Accuracy of purple line to monitor labour progress: Longitudinal study

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Abstract

Background: Precise evaluation of labour progresses can help mothers to be consulted on time and decrease maternal and neonatal morbidities**.** The purple line is non-invasive methods to assess labour progress. The current study **aimed** to assign appearance percentage of the purple line during the first stage of labour, as well as the accuracy of the purple line to predict labour progress. **Design**: Longitudinal design was adopted. A purposive **sampling** method has been employed to recruit 120 labouring women at the obstetric department in El-Nabawy El Mohandes Hospital, Fayoum. **Three tools** of data collection were used: structure interviewing questionnaire, purple line observation record and partograph. **Results**: revealed that, the purple line appears among about four fifth of the total sample. A medium positive association was found among the purple line length, dilatations of the cervix and fetal stations. The purple line appearance in the expectation of labour progress had 87.91% sensitivity, 39.53% specificity and 85.25% accuracy. In addition, the purple line was more significantly in a spontaneous labouring woman and no significant association between parity, women age, BMI, fetal birth weight and the existence of the purple lines. **Conclusion**: The purple line is useful in assisting the health care providers in assessing and determining labour progress and lessen the number of vaginal examinations, particularly at consideration of females who refuse or feel that the examining intrusive. **Recommendation**: Integration between vaginal examination and purple line to evaluate the labour progress to reduce the vaginal examination rate and its risk. Further research still needed to identify the accuracy of other noninvasive methods to assess the labour progress.

Keywords: Purple line, Monitor labour progress, Accuracy.

Introduction:

An essential aspect of maternal care is labour progression observation; and in case of no labour progress, physicians take the decision of caesarean operations. Thus, following up the labour progress is immensely fundamental in interference with the decision of normal vaginal delivery **[Fraser, et al., 2015]**. Several methods are available to measure the labour progression such as assess of uterine contractions, descent of foetal head, assessing cervical dilatations and women behaviour changes [**Danal, 2016].** Presently, the best method for assessing the labour progress is via vaginal examination to determine cervical dilatations, foetal position, presentation and moulding through, the greatest percentage of vaginal examinations [**Buchman & Libhaber, 2017**].

Vaginal examinations (VEs) can be annoying, invasive,and painful for fem ales [**Byrne & Edmonds, 2015]**. Physical and psychological disturbance can be caused by the indiscriminating

use, violation of women privacy, and repeated vaginal examinations. In contrast, there is a relation between vaginal examinations occurrence numbers, infections of urinary tract, puerperal sepsis risk and early new infections where premature ruptures of membrane have arisen. Moreover, the vaginal examining remains to cause risks of introducing infections with intra-amniotic infection (IAI) happening among 8 and 12 females every 1000 labours **[Lewin, et al., 2016]**.

Since the VEs have a negative impact, it has been restricted by the guidelines. For instance, the National Institute for Health and Clinical Excellence Intrapartum recommendations recommended that VEs must be used each 4-hours in the initial step of birth and should not be regularly conducted **[NICE, 2015]**. Similarly, the World Health Organization (WHO) limited the quantity of VEs to four in the first stage of labour if childbirth is proceeding on smoothly **[WHO, 2014].**

Using non-invasive methods are essential to lessen unnecessary interventions in labour. The studies have presented behaviours and vocalization symptomatic of the progress of labour. However, these methods have the minimum reliability to vaginal examinations **[Shepherd & Cheyne, 2016].** Monitoring cervical dilation and foetal stations throughout the labour is assessed by purple line length as a none invasive process that seemed as a point rounding the anus that extends from the anal margins reaching the scruff of the buttock throughout birth and improvements together with cervical dilations as cited by Hobbs. The direction of this progress is looks as a thermo-meter in which the mercury expanded upwards from the inter-gluteal lines to the Sacro-coccygeal joints [**Hobbs, 1998].**

The main causes for appearance of purple lines are unknown, but many scientists have been proposed that the vaso-congestion at the basis of the sacrum can cause the increase of the appearance of purple line. It lightens with pressure and slowly re-colours once the pressure was decreased. These congestions appeared due to the growing of intra-pelvic pressures as the fetal head descends, that considered appositive correlation between the decent of the foetal head and increase the presence of purple-lines. In addition, ordinary change in the shapes of the pelvis which the rhombus of Michaelis of the bones moves back throughout advanced birth, pushing out the ilea wings and growing the pelvic diameters attach another explanation to the presence of purple line **[Bonilla, et al., 2016].**

Obstetric health care team especially maternity nurses must be proactive and play a vital role in offering advice and alternative resources to help women be as comfortable and safe as possible throughout the first stage of labour. The choice and preparations that maternity nurse made during birth have a great impact on birth experience and outcome. It is argued that women who were helped and saved by maternity nurses reflected higher self-esteem and better self -efficacy, which reflect positively on the labour outcome. [**Pornprasertsuk, et al., 2018**].

Significance of the problem

The baby's birth is a core occasion for humanity, and one which have a big influence on women's lives. As well as women experience a various pain in labour, that makes them intimidated and

anxious causing the increase in blood hormones percentages as epinephrine. These changes negatively impact both the pain level and the period of the 1st and 2nd staging of labours. Although vaginal examining was the typical for the evaluation of labours progresses, but the experiences of experiencing it could produce more pain throughout what is frequently a very vulnerable and painful period for female. Furthermore, frequent vaginal examining raises the hazards for females to have Chorioamnionitis, puerperal sepsis, develop neonatal sepsis. In addition, females might state spirits of shame, guilt, and weakness that influence their own sureness in their capability to birth. The purple lines is employed as a non-invasive technique to predict labour progresses, it can be used as a substitute to VE, that seems as a purple line view rounding the anus throughout birth and continues accompanied by dilations of the cervix, but a slight evidence was exist that support its usage. In Egypt, no researches that are conducted to examine the accuracy of this non-invasive method to monitor the labour progress. In this context, the current study has two central goals: assign the appearance percentage of purple lines throughout the labour and its precision to expect the progress of first stage of labour.

Aim of Study:

The current study aimed to: Study purple line precision to monitor labour progress. This aim was achieved through:

1.Assign the appearance percentage of purple lines throughout the first stage of labour.

2. Assign the accuracy of purple line to expect labour progress in the first stage of labour.

Research hypothesis:

This study hypothesized that:

- The purple lines will appear in almost all of the labouring females.
- A positive association among cervical dilatations, fetal station, and purple lines length.

Subjects and methods

Research design: longitudinal study design was employed to agree with the study aims.

Study Setting: This study was performed at the obstetric unit in El Nabawy El Mohandes Hospital affiliated to the Ministry of Health, Fayoum, Egypt.

Subjects: A purposive sampling technique was utilized in gathering the required data. **One hundred twenty** labouring women in total were determined according to N= (z2 ×p ×q)/D2 at CI 95% and power of 80%. The sampling size based on the incidence of labouring women flow rate at the previous study year in a predetermined hospital. The sample elected in accordance to the subsequent criteria of inclusion and exclusion. The criteria of inclusion; normal low risk nulliparous or multipara, at active phase, healthy full term more than 37 wks. of gestation, singleton foetus, and cephalic presentation and accepting to take part in the study. The researchers excluded cases of females with maternal and fetal complications throughout the present gestation, any complications in the first stage (maternal-fetal), prematureness (less than 37-wks.), post-maturities (more than 42-wks.), fetal mal-presentations and fetal mal-positions. The excluded cases were limited to nine women, who had certain conditions such as the need for an emergency C-section, but the researchers

had backup for those participants.

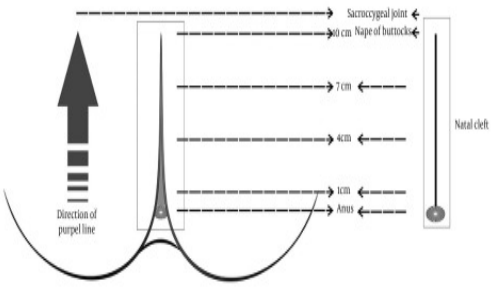
Tools for data collecting: three tools have been utilized for collecting data as the next:

Tool I. labouring women Socio-demographic data collection tool (structure interview questionnaires): This tool has been designed by the researchers afterward reviewing relative literature, which included seven questions, and divided into two parts. The first part includes a question related to the basic features of the labouring women as; women's age, education, occupation, residence, gestational age, BMI. While the second part dealt with the obstetrics data as; Parity gestational age at birth and fetal birth weight. These questionnaires were filled in the first stages of labour by the investigators.

Tool II. Labour progress assessment tool (partograph): This standardized tool was adopted from **[WHO, 2010],** this used by researchers to measure the progress of labour.

Tool III. Purple line observation record form:

This tool was adopted from [**Hobbs, 1998**], which clarifies the length of cervical dilatations on women's natal craft. **(Figure 1)**



(Figure 1)

Tools validity:

The contents tools validity was revised by three experts in Obstetrical and Gynaecological nursing to examine contents validity and according to their ideas; no modifications have been carried out in the content.

Reliability of tools:

Researchers have established the reliability of the tools of the current work via Alpha Cronbach technique. The reliability coefficients for the tools were estimated via the association coefficient Alpha (Cronbach), that presented that the reliability coefficients value to be (0.99), that are value that are approved statistically, that is a very-high coefficients.

Pilot Study

It was performed on 10% of the cases, were random chosen and not excepted from the entire sample because there no modifications were done. The aim was to assess the ease and clearness of the tools. It was assisted as well in estimating the period required to fill in these questionnaires.

Ethical consideration

An authorised consent was gotten from the director of the El Nabawy El Mohandes Hospital affiliated to the Ministry of Health, Fayoum, Egypt. The investigators announced them-selves to the females who fulfil the criteria of inclusion and informing them about the aim of this study to get their approval to participate in this study, the researchers confirmed that the study poses no risks or hazards to their health and participations in the current study are volunteers. They have been permitted to stop sharing in the study without explanation if they feel the need to do so.

Females who were ready to contribute in this study and fulfil the criteria of inclusion were contacted by the investigators and requested for verbal agreement to settle their approval, and all proceedings that happened through the data collecting were considered private.

Fieldwork:

The study lasted for 12 months, preparation about three months, followed by six months for collect data and three months for data analysis and evaluation. The study started in June 2019 and was completed by May 2020. The researchers visited the designated hospital three days/week. The researcher's screens all labouring women in the dynamic part of the 1st stage and meets the eligibility criteria were included in the study. The researchers started the interviews by welcoming the labouring women, and then explained the study aim and took an oral consent for participation. The researchers assessed the woman in lying lateral position. When the cervix opens from 3-4 cm, the purple line appeared as red/purple among the buttock and, researchers started to measure the length of purple line (in centimetres) by disposable tapes measuring from the anal margins to the nape of the buttock and then documented. For females who permitted for labour, two-health care team were present to follow the progress of labour by the two methods (the nurse researchers measure the purple line length in centimetres while medical doctor who didn't recognize the existence or non-existence of the purple lines carried out a vaginal examination to assess dilatations of the cervix and foetal head decent), then recorded the result in the partograph and observation record form of purple line**.** If cervical dilatations progress lesser than 1-cm/h in the active phase for 2 successive hours and the fetal head slope lesser than 1-cm/h it is considered abnormal progress of labour. After delivery, the researcher divided the subjects to normal and abnormal labour progresses, and the precision of purple lines to monitor labour progress was calculated.

Limitation of study:

One of the limitations of this study was the vaginal examination was done by more than one doctor in the department; but, to improve the precision, the researchers suggested that only one physician to accomplish the examinations in all patients to decrease the confusing factors.

Statistical design:

The data was statistically analysed via SPSS-20. Originally, the internal constancy coefficients were tested to guarantee the reliability of the utilized instruments for the current sample. Frequency mean and standard-deviation (SD) were estimated to define the sample. T- test, Multivariate analysis of variance (MANOVA), spearman correlation, Chi-square testing. Specificities, Sensitivities, positive and negative indicating values were as well estimated. Statistical significance was taken in to consideration at p-value <0.05.

Results:

Table (1): pointed to the distributions of socio-demographic and obstetrical characteristics of the samples under the study; the results revealed that 61.7% of the sample under the study has less than 35 years. Moreover, 33.3% of them can read and write. Also, 63.3 % of the studied sample was housewife; and, 45 % of them had normal BMI.

Regarding their obstetric characteristics the result revealed that, 55.8% of the women were multipara, in addition, 70% of them experienced spontaneous labour. Also the result show 51.7% of the studied sample, their fetal birth weight was less than or equal 3500(gm). Also, the gestational age at birth was 39.6±1.5 week.

Figure (1) Show the distribution of the sample under the study in accordance to the presence of purple lines during the first stage of labour, the result pointed to the purple lines through the first stage of birth appears among 82.5%% of the sample under the study.

Table (2): illustrates the distribution of labour progress and existence of purple line among the studied sample during the first stage of labour**,** the result exhibits that, in 87.5% of the cases with normal labour progresses in the 1st stage of labour period of labour, a purple line were found in 62.5% of the cases with abnormal labour progresses. By mean the purple line appear among 82.5% of total labour progress. In addition, the Chi-square testing consequences presented that there is a high significant correlation among the existence and non-existence of purple lines with labour progresses.

Table (3): represents the percentage estimation of vaginal examination at definite cervical dilatation where lines were existing and mean lengths of purple lines among the studied sample. The table illustrates that the purple lines was significantly more possible to be existing among labouring females in spontaneous labour (n = 83, 86.5%) in comparison with those birthing females permitted for induction of labour (n = 17, 17.7%), X^2= (5.3) p = 0.02. Also the table revealed that, the percentage of appear purple line among the study sample increase with increase the cervical dilation as; when the cervical dilation was 3-4 (cm), the purple line appears among 68.7% and 52.9% of the studied sample(spontaneous and induction of labour respectively). While, when the cervical dilation was 9-10 (cm), the purple line appears among 83.1% and 76.5% of the studied sample (spontaneous and induction of labour respectively). On the other side the mean length of purple line increased from 6.9± 2.8 and 6.7±2.4 (spontaneous and induction of labour respectively) when the cervix was 3-4 cm expanded into 9.3±1.9 and 9.4±1.6 (spontaneous and induction of labour respectively) when the cervix dilation was 9-10 cm.

Table (4): This table elaborates on the relationship among the lengths of purple lines, cervical dilations and station of fetal head among the studied sample during the first stage of labour; the results showed that the examined via a within subject's association analysing. Investigation only comprised females who have more than 2 times of estimations length of lines, cervical dilatation and stations of the fetal heads. A medium positive association was found among the lengths of the purple lines and cervical dilatation r = +0.35, 5 P = 0.001 and a medium positive association among the lengths of the purple lines and stations of the fetal heads, r = +0.51, P-value < 0.001.

Table (5): This table indicated to the accuracy of purple lines in monitoring labour progresses during the first stage of labour. The results pointed to the presence of the purple lines in predicting the labour progresses have 39.53% specificity, 87.91% sensitivity, and 85.25% accuracy.

Table (6): This table illustrates the multivariate analysing of factors accompanying with the existence of purple-lines during the first stage of labour. The purple-lines was significantly frequent to exist in females in spontaneous labours (n = 83, 60%) in comparison to hose females admitting for induction of labours (n = 17, 40%), p = 0.02. But, non significant correlation among parities, women age, BMI, fetal birth weights and existence of purple lines.

Table (1) Sociodemographic and Obstetrical characteristics distribution of the Studied sample.

Items	N (120)	%
Women's age		
< 35		61.7
≥ 35	74	38.3
	46	
Education level		
Read & write	40	33.3
Primary	22	18.3
Secondary	35	29.2
Higher education	23	19.2
Occupation		
Working	44	36.7
Housewife	76	63.3
Residence		
Rural	89	74.2
Urban	31	25.8
BMI		
Obese	4	3.3
Overweight	42	35
Underweight	20	16.7
Normal	54	45
Obstetric characteristics		
Parity		
Primiparous	53	44.2
Multiparous	67	55.8
Gestational age at birth (M±SD) wks.	39.6±1.5	
Spontaneous labour	84	70
Induction labour	36	30
Fetal birth weight (**gm**)		
≤3500	**62**	51.7
>3500	**58**	48.3

Figure (1) Distributions of the sample regarding the presence of purple-lines during the first stage of labour.

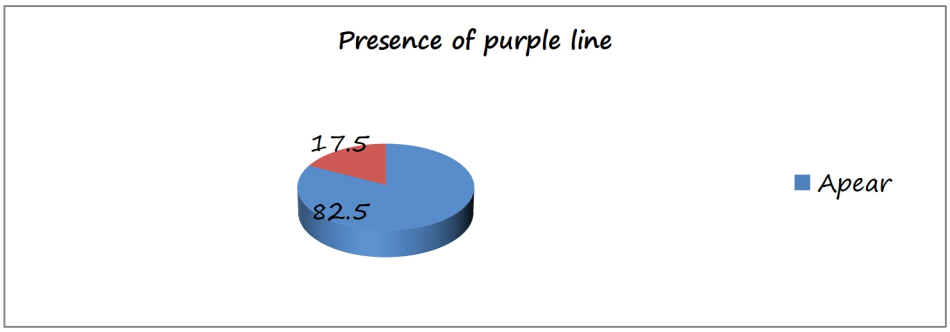


Table (2): Distribution of labour progress and existence of purple line among the study sample during the first stage of labour (n= 100).

Existence of purple line	labour Progress			X^2	P value
	Normal Labour progress	Abnormal Labour progress	Total Labour Progress		
Yes	84(87.5)	15(62.5)	99(82.5)	6.21	0.001
No	12(12.5)	9(37.5)	21(17.5)		
Total	96(100)	24(100)	120(100)		

***(n= 100) number of women whose purple line appear during first stage of labour.**

Table (3): Percentage estimation of vaginal examination at definite cervical dilatation where lines were existing and mean lengths of purple lines among the study sample. (n= 100).

	Spontaneous labour N=83		Induction of labour N=17		X^2 / p
Cervical dilatations (cm)	Vaginal examination(%) at a specific cervical dilatations where Lines was existing	Length of purple line (M±SD)	Vaginal examination(%) at a specific cervical dilatations where lines was existing	Lengths of purple lines (M±SD)	
3-4	68.7	6.9± 2.8	52.9	6.7±2.4	X^2=
5-6	74.7	7.2±2.6	64.7	7.9±2.4	(5.3)
7-8	77.1	8.5±2.0	70.6	8.1±1.7	p =
9-10	83.1	9.3±1.9	76.5	9.4±1.6	0.02

***(n= 100) number of women whose purple line appear during first stage of labour.**

Table (4). Relation among lengths of purple lines, cervical dilatations and station of fetal head among the study sample during the first stage of labour (n= 100).

Variable	Cervical dilatations	Station of fetal head
Length of puerperal line	r=+ 0.35 p=0.001	r=+ 0.51 p=0.001

Table (5): Accuracy of purple line in monitor labour progresses during the primary stage of birth (n= 100).

Variable	Sensitivity	Specificity	Positive indicative value	Negative indicative value	Accuracy
Presence of purple line	87.91%	39.53%	85.25%	40.20%	78.96%

Table (6): Mulvariate analysing of factors accompanying with the existence of purple lines during the first stage of labour (n=120).

Socio-demographic & obstetric characteristics	Present of puerperal line (n=100)	absent of puerperal line (n=20)	X^2	P -value
		(%)		
Women's age				
< 35	**61**	**70**		
≥ 35	**39**	**30**	**3.04**	**0.08**
BMI				
Obese	2	**20**		
Overweight	30	**10**	**4.54**	**1.25**
Underweight	20	**40**		
Normal	48	**30**		
Parity				
		55		
Primiparous	**42**	**45**	**1.54**	**0.61**
Multiparous	**58**			
Spontaneous labour	**83**	**60**	**4.22**	**0.02**
	17	**40**		
Induction				
Fetal birth weight (gm)				
≤3500	**54**	**65**	**6.01**	**0.09**
>3500	**46**	**35**		

Discussion:

Although childbirth creates a state of pleasure and enjoyment for most labouring women, it is characterized by pain and stress. However, these painful and stressful events may be heightened by invasive procedures. Assessing cervical dilatations and fetal station by vaginal examination could aid physicians and maternity nurses to decide if there is a regular or irregular progress of labour **[Scottish, 2018**]. The World Health Organization (WHO) recommended that vaginal examining is allowed at systematic periods of at least 4 hours if required [**WHO, 2014**]. Additionally, frequency of vaginal examination can lead to neonatal infection, also it have psychological consequences causing disruption to the emotional and physical pain **[Baker, Kenner, 2016**]. Purple-lines is considered one of the non-invasive ways to predict the progresses of labours, but there is slight confirmation that supporting its usage. So, the current study was performed to shed evidence-founded light on the accuracy of purple line to monitor labour progress and this achieved by assign the appearance percentage of purple line and evaluates its precision to expect labours progresses in the 1st stage of labour. The consequences of the present study accepted the research hypothesis, which stated that, the presence of the purple lines in almost all labouring women and their positive association among cervical dilatations, foetal station and purple line length.

The current result revealed that slightly less than two- thirds of the study sample had less than 35 years. and housewives. Moreover, one third of them can read and write. Also, about less than half of the study sample had normal BMI. This result was consolidated by **[Fatouh, Hassan, 2016]** who revealed that the females ages under study ranging from 17-41 years. with the mean ages of 26.6 ± 5.4 yrs., and less than half of them were read and write. Regarding occupations, less than three fourth of parturient females were housewife. While regarding to the obstetric characteristics the current results revealed that, quite half of the study sample was multipara, additionally, less than three quarters of them experienced spontaneous labour. Also, the results show about half of the study sample, their fetal birth weight was less than or equal 3500(gm). Also, the gestational age at birth was 39.6±1.5 weeks. These findings were in accordance to [**Ashley, et al., 2015]** who investigated the purple lines as a measuring of labours progresses'' and pointed to about half of the women were multipara, in addition, about three quarters of them experienced with spontaneous labour. And regarding the foetal birth weight, the result shows the M±SD was 3540(527) gm. Also, the M±SD of gestational age at birth was 40±1.3 wks.

As for the distribution of the study sample in accordance to the purple lines appearing during the first stage of labour the current result found out that most of the labouring women had the purple lines through the first stage of birth. The aforementioned finding of the current study is supported by way of [**Masoumeh et al., 2016]** who studied "comparing the diagnostic accuracy of purple line with transverse diagonal of michaelis sacral to predict labour progress in nulliparous and multiparous women", and reported that more than three-fourths of the labouring had the purple line in the first stage of labour. This similarity because of the most reasons to seem purple line turned into vaso-congestion at the basis of the sacrum. It blenches when pressure is carried out and gradually re-colours when pressure is withdrawing. This congestion probable happens due to

increasing intrapelvic pressure because the fetal head slopes, that might account for the association among the state of the fetal head and purple lines lengths. Also, the result supported by means of **[Narchi, et al., 2016]** who study " The utilization of the "purple line" as a auxiliary clinical method for evaluating the active phase of delivery " and exposed that the mainstream of the studied samples have the purple line throughout the active period in the 1st stage of birth and consequently the author postulates that growth in intra-pelvic pressure reasons congestion within the basi-vertebral and inter-vertebral veins across the sacrum, which in combination with the dearth of subcutaneous tissues over the sacrum, lead to this line of red-purple dis-colouration.

Regarding to the distribution of labour progress and the existence of purple line among the studied sample during the first stage of labour, the current result exhibit that most of labouring women with normal labour progresses in the 1st stage of labour had a purple line, at the same time as approximately less than two third of labouring women with abnormal labour progress have a purple line throughout the first stage of labour. In addition, the current consequences concluded that there was a highly significant correlation among the existence and nonexistence of purple lines with labour progress. The results of this study were congruent with **[Shepherd, et al., 2015]** who studied " the purple line as a measure of labour progress: a longitudinal study." and determined that most of the purple lines appears among the labouring women who experience normal labour progress rather than abnormal labour progress. This similarity may be due to, the author enrolled in his study the primi. and multi para women as the current study.

As for the proportion estimation of the vaginal exam at definite cervical dilatations where line was existing and mean lengths of purple lines among the studied sample, the currernt results illustrated that; the purple line was statically significantly(p=0.02) much more likely to be present among most of the labouring women in spontaneous labour (more than three fourth of the women who had the purple line) in comparison to those labouring females permitted for induction of labour whose represents less than quarter of women who had the purple line. Also the table revealed that, the percentage of appear purple line among the studied sample increase with increase the cervical dilation as; when the cervical dilation was 3-4 (cm), the purple line appear among more than two third and about half of the studied sample(spontaneous and induction of labour respectively). While, when the cervical dilation was 9-10 (cm), the purple line appears among most and about three fourth of the studied sample (spontaneous and induction of labour respectively). On the other side the mean length of purple line increased from 6.9± 2.8 and 6.7±2.4 (spontaneous and induction of labour respectively) when the cervix was 3 to 4-cm expanded into 9.3±1.9 and 9.4±1.6 (spontaneous and induction of labour respectively) when the cervix dilation was 9-10 cm.

The previous study result in accordance to [**Ashley, et al., 2015]** who investigated '' The purple lines as a measuring of delivery progresses, and revealed that, the purple lines was frequently existing in women experienced with spontaneous labour (more than three fourth) when compared with those females permitted for initiation of labour (slightly more than half). However, nonsignificant associations among parity and existence of lines were reported, X^2

(df = 1, n = 144) = 0.43, p-value = 0.51, phi = -0.07.

Regarding the relationship among lengths of purple lines, cervical dilation and state of fetal head among the studied sample throughout first stage of labour; the current results elaborates that, the studied via a within subject's association analyzing. Analyzing only including those females who have more two estimations of the length of lines, cervical dilatation and state of the fetal head. There was a medium positive association among length of the purple lines and cervical dilatation r = +0.35, 5 P-value = 0.001 and also a medium positive association among lengths of the purple lines and station of the fetal head, r = +0.51, P-value < 0.001.

The previous results in identical line with **[Rodrigo,et al., 2018]** who studied the usage of the purple lines in the diagnosis of cervical dilatations and fetal head station throughout the labour. The results showed that, there was a relation of the incidence of the purple lines with cervical dilatations and fetal head station were studied via the Pearson correlating coefficient. A straight association was existing among lines sizes and cervical dilations (r=0.893) and fetal head station (r=0.681) with mean diagnostics accuracy of 23.0% and 8.2%, respectively. It can be concluded that, the purple lines were verified commonly in females through labor, particularly in cases of white ethnicity and afterward early ruptures of membrane. The incidence of purple lines was connected to adequate progress of labor, and gives a straight association with the parameters of labor progress.

Also, the previous results were agreed with [**Cheyne,et al., 2016**] who studied '' the influences of an algorithm for diagnosing the active labour: a cluster randomized trial''. And the result was revealed that the purple lines existing among most of the studied sample, and a medium positive association were found among its lengths, each cervical dilatations and station of the fetal head.

In addition, the current results illustrated the accuracy of purple line in monitor labour progresses throughout the 1st stage of labour. The results pointed to the purple lines appearing in the monitor of the labour progresses have slightly less than ninety percentages for sensitivity, more than two third percentages for specificity and mire than eighty five percentages for accuracy. This results congruous with [**Alijahan , et al., 2017**] who studied ''The diagnostics accuracies of clinical and exterior pelvimetry in predicting the dystocia in nulliparous females '' and the result pointed to that , the purple lines showing in predicting the labour progresses with more than ninety percentage for sensitivity, slightly less than fifty percentage for specificity, more than eighty five percentage for positive prognostic value, about fifty percentage for negative prognostic value in the first stage of labour, and more than eighty five percentage for positive prognostic value for entire labour. This mean the purple line seems with acceptable sensitivities and specificities value which capable to expect the progresses of labour during the first stage of labour, while it's a really simple very-easy and noninvasively technique in comparison to the gold standards (vaginal examination).

On the other hand, the results of the present study contradict with **[Pornprasertsuk, et al., 2018]** who performed an investigation to find the diagnostics values of change of sacral pain and labour progress in latent phase of labour. This study concluded that the rise in sacral pain refers to had a growth in cervical progress, that was defined as the rise in cervical effacement by greater

than twenty percentage or rise in cervical dilatations in discrete numbers greater than 1-cm, with more than ninety percentage sensitivity and positive prediction value, as well as more than eighty-five percentage for specificity, and more than fifty percentage for negative prognostic values. These changes can be owing to the author assessment of the labour progresses throughout the latent phase of the primary stage of labour; but the current study evaluated labour progresses throughout the active time of the first stage.

Regarding to the factors accompanying with the existence of purple line during the first stage of labour. The present study revealed that the purple lines was significantly ($p = 0.02$) more commonly existing in females in a spontaneous labour (more than half of the sample) in comparison to females permitted for induction of labours (more than one third of the sample). But, nonsignificant correlation among parities, women age, BMI, fetal birth weights and existence of purple lines. This results in the same line with **[Rodrigo, 2018]** who studied the usage of the purple lines for the diagnosis of cervical dilatations and fetal head station through labour. The results showed that, Purple line was determined in the majority of labouring women. Pre-mature ruptures of membrane ($P=0.042$) were accompanying with improved risks of the purple lines shown. The opportunity of early expansion of the pelvic cavity afterward ruptures of membrane connected to the foetus filling the cavity produced by the bone's structures can lead to higher pressure and vascular congestion. As this happens more commonly in females with premature ruptures of membrane. Vaginal deliveries were accompanying with an improved risk of purple lines present ($P<0.001$). The lines in the sacral area, irrespective of the appearing time, was accompanying with the first stage of labour being of predictable period.

The current results also congruence with [**Ashley, et al., 2015]** who studied '' The purple lines as a measuring of labour progresses; and revealed that, the purple lines were significantly common in females in a spontaneous labour (majority of the sample) in comparison to females permitted for induction of labour (about half of the sample). But, nonsignificant correlation among parity and existence of lines was originated, ($p = 0.51$). An Independent sample t-testing was performed to match the birth weights and times in labours of those females who have lines existing at some points in their labours and those females who have no lines at any time. Nonsignificant change in birth weights was found for those females with lines (mean 3581 grams, SD 527) and those with no lines (mean 3437 grams, SD 520; $p = 0.16$).

Conclusion:

Built on the results of the current study we can conclude the next:

The current **study** has revealed that the purple line existing, in the most normal vaginal low risk labouring women and has high sensitivity and specificity. Also the study disclosed there was a medium positive association among purple line lengths and both cervical dilatations and station of the fetal head, so the results consider the purple line as a non-invasive technique for assessing the labour progress at clinics and it was suitable for routine diagnostic.

Recommendations:

Built on our study results, we recommended the next:

- Integration between vaginal examination and purple line to assess the labour progress to reduce the frequencies of vaginal examinations and its risks.
- Educate the maternity nurses the accuracy methods to measure the purple line correctly.
- Further research still needed to identify the accuracy of others non-invasive approaches to evaluate the labour progress.
- Compare the effect of using the vaginal examination and purple line during evaluate the labour progress on the psychophysical condition of Egyptian women.
- Repetition the study by using large sample to confirm the results and study other variable which influence the appear of purple line.

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Conflicts of Interest Disclosure

The authors declare that there is no conflict of interest.

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