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3 **Efficacy of a multimodal nursing intervention strategy in the process of becoming a**
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5 **mother: A randomized controlled trial**
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8
9 **Abstract**

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11 The lack of knowledge and skills for transitioning to motherhood places first-time
12 mothers at greater risk of depression and stress, may lower their perceived self-efficacy and
13 satisfaction with the maternal role, and potentially affects the mother-infant bond. The purpose
14 of this study was to test the efficacy of a multimodal nursing intervention (AMACOMPRI),
15 based on Mercer's Becoming a Mother Theory, in supporting the process of becoming a mother
16 in first-time mothers of term infants. This study was a parallel-group, double-blind, randomized,
17 controlled trial with a 4-month postpartum follow-up. The outcome measures were becoming a
18 mother, functional social support, mother-infant bond, and perceived maternal self-efficacy.
19 Sixty-six first-time mothers completed the study: 33 in the intervention group and 33 in the
20 control group. The intervention was effective in supporting the process of becoming a mother,
21 with a large effect size (Cohen's $d=1.50$) and higher scores in the intervention group than in the
22 control group (inter-group difference 13.04 points; 95% CI: 8.72-17.34) based on the Becoming-
23 a-Mother Scale. Participants in the intervention group demonstrated higher scores in functional
24 social support, perceived maternal self-efficacy, and mother-infant bond. This research provides
25 evidence for the efficacy of a innovative nursing intervention that supports the process of
26 becoming a mother. Further testing of the intervention is required in different settings and first-
27 time mothers of low and high risk newborns.
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50 *Keywords:* randomized clinical trial, mother-infant bond, maternal-child nursing, self-efficacy,
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1. Introduction

First-time mothers account for a considerable proportion of total births worldwide, irrespective of income level (Dongarwar & Salihu, 2019). The average percentage of deliveries of first-time mothers range from 40.1%-53.5% in the European Union (Euro-Peristat Project, 2018), 60.37% in China (Hung, Hsieh, & Liu, 2015), 42.9% in USA (Martin et al., 2016), and 47.7% in Colombia (National Statistical System of Colombia, 2017).

Nurses commonly provide postpartum education to healthy mothers prior to discharge, including guidance on newborn and mother care. However, postpartum follow-up is often limited to appointments with the obstetrician and the pediatrician. As in other low and middle-income countries, nurses in Colombia do not provide postpartum follow-up (Feroz, Perveen, & Aftab, 2017; Sondaal et al., 2016). The lack of knowledge and skills for transitioning to the maternal role places first-time mothers at greater risk of depression and stress, may lower their perceived self-efficacy and satisfaction with the maternal role, and potentially affects their attachment with their infant (Carvalho, Gaspar, & Cardoso, 2017; Ong et al., 2014; Shorey et al., 2018). Previous research has shown high levels of stress and lack of maternal confidence in first-time mothers of both preterm and term infants, with the latter being less studied (Olafsen et al., 2007; Vargas, Villamizar, & Ardila, 2016). Many mothers feel inadequately prepared for the postpartum experience and require educational and supporting interventions that facilitate their transition to motherhood (Martin, Horowitz, Balbierz, & Howell, 2014; Vargas-Porras, Hernández-Molina, & de Molina-Fernández, 2019).

Mercer's Becoming a Mother theory (Mercer & Walker, 2006) and research testing postpartum interventions in first-time mothers suggest the importance and feasibility of improving social support (Gao, Xie, Yang, & Chan, 2015), mother-infant bond (Çinar & Öztürk, 2014), and perceived maternal self-efficacy (Liyana, Tam, & Shorey, 2018). Additionally,

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3 individualized long-term interventions with an interactive mother-nurse relationship are effective
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5 in promoting maternal role competence (Mercer & Walker, 2006). There are, however, only a
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7 few interventions based on the most recent Mercer's theory update (Çinar & Öztürk, 2014;
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9 Fasanghari, Kordi, & Asgharipour et al., 2019; Özkan & Polat, 2011). None of these
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11 interventions support the process of becoming a mother by fostering all of these components
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13 (functional social support, mother-infant bond, and maternal self-efficacy), nor are they delivered
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15 during the three postpartum stages proposed by Mercer (described below).
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19 Multimodal interventions have been highly effective in diverse nursing settings (Valim et
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21 al., 2019). In the postpartum, for example, a multimodal program delivered by a professional
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23 nurse with expertise in perinatal care has been effective improving self-efficacy and social
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25 support (Shorey, Chan, Chong, & He, 2015a). Furthermore, Jiao et al. (2019) found that both
26
27 home-based and technology-based interventions were more effective in improving self-efficacy
28
29 and social support than usual care alone. Given this evidence, we tested the effect of a
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31 multimodal nursing intervention that combines different strategies to strengthen the process of
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33 becoming a mother using Mercer's theory as our framework.
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37 38 **Theoretical Framework**

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40 Mercer's Becoming a Mother Theory posits an ongoing process of continuous personal
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42 growth as the new mother faces the emerging challenges of motherhood that require lifetime
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44 commitment (Mercer, 2004; 2006). Mercer (2004) identified four stages of becoming a mother:
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46 "(1) commitment, attachment, and preparation (during pregnancy); (2) acquaintance, learning,
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48 and physical restoration (first 2 to 6 weeks postpartum); (3) moving toward a new normal (2
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50 weeks to 4 months); and (4) achievement of maternal identity (around 4 months)" (p. 231).
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52 Mercer also identified three main environments based on Bronfenbrenner's theory (1986): family
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3 and friends, community, and society. The present study focused on providing support during the
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5 three postpartum stages of becoming a mother as well as in the family-and-friends environment
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7 (Figure 1), which has a great influence on the process of becoming a mother and is the center of
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9 parent-infant interaction (Mercer & Walker, 2006).
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12 Becoming a mother is a complex process that is influenced by maternal and
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14 environmental variables. Social support facilitates the process of becoming a mother (Khandan,
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16 Riazi, Akbari, Nasiri, & Sheikhan, 2018; Lee, Edwards, & Hans, 2019) and is defined by Mercer
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18 as “the amount of help actually received, satisfaction with that help, and the persons (network)
19
20 providing that help” (Mercer et al., 1986, p. 341). Social support is comprised of four specific
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22 areas: emotional, physical (assisting with tasks), informational, and appraisal (feedback on
23
24 observed caregiving) (Mercer, 2006). Mercer defines perceived maternal self-
25
26 efficacy as mothers’ perceptions of their competence and confidence in mothering activities
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28 (Mercer, 2004, p. 231), consistent with Bandura’s definition of self-efficacy as being task-
29
30 specific (1997). The becoming a mother process occurs simultaneously with the development of
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32 the mother-infant bond, and the timing varies depending on mothers’ internal resources and
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34 unique context (Mercer, 1995). Importantly, these variables are interrelated (Figure 1). For
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36 example, the greater the social support, the greater the maternal self-efficacy (Shorey, Ying, &
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38 Yobas, 2020) and, in turn, the greater the mother-child bond (Çinar, Köse, & Altinkaynak, 2015;
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40 Gharaibeh & Hamlan, 2012).
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46 47 **Aims**

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49 The primary aim of this study was to assess the efficacy of a new multimodal nursing
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51 intervention focused on supporting the process of becoming a mother in first-time mothers of
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53 term infants, through evaluating the effect of the intervention on measures of becoming a mother,
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3 functional social support, mother-infant bond, and perceived maternal self-efficacy. We
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5 hypothesized that the intervention plus usual care would be more effective than usual care alone
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7 in supporting the process of becoming a mother for first-time mothers of term infants. We also
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9 hypothesized that within group analysis would demonstrate improvements in scores for
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11 functional social support, perceived maternal self-efficacy, and mother-infant bond between
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13 baseline and four months for the intervention group, but not for the control group.
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18 **2. Methods**

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20 This study adheres to the CONSORT statement on trial design and reporting (Grant et al.,
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22 2018).
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24 **2.1. Study design**

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26 This is a parallel-group, double-blind, randomized, controlled trial with two arms: An
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28 intervention group and a control group with a four-month follow-up.
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31 **2.2. Participants and study setting**

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33 Participants were recruited from postpartum rooms in a large maternal-child health care
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35 center in Colombia that serves women from multiple cities. This center was selected because it is
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37 a national and regional referral center for maternal-child care and application of national
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39 healthcare standards.
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44 Inclusion criteria for mothers were: (1) living in Bucaramanga, Floridablanca, Girón or
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46 Piedecuesta (Colombians who are culturally similar regarding beliefs about the care of mothers
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48 and infants, religion, mestizo ethnic group, and Spanish language), (2) ≥ 18 years of age, (3)
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50 postpartum, (4) first-time mothers of healthy term infants, (5) self-reported partner support, and
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52 (6) owning a smartphone with internet access. Exclusion criteria were (1) illiteracy, (2) multiple
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54 pregnancies, (3) postpartum depression, (4) mental disorders, (5) behavioral disorders, (6)
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3 mother being admitted to the hospital or having her newborn admitted to an intensive care unit
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5 during the postpartum.
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7 8 **2.3. Control group**

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10 Participants in the control group received the usual postnatal care including: (a) pre-
11 discharge nursing guidance on postpartum care, newborn care, and breastfeeding; (b) an obstetric
12 follow-up appointment (at day 8 postpartum for vaginal delivery and day 10 after cesarean
13 section) focused on detection and control of potential puerperal complications (e.g., wound
14 inspection, monitoring for postpartum hypertension or infection); (c) newborn follow-up
15 appointment (3 to 5 days postpartum) for assessment of adaptation to extrauterine life, nutritional
16 state, and neonatal abnormalities or infection as well as providing breastfeeding advice. Two or
17 three days after childbirth a nursing assistant called the mothers to remind them of both
18 appointments. Pre-discharge education was verified with individual records kept by the service's
19 chief coordinator.
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33 **2.4. Intervention group**

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35 Participants in the intervention group received the usual postnatal healthcare and the
36 multimodal intervention “Maternal Support for Becoming a First-time Mother” (AMACOMPRI,
37 for its acronym in Spanish). The AMACOMPRI (see Figure 1) was based on an extensive
38 literature review and Mercer’s most recent theory update (2004, 2006). The intervention protocol
39 was designed and validated with the support of five nurse experts with a master’s or PhD degree
40 (perinatal, maternal and neonatal, pediatric, mental health, and health communication and
41 education), who were selected as experts according to Fehring’s criteria (1994), as well as 10
42 first time mothers. See Supplementary materials for more information about intervention
43 development.
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AMACOMPRI comprises eight nurse-delivered home-based and telephone-based sessions (see Table 1). The intervention was delivered by alternating four 90-minute in-person visits and four 15-minute telephone calls. The first two sessions focused on functional social support, the second two on the mother-infant bond, the third two on perceived maternal self-efficacy, and the last two on becoming a mother (see Figure 2). The nurse who delivered the AMACOMPRI (first author) is a maternal and perinatal nursing expert with a master's degree and 15 years' professional experience in postpartum education. Training occurred over one month by thoroughly rehearsing the protocol for each session following the intervention manual. Audio records were made during rehearsal, and two supervisors provided feedback to ensure consistent and compliant delivery. A pilot test was conducted before implementing the study and a series of educational and support materials were created by the principal investigator (first author). These materials were validated with the advice and support of experts (see Supplementary materials).

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The AMACOMPRI software includes the following educational and support materials: 26 expert-conducted audio guides on specific postpartum issues, and four videos that show a first-time mother sharing her maternity experiences. The audiovisual materials were delivered through software installed on the participants' smartphones at the beginning of the study. This software allowed participants to access the content by themselves, express themselves in writing, and ask for the nurse's advice. It also allowed the nurse to respond to the participants' queries based on the nursing process and standardized nursing language (Butcher, Bulechek, Dochterman, & Wagner, 2018; Herdman & Kamitsuru, 2017; Moorhead, Swanson, Johnson, & Maas, 2018).

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The participants recorded situations related to their maternity experiences in case they

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3 needed advice from the nurse. Then, the nurse used the mother's information for the assessment
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5 conducted during the home-based or telephone-based sessions. The nurse developed and
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7 implemented a nursing care plan according to the needs of the mother. This plan was evaluated
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9 in the next follow-up session (see Table 1).
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12 **2.5. Procedure**

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15 The participants' clinical records were used to verify that all received usual care in the
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17 maternity health center. For the intervention group, the first of four home-based visits took place
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19 within 6-10 days after delivery and the last visit was made four months after delivery (see Table
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21 1). The four individual home-based sessions were scheduled from Monday to Saturday. The four
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23 telephone-based sessions were conducted at different times on the targeted day, according to the
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25 participants' availability. Topics were addressed using specific educational materials,
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27 encouraging active participation. The nurse instructed the mothers to review the audiovisual
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29 materials corresponding to each topic between sessions (see Table 1). The nurse resolved
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31 questions and concerns and guided the activities for the addressed topics. Homework on the
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33 covered topics was reviewed during the next session, and further guidance was provided through
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35 the AMACOMPRI software (see Table 1).
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40 A logbook for recording the planned activities of each session was given to each mother
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42 to evaluate their participation and commitment. The logbook included instructions for use and
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44 was arranged by book dividers for the topics of each month, each one with its corresponding
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46 checklist of activities that the mother was advised to complete. In addition, the logbook included
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48 instructions about accessing and using the AMACOMPRI software audios and videos with topics
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50 of interest useful during the postpartum. These monthly activities had checklists in the logbook
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52 that the mothers marked as they were carried out. The participants were asked to complete the
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3 activities between sessions, including both logbook registers and the use of the AMACOMPRI
4 software learning modules (see Table 1). Thus, at each home visit the nurse first reviewed the
5 entries about the previous session in the logbook and clarified any concerns. After this, the nurse
6 began with the next topic of discussion. In turn, the nurse completed her own checklist for each
7 session to verify the delivery of the intervention (see Table 1).
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14 The strategies used to guarantee the fidelity of the intervention were: (a) verifying
15 adherence to the intervention protocol, (b) using checklists of contents and activities completed
16 during the AMACOMPRI, and (c) having only one nurse deliver the intervention. Two
17 researchers monitored compliance of home-based visits by attendance lists signed by the
18 mothers. The checklists of all the activities completed were reviewed every 15 days during
19 supervision meetings to verify the intervention's homogeneous delivery. A text message was
20 sent to each participant 3–5 days before each session to remind them of the scheduled activities
21 to achieve a high participant retention rate. The participants were also encouraged during home-
22 based visits to complete the activities within the suggested timeframes.
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35 The following approaches were adopted to reduce the risk of contact between the groups.
36 During their stay in the maternity ward (one to two days), the participants were not randomized
37 to the intervention or control group, but their informed consent was obtained. With her signature
38 on the informed consent the mother agreed not to contact any other postpartum mother in the
39 same site or participating in other research. Obstetric and pediatric appointments were scheduled
40 on different days for each group (group encoded for the Maternal-child health care center). Also,
41 the AMACOMPRI intervention was exclusively delivered at the mothers' homes. The researcher
42 with access to group assignment conducted periodic audits to ensure data quality.
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54 **2.6. Data collection**

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3 The principal investigator and a postpartum nurse from the maternity center reviewed the
4 medical records of prospective participants to verify correct application of inclusion and
5 exclusion criteria. The principal investigator informed prospective participants about the research
6 and requested their written informed consent. The dates for the home-based sessions were agreed
7 upon with each participant.
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12 Two trained research assistants blinded to the study group administered the
13 questionnaires. One of them administered the initial questionnaires during the first postpartum
14 week at the participants' homes. Two or three days following four months postpartum, the other
15 research assistant administered the final questionnaires. The participants self-completed the
16 instruments in predesigned, standardized Google Docs forms using a research smartphone. All
17 responses were directly entered into the online platform, and all fields needed to be complete to
18 submit the form.
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30 **2.7. Outcome measures**

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32 The variables were measured using validated and reliable scales culturally adapted to
33 Colombian mothers.
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38 **2.7.1. Participant characteristics**

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40 The following characteristics were collected using a structured form: Age, marital status,
41 cohabitants, socioeconomic status, educational level, and main occupation.
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46 **2.7.2. Becoming a mother**

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48 Becoming a mother was measured using a culturally adapted version of the "Adoption of
49 the Maternal Role Scale" based on Mercer's theory (Garrido & Marchán, 2011). The Becoming-
50 a-Mother Scale is a 56-item self-report instrument that measures the level of the process of
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3 becoming a mother as low (56–180 points), medium (181–202 points), or high (203–224 points).

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5 This scale was previously culturally adapted and validated in Colombian first-time mothers of
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7 term infants with a partner (Vargas-Porras, Roa-Díaz, Hernández-Hincapié, Ferré-Grau, & De
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9 Molina-Fernández, 2020). Cronbach's alpha in the present study was 0.93.

12 13 **2.7.3. Functional social support**

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15 Functional social support was measured using a culturally adapted version of the
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17 Functional Social Support Subscale from the Perinatal Infant Care Social Support Scale (Leahy,
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19 2005). This is a 22-item self-reported Likert instrument. The minimum score is 22 and the
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21 maximum 88, with higher scores indicating greater functional social support. This instrument
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23 was translated into Spanish, culturally adapted, and validated in Colombian first-time mothers of
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25 term infants (Vargas-Porras, Roa-Díaz, Ferré-Grau, & De Molina-Fernández, 2020). Cronbach's
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27 alpha in the present study was 0.92.

28 29 30 31 32 **2.7.4. Mother-infant bond**

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35 Mother-infant bond was measured using a culturally adapted version of the Maternal
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37 Attachment Inventory (Müller, 1994). This is a 24-item self-report instrument that measures the
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39 level of emotional bonding and is rated as low (85 points or less), medium (86 to 89 points), or
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41 high (90 points or more). This instrument was translated into Spanish, culturally adapted, and
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43 validated in Colombian first-time mothers of term infants (Vargas, 2016; Vargas & Pardo, 2020).
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45 Cronbach's alpha in the present study was 0.90.

46 47 48 49 50 **2.7.5. Perceived maternal self-efficacy**

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52 Perceived maternal self-efficacy was measured using a culturally adapted version of the
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54 Perceived Maternal Parenting Self-Efficacy Questionnaire (Barnes & Adamson-Macedo, 2007).
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3 This is a 20-item self-reported scale. Each item of this Likert scale ranges from strongly disagree
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5 to strongly agree (scores from 1 to 4). Total scores range from 20 to 80, with higher scores
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7 indicating a higher degree of perceived self-efficacy. This questionnaire was translated into
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9 Spanish, culturally adapted, and validated in Colombian first-time mothers of term infants
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11 (Vargas-Porras et al., 2020). Cronbach's alpha in the present study was 0.93.
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15 16 **2.7.6. Maternal stress**

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18 Maternal stress was measured using a culturally adapted version of the Being a Mother
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20 Scale (BaM-13) (Matthey, 2011). This is a 13-item self-reported Likert scale with scores ranging
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22 from 0 to 39. Mothers at risk of stress related to the maternal role are identified by scores of nine
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24 and above. This scale was translated into Spanish, culturally adapted, and validated in
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26 Colombian first-time mothers of term infants (Vesga, 2018). Cronbach's alpha in the present
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28 study was 0.77.
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32 33 **2.7.7. Maternal depression**

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35 Maternal depression was measured using a culturally adapted version of the Edinburgh
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37 Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987). This is a 10-item, 4-point
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39 self-reported Likert scale with scores ranging from 0 to 30. A score of 10 or higher indicates the
40
41 probability of depression but not its severity. Any score other than 0 for question 10 indicates
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43 that immediate further evaluations are required. This scale was culturally adapted and validated
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45 in Colombian mothers (Campo-Arias, Ayola-Castillo, Peinado-Valencia, Amor-Parra, &
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47 Cogollo, 2007). Cronbach's alpha in the present study was 0.60.
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51 52 **2.8. Sample size and randomization**

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54 According to the descriptive results and statistical parameters previously obtained from
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3 the study population (Vargas-Porras et al., 2020), the sample size was estimated as follows: an
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5 effect size with a predicted delta of 10 for the score of the Becoming-a-Mother Scale between the
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7 two groups, a power of 85%, an alpha error of 5%, a standard deviation of outcome scores of
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9 13.0, a mean correlation between the first and second evaluation of 0.3, and a
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11 control/intervention ratio of 1:1. These parameters led to a targeted sample size of 64
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13 participants. Expecting a 20% loss, the sample size was increased to 76. The participants were
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15 randomized, 38 mothers to the intervention group and 38 mothers to the control group using
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17 Epidat 4.1, in two blocks of 50, at a ratio of 1:1. The software also generated an identification
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19 code that was allocated to the groups. Only one researcher had access to the randomization codes
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21 and was responsible for submitting the codes to the nurse who delivered the intervention. The
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23 nurse who delivered the intervention only had contact with participants in the intervention group.
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25 The research assistants, who administered the initial and final survey instruments, and the data
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27 analyst were blinded to group allocation.
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32 33 **2.9. Analytical methods**

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35 Intention-to-treat analysis was performed. Sociodemographic characteristics were
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37 summarized using descriptive statistics. Baseline differences between the intervention and
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39 control groups were compared using the Chi-square test, Fisher's exact test, or t-test for
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41 independent samples according to the nature of the variables.
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45 Analysis of covariance (ANCOVA) adjusted for baseline scores was used to assess the
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47 effect of the intervention. The effect size of the intervention was determined by Cohen's *d* and
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49 number needed-to-treat (NNT). Type I error rate was set at 0.05. An additional sensitivity
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51 analysis of the effect of the intervention was conducted by adjusting the ANCOVA for
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53 socioeconomic status and educational level of the participants, as well as corresponding
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3 subgroup analysis. Statistical analysis was made in Stata® 12 and G*Power, and cross-checked
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5 in R version 3.6.
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7 8 **2.10. Ethical considerations**

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10 The research was approved by Universitat Rovira i Virgili (Tarragona, Spain) and the
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12 Bioethics Committee at Clínica Materno Infantil San Luis (Bucaramanga, Colombia) on April 4,
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14 2018 (reference 00418). The investigation was conducted under the Declaration of Helsinki. All
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16 participants were required to give their informed consent before participating in the study. The
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18 study was registered at ClinicalTrials.gov under number NCT03594526.
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22 23 **3. Results**

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25 A total of 351 first-time mothers of term infants were approached, with 219 assessed for
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27 eligibility and 76 mothers recruited and randomized to the intervention or control groups (see
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29 Figure 3). The participants were recruited 24 to 48 hours into their postpartum period between
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31 the end of January and May 2019. Each participant was followed for four months from the date
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33 of her enrollment.
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37 In total, 66 participants completed the study, 33 in the control group and 33 in the
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39 intervention group. The groups were comparable except for socioeconomic status and
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41 educational level variables; therefore, the differences recorded for these two variables were
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43 assessed by a sensitivity analysis. Most of the participants were in a domestic partnership, and
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45 51.52% lived only with their partner. The main occupation reported by the majority of
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47 participants was maternity leave, and most participants reported they were exclusively
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49 breastfeeding (see Table 2). The intervention group participants completed all eight
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51 AMACOMPRI sessions, covering 98% of the total planned activities, including the use of
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53 AMACOMPRI software audiovisual materials.
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3 The AMACOMPRI software logs registered 71 consultations in writing to the nurse.
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5 Consultations requested by the mothers were mainly related to breastfeeding, how to establish a
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7 good support relationship with the mother-in-law if she was a stress generator, how to ask for
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9 more support from her partner for taking care of the baby in the night, how to maintain the
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11 relationship with her partner now that they have become parents, how to manage the stress due to
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13 the demand generated by the infant (or about not being able to provide better care). The baby's
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15 father and grandmothers watched at least 3 of the 4 videos and listened to at least three audio
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17 guides (mainly mother care in the puerperium, newborn care, and social support).
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22 No differences were observed at baseline between the two groups for any of the study
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24 variables (see Table 3). Sensitivity analyses for effects of socioeconomic status and educational
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26 level variables did not alter results for any study variable (see Supplementary Table S1).
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29 At the end of the study, the intervention group scored higher for becoming a mother ($F =$
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31 36.47 , $p = 0.000$) with a large effect size (see Table 4). Similarly, results for 'functional social
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33 support,' 'mother-infant bond' and 'perceived maternal self-efficacy' variables revealed an inter-
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35 group difference with a higher score and a large effect size in the intervention group (see Table 4
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37 and Supplementary Table S1).
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40 Finally, the exploratory within-group analysis revealed changes between baseline and
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42 final measurements with an increase in the intervention group scores for becoming a mother,
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44 functional social support, mother-infant bond, and perceived maternal self-efficacy variables. No
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46 differences were observed within the control group, except for the mother-infant bond variable;
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48 in this case, the scores were lower at the four-month measurement than at baseline (see Table 5).
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51 52 53 **4. Discussion** 54 55 56 57 58 59 60

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3 This research was the first test of efficacy of the AMACOMPRI intervention, based on
4 Mercer's theory of becoming a mother (1986; 2006), on functional social support, mother-infant
5 bond, and perceived maternal self-efficacy, all of which have been shown to facilitate the process
6 of becoming a mother (Çinar & Öztürk, 2014; Khandan et al., 2018; Shorey, Chan, Chong, &
7 He, 2014). The main result of this study is that the AMACOMPRI showed efficacy in
8 improving the process of becoming a mother measured at four months postpartum.
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12 Our findings are consistent with the work of Fasanghari et al. (2019) as well as Özkan
13 and Polat (2011) who tested interventions with first-time mothers based on Mercer's theory that
14 were delivered during pregnancy and during postpartum with final measurements made at four
15 months. Fasanghari et al. (2019) found that the probability of 'maternal identity formation' was
16 1.84 times greater in the intervention group than in the control group. Similarly, Özkan and Polat
17 (2011) found an increase in maternal identity in the intervention group with a moderate effect
18 size. Although the AMACOMPRI intervention in the current study was not delivered during
19 pregnancy, the intervention was associated with higher scores for the process of becoming a
20 mother with a large effect size compared with the control group (Cohen's $d = 1.50$). This benefit
21 was accomplished by supporting all the postpartum stages of becoming a mother, consistent with
22 Mercer's proposal that interventions to foster the process of becoming a mother should be
23 implemented at least during the first four months of the postpartum period to produce
24 appreciable changes in knowledge and skills (Alligood, 2014; Mercer & Walker, 2006).
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27 The AMACOMPRI was also associated with higher scores in participants' functional
28 social support, with a large effect size at 16 weeks (Cohen's $d = 1.40$). This difference is
29 consistent with the results of a randomized controlled trial of a nursing intervention delivered by
30 an expert postnatal educational midwife nurse, where social support improved at 12 weeks
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3 (Shorey et al., 2015a). Likewise, a randomized clinical trial in the U.S. with first-time mothers of
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5 healthy newborns reported an improvement in social support after an intervention consisting of
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7 six telephone calls made by a pediatric nurse during the first eight weeks of postpartum, in
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9 comparison to usual care alone (Hannan, 2013). These studies showed the efficacy of
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11 interventions delivered by trained nurses in increasing social support.
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15 Similar to the study by Shorey et al. (2015a), our findings may be related to the multiple
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17 types of functional social support provided by the nurse who delivered the intervention. The
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19 mothers received advice on how to seek functional social support and also may have felt directly
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21 supported by the nurse. In addition to audiovisual educational materials, the AMACOMPRI
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23 software enabled participants to contact the nurse for formal support through personalized advice
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25 or recommendations on each topic. Moreover, our findings are consistent with a correlational
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27 study of first-time Iranian mothers that showed that the greater the social support the mother
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29 received, the smoother her transition into the maternal role (Khandan et al., 2018).
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33 The AMACOMPRI was also associated with a stronger bond between first-time mothers
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35 and their infants, with a large effect size at 16 weeks (Cohen's $d = 1.39$). After AMACOMPRI
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37 implementation, the score for mother-infant bond at four months improved to the maximum
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39 score reaching a ceiling effect in the measurement instrument for all the intervention group
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41 participants (96.00 ± 0.0). This suggests the possibility that the actual improvement in the
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43 intervention group was underestimated. Although both groups maintained a high score during the
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45 four month study, the control group scores showed a decrease in the 'mother-infant bond' score
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47 between the first and the final measurement (93.85 ± 3.44 vs. 90.03 ± 6.05 ; $p < 0.001$). These
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49 results are consistent with the study of Çınar and Öztürk (2014), which showed an increase in the
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51 mother-infant bond at eight weeks among first-time mothers with full-term newborn babies who
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3 received planned baby care education and an education booklet delivered by a nurse. Finally,
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5 given the high scores in becoming a mother, a high level of mother-infant bond is also consistent
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7 with the theoretical framework. According to Mercer, the ‘becoming a mother’–‘maternal
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9 identity’ develops simultaneously with the mother-infant bond, in a mutually dependent manner
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11 (Mercer, 1995).
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15 The AMACOMPRI was associated with higher perceived maternal self-efficacy, with a
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17 large effect size at 16 weeks (Cohen’s $d = 1.79$), a result similar to that achieved by Shorey et al.
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19 (2015a), whose randomized controlled trial found that a multimodal psychoeducational program
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21 was effective increasing maternal self-efficacy at 12 weeks. A systematic review by Liyana et al.
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23 (2018) about maternal self-efficacy showed that the interventions lasting more than 10 weeks
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25 were the most effective. Unlike AMACOMPRI, none of those interventions were based on
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27 Mercer’s theory, neither focused on mother-infant bond, and only the study by Shorey et al.
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29 (2015a) included home-based sessions.
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34 Since AMACOMPRI uses multiple forms of delivery and has educational-support
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36 materials (including technology-based tools) that are intended to be complementary, it is possible
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38 that both the content and the personal contact of the intervention may have benefitted the process
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40 of becoming a mother. Further studies with AMACOMPRI are warranted, including different
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42 doses of the intervention as well as including both an attention control arm and an arm delivering
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44 the intervention through technology-based tools. This approach could discriminate between the
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46 contribution of the content and the contact of the intervention and could also reduce the
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48 intervention cost, thus favoring the incorporation of AMACOMPRI to usual clinical practice
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50 care. In the same way, a recent study in the U.S. found that the transition to Virtual Perinatal
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52 Home Visiting appears to be feasible and represents an essential connection in supporting
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3 perinatal care (Marshall et al., 2020). Within the context of the COVID-19 pandemic, the
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5 AMACOMPRI intervention could be adapted by virtualizing the content logbook and the letters,
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7 then including them in the AMACOMPRI software. This approach would enable a virtual visit
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9 module for making the intervention more accessible as well as lowering costs.
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12 Researchers from Singapore have tested technology-based and home visiting
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14 interventions compared with usual care alone in different quantitative (Jiao et al., 2019; Shorey
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16 et al. 2015a; Shorey et al. 2017) and qualitative (Shorey, Chan, Chong, He., & 2015b; Shorey,
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18 Yang, & Dennis, 2018) studies to enhance maternal self-efficacy based in Bandura's theory.
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20 Similarly, we will be conducting a complementary qualitative study to explore first-time
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22 mothers' perceptions about the AMACOMPRI components that will provide more information
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24 on the contribution of the content and contact of the intervention.
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28 Altogether, the present findings indicate that the AMACOMPRI intervention delivered
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30 by a nurse through enhancing functional social support, mother-infant bond, and perceived
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32 maternal self-efficacy strengthened the process of becoming a mother. This is the first
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34 randomized controlled trial based on Mercer's updated theory conducted during the postpartum
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36 period of first-time mothers of term infants in the Western world. Comparable works cited in our
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38 discussion are predominantly experimental trials conducted in Asian countries where most
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40 studies in this field of knowledge have been conducted.
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44 The positive results of this novel multimodal nursing intervention strategy measured with
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46 valid and reliable scales adapted to the specific cultural environment, highlight the fundamental
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48 role of nursing in fostering the process of becoming a mother among first-time mothers of term
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50 infants. This intervention has potential benefits for maternal-infant public health in different
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52 countries following adaptations pertinent to each socio-cultural context.
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4.1 Limitations and recommendations for future studies

The main limitation of this study is that the content and the contact delivered in the intervention were not tested separately. The AMACOMPRI was compared with usual care alone. In this context, the lack of an attention control group implied that it was not possible to define whether the contact, the content, or the combination of both explain our results. In future studies an attention-control group will be needed. The authors will conduct a complementary qualitative study about perceived contribution of AMACOMPRI's components.

All the participants in the intervention group obtained the maximum possible score for the mother-infant bond, i.e., a ceiling effect as a problem with the measure. Therefore, improvement beyond the maximum score could have been underestimated.

For future research, the AMACOMPRI should also be tested in pregnant mothers, in mothers with preterm infants, in mothers with perinatal high-risk conditions, and with adolescent mothers. Our findings also support conducting a multi-arm cost-effectiveness study of this intervention on maternal and infant outcomes.

4.2 Implications for practice

Perinatal and postnatal maternal health are important global indicators of social, cultural, and economic development and are priority public health concerns that may be addressed by advanced practice maternal and perinatal nursing initiatives. In this context, the AMACOMPRI supports nursing's visibility, autonomy, and leadership in postpartum care. This research contributes evidence related to the efficacy of a new Mercer's theory-based nursing intervention. The results of this study can be generalized to healthy first-time mothers with healthy term infants who receive support from their partners taking into account corresponding adaptations to each socio-cultural context and considering the potential benefits to the present and future

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3 physical and mental health of the mother and her infant.
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6 7 **5. Conclusion**

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9 This randomized controlled trial demonstrated that AMACOMPRI, a multimodal nursing
10 intervention strategy, was more effective than usual care in supporting the process of becoming a
11 mother in first-time mothers of term infants through fostering functional social support, mother-
12 infant bond, and perceived maternal self-efficacy among the participants. This innovative nurse-
13 delivered intervention warrants testing on a larger-scale. The present findings support the middle
14 range theory of Becoming a Mother proposed by Mercer and the importance of its incorporation
15 into professional nursing practice to facilitate the transition to motherhood for first-time mothers.
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39 40 41 **Figure Captions**

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43 **Figure 1.** Theoretical Framework of the study and AMACOMPRI intervention rationale (based
44 on Mercer's theory and the literature review). Note: The family-and-friends environment is
45 represented inside the circle with mother-infant-father triad is embedded. ^{a, b, c} Stages of the
46 process of becoming a mother described by Mercer (2004, 2006) that correspond to postpartum
47 period and the AMACOMPRI sessions. The literature-based rationale is depicted by the
48 representation of the interrelationship between the outcomes variables.

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50 **Figure 2.** Logic model for the AMACOMPRI intervention

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52 **Figure 3.** The CONSORT 2018 flow diagram for this study

Table 1.

Description of the AMACOMPRI intervention sessions

Session	Content and support material	Dose
Mode of delivery-Individual		Postpartum period of delivery
Session 1. Functional social support <hr/> Face to face (Home-based session)	<ul style="list-style-type: none"> • Functional social support By assigning audios for the next session, the following content topics were covered (according to the postpartum stage): <ul style="list-style-type: none"> • Social support • Postpartum maternal care • Newborn care • Breastfeeding • Warning signals in mothers and babies Support materials: <ul style="list-style-type: none"> • Logbook. • Letters for the baby's father and grandmothers • Expert audio guides • Song: By loving, you build maternity • First-time mother video: Functional social support • Mobile-based AMACOMPRI Software 	120-minute session; given once <hr/> Days 6 to 10; Mercer's "becoming a mother" stage: Acquaintance, practice, and physical restoration"
Session 2. Functional social support <hr/> Telephone (Telephone-based session)	<ul style="list-style-type: none"> • Functional social support By assigning audios for the next session, the following content topics were covered (according to the postpartum stage): <ul style="list-style-type: none"> • Social support • Postpartum maternal care • Newborn care • Breastfeeding • Stimulation of newborn in the first month • Warning signals in mothers and babies Support materials: <ul style="list-style-type: none"> • Logbook • Expert audio guides • Mobile-based AMACOMPRI Software 	15-minute session; given once <hr/> 15 days; Mercer's "becoming a mother" stage: Acquaintance, practice, and physical restoration"
Session 3. Mother-infant bond <hr/>	<ul style="list-style-type: none"> • Mother-infant bond By assigning audios for the next session, the following content topics were covered (according to the postpartum stage):	90-minute session; given once <hr/>

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Face to face
(Home-based session)

- Mother-infant bond
- Stimulation of newborn in the first month
- Breastfeeding
- Relationship with her partner
- Sexuality
- Postpartum family planning methods

1 month;
Mercer's "becoming a mother" stage:
Approaching normalization"

Support materials:

- Logbook
- Expert audio guides
- First-time mother video: Mother-infant bond
- Mobile-based AMACOMPRI Software

**Session 4.
Mother-infant bond**

Telephone (Telephone-based session)

By assigning audios for the next session, the following content-topics were covered (according to the postpartum stage):

- Mother-infant bond
- Stimulation of the two-month-old infant
- Breastfeeding
- Relationship with her partner
- Sexuality
- Postpartum family planning methods

15-minute session;
given once

1.5 months; Mercer's "becoming a mother" stage: Approaching normalization"

Support materials:

- Logbook
- Expert audio guides
- Mobile-based AMACOMPRI Software

**Session 5.
Perceived maternal self-efficacy**

Telephone (Telephone-based session)

By assigning audios for the next session, the following content-topics were covered (according to the postpartum stage):

- Maternal self-efficacy
- Stimulation of the three-month-old infant
- Breastfeeding
- Positive parenting
- Moods, postpartum depression

15-minute session;
given once

2.5 months; Mercer's "becoming a mother" stage: Approaching normalization"

Support materials:

- Logbook
- Expert audio guides

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- First-time mother video: Perceived maternal self-efficacy
- Mobile-based AMACOMPRI Software

Session 6.
Perceived maternal self-efficacy

Face to face
(Home-based session)

- **Perceived maternal self-efficacy**

By assigning audios for the next session, the following content topics were covered (according to the postpartum stage):

- Maternal self-efficacy
- Stimulation of the three-month-old infant
- Breastfeeding
- Positive parenting
- Moods, postpartum depression

Support materials:

- Logbook
- Expert audio guides
- Mobile-based AMACOMPRI Software

90-minute session;
given once

3 months; Mercer's "becoming a mother" stage: Approaching normalization"

Session 7.
Becoming a mother

Telephone (Telephone-based session)

- **Becoming a mother**

By assigning audios for the next session, the following content topics were covered (according to the postpartum stage):

- Maternal role
- Maternity
- Breastfeeding
- Stimulation of the four-month-old infant

Support materials:

- Logbook
- Expert audio guides
- First-time mother video: Becoming a mother
- Mobile-based AMACOMPRI Software

15-minute session;
given once

3.5 months; Mercer's "becoming a mother" stage: Approaching normalization"

Session 8.
Becoming a mother

Face to face
(Home-based session)

- **Becoming a mother**

Support materials:

- Logbook
- Song: By loving, you build maternity

90-minute session;
given once

4 months; Mercer's "becoming a mother" stage: Integration of maternal identity"

^a There were 26 expert audio guides in total, each one with an average duration of 10 min.

^b There were 4 videos in total, each one with an average duration of 8 min.

Table 2.
Baseline characteristics (n=66)

Baseline characteristics	Intervention Group n=33 n (%)	Control Group n=33 n (%)	p χ^2
Age of mother			
24 or under	11 (33.33)	17 (51.52)	0.135
Over 24	22 (66.67)	16 (48.48)	
Marital status			
Domestic partnership	25 (75.76)	29 (87.88)	0.202
Married	8 (24.24)	4 (12.12)	
Cohabiting with			
Partner	17 (51.52)	17 (51.52)	0.856 ^a
Partner and parents	11 (33.33)	12 (36.36)	
Partner and parents-in-law	4 (12.12)	2 (6.06)	
Relative	1 (3.03)	2 (6.06)	
Socioeconomic status ^b			
Low	16 (48.48)	24 (72.73)	0.044
Medium	17 (51.52)	9 (27.27)	
Educational level			
≤ Secondary	1 (3.03)	10 (30.30)	0.003 ^a
> Secondary	32 (96.97)	23 (69.70)	
Main occupation			
Housewife	3 (9.09)	5 (15.15)	0.255
Student	3 (9.09)	7 (21.21)	
Maternity leave	27 (81.82)	21 (63.64)	
Age of the baby			
Age in days, mean (95% CI)	8.06 (7.65, 8.46)	8.51 (8.13, 8.89)	0.108 ^c
Baby's gender			
Female	18 (54.55)	17 (51.52)	0.805
Male	15 (45.45)	16 (48.48)	
Type of delivery			
Cesarean section	23 (69.70)	16 (48.48)	0.080
Vaginal delivery	10 (30.30)	17 (51.52)	
Baby's method of feeding			
Both	6 (18.18)	10 (30.30)	0.251
Breast	27 (81.82)	23 (69.70)	

^a Fisher exact test.

^b Socioeconomic status: Socioeconomic classification status of the household neighborhood's for public services fees.

^c Student's t test.

Table 3.
Baseline study variables (n=66)

Baseline study variables	Intervention Group		Control Group		p ^a
	mean ± SD	95% CI	mean ± SD	95% CI	
Becoming a mother	202.45 ± 12.15	198.23, 206.68	194.97 ± 18.45	188.55, 201.39	0.06
Functional social support	76.12 ± 8.67	73.11, 79.14	74.00 ± 10.58	70.32, 77.68	0.38
Mother-infant bond	95.03 ± 1.64	94.46, 95.60	93.85 ± 3.44	92.65, 95.04	0.08
Perceived maternal self-efficacy	70.03 ± 7.08	67.57, 72.49	69.73 ± 7.75	67.03, 72.42	0.87
Maternal stress	3.21 ± 2.70	2.27, 4.15	2.79 ± 2.07	2.07, 3.51	0.48
Maternal depression	6.00 ± 3.03	4.95, 7.05	5.64 ± 2.54	4.76, 6.52	0.60

^a Student's t test.

For Peer Review

Table 4.

Comparative analysis of final score of becoming a mother, perceived maternal self-efficacy, functional social support and mother-infant bond between intervention group and control group (adjusted for base-line score)

Variables (Score range)	Intervention	Control	df		F Statistics ^a		Adjusted Delta ^b	95% CI	P ^c	Effect size	
	mean ± SD	mean ± SD	Model	Residual	Model	Groups				Cohen's d	NNT (95% CI)
Becoming a mother (56 to 224)	215.73 ± 5.05	199.36 ± 14.63	2	63	51.72	36.47	13.04	8.72, 17.34	0.000	1.50	1.07 (1.00, 1.17)
Functional social support (22 to 88)	83.09 ± 5.19	70.82 ± 11.26	2	63	39.65	39.01	11.16	7.59, 14.73	0.000	1.40	1.04 (1.00, 1.11)
Mother-infant bond (0 to 96)	96.00 ± 0.0	90.03 ± 6.05	2	63	25.83	27.51	5.18	3.20, 7.15	0.000	1.39	1.0 (1.00, 1.00)
Perceived maternal self-efficacy (20 to 80)	78.48 ± 2.53	71.27 ± 5.11	2	63	56.79	77.72	7.12	5.50, 8.73	0.000	1.79	1.0 (1.00, 1.00)

Abbreviations: df, degrees of freedom; SD, standard deviation; CI, confidence interval; NNT, Number Needed to Treat.

^a Corresponding value in F distribution for model and groups

^b Adjusted Delta: Mean difference between the final score of the intervention group and the final score of the control group, adjusted for the base-line scores.

^c ANCOVA, adjusted to baseline scores.

Interpretation note: Cohen's d-value ≥ 0.80 corresponds to large effect size. NNT means Number Needed to Treat to gain a better outcome, i.e., responds to the question on how many people is required to receive the intervention, in such a way that one extra person receives a beneficial result (the closer to 1.0, the larger effect size).

Table 5.
Within-group Pre- to Post-Intervention Change

Variables	Intervention (n=33)				Control (n=33)			
	Initial mean \pm SD	Final mean \pm SD	Delta pre-post ^a	p ^b	Initial mean \pm SD	Final mean \pm SD	Delta pre-post ^a	p ^b
Becoming a mother	202.45 \pm 12.15	215.73 \pm 5.05	-13.27	0.000*	194.97 \pm 18.45	199.36 \pm 14.63	-4.39	0.066
Functional social support	76.12 \pm 8.67	83.09 \pm 5.19	-6.97	0.000*	74.00 \pm 10.58	70.82 \pm 11.26	3.18	0.084
Mother-infant bond	95.03 \pm 1.65	96.00 \pm 0.00	-0.97	0.002*	93.85 \pm 3.44	90.03 \pm 6.05	3.82	0.000*
Perceived maternal self-efficacy	70.03 \pm 7.08	78.48 \pm 2.53	-8.45	0.000*	69.73 \pm 7.75	71.27 \pm 5.11	-1.55	0.126

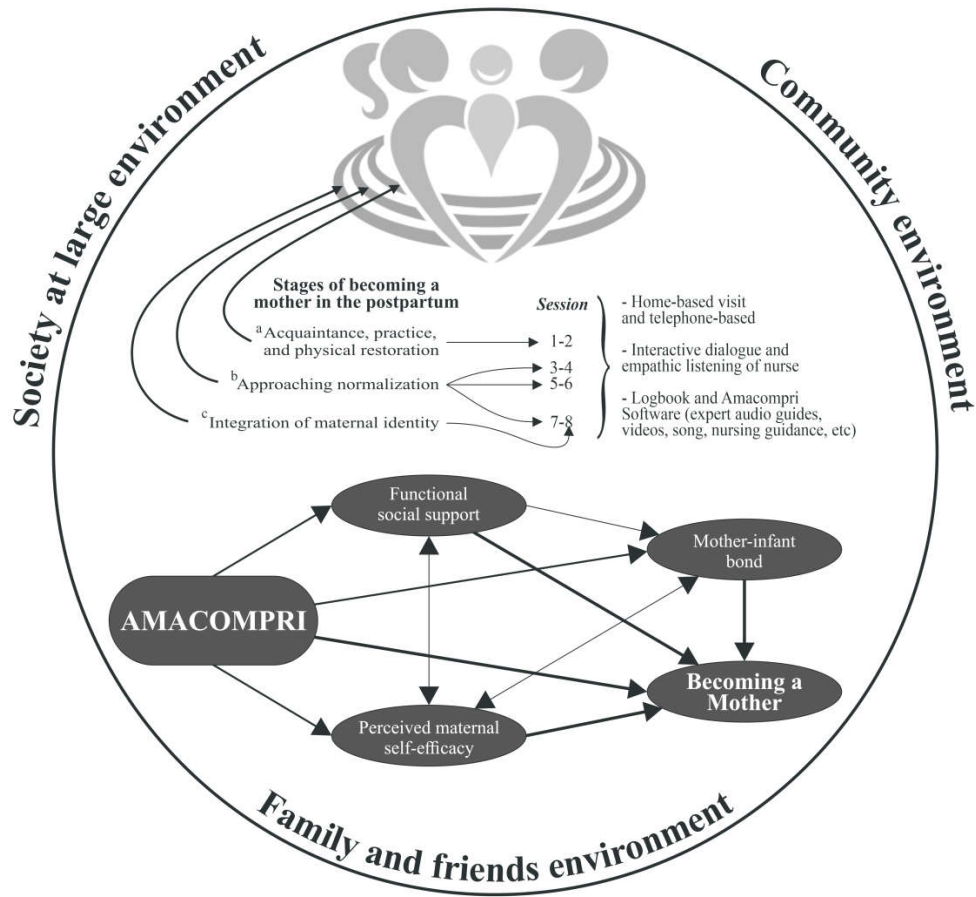
Abbreviation: SD, standard deviation.

^a Delta pre-post: mean difference between the initial and final the score.

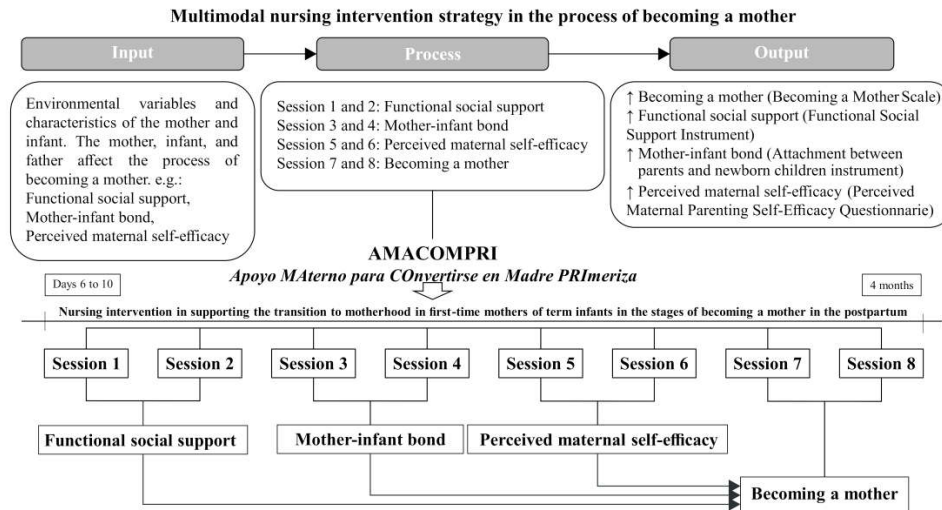
^b Student's t test.

* Statistically significant difference (p<0.05).

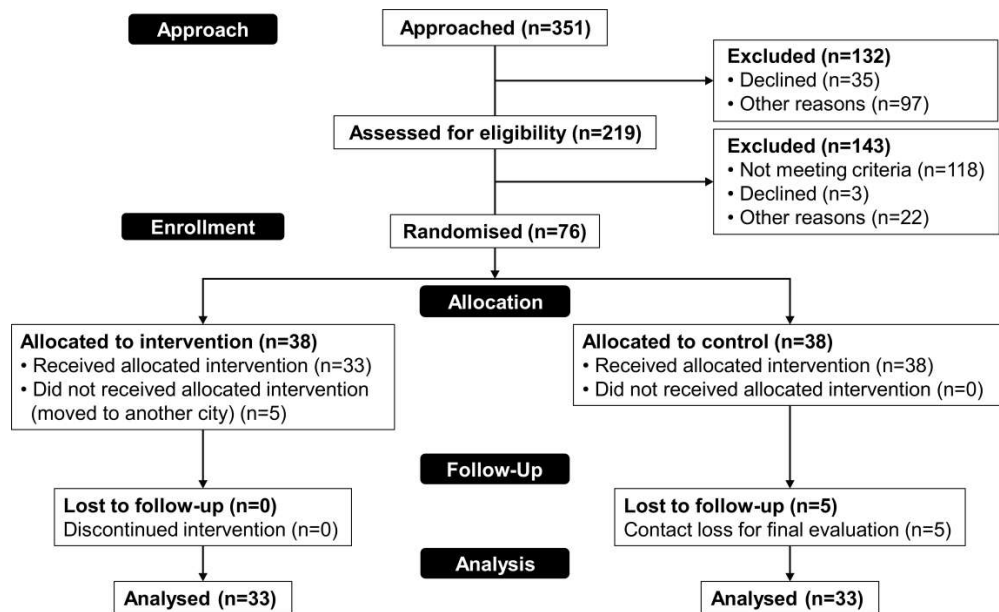
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