

1 **A quasi-experimental study to compare effectiveness of a breastfeeding arm**
2 **sling with normal breastfeeding cross-cradle hold position**

3 **Short-Title: The effectiveness of a newly designed breastfeeding arm sling**

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16 PD and SL managed the data collection process in Thailand.

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25 **NOTE: This preprint reports new research that has not been certified by peer review and should not be used to guide clinical practice.**

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1 **Abstract**

2 Breastfeeding has many benefits for the newborn and mother therefore, the World
3 Health Organization guidelines recommend exclusive breastfeeding for the first 6
4 months, with continued breastfeeding for up to two years. However, exclusive
5 breastfeeding rates in the first 6 months in Thailand were reported to be approximately,
6 14% in 2019. Research has highlighted that many mothers' have a lack of belief in
7 their ability to breastfeed, and some physical conditions, such as tiredness and
8 difficulty continually holding their baby in a comfortable position. Additionally, first-time
9 breastfeeding can contribute to mothers having difficulties breastfeeding during the
10 early postnatal period. Therefore, the *Arm sling innovation* (device) has been designed
11 to provide support and comfort whilst holding the newborn. This study compared the
12 effectiveness of the breastfeeding arm sling innovation to support breastfeeding in
13 cross-cradle hold position and normal cross-cradle hold position breastfeeding in first-
14 time mothers. A quasi-experimental pretest-posttest research design was used to
15 evaluate the effectiveness of breastfeeding before and after the intervention among
16 first-time mothers in the postnatal unit, at Ramathibodi hospital, Thailand. A total of 46
17 postpartum mothers participated in the study. The results showed that the
18 effectiveness of breastfeeding reported by mothers between using a normal cross-
19 cradle hold position and using breastfeeding arm sling innovation was statistically
20 significantly different ($t = 4.32$, $P < 0.001$) with helping to hold the baby securely without
21 slipping ($t=5.68$, $p<0.001$) and mothers can continue to breastfeed ($t=2.09$, $p <0.001$).
22 Majority of mothers were satisfied with the support of using the breastfeeding arm sling
23 innovation design. The breastfeeding arm sling innovation contributes to the
24 effectiveness of breastfeeding by assisting and supporting the mother and baby's

25 position to breastfeed more comfortably, thus assisting first-time mothers to feel

26 comfortable, confident, and able to continue breastfeeding.

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28 Introduction

29 The benefits of breastfeeding for babies are well established as breast milk is
30 naturally produced, safe, clean, provides complete nutrition, and contains antibodies
31 that help protect against many common childhood illnesses [1]. Breastfeeding
32 increases the bonding between a mother and her infant and also self-esteem for
33 mothers from the experience [1]. Therefore, the World Health Organization has
34 recommended that infants should be exclusively breastfed for the first six months of
35 life and to continue breastfeeding for up to two years and beyond [2].

36 Despite the many benefits of breastfeeding, rates in Thailand remain low.
37 World Health Organization guidelines and, also the most recent national report in
38 Thailand have reported that the six months exclusive breastfeeding rate was
39 approximately 14% in Thailand in 2019 [3]. According to the Ten Steps to Successful
40 Breastfeeding, postpartum women should facilitate immediate initiation of
41 breastfeeding, i.e., within the first hour after birth, and then attempt to breastfeed
42 every 2–3 hours with a goal of eight sessions per 24-hour period to stimulate
43 prolactin hormone to increase milk production [2,4]. However, there are a lot of
44 factors that contribute to inadequate breastfeeding such as maternal discomfort
45 which is frequently experienced by mothers during the breastfeeding period [5].
46 Previous research has found that many mothers have a lack of belief in their ability
47 to breastfeed, and some physical conditions and tiredness can also contribute to
48 them having difficulties breastfeeding during the early postnatal period [6].
49 Additionally, other problems can contribute to the first-time mothers' inability to
50 breastfeed their newborns, and some have reported feeling that they have
51 insufficient milk and difficulties latching, thus leading to shortening the duration of

52 breastfeeding [7]. It is important to note that breastfeeding experiences can vary
53 considerably between first-time and previously breastfed mothers [8].

54 Positioning of the baby's body and correct latching on of the baby is essential
55 for good attachment and successful breastfeeding [9]. A cross-cradle hold position
56 helps to guide the baby's head and mouth while feeding and can help to avoid poor
57 latching, which can cause nipple redness and/or cracking [10]. It has been reported
58 that this position is preferred by new mothers who have little experience regarding
59 breastfeeding or for babies who have not learned how to latch on the breast well
60 [11]. Therefore, the midwife's role involves helping mothers and providing support,
61 such as guidance and counseling on practical concerns like breastfeeding positions
62 and how to make mothers feel comfortable and thus promote longer duration of
63 breastfeeding [12]. Signs that a baby is well attached during breastfeeding include
64 holding the baby so that their face touches the mother's breast, their head and body
65 in alignment with the mother's breast, their mouth wide open, and more of the areola
66 is visible above the baby's top lip than below the lower lip, as according to the four
67 key signs for effective breastfeeding [2]. However, all these signs can lead to a
68 mother feeling over-tired and can make her wrist and arm become uncomfortable
69 and cause an aching sensation during breastfeeding.

70 Currently, there are several aids to help mothers breastfeed, for example, a
71 functional nursing bra and a specifically designed supporting pillow; these aids can
72 help mothers to continue breastfeeding. However, local new mothers have
73 expressed how they find it difficult to continually hold their baby in a comfortable
74 position and that their arm often aches during breastfeeding. The mothers'
75 experiences have been observed by the midwifery researchers and issues during
76 breastfeeding such as, incorrect feeding position, extreme tiredness, and wrist pain

77 have been identified whilst working in the postnatal unit at the local hospital
78 (Ramathibodi Hospital). Therefore, there is a justification to find new ways to help
79 and support first-time mothers to breastfeed comfortably and reduce the risk of wrist
80 and arm pain as well as increase self-esteem for the mothers who choose to
81 breastfeed.

82 **Definition of the methods of breastfeeding position**

- 83 - Normal breastfeeding position is a normal cross-cradle hold position breastfeeding
- 84 with a pillow support
- 85 - Breastfeeding arm sling innovation is the intervention to attach the mother's arm
- 86 whilst holding her baby to breastfeed in a cross-cradle hold position with a pillow
- 87 support

88 **Aim and Objectives**

- 89 - To compare the effectiveness of the breastfeeding arm sling innovation to support
- 90 breastfeeding in cross-cradle hold position and normal cross-cradle hold position
- 91 breastfeeding in first-time mothers.
- 92 - To evaluate the satisfaction with the breastfeeding arm sling innovation to
- 93 support breastfeeding in cross-cradle hold position in first-time mothers
- 94 The null hypothesis was that there is no difference in the mean scores for the
- 95 effectiveness of breastfeeding between using breastfeeding arm sling innovation
- 96 and breastfeeding in normal cross-cradle hold position.

97 **Materials and Methods**

98 A quasi-experimental pretest-posttest research design was used to evaluate
99 scores on the effectiveness of breastfeeding before and after using the breastfeeding

100 arm sling innovation. This study design was chosen to undertake a comparison of
101 the scores after an intervention to scores on the same measure in the same
102 participants prior to the intervention [12]. Firstly, researchers designed and
103 developed the breastfeeding arm sling innovation and conducted a pilot test of the
104 innovation. Secondly, the researchers explained study information in a step-by-step
105 approach guided by a research protocol and specific requirements of assessment to
106 midwives (research assistants) for approximately, 30-60 minutes. The midwives
107 demonstrated how they would undertake an assessment to confirm correct
108 procedure.

109 Mothers who meet the inclusion criteria were invited to participate in the
110 study. Mothers were informed about the purpose of the study and given an
111 opportunity to discuss the study to make an informed choice to participate. Mothers
112 were asked to complete a written consent form.

113 The experiment involved two stages (Fig 1). In the first stage, mothers were
114 selected to provide 15 minutes of breastfeeding by using a cross-cradle hold position
115 with the breastfeeding arm sling innovation or a normal cross-cradle hold position.
116 As it is a clinical practice to wrap a baby (swaddle) to prevent hypothermia in the
117 newborn in the postnatal unit at the study hospital [13-14], the babies in this
118 experiment were wrapped in both groups (using a cross-cradle hold position with the
119 breastfeeding arm sling innovation or a normal cross-cradle hold position), see Fig 1.

120 **Fig. 1. This is the Fig 1 Title. The experimental flowchart.**

121 In the case of breastfeeding with a normal cross-cradle hold position, the
122 midwives (research assistants) helped the mother to provide 15 minute-
123 breastfeeding. The midwives (research assistants) observed and measured the

124 effects of breastfeeding. In the case of breastfeeding with a cross-cradle hold
125 position with the breastfeeding arm sling innovation, the midwives (research
126 assistants) helped the mother to wear the sheath of the breastfeeding arm sling
127 innovation and wrap the equipment around the baby. When the baby was latched on
128 the midwives helped the mother to adhere the equipment for a firm hold. Following
129 this, the mother provided 15-minute breastfeeding. The midwives observed and
130 measured the effectiveness of breastfeeding. After breastfeeding, mothers were
131 asked to complete the effectiveness of breastfeeding and satisfaction of using
132 breastfeeding arm sling innovation questionnaires.

133 The following stage was undertaken three hours later, and 15-minute-
134 breastfeeding was repeated (normal cross-cradle hold position or breastfeeding arm
135 sling innovation with cross-cradle hold position) follow-up on the effectiveness of
136 breastfeeding and satisfaction levels outcomes were assessed.

137 **Participants and setting**

138 This study was conducted in the postnatal unit, at Ramathibodi hospital,
139 Thailand. Two hours after giving birth, mothers were transferred to the postnatal unit
140 and provided with care and support. It is normal practice for healthy mothers and
141 their newborn babies to be discharged home from the postnatal unit within 48-72
142 hours. In this unit, assistance with breastfeeding during the postpartum period is
143 provided by nurse-midwives. Research assistants, thus, are nurse-midwives who are
144 healthcare providers in the postnatal unit, having knowledge of assessing and
145 observing breastfeeding behaviour. Breastfeeding assistance can vary according to
146 the nurse-midwife that provides the care. Therefore, during the undertaking of this

147 study, the nurse-midwife who supported a mother to breastfeed continued to be the
148 same person, in order to control for any breastfeeding effect.

149 **The structured questionnaire**

150 The effectiveness of breastfeeding was recorded by a questionnaire for
151 participants and midwife assessors that was modified from the four-key points (The
152 Breastfeed Observation), which aligned with the key signs to effective breastfeeding.
153 Questions were related to the four key points of the baby's position: baby's head and
154 body in line, baby held close to mother's body, baby faces the breast with nose
155 opposite the nipple, baby's whole body supported [2].

156 Additionally, observations relating to good attachment: more areola seen above
157 baby's top lip, baby's mouth open wide, lower lip turned outwards and baby's chin
158 touches breast were considered. The participants self-reported these effective
159 breastfeeding signs, and the midwives observed these signs. Both questionnaires
160 included five items that utilised a ranked 5-point Likert-type scale to assess the
161 effectiveness of breastfeeding outcomes.

162 The breastfeeding arm sling innovation satisfaction questionnaire was
163 developed by the researchers and adapted from the diffusion of innovation model,
164 which demonstrates innovation is generally adopted when four relative advantages
165 are considered i.e., compatibility, complexity, trial-ability, and observability [15]. The
166 questionnaire includes 14 items ranked on a 5-point scale from lowest satisfaction to
167 the highest level of satisfaction. The face and content validity were tested through
168 consultation with a panel of three experts, including maternal-newborn and midwifery
169 experienced researchers from the Ramathibodi School of Nursing, Mahidol University.
170 The structure of the questionnaire also included open-ended questions and sought

171 qualitative information regarding using the breastfeeding arm sling innovation to
172 explore what participants views were and report their thoughts in their own words [16].

173 **Sample size calculation**

174 The sample size was calculated based on a pilot study involving 5 mothers that
175 were undertaken in the same setting to test the study feasibility (SD. = 1.2). According
176 to the formula to calculate the sample size, considering an alpha error of 0.05, Delta
177 0.5, and a test power of 80%, under one tail hypothesis, the sample size of 46 mothers
178 was required to participate [17].

179 **Data collection**

180 Recruitment and data collection were undertaken in the postnatal unit on a daily
181 basis, by a research assistant, who recruited participants and implemented the
182 assignment of the intervention. A midwife (research assistant) supported and advised
183 a mother how to breastfeed using the cross-cradle holding position and how to use the
184 breastfeeding arm sling innovation. The mothers who met the inclusion criteria were
185 asked to assess their breastfeeding effectiveness before the intervention. After the
186 breastfeeding intervention (15 minutes), the mothers were asked to assess their
187 breastfeeding effectiveness and measure self-reported satisfaction. The midwives
188 (research assistants) observed and completed the effectiveness of the breastfeeding
189 questionnaire in both normal breastfeeding and during the intervention.

190 **Intervention**

191 The breastfeeding arm sling innovation has been designed and tailored by
192 using spandex for the sleeves, filled with elastic and attached with 6 cm leather, see
193 Fig. 2. The spandex used for both arm wear is 5.0 cm. apart and has two straps that

194 are 63 x 7.5 cm. Both ends of the spandex are attached to Velcro straps in two
195 positions to allow adjustment of the size according to the baby's size.

196 **Fig 2. This is the Fig 2 Title. Breastfeeding arm sling innovation**

197 In the first step of applying the support equipment, the midwives (research
198 assistants) helped the mother to wear the sheath of the breastfeeding arm sling
199 innovation and wrap the equipment around the baby. When the baby was latched on
200 and feeding, the midwives (research assistants) helped the mother to adhere the
201 equipment for a firm hold, so that the mother's arm touched closely the baby's back to
202 support breastfeeding. This technique helped the mother's arm to touch the baby's
203 back, therefore enabling her to hold the newborn baby closer. An advantage of this
204 approach is that it prevents fatigue of the wrists and shoulders of the mothers during
205 breastfeeding.

206 As this research is in the experimental stage, a helper was required to support
207 how to apply the breastfeeding arm sling innovation. This initial help to use the
208 breastfeeding arm sling innovation showed mothers how to apply and use the
209 breastfeeding arm sling by themselves for further breastfeeding (Fig 2).

210 **Statistical analysis**

211
212 All data analysis was performed using the IBM SPSS Statistics 27.0.1.0
213 software package [18]. Data were expressed as means and standard deviations (SD).
214 A comparison of the means of the two groups within subjects was evaluated for
215 significance using paired t-tests. A p-value of less than 0.05 was considered
216 significant.

217 **Ethical considerations**

218

219 The study was approved by the Ethics Committee on Human Subjects of the
220 Faculty of Medicine at Ramathibodi Hospital, Mahidol University, Thailand (IRB COA.
221 MURA2021/949), in line with the Human Research Protection such as Declaration of
222 Helsinki, The Belmont Report, and the International Conference on Harmonization in
223 Good Clinical Practice (ICH-GCP).

224 **Results**

225 **Participants' demographic characteristics**

226 A total of 46 postpartum women participated in the study ranging in age from
227 19 to 40 years with a mean age of 29 years (SD = 5.65). Gestational age ranged from
228 37-41 weeks (mean gestational age 38 weeks, SD = 1.09 weeks). Mothers who
229 participated in the study were post-birth on their first day n = 18 (54.5 %), second day
230 n= 9 (27.3 %), and third day n=6 (18.2%). The babies of the participants had a mean
231 weight of 3151 grams.

232 **Differences in the effectiveness of breastfeeding observed** 233 **by mothers between groups**

234 The results of paired t-tests showed that the effectiveness of breastfeeding
235 reported by mothers between using a normal cross-cradle hold position and using a
236 cross-cradle hold position with breastfeeding arm sling innovation was statistically
237 significantly different ($t = 4.32$, $P < 0.001$). The difference in total scores of using
238 breastfeeding arm sling innovation and normal breastfeeding was statistically
239 significant (hold the baby securely without slipping: $t=5.68$, $p<0.001$; feeling no pain at
240 the nipples while the baby is suckling: $t=4.76$, $p <0.001$; baby can continue to suck:
241 ($t=2.09$, $p <0.001$); baby held close to mother's body: $t=5.76$, $p <0.001$; No pain felt at

242 the breast during sitting to breastfeed continuously: $t=4.24$, $p < 0.001$), as presented
 243 in table 1.

244 **Table 1. Comparison of the effectiveness of breastfeeding between using**
 245 **normal cross-cradle hold position and using cross-cradle hold position with**
 246 **breastfeeding arm sling innovation by mothers**

Effectiveness of breastfeeding	Using breastfeeding arm sling innovation equipment		Normal breastfeeding		t	p-value
	MEAN	SD	MEAN	SD		
1. Hold the baby tightly without slipping	3.24	0.67	2.20	1.02	5.68	<0.001
2. The feeling of no pain at the nipples while the baby is suckling	2.63	0.74	2.04	0.89	4.76	<0.001
3. Baby can continue to suck	3.02	0.86	2.33	0.97	2.09	<0.001
4. Baby held close to mother's body	3.28	0.78	2.24	1.08	5.76	<0.001
5. No pain felt at the breast during sitting to breastfeed continuously	2.65	0.77	1.96	0.89	4.24	<0.001
Total	2.97	0.60	2.15	0.80	4.32	<0.001

247

248 **Differences in the effectiveness of breastfeeding observed**
 249 **by midwives between groups**

250 Table 2 shows the effectiveness of breastfeeding observed by the midwife
 251 and indicates a significant difference in the effects of signs of baby attached during
 252 breastfeeding between normal breastfeeding and using breastfeeding arm sling
 253 innovation in all outcomes. Compared with normal breastfeeding, using
 254 breastfeeding arm sling innovation increased significantly as greater areola seen
 255 above the baby’s top lip (t = 6.03, p <0.001); baby’s chin touches breast (t = 6.26, p
 256 <0.001); baby’s head and body in line (t = 7.46, p <0.001); baby’s mouth open wide
 257 (t = 6.49, p <0.001); baby’s cheeks do not dimple during breastfeed (t = 7.29, p
 258 <0.001).

259 **Table 2. Comparison of the effectiveness of breastfeeding between using**
 260 **normal cross-cradle hold position and using cross-cradle hold position with**
 261 **breastfeeding arm sling innovation by midwife (researcher assistance)**

Effectiveness of breastfeeding	Using breastfeeding arm sling innovation equipment		Normal breastfeeding		t	p-value
	MEAN	SD	MEAN	SD		
1. More areola seen above baby’s top lip	2.93	0.77	2.22	0.59	6.03	<0.001
2. Baby’s chin touches breast	3.08	0.66	2.34	0.71	6.26	<0.001

3. Baby's head and body in line	3.24	0.77	2.04	0.87	7.46	<0.001
4. Baby's mouth open wide	3.24	0.82	2.37	0.77	6.49	<0.001
5. Baby's cheeks do not dimple during breastfeeding	3.30	0.76	2.48	0.72	7.29	<0.001
Total	3.16	0.64	2.29	0.59	8.93	<0.001

262

263 **Mothers' satisfaction using breastfeeding arm sling**
 264 **innovation**

265 The majority of the mothers were satisfied with the suitability of using the
 266 breastfeeding arm sling innovation design (52.9%, size and length 44.1% and fabric
 267 used 41.2%). While half (50%) of the mothers were satisfied with the appearance of
 268 the breastfeeding arm sling innovation, (41.2%) reported that they were very satisfied
 269 with the non-slippage. Meanwhile, satisfied level of the features of easy to use
 270 (41.2%), ease of disassembly (41.2%), and ease of cleaning (38.2%) were reported
 271 by the mothers (Table 3).

272 **Table 3. Mothers' satisfaction using breastfeeding arm sling innovation**

How satisfied are you with using the breastfeeding arm sling innovation	Satisfaction levels (%)				
	Very Satisfied	Satisfied	Neutral	Unsatisfied	Very Unsatisfied
Easy-to-use features					
1) Easy to use	17.6	41.2	35.3	2.9	2.9

2)Non slippage	41.2	41.2	17.6		
3)Easy to disassemble	5.9	41.2	41.2	11.8	
4)Easy to clean	38.2	38.2	23.5		
Suitability of equipment					
5)Design	14.7	52.9	29.4	2.9	
6) Size and length	26.5	44.1	26.5	2.9	
7) Beauty	11.8	50.0	35.3	2.9	
8) Fabric used	32.4	41.2	23.5	2.9	
Trial-ability					
9)The ability to hold a baby to breastfeed	35.3	41.2	17.6	5.9	
10)Ease of carrying a baby	35.3	41.2	17.2	5.9	
11)Pain in the arm while holding the baby	35.3	29.4	23.5	11.8	
12)Tension in the wrist while holding the baby	20.6	44.1	26.5	8.8	
Observability					
13)Satisfaction with the use of the innovation for breastfeeding	32.4	38.2	23.5	5.9	
14)Feelings of Confidence in Breastfeeding	38.2	35.3	20.6	5.9	

273

274 Regarding the trial-ability, (44.1%) of mothers reported the breastfeeding arm sling

275 innovation helped to reduce tension in the wrist while holding the baby. Mothers

276 reported that they were satisfied with their ability to hold their baby to breastfeed

277 (41.2%) and ease of carrying baby (41.2%). Overall, (32.4%) of mothers felt very
278 satisfied with the use of breastfeeding arm sling innovation and (38.2%) reported
279 feeling confident in breastfeeding.

280 **Discussion**

281 The development of innovations model is a new concept in the nursing and
282 midwifery process for developing, improving, and adapting products or procedures to
283 significantly benefit outcomes [10]. Results of the present study show the clinical
284 usefulness of the breastfeeding arm sling innovation in supporting breastfeeding. The
285 findings from this current study showed that mothers and midwives reported the
286 effectiveness of breastfeeding between using a normal cross-cradle hold position and
287 using a cross-cradle hold position with breastfeeding arm sling innovation was
288 statistically significantly different in all-term supports ($t= 4.32$, $p <0.001$) included
289 holding the baby so that their face touched the mother's breast, their head and body
290 was in alignment with their mother's breast, mouth wide open, and more of the areola
291 was visible above the baby's top lip than below the lower lip. These findings are in
292 accordance with Rahim et al. study, who emphasised success of the breastfeeding
293 process depends on the accuracy of the position and attachment of the baby to the
294 mother's breast and the ability of the baby to suck [19].

295 For a good attachment and effective breastfeeding, the baby's body positioning and
296 latching technique are crucial [9]. Improper latch and inappropriate infant positioning
297 can cause nipple pain and trauma [20]. Results from this current study demonstrate
298 that the breastfeeding arm sling innovation helped mothers to breastfeed and
299 decreased the feeling of pain at the nipples while the baby was latched on and feeding.
300 This significant improvement in comfort helped to encourage continued breastfeeding.

301 The use of an innovative breastfeeding arm sling helped the mothers who participated
302 in this study to hold the baby's body without any slipping during breastfeeding so that
303 the baby's mouth and head were in a position in alignment with the nipple. Correct
304 positioning and attachment of newborns during breastfeeding was one of the
305 recommendations by Kent et al. [21], to help reduce nipple pain, increase the duration
306 of breastfeeding, and reduce breastfeeding problems.

307 Breastfeeding can be challenging for first-time mothers who have little experience of
308 breastfeeding and newborns who have not yet learned how to properly latch on to the
309 breast [11]. The current study's results show that the breastfeeding arm sling
310 innovation helped mothers feel less pain in the arm while holding the baby and sitting
311 to breastfeed continuously. The study's findings are consistent with previous research
312 demonstrating that innovations can address patient demands or help solve problems,
313 leading to better outcomes for patients [10]. The first-time mothers in this study valued
314 the breastfeeding arm sling innovation and felt very satisfied as it helped them feel
315 comfortable during breastfeeding. This may be due to the breastfeeding arm sling
316 innovation fitting the mother's arm to promote a correct position and enabling her to
317 touch the newborn baby's back so that she can hold her baby closer during
318 breastfeeding. Given the appropriate posture during breastfeeding, the breastfeeding
319 arm sling innovation is considered acceptable among first-time mothers, with most
320 mothers using it and reporting more confidence in breastfeeding.

321 The breastfeeding arm sling innovation was reported to have very satisfactory features
322 due to its non-slipping benefit. With the features of easy to use and disassemble,
323 however, this breastfeeding arm sling innovation required assistance to help mothers
324 apply the equipment, wrapping it around the baby in order to support the correct
325 position when the baby was breastfeeding. Self-application needs to be factored in

326 when considering the development of the breastfeeding arm sling innovation in the
327 future to help mothers breastfeed independently.

328 A strength of this study is that mothers were very willing to participate in the
329 study and this is also reflected in the high levels of satisfaction reported. Midwife
330 assessors had preparatory training to assist mothers who agreed to participate.
331 However, the assessors were known to the mothers, and this may have influenced
332 their views and experiences positively or negatively as continuity of care is beneficial
333 but may also have an impact on outcomes. The quasi-experimental study design
334 allowed the participants to be their own control group, but findings are self-reported
335 and must be viewed cautiously. The research study used a non-randomised design,
336 therefore, other confounding factors not controlled for may have influenced the
337 findings and therefore this limits the inference of the research results. Another
338 limitation concerning this study was that it was limited to only first-time mothers, which
339 makes it difficult to generalise the findings to other groups of childbearing women.
340 Since the breastfeeding arm sling innovation in the present study applies to term
341 newborn babies, future development would need to consider investigation as to
342 whether preterm and differences in the baby weights would achieve similar results as
343 reported in the present study.

344 **Conclusions**

345 The development of innovations model in nursing is a new concept in the
346 nursing process for developing, improving, or adapting products or procedures to
347 significantly benefit outcomes and respond directly to patient needs. The
348 breastfeeding arm sling breastfeeding innovation contributes to the effectiveness of
349 breastfeeding by assisting and supporting the mother and baby's position to

350 breastfeed more comfortably. In conclusion, this study provides emerging evidence
351 that the breastfeeding arm sling assisted first-time mothers to feel comfortable,
352 confident, and helped them to continue breastfeeding. However, further research is
353 required to confirm or refute these initial findings.

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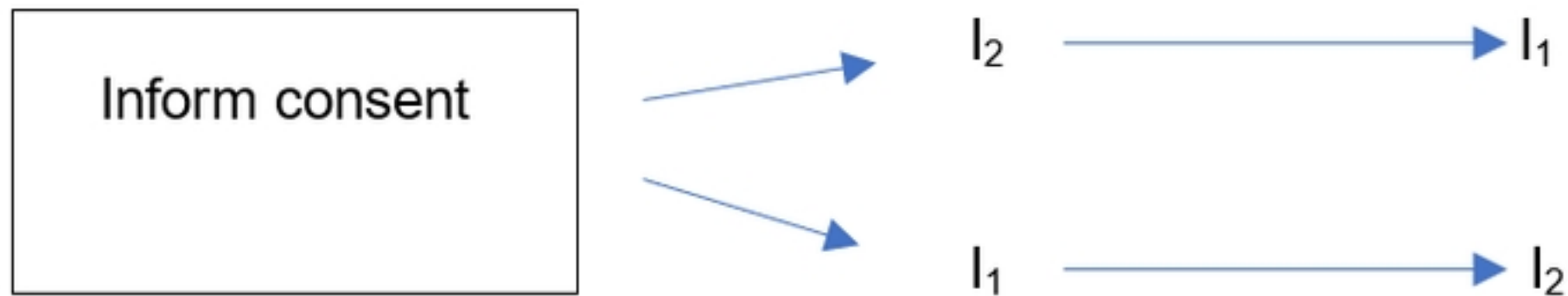
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I_1 = Normal cross-cradle hold position with a pillow

I_2 = Breastfeeding arm sling innovation with cross-cradle hold position

Figure

Design of breastfeeding arm sling innovation



Step 1: Wearing the sheath of the breastfeeding arm sling innovation and wrap the equipment around the baby



Step 2: When the baby is sucking, the midwives (research assistants) help the mother to adhere the equipment to itself for a firm hold



During using breastfeeding arm sling innovation



Figure