Behaviour of the Cervix and the Presenting Vertex in Labour in Blacks and Indians of Natal

K. MARGOLIS

SUMMARY

The mean durations of the first stage of labour for Black and Indian primiparas and multiparas have been ascertained. These figures are similar to those which have been reported.

The upper limits of normal for the duration of the first stage of labour for primiparas and multiparas have been ascertained. These figures differ from those which have been reported in that the duration is much shorter.

Interpolated time- and cervix-based graphs showing the rate of cervical dilatation have been constructed. The curves obtained differ from those reported in that they are not sigmoid in shape and have no distinct phases. Interpolated time-based graphs depicting the rate of descent of the presenting vertex have been constructed. The graphs constructed show the upper and lower limits of normal. They can be used to detect any deviation from normal very early on.

The graphs and figures obtained confirm the reliability of Crichton's principles which have been used as a guide in our unit for the past 15 years in assessing the progress of labour; but recordings of the rate of cervical dilatation, descent of the head, and fetal heart rate, on a graph, so as to compare these with the established norm in each case, is likely to be advantageous.

S. Afr. Med. J., **48**, 791 (1974).

Giles[1] was able to reduce the perinatal mortality and maternal morbidity in his obstetric unit by using Friedman's curve of the normal progress of cervical dilatation in the first stage of labour to detect early deviation from the norm.

Over the past 15 years we, too, achieved similar improvements in the King Edward VIII Obstetric Unit by applying Crichton's two basic principles for conducting labour. These basic principles are: (*a*) every patient must be carefully reassessed, and (*b*) appropriate action must be taken when a primiparous patient has not reached 6-cm dilatation within 12 hours, or has not delivered within 18 hours, of the onset of labour; or a multiparous patient has not reached 6-cm dilatation within 8 hours, or delivered within 12 hours, of the onset of labour; and irrespective of the patient's parity, cervical dilatation remains static (cervical stasis) for 4 hours (the more advanced the dilatation when stasis is detected, the greater the emergency).

In view of the valuable studies in this direction conducted by Philpott and Castle[2] in Salisbury, the possibility was entertained that further improvement could be achieved by applying a curve of the normal rate of cervical dilatation to each case to detect departures from normality at an early stage.

Whether or not Friedman's curve and Philpott's observations were directly applicable to our population group was unknown. We decided, therefore, to construct our own curve and also to determine the normal limits of the duration, and rate of progress, of the first stage of labour in Black and Indian primiparas and multiparas. Progress of labour is assessed by: the rate of dilatation of the cervix; the rate of descent of the presenting part; and the frequency and duration of uterine contractions. As the last factor is the subject of a separate analysis from this unit, only the first two factors are dealt with in this study.

DETAILS OF THE STUDY

This study was divided into two parts. The first part is the assessment of the rate of dilatation of the cervix, and the second part is the rate of descent of the presenting vertex. A total of 887 patients (657 Black and 230 Indian) were studied. Two hundred and eighty-eight Blacks and 85 Indians were primiparous, whereas 377 Blacks and 145 Indians were multiparous (Table I).

TABLE I. PARITY AND RACE OF THE PATIENTS

Parity	Blacks	Indians
0	288	85
1	144	40
2	72	31
3	54	22
4	38	18
5+	99	34

The average ages (of the women) are the simple arithmetical means, i.e. the total of all the ages in a group were divided by the number of patients in the group (Table II).

Department of Gynaecology and Obstetrics, University of Natal and King Edward VIII Hospital, Durban
K. MARGOLIS, M.B. CH.B., DIP. MID., F.C.O.G. (S.A.), M.R.C.O.G.

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The standard deviation was obtained by the formula:

$$SD = \sqrt{\frac{n}{z}(x_1 - x)^2}$$

where n is the sample size, x is the mean and x_1 are the individual members of the sample.

TABLE II. AVERAGE AGES OF THE PATIENTS ACCORDING TO PARITY AND RACE

	Blacks		Indians	
Parity	Average age (yrs)	SD	Average age (yrs)	SD
0	20,50	2,93	19,97	1,89
1	22,62	3,25	22,12	2,92
2	25,36	3,58	26,06	4,12
3	27,05	3,13	25,00	2,69
4	27,61	3,96	27,73	4,67
5+	24,10	4,98	23,86	4,52

Only vertex presentations were included and induced labours were excluded. Membranes were ruptured artificially when the cervix had reached 3-cm dilatation (if not already ruptured). Only normal, unassisted vaginal deliveries were included.

Valium (diazepam) 10 - 20 mg intramuscularly or intravenously for sedation, and pethidine 100 mg intramuscularly for analgesia before the cervix had reached 6-cm dilatation, were administered.

The birth mass of babies is shown in Table III. The same statistical analysis was used for the average birth mass and maternal age. The standard deviation was obtained by the formula:

$$SD = \sqrt{\frac{n}{z}(x_1 - x)^2}$$

where n is the sample size, x is the mean, and x_1 are the individual members of the sample.

TABLE III. AVERAGE BIRTH MASS ACCORDING TO PARITY AND RACE

	Race			
	Blacks		Indians	
Parity	Average mass (g)	SD	Average mass (g)	SD
0	2 952,95	359,45	2 698,15	318,50
1	3 098,55	436,80	2 989,35	418,60
2	3 012,10	386,75	3 043,95	354,90
3	3 144,05	414,05	2 957,50	336,70
4	3 053,05	404,95	2 843,75	436,80
5+	3 043,95	395,85	2 866,50	386,75

METHODS

The rate of dilatation of the cervix was recorded on graph cards (Fig. 1) after each vaginal examination. The abscissa reflected the duration of labour from 0 to 24 hours, with each hour further subdivided so that the duration of labour could be plotted to the nearest quarter of an hour. The ordinate reflected the cervical dilatation in centimetres and each centimetre was further subdivided so that the dilatation of the cervix could be plotted to the nearest 0,5 cm and the range was 0 - 10 cm (full dilatation).

The rate of descent of the presenting part was recorded on a graph card (Fig. 1) after each examination. The abscissa reflected the duration of labour in hours and was subdivided as for the recordings of the rate of dilatation of the cervix. The ordinate reflected the level of the presenting part (in this study the fetal vertex). In our unit the level of the presenting part is measured in fifths above the pubic symphysis. The graph also had space for recording the race, age and parity of the patient; the birth mass of the baby; and the outcome of labour.

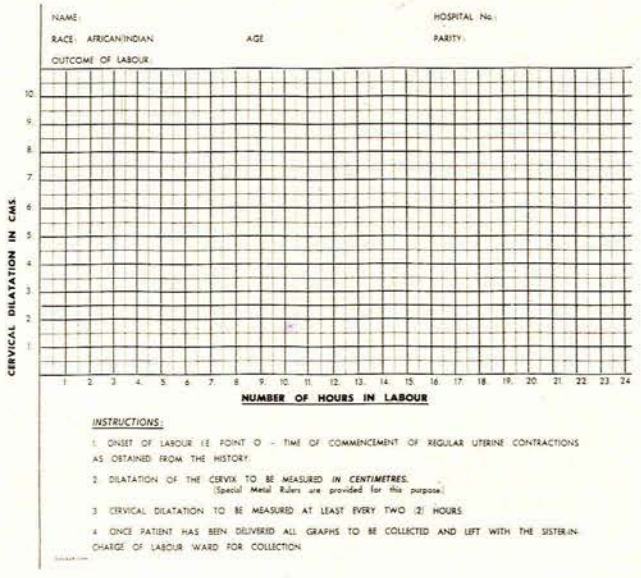

Fig. 1. Graph card for recording progress of labour.

Onset of labour corresponded to point 0 on the time scale and was obtained by questioning the patient as to the exact time of onset of painful regular uterine contractions. Doctors who recorded the results were all registrars in the Obstetric Unit, i.e. full-time staff who had served a minimum of 6 months in training in obstetrics; many had extensive experience is assessing the progress of labour by using these two parameters.

The recording of the rate of cervical dilatation was done by routine vaginal examination every 2 - 4 hours (until full dilatation) and by plotting the dilatation of the cervix to the nearest 0,5 cm against the duration of

labour to the nearest quarter of an hour. The rate of descent of the vertex was estimated by routine abdominal and vaginal examination every 2 - 4 hours (until the head was nought-fifths above the pelvic brim) and then by plotting the level of the presenting part above the pubic symphysis to the nearest one-fifth above the pubic symphysis, against the duration of labour to the nearest quarter of an hour.

RESULTS

Rate of Cervical Dilatation

Statistical analysis of results: Frequency distribution curves (histograms) show the range of values obtained. In this study the ordinate reflected the percentage of the total number of the patients, and the abscissa reflected the time in hours. The mean is that point where density balances, and is calculated by the following formula:

$$\text{Mean} = \sqrt{\frac{N}{Z}\ (i - \tfrac{1}{2})\ f\ (x_i)}$$

where N is the number of categories, i refers to the individual discrete points, and f (x_i) is the percentage frequency with which that class occurred. The median is that class which cuts in half the area of the histogram. Mode is that class which has the highest frequency of occurrence. The mean, median and mode all give an indication of the central tendencies of the distribution.

The standard deviation shows how widely or how closely the bulk of the distribution is clustered round its mean point, and is calculated by the formula:

$$6x = \sqrt{\frac{N}{Z}\ (i - \text{mean} - \tfrac{1}{2})^2\ f\ (x_i)}$$

where N is the number of classes, i refers to the individual discrete classes, 6x is the mean, calculated as above, and $(f(x_i)$ is the frequency with which the class i occurred.

The standard error is the standard deviation corrected for the number of points in the distribution and is calculated by the formula:

$$SE = SD \quad \sqrt{N}$$

The upper 10% is the point which has 90% of the area of the distribution to its left. This is quite close to the mean ± 2 standard deviations in value.

Duration of the first stage of labour was measured from the onset of regular painful uterine contractions to full dilatation of the cervix (1 = 10 cm).

Frequency distribution curves for the total duration of labour in Black and Indian primiparas and multiparas are shown in Figs 2 and 3 respectively and in Table IV. The Blacks are shown as solid blocks and the Indians are shown as open blocks.

The range of duration of the first stage of labour in Black primiparas varied from 5 to 20 hours, with a mean of 13,17 hours. In 90% of the patients the first stage of labour was completed within 18,20 hours.

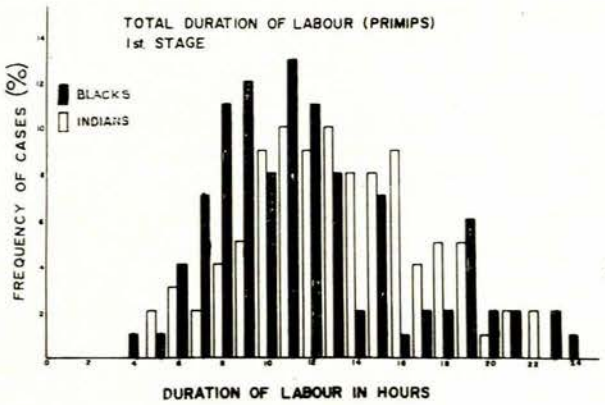

Fig. 2. Frequency distribution curves depicting the total duration of first stage of labour (primiparas).

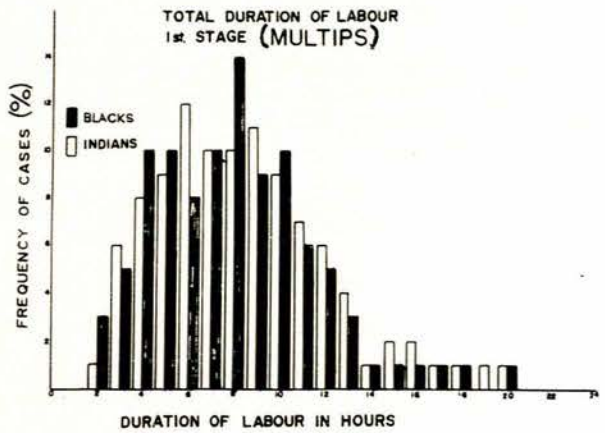

Fig. 3. Frequency distribution curves depicting the total duration of first stage of labour (multiparas).

TABLE IV. DURATION OF THE FIRST STAGE OF LABOUR ACCORDING TO PARITY AND RACE

	Mean	Median	Mode	SD	SE	Upper 10%
Black primiparas	**13,17**	**12,15**	**11,00**	**4,27**	**0,255**	**18,20**
Indian primiparas	**10,83**	**10,46**	**11,00**	**3,85**	**0,417**	**18,00**
Black multiparas	**8,20**	**7,40**	**6,00**	**3,84**	**0,197**	**12,20**
Indian multiparas	**77,37**	**7,28**	**8,00**	**3,54**	**0,294**	**12,00**

The range of duration of the first stage of labour in Indian primiparas varied from 4 to 21 hours, with a mean of 10,83 hours. In 90% of the patients the first stage of labour was completed within 18,00 hours.

The range of duration of the first stage of labour in Black multiparas varied from 2 to 20 hours, with a mean of 8,20 hours. In 90% of the patients the first stage of labour was completed within 12,20 hours.

The range of duration of the first stage of labour in Indian multiparas varied from 2 to 20 hours, with a mean of 7,37 hours. In 90% of the patients the first stage of labour was completed within 12,00 hours.

Nature of the graph of cervical dilatation obtained: Percentile graphs from observed points were obtained from each graph card by searching for cervix co-ordinates by moving up the scale at 1-cm intervals and doing the same with the corresponding time co-ordinates.

The percentile for each block of figures was calculated by using the formula:

$$Xp = X\lfloor(n-1)p\rfloor + 1 + \lceil X\lceil(n-1)p\rceil - x\lfloor(n-1)p\rfloor + \lceil 1\rceil \lceil(n-1)p - \lfloor(n-1)p\rfloor$$

From the percentiles obtained, a graph showing the 10, 30, 50 (median), 70 and 90 percentiles was plotted. It was frequently necessary to find the corresponding reading on the other axis when a particular time or cervix reading was given. This was done by interpolation.

For example, if given the time value 'X', we wish to find the corresponding value 'Y' on the cervical dilatation axis, this value can be easily found by using the value of X and the 2 points on the graph which 'bracket' X, (X_1Y_1) and (X_2Y_2), and a knowledge of similar triangles.

Time-based graphs are approached from the 'time' point of view, and interpolations are done at every hour.

Cervix-based graphs are approached from the point of view of cervical dilatation and interpolations are done every 1 cm.

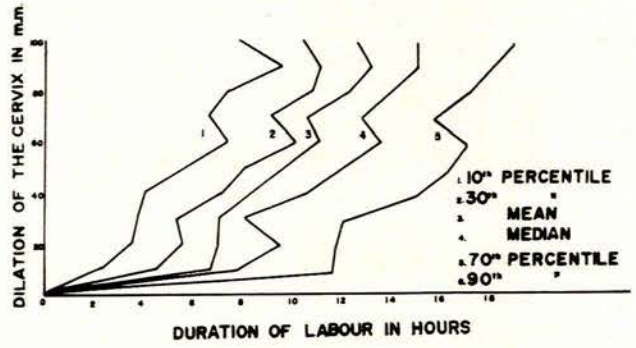

Fig. 4. Percentile graphs depicting the rate of cervical dilatation (Black primiparas).

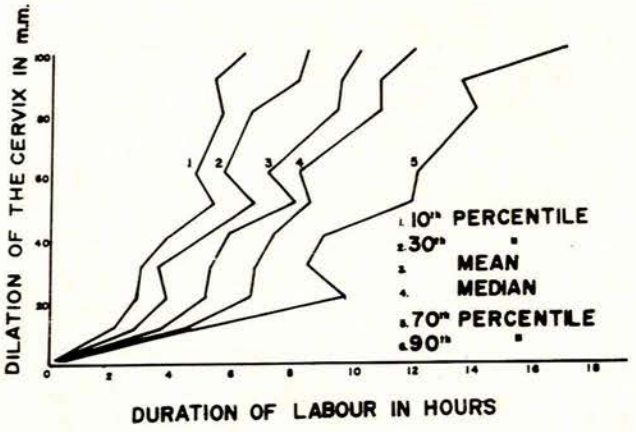

Fig. 5. Percentile graphs depicting the rate of cervical dilatation (Indian primiparas).

Thus for every hour or 1 cm dilatation of the cervix, points were plotted from which graphs depicting the arithmetic mean, 10th and 90th percentiles, were constructed.

The percentile graphs for Black and Indian primiparas and multiparas are shown in Figs 4, 5, 6 and 7, respectively. In addition, the 10%, 30%, 50% (median) 70% and 90% points are shown.

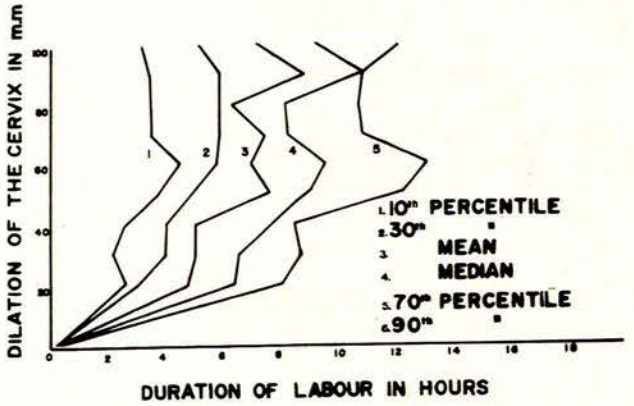

Fig. 6. Percentile graphs depicting the rate of cervical dilatation (Black multiparas).

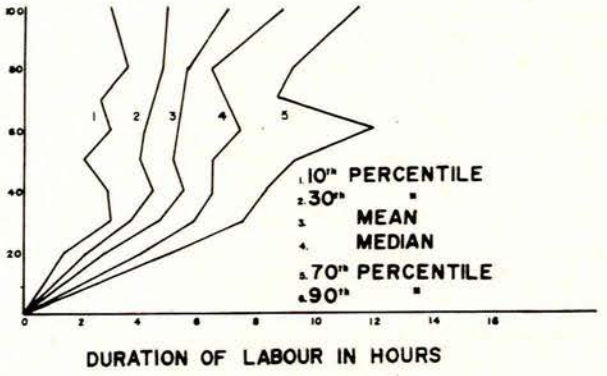

Fig. 7. Percentile graphs depicting the rate of cervical dilatation (Indian multiparas).

As percentile graphs from observed points should be regarded only as a description of the data and should not be used to determine whether a particular case is normal or abnormal, interpolated graphs using both time and cervical dilatation were calculated. The interpolated time-based graphs for Black and Indian primiparas and multiparas are shown in Figs 8, 9, 10 and 11, respectively. In addition, the 10%, 50% (median) and 90% points are shown.

The interpolated cervix-based graphs for Black and Indian primiparas and multiparas are shown in Figs 12, 13, 14 and 15 respectively. In addition, the 10%, 50% (median) and 90% points are shown. The graphs obtained were parabolas. They were very similar for the time-based and cervical dilatation-based graphs.

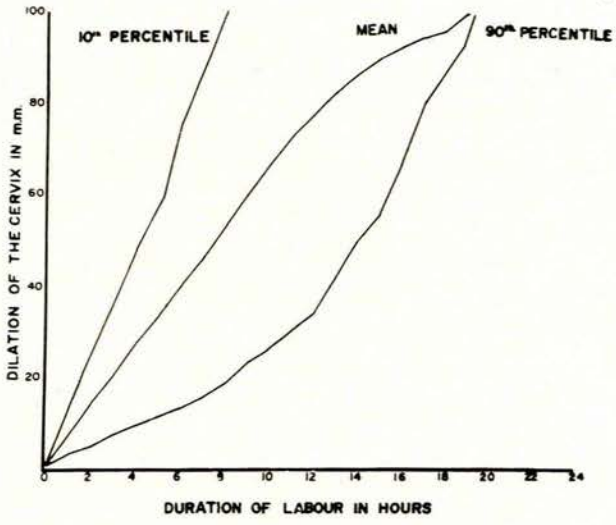

Fig. 8. Interpolated time-based graphs depicting the rate of cervical dilatation (Black primiparas).

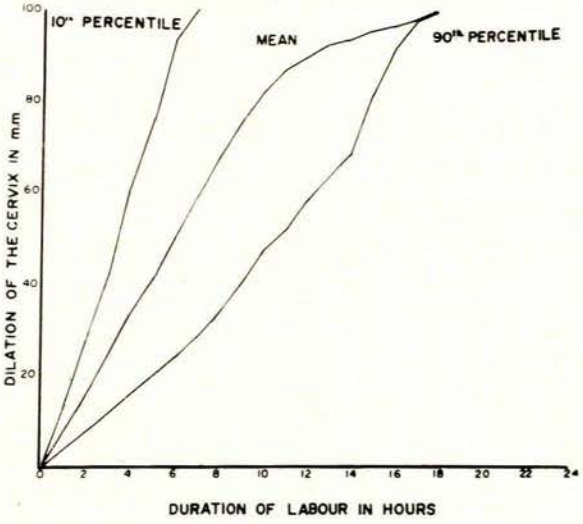

Fig. 9. Interpolated time-based graphs depicting the rate of cervical dilatation (Indian primiparas).

Rate of Descent of the Presenting Part (Vertex)

The statistical analysis used was the same as that for cervical dilatation. The percentile graphs from observed points for Black and Indian primiparas and multiparas are shown in Figs 16, 17, 18 and 19. The 10th, 30th, 50th (median), 70% and 90% percentiles are also shown.

Interpolated graphs were calculated as were those described for cervical dilatation, but in this instance only time-based interpolated graphs were calculated. The interpolated time-based graphs for the rate of descent of the presenting vertex, are shown in Figs 20, 21, 22 and 23. These graphs show the mean, 10th and 90th percentiles.

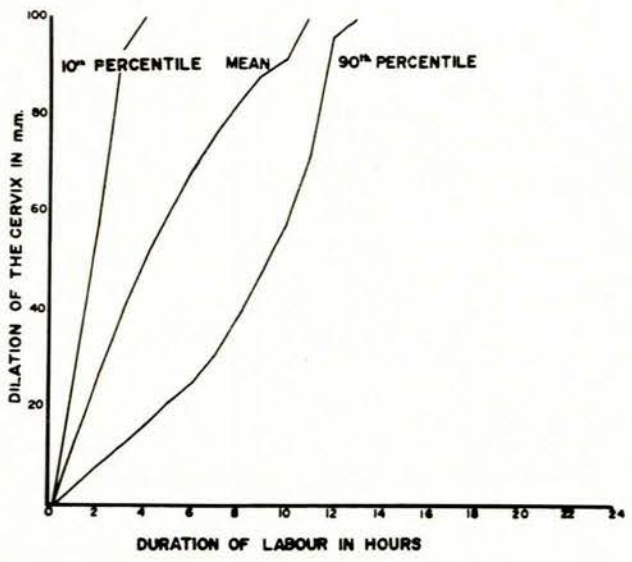

Fig. 10. Interpolated time-based graphs depicting the rate of cervical dilatation (Black multiparas).

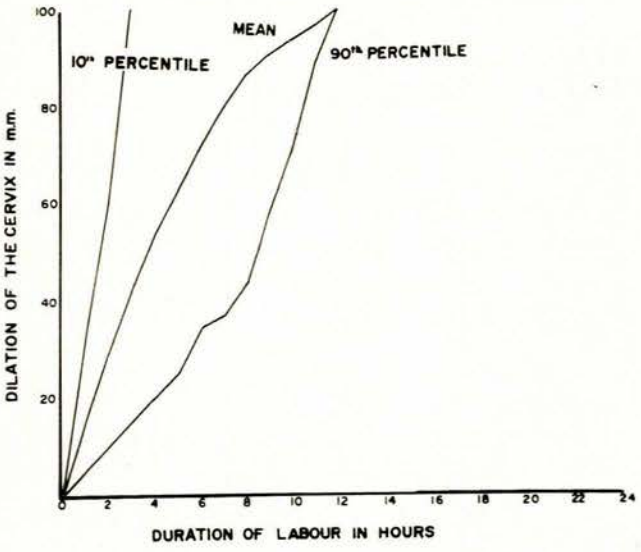

Fig. 11. Interpolated time-based graphs depicting the rate of cervical dilatation (Indian multiparas).

DISCUSSION OF RESULTS

Duration of the First Stage of Labour

The fact that the total duration of the first stage of labour for the upper 10% of patients proved to be 18 hours for primiparas and 12 hours for multiparas, confirms our clinical tenet that the majority of primiparas in our unit dilate fully within 18 hours of the commencement of labour and that the majority of multiparas dilate fully within 12 hours.

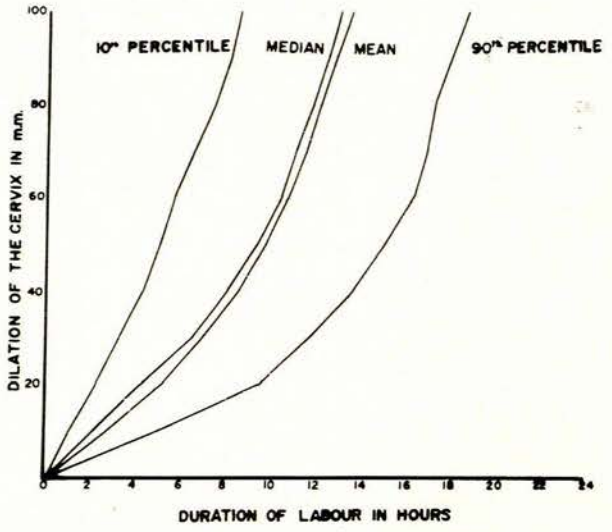

Fig. 12. Interpolated cervix-based graphs depicting the rate of cervical dilatation (Black primiparas).

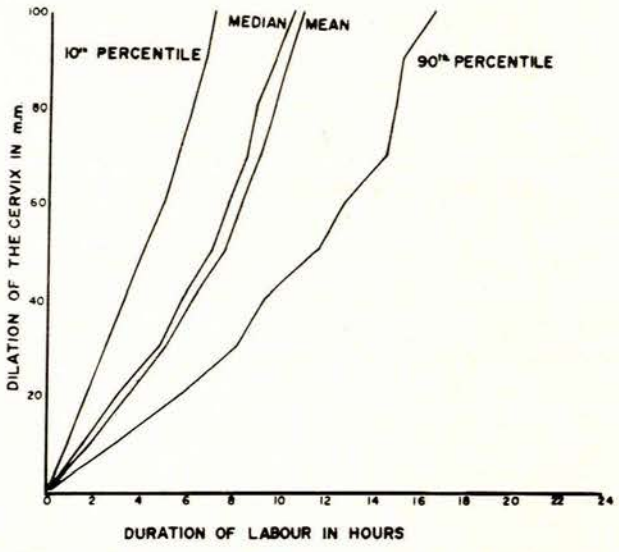

Fig. 13. Interpolated cervix-based graphs depicting the rate of cervical dilatation (Indian primiparas).

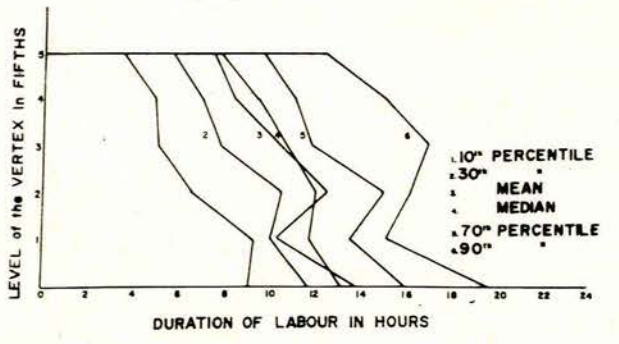

Fig. 16. Percentile graphs depicting the rate of descent of the presenting vertex (Black primiparas).

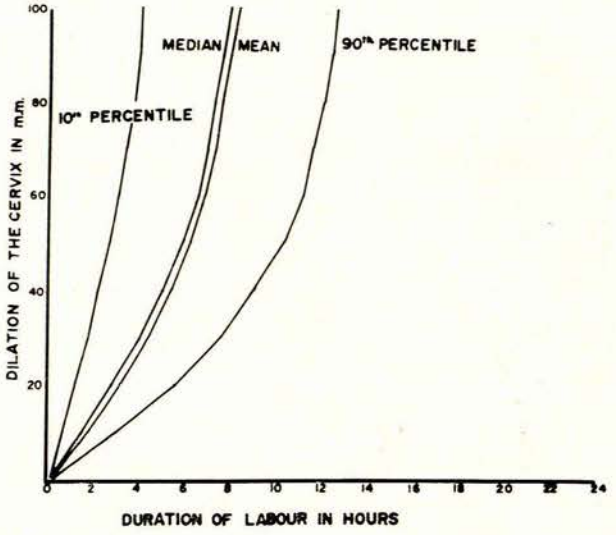

Fig. 14. Interpolated cervix-based graphs depicting the rate of cervical dilatation (Black multiparas).

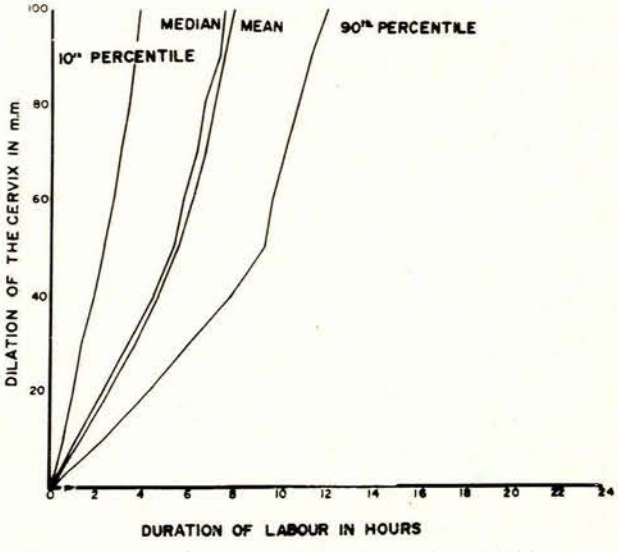

Fig. 15. Interpolated cervix-based graphs depicting the rate of cervical dilatation (Indian multiparas).

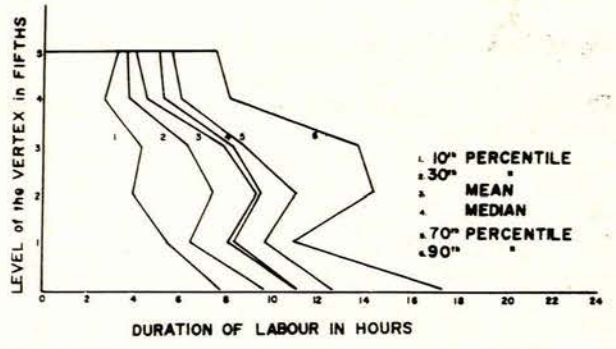

Fig. 17. Percentile graphs depicting the rate of descent of the presenting vertex (Indian primiparas).

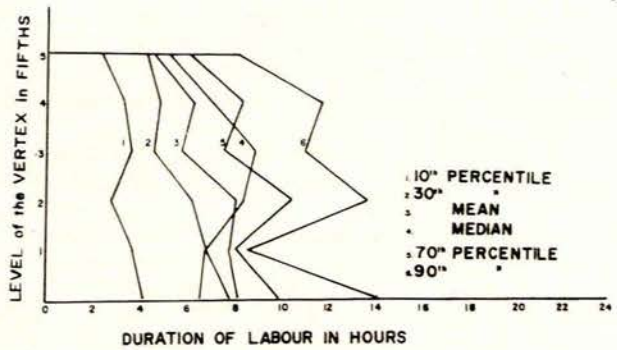

Fig. 18. Percentile graphs depicting the rate of descent of the presenting vertex (Black multiparas).

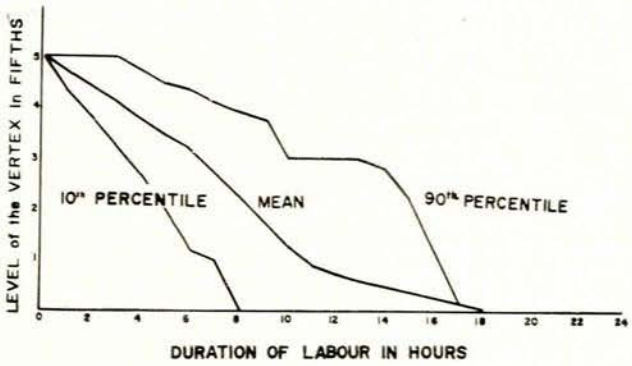

Fig. 21. Interpolated time-based graphs depicting the rate of descent of the presenting vertex (Indian primiparas).

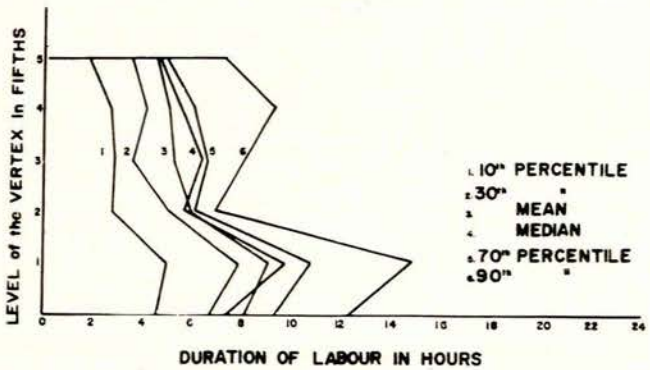

Fig. 19. Percentile graphs depicting the rate of descent of the presenting vertex (Indian multiparas).

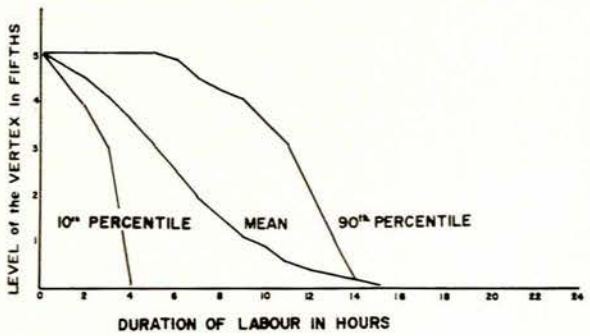

Fig. 22. Interpolated time-based graphs depicting the rate of descent of the presenting vertex (Black multiparas).

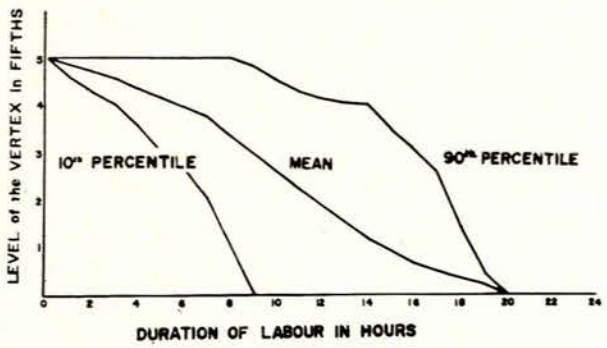

Fig. 20. Interpolated time-based graphs depicting the rate of descent of the presenting vertex (Black primiparas).

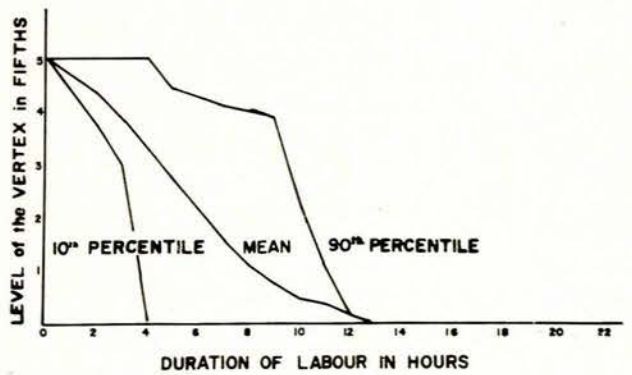

Fig. 23. Interpolated time-based graphs depicting the rate of descent of the presenting vertex (Indian multiparas).

The figures obtained for the mean duration of the first stage of labour are very close to the 13,3 hours for primiparas and 7,5 hours for multiparas obtained by Friedman.[3,4]

On the other hand, Friedman's upper limits of normal (which correspond to the upper 10% of this study) of 28,5 hours for primiparas and 18,8 hours for multiparas. were much longer than the 18 hours and 12 hours, respectively, obtained in this study.

Cervical Dilatation

The purpose of this study was to define the range of normal for the rate of dilatation of the cervix during the first stage of labour, and to construct a curve which could be used to ascertain whether or not labour is progressing within normal limits.

With this objective in view the percentile graphs, based on observed points, are not suitable, for they are to be

regarded as descriptions of the recorded data; however, interpolated graphs are suitable guides to the normality of progress in individual patients, since they are a prediction based on the recorded information. These interpolated graphs were calculated, using both the duration of labour in hours (= time), and cervical dilatation in centimetres, as a basis. The graphs obtained were similar. Graphs for the arithmetic mean, 10th, and 90th percentiles, were constructed. The 10th percentile was regarded as the lower limit of normal and the 90th percentile as the upper limit of normal, and the majority of patients fell within this range.

Rodesch *et al.*[5] constructed similar graphs, but they used the 75th percentile as the upper limit of normal.

The curve obtained was a parabola which showed steady progress, with no distinct latent and active phase. Rodesch *et al.*[5] also constructed a graph depicting the progress of the first stage of labour and their curve was very similar to the curve obtained in this study; however, it should be noted that these curves differ from Friedman's curves,[3,4] which were sigmoid in shape with a distinct latent and active phase.

The interpolated time-based graphs of the descent of the presenting vertex show, firstly, that nearly all the high vertices at the commencement of labour resulted in uncomplicated unassisted vaginal deliveries; secondly, that marked descent may occur only in labour. This feature was present in both racial groups and was not dependent on parity.

These findings agree with those of Friedman and Sachtleben[6] who found that the lack of engagement of the presenting part at the outset of labour in patients who have uncomplicated, unassisted vaginal deliveries is not all that uncommon, nor is it the ominous sign it was previously thought to be. These cases, however, still require careful observation during labour for any deviation from normal.

I should like to thank Professor Linhart, Mr Walker and Mr Zuccini for their help with the statistical analysis of the data.

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