Preterm delivery risk factors: a prevention strategy in Shiraz, Islamic Republic of Iran

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استراتيجية للوقاية من عوامل اختطار ولادة الخدَّج (المبتسرين) في مدينة شيراز الإيرانية

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الخلاصة: تم خلال المدَّة من 3 شباط/فبراير إلى 5 آذار/مارس 2000 تصنيف 1177 من الحوامل المترددات على 36 مركزاً صحياً في مدينة شيراز، إلى متعرِّضات لاختطار مرتفع (519 امرأة)، أو لاختطار منخفض (598 امرأة)، وذلك على أساس وجود عوامل اختطار ولادة الخدَّج (المبتسرين). وتلقَّت الحوامل المتعرِّضات لاختطار مرتفع تدريباً على استراتيجيات تستهدف الحد من ولادة المبتسرين. وكان معدل تواتُر ولادة المبتسرين 3% لدى المجموعة المنخفضة الاختطار، و14.6% لدى المجموعة المرتفعة الاختطار (P<0.001). وتمثَّلت العوامل المهمة المسبِّبة لولادة الخدَّج (المبتسرين) في ما يلي: توسُّع عنق الرحم أكثر من 1 سم، والتقلُّصات الرحمية قبل الأوان، والحمل بأكثر من جنين واحد، والتدخين. ولوحظ أن ولادة الخدَّج (المبتسرين) كانت أقل بدرجة يُعتدُّ بها إحصائياً لدى المجموعة المرتفعة الاختطار التي تلقَّت التدريب، بالمقارنة مع مجموعة مماثلة في دراسة سابقة لم تحصل على تدريب.

ABSTRACT From 3 February–5 March, 2000, 1117 pregnant women attending 36 health centres in Shiraz were categorized as high risk (*n* = 519) and low risk (*n* = 598) based on the presence of preterm delivery risk factors. High-risk women received training on strategies to reduce the risk of premature delivery. The frequencies of preterm delivery in the low- and the high-risk groups were 3.0% and 14.6% respectively (*P* < 0.001). The significant factors for preterm delivery were cervical dilation > 1 cm, premature uterine contractions, multifetal gestation and smoking. Premature delivery was significantly lower in the high-risk group compared with a similar group in a previous study who had not received training.

Les facteurs de risque de prématurité : la stratégie de prévention à Chiraz en République islamique d'Iran

RÉSUMÉ Du 3 février au 5 mars 2000, 1117 femmes enceintes suivies par 36 centres de santé de Chiraz ont été classées respectivement dans les catégories à haut risque (n = 519) et à risque faible (n = 598) en fonction de la présence de facteurs de risque de prématurité. Les femmes à haut risque ont été sensibilisées aux stratégies visant à réduire le risque d'accouchement prématuré et ont reçu une formation *ad hoc*. Dans les groupes à faible et haut risque de prématurité, la fréquence des accouchements prématurés était respectivement de 3,0 % et de 14,6 % (p < 0,001). Les facteurs de prématurité les plus significatifs étaient la dilatation du col > 1 cm, la précocité des contractions utérines, les grossesses multiples et le tabagisme. La prématurité s'est avérée significativement plus faible dans notre groupe à haut risque que dans un groupe comparable ayant participé à une autre étude sans avoir reçu de formation appropriée.

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Introduction

Every year around the world some 13 million premature children are born. Most of these children are born in developing countries, and they account for the largest share of prenatal morbidity and mortality [*1–7*]. The consequences of preterm delivery for children are extremely serious and a preterm neonate might be affected by them throughout his/her life. Infants born too soon die and suffer disability and other morbidity more frequently than infants born at full gestation [*6*]. They also represent a large economic burden; extremely preterm neonates might have to stay in the neonatal intensive care unit for 90 days and each day can cost approximately 750 EUR (US$ 1 = 0.76 EUR) [*4*]. In developed countries, 35% of expenses for treating diseases in children result from preterm delivery [*8*]. A study in the United Kingdom showed that 62% of mortality in neonates < 1 month and 85% of mortality in infants < 1 year occurred in those born prematurely (gestational age between 22 and 36 weeks) [*9*]. For women, preterm birth may be the tip of the iceberg of other potentially preventable morbidities and may have its own long-term physiological and psychological consequences for the mother.

Data suggest that preterm delivery has not decreased in the last decade in spite of all known risk factors [*4*]. In the United States, for instance, preterm birth has risen steadily from 9.4% in 1981 to 11.4% in 1997 [*6*].

The main causes of preterm deliveries are preterm uterine contractions, > 1 cm dilation or more than 70% effacement of cervix and abnormalities in the uterus or cervix [*8*]. Research in Finland showed that unmarried status, smoking, low education, age above 35 years and first pregnancy were the most important risk factors for preterm deliveries [*10*]. Although there are many maternal characteristics associated with preterm delivery, the etiology in most cases is not clear. Research to study risks, etiology and prevention of preterm delivery is therefore necessary in order to reduce the rate of preterm delivery and its adverse health and economic outcomes.

In the Islamic Republic of Iran, there are no extensive data about preterm delivery. A controlled trial conducted by Makiabadi in 2 hospitals of Shiraz in which 806 pregnant women were divided into 3 groups (low risk, high risk with training and high risk without training) showed that the incidence of preterm delivery in these groups was 3.1%, 8.6% and 30.4% respectively [*11*].

The objectives of the present study were to investigate and provide data on the risk factors of preterm delivery in Shiraz city and to introduce a preventive strategy to be integrated in the maternal health care programme in order to reduce the rate of preterm delivery.

Methods

In this study, all 36 health care centres of Shiraz city were involved. In the first phase of the study, a midwife from the family planning division from each centre was invited to take part in a one-week workshop (conducted by a gynaecologist) to introduce the known preterm delivery risk factors and common prevention strategies and also the study structure, objectives and data collection instrument (Table 1).

In the second phase, the health care providers trained at the workshop started collecting data on the pregnant women attending their centres. A questionnaire was used for data collection and as a screening instrument. The questionnaire devised was based on that of Holbrook et al. [*12*] and

Table 1 **Contents of the one-week workshop for training health care providers**

Content
Risk factors of preterm delivery
Items indicated in Table 2
Alcohol consumption
Hypertension
Diabetes
Bleeding
Preterm delivery prevention methods
Refraining from intensive physical activity
Resting
Employment outside the home
Care of genital health
Avoiding sexual relations
Increasing fluid intake
Avoiding anxiety and stress
Preventing and treating anaemia and malnutrition
Awareness general risk factors in pregnancy period
Preventing labour progression

Table 2 **Risk factors included in the questionnaire used as the screening instruments**

Risk factor
Major risk factors
Multifetal gestation
History of preterm delivery
History of preterm uterine contraction in previous pregnancies
History of preterm pain in previous pregnancies
History of cervical cone biopsy
History of more than one abortion in the 2nd trimester
History of at least 2 stillbirths
History of at least 2 neonatal deaths
Surgical procedures during pregnancy
Abnormalities of the uterus or cervix
Premature contractions
> 1 cm dilation or > 70% effacement
Injury or trauma to the mother
Gestational hypertension
Hydramnios
Minor risk factors
Febrile disease during pregnancy
Urinary tract infection
Liver disease
Cardiac disease
Lung disease
History of bleeding in the 2nd trimester
Smoking > 10 cigarettes a day
Smoking water-pipe 2 times a day
Pregnancy lost in the 2nd trimester
> 2 pregnancies lost in the 1st trimester
History of 1 stillbirth
Drug addiction
Essential hypertension
Hyperthyroidism
Background risk factors
Maternal age < 18 and > 35 years
Maternal height < 150 cm
Maternal haemoglobin < 11 g/dL
Maternal weight < 48 kg at the beginning of pregnancy
Weight loss of ≥ 2 kg at the 18th week of gestation
Weight gain of < 5 kg at the 32nd week of gestation

contained 14 items for major risk factors, 14 items for minor risk factors and 12 items for background risk factors (Table 2). Each major, minor and background risk factor scored 10, 5 and 2.5 respectively. If the risk score for a pregnant woman exceeded 10, she was categorized in the high-risk group, otherwise in the low-risk group. The reason for taking a risk score of 10 as the cut-point was based on Makiabadi's study [*11*] indicating a score of 10 would give > 90% sensitivity. A high sensitivity would result in including a larger number of pregnant women into the high-risk group, which would have no harmful effects on the women. Additionally, a score of 10 has been used as the cut-point in similar studies by other researchers, for instance Main et al. [*13*].

Thus, all pregnant women attending the 36 health care centres during 3 February to

Table 2 **Risk factors included in the questionnaire used as the screening instruments** *(concluded)*

Risk factor
≤ 1 year pregnancy interval
History of 1 pregnancy lost in the 1st trimester
First pregnancy or 5th and more pregnancy
Severe physical stress
Severe emotional stress
Low socioeconomic status

5 March, 2000 with gestational age less and 36 weeks were screened for the presence of preterm delivery risk factors using the questionnaire and were divided into 2 groups; low risk for preterm delivery and high risk.

In the third phase of the study, the high-risk pregnant women were divided into subgroups of 5 to 10 persons. As an intervention activity, to detect and reduce the preterm delivery risk factors, a training programme was devised by the researchers and was given by the trained health care providers to the subgroups. The programme consisted of a 4-hour training session followed by several routine consulting sessions. The contents of the training were nearly the same as those of the workshop conducted for the health care providers (Table 1). In the routine consulting sessions, previous training was briefly repeated and, if needed, clinical interventions, such as hospitalization or treatment, were prescribed.

For ethical reasons we did not to include a control group (high-risk pregnant without training) in the study. Since the protocol of health care services given to pregnant women in governmental health care centres remained the same from 1992 to 2000, and the criteria for categorizing pregnant women remained the same, the control group of Makiabadi's study (high risk without training) [*11*] was used as the control group of this study to assess the effectiveness of the prevention strategy.

All the women were followed to delivery and their delivery status was recorded (preterm or full term).

Statistical analysis

As preterm delivery has a complex etiology with several associated variables, we used a multivariate regression model to analyse the data. Statistical analyses were performed using *SPSS*, version 11 and *SYSTAT*. The chi-squared test was used as criteria for introducing independent variables into the regression models. Logistic regression (binary and polytomous response) and Cox regression model were used to analyse factors associated with preterm delivery. Polytomous response logistic regression with the following 3 levels was applied for categorizing the outcomes of the pregnant women studied:

- Level 1: Preterm delivery
- Level 2: Full term (≥ 37 weeks) delivery with intervention
- Level 3: Full term delivery without intervention (reference level) (Makiabadi's group)

In the Cox regression model, the gestational age was considered a continuous variable and was not dichotomized to < 37 and ≥ 37 weeks.

Results

There were 1117 pregnant women included in the study; 519 (46.5%) and 598 (53.5%) of the pregnant women were labeled as high risk and low risk respectively. The total number of preterm deliveries was 94 (8.4%). The number of preterm deliveries in the low-risk group was 18 (3.0%) and

in the high-risk group was 76 (14.6%); the difference was statistically significant ($P < 0.001$). Comparison of the preterm delivery rate in the high-risk group of this study (14.6%) with that of the control group of the previous study (30.4%) [*11*] showed the significant effect of the training programme ($P < 0.001$).

Table 3 presents the distribution of some risk factors in the 2 groups. The only significant differences found between the high- and low-risk groups were in education level ($P = 0.03$) and number of pregnancies ($P = 0.002$).

Table 4 shows the distribution of the main risk factors in the high-risk pregnant women. Based on the scoring procedure, women with at least 1 of these main factors were categorized in the high-risk group.

Table 3 **Sociodemographic and pregnancy data of the pregnant women by risk group**

Variable	Group				*P*-value
	Low risk		High risk		
	No.	%	No.	%	
Age(years)					0.18
≤ 21	171	29.1	166	32.3	
22–29	305	52.0	241	46.9	
≥ 30	111	18.9	107	20.8	
Total	587	100.0	514	100.0	
Education					0.03*
Illiterate	25	4.3	36	7.1	
Elementary (1–5 years)	180	30.6	169	33.5	
Guidance school (6–8 years)	197	33.5	182	36.0	
High school (9–12 years)	166	28.2	101	20.0	
University education (> 12 years)	20	3.4	17	3.4	
Total	588	100.0	505	100.0	
Occupation					0.45
Housewife	550	94.8	493	95.5	
Employed outside the home	30	5.2	23	4.5	
Total	580	100.0	516	100.0	
Number of pregnancies					0.002**
1	229	38.4	192	37.1	
2–4	331	55.4	262	50.6	
≥ 5	37	6.2	64	12.4	
Total	597	100.0	518	100.0	
Duration of pregnancy at the entry into the programme (weeks)					0.2
< 22	166	30.6	168	36.0	
22–27	208	38.4	171	36.6	
≥ 28	168	31.0	128	27.4	
Total	542	100.0	467	100.0	

*Chi-squared homogeneity test: *significant at P < 0.05; **significant at P < 0.01.*
The totals do not sum to 519 and 598 because data were missing for some women.

Table 4 **Distribution of the major risk factors in the pregnant women**

Risk factor	No. (*n* = 1117)	%
History of preterm uterine contraction	119	10.7
History of preterm delivery	52	4.7
History of preterm pain in the previous pregnancy	32	2.9
Gestational hypertension	30	2.7
Injury or trauma during pregnancy	25	2.2
Smoking > 10 cigarettes a day[a]	24	2.2
> 1 abortion in the second trimester	11	1.0
Multifetal gestation	19	1.7
> 1 cm dilation of cervix	13	1.2
> 70% thinning of the amnion	11	1.0
Hydramnios	7	0.6
Abnormalities of the uterus or cervix	6	0.5
Surgery during pregnancy	3	0.3
2 stillbirths and 2 neonatal deaths	3	0.3
Cone biopsy from cervix	1	0.1

[a]Because of the high frequency of smoking this was included with the major risk factors.

Polytomous logistic regression analysis is presented in Tables 5. The table presents the odds ratios of the outcome of delivery in level 1 in reference to level 3. As indicated in Table 5, presence of > 1 cm dilation, smoking > 10 cigarettes a day, multifetal gestation and other factors were significantly associated with preterm delivery. The regression models also showed that when comparing the delivery outcome between level 2 (full-term delivery with intervention) and level 3 (full-term delivery without intervention as the reference level), the only factor retained in the model was smoking > 10 cigarettes a day (odds ratio = 4).

Table 6 presents odds ratios from the Cox regression models. In this analysis, more factors were significantly associated with preterm delivery (presence of > 1 cm dilation, multifetal gestation, smoking > 10 cigarettes a day, other factors, injury or trauma during pregnancy, preterm uterine contractions and period of training).

Discussion

In this study, based on the risk factors of preterm delivery, the pregnant women

Table 5 **Polytomous logistic regression models indicating factors most strongly associated with preterm delivery**

Factors retained in the model	Odds ratio[a]	95% confidence interval	*P*-value
> 1 cm dilation of cervix	54.5	6.6–447.6	< 0.001
Smoking > 10 cigarettes a day	6.7	2.2–20.5	0.001
Multifetal gestational pregnancy	6.5	2.1–19.7	0.001
Other factors[b]	4.6	1.5–14.7	0.01
Training for more than 98 days	0.45	0.26–0.79	0.005

Goodness of fit for the model: D = 64.58, df = 10, P < *0.001.*
[a]Reference group: level 3 (full term delivery without intervention).
[b]Including: positive history of at least 2 stillbirths or 2 neonatal deaths; surgical procedures during pregnancy; hydramnios; abnormalities in uterus or cervix; cone biopsy from cervix.

Table 6 **Cox regression models indicating factors most strongly associated with preterm delivery**

Factors retained in the model	Odds ratio[a]	95% confidence interval	*P*-value
> 1 cm dilation of cervix	2.79	1.58–4.92	< 0.001
Multifetal gestational pregnancy	2.27	1.42–3.63	< 0.001
Other factors[b]	1.92	1.20–3.10	0.008
Smoking > 10 cigarettes a day	1.53	1.00–2.35	0.05
Injury or trauma during pregnancy	1.41	0.94–2.11	0.09
Preterm uterine contractions	1.26	1.04–1.53	0.02
Logarithm of period of training	0.67	0.55–0.82	< 0.001

Goodness of fit for the model: D = 55.15, df = 7, P < *0.001.*
[a]*Reference group: level 3 (full term delivery without intervention).*
[b]*Including: at least 2 stillbirths or 2 neonatal deaths; surgical procedures during pregnancy; hydramnios; abnormalities of the uterus or cervix; cone biopsy from cervix.*

were categorized as low- and the high-risk groups. The frequency of preterm delivery in the study group was 8.4%; 3.0% for the low-risk and 14.6% for the high-risk group. As expected, the difference between the frequencies of preterm delivery in the 2 groups was statistically significant ($P < 0.0001$). The frequency of preterm delivery in our study was higher than that of preterm delivery found in Denmark with the rate of 3.1% [*14*] and lower than that of preterm delivery in the United States with the rate of 15.2% [*15,16*].

The preterm delivery rate in the low-risk group of Makiabadi's study [*11*] was not significantly different from the frequency in the low-risk group of our study ($P > 0.05$). The frequency of preterm delivery among the high-risk group of Makiabadi's study who had not received training, considered as the control group (30.4%), was significantly higher than that of the high-risk group of the present study who had received training (14.6%) ($P < 0.0001$). This indicates the effectiveness of combining a training programme with the routine health care given to high-risk pregnant women. The results of our study are in agreement with previous reports [*2,3,17*] that suggest that participation in an organized preterm delivery prevention programme that emphasizes patient education and frequent provider contact can significantly decrease the incidence of preterm birth. Based on this, the training programme for preterm delivery prevention devised in our study was integrated into the routine health care programme for high-risk pregnant women in all health centres in the Islamic Republic of Iran.

Our results show that cervical dilation more than 1 cm increases the risk of preterm delivery about 54 fold. Other strong risk factors retained in the regression models were smoking and multifetal gestational pregnancy which increased the risk of preterm delivery over 6 fold. This concurs with the findings of other studies [*3,8,10*]. It was also found that training pregnant

women for more than 98 days (14 weeks) could decrease the risk of preterm delivery by approximately 50%. Considering this period as a continuous variable in the Cox regression gave a better result in decreasing the risk of preterm delivery.

Comparing the results of the 2 regression models showed that although the first 4 risk factors were nearly the same, the Cox regression model also revealed an association between preterm delivery and injury or trauma during pregnancy, preterm uterine contractions and the period of training. Thus Cox regression seems to provide a more comprehensive statistical analysis.

Conclusion

Our study indicates that the following risk factors increased the risk of preterm delivery among our study population: > 1 cm dilation of the cervix; smoking > 10 cigarettes a day; multifetal gestational pregnancy; injury or trauma during pregnancy; preterm uterine contractions.

Training high-risk pregnant women about the risk factors for preterm delivery and preventive strategies could be an effective way to lower the incidence of preterm delivery and consequently prenatal mortality.

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