Cervical length at 23 weeks' gestation – relation to demographic characteristics and previous obstetric history in South African women

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Objectives. To determine the distribution of cervical length in a routine population of singleton pregnancies; to examine the relationship between cervical length, demographic characteristics, and previous obstetric history; and to compare these data with data from a similar study undertaken in the UK.

Patients and methods. The study was conducted among women attending routine antenatal clinics at Coronation, Johannesburg General and Chris Hani Baragwanath hospitals. Cervical length was measured by means of transvaginal ultrasound at 23 weeks' gestation in women with singleton pregnancies attending these clinics, as part of a multicentre randomised trial investigating the value of cerclage in a short cervix.

The distribution of cervical length was determined and the significance of differences in median cervical lengths between subgroups was calculated according to maternal age, ethnic origin, maternal body mass index (BMI), cigarette smoking, alcohol intake, and previous obstetric history.

Results. Cervical screening was offered to women (N = 2 173) attending clinics for a 23-week scan during the study period (July 1999 - September 2002). Most women (N = 1 920) accepted, while 253 declined.

Complete outcomes (date and mode of delivery, gestation at delivery, birth weight, Apgar scores, maternal blood loss, whether the patient was cerclaged or not, and any complications) were obtained for 1 603 women who accepted screening. Cervical length was measured successfully in all cases.

Median cervical length was 33.7 mm and in 64 cases (3.3%) the length was 15 mm or less. Significantly shorter cervical lengths were found in those with a history of previous miscarriage, preterm delivery, those aged less than 20 years and those with an abnormal BMI.

Cervical length was not significantly shorter in black women than in coloured and white women.

Conclusions. At 23 weeks' gestation the median cervical length in a South African population was 33.2 mm. In 3.3% of the population the length was ≤ 15 mm. There was an association between cervical length, demographic characteristics and previous obstetric history.

S Afr Med J 2005; **95:** 691-695.

Preterm delivery is the leading cause of neonatal morbidity and mortality worldwide, with major health care and economic consequences.[1,2] In South Africa, among babies weighing more than 1 000 g, 1 in 6 deaths is due to preterm delivery.[3]

The risk of preterm delivery varies with maternal characteristics such as ethnic origin, age, body mass index (BMI), cigarette smoking, substance abuse, and obstetric history.[4-7]

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Ultrasound assessment of cervical length may be a useful predictor in pregnancies considered both low and high risk for preterm delivery.[5-9]

As part of a multicentre trial[10] investigating the benefit of cervical cerclage for the short cervix diagnosed on ultrasound in a routine population, we aimed to examine the relationship between cervical length, demographic characteristics and previous obstetric history in South African women.

Patients and methods

Women attending routine antenatal clinics at Coronation, Johannesburg General and Chris Hani Baragwanath hospitals were offered 2 ultrasound examinations, at 11 - 14 weeks' and at 23 weeks' gestation.

During a 36-month period (July 1999 - September 2002), women attending for routine anomaly scans were offered a transvaginal sonographic cervix assessment. Written informed consent was obtained from those opting into the study. The study was approved by the Ethics Committee of the University of the Witwatersrand.

Patients, with empty bladders, were placed in the dorsal lithotomy position, and were examined transvaginally using a multifrequency 5.0 - 7.0 mHz transducer (Toshiba Eccoccee, Toshiba, Japan). Examinations were performed according to the Fetal Medicine Foundation criteria for cervical assessment (**www.fetalmedicine.com/f-competence.htm**).

A sagittal view of the cervix was obtained by placing the probe in the anterior fornix of the vagina, avoiding undue pressure on the cervix and demonstrating the endocervical mucosa along the length of the canal. Calipers were used to measure the distance between the internal os and the external cervical os. The cervix was observed for about 3 minutes to check for any changes, particularly contractions (observed in less than 1% of patients). The shortest measurement obtained was recorded, including the presence or absence of funnelling at the internal os.

Midwives recorded patient characteristics, demographic data, and previous obstetric and medical history at the patients' first antenatal visit to the hospital. These data were entered onto a hand-held antenatal card. Ultrasound findings and patient demographic details were then recorded in a computerised database. Gestational age was determined from menstrual history and confirmed by ultrasound.

The distribution of cervical lengths was tested for normality using the Kolmogorov-Smirnov test. Unpaired Student's *t*-tests were used to calculate the significance of differences in mean cervical length between subgroups, and the chi-squared test was used to determine the significance of differences between subgroups in the percentage of cases with cervical length ≤ 15 mm; this cut-off identifies a group at very high risk for preterm delivery.

Multiple linear regression analysis was used to determine the variables that made a significant independent contribution towards explaining variance in cervical length. Maternal age and BMI were used as continuous variables.

Results

During the study period 2 173 patients attending ultrasound clinics for a routine 23-week scan were offered cervical screening. Most women (N = 1 920, 88.4%) chose to participate, while 253 declined. Complete outcomes were obtained for 1 603 of those who accepted.

The median cervical length was 33.7 mm and the mean 33.0 mm (– 1 standard deviation (SD) 25.9 mm and – 2 SD 17.6 mm respectively). The cervical length was normally distributed, with some skewness at the lower end of the histogram (Fig. 1). Cervical length was measured successfully in all cases (Fig. 1).

The cervical length was < 30 mm in 481 of 1 920 patients (25.0%), < 25 mm in 183 (9.5%), < 20 mm in 114 (5.9%) and 15 mm or less in 64 cases (3.3%) (Fig. 1).

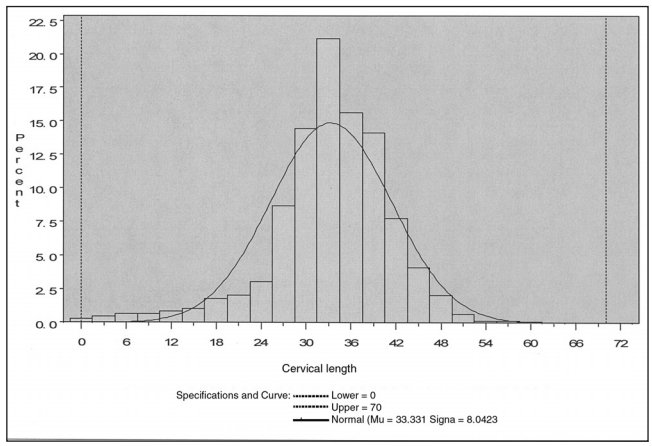

Fig. 1. Histogram of cervical length.

Five hundred and seventy patients (29.7%) were primigravidas, 254 (7.1%) had had 1 or more miscarriages and/or terminations of pregnancy before 16 weeks' gestation, 1 060 (29.5%) had had 1 or more term deliveries, with or without previous fetal losses before 16 weeks, 189 (5.3%) gave a history of 1 previous spontaneous preterm delivery at 24 - 32 weeks, and 135 (3.75%) reported a previous miscarriage at 16 - 23 weeks. Some patients in the latter 4 groups may also have had first-trimester losses or term deliveries. There was 1 termination between 16 and 23 weeks.

On comparing mean cervical length in 1 920 black and white women in our population, no significant difference was demonstrated (Table I). Of the 64 women with a very short cervix (< 15 mm), 44 (68%) were black, and 37 (57%) had a high BMI. Cervical length was also significantly shorter in women younger than 20 years, among smokers, and in women with a history of previous miscarriage or preterm delivery (Table II).

However, multiple regression analysis demonstrated the only significant independent contributors in explaining cervical length to be past obstetric history, BMI, and maternal age.

Discussion

The present study design and execution were exactly the same as those of Heath *et al.*[9] We present and compare our data, using a local population, with data from the latter study. Of the women offered the cervical assessment, 88% opted in.

The mean cervical length of 33.7 mm was less than the mean of 38 mm reported by Heath *et al.*[9] We also found higher percentages (twice as high) of shorter cervical length in all measurement groups, other than in the < 25 mm group (Fig. 1).

It has been shown that in First-World countries the incidence of preterm delivery is higher in all ethnic minorities, particularly among Afro-Caribbean patients.[8,9,11,12] In this study black women (N = 1 079) did not have shorter cervical lengths than white (N = 63) and coloured (N = 693) women.

Furthermore, although in this study 68.7% of patients with

Table I. Cervical length (mm) at 23 weeks of pregnancy v. patient characteristics*

Patient characteristics	*N* (% of 1920)	Cervical length (mean (SD)) (mm)	Comparison between groups	Mean difference (95% CI)
Ethnic group				
1. White	62 (3.2)	34.4 (7.6)	1 v. 2	1.28 (-0.860 - 3.42)
2. Black	1 079 (56.2)	33.2 (8.4)	1 v. 3	1.11 (-0.838 - 3.06)
3. Coloured	693 (36.1)	33.3 (7.5)	1 v. 4	-0.20 (-2.83 - 2.43)
4. Other	86 (4.5)	34.6 (8.2)	2 v. 3	-0.17 (-0.938 - 0.598)
			2 v. 4	-1.48 (-3.32 - 0.362)
			3 v. 4	-1.31 (-3.01 - 0.386)
Age (years)				
1. < 20	160 (8.3)	**31.7 (7.7)†**	1 v. 2	-1.82 (-3.11 - -0.529)
2. 20 - 35	1 556 (81.0)	**33.5 (7.9)†**	1 v. 3	-1.82 (-3.56 - -0.08)
3. > 35	204 (10.6)	33.5 (8.9)	2 v. 3	0 (-1.18 - 1.18)
BMI (kg/m^2)				
1. < 19.8	143 (7.5)	32.3 (7.2)	1 v. 2	-0.40 (-1.73 - 0.932)
2. 19.8 - 26	959 (50)	33.1 (7.6)	1 v. 3	-0.95 (-2.45 - 0.550)
3. > 26	818 (42.6)	33.7 (8.6)	2 v. 3	-0.55 (-1.31 - 0.207)
Smoking				
1. Smoker	279 (14.5)	**32.4 (7.5)†**	1 v. 2	-1.04 (-2.06 - -0.159)
2. Non-smoker	1 622 (84.5)	**33.5 (8.1)†**	1 v. 3	-4.25 (-7.71 - -0.789)
3. Snuff	19 (0.99)	36.7 (4.9)	2 v. 3	-3.21 (-6.88 - 0.461)
Cervical surgery				
1. Cone biopsy	2 (0.1)	27.5 (5.0)	1 v. 2	-5.85 (-17.0 - 5.29)
2. None	1 911 (99.5)	33.3 (8.03)	1 v. 3	-14.5 (-37.4 - 8.38)
3. Other	2 (0.1)	42.0 (5.7)	1 v. 4	0.92 (-22.4 - 24.2)
4. Previous cerclage	5 (0.3)	5 (0.26)	2 v. 3	-8.65 (-19.8 - 2.49)
			2 v. 4	6.77 (-0.291 - 13.8)
			3 v. 4	15.4 (-8.05 - 38.9)
Alcohol				
1. Drinker	62 (3.2)	33.3 (8.0)		
2. Non-drinker	1 858 (96.8)	33.3 (8.0)	1 v. 2	-0.10 (-2.05 - 2.3)
Obstetric history				
1. Primigravida	570 (29.7)	33.5 (7.5)		
2. Multigravida	1 350 (70.3)	33.3 (8.3)	1 v. 2	0.240 (-0.548 - 1.03)
3. Fetal loss at < 16 weeks	254 (7.1)	32.5 (9.6)	1 v. 3	0.990 (-2.31 - 2.21)
4. Delivery at > 37 weeks	1 060 (29.5)	34.1 (7.5)	1 v. 4	-0.560 (-1.32 - 0.205)
5. Delivery at 33 - 36 weeks	38 (1.1)	33.0 (6.2)	1 v. 5	0.480 (-1.98 - 2.94)
6. Delivery at 24 - 32 weeks	189 (5.3)	**30.1 (9.9)†**	1 v. 6	3.37 (2.02 - 4.72)
7. Miscarriage at 16 - 23 weeks	135 (3.7)	**28.1 (10.6)†**	1 v. 7	5.32 (3.78 - 6.86)
8. Termination at 16 - 23 weeks	1 (0.027)	34.1 (7.5)		

*Patients were grouped for earliest spontaneous delivery between 16 and 36 weeks' gestation according to obstetric history.
†Statistically significant *p*-values (< 0.05).
BMI = body mass index; CI = confidence interval.

short cervices (< 15 mm) were black, multiple regression analysis did not demonstrate a significant contribution of race in explaining variation in cervical length, after having accounted for other demographic characteristics (multiple regression analysis: β (95% confidence interval (CI)): −1.20 (−3.21 - 0.81), *p*-value 0.2426).

It has also been shown that teenagers (< 20 years), those with an abnormal (low or high) BMI, and those with a poor obstetric history have shorter cervical lengths.[9,11-13] Our study corroborated these findings (Tables I and II) (multiple regression analysis: β (95% CI): 0.07 (0.0003 - 0.14), *p*-value: 0.0400, and BMI: β (95% CI): 0.07 (0.01 - 0.13), *p*-value 0.0177).

There is a known increased risk of preterm delivery in patients with a low pre-pregnancy maternal weight, particularly in women who are very underweight (BMI < 19.8) and those with a low weight gain during pregnancy.[12]

In this study, median cervical length was shorter than in the study by Heath *et al.*,[9] and the incidence of a very short cervix in women with a low BMI was higher (Table II).

The incidence of preterm delivery was higher in pregnant smokers than non-smokers. Suggested reasons for this could include raised amniotic fluid concentrations of the

Table II. Incidence of cervical length ≤ 15 mm (64 of 1 920 patients) at 23 weeks' gestation*

Patient characteristics	[Total] *N* (%)	RR	Comparison between groups
Ethnic group			
1. White	[62] 1 (1.6)	0.48	1 v. 2
2. Black	[1 079] 44 (4.1)	1.22	1 v. 3
3. Coloured	[693] 18 (2.6)	0.78	1 v. 4
4. Other	[86] 1(1.2)	0.35	2 v. 3
			2 v. 4
			3 v. 4
Age (years)			
1. < 20	[160] 3 (1.9)	0.56	1 v. 2
2. 20 - 35	[1 556] 52 (3.3)	1.00	1 v. 3
3. > 35	[204] 9 (4.4)	1.32	2 v. 3
BMI (kg/m^2)			
1. < 19.8	[143] 3 (2.1)	0.63	1 v. 2
2. 19.8 - 26	[959] 24 (2.5)	0.75	1 v. 3
3. > 26	[818] 37 (4.5)	1.36	2 v. 3
Smoking			
1. Smoker	[279] 9 (3.2)	0.97	1 v. 2
2. Non-smoker	[1 622] 55 (3.4)	1.02	1 v. 3
3. Snuff	[19] 0	-	2 v. 3
Cervical surgery			
1. Cone biopsy	[2] 0	-	1 v. 2
2. None	[1 911] 63 (3.3)	0.99	1 v. 3
3. Other	[2] 0	-	1 v. 4
4. Previous cerclage	[5] 1 (20.0)	6.00	2 v. 3
			2 v. 4
			3 v. 4
Alcohol			
1. Drinker	[62] 1 (1.61)	0.48	
2. Non-drinker	[1 858] 63 (3.39)	1.00	1 v. 2
Obstetric history			
1. Primigravida	[570] 11 (1.9)	0.58	
2. Multigravida	[1 350] 53 (3.9)	**1.18†**	1 v. 2
3. Fetal loss at < 16 weeks	[254] 17 (6.7)	**2.01†**	1 v. 3
4. Delivery at > 37 weeks	[1 060] 22 (2.1)	0.62	1 v. 4
5. Delivery at 33 - 36 weeks	[38] 0	-	1 v. 5
6. Delivery at 24 - 32 weeks	[189] 19 (10.0)	**3.02†**	1 v. 6
7. Miscarriage at 16 - 23 weeks	[135] 20 (14.8)	4.44	1 v. 7
8. Termination at 16 - 23 weeks	[0]		

* Relative risk (RR) was calculated as a proportion of the percentage of women with a short cervix in the overall population (3.3%).
† Statistically significant *p*-values (< 0.05).
BMI = body mass index, CI = confidence interval.

inflammatory mediator platelet-activating factor, and inhibition of the enzyme that degrades platelet-activating factor.[14] Although we found a statistically significant difference in cervical length between smokers and non-smokers, this was not expressed in multiple regression analysis (Table I) (multiple regression analysis: β (95% CI): –0.57 (–1.56 - 0.42), *p*-value 0.2585).

Association between drug abuse and pretern delivery has been reported,[15] cocaine being particularly risky, possibly because of its effect on placental production of prostaglandins. Although questioned, no women in our population admitted to using illegal drugs. Our study also showed no significant difference in cervical length between those who consumed alcohol and those who did not (Table II) (multiple regression analysis: β (95% CI): 0.55 (–1.46 - 2.56), *p*-value: 0.5916).

It has been postulated that the risk of preterm delivery may be slightly higher in primigravid than in multiparous women. This study did not show a significant difference in cervical length between primigravid and multigravid women.

Our study, like others,[5,6,7,9] demonstrated that with regard to past obstetric history, cervical length was shorter in patients with previous mid-trimester losses or preterm deliveries (Tables I and II) (multiple regression analysis: β (95% CI): –1.77 (–2.16 - –1.38), *p*-value: < 0.0001).

Women in this study with a previous cone biopsy history did not have a shorter cervix. This finding differs from the finding of Heath *et al*.[9] The relatively small numbers in the current study may account for this. Further studies involving larger numbers of women may be required[15] (Tables I and II) (multiple regression analysis: β (95% CI): –0.35 (–5.55 - 4.85), *p*-value: 0.8959).

In both low and high-risk populations a short cervix at 23 weeks' gestation is associated with an increased risk of preterm delivery.

In conclusion, in using multivariate analysis this study demonstrated that significant independent contributors toward an explanation of variance in cervical length are previous obstetric history, BMI and maternal age, but not ethnicity.

This study was supported by a grant from the Fetal Medicine Foundation, London, UK (Registered Charity No. 1037116).

We would like to thank the following colleagues for their significant contribution to this study: Dr J J De Sousa from the Department of Obstetrics and Gynaecology, Coronation Hospital, Johannesburg; Sister H C Calvert, Coronation Hospital, Johannesburg; and Dr Gillian Stuart Smythe from the Department of Obstetrics and Gynaecology Johannesburg General Hospital. We would also like to thank Mr Jaco Botha, biostatistician from the Perinatal HIV Research Unit, University of the Witwaterstrand, Chris Hani Baragwanath Hospital, for statistical analysis of the data.

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Accepted 9 February 2005.