that they would receive access to Be a Mom at the end of the study. They were asked to complete the postintervention assessment protocol at the same time as the participants in the Be a Mom group (eight weeks after randomization). All participants could access usual care from their health services.

Outcome variables were assessed at baseline (Time 1 – T1) and eight weeks after randomization (Time 2 – T2) by self-report using the survey platform Limesurvey®. To reduce attrition, email and text message reminders were sent on an alternate basis each week for one month to women in both groups who failed to complete T1 and T2 online questionnaires.

Measures

Women's sociodemographic (e.g., age, marital status, number of children, employment status, educational level, household monthly income, and residence), clinical (psychopathology history) and infant-related data (e.g., infant's age, infant's sex and infant's gestational weeks at birth) were collected through a self-report questionnaire developed by the researchers.

To identify women presenting low risk for PPD, the Portuguese version of the Postpartum Depression Predictors Inventory-Revised (PDPI-R) was used [51]. This questionnaire comprises 39 items answered on a dichotomous scale (yes vs. no, except for the first two items in which participants report their marital and socioeconomic status). The PDPI-R total score ranges from 0 to 39. Higher scores indicate increased risk for PPD. In Portuguese validation studies, a score of 5 or lower is indicative of lower PPD risk [49].

Primary outcome – Positive mental health

Positive mental health was assessed using the Mental Health Continuum Short Form (MHC-SF; [52]; Portuguese Version [PV]: [53]). The MHC-SF comprises 14 items divided into three dimensions: emotional (3 items; e.g., "During the past month, how often did you feel happy?"), social (5 items; e.g., "During the past month, how often did you feel that you had something important to contribute to society?") and psychological wellbeing (6 items; e.g., "During the past month, how often did you feel that your life has a sense of direction or meaning to it?"). Each item is rated on a six-point response scale from 0 (*never*) to 5 (*every day*) in reference to the last month. In Portuguese psychometric studies, only the use of the total score was recommended as no adequate support was found for the use of the subscales as measures of distinct dimensions. The MHC-SF can be scored continuously (scores range from 0 to 70, and higher scores indicate better positive mental health) or categorically considering mental health status (flourishing, moderate mental health, languishing). Using Keyes' criteria [52], women who answered *every day* or *almost every day* at least once in the emotional wellbeing subscale and at least six times in the psychological and social wellbeing subscales were categorized as flourishing. Women who answered *never* or *once or twice* for at least one item in the emotional wellbeing subscale and at least six items in the psychological and social wellbeing subscales were categorized as languishing. Finally, women who did not fit the criteria for either flourishing or languishing were considered moderately mentally healthy. In this study, we categorized participants as flourishing and not flourishing (including both languishers and those with moderate mental health). The Cronbach's alpha values in this study ranged from .90 (intervention group – T1) to .93 (intervention group – T2).

Secondary outcomes

The Edinburgh Postnatal Depression Scale (EPDS; [54]; PV: [54]) was used to assess postpartum depressive symptoms. EPDS comprises 10 items (e.g., “I have blamed myself unnecessarily when things went wrong”) that are rated with an individualized four-point response scale (ranging from 0 to 3). The total score ranges between 0 and 30, and higher scores are indicative of more severe depressive symptoms. In this study, the Cronbach’s alpha values ranged from .80 (intervention group – T1) to .86 (control group – T2).

The Anxiety Subscale of the Hospital Anxiety and Depression Scale (HADS-A; [55]; PV: [56]) was used to assess anxiety symptoms. This widely used seven-item subscale (e.g., “Worrying thoughts go through my mind”) employs a four-point response scale (ranging from 0 to 3) that assesses the presence of anxiety symptoms in the week prior to completion. Higher scores denote higher anxiety symptoms. In this study, the Cronbach’s alpha values ranged from .76 (intervention group – T1) to .82 (intervention group – T2).

The Empowerment Scale (ES; [57]; PV: [58]) was used to assess empowerment. The ES is a self-reported questionnaire with 20 items (e.g., “I am usually confident about the decision I make”) that are rated with a four-point scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). Higher scores indicate higher levels of empowerment. The Cronbach’s alpha values in this study ranged from .79 (control group – T2) to .89 (intervention group – T2).

Women’s perception of self-efficacy in the mothering role was assessed using the Perceived Maternal Parenting Self-Efficacy (PMP S-E; [59]). This measure comprises 20 items (e.g., “I am good at understanding what my baby wants”) rated with a four-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate higher levels of perceived self-efficacy. In this study, the Cronbach’s alpha values ranged from .91 (control group – T2) to .95 (intervention group – T2).

The Satisfaction subscale of the Investment Model Scale (IMS-S; [60]; PV: [61]) was used to assess satisfaction in the relationship with the woman’s partner. This subscale comprises five items (e.g., “Our relationship makes me very happy”) answered on nine-point scale ranging from 0 (*do not agree at all*) to 8 (*completely agree*). Higher scores indicate higher satisfaction with the relationship. In this study, the Cronbach’s alpha values ranged from .81 (intervention group – T1) to .83 (control group – T2).

Be a Mom’s web system data

Data were collected through the Be a Mom website regarding the number of completed modules and pages accessed in each module, number of logins, average minutes spent on the website at each login, number of finished exercises and number of times each audio exercise was

played.

Be a Mom's acceptability and experience

At the postintervention assessment, the intervention group completed an additional set of questions referring to Be a Mom's acceptability. Participants were asked to answer questions with a two-point response scale (1 = *not applicable to me*; 2 = *applicable to me*) regarding their satisfaction with the help provided by the program, their intentions to use it again if needed and to recommend it to a friend, usefulness/relevance of the information learned and demandingness. Additional questions were presented about the participant's experience using Be a Mom; these were open-ended questions regarding the presence of others when accessing the program and reasons for not completing all modules of Be a Mom, when applicable.

Data analysis

Statistical analyses were conducted in accordance with the intention-to-treat principles following the CONSORT statement [62] so that all participants who completed baseline assessment were included even if they did not complete postintervention assessment. Data were analyzed using the Statistical Package for Social Sciences (IBM SPSS, version 23.0). Descriptive statistics and comparison tests (t-tests and chi-squared tests) were computed for sample characterization and to examine Be a Mom's usage and acceptability. Comparison analyses were also conducted between completers and dropouts and completers and non-completers. Dropout was defined as not completing the postintervention assessment regardless of the number of modules completed, and non-completers were defined as not completing the intervention.

Linear mixed models (LMMs) were used to determine the effects of the intervention over time on primary and secondary outcomes. LMMs are particularly helpful in longitudinal studies with missing data because they allow incomplete cases to be included in the analysis. All available data are used to obtain parameter estimates with small bias in the presence of data missing completely at random or missing at random [63]. Group, time and time by group interaction and covariates (variables presenting statistically significant differences between intervention and control groups at T1 and between completers and dropouts at T2: previous history of psychopathology, infant's age and category of positive mental health) were fitted as fixed effects. Participant were included as a random intercept. An LMM with an autoregressive covariance matrix was conducted for each outcome with the assumption of data missing completely at random (Little's MCAR test $\chi^2 = 415.21$, $p = .938$). Missing endpoints at posttest ranged from 119/367 (32.4%) on the MHC-SF to 127/367 (34.6%) on the SCS-SF.

Additionally, chi-squared tests were used to examine differences in the proportion of

patterns of change as a function of group (intervention vs. control group) considering the primary outcome. Based on the cutoff scores of the MHC-SF, participants were categorized as flourishing or not flourishing at both T1 and T2. Participants were then classified in accordance with their pattern of change from T1 to T2: a) maintenance – flourishing (if they were flourishing at both T1 and T2); b) maintenance – not flourishing (if they were not flourishing at both T1 and T2); c) deterioration (if they were flourishing at T1 and not flourishing at T2); and d) improvement (if they were not flourishing at T1 and flourishing at T2).

Results

Participant characteristics

Figure 1 shows the flow diagram of the participants throughout the study period. Of the 1657 women who were screened for eligibility, 72.5% ($n = 1202$) were excluded due to not meeting eligibility criteria (mostly because they presented risk for PPD; $n = 1030$, 85.7%). Of the 455 eligible participants, 367 completed the baseline assessment and were randomized and allocated to the intervention group ($n = 191$) or to the WLC group ($n = 176$).

Table 1 summarizes the baseline sociodemographic and clinical characteristics of the intervention and control groups. There were no significant differences in most sociodemographic and clinical characteristics. However, a significantly higher proportion of participants in the intervention group had a previous history of psychopathology than in the control group (25.1% vs. 14.2%, $\chi^2 = 6.86$, $p = .009$). The control group also had a significantly higher proportion of participants who were flourishing (67% vs. 57.1%, $\chi^2 = 3.86$, $p = .049$).

The overall retention rate at the postintervention assessment was 67.8%. The intervention arm had significantly higher loss to follow-up than the control arm (intervention group: $n = 87$, 45.5% vs. control group: $n = 31$, 17.6%, $\chi^2 = 32.77$, $p < .001$). Potential differences between completers and dropouts on baseline sociodemographic and clinical characteristics were explored but did not reveal any significant differences. The only exception was infant age, with infants of the participants who dropped out of the study being older than the infants of those who completed the postintervention assessment ($M = 2.11$ months, $SD = 0.97$ vs. $M = 1.77$ months, $SD = 1.20$, $t = -2.68$, $p = .008$). The proportion of women who had psychological/psychiatric treatment after the baseline assessment was also similar in both groups (intervention group: $n = 8$, 7.7% vs. control group: $n = 7$, 4.9%, $\chi^2 = 0.85$, $p = .356$).

Figure 1. Flowchart of the participants in the study.

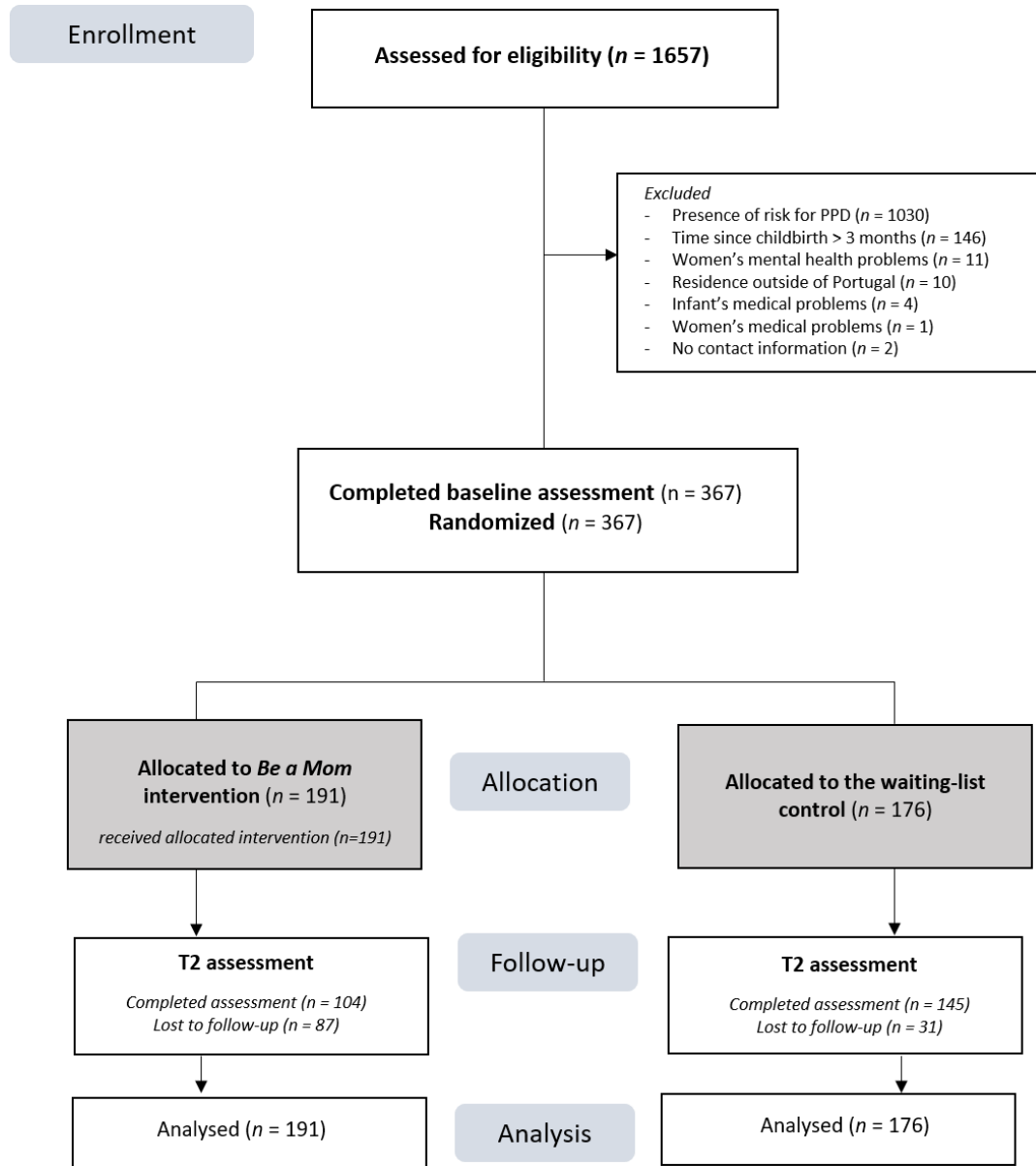


Table 1. Participants' sociodemographic and clinical characteristics at baseline.

	Intervention group (<i>n</i> = 191)	Control group (<i>n</i> = 176)	<i>t</i> / χ^2
	<i>M</i> (<i>SD</i>) / <i>n</i> (%)	<i>M</i> (<i>SD</i>) / <i>n</i> (%)	
Age	32.97 (4.04)	33.03 (4.43)	-0.14
Marital status			0.53
Married/co-habiting	183 (95.8)	170 (96.6)	
Single	4 (2.1)	2 (1.1)	
In a relationship (without living together)	4 (2.1)	4 (2.3)	
Primiparous	140 (73.3)	122 (69.3)	0.71
Employment status			3.35
Employed	176 (92.1)	170 (96.6)	
Not currently working	15 (7.9)	6 (3.4)	
Educational level			5.66
Up to the 9 th grade	2 (1.0)	4 (2.3)	
10 th to 12 th grade	30 (15.7)	26 (14.8)	
Bachelor's degree	83 (43.5)	58 (33)	
Master's or Doctorate	76 (39.8)	88 (50)	
Household monthly income			4.92
Less than 580€	8 (4.2)	9 (5.1)	
580€-1000€	88 (46.1)	80 (45.5)	
1000€-2000€	87 (45.5)	70 (39.8)	
More than 2000€	8 (4.2)	17 (9.7)	
Residence			1.06
Urban	141 (73.8)	138 (78.4)	
Rural	50 (26.2)	38 (21.6)	
Psychopathology history			6.86*
Yes	48 (25.1)	25 (14.2)	
No	143 (74.9)	151 (85.8)	
Positive mental health			3.86*
Flourishing	109 (57.1)	118 (67)	
Not flourishing	82 (42.9)	58 (33)	
Infant's age (in months)	1.89 (0.94)	1.87 (1.32)	0.16
Infant's sex			0.43
Male	98 (51.3)	93 (53.1)	
Infant's gestational weeks (at birth)	38.89 (1.64)	38.95 (1.77)	-0.33

Note. * $p < 0.05$.

Be a Mom's preliminary evidence of efficacy: Comparison with the control group

Table 2 presents the estimated marginal means of all outcome measures and fixed effects for time, group and time x group interaction as well as for covariates (psychopathology history, infant's age and category of positive mental health at baseline).

Table 2. Estimated marginal means and fixed effects for primary and secondary outcome measures.

	Group	Time 1 <i>M (SE)</i>	Time 2 <i>M (SE)</i>	Effect	<i>B (SE)</i>	95% CI	<i>p</i>
MHC-SF	<i>Intervention</i>	51.17 (0.54)	53.94 (0.69)	Time	-2.77 (0.69)	[-4.13, -1.40]	<.001
	<i>Control</i>	50.47 (0.57)	51.19 (0.61)	Group	-2.74 (0.93)	[-4.56, -0.92]	.003
				Time x Group	2.05 (0.93)	[0.22, 3.87]	.028
				Psychopathology history	0.43 (0.88)	[-1.31, 2.16]	.630
				MHC-SF baseline category	13.75 (0.73)	[12.31, 15.18]	<.001
				Infant's age	-0.10 (0.31)	[-0.70, 0.50]	.748
	EPDS	<i>Intervention</i>	6.38 (0.26)	5.26 (0.33)	Time	1.12 (0.34)	[0.45, 1.80]
<i>Control</i>		6.72 (0.27)	6.19 (0.29)	Group	0.93 (0.45)	[-0.06, 1.81]	.036
				Time x Group	-0.60 (0.46)	[-1.50, 0.31]	.194
				Psychopathology history	-1.43 (0.42)	[-2.25, -0.61]	.001
				MHC-SF baseline category	-2.75 (0.34)	[-3.42, -2.08]	<.001
				Infant's age	-0.05 (0.14)	[-0.33, 0.23]	.739
HADS-A		<i>Intervention</i>	4.40 (0.22)	3.88 (0.28)	Time	0.53 (0.29)	[-0.04, 1.09]
	<i>Control</i>	4.54 (0.23)	4.72 (0.25)	Group	0.84 (0.38)	[0.09, 1.59]	.028
				Time x Group	-0.71 (0.38)	[-1.46, 0.05]	.067
				Psychopathology history	-2.02 (0.36)	[-2.73, -1.31]	<.001
				MHC-SF baseline category	-1.62 (0.30)	[-2.20, -1.04]	<.001
				Infant's age	0.05 (0.12)	[-0.20, 0.29]	.710
	PMPSE	<i>Intervention</i>	69.06 (0.48)	73.09 (0.59)	Time	-4.11 (0.58)	[-5.14, -2.92]
<i>Control</i>		67.87 (0.50)	72.57 (0.53)	Group	-0.56 (0.81)	[-2.09, 1.05]	.517
				Time x Group	-0.63 (0.77)	[-2.15, 0.81]	.375
				Psychopathology history	-0.80 (0.79)	[-2.41, 0.72]	.285
				MHC-SF baseline category	3.84 (0.65)	[2.54, 5.10]	<.001
				Infant's age	0.94 (0.27)	[0.40, 1.47]	.001
ES		<i>Intervention</i>	61.05 (0.38)	61.52 (0.46)	Time	-0.47 (0.40)	[-1.27, 0.32]
	<i>Control</i>	61.32 (0.40)	61.05 (0.42)	Group	-0.47 (0.63)	[-1.70, 0.76]	.454
				Time x Group	0.74 (0.54)	[-0.32, 1.79]	.170
				Psychopathology history	0.73 (0.65)	[-0.55, 2.01]	.264
				MHC-SF baseline category	4.29 (0.53)	[3.24, 5.34]	<.001
				Infant's age	-0.22 (0.22)	[-0.66, 0.22]	.331
	IMS-S	<i>Intervention</i>	6.54 (0.09)	6.36 (0.11)	Time	0.19 (0.09)	[0.00, 0.37]
<i>Control</i>		6.48 (0.09)	6.30 (0.10)	Group	-0.05 (0.14)	[-0.33, 0.23]	.718
				Time x Group	-0.02 (0.12)	[-0.26, 0.23]	.901
				Psychopathology history	0.20 (0.15)	[-0.08, 0.49]	.166
				MHC-SF baseline category	0.57 (0.12)	[0.33, 0.81]	<.001
				Infant's age	-0.11 (0.05)	[-0.21, -0.02]	.024

Note. MHC-SF – Mental Health Continuum-Short Form; EPDS – Edinburgh Postnatal Depression Scale; HADS-A – Hospital Anxiety and Depression Scale-Anxiety; ES – Empowerment Scale; PMPSE – Perceived Maternal Parenting Self-Efficacy; IMS-S – Investment Model Scale-Satisfaction.

Regarding the primary outcome, the LMM revealed a significant effect of time x group interaction, with women in the intervention group reporting a greater increase in positive mental health levels than participants in the control group (see **Figure 2**).

Regarding the secondary outcomes, significant effects of group were found for depressive and anxiety symptoms. Specifically, we found that these symptoms were higher overall in the control group. Although no significant time x group interactions were found, **Figure 2** shows that a greater decrease in depressive and anxiety symptoms was found from T1 to T2 in the intervention group.

Regarding the remaining secondary outcomes, no interaction effects of time x group were found. For maternal self-efficacy and relationship satisfaction, significant effects of time were found. In both the intervention and control groups, there was a decrease in satisfaction in the relationship with the partner and an increase in maternal self-efficacy from T1 to T2, but there were no significant differences between the Be a Mom group and the WLC group.

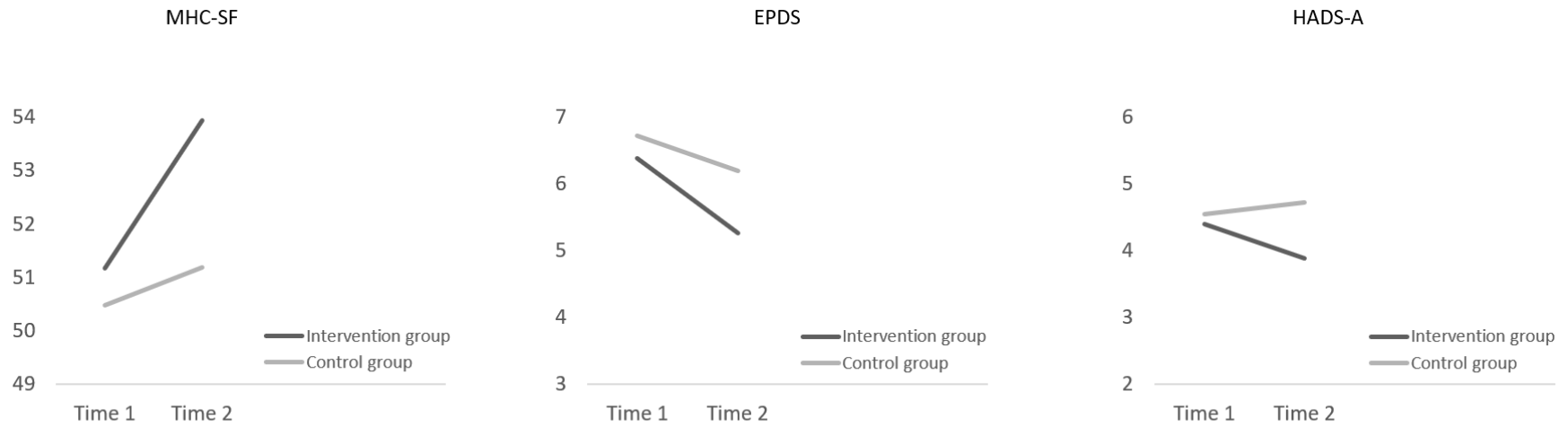


Figure 2. Intervention and control group trajectories for the Mental Health Continuum-Short Form, the Edinburgh Postnatal Depression Scale and the Anxiety subscale of the Hospital Anxiety and Depression Scale from T1 to T2 (based on mean estimates from linear mixed models).

Figure 3 shows that a significantly higher proportion of women in the intervention group had an improvement trajectory (from not flourishing at T1 to flourishing at T2) compared to women in the control group ($n = 21$, 20.2% vs. $n = 14$, 9.7%, $\chi^2 = 10.59$, $p = .014$). Additionally, a higher proportion of women in the control group had a deterioration trajectory (from flourishing at T1 to not flourishing at T2) compared to women in the intervention group ($n = 18$, 12.4% vs. $n = 4$, 3.8%).

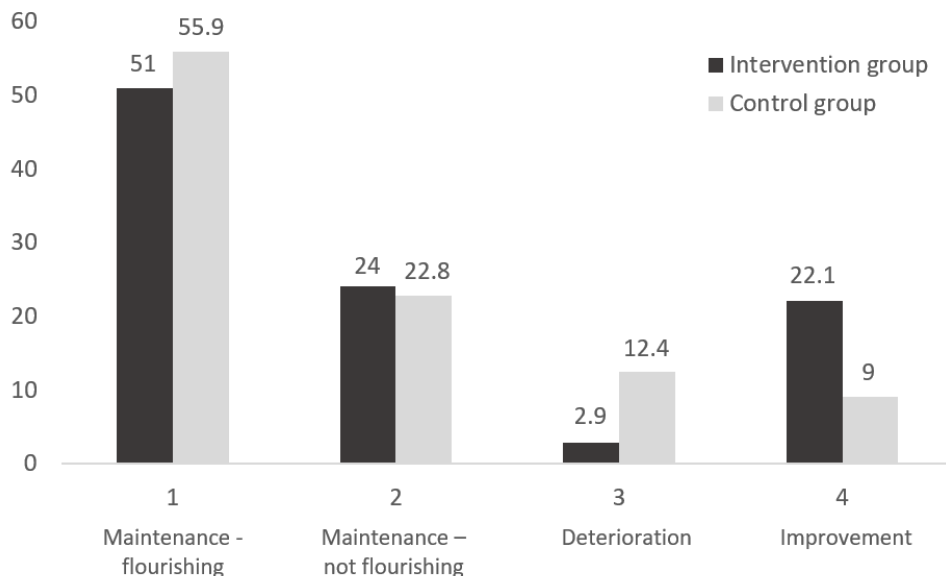


Figure 3. Trajectory of participants in the intervention and control groups from Time 1 to Time 2 regarding category of positive mental health. Maintenance – flourishing: flourishing at both T1 and T2; Maintenance – not flourishing: not flourishing at both T1 and T2; Deterioration: flourishing at T1 and not flourishing at T2; Improvement: not flourishing at T1 and flourishing at T2.

Adherence to the intervention, Be a Mom’s usage and acceptability

A total of 191 participants received an email invite to access the Be a Mom website. Of these, 62 (32.5%) completed the intervention, 23 (12%) completed half of the program, and 20 (10.5%) did not register on the website and initiate the intervention. Of the participants who registered on the Be a Mom website, 29 (17%) participants did not complete any module.

Considering all 171 participants who registered on the Be a Mom website, the average number of logins was 6 ($SD = 3.78$, range: 1-20) and the average number of minutes spent on the website in each login was 16 ($SD = 11.80$, range: 0-73). The majority of participants finished all four exercises of module 1 ($n = 128$, 74.9%) and the two exercises of module 2 ($n = 103$; 60.2%). Considering the participants who completed modules three, four and five, most of them finished all

exercises proposed (four in module three, two in modules four and five; $n = 73/80$, 91.3%; $n = 58/60$, 96.7%; $n = 30/59$, 50.8%, respectively). Most of the participants who completed module 2 listened to the two audio exercises provided (observing thoughts and distancing of thoughts) ($n = 78/103$, 75.7% and $n = 48/103$, 46.6%, respectively).

Moreover, 113 participants in the intervention group answered a questionnaire about their experience using Be a Mom and its acceptability. Of these, 55 (48.7%) did not complete the intervention. Regarding the reasons for not completing Be a Mom, 53 (96.4%) participants highlighted lack of time, one (1.8%) participant answered that it was due to personal issues and one (1.8%) answered that Be a Mom was not useful in her case. Most women accessed Be a Mom on their own ($n = 102$; 90.3%). The remaining 11 participants accessed Be a Mom with their partners ($n = 10$; 90.9%) and other family members ($n = 1$; 9.1%), and all considered it beneficial for them and for the other person.

Of the 113 participants who answered the acceptability questionnaire, 65.5% ($n = 74$) were satisfied with the help provided by Be a Mom, 85% ($n = 96$) would recommend it to a friend, and 72.6% ($n = 82$) would use it again if needed. Moreover, 92% ($n = 104$) of participants rated the quality of Be a Mom as good/excellent. Additionally, 74.3% ($n = 84$) felt that they had learned relevant information with Be a Mom. Finally, 21 women (5.7%) considered participating in Be a Mom to be too demanding.

When comparing completers and non-completers of Be a Mom, a higher proportion of completers was satisfied with the help provided by Be a Mom ($n = 43$, 74.1% vs. $n = 31$, 56.4%, $\chi^2 = 3.95$, $p = .047$). Moreover, when compared to non-completers, a higher proportion of completers would recommend Be a Mom to a friend ($n = 54$, 93.1% vs. $n = 42$, 76.4%, $\chi^2 = 6.19$, $p = .013$), would use it again if they needed ($n = 48$, 82.8% vs. $n = 34$, 61.8%, $\chi^2 = 6.22$, $p = .013$) and felt that they learned relevant information with the program ($n = 49$, 84.5% vs. $n = 35$, 63.6%, $\chi^2 = 6.43$, $p = .011$). A higher proportion of non-completers considered participating in the Be a Mom program to be too demanding compared to completers ($n = 17$, 30.9% vs. $n = 4$, 6.9%, $\chi^2 = 10.76$, $p = .001$).

Discussion

The current study examined the efficacy of a web-based intervention, Be a Mom, in increasing positive mental health among postpartum women presenting low risk for PPD compared to a waiting-list condition. The efficacy of Be a Mom on secondary outcomes (depressive and anxiety symptoms, maternal self-efficacy, empowerment and relationship satisfaction) was also examined. The results of our study suggest that Be a Mom was superior to the WLC in increasing positive mental health. Additionally, there was a decreasing trend over time in depressive and anxiety symptoms in the Be a Mom group. Be a Mom was also shown to be an acceptable web-based

intervention among low-risk postpartum women with satisfactory adherence and usage.

The significant improvement of positive mental health in the Be a Mom group is in line with previous evidence supporting the efficacy of web-based CBT interventions to promote positive mental health [42,43]. However, this is one of the first trials to successfully demonstrate this in the postpartum period. Additionally, our results showed that Be a Mom increased the proportion of flourishers over time. Conversely, a higher proportion of women in the control group had a deterioration trajectory (from flourishing at baseline to not flourishing at postintervention assessment). This is an important finding given the demonstrated importance of flourishing in protecting against future adversities and mental disorders, such as anxiety and depression [27,28], as well as its association with several health and psychosocial outcomes [24,64]. Thus, Be a Mom could have an important impact on mental health outcomes in the long term and, as such, enhance public mental health. Future studies using long-term assessments could test this hypothesis.

Regarding the secondary outcomes, the interaction effects of time and group failed to reach statistical significance. However, regarding depressive and anxiety symptoms, we found significant group effects (these symptoms were higher in the control group) as well as a trend of a greater decrease in the intervention group, particularly for anxiety symptoms. When looking at mean estimates, we found that from T1 to T2, there was an increase in anxiety symptoms in the control group contrasting with a reduction in the intervention group. This suggests that participants who received the Be a Mom program had greater benefits than those in the control group. However, although the efficacy of Be a Mom in reducing depressive and anxiety symptoms was previously demonstrated [39], it is important to note that Be a Mom seems to not have a substantial impact on such symptoms among low-risk postpartum women. A possible explanation may be the relatively low levels of depressive and anxiety symptoms at baseline, which leaves limited space for improvement.

Moreover, we found an increase over time in maternal self-efficacy in both study groups. This is consistent with the existing literature [65,66]: infants' demands become more predictable as they grow older, providing the opportunity to increase the mother's ability to successfully perform childcare tasks. However, we found that Be a Mom did not have a significant impact on the maternal self-efficacy of low-risk women. Although Be a Mom does not target caregiving behaviors, we expected that the emotional state of participants would influence the assessment of their self-efficacy, in line with Bandura's self-efficacy theory [67] and previous studies associating depressive symptoms with lower maternal self-efficacy [68]. This result is consistent with those previously found on the efficacy of Be a Mom among a high-risk sample [39] and provides further evidence that Be a Mom may not be a suitable intervention to contribute to maternal confidence and self-efficacy, at least in the short term.

With respect to the results on empowerment, small, nonsignificant differences were found between the groups over time. Looking at mean estimates, the results suggest an increase in empowerment in the Be a Mom group compared with a decrease in the control group. A previous trial in the general population highlighted the significant impact of a web-based intervention on empowerment levels [37], suggesting that individuals who access the intervention may feel that they are more informed and involved in managing their own health outcomes. However, this was not found for Be a Mom. Future trials with follow-up assessments could provide more information on the pattern of this finding.

Finally, we found that both groups presented a decline in relationship satisfaction over time. Previous studies have emphasized that the arrival of an infant can strain the romantic relationship and produce changes in the couple, with a decline in satisfaction [69]. Although Be a Mom has a module that focuses on the changes that can happen within the couple during this period, most participants (90.3%) accessed Be a Mom on their own. The strategies that are presented (e.g., acknowledging the difficulties experienced by the other member of the couple, assertive and open communication skills, accepting differences in backgrounds and parental values) should ideally be implemented in a joint effort by the two members of the couple. In the future, further efforts and instructions to involve partners when accessing Be a Mom could help clarify its impact on relationship satisfaction.

In addition to the results on the efficacy of Be a Mom, our study provided results on Be a Mom's acceptability as well as its usage and adherence. Extending on previous acceptability results among postpartum women presenting risk factors for PPD [39], Be a Mom appears to also be an acceptable option for low-risk postpartum women. However, adherence to the intervention was relatively low (only 32.5% women completed Be a Mom). This result is congruent with those found by previous research with web-based interventions applied to universal samples during the perinatal period [44,45] and could be explained by the hectic and challenging period women are experiencing, which leaves them with limited time for themselves. Additionally, Be a Mom is a fully self-guided intervention that was delivered to a low-risk sample with relatively good levels of overall mental health at baseline. It is possible that participants perceived that they did not need to complete the intervention and prioritized their limited time with other tasks. Nevertheless, those who completed the intervention or accessed half of the modules adhered to most of the exercises that were proposed.

Overall, the results of our study are very encouraging: they support mental health promotion strategies in the postpartum period and highlight the important role of web-based CBT interventions in achieving this. First, the postpartum represents an appropriate period to implement mental health promotion strategies given the pervasive consequences of mental health problems during this

period and how they might shape children's development and health outcomes in the long term [11]. Second, the finding that low-risk women may significantly benefit from Be a Mom gives strength to the argument that mental health promotion strategies at a population level are needed. Growing research has emphasized that it is not sufficient to target only groups suffering from mental disorders or at-risk groups as new cases of mental illness will emerge [70,71]. A small change in the average level of positive mental health per individual could lead to significant benefits in population terms and shift the population distribution of positive mental health [70], with a possible impact on the prevalence and burden of mental disorders. Finally, Be a Mom's brief and unguided format provides the opportunity to be delivered with low costs and to be easily disseminated at a population level. If implemented in healthcare, Be a Mom could be used as an early intervention of a stepped-care model, which is highly recommended by international guidelines [72], and could consequently provide a more efficient use of resources.

Although the results of our study are innovative and may add important input to public health policies, some limitations should be considered when interpreting our findings. First, the generalizability of the results is limited because the participants in the current study were self-selected, and it is possible that women with an interest in the topic were more likely to participate. Moreover, one criterion to be included in this study was having internet access and this could also represent a selection bias. Additionally, our sample was mainly composed of highly educated and employed women. Future studies could build on current findings by investigating the efficacy of Be a Mom in more heterogeneous and representative samples. Second, there was a high attrition rate and low adherence in the intervention group. This is in line with previous intervention studies in the perinatal period [46] and, as previously mentioned, could be explained by the demanding nature of the early postpartum period. The lower attrition rate in the control group could be explained by the added incentive of gaining access to Be a Mom by continuing participation in the study. Future intervention studies during the postpartum period need to take into account the challenging and time-restricted period women are experiencing when designing research. Brief assessment protocols could help improve attrition rates. Additionally, future studies using the Be a Mom program must be mindful of this study's low adherence. Although a great proportion of participants answered that they did not complete the program due to lack of time, it is important to understand the reasons underlying this low rate and how much does it reflect the demandingness of the early postpartum period or the intervention's structure, length and contents. Third, the lack of an active control group does not allow us to rule out the possibility that the effects found were due to social desirability or placebo effects. Fourth, while the present study found evidence of the efficacy of Be a Mom in enhancing positive mental health, the observed effect was only a short-term improvement. Thus, the results presented are best interpreted as providing promising evidence. Future RCTs with follow-

up assessments are needed to test Be a Mom's efficacy in producing enduring positive effects. Examining the long-term impact of this approach with added input from a cost-effectiveness analysis could meaningfully inform public health policies. Finally, the mechanisms that explain the participants' response to treatment were not directly explored in this study. Because Be a Mom was developed to mainly target psychological resources such as self-compassion and emotion regulation, further studies exploring whether these mechanisms are involved in explaining the increase in levels of positive mental health are needed.

Conclusions

The promotion of positive mental health in the perinatal period has received very little attention to date. This is one of the first trials to test a web-based CBT intervention for this purpose among postpartum women presenting low risk for PPD. Given our findings, Be a Mom could be considered a new mental health promotion strategy among Portuguese postpartum women. The results of this pilot trial support its preliminary efficacy in increasing positive mental health to a flourishing mental health status with the potential to reduce depressive and anxiety symptoms among a nonclinical population. As an unguided web-based intervention, Be a Mom offers an accessible intervention option that could easily be disseminated among all postpartum women. Further research with a larger sample and long-term follow-up assessments is required to consolidate our findings and significantly inform public health policies.

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EMPIRICAL STUDY IV

Be a Mom, a web-based intervention to promote positive mental health among postpartum women with low risk for postpartum depression: Exploring psychological mechanisms of change

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**Be a Mom, a web-based intervention to promote positive mental health among postpartum women with low risk for postpartum depression:
Exploring psychological mechanisms of change**

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Abstract

Background: This study explored whether Be a Mom, a brief and unguided cognitive behavioral web-based intervention, was effective in promoting psychological processes (self-compassion, psychological flexibility, emotion regulation) among low-risk postpartum women. Effects of Be a Mom in psychological processes compared with a control group were examined at post-intervention and at four-months follow-up. Additionally, this work explored whether changes in psychological processes mediated improvements in positive mental health at postintervention.

Methods: In total, 367 postpartum women presenting low risk for postpartum depression were randomly assigned to the intervention group ($n = 191$) or to a waiting-list control group ($n = 176$).

Results: Compared with the control group, the intervention group reported significantly greater baseline to postintervention increases in self-compassion. No significant effects were found at the four-month follow-up. Multilevel mediation showed that self-compassion improvements significantly mediated improvements in positive mental health among the intervention group. No significant results were found for psychological flexibility or emotion regulation.

Conclusions: This study suggests that Be a Mom has the potential to cultivate self-compassion among low-risk postpartum women and that this may be a key mechanism for promoting positive mental health in this context.

Clinical trial registration: www.clinicaltrials.gov, identifier: NCT04055974.

Keywords: web-based intervention; randomized controlled trial; positive mental health; self-compassion; postpartum period; multilevel mediation.

Introduction

The importance of research focused on postpartum women's mental health is highlighted by the long-term impact it has on infant health and development (e.g., 1), as well as the burden it imposes on economy and society (2, 3), making maternal mental health a health priority. The transition to motherhood constitutes a major life transition as it requires a number of inter- and intrapersonal changes and the need to adapt to numerous demanding tasks and responsibilities, from infant care to financial strains (4, 5). Although there is no consensus on how long the postpartum period is, psychological studies have considered that time frames of up to one year after the birth of a child are relevant to study the mother's psychological adjustment to their new role (e.g., 6, 7). Given the wide range of stressors that women may experience during this period, this life transition may adversely affect their mental health, which is common to all women in the postpartum period, including those presenting no increased psychosocial risk (8).

Numerous efforts have been made regarding the treatment and prevention of mental disorders during the postpartum period (9); however, from a public health perspective, more needs to be done. Recent studies have highlighted that the promotion of positive mental health is also essential during this period (10, 11) and may have a positive impact on infant development (12). Positive mental health has been considered a multidimensional construct that involves the presence of emotional (positive feelings), psychological (optimal functioning in life) and social (optimal social functioning) wellbeing (13). Optimal levels of wellbeing on these three dimensions can be defined as flourishing mental health (13). Positive mental health is an important aspect of coping with adversity as previous results have shown its protective role in the development of mental illness, particularly when exposed to stressful life events (e.g., 14, 15). Additionally, high levels of positive mental health have been associated with better psychosocial functioning, better physical health and greater resilience to vulnerabilities and challenges in life (13, 16, 17). More specifically, positive emotions also appear to broaden one's thought-action repertoires and facilitate behavioral flexibility and build personal resources, such as social relationships and resilience (18-20). Considering these benefits and the call for prioritization of research focused on positive mental health (21), increasing studies have focused on directly addressing positive mental health as an intervention outcome (e.g., 22, 23), including in the perinatal period (10, 24, 25).

Because positive mental health has rarely been studied, there is scarce knowledge on its determinants. Most existing research has focused on sociodemographic and situational variables (e.g., 26, 27). However, to build positive mental health, psychological processes and coping skills can be addressed and enhanced through psychological interventions that promote cognitive and emotional resources. This is the case for self-regulatory processes, such as self-compassion, emotion regulation and psychological flexibility, which have often been associated with positive

mental health (e.g., 28, 29-31).

Self-compassion can be defined as an attitude of kindness and acceptance towards oneself when confronted with difficult experiences as opposed to being self-judgmental, feeling isolated and overidentifying with personal difficulties (32). Increasing evidence has suggested that self-compassion could be a meaningful variable in the development and maintenance of positive mental health (e.g., 30, 33, 34). Because it invokes kindness, self-compassion can help guard against the self-criticism and guilt that may arise when dealing with the challenges of parenting (35). Indeed, in a sample of postpartum women, recent findings have shown that higher levels of self-compassion increased the likelihood of having higher levels of positive mental health (11). Moreover, a study using a web-based intervention grounded on the compassionate approach found that changes in self-compassion significantly mediated the effect of the intervention on changes in positive mental health among postpartum women (10).

Psychological flexibility refers to the ability to be aware of the present moment and to willingly accept and experience thoughts and feelings that unfold without trying to control or avoid them while acting in a way that is consistent with one's values (36). Previous studies with acceptance-based interventions in general adult population samples have shown that the enhancement of psychological flexibility mediated the effects of the intervention on positive mental health (37, 38). Although still scarce, it has been shown that greater psychological flexibility was a significant contributor to greater positive mental health in postpartum samples (11).

Emotion regulation is a multidimensional construct that can be broadly defined as an individual's ability to identify, to understand, to accept emotional experiences and flexibly modulate emotional responses as situationally appropriate (39). Significant negative associations with positive mental health for maladaptive emotion regulation strategies (e.g., avoidance, rumination) and significant positive associations for adaptive emotion regulation strategies (e.g., cognitive reappraisal, acceptance) have been found (28, 29). Although scarcely studied in relation to positive mental health during the postpartum period, maladaptive emotion regulation strategies have been highlighted as relevant predictors of postpartum depressive symptoms (40, 41). Considering the demands faced by women during the postpartum period, adaptively regulating emotions could be a fundamental aspect of psychological functioning and adjustment.

Considering these findings, it is meaningful to give emphasis to the development of interventions that aim to increase the positive mental health of postpartum women through the fostering of such psychological skills and resources. However, women in the postpartum period face several practical and attitudinal barriers that keep them from seeking traditional face-to-face professional help (e.g., demands associated with infant care, feelings of shame and mental health stigma; 42, 43). In this context, eHealth interventions can be particularly helpful, given their

accessibility and flexibility and have been increasingly recognized as an effective approach for the delivery of psychological interventions (44, 45). From a public health perspective, these interventions can serve as helpful mental health promotion tools that can be delivered to a broad population and have an important impact on population mental health (46).

Although still limited and very recent, there is preliminary evidence of web-based cognitive behavioral therapy (CBT) interventions as well as compassionate and acceptance-based approaches in enhancing positive mental health in perinatal samples (10, 24). This is the case of *Be a Mom*, a CBT unguided web-based intervention, which was recently found to be effective in improving positive mental health among low-risk postpartum women (25). *Be a Mom* incorporates aspects of third-wave CBT approaches and addresses concerns specific to the postpartum period (for the formative evaluation process that informed the design and intervention components see 47). Although *Be a Mom* addresses psychosocial risk factors commonly reported in the perinatal literature (e.g., social support, partner relationship), it also gives particular attention to the development of acceptance- and compassionate-focused skills that promote an adaptive transition to this demanding period. Specifically, *Be a Mom* touches on the importance of being aware and of non-judgmentally accept the diversity of thoughts and emotions that are common during this period, as well as on the importance of identifying values and goals and engaging in meaningful behaviors according to those values, as opposed to engaging in maladaptive strategies (e.g., experiential avoidance, self-criticism). A previous study found that *Be a Mom* promoted self-compassion and emotion regulation skills, and this resulted in a significant reduction of depressive symptoms among postpartum women presenting high risk for postpartum depression [PPD] (48). However, we do not know if the same mechanisms of change are responsible for the enhancement of positive mental health among low-risk women.

Therefore, building on these findings (our data derive from a recently performed two-armed pilot randomized controlled trial on the efficacy of *Be a Mom* in enhancing positive mental health (25)), the objectives of the present study were 1) to examine whether *Be a Mom* was effective in enhancing psychological processes (self-compassion, psychological flexibility, emotion regulation) among low-risk postpartum women at post-intervention and if these effects were maintained at four months follow-up; and 2) to explore whether changes in each psychological process mediated improvements in positive mental health-up.

Methods

Setting, participant recruitment and randomization

This study builds further upon the findings of a recently conducted two-arm, open-label

pilot randomized controlled trial (RCT) that showed preliminary evidence of the efficacy of Be a Mom in improving positive mental health among a sample of women presenting low-risk for PPD (25). The study was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra, and it was registered on ClinicalTrials.gov (NCT04055974). Recruitment took place during January 2019 to January 2020 and all participants were recruited online. The access to the intervention was free of cost, and no compensation was given to participants. Outcome variables were assessed at baseline (Time 1 – T1), eight weeks after randomization (Time 2 – T2) and four months after the postintervention assessment (Time 3 – T3) by self-report using the online survey platform Limesurvey. Thorough details of the study design and procedures can be found elsewhere (25).

Briefly, the study was advertised on social media websites through both unpaid cross-posting and paid advertisements. Paid advertisements targeted women aged between 18-45 years old with interests in maternity and newborn topics. Participants who clicked on the advertised link were directed to a page containing information about the aims and procedures of the Be a Mom trial, the participants' and researchers' roles and the voluntary and anonymous nature of participation. After giving online informed consent (by clicking on the option "I understand and accept the conditions of the study"), participants answered a set of questions to assess eligibility criteria. The eligibility criteria of the study were as follows: to be in the early postpartum period (up to 3 months postpartum); age ≥ 18 years; to present low risk for PPD (Postpartum Depression Predictors Inventory-Revised < 5.5); to have internet access at home; to be a resident of Portugal; and to understand Portuguese. Participants were excluded if they had a serious medical condition (physical or psychiatric) or if the infant had a serious health condition (both self-reported).

Randomization was conducted using a computerized random number generator (allocation ratio 1:1). The first author was responsible for the enrollment and assignment of participants and the last author was responsible for randomization. Participants were not blinded to the assigned group.

A *priori* calculations suggested that a sample size of at least 200 participants at postintervention assessment was needed to assess the efficacy of Be a Mom in promoting psychological resources (detecting a small effect size [$d = 0.10$] with a statistical power of 0.80 in a two-tailed test, $p < 0.05$). Considering the dropout rate of approximately 35% in the pilot study of Be a Mom (49), at least 350 participants were needed for randomization.

Intervention

Participants in the intervention arm were invited to a password-protected website with the intervention (beamom.pt). The intervention entails five modules, each averaging 45 minutes in

duration. The duration of the intervention was five weeks, but participants were given eight weeks after randomization to complete the five modules. Those who registered on the website were contacted via telephone to confirm proper use of the platform and to facilitate intervention adherence. Participants were sent an email with the postintervention assessment eight weeks after randomization.

Participants in the WLC arm were informed that they would receive access to Be a Mom at the end of the study and were also asked to complete the postintervention assessment protocol eight weeks after randomization. The T3 protocol assessment was sent to participants of both groups four months after postintervention. Participants in both groups had unrestricted access to usual treatment options. The proportion of women who had psychological/psychiatric treatment after the baseline assessment was similar in both groups at T2 (intervention group: $n = 8$, 7.7% vs. WLC group: $n = 7$, 4.9%, $\chi^2 = 0.85$, $p = .356$) and T3 (intervention group: $n = 6$, 7.1% vs. WLC group: $n = 9$, 6.7%, $\chi^2 = 0.01$, $p = .922$)

Measures

Participants answered a self-reported questionnaire developed by the researchers, including questions about sociodemographic (e.g., age, marital status, educational level) clinical (e.g., psychopathological history) and infant-related data (e.g., infant age, gestational weeks at birth).

Risk for PPD

The Portuguese Version (PV) of the Postpartum Depression Predictors Inventory-Revised (PDPI-R; 50) was used to identify women presenting low risk for PPD. Examples of the factors assessed include marital and socioeconomic status, prenatal depression and anxiety, history of depression, social support, marital satisfaction, life stress and infant temperament. The PDPI-R comprises 39 items answered on a dichotomous scale (yes vs. no, except for the first two items in which participants report their marital and socioeconomic status). The PDPI-R total score ranges from 0 to 39. Higher scores indicate increased risk for PPD. In Portuguese validation studies, a score of 5 or lower is indicative of lower PPD risk (51).

Positive mental health

The Positive mental health was assessed using the PV of the Mental Health Continuum-Short Form (MHC-SF; 52). The MHC-SF comprises 14 items divided into three dimensions: emotional (three items; e.g., "During the past month, how often did you feel happy?"), social (five

items; e.g., “During the past month, how often did you feel that you belonged to a community?”) and psychological wellbeing (six items; e.g., “During the past month, how often did you feel that you liked most parts of your personality?”). Each item is rated on a six-point response scale from 0 (*never*) to 5 (*every day*). Scores on the MHC-SF range from 0 to 70, and higher scores indicate better positive mental health. The MHC-SF also allows a classification of three positive mental health categories: flourishing mental health, moderate mental health and languishing mental health. A classification of flourishing entails scoring 4 or 5 on at least one item of the emotional wellbeing subscale in combination with a 4 or 5 score on at least six items of the social and psychological wellbeing subscales. Languishing is classified as a score of 0 or 1 on at least one item of the emotional wellbeing subscale and at least six items of the social and psychological wellbeing subscales. Those who did not fit these criteria were classified as moderately mentally healthy. In this study, we categorized participants as flourishing and not flourishing (including both languishers and those with moderate mental health). In Portuguese psychometric studies, only the use of the total score was recommended, as no adequate support was found for the use of the subscales as measures of distinct dimensions (52). Cronbach’s alpha values of this study ranged from .90 (intervention group – T1) to .93 (intervention group – T2).

Process variables

The PV of the Self-Compassion Scale – Short Form (SCS-SF; 53) was used to assess women’s self-compassion levels. The SCS-SF is a self-report measure comprising 12 items (e.g., “I’m disapproving and judgmental about my own flaws and inadequacies”) answered on a five-point response scale ranging from 1 (*almost never*) to 5 (*almost always*). Higher scores indicate higher levels of self-compassion. In our sample, Cronbach’s alpha values ranged from .85 (intervention group – T3) to .92 (control group – T2).

The PV of the Acceptance and Action Questionnaire-II (AAQ-II; 54) was used to assess psychological flexibility. Participants were asked to rate each of the seven items (e.g., “Worries get in the way of my success”) on a seven-point response scale ranging from 1 (*never true*) to 7 (*always true*). Higher scores are reflective of greater psychological flexibility. In our sample, Cronbach’s alpha values ranged from .87 (control group – T2) to .93 (intervention group – T2).

The PV of the Difficulties in Emotion Regulation Scale-Short Form (DERS-SR; 55) was used to assess emotion regulation skills. The DERS-SR comprises 18 items (e.g., “I pay attention to how I feel”) answered on a five-point scale ranging from 1 (*almost never*) to 5 (*almost always*). Higher scores suggest more adaptive emotion regulation skills. In this study, Cronbach’s alpha values ranged from .88 (intervention group – T1) to .92 (control group – T3).

Data analysis

Statistical analyses were conducted on all randomized participants, according to the intention-to-treat principles following the CONSORT statement (56). Data were analyzed using the *Statistical Package for Social Sciences* (IBM SPSS, version 23.0). Descriptive statistics were computed for sample characterization and comparison tests (t-test and chi-squared) were performed to compare the intervention and the WLC group as well as completers and dropouts (i.e., those who did not complete T2 and T3 assessments) in terms of background characteristics. Missing endpoints at T2 ranged from 119/367 (32.4%) on MHC-SF to 127/367 (34.6%) on SCS-SF and from 162/367 (44.1%) on AAQ-II to 170/367 (46.3%) on SCS-SF at T3.

Linear mixed models with an autoregressive covariance matrix were used to determine the effects of the intervention from baseline to postintervention on psychological processes. To examine if these effects were maintained after four months, linear mixed models were also performed. When conducting mixed models, all available data are used to obtain parameter estimates with small bias in the presence of data missing completely at random or missing at random (T2 Little's MCAR test $\chi^2 = 30.24$, $p = .995$; T3 Little's MCAR test $\chi^2 = 23.03$, $p = .576$) (57). Group, time and time by group interaction and covariates (variables presenting significant differences between intervention and control groups at baseline and between completers and dropouts at T2 and T3: previous history of psychopathology, infant's age, education and category of positive mental health) were fitted as fixed effects. Participant was included as a random intercept.

To examine if changes in process variables (from T1 to T2) statistically mediated the effect of Be a Mom on T1 to T2 change in positive mental health, 1-1-1 multilevel mediation models were estimated using MLmed (58), a SPSS macro that tests for mediation in multilevel data based on procedures suggested by Bauer, Preacher (59). In line with the intention-to-treat principles, multilevel mediation allows all participants to be included, irrespective of missing data. It extends on classic mediation models to account for the nested nature of repeated measures data (i.e., time nested within individuals). Thus, the relationships between variables are calculated within each individual over time and then aggregated across the sample to represent the overall relationship between those variables. Using this approach, all three proposed mediators (self-compassion, psychological flexibility and emotion regulation) were tested individually for each study group. Parameters were estimated using restricted maximum likelihood estimation. Only within-group effects were analyzed. **Figure 1** illustrates the 1-1-1 multilevel mediation model.

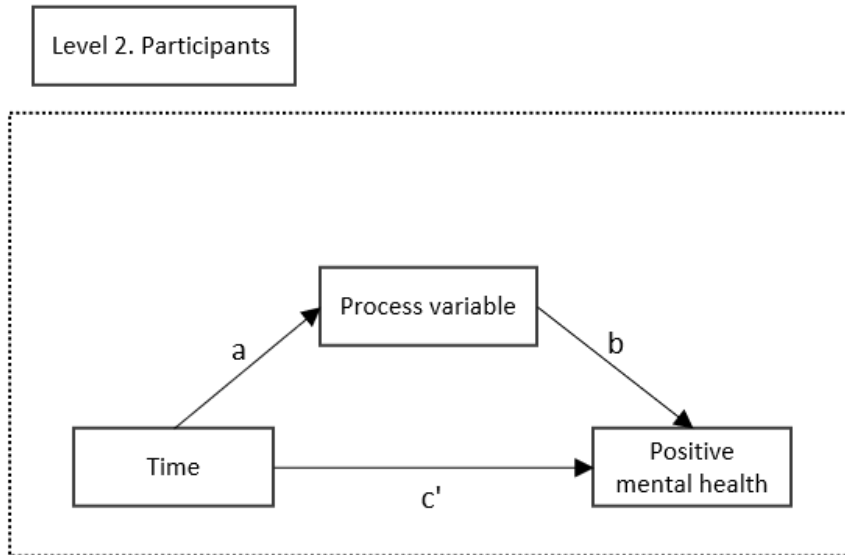


Figure 1. Illustration of the multilevel mediation model. Path a represents the effect of time on the process variable. Path b represents the change in the process variable when positive mental health changes with one unit when time is held constant. Path c' represents the direct effect of time on positive mental health when controlling for the effect of changes in the process variable. Path $a \times b$ represents the within-group indirect effect of time on positive mental health represented by changes in the process variable.

Results

Participant characteristics

The In total, 1657 women were screened for eligibility. A majority of those interested presented risk factors for PPD and were allocated to a different RCT aiming to assess the effectiveness of Be a Mom in preventing PPD. Of the 498 women who were sent the baseline assessment, 403 completed the set of questionnaires and were randomized to either the Be a Mom group ($n = 212$) or the WLC group ($n = 191$). See **Figure 1** for participant flow.

Table 1 presents the baseline descriptive characteristics of the intervention and control groups. Significant differences were found for history of psychopathology and presence of flourishing between both groups. A significantly higher proportion of participants in the intervention group had a previous history of psychopathology (25.1% vs. 14.2%, $\chi^2 = 6.86$, $p = .009$) and were not flourishing (42.9% vs. 33%, $\chi^2 = 3.86$, $p = .049$) compared with the WLC group.

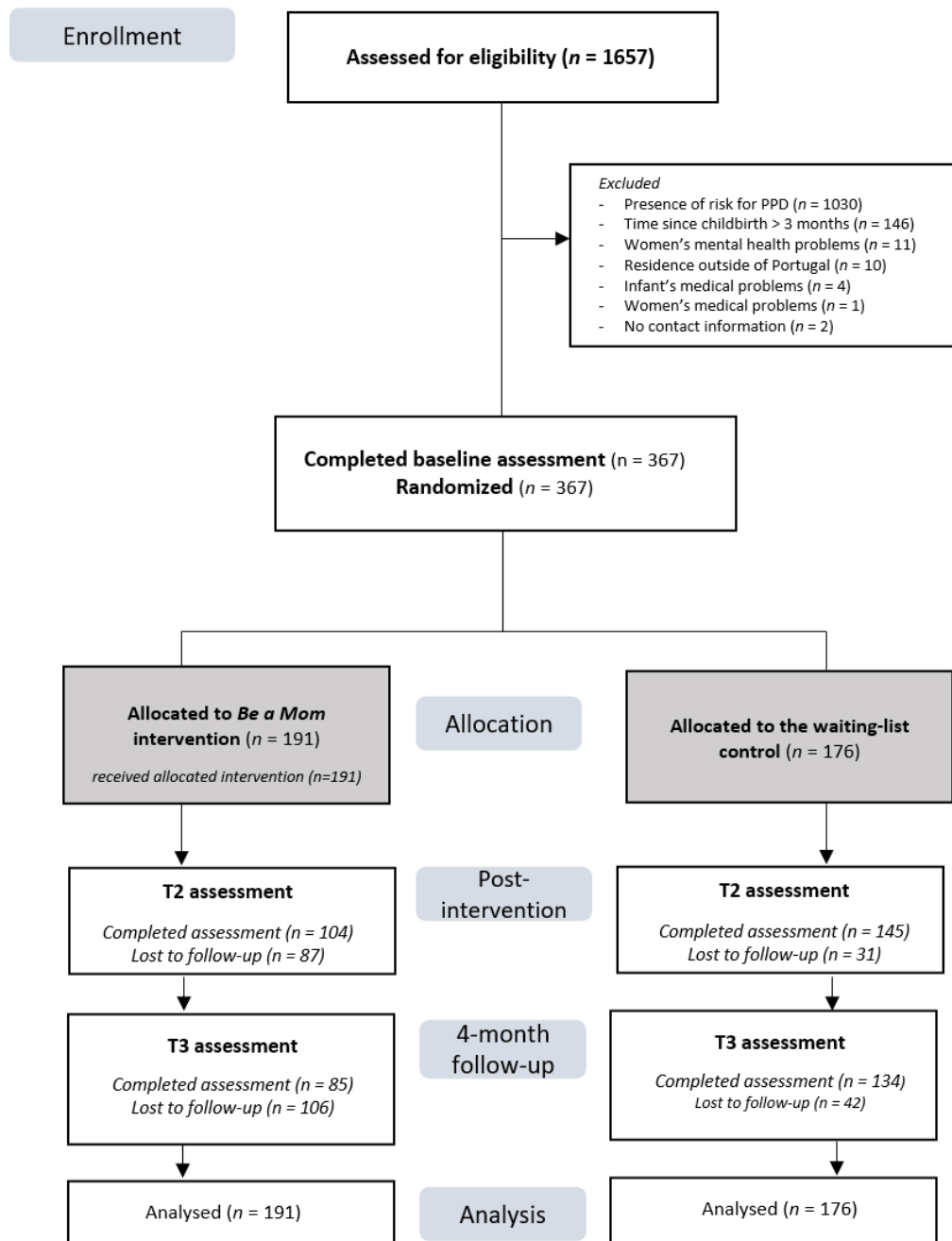


Figure 2. Flowchart of the participants in the study.

Of the 367 participants, 249 (67.8%) completed the postintervention assessment and 219 (59.7%) completed the four-month follow-up. The intervention arm presented a significantly higher loss to postintervention than the WLC arm (intervention group: $n = 87$, 45.5% vs. control group: $n = 31$, 17.6%, $\chi^2 = 32.77$, $p < .001$). Infants of the participants who dropped out from the study were significantly older than the infants of those who completed the postintervention assessment ($M = 2.12$ months, $SD = 0.96$ vs. $M = 1.77$ months, $SD = 1.20$, $t(365) = -2.77$, $p = .006$). At T3, the intervention group also presented a significantly higher loss to follow-up compared to the WLC

group (intervention group: $n = 134$, 61.2% vs. control group: $n = 42$, 28.4%, $\chi^2 = 38.09$, $p < .001$). Participants who did not complete T3 assessment had significantly older infants ($M = 2.05$ months, $SD = 0.96$ vs. $M = 1.71$ months, $SD = 0.91$, $t(365) = -3.48$, $p = .001$) and lower education (proportion of dropouts with a bachelor's degree: $n = 47$, 31.8% vs. completers: $n = 93$, 42.5%, $\chi^2 = 9.19$, $p = .027$) than those who completed the four-month follow-up assessment.

Table 1. Participants' background characteristics at baseline

	Intervention group ($n = 191$) $M(SD) / n(\%)$	Control group ($n = 176$) $M(SD) / n(\%)$	t / χ^2
Age	32.97 (4.04)	33.03 (4.43)	-0.14
Marital status			0.53
Married/co-habiting	183 (95.8)	170 (96.6)	
Single	4 (2.1)	2 (1.1)	
In a relationship (without living together)	4 (2.1)	4 (2.3)	
Employment status	140 (73.3)	122 (69.3)	0.71
Employed			3.35
Not currently working	176 (92.1)	170 (96.6)	
Educational level	15 (7.9)	6 (3.4)	5.66
Up to the 9 th grade			
High school	2 (1.0)	4 (2.3)	
Bachelor's degree	30 (15.7)	26 (14.8)	
Master's or Doctorate	83 (43.5)	58 (33)	
Household monthly income	76 (39.8)	88 (50)	4.92
Less than 580€			
580€-1000€	8 (4.2)	9 (5.1)	
1000€-2000€	88 (46.1)	80 (45.5)	
More than 2000€	87 (45.5)	70 (39.8)	
Residence	8 (4.2)	17 (9.7)	1.06
Urban			
Rural	141 (73.8)	138 (78.4)	
Psychopathology history			6.86*
Yes	48 (25.1)	25 (14.2)	
No	143 (74.9)	151 (85.8)	
Positive mental health			3.86*
Flourishing	109 (57.1)	118 (67)	
Not flourishing	82 (42.9)	58 (33)	
Infant's age (in months)	1.89 (0.94)	1.87 (1.32)	0.16
Infant's gestational weeks	38.89 (1.64)	38.95 (1.77)	-0.33
Primiparous	140 (73.3)	122 (69.3)	0.71

* $p < .05$

Change in process variables in the intervention and control groups: Examining the enhancement of process variables at post-intervention and its maintenance at four months follow-up

To examine changes in process variables between baseline and post-intervention both in the intervention and control groups, a multilevel model was estimated. Table 2 presents the estimated marginal means of the process variables and fixed effects for time, group and the time x group interaction as well as for covariates (psychopathology history, infant's age and category of positive mental health at baseline).

Table 2. Estimated marginal means and fixed effects for psychological processes at postintervention

	Group	Time 1 <i>M (SE)</i>	Time 2 <i>M (SE)</i>	Effect	<i>B (SE)</i>	95% CI	<i>p</i>
Self-compassion	<i>Intervention</i>	41.72	44.09	Time	-2.37 (0.58)	[-3.52, -1.23]	<.001
		(0.55)	(0.68)				
	<i>Control</i>	41.72	42.07	Group	-2.03 (0.92)	[-3.82, -0.23]	.027
		(0.58)	(0.61)				
				Time x Group	2.03 (0.76)	[0.53, 3.54]	.008
				Psychopathology history	4.45 (0.95)	[2.58, 6.31]	<.001
				MHC-SF baseline category	6.61 (0.78)	[5.08, 8.13]	<.001
			Infant's age	0.51 (0.33)	[-0.13, 1.16]	.120	
Psychological flexibility	<i>Intervention</i>	39.22	39.86	Time	-0.64 (0.52)	[-1.66, 0.37]	.214
		(0.50)	(0.61)				
	<i>Control</i>	39.17	39.36	Group	-0.50 (0.82)	[-2.12, 1.12]	.544
		(0.52)	(0.55)				
				Time x Group	0.45 (0.68)	[-0.89, 1.79]	.505
				Psychopathology history	4.80 (0.86)	[3.10, 6.49]	<.001
				MHC-SF baseline category	5.38 (0.70)	[3.99, 6.77]	<.001
			Infant's age	-0.30 (0.30)	[-0.88, 0.29]	.320	
Emotion regulation skills	<i>Intervention</i>	73.98	75.39	Time	-0.42 (0.82)	[-2.03, 1.20]	.614
		(0.69)	(0.87)				
	<i>Control</i>	73.11	72.94	Group	-2.46 (1.17)	[-4.76, -0.16]	.036
		(0.72)	(0.77)				
				Time x Group	0.59 (1.08)	[-1.54, 2.73]	.584
				Psychopathology history	4.04 (1.16)	[1.76, 6.32]	<.001
				MHC-SF baseline category	6.50 (0.95)	[4.63, 8.36]	<.001
			Infant's age	-0.08 (0.40)	[-0.87, 0.70]	.836	

Note. MHC-SF – Mental Health Continuum-Short Form

Significant effects of time, group and time x group interaction were found for self-compassion, with women in the intervention group reporting a higher increase in self-compassion levels when compared with participants in the WLC group.

No interaction effects of time and group were found for the remaining variables. Regarding emotion regulation skills, a significant effect of group was found, with the intervention group exhibiting overall higher emotion regulation skills. Although no significant time x group interactions were found for psychological flexibility and emotion regulation skills, **Table 2** shows a greater increase in these psychological processes from T1 to T2 in the intervention group.

Concerning the maintenance at 4 months follow-up, there were no statistically significant differences in the rate of change for process variables between the intervention and control groups at T3 (see **Table 3**). The overall higher estimated means in the intervention group suggest that gains in self-compassion for participating in Be a Mom were relatively maintained at four months

postintervention.

Table 3. Estimated means and fixed effects for psychological processes at four-months follow-up

Group	Time 2 <i>M (SE)</i>	Time 3 <i>M (SE)</i>	Effect	<i>B (SE)</i>	95% CI	<i>p</i>	
Self-compassion	<i>Intervention</i>	44.55 (0.77)	44.05 (0.83)	Time	0.50 (0.64)	[-0.77, 1.76]	.438
	<i>Control</i>	42.19 (0.63)	42.22 (0.65)	Group	-1.83 (1.06)	[-3.91, 0.25]	.085
				Time x Group	-0.53 (0.81)	[-2.13, 1.07]	.516
				Psychopathology history	3.60 (1.12)	[1.39, 5.81]	.002
				MHC-SF baseline category	-6.06 (0.96)	[-7.96, -4.17]	<.001
				Education	0.76 (0.64)	[-0.49, 2.01]	.232
				Infant's age	0.48 (0.51)	[-0.51, 1.48]	.339
Psychological flexibility	<i>Intervention</i>	40.14 (0.69)	39.87 (0.71)	Time	0.27 (0.65)	[-1.00, 1.55]	.673
	<i>Control</i>	39.42 (0.58)	39.10 (0.60)	Group	-0.77 (0.97)	[-2.67, 1.13]	.426
				Time x Group	0.05 (0.82)	[-1.58, 1.68]	.951
				Psychopathology history	3.59 (1.00)	[1.63, 5.55]	<.001
				MHC-SF baseline category	-3.47 (0.86)	[-5.16, -1.78]	<.001
				Education	0.52 (0.57)	[-0.60, 1.64]	.358
				Infant's age	0.07 (0.45)	[-0.82, 0.95]	.883
Emotion regulation skills	<i>Intervention</i>	76.21 (1.03)	75.51 (1.09)	Time	0.70 (0.77)	[-0.83, 2.22]	.368
	<i>Control</i>	73.79 (0.86)	73.68 (0.88)	Group	-1.84 (1.41)	[-4.61, 0.94]	.195
				Time x Group	-0.59 (0.98)	[-2.53, 1.35]	.550
				Psychopathology history	4.31 (1.53)	[1.30, 7.32]	.005
				MHC-SF baseline category	-5.17 (1.32)	[-7.77, -2.57]	<.001
				Education	1.12 (0.87)	[-0.60, 2.84]	.200
				Infant's age	-0.60 (0.69)	[-1.96, 0.76]	.383

Note. MHC-SF – Mental Health Continuum-Short Form

The role of psychological processes in the improvement of positive mental health from baseline to post-intervention

Tables 4 and 5 present the path coefficients, direct and indirect effects of the multilevel mediation models for self-compassion, psychological flexibility and emotion regulation skills in the intervention and control group, respectively.

Among the intervention group, there was a significant increase in self-compassion levels over time. Regarding indirect effects, the analyses revealed that baseline to postintervention increases in self-compassion were a significant mediator of change in positive mental health over that period.

Table 4. Multilevel coefficients and indirect effects for mediation of psychological processes on positive mental health in the intervention group

	<i>a</i>	<i>b</i>	Direct effect <i>c'</i>	Indirect effect	
				<i>ab</i>	95% CI
Self-compassion	2.24***	0.35**	1.26	0.78*	[0.24, 1.48]
Psychological flexibility	0.53	0.31*	1.88**	0.16	[-0.13, 0.58]
Emotion regulation skills	0.28	0.16	1.98**	0.04	[-0.21, 0.35]

* $p < .05$; ** $p < .01$; *** $p < .001$

Concerning the WLC group, the results showed that there were no significant increases in psychological processes over time. Regarding direct and indirect effects, no significant relationships were found.

Table 5. Multilevel coefficients and indirect effects for mediation of psychological processes on positive mental health in the control group

	<i>a</i>	<i>b</i>	Direct effect <i>c'</i>	Indirect effect	
				<i>ab</i>	95% CI
Self-compassion	0.34	0.23*	0.61	0.08	[-0.16, 0.40]
Psychological flexibility	0.18	0.56***	0.56	0.10	[-0.40, 0.64]
Emotion regulation skills	-0.19	0.25**	0.75	-0.05	[-0.44, 0.34]

* $p < .05$; ** $p < .01$; *** $p < .001$

Discussion

While interest in web-based interventions aimed at improving positive mental health is increasing, direct empirical evidence supporting the mechanisms of change under these interventions is lacking, particularly for the perinatal period. Understanding treatment processes and researching and intervening at such level is essential and has been considered a promising path forward for intervention science (60). Therefore, while there is evidence of the efficacy of Be a Mom in improving positive mental health (25), this study aimed to explore the mechanisms underlying this improvement. Overall, our results showed that participating in Be a Mom significantly increased self-compassion levels and that this increase was associated with the improvement in positive mental health.

Be a Mom's efficacy in significantly enhancing self-compassion levels and emotion regulation skills was previously established among a high-risk sample of postpartum women (48). This study demonstrates that this intervention is also effective in promoting self-compassion levels among low-risk postpartum women. Although no significant differences were found between the two groups at the four-month follow-up, the results suggest that the increased levels in self-

compassion among Be a Mom participants were maintained over that period. The postpartum is a time characterized by incongruences between the expectations and realities of motherhood (61) that are strongly influenced by the ideology of perfect motherhood, which can lead women to self-criticize themselves and to a sense of shame and guilt (62). When using Be a Mom, participants were taught about the myth of perfect motherhood and the pervasive role of self-criticism when dealing with postpartum stressors (e.g., infant care, breastfeeding). They were offered exercises aimed at promoting acts of compassion inwards when considering the maternal role and at promoting a sense of common humanity in which women realize that their suffering is a normal part of the human (motherhood) experience and that they are not alone in their suffering and self-judgment (32).

Although emotion regulation skills and psychological flexibility increased at postintervention, contrary to our expectations, the results were not significantly different from those reported in the WLC group. However, our results demonstrated a trend of a greater increase in the intervention group in both variables. In the case of emotion regulation skills, mean estimates showed that from T1 to T2, there was an increase in the intervention group but a decrease in the control group. The higher levels of emotion regulation skills in the intervention group are also reported at T3, suggesting that it is possible that participating in Be a Mom may have contributed to more adaptive emotion regulation strategies. Nevertheless, it is possible that Be a Mom is not as effective in fostering emotion regulation skills among low-risk women. It has been previously suggested that at-risk mothers could obtain more benefits from postpartum interventions as there is generally more room for improvement (63).

Likewise, Be a Mom did not significantly improve psychological flexibility, which is in line with what was previously found among a high-risk sample (48). It is possible that this failure in finding a significant improvement could in part be due to the instrument that was used to measure psychological flexibility. Although the AAQ-II is the most used self-report measure of psychology flexibility, it has been shown that, compared to other measures, the AAQ-II is less sensitive to treatment change (64). Indeed, previous intervention studies using an Acceptance and Commitment Therapy approach have not found significant results when considering AAQ-II scores (22, 65). Using a different measure of psychological flexibility or measuring associated constructs such as coping flexibility, (i.e., the capacity to discontinue an ineffective coping strategy and carry out an alternative one, 66) could help determine whether Be a Mom significantly promotes this psychological process.

The results of the multilevel mediation analyses between baseline and postintervention provide valuable information on the relation between the psychological processes targeted in Be a Mom and positive mental health. Specifically, self-compassion fully statistically mediated the improvement of positive mental health among the intervention group. This is consistent with the

results of a previous study using a web-based intervention for postpartum women (10) and with studies that have suggested that self-compassion is a particularly essential variable for a healthy psychological adjustment to the postpartum period (11, 67). Self-compassion appears to support positive mental health, protecting against the oftentimes stressful and negative impact of the transition to motherhood. This significant association was only demonstrated in the intervention group, suggesting that participating in Be a Mom promoted self-compassion, which, in turn, contributed to the improvement of positive mental health. Thus, promoting self-compassion during the postpartum period seems to be very valuable to a better positive mental health and this can be achieved using brief and unguided web-based interventions, grounded on CBT and third-wave CBT approaches.

Psychological flexibility and emotion regulation skills did not significantly contribute to the improvement of positive mental health. Although there is evidence of psychological flexibility as a significant mediator of positive mental health improvement among acceptance and commitment therapy-based interventions (e.g., 37), other studies have found that increases in psychological flexibility were not related to positive mental health (e.g., 68, 69). Nevertheless, when comparing multilevel mediation results of the intervention and control groups, the results suggest that significant direct effects for psychological flexibility and emotion regulation skills were only found for the intervention group. Therefore, it seems that participating in Be a Mom was beneficial for the psychological health of these women.

Although this study provides relevant contributions to the area of interventions for maternal mental health, we acknowledge some limitations. First, because of the self-selected convenience sample, caution is needed in generalizing these findings. Second, there was a high attrition rate over time. This is in line with previous studies using unguided web-based interventions, particularly in the perinatal period (70), which is recognized as a demanding time. Following the intention-to-treat principles, we used linear mixed methods and multilevel mediation to handle missing data and minimize the effect of study dropouts. However, this could have influenced the results. Regarding mediation analyses, we must acknowledge that we cannot assume that the investigated variables are independent from each other or that they only form unidirectional and linear relationships. Although our findings indicated that self-compassion plays a central role in the enhancement of positive mental health among postpartum women who use Be a Mom, they do not establish definitive evidence of causality (71). Moreover, we cannot exclude the possibility that other unknown variables could have affected positive mental health.

Extensive research on the perinatal period has focused on at-risk women and the prevention of psychopathology, particularly PPD (9). However, it has been proposed that only targeting at-risk groups is not sufficient (46) and that, from a population health perspective, targeting the promotion

of positive mental health among low-risk women is also essential. This study emphasizes that in order to achieve this goal, intervention research cannot mainly focus on diminishing psychosocial risk but instead must concentrate on investigating the influence of core psychological processes that can contribute to a better adjustment to this period. Particularly, this study is one of the first to assess psychological mediators of change during the course of a short and unguided web-based intervention for the promotion of postpartum women's mental health. Our study suggests that fostering a more compassionate, non-judgmental and accepting attitude towards the diversity of difficult internal and external experiences during the postpartum period - a significant period with implications for the overall health of women and infants - is especially important for improving positive mental health among low-risk postpartum women. In turn, promoting positive mental health and going beyond a focus on simply eliminating mental illness could result in more satisfying and fulfilling lives and set women on trajectories of growth that could consequential lead to the building of a wide range of personal resources (19, 20).

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EMPIRICAL STUDY V

Cost-effectiveness of a web-based intervention to promote maternal mental health among postpartum women presenting low risk for postpartum depression

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Cost-effectiveness of a web-based intervention to promote maternal mental health among postpartum women presenting low risk for postpartum depression

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Abstract

Background: Web-based interventions for the promotion of maternal mental health could represent a cost-effective strategy to reduce the burden associated with perinatal mental illness. This study aimed to evaluate the cost-effectiveness of Be a Mom, a self-guided web-based cognitive behavioural therapy intervention, compared with a waiting-list control.

Methods: The economic evaluation alongside a randomized controlled trial was conducted from a societal perspective over a 14-month time frame. Postpartum women presenting low risk for postpartum depression were randomized to the intervention ($n = 191$) or control ($n = 176$) group and assessed at baseline, postintervention and 4 and 12 months after postintervention. Data regarding healthcare use, productive losses and quality adjusted life years (QALYs) were collected and used to calculate incremental cost-effectiveness ratios (ICERs). Uncertainty was accounted for with nonparametric bootstrapping and sensitivity analyses.

Results: At 14 months, and after accounting for a 3.5 percent discount rate, the intervention resulted in a yearly cost saving of EUR 165.47 (-361.77, 28.51) and a QALY gain of 0.0064 (-0.0116, 0.0244). Bootstrapping results revealed a dominant ICER for the intervention group. Cost-effectiveness acceptability curves showed that at a EUR 0 willingness to pay threshold, there is a 96 percent probability that the intervention is cost-effective when compared with the control group. The sensitivity analyses generally supported the acceptable likelihood of the intervention being more cost-effective than the control group.

Conclusion: From a societal perspective, the implementation of Be a Mom among low-risk postpartum women could be a cost-effective way to improve perinatal mental health.

Keywords: Cost-effectiveness; web-based intervention; postpartum period; quality adjusted life years; randomized controlled trial

Introduction

In recent decades, research on mental illness during the postpartum period has highlighted its negative long-lasting impact on mothers' health and children's overall development (1; 2), making it a public health problem. Although less emphasized, untreated psychological symptoms and disorders during this period can also have a negative impact on society, being linked to significant economic burden (3). For instance, mother's mental illness during the perinatal period has been associated with increased maternal and child use of health services (4; 5). It has been estimated that most of the economic cost of maternal mental illness relates to adverse impacts on the child at different life stages, from increased mental and physical health costs to future productivity losses and lower earnings (6). Although economic evidence from the postpartum period is scarce, it is in line with previous findings indicating that depressive disorders are associated with increased healthcare use and work absenteeism (7).

Taking previous findings into account, psychological interventions could play a central role in reducing human and economic costs. Trials have shown the efficacy of psychological interventions in treating and preventing psychological disorders during the perinatal period (8; 9). However, extensive research has suggested that focusing solely on treatment and reduction of mental illness may not be enough (10; 11). Rather, increasing recognition has been given to the need of prioritizing a more comprehensive approach that also comprises the promotion of positive mental health (12-14). A strategy that goes beyond targeting at-risk groups for prevention and treatment of disorders could lead to significant mental health benefits in population terms (15).

Positive mental health has been linked not only to better psychosocial functioning but also to fewer missed days of work and fewer health-related limitations on activities of daily living, decreased mortality and better physical health (16-18). Furthermore, children of mothers with higher levels of positive mental health have demonstrated better development outcomes (19). Therefore, interventions aiming to promote positive mental health in the postpartum period could be greatly beneficial in reducing the societal burden of postpartum mental illness.

A few trials using unguided web-based interventions have shown their efficacy in enhancing positive mental health among postpartum women (20; 21). The use of technology-based interventions may help overcome identified barriers to mental health care during this period (22; 23) as the intervention can be available at any time of the day or night and be delivered with privacy. Additionally, web-based interventions have the potential to be easily disseminated at a population level, and current evidence suggests that they can be cost-effective (24-26).

Regarding the postpartum period, evidence for the cost-effectiveness of psychological interventions is still scarce. A systematic review of eight studies suggested that psychological screening, prevention and treatment during the postpartum period can be cost-effective (27).

However, there was notable heterogeneity across studies, making it difficult to reach a conclusion and offer solid recommendations. Additionally, to the best of our knowledge, no studies have investigated the cost-effectiveness of web-based interventions to promote positive mental health in this context. Given that the postpartum represents a crucial period, information on the cost-effectiveness of this kind of intervention could inform policy makers in balancing mental health promotion strategies.

Be a Mom is a self-guided web-based intervention developed according to cognitive behavioral therapy (CBT) principles (for the formative evaluation process that informed the design and components of the intervention please see 28) and includes content based on the third wave of CBT, namely, acceptance- and compassion-focused approaches. It was originally developed to be a preventive intervention for postpartum depression (PPD) among high-risk postpartum women and preliminary evidence showed its efficacy in reducing depressive and anxiety symptoms (29). More recently, a randomized controlled trial (RCT) was conducted to examine Be a Mom's efficacy in enhancing positive mental health among postpartum women presenting low risk for PPD (21). In the present study, we aim to describe the results of an economic evaluation conducted alongside this RCT. More specifically, in this study we aim to investigate the cost-effectiveness of Be a Mom compared with a waiting-list control (WLC) group.

Methods

Design and procedure

This study is an economic evaluation with a 14-month time horizon from a societal perspective alongside a two-arm RCT to establish the cost-effectiveness of Be a Mom for low-risk postpartum women compared with a WLC group. The results of the RCT have been reported elsewhere and showed the efficacy of Be a Mom in significantly improving positive mental health levels (21). The present study focuses only on aspects relevant to economic evaluation. The recommendations of the Consolidated Health Economic Evaluation Reporting Standards statement (30) on conducting economic evaluations and reporting the outcomes were followed. The study was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra, and it was registered on ClinicalTrials.gov (NCT04055974).

Participants were recruited online and included in the study if they fulfilled the following criteria: to be in the early postpartum period (up to 3 months postpartum); aged \geq eighteen years; to present low risk for PPD (Postpartum Depression Predictors Inventory-Revised < 5.5 ; 31); to have internet access at home; to be a resident of Portugal; and to understand Portuguese.

Participants were excluded if they had a serious medical condition (physical or psychiatric) or if the infant had a serious health condition (both were self-reported).

Eligible participants were randomly assigned (allocation ratio 1:1) to the intervention group or to the WLC group. All data were collected between January 2019 and March 2021. Data were assessed in both groups at baseline (Time 1 – T1), eight weeks after randomization (Time 2 – T2) and four and 12 months after the postintervention assessment (Time 3 – T3; Time 4 – T4) by self-report using the online survey platform Limesurvey.

Intervention

Participants in the intervention group were invited to a password-protected website that contained the Be a Mom intervention (beamom.pt). Be a Mom is a web-based CBT intervention with a fully self-guided format targeting mental health promotion of postpartum women. Fonseca, Pereira, et al. (28) previously published the formative evaluation of Be a Mom, which describes in detail the development process and components of the intervention. Briefly, Be a Mom comprises five sequential modules (with a duration of approximately forty-five minutes each) that address aspects relevant to the postpartum period (Changes & Emotions; Cognitions; Values & Support; Couple relationship; Signs of PPD & Help-seeking). The duration of the intervention was five weeks, but participants were given eight weeks after randomization to complete the five modules. All modules follow the structured and goal-oriented nature of CBT and include exercises and practical strategies to be implemented during the week. Be a Mom's content is presented in an attractive format with animations, audio exercises, and interactive exercises targeting the promotion of psychological resources. The interactive exercises have personalized feedback to support learning. Asynchronous communication channels (e.g., reminders, email contact for program-related support) are available to enable communication. In addition, the systems used are continuously updated to meet the latest security requirements.

Waiting-list control group

Participants that were randomly assigned to the WLC arm did not have access to the intervention but were informed that they could have access to it at the end of the study. Participants in both groups had unrestricted access to usual treatment options.

Measures

The study was designed to assess the participants of both groups at four observation points: baseline, postintervention, four and 12 months after postintervention. For the cost-effectiveness analysis, cost outcomes included costs related to healthcare use, cost related to productivity losses

and intervention costs and health outcomes were measured in terms of QALYs. In addition, participants answered a self-report questionnaire which included questions about sociodemographic (e.g., age, marital status, educational level), clinical (e.g., psychopathological history) and infant-related data (e.g., infant age, gestational weeks at birth).

Costs were expressed in Euro (EUR) for the reference year 2020. Because the average rate of change in the Portuguese consumer price index between 2019 and 2020 was null (32), there was no need to adjust for the effects of inflation. Since the time frame in which costs and effects occurred went beyond twelve months, a discount rate of 3.5 percent (0.3% per month) was used for both costs and effects (33).

Costs: Cost related to healthcare resource use, productivity losses and intervention costs

To collect data on healthcare utilization and productivity losses, the Portuguese version (PV) of the Trimbos and iMTA questionnaire for costs associated with psychiatric illness (TiC-P; (34) was used. The TiC-P asks participants to report their healthcare resource-use and productivity losses over the previous three months. However, aside from their baseline assessment, participants were instructed to report all health care use and productivity losses in the period since their last assessment (i.e., at T2, participants were instructed to report their resource use over the previous two months, at T3, over the previous four months and at T4, over the previous eight months). The TiC-P was also adapted for use in the postpartum period (e.g., mothers were asked to also report their infants' healthcare use).

Healthcare use costs

Healthcare use included medical consultations, contacts with a psychologist, psychiatrist, or ambulatory mental health services, contacts with other health professionals (e.g., nursing, physiotherapy, osteopathy, nutrition), hospitalizations, outpatient specialist care, emergency care, and use of medication. Healthcare unit costs were calculated based on prices from *Portaria n.º 207/2017 de 11 de julho* issued by the Portuguese Ministry of Health. Unit costs for prescription medication were calculated using the prices of the Portuguese National Authority of Medicines and Health Products, INFARMED. Therefore, for each participant, unit costs were multiplied by the corresponding reported number of consultations/health services used or reported medication dose.

Costs from productivity losses

Data regarding absence from work (absenteeism) or reduced efficiency during paid work (presenteeism) or unpaid work were collected. To measure absenteeism, participants were asked to report how many days they had been absent from work. To estimate productivity losses due to

absenteeism, the participant's average daily wage based on their reported monthly income was multiplied by the number of lost workdays.

To measure presenteeism, participants were asked to report the number of days they worked while feeling ill and their personal efficiency score on those days through a rating scale from 0 to 10 (0 meaning that feeling ill prevented them from working as efficiently and 10 meaning that feeling ill had no effect on their work). To estimate the costs that occurred due to presenteeism, the reported efficiency score was converted into a percentage reduction in productive work due to health problems. In other words, if a participant reported a value of 4, it was converted to a 60 percent reduction in productive work. The number of reported workdays with reduced functioning was multiplied by the respective percentage of productivity loss. Subsequently, this value was multiplied by the participant's average daily wage, which was calculated based on their self-reported monthly income.

Productivity losses resulting from unpaid work (e.g., domestic tasks, caring for children, running errands) were measured by asking participants the number of days they performed these tasks while feeling ill. Similar to presenteeism, they were also asked their personal efficiency score on those days on a rating scale from 0 to 10. To estimate costs for unpaid work, a substitution cost of EUR 9.5 per hour was used by using the average market price for domestic help in Portugal (35).

Intervention costs

Intervention cost included maintenance and hosting costs for the website and the time participants spent investing in the intervention (opportunity costs). The costs related to software development ("sunk costs") and research-specific costs were not assessed.

Website hosting costs were EUR 500 per year, and preventive maintenance (e.g., security updates, bug fixes) was approximately EUR 500 per year. Opportunity costs of participants' time were estimated based on Portugal's gross average wage of EUR 1314 per month, and valued at EUR 8.84 per hour (36). Considering that all five modules of Be a Mom take approximately four hours to complete, participants' time on the intervention was valued at EUR 35.36 per participant. Considering this, the total costs for the intervention were estimated at EUR 40.6 per participant.

Effects: QALYs

Health benefit outcomes were measured as QALYs (for more information see 37) based on the EQ-5D-3L (38; PV: 39). The EQ-5D-3L comprises five items covering five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). Considering a 3-point response scale, participants had to indicate their own state of health (from "no problems" to "extreme problems"). This classification system describes 243 possible health states. Using the validated

Portuguese value set (39), a utility score was calculated for each measurement point. Utilities represent the value of a particular health state on a scale from 0 to 1 (0 reflecting death and 1 reflecting perfect health). This allowed to estimate QALYs during the study period by calculating the area under the curve using the trapezoidal method (40; 41). The area under the curve method was implemented summing the areas of the geometrical shapes obtained by linearly interpolating between utility scores over the 14-month period. Therefore, participants' utility values were multiplied by the duration spent in that particular health state, which allowed to generate one QALY score per participant.

Data analysis

The statistical analysis for the economic evaluation was based on a probabilistic decision-making approach rather than a hypothesis-testing approach (42). Accordingly, the results were calculated irrespective of statistically significant differences in costs or QALYs between the intervention and control groups. A greater focus was given to estimating the central parameter of interest, the incremental cost-effectiveness ratio (ICER), along with the representation of the uncertainty surrounding that estimate.

Descriptive statistics and comparison tests (*t*-test and chi-squared) were computed for sample characterization and to compare the intervention and WLC groups, as well as completers and dropouts in terms of their background characteristics.

All data were analyzed according to the intention-to-treat principles, meaning that all randomized participants were included in the analyses, following the CONSORT statement (43). To that end, missing data were imputed using a Markov chain Monte Carlo imputation algorithm (missing data module in SPSS 23.0) with predictive mean matching. Based on the fraction of missing information (44), the number of imputations was set to 40. Baseline data of the variables with missing values and variables that differed between groups at baseline (history of psychological/psychiatric problems) and between completers and dropouts at T2, T3 and T4 (education level, infant age) were included in the imputation model as predictors.

To investigate the uncertainty around the ICER, cost-QALY pairs from the original data were bootstrapped (1000 bootstrap replications). Bootstrapping is a nonparametric method used to create new samples by generating values at random from cost-effect pairs from the original data with replacement (45; 46). The bootstrap estimate of the difference in costs, difference in effects and ICER were then calculated based on the bootstrapped means of the costs and effects in each group. The means from the resamples were plotted in a cost-effectiveness plane to give a nonparametric estimate of the joint distribution of cost and effect differences.

Based on the nonparametric bootstrapping procedure, a cost-effectiveness acceptability curve (CEAC) was graphed to show the probability of the cost-effectiveness of Be a Mom compared to the WLC across a range of willingness-to-pay (WTP) ceilings. Currently, there is no fixed WTP threshold in Portugal, so we used a maximum WTP of EUR 20,000/QALY.

To examine the robustness of the results, sensitivity analyses were performed. First, baseline adjustments were made to cost and QALYs using least squares regression as previously recommended (41; 47) to determine the impact of these adjustments on the ICER. Covariates used in the models were study group and baseline costs for cost data and study group and baseline utility for QALYs. Second, we performed analyses excluding absenteeism and presenteeism. This allowed to assess the impact of maternity leave on the results since participants had different durations of maternity leave (in Portugal, it can be up to 240 days). Additionally, since we only used the human capital approach to establish productivity losses, we conducted an analysis excluding all costs related to productivity losses. Finally, a complete cases analysis was performed (i.e., only participants who reported costs and effects in all assessment points were analysed).

Bootstrap analyses were performed using Microsoft Office Excel 2010, and all other analyses were conducted using the *Statistical Package for Social Sciences* version 23.0 (IBM Corp, Armonk, NY, USA).

Results

Participants

The 367 participants who completed the baseline assessment were randomized to the intervention ($n = 191$) or the WLC group ($n = 176$). A description of the study sample and the participant flow can be found elsewhere (21). The baseline characteristics of the sample can be found in **Table 1**.

Table 1. Participants' characteristics at baseline

	Intervention group ($n = 191$) $M(SD) / n(\%)$	Control group ($n = 176$) $M(SD) / n(\%)$	t / χ^2
Age	32.97 (4.04)	33.03 (4.43)	-0.14
Marital status			0.53
Married/co-habiting	183 (95.8)	170 (96.6)	
Single	4 (2.1)	2 (1.1)	
In a relationship (without living together)	4 (2.1)	4 (2.3)	
Employment status			3.35
Employed	176 (92.1)	170 (96.6)	
Not currently working	15 (7.9)	6 (3.4)	

Educational level			5.66
Up to the 9 th grade	2 (1.0)	4 (2.3)	
High school	30 (15.7)	26 (14.8)	
Bachelor's degree	83 (43.5)	58 (33)	
Master's or Doctorate	76 (39.8)	88 (50)	
Psychopathology history			6.86*
Yes	48 (25.1)	25 (14.2)	
No	143 (74.9)	151 (85.8)	
Infant's age (in months)	1.89 (0.94)	1.87 (1.32)	0.16
Infant's gestational weeks	38.89 (1.64)	38.95 (1.77)	-0.33
Primiparous	140 (73.3)	122 (69.3)	0.71
Healthcare costs			
Healthcare use	295 (257)	331 (311)	-1.20
Infant healthcare use	184 (117)	164 (111)	1.72
Mental health services	11 (41)	10 (40)	0.33
Medication	9 (12)	7 (8)	1.67
Productivity costs			
Absenteeism	0 (0)	14 (181)	-1.00
Presenteeism	0 (0)	2 (25)	-1.00
Domestic productivity loss	60 (206)	60 (192)	-0.00
Total costs	558 (351)	586 (462)	-0.65

* $p < .05$

The EQ-5D-3L and cost data completion rates were 100 percent (367/367), 73.8 percent (271/367), 59.7 percent (219/367) and 51 percent (187/367) at T1, T2, T3 and T4, respectively. The intervention group presented a significantly higher loss to postintervention and follow-up than the WLC arm. In total, 173 women completed all four assessment points, 64 (37%) from the intervention group and 109 (63%) women from the WLC group. The infants of the participants who dropped out from the study were significantly older than the infants of those who completed the assessments. Additionally, participants who did not complete the T3 assessment had significantly lower education than those who completed.

Costs and QALYs

Table 2 presents the average healthcare and productivity-related per-participant costs accumulated over the 14-month study period. Presented costs were based on the intention-to-treat sample. Mean total costs were EUR 1444 ($SD = EUR 827$) for the Be a Mom group and EUR 1616 ($SD = EUR 1135$) for the WLC group, resulting in a mean difference of EUR -172. The mother's healthcare use and higher productivity losses taking unpaid work into account contributed considerably to the overall higher costs in the control group.

Table 2. Average per-participant costs (in EUR) by condition cumulative over the 14-month study period (based on intention-to-treat sample, $N = 367$).

	Intervention group <i>M (SD)</i>	Control group <i>M (SD)</i>	Mean difference
Healthcare costs			
Healthcare use ^a	556.57 (485.42)	658.23 (635.62)	-101.66
Infant healthcare use ^b	580.58 (233.13)	615.60 (292.30)	-35.02
Mental health services ^c	69.12 (201.53)	67.95 (351.90)	1.17
Medication	18.46 (29.97)	16.41 (19.99)	2.05
Productivity costs			
Absenteeism	70.66 (151.01)	79.91 (269.64)	-9.25
Presenteeism	12.61 (33.49)	34.57 (75.04)	-21.96
Domestic productivity loss	95.40 (259.82)	143.38 (297.77)	-47.98
Intervention cost	40.6	-	40.6
Total costs	1444.01 (827.05)	1616.05 (1135.23)	-172.04

^a Medical consultations, hospitalizations, outpatient care, emergency room, contact with nursing practitioners, physiotherapists, dietitians

^b Medical consultations, emergency room, contacts with nursing practitioners, physiotherapists, osteopathy

^c Contacts with psychologist, psychiatrist, or ambulatory mental health services

Table 3 presents the average per-participant utility score at all time points for both groups. After applying the AUC method and the 3.5% discount rate, the average per-participant QALY during the 14-month period was 0.8807 ($SD = 0.730$) in the intervention group and 0.8743 ($SD = 1.001$) in the control group, resulting in a mean difference of 0.0064 ($SE = 0.0092$).

Table 3. Average per-participant utility score by condition at each time-point (based on intention-to-treat sample, $N = 367$).

	Intervention group <i>M (SD)</i>	Control group <i>M (SD)</i>
T1	0.8643 (0.1655)	0.8732 (0.1684)
T2	0.8903 (0.1210)	0.8806 (0.1552)
T3	0.8930 (0.1007)	0.8917 (0.1360)
T4	0.9160 (0.0931)	0.8999 (0.1215)

Cost-effectiveness

Table 4 displays the findings of the main and sensitivity analyses. Considering the main analysis, and after applying the discount rate of 3.5 percent, Be a Mom resulted in a yearly cost

savings of EUR 165.47 (95% CI -361.77, 28.51) and in a 0.0064 QALY gain (95% CI -0.0116, 0.0244). As seen in the cost-effectiveness plane in **Figure 1**, the point estimate of cost-effectiveness and the associated uncertainty were mostly contained within the southeast quadrant of the cost-effectiveness plane (75.8% of the bootstrapped ICERs). However, there are some instances where the ICER is less effective and less costly (1.6%), more effective and more costly (2.6%) and less effective and less costly (20%).

The estimated probability that Be a Mom was cost-effective was 95.8% at a WTP of EUR 0 for one QALY gained (see **Table 4** and **Figure 1**). Be a Mom had a higher probability of being cost-effective at lower WTP ceilings.

Table 4. Incremental costs and QALYs, ICERs and summary of cost-effectiveness results for main and sensitivity analyses with all estimates based on 1000 bootstrap replications

	Incremental costs (95% CI)	Incremental QALY (95% CI)	ICER	Distribution CE plane (%)				WTP ceiling			
				SE	SW	NE	NW	EUR 0	EUR 3,000	EUR 5,000	EUR 10,000
Main analysis	EUR -165.47 (-361.77, 28.51)	0.0064 (-0.0116, 0.0244)	Dominant	75.8%	20%	2.6%	1.6%	95.8%	96%	95.4%	93.6%
BA Costs/BA QALY	EUR -167.13 (-367.49, 33.23)	0.0068 (-0.0106, 0.0242)	Dominant	74.7%	20.8%	2.8%	1.7%	95.5%	95.4%	96%	94.5%
Without absenteeism and presenteeism costs	EUR -126.59 (-306.16, 52.97)	0.0064 (-0.0116, 0.0244)	Dominant	71%	20.7%	4.3%	4%	91.7%	92.6%	92%	89.8%
Without costs related to productivity losses	EUR -88.82 (-244.76, 67.12)	0.0064 (-0.0116, 0.0244)	Dominant	68.9%	19.1%	7.6%	4.4%	88%	89.6%	89.9%	88.6%
Complete cases	EUR -141.33 (-457.32, 174.66)	0.0008 (-0.0333, 0.0348)	Dominant	49.9%	43.2%	5.2%	1.7%	93.1%	89.8%	87.2%	80.4%

CE: cost-effectiveness

BA: baseline adjusted

ICER: incremental cost-effectiveness ratio

NE: northeast quadrant (the intervention was more effective and more costly than the WLC group)

SE: southeast quadrant (the intervention was more effective and less costly than the WLC group)

SW: southwest quadrant (the intervention was less effective and less costly than the WLC group)

NW: northwest quadrant (the intervention was less effective and more costly than the WLC group)

WTP: willingness to pay

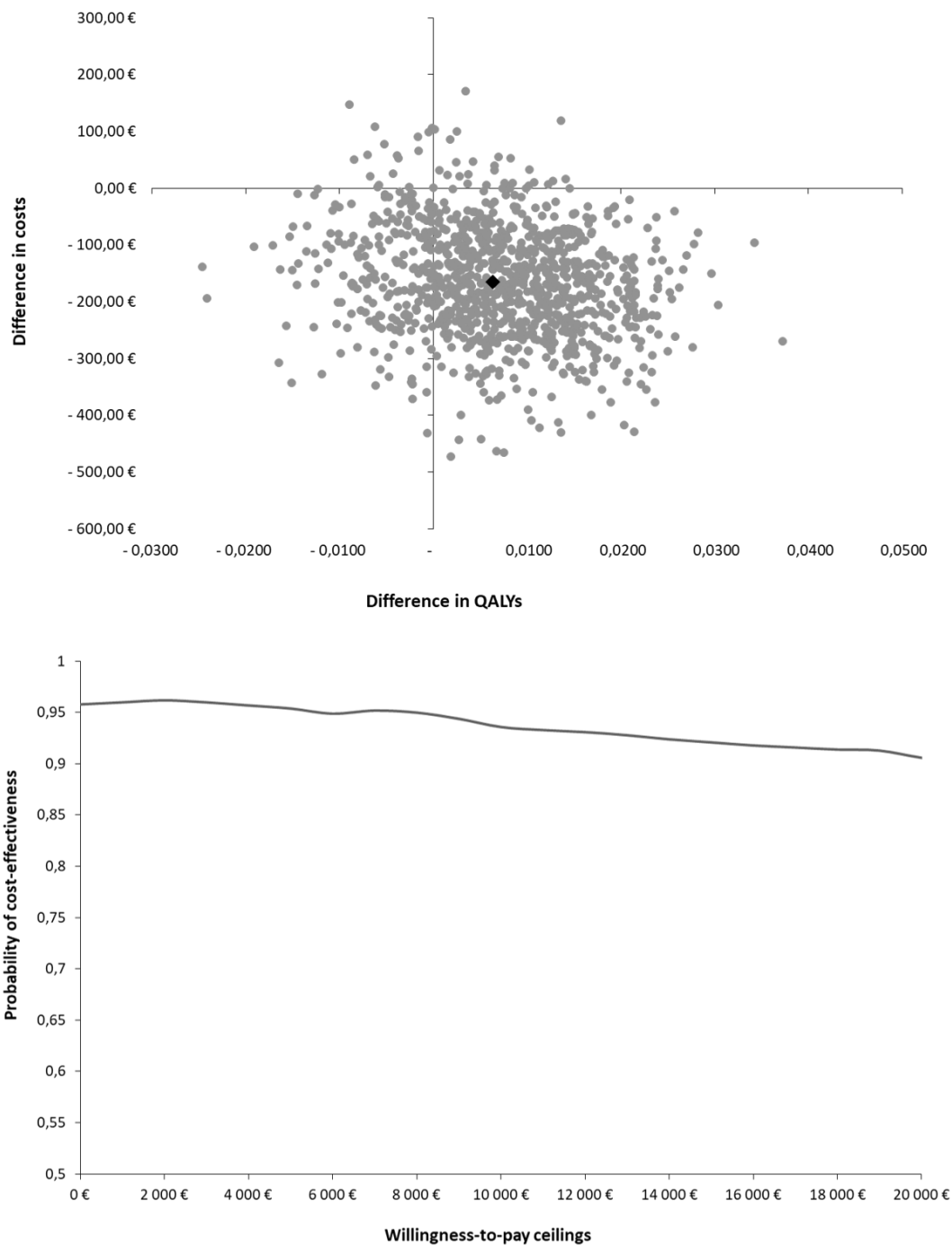


Figure 1. Cost-effectiveness plane of 1000 bootstrapped incremental ICERs and cost-effectiveness acceptability curve, main analysis

To check the robustness of these findings, different scenarios were analyzed (see **Table 4**). Overall, Be a Mom was found to be predominantly cost-effective compared to the WLC across all analyses, with ICERs falling mostly in the southeast quadrant. Analysis with baseline adjustments yielded similar results to the main analysis, with a slightly higher mean difference in QALYs and

costs. When excluding absenteeism and presenteeism costs and all costs related to productivity losses, a dominant ICER was also found. When considering the complete case analysis and comparing it with the main analysis with the intention-to-treat sample, there was a decrease in the mean difference in QALYs. Consequently, the bootstrapped ICERs fell mostly between the southeast and southwest quadrants.

Discussion

The purpose of the current study was to gain insight into the cost-effectiveness of Be a Mom, a self-guided CBT web-based intervention, in comparison with a WLC, in low-risk postpartum women. Globally, the results showed that Be a Mom resulted in higher mean QALYs and lower total costs than the waiting list control and is likely to be cost-effective. Three different sensitivity analyses were performed to test the robustness of the results. Despite some variations in the different sensitivity analyses, the results showed that, overall, the intervention was likely to be more effective and less costly than the control group.

Based on nonparametric bootstrapping, the results demonstrated a dominant ICER over a 14-month time frame, indicating that Be a Mom was likely to be more cost-effective among low-risk postpartum women than no immediate intervention. Under the scenario that there is no willingness to pay for each QALY gained, the probability that the intervention is more cost-effective than the WLC ranged from 88 to 95.8 percent. This finding is consistent with the growing body of evidence showing that web-based psychological interventions can be cost-effective (24), including those that are unguided (25), and add to the insufficient knowledge on the cost-effectiveness of these interventions during the postpartum period.

Although there were some differences from the main analysis regarding the probability of being cost-effective, sensitivity analyses showed that Be a Mom was the preferable intervention, suggesting the robustness of the findings. When performing a cost-effectiveness analysis including only participants who completed the four assessment points, the results suggest that approximately 50 percent of bootstrapped ICERs fall in the southeast quadrant. About 43 percent of bootstrapped ICERs fell in the southwest quadrant, suggesting that there is a moderate probability that Be a Mom could result in more savings than the WLC for a given decrease in QALYs. Although the complete case analysis could be biased because it only included 34 percent of participants in the intervention group, the results could cause uncertainty in the decision-making process. The percentage of ICERs falling in the southwest quadrant could be explained by the relatively small QALY differences between groups. It has been previously shown that the EQ-5D has a ceiling effect and may not be sensitive enough for detecting change in low-risk samples (43, 44). Previous reviews have suggested that the effects of psychological interventions during the perinatal period may be more

robust among higher-risk groups (9), which could mean that they have the potential to be more cost-effective. From a decision-making point of view, it might be worthwhile to consider reaching low-risk groups, as the results of our study suggest that providing Be a Mom to low-risk postpartum women can present good value for the cost.

Nevertheless, in all scenarios, our findings showed that the intervention group consistently generated lower healthcare and productivity costs. A possible explanation for this result could be associated with the significant improvement in positive mental health in the intervention group (21). There is growing evidence on the economic benefits of promoting positive mental health, such as less use of healthcare services and less absenteeism and presenteeism (16; 48).

In Portugal, there is currently no implemented strategy in the public health system to screen, prevent or promote maternal mental health in the postpartum period. The short and unguided format of Be a Mom makes it easily accessible with the potential to reach large groups of people and be integrated into primary care as an early intervention. Additionally, if Be a Mom is offered on a wide scale, the intervention cost per user could be significantly cheaper, as the costs associated with the intervention are mostly fixed and not dependent on the number of users. Therefore, this approach could represent an important pathway that could help alleviate the burden of perinatal mental illness in an economically viable way.

Although this study provides promising results, it has some limitations that should be considered. First, the generalizability of the results is limited because the participants were a self-selected sample that was mainly composed of highly educated and employed women. Furthermore, measurements were based on self-reports and, in the case of cost data, this could have resulted in recall bias and led to over- or underestimation of total costs. Third, consistent with other studies of web-based interventions (49), dropout rates were relatively high, particularly at the last assessment point. Thus, missing values had to be imputed and the procedure for handling the missing data may have led to biased results. To minimize bias, baseline costs and utilities and variables that presented significant differences between groups at baseline and between completers and dropouts were included as predictors in the imputation model. Finally, in this study, we did not capture the long-term cost-effectiveness of Be a Mom, as our last follow-up assessment was 14 months after baseline. Because of the long-term impact of perinatal mental illness, future studies with longer follow-up assessments may provide important insights.

Despite these limitations, to our knowledge, this was the first study assessing the cost-effectiveness of a web-based intervention aimed at promoting maternal mental health among low-risk postpartum women. Given the insufficient knowledge on this topic, these findings contribute to informing healthcare professionals and policy makers, and consequently promote a more efficient use of available resources. Be a Mom could be a cost-effective intervention for mothers in the

postpartum period and contribute to better maternal mental health, which could consequently impact their children's health and development.

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Chapter IV

General discussion

In this final chapter, a brief summary of the main results of the research project is presented, followed by a comprehensive discussion. This chapter has the purpose of providing a more general and integrative reflection on how the results obtained in the empirical studies help us to answer to the questions and goals that were set. Therefore, here it will only be presented the main results of each study and general critical comments, to avoid overlapping with a more detailed discussion of each finding, which has already been presented in each empirical study.

Finally, this chapter also has the purpose to critically comment the main strengths and limitations of this research project, as well as to consider the implications and contributions of the findings for future research, as well as for clinical practice and health policy.

1. Summary of the main findings

The general objective of phase I of the current research project was to understand women's positive mental in the postpartum period. To accomplish this goal, two empirical studies were conducted, taking into consideration specific research objectives: (1) to validate the most widely used measure of positive mental health for Portuguese postpartum women – the MHC-SF; and (2) to contribute to distinguish whether the characteristics of postpartum women who are flourishing are the same of those without clinically relevant postpartum depressive symptoms. The most important findings emerging from these studies are summarized as follows:

Empirical study I

- Confirmatory factor analysis showed that a bifactor model provided a better fit to the data than the original correlated three-factor structure.
- Different results (i.e., factor loadings, values of omega indices, values of the unidimensionality strength indices) indicate that the MHC-SF is better represented by a general positive mental health factor that is reliably measured by the total score. Therefore, separately computing and using the subscale scores of the MHC-SF is not recommended as each subscale explained very little variance beyond that explained by the general factor.
- The MHC-SF is a valid and reliable instrument to measure positive mental health among Portuguese postpartum women.

Empirical study II

- Factors associated with increased likelihood of flourishing mental health among postpartum women were a younger infant age, appraising the support received by others as good, and higher levels of maternal confidence, self-compassion and resilience.
- Factors associated with increased likelihood of not reporting depressive symptoms were a higher household income, fewer problems with infant's sleep, perceiving infant's temperament as easy, appraising the support received by others as good and higher levels of psychological flexibility and self-compassion.

The general objective of phase II of the research project was to test the overall efficacy of Be a Mom, a self-guided web-based CBT intervention, among postpartum women presenting low risk for PPD. Three empirical studies were conducted, and their most relevant findings are summarized below:

Empirical study III

- At postintervention, Be a Mom resulted in significant increases in positive mental health among participants in the intervention group compared to participants in the control group.
- Regarding secondary outcomes, there were no significant time by group interaction effects. Significant group effects were found for depressive and anxiety symptoms, with women in the control group reporting overall higher symptoms. Significant effects of time were found for depressive symptoms, relationship satisfaction, and maternal self-efficacy. Specifically, there was a decrease in depressive symptoms and relationship satisfaction, and an increase in maternal self-efficacy over time in both study groups.
- A significantly higher proportion of women in the intervention group reported an improvement trajectory (from not flourishing at baseline to flourishing at postintervention). Additionally, a significantly higher proportion of women in the control group reported a deterioration trajectory (from flourishing at baseline to not flourishing at postintervention).
- Results on the adherence to the intervention revealed that about 33% of participants in the intervention group completed the intervention. Most participants accessed Be a Mom on their own and completed all the exercises proposed in each module.
- Regarding acceptability, the main results showed that Be a Mom is acceptable among low-risk postpartum women, with 92% of participants rating the quality of Be a Mom as good/excellent. Moreover, most participants reported that they were satisfied with the help

provided by the intervention, would use it again if they needed and would recommend it to a friend.

Empirical study IV

- At postintervention, Be a Mom resulted in significant increases in self-compassion among participants in the intervention group compared to participants in the control group.
- Results did not show significant time by group interaction effects for psychological flexibility and emotion regulation. A significant group effect was found for emotion regulation, with participants in the intervention group reporting higher emotion regulation skills.
- There were no statistically significant changes from postintervention to the four-month follow-up in the measures assessing psychological processes. Estimated means indicated that gains in self-compassion at postintervention were maintained at the four-month follow-up.
- Multilevel mediation results revealed that increases in self-compassion statistically mediated the improvement of positive mental health among the intervention group from baseline to postintervention.
- Changes in psychological flexibility and emotion regulation skills from baseline to postintervention did not significantly contribute to the improvement of positive mental health in the intervention group.

Empirical study V

- Considering a societal perspective, Be a Mom was likely to be more cost-effective than offering no intervention among low-risk postpartum women over a 14-month period.
- Compared with the control group, participants in the intervention group reported less costs associated with healthcare use and productivity losses and increased QALYs over the 14-month period, which resulted in a dominant ICER.
- Under the scenario that there is no willingness to pay for each QALY gained, the probability that Be a Mom is more cost-effective than a waiting-list control group ranged from 91.7% to 95.8%.
- Different sensitivity analyses were conducted to check the robustness of the main findings. More specifically, we conducted analyses with baseline adjustments to costs and QALYs, we excluded absenteeism and presenteeism costs and we ran an analysis including only

complete cases. Results showed that Be a Mom was found to be predominantly cost-effective compared to the control group across all analyses.

2. General discussion of the main findings

In this section, we will discuss the two main contributions of this research project: first, the mounting evidence from our empirical studies supporting the dual-continua model of mental health; second, the different findings demonstrating the overall efficacy of Be a Mom as an early intervention for maternal mental health.

2.1. Supporting evidence of the dual-continua model of mental health

Congruent with previous literature, the multiple findings stemming from our empirical studies support the dual-continua model of mental health, emphasizing how positive mental health and mental illness are two separate dimensions.

In 2008, the WHO had projected that in 2030 depression would be the leading cause of burden in the world (WHO, 2008). Vigo et al. (2016) argued that the burden of mental illness was underestimated and provided an estimate of mental illnesses as a leading cause of global burden of disease. In a 2017 report, the WHO stated that depression was the single largest contributor to global disability and that anxiety disorders were ranked in 6th place (WHO, 2017). While there is vast research on mental illness and on interventions aimed at reducing psychological disorders, some findings suggest that the effectiveness of psychotherapy interventions is not improving (Friborg & Johnsen, 2017; Johnsen & Friborg, 2015) and prevalence rates of mental illness have remained persistently high (Richter et al., 2019), in particular after the start of the COVID-19 pandemic (Nochaiwong et al., 2021).

In this context, increasing research findings have underlined the need to regard mental health as having two continuums – mental illness and positive mental health (e.g., Keyes, 2005; Trompetter et al., 2017). Several findings have highlighted how actively addressing both dimensions of mental health may be a vital approach in responding to the increasing burden of mental illness at a population level (Iasiello et al., 2020). The results of our empirical studies are in line with previous literature and highlight three main topics: first, our results reinforced that mental illness and positive mental health need to be assessed using specific and dedicated scales; second, we demonstrated that both dimensions of mental health have common but also differential associated

factors; and third, our results provided further evidence that psychological interventions can lead either to improvements in indicators of positive mental health and mental illness, or to changes in only one of the domains, underpinning the need to address positive mental health in intervention research.

The use of a validated measure of positive mental health in the postpartum period allowed us to test the hypotheses of the remaining empirical studies. Only with an instrument that independently measured positive mental health it was possible to gather evidence of the independence of both constructs. Empirical study I was not only a validation to the Portuguese population, but also the first study on the validity of the MHC-SF in the postpartum period. Validating self-report measures that were developed for use with the general population in the postpartum period is relevant due to unique nature of this period, and previous studies with other measures have also highlighted this issue (Meades & Ayers, 2011). Indeed, when compared to studies with other samples (Karaś et al., 2014; Petrillo et al., 2015), our results suggested an overall higher percentage of flourishers. A previous study demonstrated an increase in psychological wellbeing levels in women from pregnancy to eight weeks after birth (Brandel et al., 2018). Even though the transition to motherhood entails several challenges, the birth of a baby could provide a higher sense of purpose in life, personal growth, meaning, increased positive emotions and life satisfaction (Dyrdal & Lucas, 2013; Nelson et al., 2013). Therefore, although the MHC-SF revealed good psychometric properties among postpartum women, it might be useful to study more in depth the flourishing rates in postpartum women and to explore how they might vary between different samples based on the MHC-SF flourishing operationalization. This could inform how valid the MHC-SF cutoff scores might be among postpartum women or if a more conservative criteria to operationalize flourishing could be needed.

Moreover, including positive mental health in psychological assessment and screening can have significant implications as it allows the identification of different subgroups. In a national conference, we presented preliminary results from the sample recruited in phase I of our research project in which we divided women into four subgroups consistent with the dual-continua model of mental health presented in Figure 1. Our results showed that postpartum women without clinically relevant depressive symptoms who also did not have flourishing mental health reported lower levels of resilience, psychological flexibility and self-compassion than those who had depressive symptoms but were also flourishing (Monteiro et al., 2020). An assessment focused only on mental illness would consider the women in the group without depressive symptoms as mentally healthy. However, the results suggested that the mere absence of depressive symptoms did not translate into better levels of psychological resources, which may place these women in a more vulnerable position in the face of future adversity. Thus, despite not experiencing depressive symptoms, these

women may experience more difficulties in adapting to motherhood and the different changes and reorganizations it entails. This is congruent with previous findings, suggesting that the absence of flourishing mental health seems to represent a greater vulnerability than not presenting psychological symptoms (Keyes, 2005) and further strengthens the need to include positive mental health in routine assessment.

Our results also support the dual-continua model of mental health by showing different patterns of association between both domains of mental health and sociodemographic, infant-related and psychological factors among postpartum women. More specifically, positive mental health was independently related to more “positive” factors, such as social support, self-compassion, resilience, maternal confidence. On the other hand, sociodemographic factors such as income, and infant-related factors such as a difficult infant temperament or poor infant sleep, were related to postpartum depressive symptoms. It should be noted that associations of positive mental health and mental illness to these factors were demonstrated after controlling for mental illness and positive mental health, respectively. Therefore, although these dimensions were related, we can conclude that they had independent associations with the different factors. Although our findings resulted from a study with an explorative nature, they raise important questions which answers could help with the design of better targeted mental health care and significantly improve its outcomes. Further research could provide much needed insight into the efficacy of interventions through the dual-continua model lens, and answer questions such as if there are some individuals who could benefit more of an intervention in terms of psychopathology, positive mental health or both and what characteristics do these individuals have.

Finally, our results signal the importance of targeting and assessing positive mental health in interventions. The bipolar model implies that an improvement in positive mental health and a reduction in mental illness signify the same outcome (Herron & Trent, 2000). However, the dual continua model of mental health advocates that an improvement in one of the continuums does not exclude nor guarantee an improvement in the other. The results of our trial reinforce this by showing the importance of capturing both dimensions of mental health in interventions. If we only aimed to measure the illness domain of mental health, we could have concluded that low-risk postpartum women may not benefit from Be a Mom. However, a failure to see an effect in depressive and anxiety symptoms did not mean that Be a Mom did not have a positive effect on the mental health of the participants. This is congruent with previous studies that have used measures to evaluate both constructs and found that most individuals improved in either mental illness or positive mental health (Newnham et al., 2010; Trompetter et al., 2017), suggesting that interventions could have independent effects on both domains of mental health. Given our results, low-risk women in the postpartum period can be the target of psychological interventions, even if they present less

clinically relevant depressive and anxiety symptoms. This further reinforces the importance of considering positive mental health indicators when assessing the efficacy of psychological interventions.

Congruent with previous literature, our research findings strengthened that addressing the burden of postpartum mental illness on society as a whole can only be possible with a wide approach incorporating both dimensions of mental health and including all women in the postpartum period and not just those with mental illness. Therefore, in addition to preventing and reducing mental illness, promoting positive mental health should be seen as an essential outcome when intervening with postpartum women.

2.2. Be a Mom as an early intervention for postpartum women

The results of the RCT conducted to assess Be a Mom's efficacy among primary and secondary outcomes have been previously outlined. Overall, the findings of our empirical studies III, IV and V support the use of Be a Mom as an effective psychological intervention for postpartum women presenting low risk for PPD. In particular, Be a Mom is a suitable intervention to improve positive mental health and self-compassion levels. Additionally, Be a Mom also represents a cost-effective approach among low-risk postpartum women. The relevance of these findings will be discussed in more detail below.

First and foremost, empirical study III represents the first study to demonstrate that a web-based CBT intervention targeting low-risk postpartum women can have a significant effect in improving positive mental health. In line with Huppert's model (2005), targeting the increase of positive mental health levels in the population instead of a sole focus on the prevention and treatment of mental illness might result in a significant shift for mental illness outcomes in the future. In line with this, previous research has consistently shown that higher levels of positive mental health are seen as a protective factor in the long-term development of mental illness (e.g., Lamers et al., 2015; Wood & Joseph, 2010). Thus, Be a Mom could be part of a comprehensive approach promoting maternal mental health which could have a snowballing effect on the prevalence and burden of mental disorders in the postpartum period.

Additionally, our findings showed that Be a Mom is efficacious in improving self-compassion levels. Unrealistic culturally derived beliefs about motherhood have long been pointed out as important factors contributing to the onset and maintenance of mental illness in the postpartum period (Milgrom, 1999; Sonnenburg & Miller, 2021). One dominant societal discourse is the "perfect mother" ideology, which refers to the idealized characteristics and behaviors that good mothers should have. This ideology plays a role in shaping women's expectations about their role as mothers

and, because it is difficult to meet such high standards, often leads to feelings of guilt and shame (Dunford & Granger, 2017). In light of this, self-compassion seems to play a vital role in the psychological adjustment to this period. A large body of literature on the perinatal period has focused on risk factors for mental illness and how to deal with symptoms and illness (Milgrom et al., 2008; Norhayati et al., 2015) and the focus on psychological resources has been scarcer. Empirical study II not only provided evidence on the independence of both dimensions of mental health but also brought important insights to which factors would contribute to better mental health in interventions in the postpartum period, highlighting the important role of self-compassion.

Be a Mom was developed to foster psychological resources and self-compassion was an underlying mechanism in its development (Fonseca et al., 2019; Fonseca et al., 2018). Be a Mom's content aimed to promote the different components of self-compassion. Particularly, Be a Mom addresses the myth of the perfect motherhood and the negative impact of self-criticism, fostering a more accepting attitude of inner experiences and actions of compassion inwards (mindfulness and self-kindness), and shares personal stories of fictional characters who are mothers to highlight that their experiences are often common to most women in the postpartum period (common humanity). Congruently, the results from our empirical study IV showed that self-compassion was an important mediator of change to improve positive mental health among low-risk women. Promoting self-compassion attributes such as awareness, forgiveness, kindness and feelings of inter-connectedness with others could have contributed to increase indicators of positive mental health such as self-acceptance, personal growth, positive emotions, positive relationship with others and social integration.

Although Be a Mom's content also sought to increase psychological flexibility levels of participants, it was not found to be a central mechanism contributing to positive mental health. In empirical study II we found that psychological flexibility was only associated with a decreased likelihood of presenting depressive symptoms and not with an increased likelihood to present flourishing mental health. Previous evidence also suggested that psychological flexibility seemed to be more central for mental illness than for positive mental health (Wersebe et al., 2018), although other studies found that it contributed to positive mental health (Fledderus et al., 2010). It is also a possibility that the questionnaire that was used to assess psychological flexibility (i.e., the AAQ-II) may have influenced the results. The AAQ-II aims to measure experiential avoidance, which represents only one of the components of psychological flexibility, and which has been identified as a central factor contributing to depression (Rueda & Valls, 2016; Shallcross et al., 2010). In the pilot study of Be a Mom with high-risk women, results showed that scores on the AAQ-II were not significantly associated with the decrease in depressive and anxiety symptoms (Fonseca et al., 2020). Although Be a Mom addresses experiential avoidance by showing the consequences of

avoiding unpleasant thoughts and emotions, it mainly targets the building of resources such as awareness of and commitment to personal values. In this sense, measuring other aspects of psychological flexibility such as values and committed action could help better understand the impact of Be a Mom on psychological flexibility levels among low-risk women.

The results of our RCT on the efficacy of Be a Mom also showed a trend of a greater decrease in the intervention group for depressive and anxiety symptoms and an increasing trend for emotion regulation skills. Nevertheless, it is important to note that our RCT did not show a significant effect in these outcomes. Different reasons could have contributed to this non-significance, including the size of the sample, and the amount of missing data. Still, it is important to point out the characteristics of our sample. In the pilot study of Be a Mom, which was conducted with women presenting high risk for PPD, results showed that participating in the intervention significantly decreased anxiety and depressive symptoms, and increased emotion regulation skills (Fonseca et al., 2020; Fonseca et al., 2019). Therefore, we can argue that high-risk women present different characteristics. Indeed, when looking at baseline mean estimates, it is evident that baseline scores in depressive and anxiety symptoms were lower in the RCT with low-risk women (EPDS mean intervention group: 6.38; HADS-A mean intervention group: 4.40) than in the RCT with high-risk women (EPDS mean intervention group: 9.32; HADS-A mean intervention group: 6.91). It is thus important to consider that low-risk women may not benefit from Be a Mom in the same way that high-risk women, when considering these outcomes, reinforcing the argument to consider other indicators when assessing the efficacy of the intervention.

Our results also highlight the benefit of interventions such as Be a Mom in targeting low-risk women not only given our findings in psychological measures but also when considering the results about the acceptability of the intervention. Although the vast majority of intervention research in the perinatal period has focused on developing interventions for high-risk women (Cuijpers & Karyotaki, 2021; Sockol, 2015), our results showed that most women who participated in Be a Mom found the contents of the intervention to be relevant for them and reported that they were satisfied with the help received and intended to use it again if needed. This indicates that women from our study related to the content and exercises that were provided despite not presenting risk for PPD, suggesting that even low-risk women struggle with the numerous demands of the postpartum period and can build important resources to help them deal with these challenges, which was successfully demonstrated by the efficacy results.

Finally, on top of the improvements in positive mental health and self-compassion, our results suggest that using Be a Mom reduces costs related to healthcare use, absenteeism and presenteeism, demonstrating that Be a Mom represents a cost-effective approach among low-risk postpartum women, emphasizing its widespread use in the postpartum period. The literature on the

cost-effectiveness of psychological interventions in the postpartum period is still very limited despite the mounting evidence on the long-term costs associated with postpartum mental illness (Bauer et al., 2016). The results of empirical study V showed that women in the intervention group not only reported less costs associated with healthcare use but also reported less use of healthcare services for their infants. One of the concerns often reported in the literature is the increased use of healthcare services by children of mothers presenting mental illness (Adler & Azuri, 2021; Lyngsøe et al., 2019; Moore Simas et al., 2020). Indeed, these indirect costs seem to be associated with the long-lasting consequences of the mother's mental illness on their children's emotional and cognitive development (Slomian et al., 2019; Stein et al., 2014). Given the evidence showing that the costs of perinatal mental health problems are extremely high, the effects of Be a Mom on a 14-month time frame suggest that its benefits justify its implementation and use among low-risk postpartum women.

3. Contributions to research: Strengths and limitations and implications for future research

3.1. Strengths and limitations

This research project has important theoretical, methodological and statistical strengths that reinforce the validity, relevance and innovation of the results to the current knowledge and understanding of promoting positive mental health in the postpartum period through web-based interventions.

First, the pioneering nature of the research work carried out, in terms of international and national literature, should be highlighted. To our knowledge, this was one of the first scientific works to study positive mental health in the postpartum period, particularly: 1) the first validating a widely used positive mental health measure to the postpartum period context; 2) the first exploring the factors associated with flourishing among postpartum women; 3) the first investigating positive mental health conceptualized as emotional, psychological and social wellbeing as a primary outcome of an intervention for postpartum women's mental health; 4) one of the first going beyond examining the efficacy of a web-based intervention in postpartum women and exploring its mechanisms of change and its cost-effectiveness.

Second, our research questions and objectives were underpinned by solid theoretical frameworks, particularly the dual-continua model of mental health. In turn, our empirical results contributed to supporting this theoretical model as well as provided evidence-based guidelines for clinical practice and policy in the postpartum context that go beyond a model which focus exclusively on mental illness and views it as an opposite end of mental health.

Finally, the methodological and statistical choices that were implemented additionally strengthened this research. More particularly, to investigate the efficacy of Be a Mom, we conducted a two-arm RCT with four assessment points. RCTs are considered the gold standard of intervention research and allowed us to investigate not only the efficacy of the intervention with minimal bias, but also to explore its mechanisms of change and cost-effectiveness with more accuracy, contributing to the literature on intervention research during this period. Moreover, the use of advanced statistical techniques innovatively contributed to the literature. In this context, we highlight 1) the use of the bifactor model and the statistical indices derived from it in the psychometric study of the MHC-SF, which provided significant and invaluable information in determining whether the MHC-SF subscale scores were reliable after accounting for the general factor; 2) the use of linear mixed models to investigate the efficacy of Be a Mom on several outcomes, which allowed to handle missing data with minimal bias; 3) the use of multilevel mediation, which allowed to investigate the

mechanisms contributing to the improvement of positive mental health among women who received the intervention by taking into account the nested nature of repeated measures data; and, 4) the use of bootstrapping of individual data of cost and QALYs to estimate the cost-effectiveness of Be a Mom.

Despite these strengths, we must also acknowledge some methodological limitations that should be considered in the interpretation of our research findings.

First, the online recruitment, which was common to all empirical studies, could have led to a self-selection bias, i.e., women who were more interested in the topics of the research may have been more motivated to participate. Moreover, when analyzing the characteristics of the samples of our empirical studies, we found that most women were in a relationship, were highly educated and employed. It is possible that the online recruitment may have led to an over-representation of women in a relationship, with higher education and income, which could have also contributed to our findings. Thus, there are significant limitations when generalizing the results of our research work to all women in the postpartum period.

Second, empirical studies I and II had a cross-sectional design, which prevents the establishment of causal relationships between variables and implies that our results must be interpreted in terms of interrelationships between variables at a certain point in time.

Third, the exclusive use of self-report measures could have influenced the results, particularly considering data on healthcare use, absenteeism and presenteeism. Self-report methods are sensitive to various biases (e.g., social desirability, response fatigue, difficulties in understanding or loss of interest) that can lead to incorrect questionnaire completion and compromise the validity of responses.

An additional set of limitations that are specific to the RCT study should be highlighted. First of all, despite our efforts to maximize participants' retention through text message and email reminders, our results revealed low adherence rates to the intervention and a high proportion of participants dropping out from the study, particularly in the last assessment points. The low adherence to the intervention may have different explanations. When enrolling in the study, women had to be between 0 and 3 months postpartum. This means that at the time of the intervention some of them may still be in the very early postpartum period and time constraints could have prevented them to finish the intervention modules in 8 weeks. Indeed, most women who had not completed the intervention at the time of the postintervention assessment selected lack of time as the main reason for not completing the five modules. Moreover, the unguided format of Be a Mom could have also contributed to the low adherence rates. Previous literature has shown that the accountability to a therapist and the human support involved in guided web-based interventions

could increase intervention adherence (Baumeister et al., 2014; Mohr et al., 2011). On the other hand, it is important to note that other studies have reported high dropout rates when assessing the efficacy of web-based interventions (Lee et al., 2016; Richards & Richardson, 2012), emphasizing this as an important area of future research. In addition, the use of a WLC control, in which treatment is provided only after a period of time equivalent to or greater than the intervention group, may have led to biases in the results, as they could have been overestimated (Mohr et al., 2009). However, in our study, women could access usual care, so our findings can also be interpreted as the improvements Be a Mom offers compared to current practice. Third, process variables were collected in the same timeframe as the primary outcome. Therefore, we have to limit the interpretation of our findings and cannot fully conclude that they represent associations between causes and consequences. Finally, a longer follow-up to evaluate if improvements in positive mental health in the intervention group are maintained over a long period of time was lacking in our study.

3.2. Implications for future research

The contributions of our research project and the limitations that have been pointed out are the starting point for reflecting on future research.

Based on the generalizability limitations that were mentioned in the previous section, it would be worthwhile to broaden the research population in future studies. If there is a public mental health strategy to increase the prevalence of flourishing mental health in the general population (community), this requires a representative population sample including lower educated people and more culturally diverse groups than was presented in the current study. A more homogeneous distribution of sample characteristics would also enable the investigation of group differences in positive mental health and the identification of the socio-demographic and clinical conditions in which flourishing is more likely to occur (i.e., moderation analyses).

Regarding the limitations of the RCT study, future research with the Be a Mom intervention could include the use of an active or component control groups (for example, control groups with Be a Mom content only addressing one of the mechanisms of the intervention or only addressing risk factors). This would not only allow to minimize possible bias but could also be useful in understanding mechanisms and testing effects of specific components of the intervention.

Moreover, additional time-points and longer follow-ups are needed to understand the efficacy of Be a Mom in the long-term. Longer follow-ups would allow to test if the increases in positive mental health would result in a reduced risk to develop mental illness or in a better adjustment to different life challenges and transitions, which would help to further understand the long-term potential of interventions aimed at promoting mental health.

Also, because we could not fully assert whether changes in self-compassion occurred prior to changes in positive mental health, future studies should measure outcome and process variables repeatedly throughout treatment to account for temporality and to confirm that self-compassion is a mechanism of the improvement in positive mental health. Including more assessment points would allow more rigorous mediational analyses and provide further information on which mechanisms should be targeted more intensely.

Another important topic to further develop pertains to the low rates of engagement with the intervention, which are common to other studies with web-based interventions. Previous literature has suggested that greater engagement with web-based interventions is associated with better treatment outcomes (Donkin et al., 2011; Gan et al., 2021). Including human support through a therapist that can be perceived as trustworthy and an expert in the beginning or during the intervention (e.g., diagnostic interview, availability to provide help throughout the intervention), can add feelings of accountability. On the other hand, our findings suggest that there is a strong need to identify characteristics of individuals and interventions that are related to treatment dropout. In our study, some women were more prone to dropout than others, as our results showed that a higher proportion of women with older infants and with less education levels dropped out. A greater knowledge on who may benefit more from an unguided web-based intervention such as *Be a Mom* could also help improve adherence rates. Additionally, the intervention could include components based on frameworks such as the Persuasive System Design, which is rooted in research on human-computer interaction and persuasive technology (Wu et al., 2021). To increase engagement, features such as dialogue support (e.g., praise, reminders, rewards) or credibility support (e.g., trustworthiness, expertise, real-world feel) could increase the interaction with the intervention and facilitate its primary purpose.

In line with this, low levels of engagement have been reported as barriers to the adoption and implementation of e-mental health in healthcare settings (Gan et al., 2021). Given that research on e-mental health has unequivocally provided evidence on its efficacy and potential to improve mental health care services, future research on the best way to implement an intervention such as *Be a Mom* in a “real world” setting is the logical next step. Studies aiming to provide an in-depth understanding of contextual barriers and facilitators to the implementation of web-based interventions in mental healthcare services are particularly needed (especially in Portugal), and should include different stakeholders (e.g., patients, health professionals, policy makers, regulators). Understanding the importance of implementation quality and the wide range of influencing factors could be critical to effective evidence-based practice, and such knowledge could be vital to facilitate a successful uptake of web-based interventions.

Finally, further research on the dual-continua model of mental health is still necessary. Although this model provides a more comprehensive view of mental health, more research still needs to be conducted to capture the complex reality of what determines mental health. Our findings shed light on factors contributing to mental health during the postpartum period, but the complex relationships between both dimensions of mental health, and more importantly, what influences and contributes to complete mental health is still somewhat unexplored. On the other hand, the dual-continua model still focus primarily on a positive psychology framework (Iasiello et al., 2020). Well-accepted and empirical validated constructs and therapies, such as CBT (Fordham et al., 2021), Mindfulness-based therapies (Goldberg et al., 2021) and a myriad of psychological resources (Hayes & Hofmann, 2018; Hofmann & Hayes, 2018), could be integrated in this model to help capture the complex reality of mental health and help provide a comprehensive overview of the building blocks of complete mental health. In line with this, further research is warranted on which interventions are better suited to improve positive mental health. Interventions and treatment paradigms such as CBT have implicitly or explicitly adopted the dual-continua model, by designing program components that improve positive mental health even though the primary focus might be in reducing mental illness. Classical CBT psychotherapists are mostly trained to treat psychological disorders clearly defined by a set of symptoms. Although some techniques, such as problem solving and effective communication strategies, may intent to build resources, the focus is mostly to identify and reduce dysfunctional emotional, cognitive and behavioral patterns. More recently, third wave CBT therapies such as CFT and ACT have aimed to mostly focus on building resources (e.g., acceptance, awareness, self-compassion) and our results show that these mechanisms can be important to build positive mental health. More research could help guide interventions aiming to improve positive mental health.

4. Implications for clinical practice and health policy

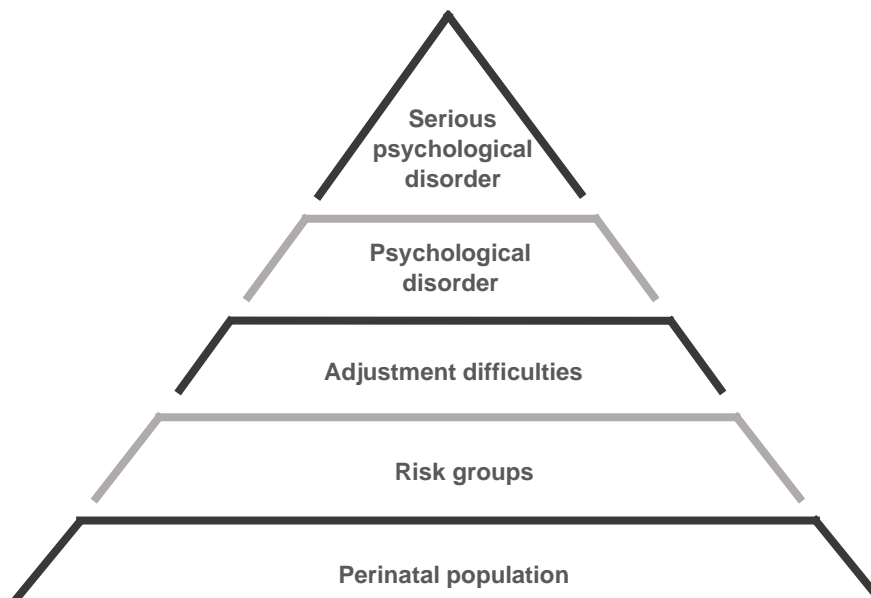
The set of results obtained in this research not only add evidence-based knowledge to the current state of the art, but also provide important contributions to improve clinical practice and health policies on the topic of mental health promotion in the transition to motherhood. The following is the result of our extensive literature review, the discussion of our findings, but also of our own clinical experience with women in the perinatal period.

One of the main clinical and health policy implications resulting from this dissertation is related to the need of a reform in the mental healthcare system. Current mental health services provide “reactive” healthcare, mainly focused on the treatment of mental illness. Our findings call attention to the urgent need to shift from the commonly used bipolar model of mental health to a dual-continua model that considers both positive mental health and mental illness indicators. At the same time, our results underline the need to promote mental health, rather than just prevent and treat disorders, drawing attention to the role of e-mental health interventions as an effective pathway to deliver mental health promotion in the postpartum period.

In this sense, integrated- and stepped-care models are an approach that could integrate such findings and bring significant changes for perinatal mental healthcare. Our findings clearly emphasize the multifold benefits of using a stepped-care model in mental healthcare, and such models have been recommended by international guidelines (Australian Government Department of Health, 2019; NICE, 2011). A stepped-care model represents an evidence-based, staged system comprising a hierarchy of interventions which can be matched to the individual’s needs. **Figure 5** illustrates an example of different levels of mental healthcare response within a stepped-care model for perinatal mental health. At the base of the pyramid, mental health promotion strategies should aim to target all women in the perinatal period, including low-risk women. Unguided web-based interventions have the potential to easily reach all women, without the need of using increased human or economic resources. Going upwards in the pyramid, and with the help of routine screening, more targeted prevention strategies could be made available for at-risk groups. In this step, *Be a Mom* could also be used as it was found to significantly reduce depressive and anxiety symptoms among women presenting high risk for PPD (Fonseca et al., 2020). The top sections of the pyramid correspond to increasingly more severe cases in which mental health care responses should vary according to the severity of the symptoms, providing treatment interventions with different modalities and intensities. As illustrated, when adopting this approach, mental health promotion strategies would precede prevention and treatment of mental illness. Moreover, different

types of e-mental health interventions could increase access to healthcare and improve outcomes in all sections of the pyramid.

Figure 5. Example of a stepped-care model for perinatal mental healthcare. Model adapted from NICE, 2011



Implementing mental health promotion interventions as part of a first step could bring significant changes to the direct and indirect negative consequences of mental disorders during the postpartum period. For instance, according to the literature, adding the promotion of positive mental health to the current healthcare system opens up the potential to minimize the risk for future mental illness (Huppert, 2009; Keyes et al., 2010). At the same time, even in the presence of mental illness, promoting positive mental can lead to greater odds of recovering (Iasiello et al., 2019).

Although psychotherapists and mental health services may be aware of the importance to promote mental health, daily clinical practice is predominantly illness-oriented and in Portugal, to the best of our knowledge, there are no approaches including positive mental health in clinical psychology practice or mental health care as a whole. Mental healthcare systems should strive to promote complete mental health in individuals, not just reduce their mental illness. In this sense, the assessment and promotion of positive mental health should be considered as an additional goal, complementary to the assessment and treatment of psychopathology in all steps of the pyramid. Next, we will briefly focus on the outputs of this research project that directly impact the assessment and promotion of positive mental health: the MHC-SF and the Be a Mom intervention.

In Portugal, at the moment, there is no universal psychological screening as part of routine perinatal care. However, several international guidelines for the management of perinatal mental health advocate enquiring all women about past and current risk factors acknowledged to be related to poor mental health outcomes (NICE, 2014 updated 2020). While this is extremely important and remains overlooked in several countries, when conducting assessments solely through a mental illness lens it cannot be possible to shift to a mental health promotion approach.

When assessing the overall mental health status of individual, measures of both positive mental health and mental illness should be included. Based on the literature and the results from our empirical studies, focusing on either mental illness or positive mental health cannot provide a complete image of the mental health status of an individual. As the literature as shown, simply using positive items of mental illness measures is not a valid assessment approach and questionnaires specifically designed to capture either construct in a representative manner should be used.

An important contribution of this research was providing researchers and clinicians with a robust measure of positive mental health for use with postpartum women that is also brief and easy to use. The MHC-SF is one of the best evaluated questionnaires for positive mental health assessment that is currently available and the only measure assessing all theoretically derived aspects of emotional, psychological and social wellbeing.

Adding the assessment of positive mental health to the existing assessment of mental illness enables mental health professionals to identify previously invisible subgroups. As previously mentioned, the absence of flourishing mental health seems to represent greater vulnerability than not presenting psychological symptoms. On the other hand, individuals with mental illness but who are also flourishing seem to have greater resources that can be consciously encouraged. This degree of insight can only be possible with the assessment of both dimensions of mental health. With this knowledge, interventions can be more targeted considering the characteristics of each subgroup.

Besides providing a valid measure to assess positive mental health among postpartum women, our research project provides evidence recommending the use of Be a Mom as an early intervention for low-risk postpartum women. Be a Mom can be seen as an effective approach to address the significant burden of postpartum mental illness on the society as a whole, as it was shown to incorporate both dimensions of mental health, to include all women in the postpartum period and to be a cost-effective intervention. Therefore, it offers an accessible intervention option that could easily be disseminated at a population level. Be a Mom could then be part of an alternative model of care that can meet the increasing mental healthcare needs of the perinatal period (Berthelot et al., 2020; Lebel et al., 2020).

Despite the numerous studies demonstrating the efficacy of web-based psychological interventions, the implementation of e-mental health in routine care has been difficult, especially due to barriers such as negative attitudes from mental health professionals who have showed concerned over the difficulty in establishing an effective therapeutic alliance (Topooco et al., 2017). However, since the beginning of the COVID-19 pandemic, health professionals and the public seem to be much more favorable to digital health tools than in previous years. For example, a recent study with 3070 participants showed that most reported that telepsychiatry has been just as helpful as in-person treatment and 64.2% reported that they would be likely to continue using remote treatment services in the future after the pandemic resolves (Guinart et al., 2020). The increase use of digital mental health tools has been not only associated with difficulties in providing face-to-face psychotherapy due to increased risk of infections but also the stressors associated with the COVID-19 pandemic (e.g., isolating, financial losses) led to an increase in mental health problems (Vindegaard & Benros, 2020).

Without a doubt, the COVID-19 pandemic has offered the opportunity for a shift in mental health care provision towards digital health promotion, prevention and treatment (Wind et al., 2020). However, this change requires the involvement of not just mental health professionals and patients but other stakeholders, such as policymakers, companies or funders. There has been an increasing movement to make changes in the regulatory framework regarding digital health interventions and regulators have started to evaluate and enable changes that will contribute to speeding up the adoption of such interventions. In 2019, Germany established DiGA, a framework that provides individuals free access to prescription digital therapeutics through their statutory health insurance (Stern et al., 2020). There are currently 22 digital health applications approved for reimbursement, of which almost 50% are focused on mental health. Other European countries have been following Germany's footsteps, such as France, Belgium and Italy, which have been creating procedures to approve digital therapeutics for reimbursement (MedTech Europe, 2021; Lovell, 2021). Likewise, in the United States, the Food and Drug Administration (FDA) developed a digital health pre-certification program to provide a streamlined path to software product approval (FDA, 2019). Additionally, there is already a Medicaid program to reimburse for prescription digital mental health therapeutics (Beerman, 2021).

In Portugal, the publication of the National Strategic Telehealth Plan in 2019 (Serviços Partilhados do Ministério da Saúde, 2019) proposed strategic measures to expedite the full integration of digital health within the everyday sphere of healthcare. However, mental health care was not part of the plan and is not mentioned in the document. Additionally, the Portuguese National Mental Health Plan does not mention digital mental health interventions (Programa Nacional para a Saúde Mental, 2017), despite the existence of guidelines for the practice of e-mental health

published by the Portuguese Psychologists Association (Carvalho et al., 2019), which aimed to provide practical and deontological orientation. A study conducted before the COVID-19 pandemic with 1077 members of the Portuguese Psychologists Association showed that most psychologists were not familiar with web-based psychological interventions and reported negative attitudes towards such interventions (Mendes-Santos et al., 2020). The COVID-19 pandemic could represent an opportunity to align both national plans and take advantage of the potential of e-mental health in promoting the mental health of the Portuguese population, which in turn could have an impact on overall health (Keyes, 2004).

Hopefully, the findings from this research project can inform policy making decisions around the development and implementations of web-based interventions for this population and serve as a starting point for the implementation of future mental health promotion strategies in the postpartum period in Portugal.

Maternal mental health is fundamental to the health of the family system and societies. The postpartum period represents an influential time of life and healthcare systems can use the opportunity that maternity care brings to maximize women's mental health, which in turn can have an effect in the optimal development of children.

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Appendix

APPENDIX

Perceived Maternal Parenting Self-Efficacy scale: Factor structure and psychometric properties among Portuguese postpartum women

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Perceived Maternal Parenting Self-Efficacy Scale: Factor structure and psychometric properties among Portuguese postpartum women

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Abstract

Objective: The aim of this study was to investigate the factor structure and psychometric properties of the Perceived Maternal Parenting Self-Efficacy (PMPS-E) Scale among Portuguese postpartum women.

Design: Quantitative cross-sectional study.

Setting: Data were collected through an online survey placed on social media websites targeting Portuguese adult women in the postpartum period (0-12 months after delivery).

Participants: The total sample consisted of 893 participants who gave birth after 37 weeks of gestation.

Results: After conducting exploratory and confirmatory factor analyses, our results revealed that a correlated three-factor model yielded a significantly better fit to the data than the original four-factor model. High reliability was found for the total scale ($\alpha = .95$) and for the three factors (α from .88 to .94). The PMPS-E presented significant and moderate to large correlations with other measures related to maternal self-efficacy. Participants who were multiparous, had older infants (>5 months old) and perceived their infant temperament as easy reported higher maternal parenting self-efficacy than those who were primiparous, had younger infants (≤ 5 months old) and perceived their infant temperament as difficult.

Conclusions: The results of this study showed that the European Portuguese version of the PMPS-E is a valid and reliable instrument for assessing maternal parenting self-efficacy among postpartum women.

Implications for practice: The PMPS-E may be a valuable instrument to detect parenting self-efficacy difficulties among postpartum women and thus contribute to strategies to improve women's overall psychological adjustment to the postpartum period, with a possible impact on the mother-infant relationship.

Keywords: exploratory factor analysis; confirmatory factor analysis; psychometric properties; perceived maternal parenting self-efficacy; postpartum period

Introduction

The postpartum period is a time of transition, learning and adjustment for women (Nelson, 2003). During the first postpartum year, women are faced with several challenges and must continuously learn new tasks, abilities and behaviors related to childcare. Because of the endless responsibilities mothers tackle when caring for their infants, maternal parenting self-efficacy, defined as the women's belief in her ability to deal with parenting situations (Hess et al., 2004; Jones & Prinz, 2005), is very important in facilitating a successful adjustment to the maternal role (Mercer, 2004; Ngai et al., 2010). Indeed, research shows that believing in the ability to safeguard the infant's needs and provide care may be as important as having the skills to perform these tasks (Leahy-Warren & McCarthy, 2011).

Maternal parenting self-efficacy is a pertinent topic because of the significant impact it has on parenting practices, infant development and women's psychological health (Coleman & Karraker, 2000). Research has suggested that parenting self-efficacy is a central variable in infant development given its direct influence on child behavior (e.g., Coleman & Karraker, 2003), as well as its indirect influence through the mother-infant relationship (e.g., Gharaibeh & Hamlan, 2012) and through parenting practices. For instance, higher levels of parenting self-efficacy have been associated with more positive parenting practices (Coleman & Karraker, 1998; Dumka et al., 2010; Jones & Prinz, 2005) and parental competence (Jones & Prinz, 2005; Teti & Gelfand, 1991). In turn, according to self-efficacy theory (Bandura, 1997), parents with low parenting self-efficacy beliefs may be more inhibited to acquire new knowledge and skills and more prone to giving up when challenges arise. Consequently, struggles with parenting may confirm beliefs of low efficacy, leading to increased levels of psychopathological symptoms (Law et al., 2019).

When considering women's psychological health, low maternal parenting self-efficacy has been associated with an increased risk of postpartum depression, parenting dissatisfaction and maternal stress (Kohlhoff & Barnett, 2013; Law et al., 2019; Salonen et al., 2009). Other studies have highlighted the protective role of maternal parenting self-efficacy against socioeconomic adversity (Ardelt & Eccles, 2001) and against the impact of prenatal stress on emotional and behavioral regulation problems in the infants (Bolten et al., 2012). Moreover, considerable evidence has shown that the promotion of maternal self-efficacy is an important mechanism in the reduction of postpartum depressive symptomatology (Haslam et al., 2006; Mickelson et al., 2017). In line with these findings, a recent systematic review emphasized the beneficial influence of maternal self-efficacy against the detrimental effects of postpartum psychological distress on the health of both mothers and infants (Liyana Amin, Tam, & Shorey, 2018). Because maternal parenting self-efficacy can be improved (Bandura, 1997), it has been included as one of the target areas of intervention

for mothers in the postpartum period (Perez-Blasco et al., 2013; Shorey et al., 2015). Therefore, considering the clinical implications that the promotion of maternal parenting self-efficacy may have, it seems essential to have valid and reliable instruments to assess this variable in the postpartum period.

Assessing maternal parenting self-efficacy: The Perceived Maternal Parenting Self-Efficacy Scale

A recent systematic review assessing the psychometric qualities of parenting self-efficacy self-report measures has considered the Perceived Maternal Parenting Self-Efficacy Scale (PMPS-E; Barnes & Adamson-Macedo, 2007) as one of the most appropriate questionnaires for measuring parenting self-efficacy (Wittkowski et al., 2017). The PMPS-E is a self-report questionnaire that was originally developed to assess maternal parenting self-efficacy among mothers of hospitalized preterm infants (Barnes & Adamson-Macedo, 2007). It was developed according to Bandura's self-efficacy theory (Bandura, 1997) as it combines the assessment of specific parenting tasks or activities within the broader domain of parenting. The PMPS-E comprises 20 items divided into four dimensions: care taking procedures (four items; e.g., "I am good at changing my baby"), evoking behaviors (seven items; e.g., "I am good at soothing my baby when he/she continually cries"), reading behaviors (six items; e.g., "I can tell when my baby is sick") and situational beliefs (three items, e.g., "I can show affection to my baby"). The items and subscales of the PMPS-E were theorized from the self-efficacy theory, similar relevant scales and the original authors' expertise and specialist knowledge. The results of the exploratory factor analysis from the original study were congruent with the four theorized subscales. However, no confirmatory factor analysis was conducted to confidently support the four-factor structure. Acceptable values of internal consistency and temporal stability were also demonstrated (Barnes & Adamson-Macedo, 2007).

The PMPS-E has been translated and validated in other countries, such as Italy (Pedrini et al., 2019), Colombia (Vargas-Porras et al., 2020) and Brazil (Tristão et al., 2015), among samples of postpartum women with both preterm and term infants. All validation studies supported the four-factor structure of the PMPS-E, although only the factor structure of the Italian version was examined using a confirmatory factor analysis (Pedrini et al., 2019). Nonetheless, the results from all three studies showed that the items of the PMPS-E loaded onto different factors than those in the original study. This may reflect the different settings in which the PMPS-E was validated, but it also suggests that the factor structure of the PMPS-E needs further examination. Regarding reliability, good reliable indices were found in all validation studies.

Taking into account the lack of a reliable measure of maternal parenting self-efficacy among Portuguese postpartum women, the present study aimed to adapt the European Portuguese version

of the PMPS-E, explore its factor structure, and assess its psychometric properties, specifically concerning validity (convergent and known groups) and reliability.

Methods

Procedure

Data were collected through an online survey placed on the website of the host institution, and a link to the survey was posted on social media websites. Women aged 18 years or older in the postpartum period (0-12 months after delivery) who delivered a healthy infant after 37 weeks of gestation were invited to participate in a study about mental health in the postpartum period. Study enrollment occurred between August and November 2018. Informed consent was obtained from all participants (by clicking on the option “I understand and accept the conditions of the study”) after information was given about the study’s goals and the voluntary and anonymous aspects of participation. The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences, University of Coimbra.

Translation process

The translation of the PMPS-E to European Portuguese was developed in several steps through a forward-backward translation procedure. First, after obtaining authorization from the authors of the original version to translate and validate the scale, two bilingual Portuguese researchers independently translated the items. The two translated versions were compared, and after discussing and analyzing their similarities/differences, both researchers agreed on a single reconciled version. Second, a third bilingual and independent translator, who was not familiar with the scale, conducted the back translation of this reconciled version. Finally, the original and the back-translated versions were compared, and translation difficulties were analyzed and resolved between translators to obtain a comprehensible measure that was conceptually consistent with the original.

Measures

Sociodemographic (e.g., age, marital status, education), health (e.g., prior history of psychopathological problems) and infant-related data (e.g., infant’s age, gestational weeks at birth, perceived temperament) were collected through a self-report questionnaire developed by the authors. More specifically, infant's temperament as perceived by the mother was assessed through a self-report item, answered on a four-point scale that ranged from 0 (*very difficult*) to 3 (*very easy*).

The women's perception of self-efficacy in the mothering role was assessed using the PMPS-E (Barnes & Adamson-Macedo, 2007). This measure comprises 20 items (e.g., "I am good at understanding what my baby wants") rated with a four-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate higher levels of perceived maternal parenting self-efficacy (total score ranges from 20 to 80).

General self-efficacy was assessed with the General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995; Portuguese version [PV]: Araújo & Moura, 2011). The GSE comprises 10 items (e.g., "I am confident that I could deal efficiently with unexpected events") rated with a four-point scale ranging from 1 (*not at all true*) to 4 (*exactly true*). The total score on the GSE ranges from 10 to 40, with higher scores indicating higher general self-efficacy. In the present sample, the Cronbach's alpha was .90.

The Resilience Scale (RS14; Wagnild, 2009; PV: Pinheiro & Matos, 2013), was used to assess resilience. This scale comprised 14 items (e.g., "I feel like that I can handle many things at a time") scored on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores indicate a greater ability to respond with resilience, and the total score ranges from 14 to 98. In our sample, the Cronbach's alpha was .92.

Maternal confidence was measured with the Maternal Confidence Questionnaire (MCQ; Parker & Zahr, 1985; PV: Nazaré et al., 2013). The MCQ comprises 13 items (e.g., "I feel satisfied with my role as a mother") answered on a five-point response scale ranging from 1 (*never*) to 5 (*always*). Higher scores indicate higher maternal confidence (total score ranges from 13 to 65). In our sample, the Cronbach's alpha was .84.

Maternal bonding was measured with the Maternal Attachment Inventory (MAI; Müller, 1994; PV: Galvão, 2006). The MAI comprises 26 items (e.g., "I feel warm and happy with my baby") answered on a four-point response scale ranging from 1 (*almost never*) to 4 (*almost always*). The total score ranges from 26 to 104, and higher scores denote higher maternal bonding. In our sample, the Cronbach's alpha was .95.

The Edinburgh Postnatal Depression Scale (EPDS, Cox et al., 1987; PV: Areias et al., 1996) is a 10-item self-report questionnaire of depressive symptoms in the perinatal period. In each item, participants are asked to indicate one of four individualized responses that are rated from 0 to 3. The total score ranges between 0 and 30, and higher scores are indicative of more severe depressive symptoms. In our sample, the Cronbach's alpha was .89.

Data analysis

Statistical analyses were performed with the *Statistical Package for the Social Sciences* (IBM SPSS, version 23.0) and with AMOS 22 (IBM Corporation, Meadville, PA, USA). Descriptive statistics

were first calculated to explore the sample's sociodemographic, health- and infant-related characteristics. Each item's descriptive statistics, distribution and floor and ceiling effects were computed to examine the item's characteristics. Skewness values < 3 and kurtosis values < 8 were considered to not pose a considerable bias to a normal distribution (Kline, 2016). Floor or ceiling effects were considered to be present if more than 15% of respondents achieved the lowest or highest possible score, respectively (Terwee et al., 2007). A confirmatory factor analysis (CFA) using maximum likelihood estimation was conducted to test the factor structure shown in the original validation study (Barnes & Adamson-Macedo, 2007). To indicate a good fit, the chi-square index (χ^2) should be nonsignificant, which is rarely obtained when the sample is large (Van de Schoot et al., 2012). Thus, the following indices were also used to assess goodness of fit of the CFA model: comparative fit index (CFI), Tucker Lewis index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). The model was considered to have a good fit when CFI/TLI $\geq .95$, RMSEA $\leq .06$ and SRMR $\leq .08$ (Hu & Bentler, 1999) and an acceptable fit when CFI/TLI $> .90$ and RMSEA $< .10$ (Marôco, 2014).

Because a good model fit was not achieved with the original factor structure, exploratory factor analysis (EFA) followed by CFA was conducted. The total sample was randomly divided into two subsamples (subsample one: $n = 448$ and subsample two: $n = 445$). In subsample 1, an EFA using a principal component analysis with Oblimin oblique rotation was conducted to identify the factor structure of the European Portuguese version of the PMPS-E. Factor extraction was determined through Kaiser's criterion (eigenvalues ≥ 1) followed by parallel analysis (Hayton et al., 2004). The factor loadings threshold of .40 was used to indicate that the item contributed sufficiently to the factor. In subsample 2, two CFAs were performed: one with the three-factor structure obtained from the EFA and another with the original four-factor structure. The assessment of fit was based on the abovementioned indices. To compare the models, $\Delta\chi^2$ (with a significant difference between the χ^2 scores indicating that the model with the lowest χ^2 presents a better fit) and Akaike information criterion values (with the lowest values being indicative of a better fit; Kline, 2016) were used.

The Cronbach's alpha coefficient was computed to examine the internal consistency of the PMPS-E. Cronbach's alpha coefficients were calculated for both the total and the PMPS-E factors, and values above .70 were indicative of good reliability. Pearson correlations were conducted to provide evidence of the validity of the PMPS-E total and factor scores in relation to other measures related to maternal self-efficacy (small effect: $r = .10$; medium effect: $r = .30$; large effect: $r = .50$; Cohen, 1992). Finally, known-groups validity was examined by comparing the PMPS-E scales across groups expected to differ in this construct. Multivariate analyses of variance (MANOVA) were conducted to compare the PMPS-E scores according to parity (primiparous vs. multiparous),

perceived infant temperament (difficult vs. easy), infant care responsibilities (shared between the mother and the father vs. belonging exclusively to the mother), and infant age (using infant's median age as the cutoff). A p -value of .05 was set as the significance cut-off point.

Results

Characteristics of the participants

The total sample of this cross-sectional study consisted of 893 Portuguese postpartum women with a mean age of 31.98 years ($SD = 4.78$; range 18-45). Infants were aged between zero and 12 months old (M mean = 5.56, $SD = 3.34$; $Mdn = 5$, $IQR = 5$), and this was the first child for most women ($n = 575$; 64.4%). The majority of women were married/cohabiting ($n = 794$; 88.9%), were employed ($n = 726$; 81.3%), had completed university studies (bachelor's degree or postgraduate studies; $n = 567$; 63.5%), lived in an urban area ($n = 660$; 73.8%) and had a household monthly income between 1000€ and 2000€ ($n = 517$; 57.9%). **Table 1** shows the sociodemographic, health- and infant-related characteristics of the total sample and of the subsamples used in the EFA (subsample 1) and the CFA (subsample 2). No significant differences regarding sociodemographic, health- and infant-related characteristics were found between the subsamples.

Table 1. Sociodemographic, health and infant-related characteristics of the total and subsamples

	Total ($n = 893$)	Subsample 1 ($n = 448$)	Subsample 2 ($n = 445$)	t / χ^2
Age $M (SD)$	31.98 (4.78)	31.77 (4.75)	32.18 (4.81)	-1.29
Marital status $n (%)$				2.63
Married/cohabiting	794 (88.9)	391 (87.3)	403 (90.6)	
In a relationship (without living together)	16 (1.8)	10 (2.2)	6 (1.3)	
Single	67 (7.5)	38 (8.5)	29 (6.5)	
Separated/divorced	16 (1.8)	9 (2.0)	7 (1.6)	
Employment status $n (%)$				0.67
Employed	726 (81.3)	369 (82.4)	357 (80.2)	
Not currently working	167 (18.7)	79 (17.6)	88 (19.8)	
Educational level $n (%)$				2.45
Up to the 9 th grade	57 (6.4)	31 (6.9)	26 (5.8)	
High school	269 (30.1)	139 (31.0)	130 (29.2)	
Bachelor's degree	351 (39.3)	165 (36.8)	186 (41.8)	
Postgraduate studies	216 (24.2)	113 (25.2)	103 (23.1)	
Household monthly income $n (%)$				1.24
<500€	9 (1.0)	3 (0.7)	6 (1.3)	
500€-1000€	169 (18.9)	83 (18.5)	86 (19.3)	
1000€-2000€	517 (57.9)	263 (58.7)	254 (57.1)	
2000€-3500€	163 (18.3)	81 (18.1)	82 (18.4)	
>3500€	35 (3.9)	18 (4.0)	17 (3.8)	
Residence $n (%)$				0.03
Urban	660 (73.9)	330 (73.7)	330 (74.2)	
Rural	233 (26.1)	118 (26.3)	115 (25.8)	

Physical health problems <i>n</i> (%)				1.21
Yes	54 (6.0)	31 (6.9)	23 (5.2)	
No	839 (94.0)	417 (93.1)	422 (94.8)	
History of psychological problems <i>n</i> (%)				0.27
Yes	224 (25.1)	109 (24.3)	115 (25.8)	
No	669 (74.9)	339 (75.7)	330 (74.2)	
Infant's age <i>M</i> (<i>SD</i>)	5.56 (3.34)	5.57 (3.34)	5.54 (3.35)	0.12
Primiparous <i>n</i> (%)				0.04
Yes	575 (64.4)	287 (64.1)	288 (64.7)	
No	318 (35.6)	161 (35.9)	157 (35.3)	
Currently breastfeeding <i>n</i> (%)				0.05
Yes	609 (68.2)	304 (67.9)	305 (68.5)	
No	284 (31.8)	144 (32.1)	140 (31.5)	
Infant care responsibilities <i>n</i> (%)				0.02
Belong exclusively to the mother	337 (37.7)	170 (37.9)	167 (37.5)	
Shared between the mother and the father	556 (62.3)	278 (62.1)	278 (62.5)	

Preliminary analysis

Skewness and kurtosis values showed that the items did not reveal severe deviations from the normal distribution (Kline, 2016). Skewness values ranged between -2.09 and -0.05, and kurtosis values ranged between -0.96 and 2.38. There were ceiling effects for all items. All descriptive and item analyses are displayed in **Table 2**.

Table 2. European Portuguese version of the PMPS-E: Descriptive and item analyses

Item no.	Item	<i>M</i> (<i>SD</i>)	Skewness	Kurtosis	Floor (%)	Ceiling (%)
1	I believe that I can tell when my baby is tired and needs to sleep	3.61 (0.55)	-1.31	2.07	0.7	64.2
2	I believe that I have control over my baby	3.63 (0.50)	-0.78	-0.88	0.9	64.4
3	I can tell when my baby is sick	3.48 (0.53)	-0.32	-0.88	0.1	49.9
4	I can read my baby's cues	3.38 (0.55)	-0.29	0.16	0.4	40.8
5	I can make my baby happy	3.63 (0.52)	-1.00	0.44	0.2	64.4
6	I believe that my baby responds well to me	3.66 (0.50)	-1.01	0.09	0.1	66.9
7	I believe that my baby and I have a good interaction with each other	3.72 (0.47)	-1.23	0.15	0.9	72.7
8	I can make my baby calm when he/she has been crying	3.55 (0.55)	-0.78	0.01	0.2	57.4
9	I am good at soothing my baby when he/she becomes upset	3.51 (0.57)	-0.64	-0.39	0.1	54.1
10	I am good at soothing my baby when he/she becomes fussy	3.43 (0.60)	-0.55	-0.44	0.1	48.4
11	I am good at soothing my baby when he/she continually cries	3.35 (0.66)	-0.58	-0.33	0.3	44.6
12	I am good at soothing my baby when he/she becomes more restless	3.42 (0.58)	-0.42	-0.72	0.0	47.1
13	I am good at understanding what my baby wants	3.31 (0.57)	-0.27	0.21	0.4	35.9
14	I am good at getting my baby's attention	3.52 (0.55)	-0.65	0.07	0.3	54.1
15	I am good at knowing what activities my baby does not enjoy	3.38 (0.54)	-0.05	-0.96	0.0	40.9
16	I am good at keeping my baby occupied	3.20 (0.58)	-0.08	-0.15	0.1	28.6
17	I am good at feeding my baby	3.61 (0.54)	-1.04	0.54	0.2	63.2
18	I am good at changing my baby	3.73 (0.47)	-1.36	1.05	0.1	73.6
19	I am good at bathing my baby	3.61 (0.58)	-1.29	1.24	0.3	65.6
20	I can show affection to my baby	3.86 (0.35)	-2.09	2.38	0.0	86.1

Factor structure of the European Portuguese PMPS-E

First, to evaluate the goodness of fit of the correlated four-factor structure originally proposed by the authors of the PMPS-E (Barnes & Adamson-Macedo, 2007), a CFA was conducted. The results obtained indicated that a correlated four-factor structure did not show a good fit to the data: $\chi^2_{(164)} = 1585.46$ $p < .001$; CFI = .885; TLI = .867; RMSEA = .099 (0.94-0.103, $p < .001$); SRMR = .077.

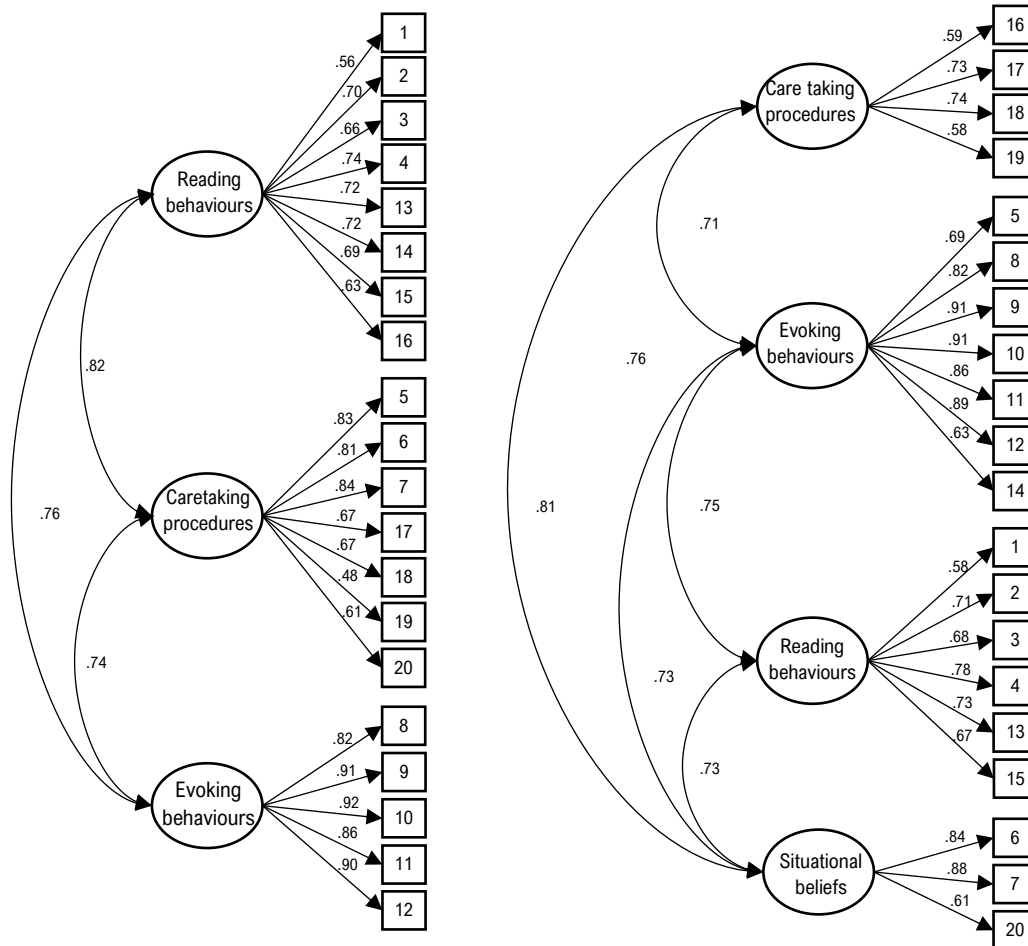
Following the poor fit of the original four-factor structure and to explore the factor structure of the European Portuguese PMPS-E, an EFA followed by CFA was conducted in the two randomly generated subsamples.

The Kaiser-Meyer-Olkin test (KMO = .96) and Bartlett's test of sphericity [$\chi^2_{(190)} = 6610.46$, $p < .001$] confirmed the adequacy of subsample 1 for principal component analyses. The EFA indicated three factors with eigenvalues greater than one, which accounted for 66.57% of the total variance. This was further confirmed after conducting a parallel analysis (Hayton et al., 2004). The first factor, with eight items that accounted for 52.80% of the variance, assessed the mothers' perceptions of their ability to understand and identify changes in their baby's behavior (e.g., "I believe that I can tell when my baby is tired and needs to sleep"). Consistent with the original designation, this factor was labeled reading behaviors. The second factor, with seven items explaining 7.9% of the variance, assessed mothers' perceptions of their ability to perform tasks related to infant care related to physical or emotional needs (e.g., "I am good at feeding my baby" or "I can show affection to my baby"). Similar to the original version, this factor was labeled caretaking procedures. Finally, the third factor, with five items that explained 5.9% of the variance, assessed the mothers' perceptions of their ability to elicit a change in the infant's behavior (e.g., "I am good at soothing my baby when he/she becomes upset"). This factor was labeled evoking behaviors. Item factor loadings ranged from .43 (item 14) to .83 (item 3) in the reading behaviors factor, from .51 (item 5) to .86 (item 18) in the caretaking procedures factor, and from .76 (item 8) to .92 (item 11) in the evoking behaviors factor.

Because the EFA-derived factor solution differed from the originally proposed factor structure of the PMPS-E, two CFAs were performed on subsample two: 1) the correlated four-factor model proposed by Barnes and Adamson-Macedo (2007) and 2) the correlated three-factor model previously identified by the EFA. Figure 1 displays the factor structure and factor loadings of both competing models. Our results showed that the correlated four-factor model did not present a good fit to the data ($\chi^2_{(164)} = 857.45$, $p < .001$; CFI = .883; TLI = .864; RMSEA (90% CI) = .098 (.091-.104); SRMR = .076; AIC = 949.45), while the correlated three-factor model presented an acceptable fit to the data ($\chi^2_{(167)} = 660.00$, $p < .001$; CFI = .917; TLI = .905; RMSEA (90% CI) = .082 (.075-.088);

SRMR = .052; AIC = 746.00). The comparison between the two models ($\Delta\chi^2_{(3)} = 197.45, p < .001$) suggested that the three-factor model presented a better fit to the data.

Figure 1. Confirmatory factor analyses of the correlated three-factor model and the correlated four-factor model



Reliability

Considering the whole sample, a high reliability was found for the total scale ($\alpha = .95$). For the three factors, the alphas obtained also revealed good internal consistency (reading behaviors, $\alpha = .88$; caretaking procedures, $\alpha = .88$; evoking behaviors, $\alpha = .94$). Cronbach's α if item deleted ranged from .94 to .95 considering the total scale. The item-total correlation ranged from .53 to .71 in the evoking behaviors factor, from .52 to .74 in the caretaking procedures factor and from .73 to .80 in the evoking behaviors factor.

Association with other measures

As shown in **Table 3**, the PMPS-E total and subscale scores were significantly and positively correlated with general self-efficacy, maternal bonding, maternal confidence and resilience and significantly and negatively correlated with postpartum depressive symptoms. The results revealed moderate correlations with all the measures, except for a large correlation with the measure of maternal confidence.

Table 3. Pearson's bivariate correlations between the PMPS-E total and subscales scores and other variables related to maternal self-efficacy

	PMPS-E total	PMPS-E Reading behaviors	PMPS-E Caretaking procedures	PMPS-E Evoking behaviours
General self-efficacy (GSE)	.32***	.31***	.27***	.27***
Maternal bonding (MAI)	.31***	.28***	.25***	.30***
Postpartum depressive symptoms (EPDS)	-.27***	-.22***	-.25***	-.26***
Maternal confidence (MCQ)	.70***	.68***	.60***	.57***
Resilience (RS14)	.42***	.40***	.39***	.33***

*** $p < .001$

Note. PMPS-E = Perceived Maternal Parenting Self-Efficacy; GSE = General Self-Efficacy Scale; MAI = Maternal Attachment Inventory; EPDS = Edinburgh Postnatal Depression Scale; MCQ = Maternal Confidence Questionnaire; RS14 = Resilience Scale-14

Known-groups validity

When analyzing differences between primiparous and multiparous mothers, a marginally significant multivariate effect of group was found (Wilks' Lambda = .99, $F(3,889) = 2.50$, $p = .059$, $\eta_p^2 = .008$). As presented in **Table 4**, subsequent univariate tests indicated that compared to women with more children, primiparous mothers reported significantly lower scores in the total score, and in the reading behaviors and evoking behaviors factors.

Regarding perceived infant temperament, the results indicated a significant multivariate effect of group (Wilks' Lambda = .93, $F(3,889) = 22.56$, $p < .001$, $\eta_p^2 = .071$). Follow-up tests revealed that women who perceived their infant's temperament as difficult reported significantly lower scores in the PMPS-E total and in all three factors than women who perceived their infant's temperament as easy.

A significant multivariate effect of group was also found for infant age (Wilks' Lambda = .98, $F(3,889) = 7.53$, $p < .001$, $\eta_p^2 = .025$). Univariate tests showed that women with younger infants (\leq five months old) reported significantly lower scores in the three factors and total score of the PMPS-E than women whose infants were older than five months.

No significant multivariate effects were found regarding infant care responsibilities (Wilks' Lambda = 1.00, $F(3,889) = 0.26$, $p = .855$, $\eta_p^2 = .001$).

Table 4. Descriptive statistics and multivariate analysis of variance on parity and perceived infant temperament

	Parity		<i>F</i>	<i>p</i>	η_p^2
	Primiparous <i>M</i> (<i>SD</i>)	Multiparous <i>M</i> (<i>SD</i>)			
PMPS-E Total	70.18 (7.73)	71.31 (7.47)	4.49	.034	.005
Reading behaviors	27.32 (3.29)	27.87 (3.12)	5.94	.015	.007
Caretaking procedures	25.74 (2.66)	25.94 (2.63)	1.16	.281	.001
Evoking behaviors	17.12 (2.74)	17.50 (2.54)	4.21	.040	.005
	Perceived infant temperament		<i>F</i>	<i>p</i>	η_p^2
	Difficult <i>M</i> (<i>SD</i>)	Easy <i>M</i> (<i>SD</i>)			
PMPS-E Total	67.06 (8.32)	71.50 (7.73)	52.23	<.001	.055
Reading behaviors	26.31 (3.46)	27.83 (3.10)	5.94	<.001	.036
Caretaking procedures	24.89 (2.90)	26.05 (2.52)	1.16	<.001	.032
Evoking behaviors	15.86 (3.03)	17.62 (2.45)	4.21	<.001	.071
	Infant care responsibilities		<i>F</i>	<i>p</i>	η_p^2
	Exclusively mother <i>M</i> (<i>SD</i>)	Shared with father <i>M</i> (<i>SD</i>)			
PMPS-E Total	70.82 (7.76)	70.44 (7.60)	0.50	.478	.001
Reading behaviors	27.59 (3.35)	27.47 (3.17)	0.33	.568	.000
Caretaking procedures	25.91 (2.62)	25.75 (2.66)	0.76	.384	.001
Evoking behaviors	17.31 (2.62)	17.22 (2.71)	0.23	.632	.000
	Infant's age		<i>F</i>	<i>p</i>	η_p^2
	≤5 months <i>M</i> (<i>SD</i>)	>5 months <i>M</i> (<i>SD</i>)			
PMPS-E Total	69.70 (7.70)	71.65 (7.47)	14.52	<.001	.016
Reading behaviors	27.09 (3.22)	28.03 (3.18)	18.92	<.001	.021
Caretaking procedures	25.64 (2.75)	26.01 (2.50)	4.37	.037	.005
Evoking behaviors	16.97 (2.68)	17.61 (2.64)	12.79	<.001	.014

Discussion

The main goal of the present study was to provide evidence of the reliability and validity of the European Portuguese version of the PMPS-E, thus making available to the Portuguese postpartum population an instrument that includes task-specific items to assess maternal parenting self-efficacy. Given the previous inconsistent findings regarding the structure of the PMPS-E, we also aimed to examine its factor structure, and this is one of the first studies to analyze it via CFA. Overall, our main results showed that the original four-factor structure did not acceptably fit the data and that a three-factor structure provided a better fit. Our results also demonstrated that the PMPS-E is a valid and reliable measure of maternal parenting self-efficacy among Portuguese postpartum women.

Contrary to the original study of the PMPS-E and subsequent validation studies in other cultures, the results from our EFA indicated a three-factor structure, which was additionally corroborated through a CFA using a different sample. Although all previous validation studies of the PMPS-E suggested a four-factor structure, the results of those EFAs demonstrated that the items of the instrument had different factorial organizations in each version of the instrument. Indeed, in the case of the validation study in Brazil (Tristão et al., 2015), the EFA proposed a different organization of the items compared with the original structure, but the authors decided to keep the original structure for conceptual reasons. Conversely, the Italian (Pedrini et al., 2019) and Colombian (Vargas-Porras et al., 2020) versions of the PMPS-E recommended the different item organization obtained in the EFA and, in the case of the Italian version, this was confirmed via CFA (Pedrini et al., 2019). In both versions, and similar to our findings, no support was found for the situational beliefs factor. In our study, the three items that originally belonged to this factor loaded onto the caretaking procedures factor. Along with item 5 (“I can make my baby happy”), which originally belonged to the evoking behaviors factor, these items seem to refer to the mother’s perception of her capability to care for the infant’s emotional needs (item 6: “I believe that my baby responds well to me”; item 7: “I believe that my baby and I have a good interaction with each other”; item 20: “I can show affection to my baby”). Additionally, contrary to the original version, our results showed that items 14 (“I am good at getting my baby’s attention”) and 16 (“I am good at keeping my baby occupied”) belonged to the reading behaviors factor. Theoretically, it is reasonable that these items represent the same dimension as they are related to the mother’s perception of her ability to recognize and understand the infant’s behavior and responses to environmental stimuli.

The different results found in our study compared to other studies could be explained by cultural differences but also by the characteristics of the samples used. Our sample was composed of postpartum women (0-12 months after delivery) who delivered a healthy baby after 37 weeks of

gestation, including both primiparous and multiparous mothers. Previous psychometric studies of the PMPS-E have used only primiparous mothers (Vargas-Porras et al., 2020) or only mothers of preterm infants (Pedrini et al., 2019). Additionally, most studies used samples in the immediate postpartum period, with only one study examining the PMPS-E factor structure and psychometric properties in a sample of postpartum women from 0 to 6 months after delivery (Vargas-Porras et al., 2020). Assessing the validity of maternal parenting self-efficacy measures beyond the immediate postpartum period and among multiparous mothers and those who deliver full-term infants is relevant, as each infant is different and demanding developmental tasks and infant care challenges also arise as the infant ages.

Although the differences in the structure of the instrument are theoretically justified, future studies are needed to investigate the replicability of the three-factor model. In fact, the results from the CFA showed that a three-factor structure only provided an acceptable fit to the data. Thus, we consider that some caution is needed when differentiating between the factors of the PMPS-E and that an overall score of the PMPS-E should preferably be used, as recommended by the original author of the instrument (Barnes & Adamson-Macedo, 2007).

Regarding reliability, and consistent with previous findings, our results showed very good internal consistency (and above the threshold of .70; Nunnally, 1978) for the total score and for the factors of the PMPS-E. At the item level, all items appeared to be worthy of retention, and the values of item-total correlations indicated the items' adequacy to the construct the PMPS-E intends to assess. There was a tendency for ceiling effects in all items, which has been reported in other validation studies (Barnes & Adamson-Macedo, 2007; Tristão et al., 2015). The inclusion of postpartum women up to 12 months after delivery who delivered a healthy full-term infant may have potentially accentuated the ceiling effects. Moreover, the online recruitment could have led to an over-representation of women with higher education and income, which could have also contributed to these results.

Supporting the convergent validity of the scale, the results of the correlation analyses showed positive associations between the PMPS-E total and subscale scores and general self-efficacy, maternal bonding, maternal confidence and resilience, corroborating previous literature (e.g., Pedrini et al., 2019; Sevigny & Loutzenhiser, 2010). In addition, significant and negative correlations between the PMPS-E subscales and total scores and postpartum depressive symptoms were found. This result is consistent with previous studies showing a negative association between maternal self-efficacy and depressive symptoms (e.g., Albanese, Russo, & Geller, 2019; Leahy-Warren, McCarthy, & Corcoran, 2012) and corroborates the assumption that higher maternal parenting self-efficacy is associated with a better psychological adjustment of mothers.

As additional support for the construct validity of the scale, specifically its known-groups validity, we found that multiparous mothers, those with older infants (>5 months old) and those who perceived their infant's temperament as easy presented significantly higher levels of maternal parenting self-efficacy than those who were primiparous, those who had younger infants (≤ 5 months old) and those who perceived their infant's temperament as difficult. These results are consistent with previous literature (e.g., Barnes & Adamson-Macedo, 2007; Botha et al., 2020; Verhage et al., 2015; Zheng et al., 2018) and suggest that increasing childcare experience may be associated with higher levels of maternal parenting self-efficacy and that interpreting infant signals more negatively may also impact the perception of parenting performance, both consistent with Bandura's self-efficacy theory (Bandura, 1997).

This study has some limitations that should be noted. First, potential limitations imposed by the sample, the sampling strategy and the study design should be acknowledged. Online recruitment could increase the likelihood of self-selection bias. Furthermore, the representativeness of the sample may have been compromised by the high and disproportionate number of participants who had completed a university degree and were employed, which could have also resulted from the online recruitment. This, together with the cross-sectional design, suggests the need for caution in interpreting and generalizing these findings to all women in the postpartum period. Second, the test-retest reliability was not determined. Therefore, further test-retest and sensitivity to change studies should be conducted.

Despite these limitations, the present study contributes to the narrow literature on PMPS-E performance. This was one of the first studies to test the factor structure of the PMPS-E through CFA. As the PMPS-E has been considered one of the most robust measures to assess maternal parenting self-efficacy (Wittkowski et al., 2017), further evidence of its factor structure through CFA is warranted. Specifically, our results demonstrated that a three-factor model showed a better fit to the data than the original four-factor model. Additional research is required to extend and replicate these findings. In addition, the results of this study provide a reliable and valid measure of maternal parenting self-efficacy for clinical practice and research among the Portuguese postpartum population. Specifically, the PMPS-E may be used to assess perceived difficulties among mothers and to provide a more comprehensive understanding of women's psychosocial adjustment to this period. Given the association between maternal parenting self-efficacy and infant outcomes, the PMPS-E could be of great value when assessing the efficacy of interventions targeting the improvement of maternal self-efficacy.

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