

Original Article

Perinatal and Developmental Outcomes of Teenage Pregnancy: An Analysis of a 10-year Period in a Local Region in Hong Kong

F CHOI, AWF CHENG, WK CHIU

Abstract

Introduction: Teenage pregnancy accounts for 11% of births worldwide. It is associated with poorer perinatal and developmental outcomes when compared to their adult counterparts. **Methods:** A retrospective cohort study was conducted in a Hong Kong regional hospital, comparing the perinatal outcomes between babies delivered to teenage mothers aged below 20 years and those delivered to mothers aged between 20 and 34 years. Risk factors which may affect developmental outcomes were also analysed. **Results:** Teenage pregnancy was associated with more preterm deliveries (<37 weeks) ($p<0.001$), more babies with low birth weight ($p<0.001$) and more babies who were small for gestational age ($p=0.015$). They also had significantly higher odds of delivering preterm babies when compared to adult mothers (aORs 9.309, 95% CI 1.918 to 45.173, $p=0.006$). Amongst the teenage pregnancy cases, those with prior CCDS follow-up had significantly higher number of children with developmental delay ($p=0.017$). **Conclusions:** Teenage pregnancy is associated with adverse neonatal outcomes, which may be due to biological immaturity, poor socio-economic status or a combination. Developmental delay is often found in children of teenage mothers. It is essential to identify risk factors to provide social support and education so that children will be able to cope with their everyday activities better.

Key words

Developmental outcomes; Perinatal outcomes; Teenage pregnancy

Introduction

Teenage pregnancy refers to pregnancy in girls between 10 to 19 years old. It is estimated 11% of births globally are born to adolescents aged 15 to 19 years.¹ Not only are these teenage girls more vulnerable to poor obstetric outcomes, they are also at increased risk of adverse perinatal outcomes.² Many studies reported higher rate of

preterm births, low birth weight, intrauterine growth restriction (IUGR), congenital malformations, neonatal intensive care unit (NICU) admissions and perinatal mortality among teenage pregnancies.¹⁻⁴ Some proposed young women who are still growing themselves may compete for nutrients with the foetus, leading to foetal growth impairment, resulting in low birth weight babies or babies who are small for gestational age (SGA).⁴ However, there is conflicting evidence as to whether these adverse perinatal outcomes were attributed by the physical immaturity of these teenage mothers or the unfavourable socio-environmental factors.^{1,5} This discrepancy can be explained by the heterogeneity between study settings, small sample size and different sociocultural backgrounds.¹

Apart from adverse perinatal outcomes, the cognitive development of these children is also of concern. In addition to maternal age, there are many psychosocial factors which may affect the developmental progress of children, such as educational status, financial support and maternal mental health.⁶ Although studies on the

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relationship between young maternal age and children's cognitive outcome have been performed, most of them were retrospective and did not account for certain confounding factors, for example, smoking and partner status, which were hypothesised to contribute to poorer developmental outcomes.⁷ It is essential to identify risk factors which may affect a child's development so that support can be provided earlier, helping the family and child cope with their daily living.

The aim of this study is to investigate whether teenage mothers are at higher risk of adverse perinatal outcomes when compared with their adult counterparts and to identify risk factors amongst teenage mothers which may lead to poorer cognitive outcomes of their offspring.

Methods

This is a retrospective cohort study covering the period from 1 January 2008 to 31 December 2017.

Ninety-five babies born to primiparous women aged under 19 years old who were under the Comprehensive Child Development Service (CCDS) follow-up in the Kowloon East cluster during the above period were included. CCDS provides integrated follow-up to most teenage mothers in Hong Kong. 285 babies born to primiparous women aged between 20 and 34 years were matched for comparison.

As advanced maternal age (>35 years) is known to be an independent risk factor for adverse perinatal outcomes, women aged 20 to 34 years are considered to have a reasonably lower risk of age-related pregnancy complications.⁴ Multiparous women, women aged above 35 years, and women with multiple pregnancies were excluded.

The sample size was calculated based on the population size of Kwun Tong district. With a confidence interval of 95%, margin of error of 5% and power of 80%, the required total sample size was calculated to be 380.

Demographics, past medical history, clinical parameters and outcomes were collected from the Hospital Authority Clinical Management System / electronic Patient Record system via the Clinical Data Analysis and Reporting System (CDARS). Baseline demographic data included were maternal age, ethnicity, marital status, maternal smoking and drinking status, maternal educational level, maternal past medical history and mode of delivery. The outcome parameters included were gestational age at birth, birth weight, Apgar scores, neonatal complications, for example

respiratory distress syndrome, intraventricular haemorrhage and necrotising enterocolitis, neonatal infections, congenital anomalies and birth trauma.

Definitions

Gestational age at birth was defined as the number of completed weeks of gestation between the first day of the last menstrual period and the delivery date.

Perinatal outcomes examined were preterm delivery (<37 completed weeks); very preterm delivery (<32 completed weeks); extremely preterm delivery (<28 completed weeks); low birth weight (LBW) (birth weight <2500g); very low birth weight (VLBW) (birth weight <1500g); extremely low birth weight (ELBW) (birth weight <1000g); small for gestational age (SGA) (birth weight <10th percentile for gestational age); large for gestational age (LGA) (birth weight >90th percentile for gestational age); low Apgar score at 1 minute and 5 minutes of life (Apgar score <7); mode of delivery (spontaneous vaginal delivery, Caesarean section, forceps delivery or vacuum extraction); NICU admission; neonatal complications including congenital anomalies, neonatal infections, respiratory distress syndrome, intraventricular haemorrhage, necrotising enterocolitis and birth trauma were defined according to the International Classification of Disease coding version nine (ICD-9) in the clinical management system and medical records.

Children were considered developmental delay by formal assessment at the Child Assessment Centre (CAC) where available. For those who were not assessed by CAC at the time of data collection, their developmental progress was assessed by the same paediatrician at their Maternal Child Health Care Centre (MCHC) follow-up, who has experience in developmental assessment.

Risk factors included in the subgroup analysis were maternal psychiatric disorder; maternal smoking status; assistance in childcare; prior CCDS follow-up; Comprehensive Social Security Assistance (CSSA) support and history of child abuse.

Statistical Analysis

Categorical variables were compared using the Pearson Chi square test or Fisher's Exact test (where expected frequencies were <5), as appropriate in univariate analysis. Continuous variables were compared using the Mann Whitney U test and were reported as median and interquartile range. A two-sided p-value of less than 0.05 was considered statistically significant.

Multivariable logistic regression analysis was used to

identify the odd ratios for neonatal outcomes for teenage pregnancies. Crude and adjusted odd ratios (aOR) with their 95% confidence intervals (CI) were used to present the effects among mothers <20 years old compared with those aged between 20 and 34 years.

Statistical Package for Social Sciences for Windows, version 24.0 (SPSS, Chicago, IL, USA) was used for statistical analysis.

Results

Baseline Characteristics

Ninety-five cases were under CCDS follow-up for teenage pregnancy from 1 January 2008 to 31 December 2017, with a mean age at delivery being 17 years (interquartile range: 16 to 18 years). 285 adult mothers were included, with a mean age at delivery being 25 years (interquartile range: 25.5 to 29 years). Table 1 showed the baseline demographics of the two groups. There were more mothers who were smokers (35.8% vs 4.9%), unmarried (1.1% vs 95.8%) and without tertiary education (0% vs 46.7%) in the teenage group. There was significant

difference on the modes of delivery ($p=0.01$), with less spontaneous vaginal delivery (73.3% vs 86.3%) and more instrumental delivery (26.7% vs 13.7%) in the teenage mother group. There was no statistically significant difference in other baseline characteristics.

Neonatal Outcomes

Univariate analysis (Table 2) showed that teenage pregnancy was associated with more preterm babies delivered before 37 weeks (11.6% vs 0.7%, $p<0.001$), more babies with LBW (9.5% vs 0%, $p<0.001$), more babies who were SGA (3.2% vs 0%, $p=0.015$) and more babies with Apgar score less than 7 at 1 minute of life (3.2% vs 0.4%, $p=0.05$).

Table 3 showed the crude and adjusted odd ratios for neonatal outcomes by maternal age group. Teenage mothers were found to have significantly higher odds of delivering preterm babies when compared to adult mothers (aORs 9.309, 95% CI 1.918 to 45.173, $p=0.006$).

Developmental Delay in Teenage Mother Group

In this study, the rate of developmental delay in children born to teenage mothers was 25.3%. Further analysis

Table 1 Baseline demographics of teenage and adult mothers

	Teenage (n=95)	Adult (n=285)	P-value
Maternal age (median +/- IQR)	17 (16-18)	28 (25.5-29)	<0.001
Ethnicity			0.009
Hong Kong Resident	93 (97.9%)	256 (89.8%)	
China Tourist	2 (2.1%)	29 (10.2%)	
Married	1 (1.1%)	273 (95.8%)	<0.001
Smoker	34 (35.8%)	14 (4.9%)	<0.001
Drinker	3 (3.2%)	5 (1.8%)	0.418
Educational level			<0.001
Secondary	95 (100%)	152 (53.3%)	
Tertiary	0 (0%)	133 (46.7%)	
Religion	0 (0%)	8 (2.8%)	0.209
Antenatal booked case	88 (92.6%)	278 (97.5%)	0.028
Spontaneous vaginal delivery	82 (86.3%)	209 (73.3%)	0.01
Instrumental delivery	13 (13.7%)	76 (26.7%)	0.01
Psychiatric illness	3 (3.2%)	13 (4.6%)	0.770
Diabetes mellitus	0 (0%)	7 (2.5%)	0.200
Hypertension	0 (0%)	4 (1.4%)	0.576
Genitourinary tract infection	8 (8.4%)	13 (4.6%)	0.154

exploring the risk factors among teenage pregnancy group which may lead to children with developmental delay was performed. As shown in Table 4, the cases with prior CCDS follow-up had significantly higher numbers of children with developmental delay (91.7% vs 66.2%, $p=0.017$).

Discussion

Baseline Characteristics

In this study, it was found that teenage mothers were less likely to have given birth via instrumental delivery when compared to their adult counterparts. This is consistent with previous studies which showed a decreased rate of Caesarean section and instrumental delivery in teenage mothers.^{2,4,8} However, some studies showed an increased rate of emergency Caesarean sections among teenage mothers with indications of non-reassuring foetal status due to preterm labour or cephalo-pelvic disproportion due to pelvic bone immaturity.^{1,2} By evaluating the nature of Caesarean section being emergency or elective, more insight can be provided on whether the finding of less Caesarean section among teenage mothers is due to biological factors, maternal preference or socio-cultural background. Teenage mothers having higher rates of spontaneous vaginal delivery may be explained by a more favourable myometrial function, greater elasticity of connective tissues, lower compliance of cervix and low birth weight babies, as suggested by a Turkish study.⁹⁻¹¹

Neonatal Outcomes

Many studies confirmed that teenage pregnancies are associated with preterm deliveries, which is similar to the findings of this study of teenage pregnancies having a higher rate of preterm deliveries <37 weeks. There is no clear explanation but many studies support that biological immaturity in youngsters give rise to a higher incidence of premature rupture of membrane (PROM), leading to more genitourinary infections, hence preterm deliveries.⁹ However, there was no significant difference in the rate of genitourinary tract infections between the two groups in this study, but teenage mothers tend to have a higher rate.

Another explanation is the insufficiency in uterine and cervical blood supply maturation, which also leads to an increased susceptibility to infection and increased prostaglandin production, hence a trend towards increased preterm deliveries.¹² Some also gave the explanation of adolescents have a shorter cervix and a smaller uterine volume, which may not be sufficient to accommodate for

a term foetus, so they tend to give birth to preterm babies.¹³

However, it is debatable whether these preterm deliveries are more associated with the biological immaturity of young mothers or their unfavourable socio-economic conditions.

International studies have found many social factors contribute to a higher rate of premature deliveries among young mothers, including poor antenatal care, low socioeconomic status and negative lifestyle factors.¹⁴

In this study, it was found there were significantly less number of antenatally booked cases, more smokers and less mothers who have received tertiary education among teenage mothers. These social factors could contribute to the higher rate of preterm deliveries as inadequate antenatal care and risky behaviours are known risk factors for adverse neonatal outcomes.¹⁵

Although some studies showed teenage pregnancy itself was not a significant risk factor for adverse neonatal outcomes after adjusting for socioeconomic factors, our study confirmed that teenage mothers have a significantly higher chance of delivering preterm babies than the adult mothers after adjusting for maternal smoking, education level, antenatally booked cases and maternal ethnicity.

Teenage pregnancy is complex with many biological and social factors interlinked. It is difficult to determine any causative factors which may give rise to adverse neonatal outcomes. It is likely the adverse neonatal outcomes are due to a combination of gynaecological immaturity and unfavourable socioeconomic factors.

This study also confirmed teenage pregnancies are associated with LBW babies, which is consistent with most studies. However, in accordance with a study in 2009, there was no significance after adjusting for confounding factors.¹⁶ Some studies found there was no significant difference between the mean birth weight and the proportion of LBW babies between teenage and adult mothers.³ LBW babies may be associated with their prematurity as teenage pregnancies tend to give rise to preterm deliveries. A cohort showed significantly increased risk of delivering babies extremely preterm (<28 weeks) in teenage mothers; and as extreme prematurity and ELBW is intrinsically linked, this may explain the relationship between LBW babies and teenage pregnancy, but may only remain true for extreme preterm babies.⁴

Teenage pregnancies were also found to be associated with babies who are SGA. However, this is in contrast with the finding in a Swedish study that there was no increased risk for SGA babies in adolescent mothers.⁸ This Swedish

Table 2 Comparison in neonatal outcomes between teenage and adult pregnancies

	Teenage (n=95)	Adult (n=285)	P-value
Gestation (median +/- IQR)	39 (38-40)	39 (39-40)	0.05
Preterm <37 weeks	11 (11.6%)	2 (0.7%)	<0.001
Preterm <32 weeks	1 (1.1%)	0 (0%)	0.250
Preterm <28 weeks	1 (1.1%)	0 (0%)	0.250
Birth weight (median +/- IQR)	3095 (2750-3320)	3330 (3152.5-3556.5)	<0.001
ELBW	0 (0%)	0 (0%)	–
VLBW	1 (1.1%)	0 (0%)	0.250
LBW	9 (9.5%)	0 (0%)	<0.001
SGA	3 (3.2%)	0 (0%)	0.015
LGA	2 (2.1%)	5 (1.8%)	1.000
Apgar score <7 at 1 min	3 (3.2%)	1 (0.4%)	0.050
Apgar score <7 at 5 min	1 (1.1%)	0 (0%)	0.250
NICU admission	36 (37.9%)	117 (41.1%)	0.587
RDS	2 (2.1%)	0 (0%)	0.062
IVH	0 (0%)	0 (0%)	–
NEC	0 (0%)	0 (0%)	–
Neonatal infections	2 (2.1%)	0 (0%)	0.062
Congenital anomalies	1 (1.1%)	0 (0%)	0.250
Birth trauma	1 (1.1%)	1 (0.4%)	0.438

Table 3 Odd ratios (ORs) in neonatal outcomes in teenage pregnancies

	Crude ORs	95% CI	P-value	Adjusted ORs*	95% CI	P-value
Preterm	18.53	4.03-85.25	<0.001	9.309	1.918-45.173	0.006
LGA	1.20	0.23-6.31	0.826	0.765	0.123-4.766	0.774
Apgar score <7 at 1 min	9.26	0.95-90.12	0.055	3.281	0.287-37.526	0.339
NICU admission	0.88	0.54-1.41	0.587	0.757	0.423-1.355	0.348
Birth trauma	3.02	0.187-48.778	0.436	7.242	0.24-218.358	0.255

* Adjusted for maternal smoking, education level, maternal ethnicity and antenatal booked cases

Table 4 Subgroup analysis on risk factors for developmental delay in teenage pregnancy group

	Developmental delay (n=24)	Normal development (n=71)	P-value
Maternal mood disorders	2 (8.3%)	7 (9.9%)	1.000
Maternal smoking	11 (45.8%)	23 (32.4%)	0.235
Caretaker assistance	24 (100%)	70 (98.6%)	1.000
Prior CCDS follow-up	22 (91.7%)	47 (66.2%)	0.017
CSSA	8 (33.3%)	17 (23.9%)	0.366
Child abuse	1 (4.2%)	1 (1.4%)	0.443
Maternal drinking	0 (0%)	3 (4.2%)	0.569

study also pointed out maternal smoking appears to be a significant independent risk factor for SGA in all age groups, but has less significance in younger mothers.⁸ The difference in socio-economic status may attribute to such adverse neonatal outcomes, although a study found the risk for SGA persisted even after restricting the analysis to women with age-appropriate education level, adequate antenatal care, non-smokers and non-drinkers.¹⁷

Teenage pregnancies were found to be associated with more babies born with Apgar score less than 7 at 1 minute of life. This is consistent with a study which showed teenage mothers had increased risks for adverse neonatal outcomes, including low Apgar score.¹⁸ The study also attributed the increased risk to maternal physical immaturity with maternal height as a measurement, explaining shorter maternal height relates to smaller pelvic size, thus increasing the risk of preterm deliveries, hence a higher chance of neonatal asphyxia. However, this study did not include maternal height or pelvic size as a measurement of physical maturity and could not demonstrate this relationship. Also, there was only significant difference in the Apgar score at 1 minute of life and not for that at 5 minutes of life. Apgar score is used to report the status of a newborn immediately after birth and assess the response to resuscitation if warranted. A low Apgar score at 1 minute of life does not predict an infant's outcome but that at 5 minutes of life correlates with neonatal mortality in large populations, but still does not predict future neurologic dysfunction.^{19,20} Although there is statistical significance in the difference in Apgar score at 1 minute of life between the two groups, the clinical significance is yet to be confirmed. By obtaining and comparing Apgar scores at 10, 15 and 20 minutes of life, the clinical impact of teenage pregnancies on adverse outcomes can be further explored.

Developmental Delay in Teenage Mother Group

The rate of developmental delay in children born to teenage mothers in this study was 25.3%.

There is a paucity of local data on the epidemiology of developmental delay in the general population. According to a local study by *Tang et al* in 2008, the rate of developmental delay in children among referrals to Child Assessment Service in Hong Kong was 23%.²¹

A child's developmental progress can be affected by many biological and psychosocial factors. In this study, it was found that cases with prior CCDS follow-up had significantly higher numbers of children with developmental delay.

CCDS is a multidisciplinary service which provides comprehensive support to young children and their families using MCHC as a platform. One of its aims is to improve health and developmental outcomes of three main at-risk groups of children, including mothers who have mental illness, mothers who have history of illicit drug use and teenage mothers.

The results seemed to be a surprise as one would have thought earlier engagement and more support throughout a child's growth and development should alert both the caretaker and clinician of any signs of delay at a timely manner for formal assessment and intervention. However, on second thought, it was by recruiting these at-risk cases into CCDS which allowed for early identification of developmental delay, prompting for expedient CAC referral and early schooling with appropriate training. Moreover, these cases would be followed up for longer time so that their progress could be monitored closely.

On the other hand, cases with prior CCDS follow-up may not only be looked after early due to teenage pregnancy, but may have co-existing risk factors requiring close monitoring. Further investigation into whether these teenage mothers had mental illness or drug abuse history at the same time which required early CCDS follow-up may be beneficial to determine more associated risk factors leading to delay in their children's cognitive outcome.

Studies have shown children of teenage mothers are at three to four times higher risk of developmental delay in intelligence, language and social-emotional functions than those of adult mothers.²² Most studies found that poor financial status, presence of maternal smoking and poor social support were risk factors for developmental delay in children.^{7,22} On the contrary, our study did not show any significant role of CSSA support, maternal smoking and caretaker assistance in the delay in development of children.

Another risk factor contributing to developmental delay is co-parenting conflicts. It commonly occurs in families with complex parent-grandparent relationships. Studies have shown that greater adolescent-mother conflict predicts a greater likelihood of the child being delayed in development.²²

World-renowned Nurse-Family Partnership program led by Professor David Olds has been shown to be effective in improving birth, health and developmental outcomes, especially for young, first-time mothers and their children.²³ The program starts prenatally, giving support and equipping young mothers with parenting techniques throughout the first two years of childhood. It

is the responsive and engaging parenting which provides secure attachment for children to achieve their best developmental outcome. By making use of CCDS as a platform and with more resources, enhancement can be made by incorporating similar parenting programs to provide easy access to health resources and support to teenage mothers.

Biological factors such as parental intelligent quotient and history of breastfeeding may influence a child's development. These could be included in future studies to determine their significance. By analysing each domain of development for longer period by formal assessment, potential risk and protective factors can be identified and timely interventions can be provided.

Strengths and Limitations

This is the first cohort study in Hong Kong studying the impact of teenage pregnancy on perinatal and developmental outcomes. This study covers certain socio-economic and cultural factors which is important in exploring outcomes that are biologically and socially affected. Through selecting cases with comprehensive follow-up under CCDS, the chance of missing data can be minimised. It also provides a brief insight into the negative impact of teenage pregnancy and the potential consequences it may lead to, hoping to alert the society for the implementation of adequate sexual education to reduce teenage pregnancies and provision of support programs for the families.

However, with the nature of this study being retrospective, it is prone to confounding factors. This study only covers data from a single centre and does not include different sociocultural backgrounds in such a diverse society. More samples from other centres can be included to provide a more comprehensive overview on the sociocultural impact. Although some socioeconomic factors have been included in this study, a more diverse variety for example parental substance abuse history, parental alcohol intake, parental educational level and social services received, can be explored in more detail in future studies for a better coverage. By extending the study for a longer duration and including more potential risk factors, the developmental progress can be monitored in more detail and can provide a better insight into how to prevent developmental delay in the group of at-risk teenage mothers.

Conclusion

Teenage pregnancy is associated with adverse neonatal outcomes, like preterm delivery. This may be due to biological immaturity or poor socio-economic status or a combination. Developmental delay is often found in children of teenage mothers and requires intensive support. It is essential to identify risk factors among teenage mothers and their families to provide better social support and appropriate education so that children will be able to cope with their everyday activities better.

Ethics Approval

This study was approved by the Kowloon Central / Kowloon East Cluster Research Ethics Committee of the Hospital Authority (KC/KE-18-0210/ER-2) and written informed consent was waived.

Declaration of Interests

Nil for all authors.

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