

(RESEARCH ARTICLE)



## Rate of cervical dilatation and duration of active phase of labor among low-risk pregnant women delivering at Dodoma regional referral hospital

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### Abstract

**Background:** Cervical dilation at the onset of the active phase of labor determines the rate of cervical dilatation and the duration of the active phase of labor. Identifying the abnormality toward the natural progress of the active phase of labor is important because timely intervention has been observed to be controversial among developing countries during the current practice among health care providers due to different opinion on the onset of the active phase. Thus, indication like poor progress of labor has been poorly explained in which it has become a common indication for a steady increased rate of primary cesarean section and increased new born morbidity due to birth asphyxia.

**Objective:** This study aimed at determining the rate of cervical dilatation and duration of active phase of labor among low-risk pregnant women delivered at Dodoma Regional Referral Hospital.

**Methods:** This is a hospital-based prospective cross-sectional study where systematic sampling method was employed in obtaining sample of 300 pregnant women. Local partograph and a semi structured questionnaire were used to record the information and findings. Data were analyzed using SPSS version 25. One sample t-test was used to determine and compare the rate and duration of active labor with the WHO standard rate. P value < 0.05 was considered statistically significant.

**Results:** The mean rate of cervical dilatation during active phase for nulliparous was 0.81cm/hour and multiparous was 0.89cm/hour respectively, which is observed to be slower than standard WHO rates. The duration of the active phase of labor was 7.6 hours for nulliparous and 6.8 hours for multiparous.

**Conclusion:** The rate of cervical dilatation was much slower hence the longer duration of active phase in both groups than the WHO standards.

**Keywords:** RRH- Regional Referral hospital; UDOM- University of Dodoma; Active phase of labor; Gestation age in weeks; Body mass index; Rate of cervical dilatation, Duration of active phase of labor

### 1. Introduction

The length of cervical dilation at the onset of active labor affects the rate of cervical dilatation and labor duration (Suzuki et al, 2010). Initially, Friedman suggested that active labor should start from 3 centimeters cervical dilation with the

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expected rate of cervical dilation being 1.2 centimeters/hour to 1.5centimeters/hour (Friedman et al, 1955). Other studies have shown a slow rate of dilatation of up to 0.6 centimeters/hour when active labor considered from 3centimeters, which means that the patient will be in active labor for a longer duration than Friedman thought before (Lavender et al., 2005).

Active labor was considered as a period where there is maximum acceleration of cervical dilatation where it was recommended by WHO to be from 4 centimeters dilatation; this was done after reviewing what was recommended in different studies on the true definition of active labor (World Health Organization, 2018). The Canadian Association of Obstetrics and gynecology define active labor from 4 centimeters cervical dilatation in nulliparous but high up to 5cm in multiparous women (Lee et al., 2016; Prasantha et al., 2006).

A review of the Friedman labor curves showed that, initiation of active phase of labor below 5 centimeters the rate of cervical dilation will be much slower than expected and doesn't follow linear relation (Hildingsson & Blix, 2015; J. Zhang & Duan, 2018). Contemporary labor curves suggest that when active labor is initiated below or above 6 centimeters, the rate of cervical dilation differs, although it doesn't affect the outcome (Neal et al., 2010).

The proposed Friedman partograph was associated with the diagnosis of the slow progress of labor due to slower rate of dilatation which is <1cm/hour noted among Sub- Saharan countries leading to the increase in the risk of primary cesarean section (Augustino, 2019). In Tanzania, the current practice defines the active phase of labor from 3cm cervical dilatation which makes women more prone to intervention due to early diagnosis of prolonged labor with steady increase in rate of primary c/section, although some facilities still using the recommended WHO criteria for defining the active phase of labor (Chuma et al., 2014)

A significant problem in obstetrical care is the lack of uniform definition of the labor stages, especially for the initial landmark of the active phase of the first stage of labor (Hanley GE, et al., 2016). Depending on the definition of when the active phase begins and other maternal factors like BMI, it results in different durations of labor and dilation rates (Gunnarsson et al., 2017). According to ACOG and SMFM, the active phase of the first stage of labor begins at 6 cm cervical dilatation although Juhasova et al, did a study and reports a rate of cervical dilatation ranging from 0.29 to 1.57 cm/hour in nulliparous and from 0.32 to 4.47 cm/hour in multiparous women with significant differences in dilation rates noted from 6 cm of cervical dilatation (Juhasova et al., 2018).

Moderate-certainty evidence from two studies suggests that the median duration of the nulliparous active phase when the starting reference point was 4 cm was 3.7–5.9 hours and 2.2–4.7 hours for multiparous women (Say et al., 2014). A study done by Abalos et al reported a median duration of 2.9 hours in nulliparous and 2.2–2.4 hours in multiparous when the starting reference point for active phase was 6 cm (Abalos et al., 2018). But Chen et al reported a mean duration of 4.7 hours and statistical limits of 9.9 hours for the active phase with a starting reference point of 3 cm. Sensitivity analysis excluding studies with any intervention (augmentation, instrumental vaginal birth, and second-stage cesarean section) shows a similar range of mean durations for the active phase starting at 4 cm. This sensitivity analysis did not include any studies reporting median labor duration (Chen et al., 2018).

The duration of the active phase of the first stage of labor was different depending on the initial cervical dilatation where those with higher cervical dilatation at the onset of active labor had shorter duration than others and had less risk of cesarean section (Sherry et al., 2013). When the active phase of labor is considered too early has been associated with a longer duration of active labor, which may reach up to 7 hours compared to when the onset of the active phase of labor is considered late (Pujar et al., 2015).

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## 2. Methodology

This was a Comparative prospective cross-sectional study conducted from March to June 2020 including low-risk pregnant women in active phase of labor delivering at Dodoma regional referral hospital, Dodoma- Tanzania. It included low-risk pregnant women with GA> 37wks and < 42wks (at term pregnancies), single tone, cephalic presentation. Women with labor induction at term. Exclusion criteria are Age < 18 years, Low-risk pregnant women (with no any risk condition threatening life of mother or fetus eg. PIH, Gestation Diabetes mellitus) in the late active phase of labor, thus cervical dilatation of >7 cm, term pregnancy single tone with non-vertex presentation in the active phase of labor, referral cases in active phase with single tone fetus at term with vertex presentation.

Initiation cervical assessment for the participants who met the inclusion criteria was done by the researcher or by the research assistants at the time of admission to labor ward. The same process of recruiting was repeated until the sample

size was achieved. Those who were in the active phase of labor with cervical dilatation from 3- 6 centimeters were enrolled and partograph was initiated. After 4 hours the researcher or an assistant researcher repeated the vaginal assessment to see the cervical dilatation as per protocol. Information concerning multiparous was in Group B, and for nulliparous was in Group A. The researcher and assistant researchers continued to fill the structured questionnaire with the information obtained from patient's partograph concerning the labor progress and outcome. The information included the mode of delivery, newborn APGAR score, and any immediate complication which occurred during labor.

Women who had a cervical dilatation of seven centimeters and above at the time of admission were excluded from the study. This is because they were in a late stage of the active phase of labor.

Partograph was opened for those who was in active phase. This was done after an initial vaginal assessment by the researcher or researcher assistant using a referencing cervical gram chart and completed after delivery. A well-constructed and structured questionnaire was used to extract information from the client partograph and theatre operating register. The questionnaire contained parts of personnel information (demographic data) followed by the fetal monitoring chart, labor progress chart and the mode of delivery and the information regarding the maternal and neonatal outcome.

Partograph was used as a monitoring tool where documentation was done in a way that all parameters monitored and recorded during labor was easily extracted. Fetal heart rate was recorded using Pinnard fetoscope because it easily available, less expensive and easy to use as compared to doppler scan. The Mother's information was captured from the first part of partograph such as client registration number, age of the patient, gestation age, gravidity, date and time of hospital admission. Fetal progress was plotted on the partograph including FHR, status of membrane (if rupture was spontaneous or artificial), state of the liquor, molding, all this information was filled through partograph.

All other information regarding labor progress ie. cervical dilatations, descent of the presenting part, uterine contractions, alert and action line, detection of abnormal labor, time of intervention and time of action, duration of active phase of labor were all extracted from the partograph. BP, PR, temperature, urine for protein and acetone from the mother was also assessed.

## 2.1. Statistical analysis

Data were analyzed using statistical software SPSS version 25. Where descriptive analysis for the participant demographic characteristics and intrapartum information was done where Mean was calculated and simple frequency table was plotted.

Rate of cervical dilatation among the participants was calculated by determine the individual dilatation of cervix during active phase of labor from the initial cervical dilatation at the enrollment of active phase to full dilatation divide by the time used to reach full dilatation and one sample independent T-test was determined to compare the mean rate of dilatation for nulliparous and multiparous and compare it with the standard WHO minimal rate of cervical dilatation per hour where nulliparous was 1.2cm/hour and multiparous was 1.5cm/hour. The rate was determined in two groups for both nulliparous and multiparous where the first group was the overall rate of dilatation for nulliparous and multiparous, the second group was according to the initial cervical dilatation at admission to labor ward where those enrolled with 3-4cm dilatation grouped together and those enrolled with 5-6cm cervical dilatation grouped together this is because of challenges in detecting the exactly difference in dilatation between 3 - 4cm similar as to 5- 6cm.

To determine the individual duration of active phase of labor; One sample T- test was determined after comparing the overall duration of active phase for nulliparous and multiparous with the known standard WHO duration of active phase of labor which is 4 hours. This was extracted from the standard rate of cervical dilatation during active phase of labor as recommended by WHO, where 1.2cm/hr was the minimal rate of cervical dilatation for nulliparous and 1.5cm/hr was the minimum rate of cervical dilatation for multiparous. It was calculated that from 4 cm to reach full dilatation of cervix (10cm) which is 6 cm therefore the expected duration for nulliparous was 5 hours and multiparous expected to use 4 hours, so the duration was calculated as the average between duration for nulliparous and duration for multiparous where the duration was 4 hours.

## 2.2. Ethics statement

The permission to conduct the research was granted by the Institutional research committee of the University of Dodoma (UDOM) with reference no UDOM/DRP/134 and allowed data collection at Dodoma referral regional hospital. All participants had informed signed consent to be involved in this research as per University of Dodoma protocol with assurance of confidentiality. The findings obtained from this research were granted permission for publication.

### 3. Results

Three hundred low-risk women who met the inclusion criteria were enrolled in the study after consenting to participate. Of all participants, 137 (46%) were nulliparous and 163 (54%) were multiparous. Table 1 reports the demographic responses of the participants. The mean age for the participants was 25.03 with SD of 5.71, and the mean gestation age was 39 weeks.

**Table 1** Socio-Demographic characteristic and intrapartum information of the participants (N=300)

<b>Variable</b>	<b>Total N (%)</b>	<b>Nulliparous N (%)</b>	<b>Multiparous N (%)</b>
<b>Age</b>			
<20	62 (20.67)	54 (39.42)	8 (4.91)
20-29	181 (60.33)	71 (51.82)	110 (67.48)
>30	57 (19.00)	12 (8.76)	45 (27.61)
<b>Patient Education</b>			
No formal Education	15 (5.00)	5 (3.65)	10 (6.13)
Formal Education	285 (95.00)	132 (96.35)	153 (93.87)
<b>Patient Occupation</b>			
Employed	59 (19.67)	20 (14.71)	38 (23.31)
Self Employed	129 (43.00)	46 (33.82)	83 (50.92)
Peasant	112 (37.33)	70 (51.47)	42 (25.77)
<b>Marital status</b>			
Single	48 (16.00)	27 (19.71)	21 (12.88)
Married	252 (84.00)	110 (80.29)	142 (87.12)
<b>Residence</b>			
Rural	88 (29.33)	38 (27.74)	50 (30.67)
Urban	212 (70.67)	99 (72.26)	113 (69.33)
<b>Gestation Age</b>			
37-40	258 (86.00)	128 (93.43)	130 (79.76)
>40	42 (14.00)	9 (6.57)	33 (20.25)

Using One sample Independent T-test, a comparison of the rate of cervical dilatation during active phase of labor with the recommended WHO standard rate; hence the mean rate of cervical dilatation for nulliparous was 0.81 cm/hour and multiparous had a mean rate of cervical dilatation of 0.88 cm/hour. The mean rates of cervical dilatation of both groups differed significantly with that of WHO with a  $p$ -value of <0.0001.

Depending on the initial cervical dilatation at admission to labor ward the rate of cervical dilatation was calculated for both nulliparous and multiparous. Nulliparous admitted with cervical dilatation of 3-4 centimeters had a mean rate of 0.70 cm/hour while those admitted with cervical dilatation of 5-6 centimeters had a rate of 0.86 cm/hour. Similar for multiparous admitted with cervical dilatation of 3-4 centimeters had a mean rate of 0.81 cm/hour while those admitted with 5-6 centimeters cervical dilatation had 0.95 cm/hour. All mean rates of cervical dilatation were statistically significant with a  $p$ -value of <0.0001. All described in the Table 2 below.

**Table 2** Comparison of the rate of cervical dilatation (cm/hr) to the WHO rate

Variable		Mean	95% CI		WHO rate	t-value	P- value
			Lower	Upper			
Nulliparous		0.8103	0.7622	0.8584	1.2	-13.43	<0.0001
Multiparous		0.8834	0.8398	0.9270	1.5	-23.38	<.0001
Nulliparous	3-4 cm	0.7036	0.6530	0.7542	1.2	-16.46	<.0001
	5-6 cm	0.8679	0.8007	0.9351	1.2	-8.21	<.0001
Multiparous	3-4 cm	0.8176	0.7693	0.8660	1.5	-23.49	<.0001
	5-6 cm	0.9500	0.8783	1.0218	1.5	-12.76	<.0001

Results were analyzed into groups depends on parity and initial cervical dilatation during admission to labor ward as shown in Table 3 below. One sample independent t- test comparing the results to the WHO standard average duration of active labor which is 4 hours. The duration of active phase of labor which ranges from 4-5 hours was calculated from the standard rate of cervical dilatation during active phase which ranges from 1.2 cm/hour to 1.5 cm/hour (WHO, 2018a). Nulliparous had a mean duration of active phase of labor of 7.6 hours while multiparous had a mean duration of 6.8 hours with statistical significance and a *p*-value of <0.0001.

**Table 3** Comparison of duration of labor active phase of labor to the WHO standard duration of active labor in hours

Variable	Mean	95% CI		WHO duration	t-value	P- value
		Lower	Upper			
Nulliparous	7.6058	7.2912	7.9205	4	10.2	<.0001
Multiparous	6.8589	6.5559	7.1619	4	12.4	<.0001

#### 4. Discussion

The rate of cervical dilatation during active labor in our study was found to be slower for both nulliparous and multiparous women which is slower than the suggested WHO standards with multiparous showing a higher rate of dilatation than nulliparous. Nulliparous has a rate of 0.81cm/ hour and multiparous 0.88cm/hour which is similar to the study from University of Zurich which was done by Jusahova et al shows that cervical dilation range from 0.29-1.57cm/hour in nulliparous and 0.32- 4.47cm/hr in multiparous where the progress is much faster in multiparous compared to nulliparous, this similarities are due to the same state of initial cervical dilatation at the onset of active labor without any obstetrical intervention (Juhosova et al., 2018)

Another resemblance in the findings was observed in a prospective cohort study in two Sub-Saharan African countries, found out that, Multiparous have faster rate of dilatation than nulliparous regardless of the initial state of dilatation using a multistate Markov model because gravidity is associated with faster rate of dilatation (Arulkumaran, Gibb, Lun, Heng, & Ratnam, 1984). The findings were a little bit different from the study which was done in India and shows that rate of cervical dilatation is 1.2cm/hour to 1.5cm/hour similarly to the Friedman's proposal, this can be explained by the study population which involves only nulliparous but also higher cervical dilatation at the onset of active phase which was considered from 6cm and is associated with steep acceleration of dilatation. (Pitchaimuthu et al., 2018)

In a journal of midwife Jeremy et al found different results that women may present with 0.5cm/hour during active labor and still considered to be normal as was shown in this study where the rate of dilatation was less than 1cm/hour during active labor but higher than their study and this did not affect the outcome of labor, the dissimilarity may be associated with different in study design where they did database review. (Neal et al., 2010). Different findings were reported in a study which was done in Mexico and found that women do differ in their rate of dilatation this can be explained by the factor that in each study it involves women of different ethnic groups which may affect the practice and monitoring of women during labor (Albers et al., 1996)

In comparing the duration of active phase of labor in this study it was revealed that nulliparous and multiparous had significant longer duration of labor with overall mean duration of 7.6hours and 6.8hours in the two groups respectively. The result also shows that there was a significant shortening of labor duration with late onset of active phase of labor where nulliparous may have a duration of 7.98 hours which reached 8.3hours when cervical dilatation was less than 5cm but shorter duration up to 6.6hours when active labor begins above 5 cm dilatation. Similarly, to multiparous where the duration was 7.7 hours if the dilatation was less than 5cm and up to 6hours when above 5cm.

Similar findings was reported in a study done by Suzuki et al in Japanese women though the rate of dilatation was much faster in their study, this similarity in the duration of labor and the existing difference in the rate of dilatation may be explained with the different in study design where they did retrospective design by reviewing the pre-existing information of labor but also the large sample size.(Suzuki et al., 2010), similarly as Juhasova et al reported a longer duration of active phase of labor in nulliparous which was 9.47 hours and multiparous 7.33 hours this duration was almost similar to the higher limit of labor duration in my study (Juhasova et al., 2018).

Similar results were also reported from a study in Delta Medical College, Dhaka, Bangladesh, which showed that, nulliparous women had longer duration of labor with mean time of 8 hours than multiparous who had mean time of 6 hours this similarity in the findings may be associated with nutritional status which may affect the overall bone development in young nulliparous which is less likely to affect multiparous. (Shuchi et al., 2019)

In comparing the findings from this study shows that, the variation of multiparous curves is smaller than that of nulliparous curve which is because multiparous women may enter the active phase of labor with more organized contractions than nulliparous women and the speed of cervical dilation in active phase is slower in nulliparous than in multiparous as found in a study which was done by Zang et al and found that the late the onset of labor the shorter the duration will be but also been previously exposed to labor favors the progress in multiparous (Zhang et al., 2010)

Vahratian et al also found there was a difference between nulliparous and multiparous duration of labor but overall, there is shorter duration in their population compared to the findings from my study because of the initial cervical dilatation at the onset of active phase of labor in my study majority were at 3-4cm dilatation which may hinder the results and affect the duration of labor but also multiparous has shorter duration due to faster rate of dilatation associated with previous exposure to labor (Vahratian et al., 2006).

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## 5. Conclusion

It was revealed that women involved in this study had a slower rate of cervical dilatation compared to the WHO rates, with normal labor progress. Further observation from this study is that pregnant women involved had a longer duration of active phase as compared to the calculated standard WHO duration. This in fact indicated that, there is an association between cervical dilatation and the duration of labor.

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## Compliance with ethical standards

### *Acknowledgement*

I thank all the mothers who participated in this study.

### *Disclosure of conflict of interest*

The author declares no conflict of interest.

### *Statement of ethical approval*

Ethical approval was given under the institutional research review committee and given clearance no UDOM/DRP/134

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

*Authors contribution*

- **Conceptualization:** Deusdedit K William
- **Formal analysis:** Deusdedit K William, Maria Rweyemamu, Athanase Lilungulu, Abdallah R Mlwati, Secilia Kapalata.
- **Supervision:** Maria Rweyemamu
- **Writing- original draft:** Deusdedit K William
- **Writing- reviewing and editing :** Deusdedit K William, Maria Rweyemamu, Athanase Lilungulu, Abdallah R Mlwati, Secilia Kapalata

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