Bidirectional relationship between physical health symptoms and depressive symptoms in the pre- and postpartum period

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Abstract

Objective: to test the bidirectional relationships between physical health symptoms (PHS) and depressive symptoms (DS) as well as between the intensity of 'any pain' and DS in the pre- and postpartum period. **Method:** women (N = 615) completed the Edinburgh Postnatal Depression Scale, the Patients Health Questionnaire-15, and numerical pain rating scales when they were between 32 and 37 weeks of gestation, and subsequently one, three, and six months postpartum. We conducted two random intercept cross-lagged panel models (RI-CLPM). **Results:** both models presented excellent fits. The relationship between PHS and DS was bidirectional across all the data waves ($\chi^2(9) = 6.610$, $p = .678$, CFI = 1, TLI = 1, RMSEA = 0). The magnitude of the standardized cross-lagged regression coefficient was relatively similar from DS to PHS (raging between .081 and .171); and from PHS to DS (raging between .121 and .138). The relationship between 'any pain' intensity and DS was also bidirectional, but only during the postnatal period ($\chi^2(9) = 11.765$, $p = .227$, CFI = .99, TLI = .98, RMSEA = .022). The magnitude of the standardized cross-lagged regression coefficient was higher from DS to 'any pain' intensity (raging between .214 and .216); than from 'any pain' intensity to DS (raging between .092 and .097). **Conclusions:** concurrently intervening over physical and mental health symptoms could promote women´s perinatal health.

Keywords: Depression, Pain, physical health, Prospective Longitudinal Study, Postpartum, RI-CLPM.

Introduction

Postpartum health problems (including pain and depression) seem more common than previously thought and impact women´s quality of life in the long run [1]. During the prenatal and postnatal period, women experience a broad range of moderate to severe physical health symptoms—PHS [1]. 'Any pain' after childbirth (e.g. perineal pain, headaches, and pain related to abdominal incisions, the back, or nipples) is one of the most common postpartum PHS [2, 1]. In fact, after delivery numerous body areas – some of them even distal to the areas involved in delivery – can be affected by pain [1]. Some of these pains appear during pregnancy and are not necessarily due to the partum [1]. In many cases these pains persist and between 6.1% to 11.5% of the women giving birth develop postpartum chronic pain [3]. Furthermore, not only physical health but also mental health is affected during the pre- and postpartum period, with around 11.9 % of women experiencing postpartum depression [4].

According to previous research, PHS and depressive symptoms (DS) seem to be associated [5, 6]. However, few studies have examined these relationships in the context of childbirth and less so in longitudinal designs. Two studies have examined whether PHS predict DS [7, 8], one cross-sectionally at six weeks postpartum [7] and the other one longitudinally between three and six months after partum [8]. The findings of both studies indicated that PHS increases the odds of reporting DS. Two other studies have examined this relationship in the opposite direction, and have looked at whether DS predict PHS [9, 10]. Nicholson et al. [9] found that DS were associated with seven of eight medical outcomes in women with early pregnancy (including bodily pain). However, their study was cross-sectional and focused only on the prepartum period. Setse et al. [10] found that compared to women without DS, women who

were depressed in both the second and third trimester of pregnancy had statistically significant lower scores in health-related quality of life three days postpartum.

Taken together, the previous studies suggest that the relationship between PHS and DS may be bidirectional. Outside the childbirth context, the results of one study in which normal older and middle-aged adults participated supported this hypothesis [11]. Nonetheless, no study has tested these bidirectionally in the context of childbirth yet.

Regarding the specific relationship between pain and DS, three studies support this association in the context of childbirth [2, 12, 13]. Gaudet et al. [13] found that – compared with women without problematic perinatal pain – women reporting problematic perinatal pain had more chances to also present postpartum depression. Chang et al. [2] reported that the presence of perineal pain four to six weeks postpartum was associated with depression six months postpartum. Finally, Eisenach et al., [12] reported that severity of acute postpartum pain within 36 hours postpartum predicted depression eight weeks postpartum. In contrast, Jardri, Maron, Delion, and Thomas [14] found that pain intensity assessed between day three and five postpartum were not related to DS eight weeks postpartum [14]. To the best of our knowledge, only one study has examined the relationship in the opposite direction. Specifically, Lou and Kong [15] found that prenatal DS were associated with post-caesarean pain assessed 24, 48, and 72 hours after C-section.

Again, taken together, the evidence seems to suggest that the relationship between pain and DS could be bidirectional. Two studies have tested this relationship outside the context of childbirth [16, 17] among individuals with chronic pain. One of them supported this relationship [16], whereas the other did not [17]. The bidirectionality of the relationship between pain and depression have never been examined in the context of childbirth.

The first purpose of the present study was to test the bidirectional relation between PHS and DS during the pre- and postpartum period. We expected to find that the relationship between PHS and DS would be reciprocal. Secondly, we aimed to examine whether the relationship between the intensity of 'any pain' and DS was also bidirectional. We expected to find that this relationship would also be reciprocal. We analyzed four waves of data, starting four to eight weeks before delivery and ending six months postpartum.

Method

Participants and procedure

Pregnant women from four medical centers of a university health network in Santiago de Chile participated in the present study (N = 615). To be eligible, women had to be older than 18, at 32–37 weeks of gestation, able to understand the Spanish language, and have no previous chronic pain condition. The recruitment strategies included research assistants approaching potential participants directly while they were waiting to be attended by their physicians, as well as dissemination of information by health professionals and flyers placed in the waiting room. Before participation, we conducted an informed consent process, explaining all the research procedures to the women and that participation in the study was voluntary. We asked women who consented to participate to complete a battery of questionnaires, either in a face-to-face interview or via telephone, according to the participants´ preferences. We contacted them again by phone one, three, and six months after childbirth and asked them to complete a shorter battery of questionnaires, either by telephone or email. For each completed set of questionnaires, they received a gift card to spend at retails stores (10,000 Chilean pesos for the first interview and 5,000 for each follow-up interview, which correspond approximately to a value of US$14 and

US$7, respectively). The study protocol was approved by the ethical committee of the host university (protocol number 160826002).

As in most longitudinal research, we had some attrition over time that resulted in missing data (Figure 1). Of the 615 women that enrolled in the study before partum, we obtained data from 80% (n = 494), 83% (n = 513), and 79% (n = 483) of the participants, at one, three, and six months postpartum, respectively. The number of participants providing data at all waves was 66% (n = 407), and 84% (n = 516) which provided at least three waves of data. Missing data at the item level was very rare and, when present, we averaged over the available items. For our specific analysis, the matrix of variables had 13% of missing data. We computed an independent sample t-test and chi-squared test to identify differences in the demographics and the variables of interest for the study between participants who completed all the assessment and those who missed at least one evaluation. Participants who did not complete all the assessments had a slightly lower educational level and family income than those who did ($\chi^2(4) = 13.615$, p = .009; $\chi^2(6) = 15.34$, p = .02, respectively). No differences were observed in DS, PHS, and 'any pain' intensity.

Measures

Numerical pain intensity rating scales (18). In order to assess pain intensity, we asked for participants to evaluate their current, worst, minor, and average pain in the last week using four numerical rating scales (NRSs) ranging from 0 (no pain) to 10 (worst pain imaginable). We averaged the answers to each scale to obtain the final score in the intensity of 'any pain'.

Edinburgh Postnatal Depression Scale (EPDS) [19]. The EPDS has been validated in Chile during both the postpartum period [20] and pregnancy [21]. It comprises 10 items rated in a four-point scale ranging from zero to three. The global score on depression is obtained by adding the

items scores. A higher score indicates higher depressive symptoms. One advantage of this scale is that it does not evaluate somatic symptoms of depression, which are prevalent during pregnancy and postpartum. For the current sample Cronbach's α were .82, .83, .83, and .87 for the prenatal, and the one-, three-, and six-months postpartum assessments, respectively.

Patient Health Questionnaire-15 (PHQ-15) [22]. It comprises 15 items assessing the severity of somatic symptoms on a scale ranging from zero ('not bothered at all') to two ('bothered a lot'). A global score ranging from zero to thirty can be obtained with the sum of the items scores. The Spanish version showed acceptable internal reliability (Cronbach's α = .78) and adequate convergent, divergent, discriminant, and predictive validity [23]. For the current sample Cronbach's α were .70, .73, .75, and .79 for the prenatal, and the one-, three-, and six-months postpartum assessments.

In addition, all participants provided demographic and previous pregnancy history. Specifically, we recorded information about participants´ age, educational level, family income, health care system, number of previous children, and marital status. In the first measurement postpartum (one month after delivery), we recorded information about delivery (vaginal versus caesarean). Because socioeconomic status (SES) and type of health care insurance (public versus private) are strongly associated in Chile [24], type of health care insurance was used as a proxy for SES. In order to test for differences by educational level, multigroup analysis was run by level of education (high school or less versus university education).

Data Analytic Plan

In order to examine whether the relationship between DS and PHS was bidirectional, we fitted a random intercept cross-lagged panel model to the data (RI-CLPM) [25]. See R-Scripts for the analyses in Supplemental material 1. This model overcomes the limitation of the

155 traditional cross-lagged panel model (CLPM). Specifically, it separates the between-individual,
156 time-invariant components of each construct, from the within-individual time-varying
157 components, leaving the within-subject variation free from the time-invariant components.
158 Namely, while some women are likely to present time-invariant higher levels of DS, we were
159 especially interested in whether increasing within-person DS are associated with subsequent
160 change in PHS and vice versa (see Figure 2). The autoregressive parameters represent the within-
161 individual relationship of DS and PHS with their previous level, testing for the intra-individual
162 degree of stability for each construct. The cross-lagged regression parameters evaluate the extent
163 to which within-individual change in DS is associated with the women´s prior PHS, and the
164 extent to which within-women change in PHS are associated with DS in the previous time
165 period. For both DS and PHS, within-person changes over time were separated from stable
166 between-person differences by including random intercepts. Because the intervals between the
167 observations varied over time, we removed the constraint on the factor loadings, and therefore,
168 they do not represent random intercept but traits [25]. In order to test for the stability of the
169 autoregressive and cross-lagged effects, we tested the invariance of autoregressive and cross-
170 lagged parameters [25]. We also used multigroup analyses to test the invariance of the regression
171 parameters by educational level, type of health system, primiparous status, and type of delivery
172 (vaginal versus caesarean). In order to examine whether the relationship between DS and 'any'
173 pain intensity was bidirectional we conducted another RI-CLPM following the same procedure.
174 Models were fit using the lavaan library [26] in R [27] with robust standard errors
175 (estimator = 'mlr') and full information maximum likelihood (FIML). FIML allows for the use of
176 all data available, without the need to discard cases with missing data in the outcome variables
177 and is considered an efficient method to handle data that are missing at random [28].DS, and

178 'any' pain intensity were log-transformed prior to analysis because they were positively skewed.
179 We used a significance level of .01, but reported exact *p-values.*

180 **Results**

181 Sociodemographic characteristics and descriptive statistics of the major variables of the
182 study are shown in Table 1 and Table 2, respectively. The mean age of the sample was 30.9
183 years (*SD* = 5.3; range = 18–44). The proportion of vaginal delivery was slightly higher (53.4%)
184 than caesarean delivery. Our sample presented similar characteristics to the population of women
185 giving birth in the Metropolitan Region of Santiago (RM, Santiago, Chile), with the exception
186 that the participants of our study presented a higher educational level and were more frequently
187 reported to be married than the RM women´s population [29].

188 **Bidirectional relation between PHS and DS**

189 Model fit to the data was excellent; $\chi^2(9) = 6.61$, $p = .678$, CFI = 1, TLI = 1, RMSEA = 0.
190 The variances of both random intercepts were significantly different from 0 (0.370 and 0.181, for
191 depression and physical health, $p < .001$), suggesting the need to include these parameters in the
192 model, and thus providing evidence in favor for the RICLPM over the CLPM model. Parameter
193 invariance across time was tested for autoregressive and cross-lagged parameters. Except for the
194 autoregressive parameter for PHS from pre- to postpartum, all other parameters were invariant
195 over time ($\Delta\chi^2(\Delta 9) = 15.94$, $p = .068$). The parameters for the final model—with restricted
196 parameters— of DS and PHS are presented in Figure 2.

197 All autoregressive coefficients were significant, with the exception of the autoregressive
198 parameter relating the prepartum with the one-month postpartum PHS. Likewise, all cross-
199 lagged associations were significant from DS to PHS (unstandardized $b = 0.091$, $SE = 0.025$, $p <$
200 .001), and from PHS to DS (unstandardized $b = 0.245$, $SE = 0.065$, $p < .001$). There was no

significant association between DS and PHS at the prenatal assessment (r = -.004, SE = 0.017, p = .827). Finally, there was a significant association between the trait-like DS and PHS latent variables (cov = .139, SE = 0.017, p < .001), with a moderately high correlation (r = .62). Separate multi-group analysis showed no differences in autoregressive and cross-lagged parameters by educational level ($\Delta\chi^2(\Delta 24)$ =30.143, p = .180), type of health system ($\Delta\chi^2(\Delta 24)$ =32.984, p = .104), type of delivery ($\Delta\chi^2(\Delta 24)$ = 35.09, p = .067), or primiparous status ($\Delta\chi^2(\Delta 20)$ = 15.932, p = .720).

Because two items from the PHQ15 (i.e., having difficulties sleeping and feeling tired) overlap with symptoms of depression, we rerun the analysis using the scores of the remaining 13 items. The results were virtually identical to the results reported, both in the adjustment of the models and the significance and interpretation of the parameters.

Bidirectional relation between 'any pain' intensity and DS.

The model fit was excellent; $\chi^2(9)$ =11.765, p = .227, CFI = .99, TLI = .98, RMSEA = .022. The variances of both random intercepts were significantly different from 0 (0.368 and 0.119, for depression and pain intensity, p < .001), again supporting the RI-CLPM over the CLPM model. Similar to the previous model, except for the relationship of 'any pain' intensity between the two first waves of data, all autoregressive parameters were significant. The parameters for the final model—with restricted parameters— of DS and “any pain” intensity are presented in Figure 3.

During the postnatal period, all significant auto-regressive and cross-lagged parameters were invariant ($\Delta\chi^2(\Delta 8)$ =14.395, p =.072). Cross-lagged parameters from DS to 'any pain' intensity (unstandardized b = 0.251, SE = 0.050, p < .001) were significant, while cross-lagged parameters from 'any pain' intensity to DS were significant only after delivery (unstandardized b

224 = 0.105, SE = 0.041, p = .01). Finally, the correlation between the trait-like DS and 'any pain'
225 intensity latent variables was .31 (p < .001). Separate multi-group analysis showed no differences
226 in autoregressive and cross-lagged parameters by educational level ($\Delta\chi^2(\Delta 22)$ = 30.604, p =
227 .104), type of health system ($\Delta\chi^2(\Delta 22)$ = 21.434, p = .494), type of delivery ($\Delta\chi^2(\Delta 22)$ =23.553,
228 p = .371), or primiparous status ($\Delta\chi^2(\Delta 22)$ =26.792, p = .219).

229 Because the pain intensity index is a composite of diverse pain items (e.g., average,
230 worse, least and current pain), we rerun the analysis of pain intensity using each of the
231 components in order to test for the sensitivity of the results. Except for minor differences with
232 the *least pain* item, the results were consistent with those obtained for the whole scale (results
233 available upon request). We only report the results for the whole index because it is the most
234 widely used and most reliable index (18).

235 **Discussion/conclusions**

236 The present study aimed to test the bidirectional relationship between PHS (including
237 'any' pain intensity) and DS during the pre and postpartum period using RI-CLPM with four
238 longitudinal waves, starting four to eight weeks before delivery and ending six months
239 postpartum. As expected, the relationship between PHS and DS was bidirectional along all the
240 data waves. The relationship between 'any pain' intensity and DS was also reciprocal; but only
241 during the postpartum period.

242 Our results are in line with those found by Meeks et al. [11], who provided evidence for a
243 bidirectional relationship between PHS and DS among normal older and middle-aged adults. We
244 extend their findings to the context of childbirth, while using more rigorous data analyses
245 methods which are available nowadays (i.e. RI-CLPM). Our results also support Schaffir et al.´s
246 findings [7] who, in a cross-sectional study, found that postpartum PHS were associated with

increased odds of having depression. In addition, our findings back up the results found by Woolhouse et al. [8], which indicated that women reporting five or more health problems in the first three months postpartum presented a three-fold increase in likelihood of reporting subsequent DS at 6–12 months postpartum. Furthermore, our results are also consistent with previous findings showing an association between DS and PHS during pregnancy [9, 10], but extend these findings to the postpartum period. Moreover, unlike these studies, we examined the relationship between these two constructs in both directions. The magnitude of the standardized cross-lagged regression coefficient was relatively similar from DS to PHS and from PHS to DS.

PHS and DS were not related during the prenatal period. Nonetheless, the correlation of the trait-like variance of both constructs was significantly high, sharing around 40% of their variance (r^2 = .389). At the prenatal period, only the between-individual (trait-like) variance – and not the within-individual variance – of these constructs can be examined. This may be the reason why we found no association between both constructs prenatally. Studies including more than one prepartum assessment are needed to test whether the relationship between PHS and DS is bidirectional during pregnancy. On the other hand, prepartum PHS were not related to PHS assessed one month after delivery, suggesting that PHS substantially changed from the prenatal to the postnatal period, producing a relative discontinuity in the between women´s ranking of PHS. To examine the nature of these changes, we conducted a post hoc paired-sample t-test, whose results indicated that PHS significantly decreased from the prenatal to the one-month postpartum assessment (Mdiff = 2.23, t (491) = 11.40, p < .001). Therefore, as previously reported [30], women's physical health seems to improve after delivery, as their bodies start to return to normality.

Regarding the relationship between the intensity of 'any pain' and DS, our results are in line with those found by a longitudinal study conducted among chronic pain patients [16], in which pain intensity and depression affected each other over 12 months. However, they contrast with the findings of Lerman et al. [17], who reported that a latent depression/anxiety variable longitudinally predicted pain, but pain did not predict depression/anxiety among patients with chronic pain. However, one limitation of this study is that they used traditional CLPM, which has been criticized [25]. By using RI-CLPM we overcome this limitation. In addition, our results are in line with the findings of previous studies in which the presence of postpartum pain was associated with postpartum depression [2, 12,13]. However, they contrast with the position of Jardri et al. [14], who failed to find an association between pain intensity and postpartum DS. Nonetheless, these authors assessed pain intensity a few days after partum, whereas we assessed pain intensity one-, three-, and six-months postpartum, which may account for the discrepancies.

Unexpectedly, neither prepartum 'any pain' intensity predicted DS within-individual variability from the prepartum to the postpartum assessment, nor prepartum DS predicted 'any pain' intensity within-individual variability from the prepartum to the postpartum assessment. These results contrast with those found by Lou and Kong [15], who reported that prepartum DS were associated with post-caesarean pain assessed 24, 48, and 72 hours after C-section. Nonetheless, these differential findings may be due to the statistical procedures used to analyze data, as the RI-CLPM removed trait-like variability of both constructs. To our knowledge no studies until now had previously examined the relationship between prepartum pain and postpartum DS and, less so, between prepartum pain and within-individual changes in DS. Other reasons why our results may differ from those found in this previous study are that in our study

291 the time frame for postpartum assessments was longer and that we included both women who
292 give birth vaginally and women undergoing caesarean section.

293 The correlation of the trait-like variance of 'any' pain intensity and DS was small, with
294 both constructs sharing 11% variance (r^2 = .11). As in the case of PHS, 'any pain' intensity and
295 DS were not related during the prepartum period, which may be due to the fact that at the
296 prepartum period, only the between-individual (trait-like) variance – and not the within-
297 individual variance – of these constructs can be examined. Furthermore, as in the case of PHS,
298 prepartum 'any pain' intensity was not related to 'any pain' intensity assessed one month after
299 delivery, suggesting that pain intensity substantially changed from the prepartum to the
300 postpartum period. In fact, the results of a post hoc paired-sample t-test showed that, 'any pain'
301 intensity decreased after delivery (Mdiff = 1.39, t (490) = 13.06, p < .001).

302 Finally, our results seem to indicate that women´s PHS change moderately during the
303 postpartum and tend to stabilize over time, as suggested by the increase in autoregressive
304 coefficients over time. In contrast, DS and pain intensity show low stability along the postpartum
305 period. To our knowledge, this is the first study in which intraindividual variations in physical
306 and mental health are examined in the context of childbirth, while controlling for between-
307 individual differences.

308 There are multiple pathways by which DS could impact physical health. For example, DS
309 have been related to oxidative stress, inflammation, an unhealthy, and physical inactivity
310 lifestyle (31). DS have also correlated with adherence to drug prescriptions among patients with
311 several medical conditions [32]. As Pariante [33] states, 'depression, and mental health problems
312 in general, can no longer be seen only as a disorder of the mind, or indeed only as a disorder of
313 the brain' (p. 557). The strong impact of the immune system on emotions and behaviors

demonstrates that mental health is the health of the whole body. On the other hand, PHS could lead to DS by multiple pathways, including physical inactivity [34]. For example, PHS can inhibit a healthy diet and exercise plan [35], leading to weight gain, which in turn could lead to DS [37]. Despite this, the specific pathway linking postpartum DS and postpartum PHS remains to be studied.

Our findings suggest that in order to foster a better postpartum it is important that health professionals pay attention to both physical and mental health symptoms and offer an integral healthcare approach as both types of symptoms mutually influence each other. When physicians address DS they must take care to validate PHS and not attribute them to emotional conflicts, thus avoiding giving patients a wrong message that minimizes or invalidates their physical discomfort. Explaining to the patients the reciprocal relationship between DS and PHS and the rationale to address both types of symptoms simultaneously is important in order to promote mutual understanding, patients' adherence to prescriptions, and to prevent attitudinal barriers to mental health treatments [38].

The present study has some limitations. First, we used self-reported measures to assess PHS and research methodologies would be strengthened by the inclusion of objective health measures. Second, one limitation of the PHQ-15 is that it does not included upper respiratory tract symptoms (e.g., running nose, cough) and therefore, our conclusions cannot be extrapolated to these physical health symptoms [22]. Nonetheless, respiratory symptoms are not common in the postpartum period. Third, we assessed the intensity of 'any pain' perceived during the last week, therefore the pains referred to by participants may correspond to different kinds of pain and might not necessarily be related to pregnancy. To better understand the impact of pain on mental health during pregnancy and after delivery it would be beneficial to examine in more

337 detail the location and length of perceived pains. Fourth, we examined the relationship between
338 DS and PHS during the first six months postpartum. Future studies could examine this
339 relationship after longer follow-up periods. Fourth, risks factors for pain and disability (e.g. job
340 dissatisfaction, substance abuse, marital dissatisfaction, trauma exposure, or pre-existing mental
341 health diagnoses) were not controlled for in this study which could have affected our results.
342 Furthermore, some important aspects related to pain other than pain intensity (for example, pain
343 catastrophizing, pain disability, or pain coping) were not considered. Future studies should
344 examine the relationship between DS and these constructs, as there may be a stronger
345 relationship between them. Fifth, this study was conducted with a sample with higher
346 educational levels than the population of women giving birth in the RM of Santiago. It is
347 possible that the relationship between DS and PHS is stronger among more vulnerable samples.
348 Our study needs to be replicated in different populations to discover whether the results are the
349 same. Sixth, the measurement of the outcomes considered in this study were taken several
350 months apart. Individual variation in these outcomes may happen within days and, therefore,
351 individual changes occurring within the time interval between the measurements may have not
352 been observed. Future longitudinal studies using more frequent assessment (e.g., daily) need to
353 be conducted. Seventh, even though no significant differences were found on studied variables
354 between those participants who completed all measures and those who missed one or more
355 assessments, we did find differences on socioeconomic variables. The main reason for missing
356 follow-up evaluations was inability to contact the participants (by phone or email). It is possible
357 that participants from lower socioeconomic levels had less access to a personal mobile phone,
358 which was not considered as an inclusion criterion for the study. On the other hand, it is also
359 possible that these participants change their contact method in a higher proportion. Future

longitudinal designs would benefit from adding additional contact methods as could be network contacts [39]. Given the fact that variables included in the study are probably related to the missing data mechanism, we feel confident that the missing at random assumption (MAR) underlying the methods we used to handle missing data is reasonable. Finally, conducting a second order multi item model including a measurement model for the repeated measurements of each construct would have been desirable in order to control for measurement error. Nonetheless, due to the high number of items of the questionnaires we used in the present research this was not possible and, therefore, the estimates of the RI-CLPM parameters may have been underestimated".

Despites these limitations, this is the first study tackling the bidirectionality of the relationship between PHS (including 'any pain' intensity) and DS in the context of childbirth. Furthermore, we analyze four waves of data using RI-CLPMs, which has been strongly recommended in order to avoid erroneous conclusions regarding the presence, predominance, and sign of causal influences [25]. This statistical procedure has recently started to be popularized, and to our knowledge, none of the studies conducted until now have examined the relationship between DS and PHS (or pain) using this novel method of analysis. Finally, several covariates were controlled for, specifically, the health system, type of delivery, and primiparous status; and presenting chronic pain before pregnancy was an exclusion criterion for participation. In summary, PHS (including the intensity of 'any pain') and DS mutually influence each other during the pre- and postpartum period. Concurrently intervening over physical and mental health symptoms could promote women´s perinatal health.

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561 Table 1

562 *Sociodemographic characteristics (N = 615)*

Variables	N	%
Marital status (n = 612)		
Married	214	35.0
Unmarried	398	65.0
Parity (n = 613)		
Nulliparous	325	53.0
Uniparous	205	33.4
Multiparous	83	13.5
Educational level (n = 613)		
Primary education	10	1.6
Secondary education	67	10.9
Technical	153	25.0
University	317	51.7

Postgraduate	66	10.8
Family income[a] (n = 610)		
≤ 800,000	159	26.1
800,001 – 1,700,000	268	43.9
≥1,700,001	183	30.0

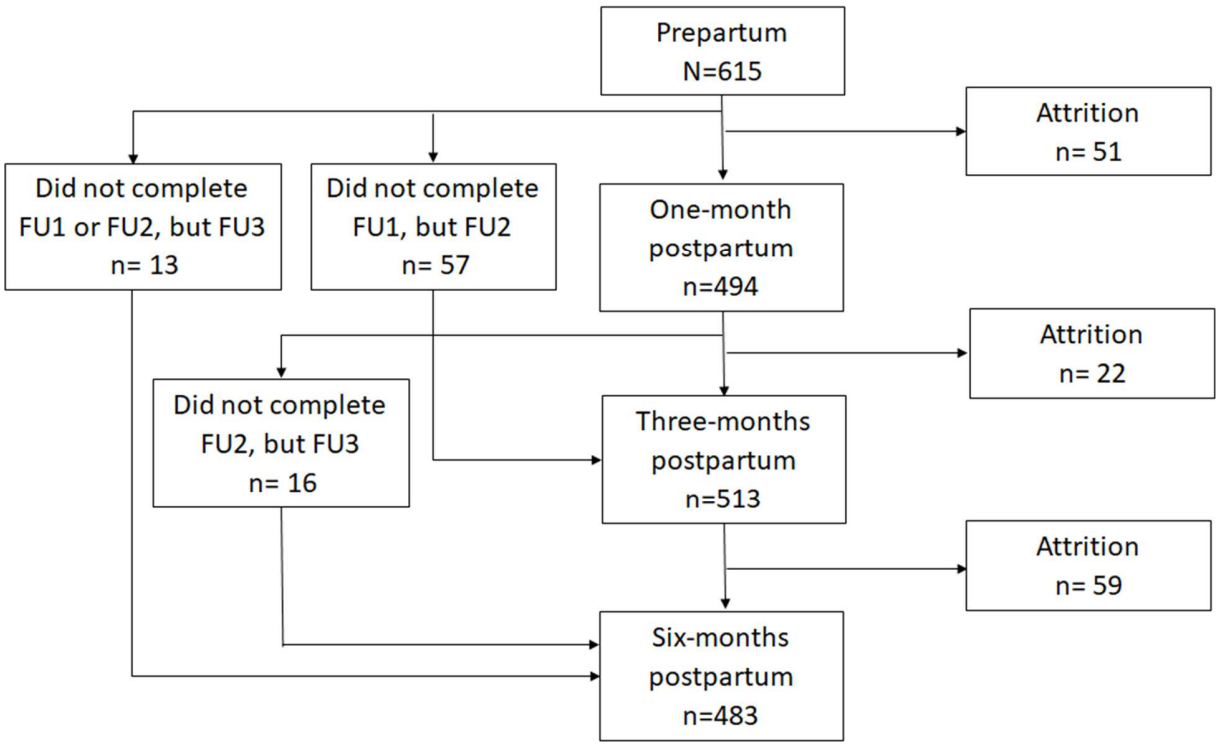
Notes. [a] Measured in Chilean pesos (one United States dollar = 729 approximately Chilean pesos).

Table 2

Means, standard deviations, and ranges of physical health symptoms (PHS), depressive symptoms (DS), and 'any pain' intensity (PI) four to eight weeks before delivery, and one-, three-, and six-months postpartum.

	Four-eight weeks before delivery	One-month postpartum	Three-months postpartum	Six-months postpartum
	(*N* = 614)	(*N* = 494)	(*N* = 513)	(*N* = 483)
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Variable				
PHS	9.8(4.1)	7.7(4)	6.8(4.2)	6.8(4.5)
DS	5.9(4.5)	5.8(4.6)	5.4(4.9)	5.6(5.3)
PI	3.5(1.7)	2.1(1.9)	2.0(1.9)	2.2(2.1)

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



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583 Figure 1 A flow diagram shows enrollment, attrition and drop-out to specific assessments.

584 Abbreviations: FU= follow up.

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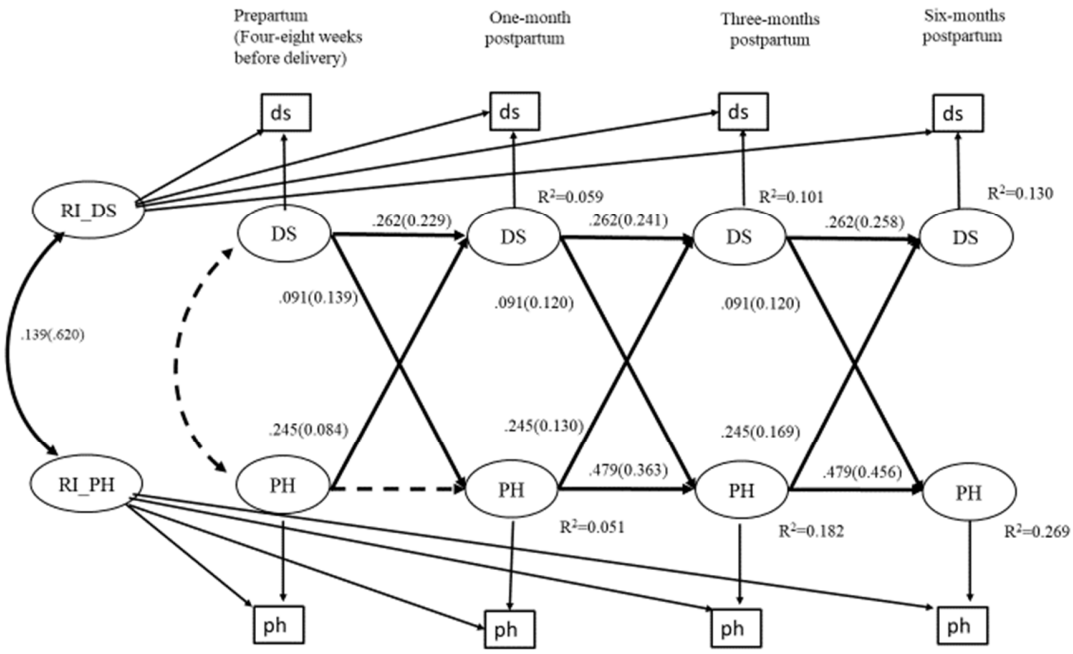
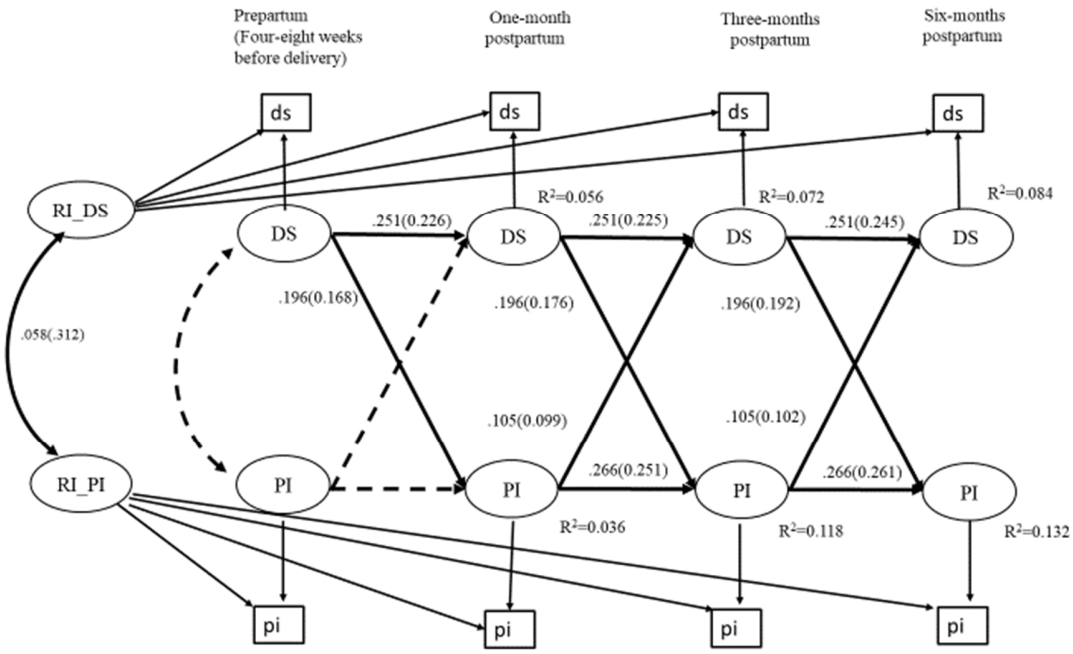


Figure 2. Random intercept cross-lagged model of physical health symptoms and depressive symptoms. ds= observed depression, DS= within-person centered depression, ph= observed physical symptoms, PH= within-person centered physical symptoms, RI_DS= random intercept of depressive symptoms, RI_PH= random intercept of physical symptoms. We present coefficients from the model with parameter restrictions, standardized coefficients in parenthesis. Dashed lines indicate paths with non-significant coefficients. All coefficients shown are significant $p < .001$.



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610 Figure 3. Random intercept cross-lagged model of 'any pain' intensity and depressive
611 symptoms. ds= observed depression, DS= within-person centered depression, pi= observed pain
612 intensity, PI= within-person centered pain intensity symptoms, RI_DS= random intercept of
613 depressive symptoms, RI_PI= random intercept of pain intensity. We present coefficients from
614 the model with parameter restrictions, standardized coefficients in parenthesis. Dashed lines
615 paths with non-significant coefficients. All coefficients shown are significant $p < .01$.