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Assessment of knowledge of blood loss at delivery among postpartum patients

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Background: Postpartum hemorrhage (PPH) is a leading cause of obstetric morbidity. There is limited understanding of patients' knowledge about blood loss at delivery, PPH, and PPH-related morbidities, including transfusion and anemia.

Methods: We surveyed 100 healthy postpartum patients who underwent vaginal or cesarean delivery about blood loss, and whether they received information about transfusion and peripartum hemoglobin (Hb) testing. Responses were compared between women undergoing vaginal delivery vs. cesarean delivery; $P < 0.05$ considered as statistically significant.

Results: In our cohort, 49 women underwent vaginal delivery and 51 women underwent cesarean delivery. Only 29 (29%) of women provided blood loss estimates for their delivery. Women who underwent cesarean delivery were more likely to receive clear information about transfusion therapy than those undergoing vaginal delivery (43.1% vs. 20.4% respectively; $P = 0.04$). Women who underwent vaginal delivery were more likely to receive results of postpartum Hb tests compared to those undergoing cesarean delivery (49% vs. 29.4%; $P = 0.02$).

Conclusion: Our findings suggest that women are poorly informed about the magnitude of blood loss at delivery. Hematologic information given to patients varies according to mode of delivery. Further research is needed to better understand the clinical implications of patients' knowledge gaps about PPH, transfusion and postpartum anemia.

1 **Title Page**

2 **Title: Assessment of Knowledge of Blood Loss at Delivery Among Postpartum Patients**

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48 **Abstract:**

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50 limited understanding of patients' knowledge about blood loss at delivery, PPH, and PPH-related
51 morbidities, including transfusion and anemia.

52 **Methods:** We surveyed 100 healthy postpartum patients who underwent vaginal or cesarean
53 delivery about blood loss, and whether they received information about transfusion and
54 peripartum hemoglobin (Hb) testing. Responses were compared between women undergoing
55 vaginal delivery vs. cesarean delivery; $P < 0.05$ considered as statistically significant.

56 **Results:** In our cohort, 49 women underwent vaginal delivery and 51 women underwent
57 cesarean delivery. Only 29 (29%) of women provided blood loss estimates for their delivery.
58 Women who underwent cesarean delivery were more likely to receive clear information about
59 transfusion therapy than those undergoing vaginal delivery (43.1% vs. 20.4% respectively;
60 $P = 0.04$). Women who underwent vaginal delivery were more likely to receive results of
61 postpartum Hb tests compared to those undergoing cesarean delivery (49% vs. 29.4%; $P = 0.02$).

62 **Conclusion:** Our findings suggest that women are poorly informed about the magnitude of blood
63 loss at delivery. Hematologic information given to patients varies according to mode of delivery.
64 Further research is needed to better understand the clinical implications of patients' knowledge
65 gaps about PPH, transfusion and postpartum anemia.

66

67 **Key Words:**

68 **postpartum hemorrhage; anemia; patient knowledge; estimated blood loss**

69 **Short title: Patient survey of blood loss at delivery**

71 Introduction:

72 In the United States, the rate of severe postpartum hemorrhage (PPH) has been steadily
73 increasing.^{1,2} In order to decrease the frequency of PPH, clinical guidelines have been published
74 to optimize PPH management practices.³⁻⁵ Obstetric and anesthetic care providers may also
75 obtain updates about PPH management from literature review and other educational forums,
76 such as seminars and conferences. However, it is uncertain whether patients receive information
77 about PPH and PPH-related morbidities, such as transfusion and postpartum anemia.

78 If patients are inadequately informed about PPH, transfusion, and postpartum anemia,
79 this may have important clinical and health-related implications. Firstly, PPH is recognized as an
80 important cause of postpartum anemia. Women who develop postpartum anemia may be at risk
81 for anemia-related morbidities, including: postpartum depression, reduced cognition, and
82 impaired maternal-neonatal bonding.⁶ Secondly, patients who experience PPH may not receive
83 postpartum counseling. This may negatively impact on how patients cope with the emotional
84 trauma of experiencing major PPH.⁷ Thirdly, patient-centered care and shared decision-making
85 about transfusion have been promoted in the perioperative and medical literature.⁸⁻¹⁰ These
86 approaches have not been well described in the obstetric setting, therefore examining patients'
87 knowledge of anticipated and actual blood loss at delivery may help inform clinical practice.

88 To evaluate patients' knowledge and perceptions of postpartum blood loss, we surveyed a
89 cohort of women who underwent vaginal delivery or cesarean delivery at a US tertiary obstetric
90 center. We secondarily examined whether patients receive information from their care providers
91 about transfusion, and antepartum and postpartum Hb levels.

92

93

94 Methods:

95 This study was approved by Stanford University IRB, Stanford, CA (Protocol#26391).

96 Using a convenience sample, we enrolled 100 healthy (ASA physical status 1 or 2) patients who
97 underwent vaginal delivery or cesarean delivery at Lucile Packard Children's Hospital, a tertiary
98 obstetric center in California, USA. During the postpartum hospitalization, postpartum patients
99 were approached and written informed consent was obtained. We excluded women with
100 psychological disorders or psychiatric disease.

101 For this study, we asked patients two sets of questions about blood loss. One set of
102 questions assessed patients' baseline knowledge of normal blood loss following an
103 uncomplicated vaginal or cesarean delivery. The second set of questions was related to the blood
104 loss that occurred for their actual delivery (vaginal or cesarean). For each set of questions, a
105 trained study investigator (PH, BR, KA) surveyed patients using a written questionnaire and
106 recorded patients' responses. Survey questions are presented in an online supplement
107 (Supplement 1). The questionnaire also contained questions related to patients' socioeconomic
108 status and educational background.

109 For the first set of questions, we asked patients to quantify volumes of blood loss for a
110 normal, uncomplicated vaginal delivery and cesarean delivery. For the second set of questions,
111 we asked patients to quantify the estimated blood loss for their actual delivery (hereafter referred
112 to as $EBL_{patient}$), and to indicate whether an obstetric care provider informed them of their EBL.
113 For each patient's delivery hospitalization, we abstracted demographic, medical, obstetric and
114 laboratory data from the electronic medical record, including: total EBL for their delivery
115 (hereafter referred to as $EBL_{delivery}$), the antenatal hemoglobin (Hb) level most proximate to

116 delivery, the postpartum Hb level measured closest to the day of hospital discharge, and relevant
117 transfusion data.

118 For our secondary analysis, we asked directed questions related to transfusion and Hb
119 testing. We assessed whether patients were given information, during the antenatal period, about
120 transfusion, and whether they would consent to a transfusion, if clinically indicated. We asked
121 patients whether they received information about their antenatal and postpartum Hb levels from
122 obstetric care providers.

123 *Statistical Analyses:*

124 Data are presented as mean (standard deviation), median [interquartile range], and number
125 (percentages), as appropriate. For continuous data, we assessed normal distributions using QQ
126 plots and the Kolmogorov-Smirnov test. We compared patient characteristics and survey
127 responses between women who underwent vaginal vs. cesarean delivery with a t test or Mann-
128 Whitney test for continuous data, and χ^2 test or Fisher's exact test for categorical data. We
129 compared EBL_{patient} values to EBL_{delivery} values for women who underwent vaginal and cesarean
130 delivery respectively, using Wilcoxon signed rank sum test.

131 Using EBL data, we classified PPH using the following EBL thresholds: ≥ 500 ml EBL
132 for vaginal delivery and ≥ 1000 ml EBL for cesarean delivery. We calculated sensitivity,
133 specificity, positive predictive value (PPV) and negative predictive value (NPV) to determine
134 whether PPH was accurately classified by patients' EBL estimates for their actual delivery.
135 Statistical analysis was performed using STATA version 12 (Stata Corp., College Station, TX).
136 $P < 0.05$ was considered as statistically significant.

137

138 **Results:**

139 A total of 100 patients were recruited, of which 49 underwent vaginal delivery and 51 underwent
140 cesarean delivery. Demographic, socioeconomic, and obstetric characteristics for the full cohort
141 and for women stratified by mode of delivery are presented in Table 1. In the full cohort, the
142 majority of women had private health insurance, were Caucasian or Asian, married, and had an
143 annual household income of at least \$50,000. Compared to women who underwent vaginal
144 delivery, women who underwent cesarean delivery were older, had a higher parity, were
145 delivered at a later gestational age, and were more likely to have undergone prior cesarean
146 delivery.

147 Data related to the first set of questions about blood loss for an uncomplicated vaginal or
148 cesarean delivery are presented in Table 2. Over two-thirds of patients did not provide estimates
149 for normal blood loss after an uncomplicated vaginal or cesarean delivery. Among those who
150 were willing to provide estimates, patients reported that the mean normal blood loss is higher
151 after an uncomplicated cesarean delivery compared with an uncomplicated vaginal delivery.

152 The median [IQR] EBL_{delivery} values were significantly higher for women who underwent
153 cesarean delivery compared to vaginal delivery (730 [600-1000] ml vs. 250 [200-300] ml
154 respectively; $P < 0.001$). A total of 18 women experienced PPH: four of these women underwent
155 vaginal delivery, and 14 underwent cesarean delivery. Of note, no patients received transfusion.

156 Complete data on EBL_{patient} and EBL_{delivery} values were available for only 29 patients
157 (Figure 1). For those with complete data who underwent vaginal delivery ($n=16$), EBL_{patient}
158 values were significantly higher than EBL_{delivery} values (400 ml [300-578 ml] vs. 250 [200-300
159 ml] respectively; $P=0.02$). In contrast, for those with complete data who underwent cesarean
160 delivery ($n=13$), EBL_{patient} values were significantly lower than EBL_{delivery} values (550 ml [400-
161 800 ml] vs. 750 [600-1000 ml]; $P=0.02$). For the 29 patients with complete EBL_{patient} and

162 EBL_{delivery} data, we calculated sensitivity, specificity, PPV and NPV to determine whether PPH
163 was accurately classified according to EBL_{patient} values. The sensitivity was 60% (95%
164 CI=14.7% - 94.7%), specificity was 83.3% (95% CI=62.6%-95.3%), PPV was 42.9% (95%
165 CI=9.9%-81.6%), and NPV was 90.9% (95% CI=70.8%-98.9%).

166 Hb levels were not measured before or after delivery for 11 women and 20 women,
167 respectively. Predelivery Hb levels were similar for those who underwent vaginal vs. cesarean
168 delivery: 12.4 (1.4) g/dl vs. 12.3 (0.9) g/dl, respectively; P=0.8. Similarly, no significant
169 difference was observed in the last Hb measured before hospital discharge between women who
170 underwent vaginal vs. cesarean delivery: 10.6 (1.1) g/dl vs. 10.4 (1.0) g/dl, respectively; P=0.3.

171 Data of patients' knowledge of transfusion and Hb levels are presented in Table 3.

172 Women who underwent cesarean delivery were more likely to have received clear and
173 understandable information about transfusion and were more likely to consent to transfusion
174 compared to women who had a vaginal delivery. With regard to Hb levels, patients who
175 underwent vaginal delivery were more likely to have known their Hb level before delivery
176 compared to those who underwent cesarean delivery. The proportion of patients who stated that
177 their postpartum Hb level was measured was similar among women who underwent vaginal vs
178 cesarean delivery (40.8% vs. 47% respectively; P=0.74). However, among women who stated
179 that their postpartum Hb level was measured, only 3 (7%) were given the test result.

180

181 **Discussion:**

182 Our study provides insight into obstetric patients' perceptions and knowledge of blood loss at
183 delivery, transfusion, and laboratory testing for anemia. Over two-thirds of patients did not
184 provide blood loss estimates for their delivery. Additionally, less than 50% of patients indicated

185 that they received information about their pre- or post-delivery Hb levels. Lastly, the quality of
186 transmitted information about transfusion and patients' consent for transfusion varied according
187 to mode of delivery. Based on our findings, a low proportion of women who deliver at a US
188 tertiary obstetric center receive information about the clinical implications of peripartum blood
189 loss, transfusion, and Hb testing before and after delivery.

190 It is unclear why the majority of women in our study did not provide blood loss
191 (EBL_{patient}) values. We speculate that the reason is that many patients did not receive blood loss
192 information after delivery. Those who did provide blood loss estimates for their delivery were
193 relatively poor at correctly classifying PPH (sensitivity=60%; PPV=42.9%). One possible
194 explanation for these findings is that, within this subcohort [of women who gave blood loss
195 estimates], women may not have been informed about the magnitude of their peripartum blood
196 loss. In addition, it is also possible that some women correctly estimated their blood loss without
197 receiving any EBL information from their obstetric care provider.

198 Although it is unclear whether patients who undergo uncomplicated deliveries need to be
199 notified of their EBL or postpartum Hb levels, patients who experience PPH may benefit from
200 receiving more detailed information about these indices. Thompson et al. reported that patients
201 who experience PPH express interest in receiving information related to their delivery, and may
202 benefit from counseling, psychological support, and assistance with physical recovery.¹¹
203 Furthermore, physicians' estimate of blood loss can often be lower than the actual volume of
204 blood lost at delivery.^{12,13} Therefore, if blood loss is underestimated for women with PPH, then
205 these women may develop anemia that goes undetected after delivery. To improve patient
206 awareness of postpartum anemia, there may be benefit in providing patients with information

207 sheets which contain advice about seeking medical review if they experience anemia-related
208 symptoms (e.g., low mood, fatigue, poor cognition).

209 In our study, patients who underwent cesarean delivery were more likely to receive
210 information about transfusion compared to those who underwent vaginal delivery. Obstetricians
211 may be more likely to discuss the need for transfusion with patients who undergo cesarean
212 delivery, as these women are at greater risk of PPH than those undergoing vaginal delivery.¹⁴
213 Surprisingly, 20% of women who underwent vaginal delivery reported that they would not
214 provide consent for a blood transfusion should the obstetrician deem it necessary. This finding is
215 somewhat concerning as prompt transfusion therapy may be needed for women who experience
216 severe PPH or postpartum anemia. Misconceptions about transfusion risk may explain why
217 patients object to transfusion therapy. These misconceptions may be influenced by
218 sociodemographic factors. For example, in a survey of patients' perceptions of transfusion by
219 Vetter et al., patients with a high school education or less expressed increased concern about the
220 risk of allergic reaction, dyspnea, human immunodeficiency virus transmission, and medical
221 error.⁹ In a different survey examining patients' beliefs about transfusion, Finucane et al.
222 observed that patients' decision to receive transfusion may vary according to patient's sex,
223 race/ethnicity, and prior educational history.¹⁵ In light of these findings, counseling during the
224 antenatal period may help allay the concerns and fears of patients who express a desire to avoid
225 transfusion.

226 Antenatal and postpartum anemia can affect up to 52% and 24% women respectively.^{6,16}
227 However, in our study, despite the majority of women having Hb levels measured before and
228 after delivery, fewer than 50% indicated that they received any information regarding the results
229 of these tests. Hb testing was less common for women who underwent vaginal delivery. To

230 determine optimal screening practices, more population-based studies are needed to assess the
231 frequency of postpartum anemia.

232 There are some limitations to our study. Our cohort size was relatively small, with
233 patients recruited at a single, tertiary obstetric center. In addition, the majority of women had
234 private insurance, were well educated, were Caucasian or Asian, and had an annual income of >
235 \$50,000. Therefore, the specific characteristics of our study population limit the generalizability
236 of our findings. Further investigations are needed to assess knowledge and perceptions of blood
237 loss among women from other sociodemographic backgrounds, including those without English
238 proficiency. Our study cohort comprised healthy women who underwent uncomplicated vaginal
239 or cesarean delivery. We did not collect information on indications for cesarean delivery or, if
240 given, the timing of antenatal counseling. It is possible that the presence of select risk factors for
241 PPH may influence if and when physicians inform patients about peripartum blood loss, anemia
242 or transfusion. For example, the likelihood of antenatal counseling may be greater for women
243 with antenatal conditions linked to severe PPH, such as placenta previa or accreta, than for
244 women with uncomplicated pregnancies. Recall bias is a possibility as we performed our survey
245 after delivery. Patients' responses may have differed if our survey had been prospectively
246 performed. Lastly, this was a convenience sample, therefore the proportion of patients who
247 underwent cesarean delivery in our study cohort (51%) is not representative of the rate of
248 cesarean delivery at LPCH (approximately 31%). In addition, in our study cohort, the proportion
249 of women who experienced PPH (18%) is higher than reported in the literature.¹² As our study
250 was exploratory in nature, further studies are needed to validate our findings using populations
251 are more representative of a typical delivery population.

252 In conclusion, our findings suggest that obstetric patients receive limited information
253 about peripartum blood loss, transfusion and peripartum Hb testing. In addition, patients'
254 understanding of transfusion and postpartum Hb testing may vary according to mode of delivery.
255 Future qualitative studies are needed to examine whether better patient-provider communication
256 improves patients' understanding and awareness about the clinical implications of PPH, anemia,
257 and transfusion therapy, and to examine alternative ways to disseminate relevant information to
258 patients.

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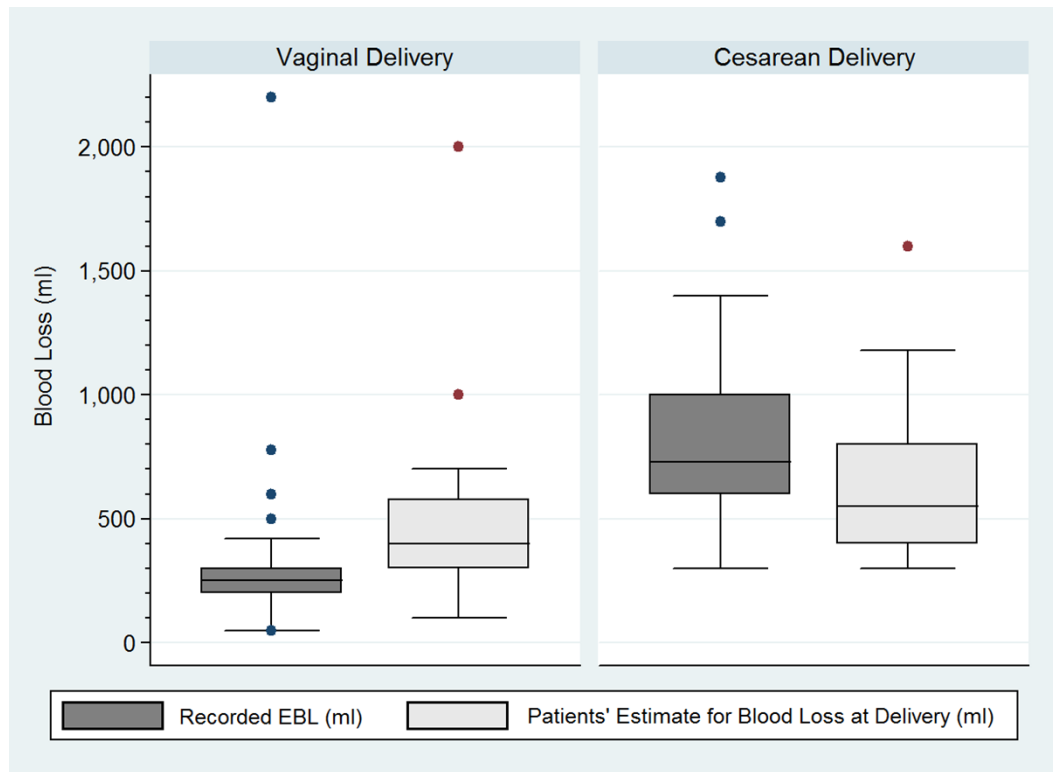
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262

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305

306 **Figure 1. Recorded estimated blood loss versus patients' estimate for blood loss at delivery.**307 **Blood loss was not recorded in the medical records of 4 patients who underwent vaginal**308 **delivery and 1 patient who underwent cesarean delivery.**309 **32 patients for vaginal delivery and 37 patients for cesarean delivery did not know or chose**310 **not to answer this question.**

311

312

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314

315 **Table 1. Maternal Characteristics**

	All Deliveries (n=100)	Vaginal Deliveries (n=49)	Cesarean Deliveries (n=51)	P value
Maternal age (y)	33 (6)	30 (5)	36 (6)	<0.001

Race / Ethnicity:				0.54
Caucasian	51 (51.0%)	27 (55.1%)	24 (47.1%)	
Asian	32 (32.0%)	14 (28.6%)	18 (35.3%)	
African-American	2 (2.0%)	0 (0.0%)	2 (3.9%)	
Other	15 (15.0%)	8 (16.3%)	7 (13.7%)	
Insurance type:				0.08
Private	81 (81.0%)	36 (73.5%)	45 (88.2%)	
Public	19 (19.0%)	13 (26.5%)	6 (11.8%)	
Parity	1 [0-1]	0 [0-1]	1 [0-1]	0.03
Highest level of education:				0.61
Less than college	23 (23.0%)	13 (26.5%)	10 (19.6%)	
College degree	26 (26.0%)	11 (22.4%)	15 (29.4%)	
Graduate degree	51 (51.0%)	25 (51.0%)	26 (51.0%)	
Annual household income:				0.45
Less than \$10,000	2 (2.0%)	2 (4.1%)	0 (0.0%)	
Between \$10,000 - \$49,000	19 (19.0%)	10 (20.4%)	9 (17.6%)	
Equal to or greater than \$50,000	75 (75.0%)	35 (71.4%)	40 (78.4%)	
Missing	4 (4.0%)	2 (4.1%)	2 (3.9%)	
Marital status:				1.00
Married	91 (91.0%)	45 (91.8%)	46 (90.2%)	
Unmarried – lives with other adults	7 (7.0%)	3 (6.1%)	4 (7.8%)	
Unmarried – lives without	1 (1.0%)	0 (0.0%)	1 (2.0%)	

other adults				
Unknown	1 (1.0%)	1 (2.0%)	0 (0.0%)	
Gestational age at delivery (weeks)	39 [38-39]	39 [38-40]	39 [37-39]	0.02
Prior cesarean delivery	30 (30.0%)	2 (4.1%) ^a	28 (54.9%)	<0.001
Multiple gestation:				1.00
Singleton	97 (97.0%)	48 (98.0%)	49 (96.1%)	
Twins or higher-order	3 (3.0%)	1 (2.0%)	2 (3.9%)	
Known history of anemia or coagulation disorder	6 (6.0%)	4 (8.2%)	2 (3.9%)	0.43

316 Data presented as mean (SD), median [IQR], and n (%).

317 ^a Missing data for 1 patient

318

319

321 **Table 2. Survey of Patients' Knowledge of Normal Blood Loss for an Uncomplicated**
 322 **Vaginal and Cesarean Delivery**
 323

	All Deliveries (n=100)	Vaginal Deliveries (n=49)	Cesarean Deliveries (n=51)	P value
What is the normal blood loss after a vaginal delivery?	350 [350-500] ^a	350 [350-500]	350 [350-500]	0.70
What is the normal blood loss after a CD?	750 [500-750] ^b	750 [350-750]	750 [500-750]	0.66

324 Data presented as median [interquartile range] and n (%)

325 CD = cesarean delivery; EBL = estimated blood loss.

326 ^a 39 patients for vaginal delivery and 34 patients for cesarean delivery did not know or chose not to
 327 answer this question.

328 ^b 44 patients for vaginal delivery and 32 patients for cesarean delivery did not know or chose not to
 329 answer this question.

330

331

332 **Table 3. Survey of Patients' Knowledge of Transfusion and Hemoglobin Values**
 333

	All Deliveries (n=100)	Vaginal Deliveries (n=49)	Cesarean Deliveries (n=51)	P value
What was the quality of information you received about blood transfusion?				0.04
Clear and understandable	32 (32.0%)	10 (20.4%)	22 (43.1%)	
Incompletely explained but I have a good understanding	41 (41.0%)	20 (40.8%)	21 (41.2%)	
Poorly explained and I have limited understanding	10 (10.0%)	6 (12.2%)	4 (7.8%)	
Not explained and I have no understanding	13 (13.0%)	10 (20.4%)	3 (5.9%)	
Missing	4 (4.0%)	3 (6.1%)	1 (2.0%)	
If a blood transfusion was needed, would you give consent?				0.09
Yes	85 (85.0%)	38 (77.6%)	47 (92.2%)	
No	14 (14.0%)	10 (20.4%)	4 (7.8%)	
Missing	1 (1.0%)	1 (2.0%)	0	
Were you given any information about your Hb level before your delivery?				0.02
Yes	39 (39.0%)	24 (49.0%)	15 (29.4%)	

No	57 (57.0%)	25 (51.0%)	32 (62.8%)	
Missing	4 (4.0%)	0 (0.0%)	4 (7.8%)	
Was your Hb level measured after delivery?				0.74
Yes	44 (44.0%)	20 (40.8%)	24 (47.0%)	
No	33 (33.0%)	18 (36.7%)	15 (29.4%)	
Don't know	22 (22.0%)	11 (22.4%)	11 (21.6%)	
Missing	1 (1.0%)	0	1 (2.0%)	

334 Data presented as n (%)

335 Hb = hemoglobin.

336

337