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Describing latent phase duration and associated characteristics among 1281 low-risk women in spontaneous labor

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Abstract

Background: Recent research suggests that latent phase of labor may terminate at 6 rather than 4 centimeters of cervical dilation. The **objectives** of this study were to: 1) characterize duration of the latent phase of labor among term, low-risk, U.S. women in spontaneous labor using the women's self-identified onset; and 2) quantify associations between demographic and maternal/newborn health characteristics and the duration of the latent phase.

Methods: This prospective study (n = 1281) described the duration latent phase in hours, stratified by parity at the mean, median, 80th, 90th, and 95th percentiles. The duration of the latent phase was compared for each characteristic using t-tests or Wilcoxon Rank-Sum tests and regression models that controlled for confounders.

Results: In this sample of predominantly white, healthy women, duration of the latent phase was longer than described in previous studies: The median duration was 9.0 hours and mean duration was 11.8 hours in nulliparous women. The median duration was 6.8 hours and mean duration was 9.3 hours in multiparous women. Among nulliparous women, longer duration was seen in women

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whose fetus was in a malposition. Among multiparous women, longer durations were noted in women with chorioamnionitis and those who gave birth between 41 - 41+6 weeks gestation (vs. 40 – 40+6 weeks gestation).

Conclusion: The latent phase of labor may be longer than previously estimated. Contemporary estimates of latent phase of labor duration will help woman and providers accurately anticipate, prepare, and cope during spontaneous labor.

Keywords

Labor; Latent phase; Labor progress; Chorioamnionitis; Fetal malposition; Postdates

Introduction

The latent phase of labor is the time between the beginning of labor symptoms and the onset of the active phase.[1] The latent phase has been described as highly variable both in duration and with regard to women's experiences.[2–4] Clinical guidelines for the care of healthy, low-risk women recommend remaining at home during latent phase.[5,6] While most women describe contractions as the primary harbinger of latent labor onset, other symptoms such as gastrointestinal changes may be the first sign of latent phase.[2,7–11] The latent phase usually begins outside of the hospital, and the time of onset is determined by the woman's first recognition of symptoms. For these reasons, defining spontaneous latent phase onset by the timing of hospital admission likely truncates estimates of latent phase duration.[13]

Four published studies have characterized the latent phase and/or analyzed the association between the duration of latent phase and outcomes among cohorts in the United States.[4,13–15] In 3 of these studies, latent phase onset was either unspecified,[4,13] or was defined by hospital admission.[14] The 1 study that defined labor onset by the woman's report of symptom onset did not examine the association between demographic or health characteristics and duration of the latent phase.[15]

Relationships among factors that initiate and propagate spontaneous labor are complex, and we are early in our understanding of these processes.[16–18] Although a growing body of recent research has characterized duration of the active phase and associated outcomes, suggesting that latent phase may terminate at 6 rather than 4 centimeters of cervical dilation,[3,19] the entire duration of the latent phase and associations have not yet been fully explored.[12,20] Women will likely benefit from accurate estimates of labor duration to help them anticipate, prepare, and cope with the experience of labor. As well, the duration of the latent phase may affect perinatal outcomes, and longer durations may herald abnormal labor progress.[14] It is important to differentiate which women will derive greater benefit from supportive care versus judicious intervention during the latent phase of labor.[5,21,22]

Informed by these considerations, the purposes of this study were to: 1) characterize the duration of latent phase among low-risk, U.S. childbearing women in spontaneous labor using the women's self-identification of labor onset to define the beginning of latent phase; and 2) quantify associations between demographic and maternal/newborn health

characteristics at 5 thresholds of the duration of the latent phase distribution (mean; median; and 80th, 90th, and 95th percentiles).

Materials and Methods

Data

The Oregon Health & Science University (OHSU) certified nurse-midwifery (CNM) practice has been at OHSU for 43 years. CNMs in this practice attend approximately 600 women during birth annually and are licensed, independent practitioners who consult as needed with other providers. Since 2012, the OHSU CNM faculty has been collecting observational data about women receiving care with this practice. This data collection was initiated for quality improvement and received OHSU Institutional Review Board (IRB) approval. Information is recorded at 3 points of clinical care: 1) the initial outpatient prenatal visit, 2) inpatient labor, birth, and postpartum care, 3) and the 6-week postpartum visit.

Data set questions are phrased to elicit unambiguous information, with most questions requiring a yes/no response such as ‘was epidural analgesia used for labor and/or birth?’ Non-binary questions require more information; e.g., ‘vaginal examination at time of amniotomy’ elicits response regarding effacement, dilation, and station (on a −1 to +5 scale). Questions were designed to gather a level of detail regarding midwifery clinical care processes and outcomes not easily captured by administrative or electronic health record data. For example, when the midwife indicates that an induction was initiated, she is prompted to specify all methods used for induction (i.e., acupuncture, amniotomy, Cervidil, Foley bulb, misoprostol, Pitocin, prostaglandin gel, herbs, castor oil).

All data forms collected for this prospective cohort are reviewed bi-weekly by a data entry team. CNM students, trained in data entry and verification, transfer data into the Research Electronic Data Capture (REDCap) system. Uncertainties or missing data were highlighted and addressed by the faculty who provided clinical care. Additionally, the CNM director compares a convenience sample (generally 10 cases) to the data recorded in the women’s electronic medical records twice monthly. This is accomplished both for ongoing quality assessment and to resolve any uncertainties or discrepancies.

Upon OHSU IRB approval to use this data repository for the current study, a de-identified sample was obtained. Ten percent of the sample was randomly selected for double-verification to assess accuracy between paper data collection forms, electronic medical records, and REDCap database. This process determined 99% data accuracy. All women in the study received antepartum and intrapartum care with the CNMs and met the following inclusion criteria: age 21 years or older, 37 or more weeks gestation, and in spontaneous labor with a singleton, non-anomalous, live, fetus in vertex presentation. We excluded women with a prior cesarean birth (Figure 1).

Providers recorded the date and time (in hours, minutes) when a woman self-reported onset of the latent phase. Providers also recorded the date and time (in hours, minutes) of active phase onset; this time point was used to define the termination of the latent phase. While cervical examination is frequently performed to determine active phase onset, cervical

examination was not required for identifying transition to active phase. Within this practice, providers may rely on women's symptoms or behavior, e.g., shaking, emesis, increased expression or reports of pain,[7,23,24] to identify the transition from the latent to the active phase of labor. Active phase signs and symptoms are frequently more prominent when women labor without analgesia,[25] and 71% of women in this dataset did not use epidural anesthesia. Since the median years of practice of CNM providers was 31 years, the CNM team collecting data for this study was experienced in recognizing the transition from latent to active labor and also experienced in caring for a population of women in whom this transition is not masked by epidural use.

Analysis

We first described the duration of latent phase by parity. We focused unadjusted analyses on 2 measures of central tendency (mean, median) as well as 3 points of distribution marking longer latent phase (80^{th}, 90^{th}, and 95^{th} percentiles). This approach was selected to facilitate comparison with existing estimates of the duration of the latent phase.[4,14,15] We compared the length of women's latent phase by each characteristic (e.g., did vs. did not receive a diagnosis of chorioamnionitis during labor) at each point of the duration of latent phase distribution (e.g., latent labor duration < mean vs. ≥ mean) using t-tests and Wilcoxon Rank-Sum tests. Our primary exposure variables were maternal demographic (e.g., age), health (e.g., pregnancy weight gain), and fetal characteristics (e.g., position at birth). Continuous variables (e.g., gestational age) were transformed into clinically-relevant categorical variables (e.g., early term vs. term gestational age). Our primary outcome was duration of the latent phase of labor.

Multivariate logistic regression models were fit to examine the adjusted association between latent phase that terminated or continued at and beyond the mean, 80^{th}, 90^{th}, and 95^{th} percentiles of the duration of the latent phase and variables of interest that included: partner status, maternal age, maternal height, Body Mass Index category (normal, overweight, obese), excess pregnancy weight gain, Group Beta streptococcus vaginal colonization, gestational diabetes, pre-labor rupture of membranes, gestational age at birth, birth weight, chorioamnionitis, and fetal position at birth.

The mean was the point of central tendency selected for analysis. The logistic regression models compared women at each point of the duration of latent phase distribution (e.g., ≥mean duration of latent phase) to those below each distribution point (e.g., <mean duration of latent phase). All models controlled for maternal age, maternal height, BMI category (normal, overweight, obese), pregnancy weight gain, partner status, gestational diabetes, pre-labor rupture of membranes, GBS status, and neonatal birth weight (unless the variable was the outcome being examined). All analyses were conducted in Stata 15.

Results

After excluding data from women who did not meet eligibility criteria, our final sample included 665 nulliparous and 616 multiparous women (N = 1281). The women in this sample were predominantly married or partnered, white, and the majority gained gestational weight within Institute of Medicine (IOM) recommended guidelines (Table 1). Compared to

nulliparous women, a higher percentage of multiparous women experienced shorter duration of latent phase (Figure 2). Among nulliparous women, the mean duration of the latent phase was 11.8 hours and the median was 9.0 hours. Among multiparous women, the mean duration of the latent phase was 9.3 hours and the median was 6.8 hours (Table II).

After adjusting for confounders, four variables remained significantly associated with longer latent phase at various distribution points. Nulliparous women whose fetus was in a malposition (occiput posterior or occiput transverse) either at birth or at the last cervical examination prior to birth had a duration of latent phase that was significantly longer when compared to women whose fetus was in an occiput anterior position [mean, 11.8 vs. 9.0 hours, $P<0.05$; median, 16.2 vs. 11.6 hours, $P<0.01$] (Figure 3). Multiparous women diagnosed with chorioamnionitis (defined as fever of $\geq 38^{C}$ and one other symptom, e.g., tachycardia) had significantly longer duration of the latent phase than did multiparous women who did not have chorioamnionitis. When the median duration of latent phase for these women was evaluated it was more than 2-fold longer than the median duration of multiparous women not diagnosed with chorioamnionitis (mean, 18.3 vs. 9.1 hours, $P<0.01$; median, 15.9 vs. 6.5 hours, $P<0.01$) (Figure 3). Multiparous women who were not partnered or married also experienced longer latent phase (mean, 14.2 vs. 9.2 hours, $P<0.05$; median, 15.4 vs. 6.5 hours, $P<0.05$].

Based on research that has evaluated active phase and second stage labor progress, we hypothesized that women with higher BMI, greater gestational weight gain, and longer gestational age at birth would have a longer duration of the latent phase.[26–28] These comparisons were not statistically significant among nulliparous women. Findings were also non-significant among multiparous women with the exception that those who gave birth at late term (vs. term) gestational age had significantly longer duration of latent phase [mean: 7.5 vs. 6.5 hours, $P<0.05$; median 11 vs. 8.6 hours, $P<0.05$] (Figure 3). We found no additional relationships between the duration of the latent phase and other demographic or maternal/newborn health characteristics in this population.

During multivariate analysis after adjusting for partner status, maternal age, maternal height, Body Mass Index category (normal, overweight, obese), excess pregnancy weight gain, Group Beta streptococcus vaginal colonization, gestational diabetes, pre-labor rupture of membranes, gestational age at birth, birth weight, chorioamnionitis, and fetal position at birth. (unless the variable was the outcome being examined) we found that among nulliparous women, fetal malposition was significantly associated with duration of latent phase at and beyond the 95^{th} percentile. Among multiparous women: a) chorioamnionitis was significantly associated with longer latent phase at and beyond the mean, 80^{th}, and 90^{th} percentiles, but not beyond the 95^{th}percentile; b) late term (vs. term) gestational age at birth was associated with significantly longer duration of latent phase at and beyond the 90^{th} percentile; and c) those without (vs. with) partners experienced significantly longer latent phase only at the 80^{th} percentile (Table III).

Discussion

In this low-risk population of women in spontaneous labor, nulliparous women's durations of the latent phase of labor were longer than the normal duration of this stage of labor identified in previous U.S. studies.[4,14,15] By defining the onset of latent phase as beginning with the woman's report of labor onset, this dataset allowed us to estimate the entire duration of spontaneous latent phase which commonly starts outside of a hospital setting. Women in this sample frequently chose and received labor care that can be characterized as non-interventional in the absence of complications (e.g., 76% of women in this practice experience spontaneous labor, 73% of labors proceed without augmentation, and 71% choose to labor without epidural). These factors create a unique opportunity to observe the natural history of contemporary spontaneous latent phase among low risk women who labor and give birth in a high-resource country.

Our duration of latent phase labor findings were similar to estimates observed in recent European samples. For example, a study of contemporary, low-risk Swedish women in spontaneous labor that used the woman's self-report to identify latent phase onset, found mean duration of the latent phase to be 13.9 hours duration among nulliparous women and 10.8 hours among multiparous women.[29] The study by Gross et al. conducted in Germany that assessed low-risk women's perceptions of the duration of latent phase vs. their midwives' perceptions of latent phase duration determined that women's estimates were similar to our study findings (median time- nulliparous: 11 hours; multiparous: 6.5 hours).[30] Notably, midwives in the Gross study provided duration of latent phase estimates that are similar to Friedman's estimates.[4,13,30] So while it is possible that our findings are indicative of actual changes in the duration of the latent phase of labor, potentially related to different health characteristics between current and prior samples, it is more likely that our findings reflect the difference in how latent phase duration was previously measured in U.S. samples.

Recent investigation regarding duration of the first stage of labor provided updated estimates of cervical dilation associated with active labor onset, suggesting that latent phase may last until 6 rather than 4 centimeters of cervical dilitation.[3,19,31] This work has led to broad efforts to redefine the onset of active labor for clinical practice. Considered in light of our findings, the latent phase of labor may be much longer than previously estimated. Older latent labor time estimates truncated duration in two ways: 1) they did not consistently include latent labor duration prior to hospital admission, and 2) they did not include the time required for the cervix to dilate from 4 to 6 cm.

Pregnant women often seek information as they prepare for labor.[32] Among the many pieces of information that may be of interest is what to expect for the duration of each phase of labor. For example, women may feel safe to continue daily activities and not transition to the hospital if they know that latent labor lasts on average 9-12 hours for nulliparous women and 7-9 hours for multiparous women, rather than Friedman's older estimates of an average of 7-8 hours for nulliparous women and 4-5 hours for multiparous women.[4,13] Use of more accurate estimates of the normal duration of the latent phase of labor could also assist maternity care providers in differentiating women who are in physiologic latent labor from those whose might benefit from additional support or intervention. Better estimates of the

normal duration of this phase of labor can also inform health systems changes, such as improved antenatal preparation to support women with uncomplicated labors to remain home until active labor, or might inform facilities changes, such as creating a latent labor lounge.[22,33]

Our results also suggest there is association between fetal malposition and longer latent phase among nulliparous women. It is unclear if the association indicates that a malpositioned fetus from the onset of the latent phase leads to a longer latent phase or if longer duration of latent phase is dysfunctional or unable to accomplish the internal fetal rotation to occiput anterior. An additional possibility is whether women in this group may have pelvis types that encouraged both fetal malposition and a longer latent phase. Similar to prior research regarding active phase duration,[34] these study findings further suggest that there is a positive association between chorioamnionitis and longer latent phase among multiparous women, though the temporal relationship of these variables also cannot be determined. Mediating factors might include the increased potential for more cervical examinations or physiologic changes related to longer labor that could render women more vulnerable to infection. It is also possible that the origin of factors that ultimately lead to chorioamnionitis during active or second stage labor may be present, but perhaps subclinical, during or prior to latent phase and may lengthen the latent phase. Alternately, infection may disrupt the cascade that propagates normal labor. If these study findings are replicated, increased caution with frequency of cervical examination and/or heightened attention to markers of chorioamnionitis may be appropriate among multiparous women with longer duration of the latent phase of labor.

Findings further indicate that multiparous women giving birth post-term may experience a longer latent phase than those delivering at term; a similar tendency was noted among nulliparous women, although the differences were not statistically significant. As greater knowledge develops regarding variation in labor processes and outcomes by gestational age, duration of latent phase should be evaluated as a potential driver or harbinger of gestational age differences in overall labor progress. Study findings also raise the question of whether support from a partner or spouse might decrease either the length of latent phase or delay women's perceptions of latent phase onset. Given the small proportion of single women in this sample, these findings should be considered exploratory.

Women have reported that the latent phase of labor is a time of great uncertainty and anxiety.[36] Revised estimates of the normal duration of the latent phase of labor may enhance women's labor experiences, an important direction for future research. In addition, women's perceptions of the latent phase drive several important decisions, including when to present to the hospital and/or request pain relief.[36] Effectively helping low-risk women delay hospital admission until the active phase is established is a particularly important target because of robust evidence demonstrating that hospital admission during the latent phase is associated with more interventions without concomitant benefit,[37–47] and lower cost-effectiveness.[48]

Future research should also investigate the latent phase of labor among other populations, including women with higher risk for poor outcomes, those receiving care from other

maternity care providers, and those birthing in different settings. Additionally, future science should evaluate relationships between the duration of latent phase and labor/birth outcomes of active and second stages of labor as well as outcomes in the early postpartum. Finally, more information is needed about preparation women are given before the experience of labor,[33] their symptoms and successful coping mechanisms during of latent phase,[11] as well as how these factors may shape decision-making regarding when to transport to the hospital.[49] This information will importantly inform efforts to decrease hospital admission during the latent phase of labor.[2,50,51]

Strengths and Limitations

Strengths of this study include the use of a data set that enables estimation of the entire duration of spontaneous labor experienced by women with an a priori low-risk for labor abnormalities who gave birth in a high resource setting. Using the laboring woman's report of the onset of latent labor corresponds both with the definition of latent phase[1] and recent recommendations for latent phase research.[12] Since women in this sample were less likely to use common labor interventions such as pharmacologic augmentation or epidural analgesia,[35] these study findings add to the sparse knowledge of the natural history of spontaneous latent labor.

While our results are valuable in that they contribute to a rarely studied area of women's health, our sample is not representative of the U.S. population. The women who sought care at this location were predominantly white, partnered/married, with frequently normal BMIs, low levels of co-morbidities, and recommended gestational weight gain. In addition, the women in this sample self-selected midwifery-care and non-intervention during childbearing. Future research should include women more representative of the broader population of childbearing women in the U.S. Comparisons at the 80^{th}, 90^{th}, and 95^{th} percentiles of duration of latent phase distribution necessarily include low sample sizes. Relationships that might be detected with a larger sample may have been missed with the smaller sample at these points of distribution.

Conclusions

Our study contributes new, contemporary estimates of the natural history of the duration of spontaneous latent phase. Importantly, we found that the latent phase of labor may be longer than previously estimated among healthy U.S. women with low-risk pregnancies in spontaneous labor. These new duration of latent phase estimates refine understanding of normal parameters for this portion of labor. Childbearing women, maternity care providers, and health systems might use this information to enhance anticipation, preparation, and coping during the spontaneous latent phase of labor.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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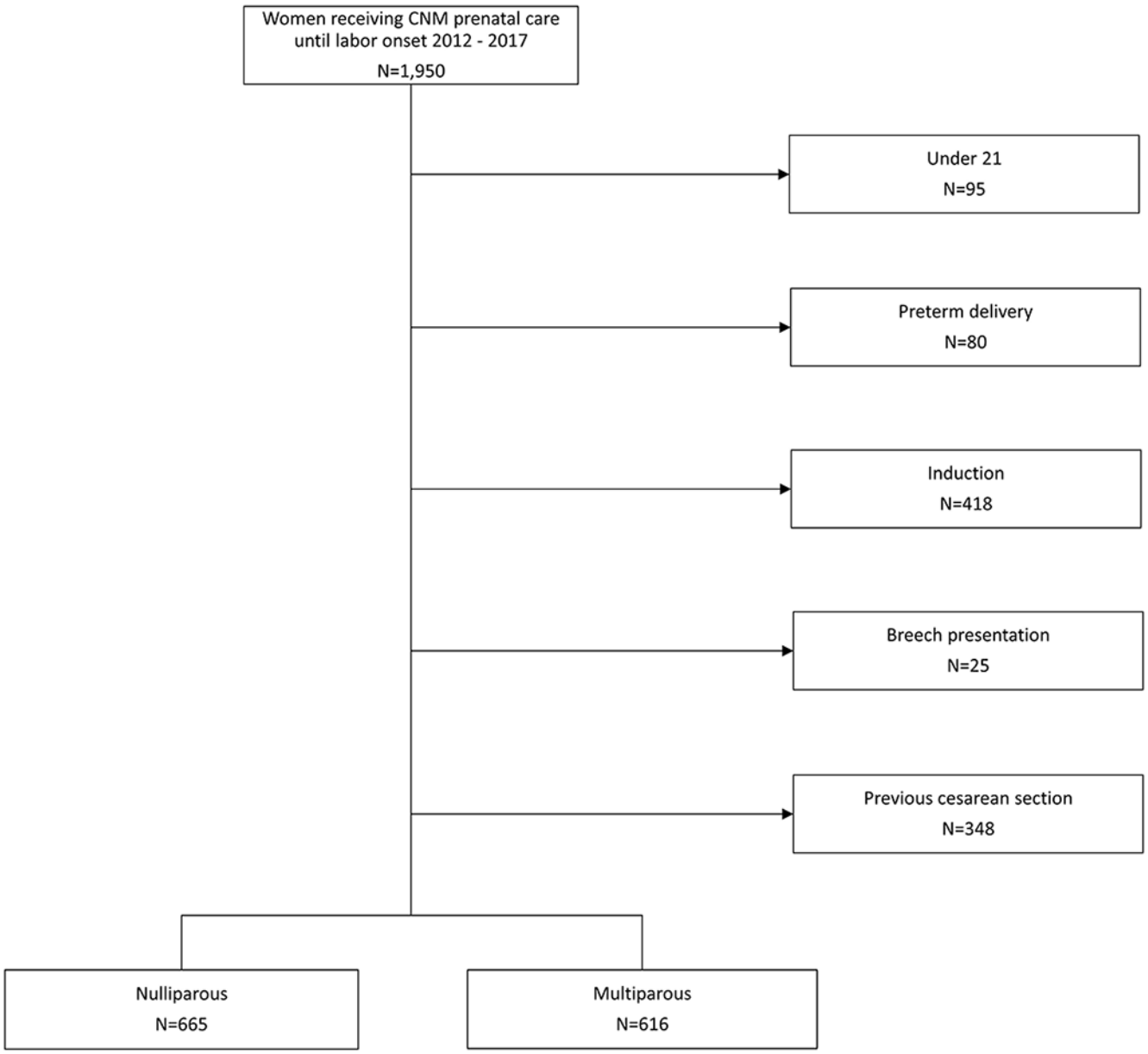

Figure 1.
Exclusion chart for nulliparous and multiparous samples, CNM Database, Portland, OR, 2012-2017

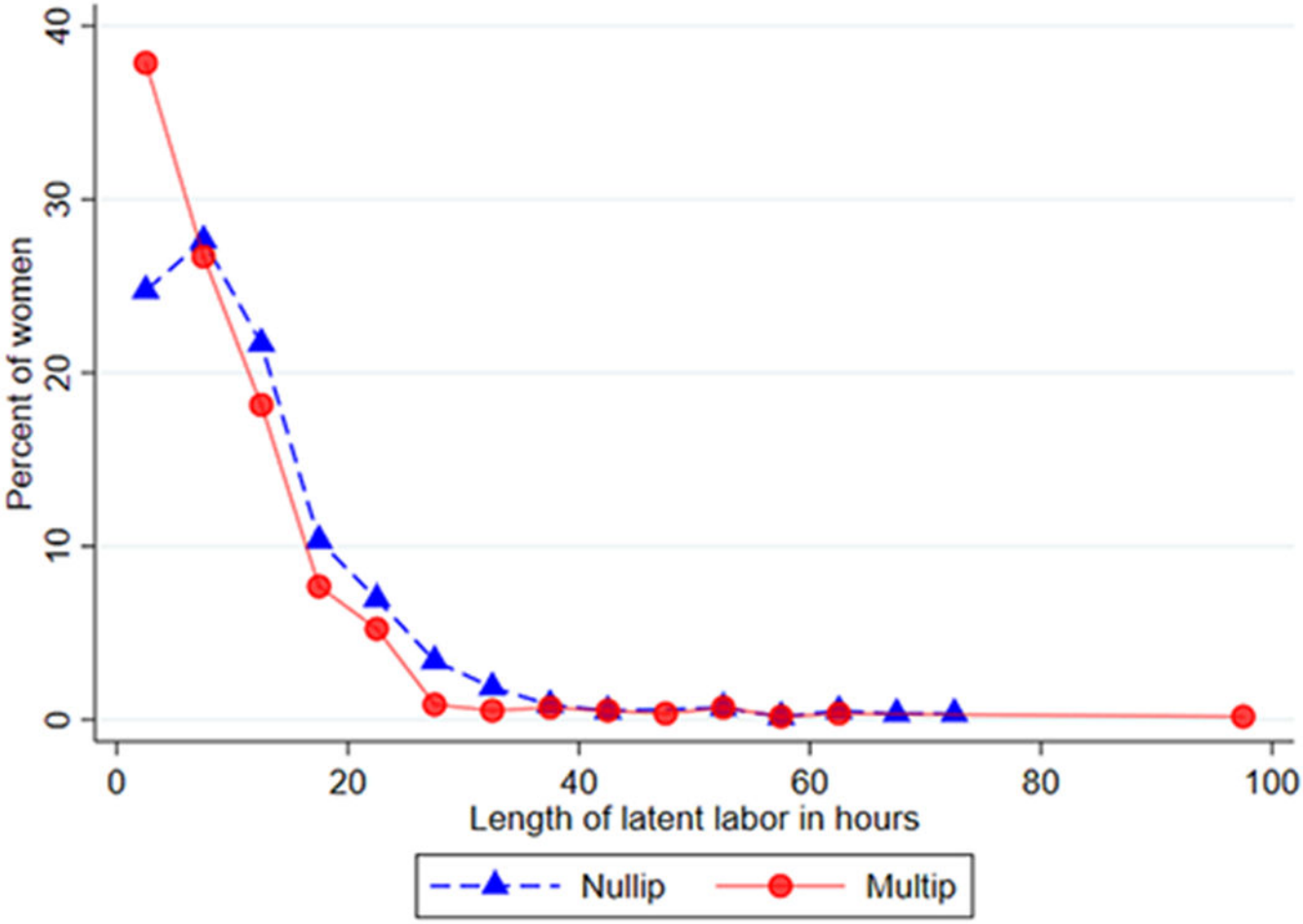

Figure 2.
Latent phase distribution among nulliparous and multiparous women in spontaneous labor, CNM Database, Portland, OR, 2012-2017

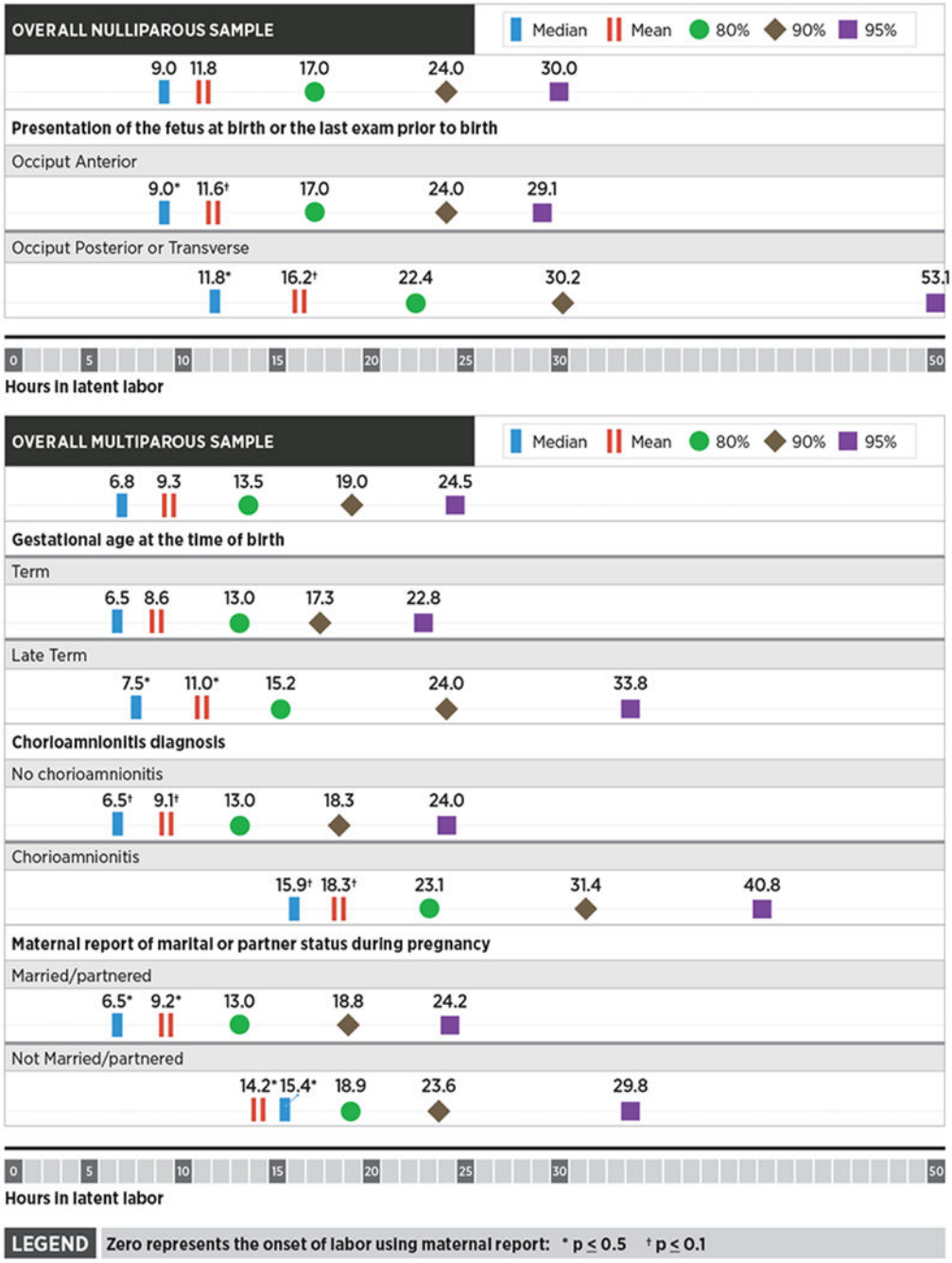

Figure 3.

Results of unadjusted analyses comparing characteristics with significant differences of nulliparous and multiparous women and hours of spontaneous latent phase labor less than vs. at and beyond the mean, median, and 80th, 90th, and 95th percentiles, CNM Database Portland, OR, 2012-2017

Table I.

Characteristics of low-risk women in spontaneous labor at term by parity, CNM Database, Portland, OR, 2012-2017

Demographic Characteristics	Nulliparous (n=665) n(%)	Multiparous (n=616) n(%)
Race		
Caucasian	580 (89.1)	541 (89.6)
African American	7 (1.1)	13 (2.2)
Asian	46 (7.1)	35 (5.9)
Multiracial	13 (2.0)	8 (1.3)
Native American	1 (0.2)	4 (0.7)
Native Hawaiian	49 (0.6)	3 (0.5)
Married or Partnered	641 (97.7)	597 (97.1)
≥ 35 years of age	148 (22.8)	164 (27.0)
Hypertension or preeclampsia	19 (2.9)	20 (3.3)
Gestational diabetes	51 (7.7)	39 (6.3)
Body mass index		
Underweight	25 (3.8)	23 (3.8)
Normal	442 (66.6)	392 (63.8)
Overweight	131 (19.7)	132 (21.5)
Obese	66 (9.9)	67 (10.9)
Excess pregnancy weight gain by Institute of Medicine guidelines	19 (2.9)	18 (3.0)
Group Beta streptococcus vaginal colonization	154 (23.5)	147 (24.3)
Pre-labor rupture of membranes	21 (3.2)	21 (3.4)
Chorioamnionitis	37 (5.6)	16 (2.6)
Gestational age at delivery		
Early term (37 0/7– 38 6/7 weeks)	84 (12.8)	101 (16.6)
Term (39 0/7– 40 6/7 weeks)	413 (62.7)	371 (60.9)
Late term (41 0/7 – 41 6/7 weeks)	143 (21.7)	112 (18.4)
Postterm (42 0/7 + weeks)	19 (2.9)	25 (4.1)
Birthweight by gestational age *		
Small for gestational age	30 (5.2)	25 (4.6)
At gestational age	472 (82.4)	460 (84.4)
Large for gestational age	71 (12.4)	60 (11.0)
Fetal position at birth		
Occiput Anterior	537 (90.9)	544 (93.5)
Occiput Posterior/ Occiput Transverse	54 (9.1)	38 (6.5)

*Infants were designated small for gestational age if their birthweight was in the bottom 10th percentile for gestational age; infants were considered large for gestational age if their birthweight was at or above the 90th percentile for their gestational age

Table II.

Duration of latent phase labor among low-risk women in spontaneous labor at term, CNM Database, Portland, OR, 2012-2017

	Nulliparous		Multiparous	
Point of distribution	**Duration latent phase (hours)**	**Number of women continuing latent phase beyond identified point of distribution (n)**	**Duration latent phase (hours)**	**Number of women continuing latent phase beyond identified point of distribution (n)**
50%/median	9.0	305	6.8	287
mean	11.8	220	9.3	254
80%	17.0	124	13.5	116
90%	24.0	62	19.0	59
95%	30.0	31	24.5	29

Table III.

Adjusted odds ratios for prolonged latent phase of labor by selected characteristics, with duration of latent phase at the mean, 80th, 90th, and 95th percentiles of duration of latent phase distribution, CNM database, Portland, OR, 2012-2017

		Adjusted odds of prolonged latent phase			
	Parity	**Mean (95% CI)**	**80th percentile (95% CI)**	**90th percentile (95% CI)**	**95th percentile (95% CI)**
Occiput Posterior or Transverse	Nulliparous	1.33 (0.61-2.90)	2.14 (0.94-4.87)	2.55 (0.95-6.87)	3.35 (1.02-11.01)
Chorioamnionitis	Multiparous	4.78 (1.46-15.62)	17.18 (4.58-64.42)	7.04 (2.02-24.52)	4.57 (0.86, −24.27)
Late term delivery	Multiparous	1.41 (0.91- 2.18)	1.54 (0.90-2.62)	2.09 (1.05-4.17)	3.38 (1.36- 8.38)
Partner	Multiparous	0.56 (0.18- 1.71)	0.21 (0.06-0.69)	0.41 (0.10-1.70)	0.56 (0.06-4.89)

Comparisons are as follows (referent category second):
Occiput Posterior or Transverse vs. Occiput Anterior, Chorioamnionitis present vs. no chorioamnionitis, Late term delivery vs. term delivery, Partnered vs. unpartnered

Models adjusted for:
partner status, maternal age, maternal height, Body Mass Index category (normal, overweight, obese), excess pregnancy weight gain, Group Beta streptococcus vaginal colonization, gestational diabetes, pre-labor rupture of membranes, gestational age at birth, birth weight, chorioamnionitis, and fetal position at birth (unless the variable was the outcome being examined)