Original Article

Prospective Cohort Study of Adverse Pregnancy Outcomes in Extremely Young Maternal Age

Saifon Chawanpaiboon MD[1], Kanjana Pimol BN[1], Supavade Sodsee BN[1], Vitaya Titapant MD[1], Julaporn Pooliam MS[2]

[1] Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

[2] Clinical Epidemiological Unit, Office for Research and Development, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: To study the adverse outcome in pregnant women age 16 years or younger.

Materials and Methods: The study design was a prospective cohort study. The patients age 16 years or younger and 20 to 29 years who came to antenatal care between July 1, 2013 and June 30, 2016, were enrolled in the present study. The patient data including demographic, hospital course, maternal laboratory investigations, maternal complications, placental complications, and neonatal outcomes were recorded. Data were analyzed using SPSS version 14 (IBM, Armonk, NY, USA). The Chi-square test and analysis of variance were used to compare categorical variables and continuous variables, respectively, between the two groups. Results were reported as number, percentage, or mean and standard deviation. A *p*-value less than 0.05 was considered significant.

Results: Anemia, obstetric complications including hypertension, pulmonary disease, and gestational diabetes mellitus [GDM] were different with statistical significance between the two groups of pregnant women. Venereal diseases were high in young maternal age group while hepatitis B carriers were low in this group. Maternal education, occupation, maternal income, and knowledge of birth control methods for pills and DMPA were also different with statistical significance between the two groups.

Conclusion: Pregnancy among the extremely young age entails greater risk of adverse pregnancy outcomes for both mothers and neonates. Health care providers should adjust their prenatal care for young pregnant women with multidisciplinary teams.

Keywords: Adverse pregnancy outcome, Extremely young maternal age

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Teenage pregnancy is still the major problem in Thailand and low-income countries. About 11% of total births globally are from the mothers at age 15 to 19 years (around 16 million women) and 95% of these occur in under developed countries[1]. Niger has the highest rate of teenage pregnancy around 201 births/1,000 women at age 15 to 19 years in 2015. Thailand has continued decreasing in birth rates of teenage women between 1960 and 2015, from 60 to 45 births/1,000 women age 15 to 19 years[2]. The adolescent birth rate is lowest in Japan and Denmark.

The pregnancy at the age below 15 years have many problems including the immature physical development of the mother[3], socioeconomic factors, and biological effects of age[4]. Teenage mothers will get a serious issue that will impact their future life. Fertility rates among 15 to 19-years old in Thailand rose from 39.7 per 1,000 in 1996 to 53.6 per 1,000 in 2011[5]. An estimated 129,541 girls between the ages of 15 and 19 became mothers in 2013, and an additional 3,725 girls under the age of 15 became mothers in the same year[6]. The main problems of teenage pregnancy are the educational interruption and economic problems.

Teenage pregnancy is considered a high-risk pregnancy and has numerous negative socioeconomic impacts at family and social levels. The environmental degradation, poor family income, less educated population, and lack of warmth and care from family are the causes of teenage pregnancy[5]. Most of the Thai teenagers have unintentional pregnancies because of lack of knowledge about safe sex and pregnancy prevention. From the previous study, teenage mothers were at high risks of developing health problems including anaemia, toxaemia, preterm delivery, and adverse neonatal outcomes[7]. However, there are few adverse neonatal outcomes when there is a high quality antenatal care in some countries[8,9]. The authors planned to study the outcome after improving the

Correspondence to:

Chawanpaiboon S. Maternal Fetal Medicine Unit, Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
Phone: +66-2-4194777 ext. 8, **Fax**: +66-2-4182662
Email: saifon.cha@mahidol.ac.th

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antenatal care at Siriraj Hospital. Prospective study of adverse pregnancy outcomes in teenage pregnancy were studied and reported.

Materials and Methods

The present study was approved by the Siriraj Ethics Committee of the Faculty of Medicine Siriraj Hospital, COA No. Si 615/2012. The study design was a prospective cohort study. The sample size, using a power and precision analysis formula was calculated by the incidence of preterm labor, gestational hypertension, gestational diabetes mellitus [GDM], caesarean section, anemia, low birth weight infant, fetal anomalies, and admission of infants to the neonatal intensive care unit [NICU] at Siriraj Hospital. The largest sample size calculated (approximately 1,100 patients per group) was chosen. It was based on the incidence rates of NICU admissions.

The study design was a prospective cohort study. The pregnant women age 16 years and younger and 20 to 29 years who came to antenatal care between July 1, 2013 and June 30, 2016, were enrolled in the present study. The patient information including demographic data, hospital course, maternal laboratory investigations, maternal complications, placental complications, and neonatal outcomes were recorded. Data were analyzed using SPSS version 14 (IBM, Armonk, NY, USA). The Chi-square test and analysis of variance were used to compare categorical variables and continuous variables, respectively, between the two groups. Results were reported as number, percentage, or mean and standard deviation. Subgroup analysis was also performed. The level of statistical significance (*p*-value) was smaller than 0.05.

The definition of all recorded adverse outcomes in mother and newborns was classified as the following.

Definition of adverse outcomes in mother

Anemia means pregnant women with hemoglobin concentration below 11.0 grams per dL or hematocrit below 33%[10].

High blood pressure during pregnancy means that people with systolic blood pressure at 140 mmHg or greater or diastolic blood pressure at 90 mmHg or greater for twice when measured at least six hours apart[11].

Diabetes mellitus is diagnosed by the criteria of abnormal glucose tolerance test. The pregnant women must have a screening test with glucose 50-gram one hour challenge test. The positive screening test will be followed by a diagnostic 100 grams oral glucose tolerance test [OGTT]. The normal blood glucose level at 0, 1, 2, 3 hours are not greater than 105, 190, 165, 145 mg/dL, respectively. If they are abnormal more than two values, pregnant women would be diagnosed with GDM. The pregnant women who can control blood glucose level to normal by dietary means alone is diagnosed as GDMA1. If insulin therapy is considered, the pregnant women are diagnosed with GDMA2[12].

Placental abruption means the separation of placenta from attachment before delivery of the baby[13].

Placenta previa means the placental attachment cover or near the internal cervical os[13].

Preterm birth means the birth between gestational age between 24+0 to 36+6 weeks[14].

Definition of adverse outcomes in neonate

Neonatal deaths[15]:

• Stillbirth means no vital signs of the baby during or after birth.

• Early neonatal death means death of a baby during the first seven days after birth.

• Late neonatal death means the death of infants from 8 to 28 days after birth.

Low birth weight means neonatal birth weight less than 2,500 grams[15].

Congenital abnormalities are defined as neonates with structural congenital anomalies.

NICU admission means newborns treated in the neonatal intensive care unit.

Results

Between July 1, 2013 and June 30, 2016, all pregnant women of 1,200 cases of maternal age in each group of 16 years or younger and 20 to 29 years were included. Six hundred sixty and 1,150 cases of maternal age 16 years or younger and 20 to 29, respectively had delivered in Siriraj Hospital. Demographic data including body mass index [BMI], gravida, parity, and abortion among the two groups were different with statistical significance (Table 1). The missing cases were those of delivery in other places.

Occupations, incomes and education of mothers in the two groups were different. Education level in maternal age group of 20 to 29 years was highest while the mothers age 16 years or younger had lowest incomes (Table 2). Hypertension, pulmonary diseases, and gestational diabetes were significantly low in the young maternal age group (Table 3).

High rate of spontaneous delivery was significantly found in the young maternal age group, while low rate of cesarean section was also significantly found in the

Table 1. Patients characteristics by maternal age between age ≤16 and age 20 to 29 groups

Characteristics	Age ≤16 years (n = 660)	Age 20 to 29 years (n = 1,150)	*p*-value
Maternal age	15.43±0.75 (13 to 16)	24.51±2.94 (20 to 29)	<0.001
Body mass index (kg/m^2)	20.89±4.09 (12.98 to 58.20)	21.60±4.09 (14.04 to 42.45)	<0.001
Drug abuse	0 (0.0)	2 (0.2)	0.536
No ANC	1 (0.2)	4 (0.3)	0.658
Gravida			<0.001
1	563 (85.3)	589 (51.2)	
2	85 (12.9)	405 (35.2)	
3	12 (1.8)	119 (10.3)	
4	0 (0.0)	27 (2.4)	
≥5	0 (0.0)	10 (0.9)	
Parity			<0.001
0	587 (88.9)	669 (58.1)	
1	70 (10.6)	385 (33.5)	
2	3 (0.5)	80 (7.0)	
3	0 (0.0)	16 (1.4)	
Abortion			<0.001
0	630 (95.5)	1,010 (87.8)	
1	28 (4.2)	116 (10.1)	
2	2 (0.3)	19 (1.7)	
≥3	0 (0.0)	5 (0.4)	
VDRL reactive*	19 (2.9)	15 (1.3)	0.018
HBS Ag positive**	6 (0.9)	34 (3.0)	0.004
Anti HIV positive***	3 (0.5)	1 (0.1)	0.141
Hematocrit (%)	34.97±3.47 (22.0 to 46.0)	36.13±3.28 (16.8 to 48.7)	<0.001
Total thalassemia****	249 (37.7)	364 (31.7)	0.009
Hb H disease	2 (0.3)	5 (0.4)	1.000
Beta thalassemia trait	6 (0.9)	9 (0.8)	0.775
Hb E trait	134 (20.3)	246 (21.4)	0.584
Alpha thalassemia trait	95 (14.4)	90 (7.8)	<0.001
Other types	20 (3.0)	34 (3.0)	0.929
Blood group			0.775
O	238 (36.1)	423 (36.8)	
A	142 (21.5)	238 (20.7)	
B	224 (33.9)	397 (34.5)	
AB	50 (7.6)	87 (7.6)	
No test + no data	6 (0.9)	5 (0.4)	
Rh			0.373
Positive	653 (98.9)	1,143 (99.4)	
Negative	1 (0.2)	2 (0.2)	
No test + no data	6 (0.9)	5 (0.4)	
Total weight gain (kg)			0.054
<5	28 (4.3)	39 (3.4)	
5 to 9.9	101 (15.3)	139 (12.1)	
10 to 14.9	268 (40.6)	452 (39.3)	
15 to 19.9	148 (22.4)	331 (28.8)	
≥20	113 (17.1)	187 (16.2)	
	2 (0.3)	2 (0.2)	

ANC = antenatal care; VDRL = venereal disease research laboratory; HBS Ag = hepatitis B surface antigen

Data are n (%) or mean ± standard deviation (range) unless otherwise specified

p-value represents Chi-square test or Fisher's exact test comparison between groups for categorical variables and unpaired t-test for continuous variable

* VDRL reactive means positive screening test for syphilis, ** HBS Ag positive means positive screening test for hepatitis B carrier, *** Anti HIV positive means positive screening test for the HIV virus antibodies, **** Some patients may have both types of thalassemia

low birth weight (Table 4).

Discussion

Adolescent pregnancy is defined as the pregnancy females under the age 20[16] or occurring before the full somatic development is achieved[17]. One million women under 15 years give birth every year and most of them are in low- and middle-income countries[18].

Table 2. Social data by maternal age between age ≤16 and age 20 to 29 groups

	Age ≤16 years (n = 660), n (%)	Age 20 to 29 years (n = 1,150), n (%)	*p*-value
Occupation			<0.001
Housewife	361 (54.7)	293 (25.5)	
Employee	155 (23.5)	590 (51.3)	
Business owner	5 (0.7)	35 (3.0)	
Public service	1 (0.2)	73 (6.3)	
Student	107 (16.2)	26 (2.3)	
Other	31 (4.7)	133 (11.6)	
Income (baht/month)			<0.001
<5,000	473 (71.7)	324 (28.2)	
>5,000 to 10,000	143 (21.7)	417 (36.3)	
>10,000 to 20,000	40 (6.0)	346 (30.1)	
>20,000 to 30,000	4 (0.6)	50 (4.3)	
>30,000	0 (0.0)	13 (1.1)	
Education			<0.001
No	5 (0.8)	22 (1.9)	
Primary	72 (10.9)	82 (7.1)	
Junior high school	397 (60.2)	275 (23.9)	
Senior high school	112 (17.0)	295 (25.7)	
Vocational certificate	60 (9.1)	100 (8.7)	
High vocational certificate	6 (0.9)	88 (7.7)	
Bachelor	7 (1.1)	269 (23.4)	
Master's degree	0 (0.0)	7 (0.6)	
No data	1 (0.2)	12 (1.0)	
Pregnancy			<0.001
Intended	296 (44.8)	888 (77.2)	
Unintended	364 (55.2)	262 (22.8)	
Total knowledge of birth control*	506 (76.7)	855 (74.3)	0.272
Pills	478 (72.4)	728 (63.3)	<0.001
DMPA	20 (3.0)	108 (9.4)	<0.001
Condom	6 (0.9)	16 (1.4)	0.368
Implant	0 (0.0)	9 (0.8)	0.031
IUD	0 (0.0)	5 (0.4)	0.166
TR	0 (0.0)	1 (0.1)	1.000

DMPA = depot medroxyprogesterone acetate; IUD = intrauterine device

p-value represents Chi-square test or Fisher's exact test comparison between groups for each category

* Some patients may have both types of knowledge of birth control

Teenage pregnancy is still the major problem around the world. Among 35 developed countries, Romania has the highest rate of adolescent pregnancy (61 per 1,000 women aged 15 to 19 in 2011), while in 2008, adolescents aged 15 to 19 in developing countries had estimated 14.3 million births[19]. Poor socioeconomic and educational conditions are related to teenage pregnancy. Adverse pregnancy outcome of both extremely young mothers and neonates are still the major issues in developing countries. Adolescents through 19 years of age were previously studied. Aim of the present study was to find from the pregnant mothers 16 years old or younger, which adverse pregnancy outcomes adolescents were specifically at risk for. The reasons for selection the reference group aged 20 through 29 years were that women older than 29 years are known to be at higher risk for diabetes, placenta previa, and cesarean delivery, and their newborns are known to be at higher risk for NICU admission[20].

The present study showed that young maternal age had higher incidence of low BMI, which was consistent with the previous report[21]. In Japan, the percentage of leanness has been increasing in young women, and the percentage of low birth weight infants (less than 2,500 g) has increased[22]. The present report also confirmed that young mothers have the poor pregnancy outcome including low birth weight baby. Not only the risk of delivering low birth weight infants, those of premature, and small-for-gestational-age infants are also high in young maternal age group[23].

Most of young pregnant women are from poor and low socioeconomic families and communities. When they get pregnant, most of them have to drop out of school. The present study showed that most of the young pregnant women graduated at junior high school level. They will lose the chance to find a good job, which will affect their income. Low educational level

Table 3. Underlying medical conditions and medical and obstetrics complications by maternal age between age ≤16 and age 20 to 29 groups

	Age ≤16 years (n = 660), n (%)	Age 20 to 29 years (n = 1,150), n (%)	*p*-value
Heart diseases	2 (0.3)	8 (0.7)	0.343
Thyroid disease	4 (0.6)	14 (1.2)	0.207
Hypertension	0 (0.0)	8 (0.7)	0.031
Pulmonary disease	0 (0.0)	10 (0.9)	0.017
Diabetes mellitus	1 (0.2)	8 (0.7)	0.168
Hypertensive disorders in pregnancy	28 (4.2)	52 (4.5)	0.781
No	632 (95.7)	1,098 (95.5)	
Gestational HT	11 (1.7)	21 (1.8)	
Mild pre-eclampsia	12 (1.8)	12 (1.1)	
Severe pre-eclampsia	4 (0.6)	14 (1.2)	
Chronic HT with superimposed pre-eclampsia	1 (0.2)	5 (0.4)	
Gestational diabetes	8 (1.2)	79 (6.9)	<0.001
No	652 (98.7)	1,071 (93.1)	
GDM A1	7 (1.1)	69 (6.0)	
GDM A2 at least	1 (0.2)	10 (0.9)	
Placenta previa	1 (0.2)	9 (0.8)	0.104
No	659 (99.8)	1,141 (99.2)	
Marginalis	0 (0.0)	5 (0.4)	
Totalis	1 (0.2)	4 (0.3)	
Delivery, gestational week			0.205
Preterm	70 (10.6)	145 (12.6)	
• Extremely preterm (<28 weeks of gestation)	11 (1.7)	20 (1.7)	
• Very preterm (28 to 32 weeks of gestation)	5 (0.7)	15 (1.3)	
• Moderate and Late preterm (33 to 36 weeks of gestation)	54 (8.2)	110 (9.6)	
Term (≥37 weeks of gestation)	590 (89.4)	1,005 (87.4)	
PPH	24 (3.6)	50 (4.3)	0.462
No	636 (96.3)	1,100 (95.6)	
Yes: uterine atony	15 (2.3)	31 (2.7)	
Yes: retain placenta	2 (0.3)	3 (0.3)	
Yes: tear birth passage	7 (1.1)	15 (1.3)	
Yes: other	0 (0.0)	1 (0.1)	

HT = hypertension; GDM = gestational diabetes mellitus; PPH = postpartum hemorrhage

p-value represents Chi-square test or Fisher's exact test comparison between groups for each category

of young mothers may also relate to poor knowledge of contraceptive methods.

Unintended pregnancy, poverty, ignorance of pregnancy signs and symptoms, and lack of knowledge of antenatal care are commonly found in extremely young maternal age (16 years or younger)[18]. Appropriate care will decrease the adverse pregnancy outcomes, which results from social rather than physiological conditions[24].

From the present study, sexually transmitted diseases including HIV infection were not significantly high in extremely young pregnant women as shown in a previous study[25]. However, venereal disease was higher in the extremely young pregnant women. Hepatitis B carrier is lower in the young maternal age group, which may result from the policy of the Ministry of Health and advance program of active immunization for hepatitis B vaccination of newborn in Thailand[26].

Young mothers had higher rate of anemia with the antenatal hemoglobin concentration less than 10 g per dL, which corresponded to previous study[27]. This might be the result of poor nutrition during pregnancy[24]. Thalassemia is a genetic disease that is common in Thailand. Alpha thalassemia was found to be higher in pregnant women 16 years or younger than those in the control group, however, no clinical evidence can explain to this finding.

The risks of hypertensive disorder in pregnancy and preterm delivery were not common in this age group. The administration of magnesium sulfate to prevent convulsions in patients with severe pre-eclampsia, and administration of steroid drug to promote lung maturity in the newborn were not frequently used in the study.

The rate of preterm births in young mothers was not high as in a previous study[7]. Most young women

Table 4. Medical administrations and delivery outcomes by maternal age between age ≤16 and age 20 to 29 groups

	Age ≤16 years (n = 660)	Age 20 to 29 years (n = 1,150)	*p*-value
Dexamethasone	9 (1.4)	17 (1.5)	0.844
Bricanyl	4 (0.6)	12 (1.0)	0.339
Magnesium sulfate	3 (0.5)	10 (0.9)	0.396
Gestational age at delivery or abortion (weeks)	38.03±3.67 (5 to 42)	37.79±3.80 (6 to 41)	0.189
Gestational age at delivery (weeks)	38.46±1.57 (29 to 42) (n = 649)	38.23±1.73 (27 to 41) (n = 1,131)	0.005
Mode of deliveries	(n = 649)	(n = 1,131)	
Normal labor	484 (74.6)	645 (57.0)	<0.001
F/E, V/E	13 (2.0)	29 (2.6)	0.453
Cesarean section	152 (23.4)	456 (40.3)	<0.001
Other	0 (0.0)	1 (0.1)	1.000
Fetal numbers			<0.001
1	587 (88.9)	668 (58.1)	
2	70 (10.6)	385 (33.5)	
≥3	3 (0.5)	97 (8.4)	
Neonatal weights	(n = 649)	(n = 1131)	0.597
≥4,000 g	5 (0.8)	17 (1.5)	
2,500 to 3,999 g	572 (88.1)	986 (87.2)	
1,500 to 2,499 g	69 (10.6)	122 (10.8)	
1,000 to 1,499 g	3 (0.5)	6 (0.5)	
Mean neonatal weights (grams)	2,951.57±397.84 (1,380 to 4,530)	3,018.86±471.60 (1,040 to 4,680)	0.001
Ventilator	3 (0.5) (n = 649)	3 (0.3) (n = 1,131)	0.674
Structural abnormalities	2 (0.3) (n = 649)	5 (0.4) (n = 1,131)	1.000
Bilateral cleft lip	0 (0.0)	1 (0.1)	
Fetal CPAM	0 (0.0)	1 (0.1)	
Lung (fetal diaphragmatic hernia)	0 (0.0)	2 (0.2)	
Abdominal (gastroschisis)	0 (0.0)	1 (0.1)	
Pyelectasis	1 (0.2)	0 (0.0)	
Twins	1 (0.2)	0 (0.0)	
Apgar scores			
1 minute	8.57±1.14 (0 to 10)	8.45±1.22 (0 to 10)	0.036
5 minutes	9.77±0.78 (0 to 10)	9.68±0.95 (0 to 10)	0.037
Stillbirth	1 (0.2) (n = 649)	4 (0.4) (n = 1,130)	0.658
Abortion	11 (1.7)	18 (1.6)	0.869
Cause of abortion			
• Blighted ovum	0 (0.0)	4 (0.3)	
• Down's syndrome	0 (0.0)	2 (0.2)	
• Miss abortion	1 (0.2)	1 (0.1)	
• Spontaneous incomplete abort	5 (0.8)	8 (0.7)	
• Fetal abnormality	4 (0.6)	2 (0.2)	
• Ectopic	1 (0.2)	0 (0.0)	
• Unknown	0 (0.0)	1 (0.1)	
Method of abortion			
• Surgical	8 (1.2)	18 (1.6)	
• Medical	1 (0.2)	0 (0.0)	
• Spontaneous	2 (0.3)	0 (0.0)	
Duration from admission to discharge	4.37±2.80 (1 to 29)	4.36±2.75 (1 to 59)	0.937
Duration from admission to delivery	0.58±1.75 (0 to 17)	0.55±2.11 (0 to 55)	0.730

F/E = forceps extraction; V/E = vacuum extraction; CPAM = congenital pulmonary airway malformation

Data are n (%) or mean ± standard deviation (range) unless otherwise specified

p-value represents Chi-square test or Fisher's exact test comparison between groups for categorical variables and unpaired t-test for continuous variable

had term deliveries. However, the low birth weight was significantly high in this age group similar to the previous study[7]. The low birth weight infants could be from spontaneous preterm and indicated preterm[24].

High socio-economic status, high education, and marital status were reported to associate with lower

risk of adverse neonatal outcomes[28]. The rate of cesarean delivery was lower in the study group. This may be explained by the low birth weight common in this group.

The power to evaluate the relation between the two groups of pregnant women is sufficient because of the large sample size and rare adverse pregnancy outcomes including neonatal deaths, neonatal abnormalities, and NICU admission of infants that were also reported. The homogeneous population of studied women also supported the findings of the present study. The results indicate that pregnant Thai girls 16 years or younger are at risk for adverse maternal and neonatal outcomes.

The strength of the present study was the prospective cohort study. The data collection, especially the plan of pregnancy and the knowledge of contraceptive methods were precise. However, our study had some limitations. Some pregnant women did not deliver at Siriraj Hospital, therefore, the complete data could not be collected.

Conclusion

The results of the present study showed that pregnancy among the extremely young age entails greater risk of adverse pregnancy outcomes for both mother and neonates. As a result of less than optimal mental and physical conditions, a lack of care and attention to their health may happen, providing an opportunity for adverse effects on the mother and fetus during pregnancy in the young pregnant women[24].

The intensive educational programs about contraception, safe sex, and the effects of maternal age on pregnancy should be organized to the youth generation. It is necessary that young women know about prevention of pregnancy and safe-sex to reduce adolescent pregnancy. Contraceptive methods should be included in the course. However, cultural, social, and moral status among Thai people are the major issues for sex education. An antenatal care plan to reduce complications for both mother and fetus during pregnancy, delivery, and the postpartum period must be implemented.

What is already known on this topic?

From the previous authors' study[7], the adverse outcome in pregnant women 16 years old or younger was retrospectively reported. The adverse pregnancy outcomes in young maternal age include anemia, obstetric complications, hypertensive disorders, medical diseases, and GDM.

What this study adds?

The result of the study presented the problems of venereal diseases, high hepatitis B carriers, maternal education, occupation, maternal income, and knowledge of birth control methods for pills and DMPA among those two age groups.

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Potential conflicts of interest

The authors declare no conflict of interest.

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