A matched cohort study of postpartum placentophagy in women with a history of mood disorders: no evidence for impact on mood, energy, vitamin B12 levels, or lactation

Authors: Emily Morris,[a,b] Caitlin Slomp,[b] Catriona Hippman,[b] Angela Inglis MSc,[a,b] Prescilla Carrion,[b] Rolan Batallones,[b] Heather Andrighetti,[b] Jehannine Austin[a,b].

[a]Department of Medical Genetics, University of British Columbia, C234 - 4500 Oak Street Vancouver, BC, Canada

[b]Department of Psychiatry, University of British Columbia, Rm, 938 W28th Ave, Vancouver, BC, Canada

Corresponding author:

Jehannine Austin

UBC Departments of Psychiatry and Medical Genetics

Rm A3-127, 3rd Floor, Translational Lab Building,

938 W28th Ave,

Vancouver, BC V5Z 4H4, Canada

Tel.: +1 604 875 2000x5943

fax: +1 604 875 3871

e-mail: jehannine.austin@ubc.ca

Dr. Austin reports grants and personal fees from CIHR, grants and personal fees from Michael Smith Foundation, personal fees from Canada Research Chair, personal fees and non-financial support from BC Mental Health & Substance Use Services, non-financial support from BC Women's Health Research Institute, during the conduct of the study; grants from Pfizer Canada, outside the submitted work.

All other authors: Declarations of interest: none.

Abstract

Objective: Though empirical studies investigating its effects are scarce, postpartum placentophagy is increasing in popularity due to purported benefits for mood, energy, lactation, and overall nutrition. Therefore, we sought to test the hypotheses that women who consumed their placenta (placentophagy exposed, PE) would have: 1) less depressive symptoms, 2) more energy, 3) higher B12 levels, and 4) less pharmaceutical lactation support during the postpartum than women who did not consume their placenta (non placentophagy exposed, NE).
Methods: Using data from a large, longitudinal study of gene x environment effects involving perinatal women with a history of mood disorders, we identified PE cohort and matched them 4:1 (by: psychiatric diagnosis, psychotropic medication use, supplementation, income, and age) with an NE cohort from the same dataset. We investigated differences between PE and NE cohorts with respect to: scores on the Edinburgh Postnatal Depression Scale (EPDS) and Sleep-Wake Activity Inventory (SWAI), B12 levels, and use of pharmaceutical lactation support (Canadian Taskforce Classification II-2).
Results: Our sample of 138 (28 in PE cohort, matched to 110 in NE cohort) provided 80% power at $\alpha = 0.0125$ to detect an effect of moderate magnitude (which can be used to approximate an effect of clinically significant magnitude). There were no differences in EPDS or SWAI scores ($p=.28$, and $p=.39$, respectively), B12 levels ($p=.68$), or domperidone use ($p=1$) between PE and NE cohorts.
Conclusion: These data provide no support for the idea that postpartum placentophagy improves mood, energy, lactation, or plasma B12 levels in women with a history of mood disorders.

Keywords: placentophagy, placenta, postpartum depression, lactation, postpartum energy, vitamin B12

Introduction

Recent media coverage of celebrities engaging in postpartum placentophagy [1] has been accompanied by increasing popularity of the practice in the broader population [2-4]. Rationale for the practice is typically based on anecdotal reports of benefits derived from the hormones and nutrients contained in the placenta [5-10]. Though consumption of placenta (frozen/dehydrated, ground and encapsulated, or ingested in a less processed form, e.g. cooked [11]) is often cited as beneficial to women's mood, energy, general nutrition, and lactation, empirical studies regarding human placentophagy and any of these outcomes are scarce and limited [12-14]. As placentophagy is not without significant (potentially life-threatening) risks [9,15], data are needed regarding its potential benefits, in order to provide evidence-based guidance regarding this practice.

The purpose of this study was to empirically investigate the effect of postpartum placentophagy on maternal mood, energy, micronutrients, and lactation. Because women engage in placentophagy due to its purported beneficial effects on these outcomes [3], we aimed to test the hypotheses that in the postpartum, women who consumed their placenta (placentophagy exposed, PE) would have: 1) less depressive symptoms, 2) more energy, 3) higher plasma B12 levels, and 4) less pharmaceutical lactation support, than a matched cohort of women who did not consume their placenta (non placentophagy-exposed, NE).

Materials & Methods

We conducted a matched retrospective cohort study through secondary analysis of data collected in the context of a Canadian prospective longitudinal study on perinatal psychopathology in women (N=365) with a history of a psychiatric disorder (recruitment described elsewhere [16]). The prospective longitudinal study from which data were drawn for

this investigation was observational in nature; no experimental interventions were provided to participants.

After providing informed consent, each participant completed demographic questionnaires at enrolment (during pregnancy), and past history of a psychiatric diagnosis was confirmed with the Structured Clinical Interview for the DSM IV [17]; women did not need to be currently experiencing a perinatal mood episode to enrol in the study. At each of three postpartum time-points (1-2 weeks postpartum, 1-2 months postpartum, and 3-4 months postpartum), we administered instruments to measure depression and energy (see *Outcome Measures*), and participants were explicitly asked to report all medications and vitamins/supplements taken, including consumption of placenta in any form (encapsulated or non-encapsulated (e.g., consumed as a food)). Rather than seeking to influence participants' activities with regard to use of supplements (including placenta) or medications (e.g. domperidone), we simply recorded each woman's reported practice. Blood was drawn at each visit, after which plasma was separated from red blood cells by centrifugation, and frozen at -70°C for later analysis of B12. The study was approved by the University of British Columbia Research Ethics Board (H06-70145).

Inclusion criteria and cohort matching

We extracted data related to all pregnancies where: women had consumed their placenta after delivery, and we had data from at least one study time-point after initiation of placentophagy (PE cohort). To increase power, given the limited number of women in the PE cohort, we attempted to match each participant in the PE cohort with four NE women – this allows control for variables that are known to be correlated with the outcomes, but that are not of direct interest to the study [18]. We matched our cohorts according to psychiatric diagnosis

and postpartum psychotropic medication use (i.e. taking a daily anti-depressant or mood stabilizer), age, income level, and consumption of a postpartum multivitamin and B12 supplement (see Table 1). More specifically, women in the PE cohort were categorized according to whether they used psychotropic medication and B12 supplements *after* they had initiated placentophagy. NE women were categorized according to whether they used psychotropic medications and B12 supplements *after* the postpartum time-point at which their index PE woman initiated placentophagy. Women were included in the NE cohort only if outcome data (described below) were available for at least one study time-point after their index PE woman had initiated placentophagy.

Outcome Measures

Depression symptoms: Edinburgh Postnatal Depression Scale (EPDS)

The EPDS is a 10-item, self-administered, Likert scale-based questionnaire (each item is rated by selecting from 4 options, scored from 0 to 3) that has been validated for prenatal use [19]. Total scores range from 0 to 30, with higher scores indicating higher levels of depression. To test the hypothesis that PE women would have less depressive symptoms than NE women, we used highest postpartum EPDS score after initiation of placentophagy as our outcome variable for PE women. For NE women, we used the highest postpartum EPDS score after their index PE woman initiated placentophagy. This strategy allowed for potential differences in timing of emergence of most severe symptomatology.

Energy: Excessive daytime sleepiness subscale of the Sleep-Wake Activity Inventory (SWAI)

The SWAI is a self-report measure of sleepiness, with a validated 9-item excessive daytime sleepiness subscale [20] that we used in this study. Each item is scored on a Likert scale (1=always to 9=never). Scores on the excessive daytime sleepiness subscale range from 9 to 81,

and lower scores indicate lower energy (i.e., a higher degree of daytime sleepiness). To test the hypothesis that PE women would have more energy than NE women, we used the lowest postpartum SWAI subscale score after initiation of placentophagy as our outcome variable for PE women. For NE women we used the lowest postpartum SWAI subscale score after their index PE woman initiated placentophagy. This strategy allowed for differences in timing of emergence of the most severe symptoms.

Plasma vitamin B12

Plasma vitamin B12 (a nutrient present in abundance in the placenta, and that should therefore present in women's plasma after placentophagy) was quantified using chemiluminescent immunoanalysis, (using Abbott architect i1000, as described elsewhere [21]. To test the hypothesis that PE women would have higher plasma B12 levels (continuous variable) than NE women, we used lowest postpartum B12 measure after initiation of placentophagy as our outcome variable for PE women. For NE women we used the lowest postpartum B12 measure after their index PE woman initiated placentophagy. This strategy allowed for differences in timing of fluctuation of B12 levels.

Lactation: Use of Domperidone

Domperidone is thought to enhance milk production, and is often used off-label for this purpose in Canada, despite limited data supporting its efficacy and some safety concerns [22-24]. To test the hypothesis that PE women would use less pharmaceutical lactation support than NE women, we categorized women according to whether they took domperidone for the

168 indication of poor milk production at any time in the postpartum after initiation of
169 placentophagy (or, for the NE cohort, after their index PE woman initiated placentophagy).
170
171 ***Analyses/power***
172 Descriptive statistics were applied to demographic data. Data distributions of the highest
173 EPDS scores, lowest SWAI excessive daytime sleepiness subscale scores, and lowest plasma
174 B12 levels were assessed for normality using Shapiro Wilk tests. Mann-Whitney U tests were
175 used for comparisons, as data were not normally distributed. We applied Fisher's Exact test to
176 compare rates of domperidone use between PE and NE cohorts.
177 There were no pre-existing data from which to estimate the size of the effect of
178 placentophagy on the outcomes of interest, and therefore no data on which to base a power
179 calculation. We therefore conducted a compromise calculation (using G*power) to determine
180 the power of our available dataset to detect an effect of moderate magnitude (which can be used
181 to approximate an effect of clinically significant magnitude [25]). A significance threshold (α)
182 of $p < 0.0125$ was applied (to allow for four tests at a nominal overall significance level of
183 0.05). Common language (CL) effect sizes were calculated when applicable with values of 0.56,
184 0.64, 0.72 corresponding to small, moderate and large effect sizes, respectively [26]. All
185 analyses were performed using IBM SPSS Statistics version 24 (IBM Corp. Armonk, N.Y).
186 **Results**
187 We found that 28 of the 365 women in the larger study met inclusion criteria for our PE
188 cohort (27 used encapsulated placenta, the other ingested it raw and blended), and matched them
189 (according to the process described above) to an NE cohort of n=110 (we successfully made
190 four NE matches each for 26 of the PE cohort, and made three NE matches each for the

remaining two). One of the PE cohort did not complete the SWAI and was therefore excluded from the analysis of energy levels (along with her NE matches). One of the PE cohort could not be matched for B12 supplement use (due to the use of additional B12 supplements), and was thus excluded from the analysis of plasma B12 levels. Demographic data are displayed in Table 1. Our dataset afforded 77% power to detect an effect of d=0.65.

<<Insert Table 1 about here>>

Of the 28 women in the PE cohort, the majority (n=21) commenced consumption of their placenta prior to the 1-2 weeks postpartum time-point, with the remaining seven initiating prior to the 1-2 month time-point.

Effect of placentophagy on depression symptoms

Highest postpartum EPDS scores for PE and NE cohorts are shown in Figure 1. There were no significant differences in highest postpartum EPDS scores between cohorts (p=0.282, CL effect size=0.57).

<<Insert Figure 1 about here>>

Effect of placentophagy on energy

Lowest SWAI scores for the two cohorts are shown in Figure 2. There were no significant differences in lowest postpartum SWAI scores between cohorts (p=0.389, CL effect size=0.55).

<<Insert Figure 2 about here>>

Effect of placentophagy on plasma vitamin B12 levels

Lowest postpartum plasma vitamin B12 levels for the two cohorts are shown in Figure 3. There were no significant differences in lowest postpartum plasma vitamin B12 between cohorts ($p=0.685$, CL effect size=0.53).

<<Insert Figure 3 about here>>

Effect of placentophagy on lactation

A small proportion of women used domperidone in the postpartum (total n=21), and the proportion of women who used it was identical between cohorts ($p=1.0$, see Table 1).

Discussion

This is the largest study to date – of which we are aware - to examine the effect of postpartum placentophagy on mood and energy, and the first to use objective measures to examine the effects of placentophagy on plasma vitamin B12 and lactation. We identified no significant differences in depression symptomatology, energy levels, plasma vitamin B12 levels (a nutrient that should be abundant in placenta) or the use of pharmaceutical lactation supplements (domperidone) between matched cohorts of women who did and did not engage in postpartum placentophagy – all of whom had a history of a mood disorder.

In a previous study, the most commonly reported motivation for women to engage in postpartum placentophagy was to improve mood [3]. However, our data show that among

237 women with the greatest need for an intervention to improve postpartum mood (due to increased
238 risks for postpartum episodes associated with a history of a mood disorder [27,28]), there was
239 no significant difference in postpartum mood symptoms between women who consumed their
240 placenta, and those who did not. Similarly, we found no differences between the cohorts in
241 terms of energy levels.

242 These results are broadly in line with the little previous data that exists on this topic. One
243 small, randomized, placebo-controlled pilot trial investigated depression symptomatology (also
244 using the EPDS) and fatigue in 12 women who consumed their placenta, and 18 controls, and
245 also found no robust differences between groups [13]. In the current study, the differences
246 between groups were not statistically significant, and effect sizes were small (with the direction
247 of the effects in the opposite direction to that hypothesized (i.e. women in the PE cohort had
248 more depressive symptoms (higher EPDS scores) and lower energy (lower SWAI scores))

249 Similarly, our data showing no effect of placentophagy on B12 levels are concordant
250 with findings related to other micronutrients that are primarily obtained through animal products
251 (and are thus likely to be present in the placenta): specifically, one study showed no effect of
252 placentophagy on iron [12]. Ceiling effects are possible, given that most women were also
253 taking a multivitamin, though this is not evident from the data (Figure 3).

254 While women in previous studies have self-reported that placentophagy increases milk
255 production [3, 11, 14], we found identical rates of use of domperidone (commonly prescribed in
256 Canada to improve lactation in women with poor milk production). Given that the PE cohort
257 may be enriched for those who eschew pharmaceutical interventions [3,5], our data may
258 underestimate the need for lactation support in this cohort.
259

Conclusion

Our data provide no evidence to support the idea that placentophagy improves mood, energy, plasma vitamin B12, or lactation in the postpartum period – at least in women with a history of depression. Given concerns about serious and life-threatening risks that have been associated with placentophagy, these data can help inform risk-benefit discussions of placentophagy.

Limitations

Our study consisted of a cohort of women with a history of mood disorders and as such, our data may not be generalizable to populations of postpartum women who do not have a past history of mental illness. Though the study was adequately powered to detect effects of moderate to large magnitude, the observed effect sizes of placentophagy on the outcomes of interest were small/very small, suggesting that any difference that may be attributed to placentophagy is too small to be clinically meaningful. However, to guide future studies on the outcomes of postpartum placentophagy, our data indicate that sample sizes of N=620 for EPDS and SWAI, and N=2476 for B12, would be required for studies to have 80% power to detect effects of the size observed in this study. We could not conduct a power calculation for lactation as the rates of domperidone use were identical between cohorts.

Although adequately-powered randomized, double-blind, placebo-controlled trials represent the gold standard, our study utilized a matching technique (including matching for demographic, psychiatric, and vitamin supplementation/medication use) that aims to mitigate many of the confounding factors that would otherwise impact hypothesis interpretation. Further, the data were collected in the context of a larger study in which the collection of data about placentophagy was incidental; this serves to minimize the potential for participant bias

283 influencing our self-reported outcome measures. All but one woman in the current study
284 ingested encapsulated placenta. It is possible that the mechanism of delivery matters, and
285 perhaps different outcomes could be observed with cohorts using less processed forms of
286 placenta or a standardized method of encapsulation, but, in this study, the datapoints from the
287 one woman who consumed her placenta raw were not outliers. We did not record data regarding
288 women's motivation(s) for placentophagy in our study, and did not match for variables other
289 than those listed above. Most women were also taking a daily multivitamin, raising the
290 possibility that the effect of placentophagy on B12 levels could be masked; however women are
291 advised to take vitamin supplements during the postpartum, [29] so our data actually provide
292 insight into the effect of placentophagy in a naturalistic context.

293 As domperidone is not routinely used by all women with lactation problems, often due to
294 its safety and efficacy concerns, we may underestimate the number of women with lactation
295 problems in our study.

296

297

298

299

300

301

302

Acknowledgements

The authors thank Arianne Albert from the BC Women's Health Research Institute for her help with the statistical analyses. The authors thank Roger Dyer and Janette King from the BC Children's Hospital Research Institute for the B12 analyses, and the Translational Psychiatric Genetics Group (TPGG) for their varied contributions, and the team's volunteers. The study was funded by the Canadian Institute of Health Research (CIHR). JA was supported by the Canada Research Chairs Program, and BC Mental Health and Substance Use Services.

326

327

328

329

330 **References**

331 [1]Jackson D. Khloe Kardashian wants to eat her placenta: 5 other stars who have. 2018 Feb
332 26,:online.

333 [2]Cremers GE, Low KG. Attitudes toward placentophagy: a brief report. Health Care Women
334 Int 2014 February 01;35(2):113-119.

335 [3]Selander J, Cantor A, Young SM, Benyshek DC. Human maternal placentophagy: a survey
336 of self-reported motivations and experiences associated with placenta consumption. Ecol Food
337 Nutr 2013;52(2):93-115.

338 [4]Beacock M. Does eating placenta offer postpartum health benefits? British Journal of
339 Midwifery 2012;20(7):464-469.

340 [5]Farr A, Chervenak FA, McCullough LB, Baergen RN, Grunebaum A. Human placentophagy:
341 a review. Am J Obstet Gynecol 2017 August 30.

342 [6]Young SM, Benyshek DC. In search of human placentophagy: a cross-cultural survey of
343 human placenta consumption, disposal practices, and cultural beliefs. Ecol Food Nutr 2010
344 December 01;49(6):467-484.

345 [7]Young SM, Gryder LK, David WB, Teng Y, Gerstenberger S, Benyshek DC. Human
346 placenta processed for encapsulation contains modest concentrations of 14 trace minerals and
347 elements. Nutr Res 2016 August 01;36(8):872-878.

348 [8]Young SM, Gryder LK, Cross C, Zava D, Kimball DW, Benyshek DC. Effects of
349 placentophagy on maternal salivary hormones: A pilot trial, part 1. Women Birth 2017
350 November 23.

351 [9]Coyle CW, Hulse KE, Wisner KL, Driscoll KE, Clark CT. Placentophagy: therapeutic
352 miracle or myth? Archives of Women's Mental Health 2015;18(5):673-680.

353 [10]Young SM, Gryder LK, Zava D, Kimball DW, Benyshek DC. Presence and concentration
354 of 17 hormones in human placenta processed for encapsulation and consumption. Placenta 2016
355 July 01;43:86-89.

[11]Enning C editor. Placenta: The Gift of Life. : Motherbaby Press; 2011.

[12]Gryder LK, Young SM, Zava D, Norris W, Cross CL, Benyshek DC. Effects of Human Maternal Placentophagy on Maternal Postpartum Iron Status: A Randomized, Double-Blind, Placebo-Controlled Pilot Study. J Midwifery Womens Health 2017 Jan;62(1):68-79.

[13]Young SM, Gryder LK, Cross C, Zava D, Kimball DW, Benyshek DC. Placentophagy's effects on mood, bonding, and fatigue: A pilot trial, part 2. Women Birth 2017 November 23.

[14]Soykov-Pachnerova E, Bruta V, Golova B, Zvolska E. Placenta as a lactagogon. Gynaecologia 1954 Dec;138(6):617-627.

[15]Buser GL, Mato S, Zhang AY, Metcalf BJ, Beall B, Thomas AR. Notes from the Field: Late-Onset Infant Group B Streptococcus Infection Associated with Maternal Consumption of Capsules Containing Dehydrated Placenta - Oregon, 2016. MMWR Morb Mortal Wkly Rep 2017 Jun 30;66(25):677-678.

[16]Yaremco E, Inglis A, Innis SM, Hippman C, Carrion P, Lamers Y, et al. Red blood cell folate levels in pregnant women with a history of mood disorders: a case series. Birth Defects Res A Clin Mol Teratol 2013 June 01;97(6):416-420.

[17]First, MB, Spitzer, RL, Gibbon ,M, Williams, JBW. Structured clinical interview for DSM-IV Axis I Disorders- Clinician Version (SCID-CV). American Psychiatric Press 1997.

[18]Stuart EA. Matching methods for causal inference: A review and a look forward. Stat Sci 2010 Feb 1;25(1):1-21.

[19]Murray D, Cox JL. Screening for depression during pregnancy with the edinburgh depression scale (EDDS). Journal of Reproductive and Infant Psychology 1990;8(2):99-107.

[20]Rosenthal L, Roehrs TA, Roth T. The Sleep-Wake Activity Inventory: a self-report measure of daytime sleepiness. Biol Psychiatry 1993 Dec 1;34(11):810-820.

[21]Rukhsana J, Perrotta PL, Okorodudu AO, Petersen JR, Mohammad AA. Fit-for-purpose evaluation of architect i1000SR immunoassay analyzer. Clin Chim Acta 2010 Jun 3;411(11-12):798-801.

[22]Osadchy A, Moretti ME, Koren G. Effect of Domperidone on Insufficient Lactation in Puerperal Women: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Obstetrics and Gynecology International 2011;2012:642893.

[23]Paul C, Zenut M, Dorut A, Coudore MA, Vein J, Cardot JM, et al. Use of domperidone as a galactagogue drug: a systematic review of the benefit-risk ratio. J Hum Lact 2015 Feb;31(1):57-63.

[24]Sewell CA, Chang CY, Chehab MM, Nguyen CP. Domperidone for Lactation: What Health Care Providers Need to Know. Obstet Gynecol 2017 Jun;129(6):1054-1058.

[25]Sloan J, Symonds T, Vargas-Chanes D, Fridley B. Practical Guidelines for Assessing the Clinical Significance of Health-Related Quality of Life Changes within Clinical Trials. Drug Inf J 2003;37(1):23-31.

[26]Kerby DS. The Simple Difference Formula: An Approach to Teaching Nonparametric Correlation. Comprehensive Psychology 2014;3:11.IT.3.1.

[27]Marks MN, Wieck A, Checkley SA, Kumar R. Contribution of psychological and social factors to psychotic and non-psychotic relapse after childbirth in women with previous histories of affective disorder. J Affect Disord 1992;24(4):253-263.

[28]Howard L. Postnatal depression. Am Fam Physician 2005;72(7).

[29]Wilson RD, Wilson RD, Audibert F, Brock J, Carroll J, Cartier L, et al. Pre-conception Folic Acid and Multivitamin Supplementation for the Primary and Secondary Prevention of Neural Tube Defects and Other Folic Acid-Sensitive Congenital Anomalies. Journal of Obstetrics and Gynaecology Canada 2015;37(6):534-549.

Table 1. Characteristics of women who engaged in placentophagy and a matched non-exposed cohort

	Placentophagy exposure (PE) (n=28)	Non-exposed (NE) (n=110)	Total (N=138)
Demographics:			
Age - mean (SD)	32.7 (5.47)	31.0 (5.29)	31.3 (5.36)
Psychiatric Diagnosis - n (%)			
Depression	24 (85.7)	94 (85.5)	118 (85.5)
Bipolar disorder	4 (14.3)	16 (14.5)	20 (14.5)
Annual Household Income - n (%)			
<$20,000	4 (14.3)	9 (8.2)	13 (9.4)
$20,000 -40,000	5 (17.9)	16 (14.5)	21 (15.2)
$41,000 – 60,000	3 (10.7)	23 (20.9)	26 (18.8)
$61,000- 80,000	5 (17.9)	21 (19.1)	26 (18.8)
$81,000- 100,000	4 (14.3)	22 (20.0)	26 (18.8)
>$100,000	7 (25.0)	19 (17.3)	26 (18.8)
Use of supplements and medicines			
[a]Postpartum use of a daily psychotropic medication - n (%)	5(17.9)	16 (14.5)	21 (15.2)
Postpartum use of daily multivitamin - n (%)	26 (92.9)	102 (92.7)	128 (92.7)
[b,d] Postpartum use of an additional vitamin B12 supplement - n (%)	2 (7.4)	6 (5.7)	8 (6.0)
Outcomes:			
Highest postpartum EPDS score - mean (SD)	9.29 (5.17)	8.15 (4.78)	8.38 (4.86)
[c] Lowest postpartum SWAI score- mean (SD)	55.81 (9.23)	57.78 (11.29)	57.38 (10.90)
[d] Lowest plasma vitamin B12 (pg/mL) – mean	466.26 (165.90)	453.41 (205.92)	456.02 (201.25)
Postpartum use of domperidone - n (%)	4 (14.29)	17 (15.45)	21 (15.21)

[a] Initiated prior to time-point at which highest EPDS score was recorded

[b] Either as part of a vitamin B Complex or as a separate B12 supplement, initiated prior to time-point at which lowest B12 was recorded

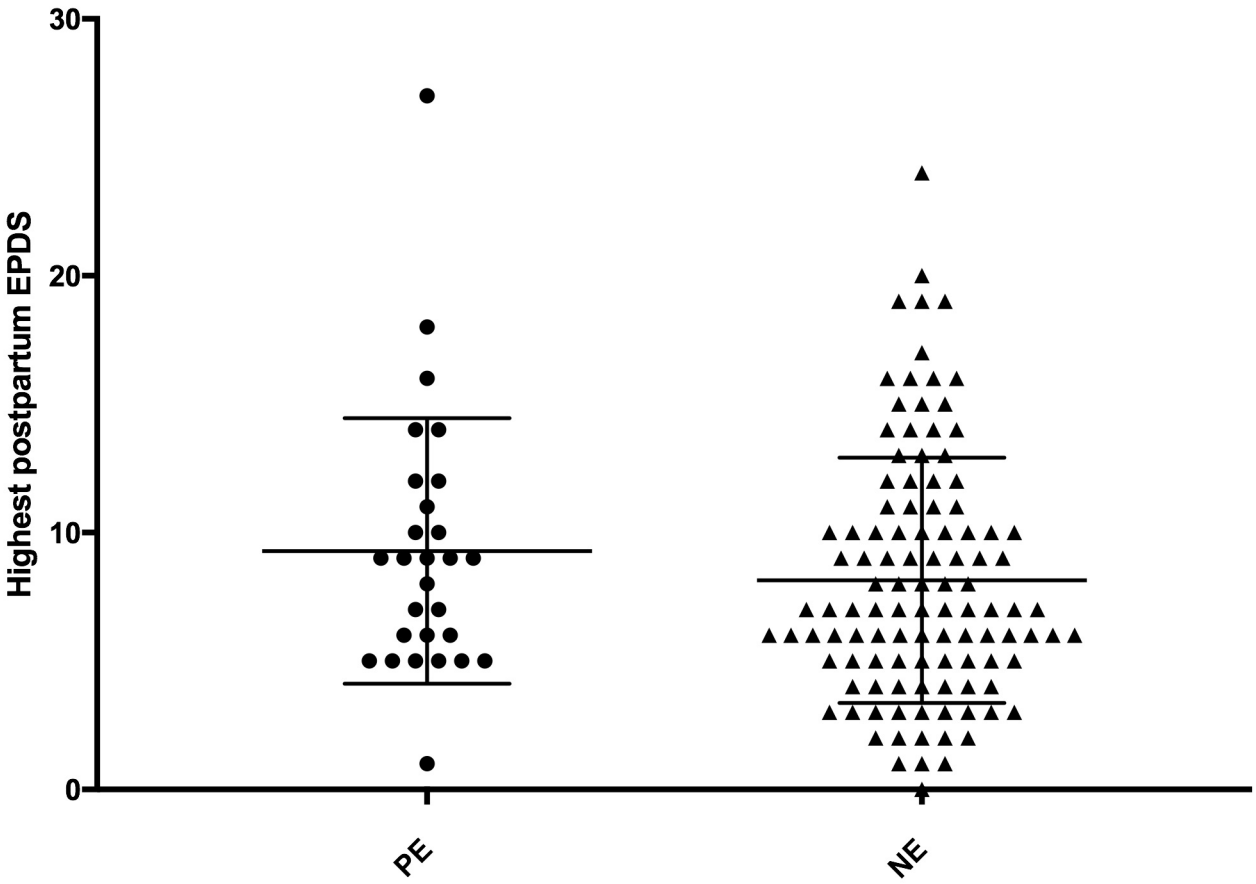
[c] PE cohort n=27 and NE cohort n=106 (1 from the PE cohort did not complete the postpartum SWAI subscale of interest, and was excluded along with her NE matches)

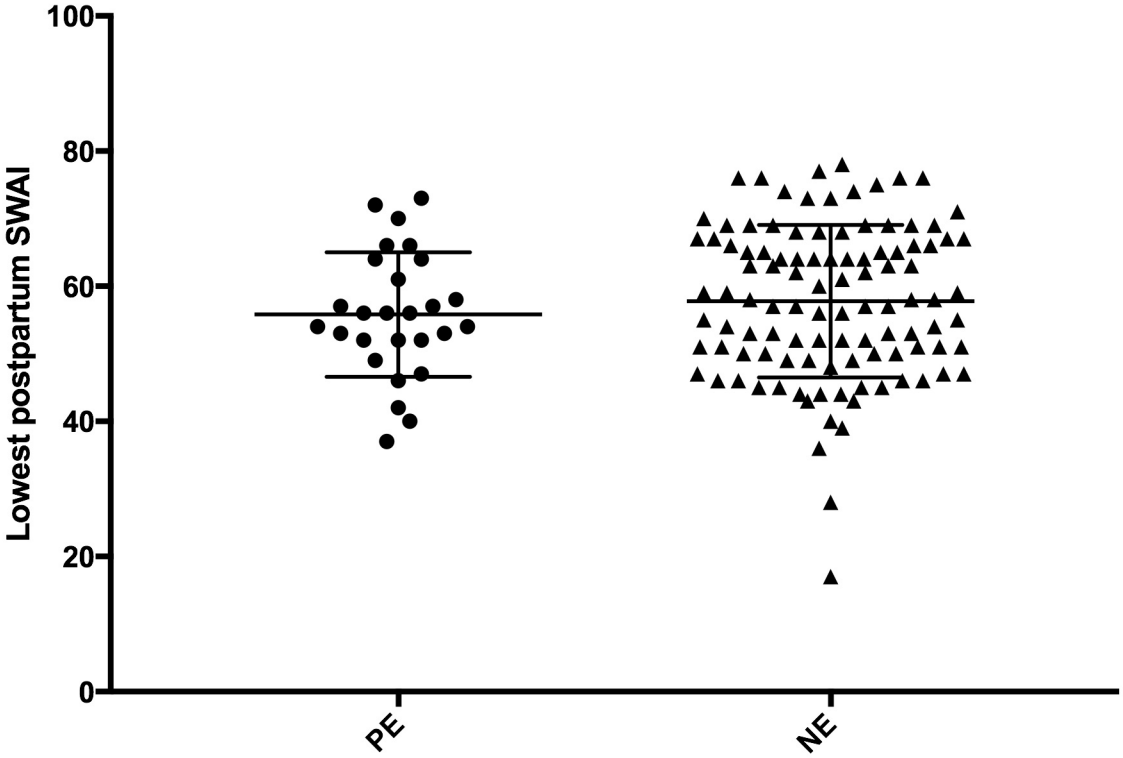
[d]PE cohort n=27 and NE cohort n=106 (1 from the PE cohort was taking additional vitamin B12 was excluded, due to no adequate NE matches)

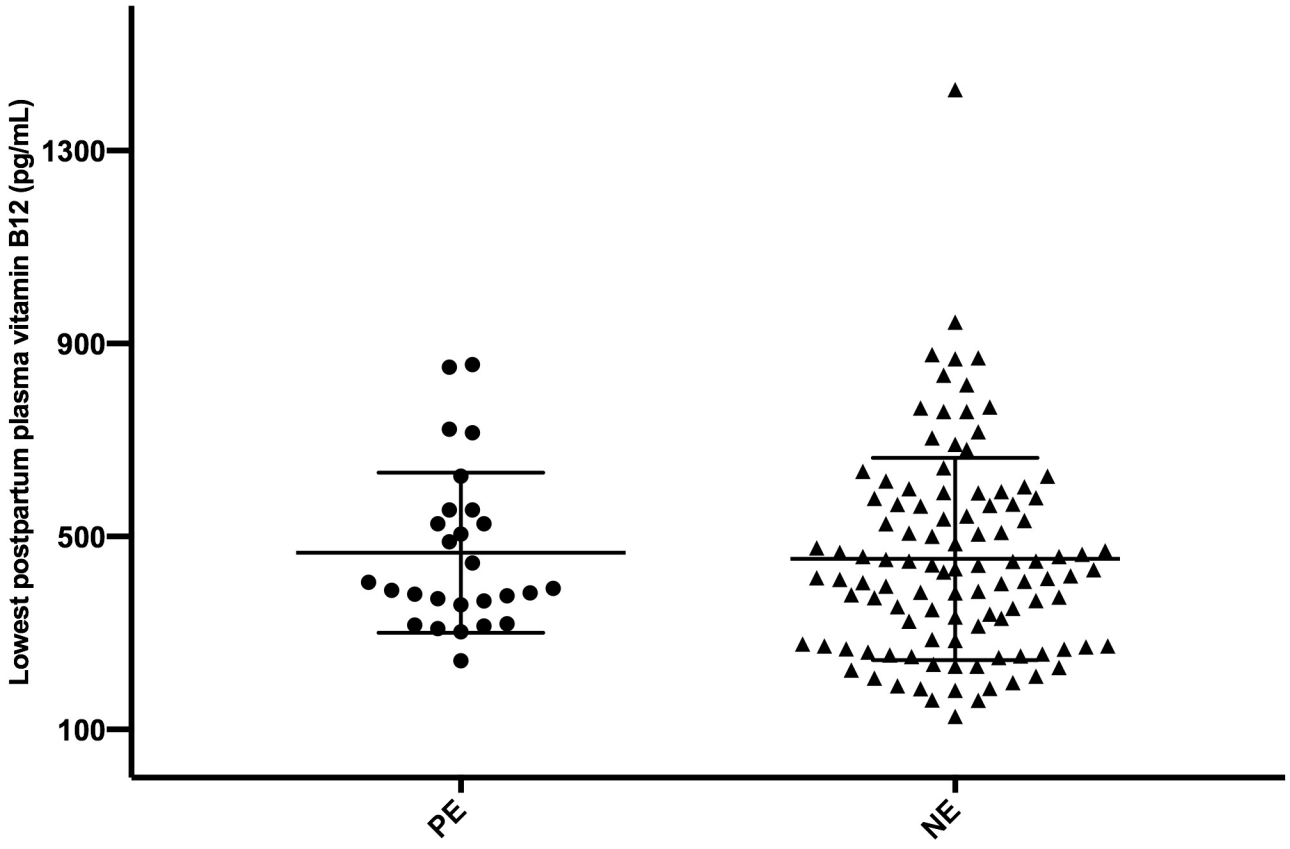
418 **Legends**

419
420
421 Figure 1. Comparison of highest postpartum EPDS score in women who consumed their
422 placenta (PE) and those who did not (NE).
423
424 Figure 2. Comparison of lowest SWAI daytime sleepiness subscale scores for cohorts of women
425 who consumed their placenta (PE) and those who did not (NE).
426
427 Figure 3. Comparison of lowest postpartum plasma vitamin B12 levels (pg/mL) in women who
428 consumed their placenta (PE) and those who did not (NE).

429


Highest postpartum EPDS
30
20
10
0
PE
NE


Lowest postpartum SWAI
100
80
60
40
20
0
PE
NE


Lowest postpartum plasma vitamin B12 (pg/mL)
1300
900
500
100
PE
NE