

What is already known on this topic

The term Gulf war syndrome has been used to describe illnesses and symptoms experienced by veterans of the 1991 Gulf war

Concerns exist over the validity of Gulf war syndrome as a unique entity

What this study adds

17% of Gulf war veterans believe they have Gulf war syndrome

Holding the belief is associated with worse health outcomes

Knowing someone else who believes they have Gulf war syndrome and receiving more vaccinations were associated with holding the belief

It may also result from the way in which armies prepare personnel for exposure to adversity, in the hope that they will not become disabled and that the likelihood of subsequent illness is reduced.¹²

The future health needs of the all service personnel should now be considered. As research findings are published, pertinent information should be fed back to all service personnel in order to minimise misconceptions about the nature of the illness and to prevent competing models of illness that may be harmful.

Contributors: TC had the original idea for the study, framed the hypotheses, contributed to the analyses, prepared the manu-

script, and acts as guarantor. MH conducted the main analyses. CU was the study coordinator. LH assisted with data collection. KI assisted in the study design and data collection. SW and AD were the grant holders and contributed to the manuscript.

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Teenage pregnancy and risk of adverse perinatal outcomes associated with first and second births: population based retrospective cohort study

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Abstract

Objective To determine whether first and second births among teenagers are associated with increased risk of adverse perinatal outcomes after confounding variables have been taken into account.

Design Population based retrospective cohort study using routine discharge data for 1992-8.

Setting Scotland.

Main outcome measures Stillbirth, preterm delivery, emergency caesarean section, and small for gestational age baby among non-smoking mothers aged 15-19 and 20-29.

Results The 110 233 eligible deliveries were stratified into first and second births. Among first births, the only significant difference in adverse outcomes by age group was for emergency caesarean section, which was less likely among younger mothers (odds ratio 0.5, 95% confidence interval 0.5 to 0.6). Second births

in women aged 15-19 were associated with an increased risk of moderate (1.6, 1.2 to 2.1) and extreme prematurity (2.5, 1.5 to 4.3) and stillbirth (2.6, 1.3 to 5.3) but a reduced risk of emergency caesarean section (0.7, 0.5 to 1.0).

Conclusions First teenage births are not independently associated with an increased risk of adverse pregnancy outcome and are at decreased risk of delivery by emergency caesarean section. However, second teenage births are associated with an almost threefold risk of preterm delivery and stillbirth.

Introduction

Teenage pregnancy is an important public health problem as it often occurs in the context of poor social support and maternal wellbeing. Some studies have suggested that first teenage pregnancies have a higher frequency of adverse perinatal outcomes.^{1 2} However,

there is argument about whether this is an independent association^{1,2} or explained by confounding factors.³⁻⁵ In general, the risk of adverse outcomes is lower in second pregnancies. However, longitudinal studies comparing outcomes in first and second pregnancies in teenagers have produced inconsistent results.⁶⁻⁹ Cross sectional studies comparing the outcome of second births in teenagers and older women have observed increased rates of preterm birth, low birth weight, and perinatal death^{10,11} but have failed to adjust for potential confounding factors such as smoking and socioeconomic deprivation.

Scotland is well placed to study the outcomes of teenage pregnancy. Teenage pregnancy rates in the United Kingdom are the highest in western Europe. Routine obstetric data have been collected on more than 99% of births in Scotland for over 20 years.¹² Scotland has a population that is relatively homogeneous in terms of race, and health care is free at the point of access, including all medical, surgical, drug, and dental treatment during pregnancy. The aims of this study were to determine whether teenage pregnancy was associated with increased rates of adverse perinatal outcome, whether the association differed by parity, and whether any associations were independent of confounding factors.

Methods

We used the Scottish morbidity record 2 (SMR2) database to identify all singleton births resulting in a live or stillborn baby during 1992-8. Inclusion in the main study group was restricted to first or second births, gestation at birth of between 24 and 43 weeks, birth weight >500 g, maternal age between 15 and 29 years, and non-smoking mothers. We also selected a second cohort who fulfilled all the above criteria except that they were classified as smokers at the time of first attendance for antenatal care.

Definitions and denominators

First births were defined as births to women who had had no previous pregnancies or whose previous pregnancies had all ended in either therapeutic abortion or miscarriage. Second births were defined as having been preceded by only one pregnancy that did not result in abortion. Gestational age at birth was defined as the number of completed weeks of gestation based on the estimated delivery date in the clinical record. A small for gestational age baby was defined as a live baby who was less than the 5th percentile of birth weight for the given week of gestation, using percentiles derived from all Scottish singleton live births recorded in the SMR2 database with values for both birth weight and gestational age in 1992-8 (n = 409 541). The denominator was all live births.

Very preterm delivery was defined as birth of a live baby at 24 to 32 weeks' gestation, and the denominator was all live births at or after 24 weeks' gestation. Moderately preterm delivery was defined as live births at 33 to 36 weeks' gestation, and the denominator was all live births at or after 33 weeks' gestation. Stillbirth was defined as delivery of a dead baby at or after 24 weeks' gestation, and the denominator was all births at or after 24 weeks' gestation. Neonatal death was defined as death of a liveborn baby in the first 28 days of life, and

the denominator was all live births. Emergency caesarean section was defined as any unplanned caesarean delivery, and the denominator was all live births.

Maternal age was defined as the age of the mother in completed years at the time of birth because many of the outcomes were delivery related. Maternal height was measured in centimetres. Postcode of residence was used to derive Carstairs socioeconomic deprivation scores.¹³ These are based on 1991 census data on car ownership, unemployment, overcrowding, and social class within postcode sectors. The deprivation scores were then used to categorise women into quintiles based on the study population. Non-smoking was defined as never having smoked at the time of first attendance for antenatal care, and smokers were defined as women who were current smokers at the time of first attendance for antenatal care. Details of the statistical analyses are available on the *BMJ's* website.

Results

Data were complete in 371 531 (90.3%) cases, and the main study group comprised the 110 233 non-smoking women aged between 15 and 29 years having a first or second birth between 24 and 43 weeks gestation of a baby weighing over 500 g.

Table 1 shows the demographic characteristics and the frequency of adverse outcomes in the study group.

We then compared the risk of adverse outcomes associated with maternal age 15-19 between first and second births. This indicated that the risk of delivering a small for gestational age baby and of having an emergency caesarean section did not differ significantly by parity. However, when the risk of adverse obstetric outcomes associated with maternal age 15-19 was compared for first and second births, there were

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Table 1 Study group characteristics and crude outcomes. Values are numbers (percentages) of women unless stated otherwise

	Women aged 15-19		Women aged 20-29		P value*
	First births (n=9699)	Second births (n=1225)	First births (n=59 315)	Second births (n=39 994)	
Demographic characteristics					
Mean (SD) height (cm)	161.8 (6.3)	160.9 (5.9)	162.9 (6.5)	162.3 (6.4)	<0.001
Socioeconomic deprivation quintile:					
1	698 (7.2)	65 (5.3)	11 411 (19.2)	6 856 (17.1)	<0.001
2	1299 (13.4)	150 (12.2)	11 890 (20.0)	8 014 (20.0)	
3	1889 (19.5)	265 (21.6)	11 737 (19.8)	8 141 (20.4)	
4	2340 (24.1)	309 (25.2)	11 719 (19.8)	8 113 (20.3)	
5	3257 (33.6)	411 (33.6)	11 163 (18.8)	7 969 (19.9)	
Unclassified	216 (2.2)	25 (2.0)	1 395 (2.4)	901 (2.3)	
Previous spontaneous abortions:					
0	9206 (94.9)	1099 (89.7)	52 647 (88.8)	32 781 (82.0)	<0.001
1	452 (4.7)	119 (9.7)	5 726 (9.7)	5 954 (14.9)	
>1	41 (0.4)	7 (0.6)	942 (1.6)	1 259 (3.1)	
Previous therapeutic abortions:					
0	9192 (94.8)	1158 (94.5)	54 581 (92.0)	36 598 (91.5)	<0.001
1	488 (5.0)	66 (5.4)	4 345 (7.3)	3 053 (7.6)	
>1	19 (0.2)	1 (0.1)	389 (0.7)	343 (0.9)	
Outcomes					
Birth weight <5th percentile	410 (4.2)	24 (2.0)	2 281 (3.8)	832 (2.1)	<0.001
Delivery 24-32 weeks	121 (1.2)	17 (1.4)	602 (1.0)	220 (0.6)	<0.001
Delivery 33-36 weeks	481 (5.0)	56 (4.7)	2 588 (4.4)	1 173 (2.9)	<0.001
Stillbirth	46 (0.5)	9 (0.7)	247 (0.4)	121 (0.3)	0.002
Neonatal death	22 (0.2)	3 (0.2)	146 (0.2)	67 (0.2)	0.07
Emergency caesarean section	831 (8.6)	51 (4.2)	8 346 (14.1)	2 240 (5.6)	<0.001

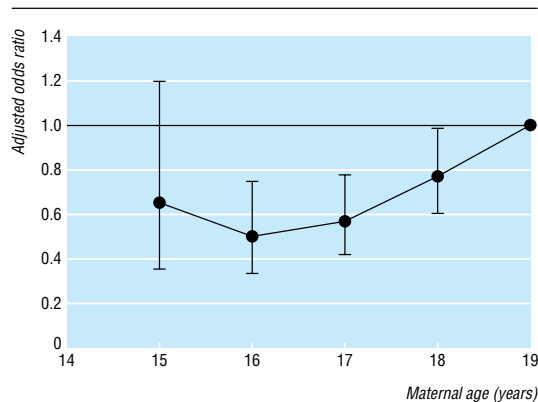
* χ^2 and analysis of variance tests applied to categorical and continuous data respectively.

Table 2 Univariate and multivariate logistic regression analysis of the risk of adverse perinatal outcomes among women aged 15 to 19 years of age compared with women aged 20-29 years (non-smokers)

Outcomes	First births (n=63 565)		Second births (n=38 467)	
	Unadjusted odds ratio (95% CI)	Adjusted odds ratio† (95% CI)	Unadjusted odds ratio (95% CI)	Adjusted odds ratio† (95% CI)
Birth weight <5th percentile	1.1 (1.0 to 1.2)	1.0 (0.9 to 1.1)	1.0 (0.7 to 1.5)	0.9 (0.6 to 1.4)
Delivery 24-32 weeks	1.2 (0.9 to 1.4)	1.1 (0.9 to 1.4)	2.7 (1.6 to 4.6)**	2.5 (1.5 to 4.3)***
Delivery 33-36 weeks	1.1 (1.0 to 1.2)*	1.1 (1.0 to 1.2)	1.7 (1.2 to 2.2)***	1.6 (1.2 to 2.1)**
Stillbirth	1.2 (0.8 to 1.7)	1.1 (0.8 to 1.6)	2.7 (1.4 to 5.4)**	2.6 (1.3 to 5.3)**
Neonatal death	0.8 (0.4 to 1.3)	0.8 (0.5 to 1.4)	1.2 (0.3 to 5.0)	1.0 (0.2 to 4.3)
Emergency caesarean section	0.6 (0.5 to 0.6)***	0.5 (0.5 to 0.6)***	0.8 (0.6 to 1.0)	0.7 (0.5 to 1.0)*

* P<0.05, **P<0.01, ***P<0.001.

†Adjusted for maternal height category, socioeconomic deprivation quintile, previous spontaneous and therapeutic abortions, and year (risks associated with second births also adjusted for previous perinatal death).



Adjusted odds ratios and 95% confidence intervals for delivering a small for gestational age baby (less than the 5th percentile for gestational age) associated with maternal age among first teenage births to non-smokers. Odds ratios were adjusted for maternal height category, socioeconomic deprivation quintile, previous spontaneous and therapeutic abortions, and year. The reference category was women giving birth aged 19

significant differences in the odds ratios of moderately premature birth ($P=0.01$), extremely premature birth ($P=0.004$), and stillbirth ($P=0.03$) (table 2). Therefore, the multivariate analyses were stratified by parity.

On multivariate analysis, women aged 15-19 years having first births were not at increased risk of any of the six adverse outcomes studied compared with women aged 20-29 (table 2). However, among second births, mothers aged 15-19 were at significantly increased risk of moderately and extremely premature birth and stillbirth (table 2). Emergency caesarean section was less likely among younger mothers at both first and second births. There were no significant interactions between maternal age at the time of delivery and socioeconomic deprivation quintile, height, year of

delivery, or previous abortions for any of the outcomes for either first or second births.

When the risk of adverse outcome was compared within the age range 15-19, there was no significant variation in the risk of moderately or extremely premature birth, stillbirth, neonatal death, or delivery by emergency caesarean section. However, compared with 19 year old women, the risk of delivering a baby weighing less than the fifth percentile for gestational age was significantly lower among women aged 16 to 18 (figure).

The proportion of women who were current smokers but fulfilled the other inclusion criteria at the time of first attendance for antenatal care varied by age and parity. Among women aged 15-19, 12 862 (47.5%) of first births and 2148 (54.8%) of second births were to smokers, whereas among women aged 20-29, 28 875 (27.4%) of first births and 26 120 (34.1%) of second births were to smokers ($P<0.001$).

When outcomes among 70 005 smokers were analysed, the risks associated with maternal age 15-19 again varied by parity. Among first births to smokers, there was a weak positive association between being aged 15-19 and moderately premature birth (table 3). Among second births to smokers, women aged 15-19 were at increased risk of moderately and extremely premature delivery and neonatal death. For both first and second births among smokers, being aged 15-19 was associated with a decreased risk of delivering a small for gestational age baby and being delivered by emergency caesarean section (table 3).

Discussion

Compared with older women, women who had a first birth during their teenage years were not at increased risk of any of the adverse outcomes studied and, indeed, were at significantly decreased risk of requiring emergency caesarean section. A previous study from the United States found that first teenage birth was independently associated with an increased risk of intrauterine growth restriction and of premature delivery,¹ and a Swedish study observed that first teenage births were at increased risk of perinatal death.² The main weakness of both studies was the failure to adjust for maternal smoking. Smoking is one of the strongest risk factors for adverse perinatal outcomes,¹⁴ and previous studies have shown that pregnant teenagers are more likely to smoke than pregnant older women.^{15 16} Our findings in non-smoking mothers suggest that the positive associations previously reported among first

Table 3 Adjusted odds ratios† (95% confidence intervals) for adverse outcomes in first and second births to women aged 15 to 19 compared with women aged 20-29 (smokers)

Outcomes	First births (n=38 087)	Second births (n=25 992)
Birth weight <5th percentile	0.8 (0.7 to 0.9)***	0.8 (0.6 to 1.0)*
Delivery 24-32 weeks	1.1 (0.9 to 1.4)	2.1 (1.5 to 2.9)***
Delivery 33-36 weeks	1.1 (1.0 to 1.3)**	1.5 (1.2 to 1.8)***
Stillbirth	0.9 (0.7 to 1.2)	0.5 (0.2 to 1.2)
Neonatal death	1.4 (0.9 to 2.1)	2.5 (1.3 to 4.8)**
Emergency caesarean section	0.5 (0.5 to 0.6)***	0.7 (0.6 to 0.9)**

*P<0.05, **P<0.01, ***P<0.001. †Odds ratios adjusted for maternal height category, socioeconomic deprivation quintile, previous spontaneous and therapeutic abortions, and year (risks associated with second births also adjusted for previous perinatal death).

What is already known on this topic

Teenage mothers are more likely to deliver prematurely and to have a perinatal death than older women

Teenage mothers are also more likely to smoke, be having a first baby, and live in adverse social circumstances

What this study adds

Non-smoking women aged 15-19 having a first birth were not at increased risk of adverse obstetric outcomes compared with women aged 20-29 after potential confounding variables were adjusted for

Non-smoking women aged 15-19 having a second birth were at significantly increased risk of both premature delivery and stillbirth compared with women aged 20-29

births might simply reflect inadequate adjustment for confounding variables. Indeed, when outcomes were compared within the age range 15-19, women aged 16-18 had a decreased risk of intrauterine growth retardation, which is consistent with a previous population based study from the United States.¹⁷

By contrast, we found that second births among women aged between 15 and 19 years were associated with an almost threefold risk of extremely premature birth and stillbirth compared with women aged between 20 and 29 years (table 2). A similar pattern was observed among women who smoked. However, the Scottish mortality record database does not include information on the number of cigarettes smoked a day or the duration of smoking. Both of these might be expected to vary systematically with age. Since there is a dose-effect relation between smoking and adverse outcomes,¹⁸ the findings among smokers should be interpreted with caution.

Conclusions

Our findings suggest a causal relation between second teenage birth and adverse pregnancy outcome. It is unlikely that the association can be explained by differences in the interval between pregnancies among teenage and older mothers since the associations

observed were much greater than those previously reported for short intervals between pregnancies.¹⁹ Furthermore, teenage mothers were not at increased risk of a small for gestational age baby, which is known to be more common after a short interval between pregnancies.¹⁹ A biological cause could be confirmed or refuted only by access to more detailed socio-economic information at the individual level. This would require prospective collection of data.

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