Gynecology and Obstetrics Clinical Medicine 2 (2022) 86–90

Contents lists available at ScienceDirect

Gynecology and Obstetrics Clinical Medicine

journal homepage: www.keaipublishing.com/en/journals/gynecology-and-obstetrics-clinical-medicine

Short Report

Obstetrical specificities of Ivorian adolescent mothers on a single-center hospital series of 1040 cases

Edele Kacou Aka *, Apollinaire Horo, Mohamed Fanny, Luc Olou, Perel Konan, Abdoul Koffi, Ana Toure-Ecra, Mamourou Kone

Université Félix Houphouët Boigny (FHB), Centre Hospitalier Universitaire de Yopougon-Abidjan, Service de Gynécologie-Obstétrique, Abidjan, Cote d'Ivoire

ARTICLE INFO

Keywords:
High-risk pregnancy
Adolescent girl
West Africa

ABSTRACT

Overview and aim: The precocity of sexual intercourse among adolescent girls is a prominent source of unwanted pregnancy. Here, we aim to survey the past issues relating to the pregnancy, childbirth, and materno-fetal prognosis of Ivorian adolescent women.

Methods: We conducted a retrospsective study with adolescent group (n = 1040) versus young adult group aged 20 to 24 (n = 736) over three years from1st January 2016 to 31rd December 2018 at the Department of Obstetrics and Gynecology at the University of Abidjan-Yopougon Hospital. Maternal and fetal outcomes of the two groups were analyzed and compared by using Pearson's Chi^2 tests and Fisher's exact tests, followed by multivariate analysis and logistic regression using Stata software version 20.

Results: The average age of adolescent girls in our study was 17.45 years (SD = 1.39) and a minimum of 12 years. Adolescents consulted less ($P < 0.0001$) and later ($P < 0.0001$) versus young adults aged 20 to 24. The proportion of adolescent girls (47.6%) versus young adults (39.1%) who had underwent caesarean section was significantly higher ($P = 0.0004$). These adolescents were 3.5-fold more likely to develop hypertension and its complications in the postpartum period and 2.5-fold more likely to contract a postpartum infection. Maternal mortality was not significantly associated with adolescence (OR = 0.52 (95%CI: 0.22–1.19; P = 0.0891). The risk of prematurity, early neonatal death, and neonatal admission were 2.02 (95%CI: 1.56–2.63; $P < 0.0001$), 1.55 (95%CI: 1.14–2.13; $P = 0.0040$), and 1.73 (95%CI:1.12–2.71; $P = 0.0097$) in adolescence, respectively.

Conclusion: Adolescent childbirth remains associated with a poor prognosis.

1. Introduction

According to the World Health Organization, teenage or adolescent pregnancy is a pregnancy occurring in girls aged 10–19.[1] The incidence of adolescent pregnancy is highest in Sub Saharan Africa (143 per 1000 girls aged between 15 and 19 years). In Europe, it is well over 20 per 1,000.[2] These pregnancies are considered by most authors to be high-risk pregnancies. High death rates among adolescent mothers are usually due to eclampsia, postpartum haemorrhage, sepsis, HIV infection, malaria and obstructed labour.[3] Childbearing during adolescence is not only a risk factor for adverse maternal health outcomes but also has negative impacts on child health indices and the future well-being of the infants. Previous studies have documented associations between adolescent births and increased incidence of negative perinatal and child health outcomes, such as preterm delivery, low birth weight and perinatal death.[4]

According to the general population census in 2014 for Côte d'Ivoire, adolescents represented 31% of the total national population (7,028,113 people), of which 57% lived in urban areas.[5] This continuously-growing population presents peculiarities because of its vulnerability in reproductive health. Indeed, adolescence is a sensitive developmental stage marked by physiological, morphological, psychosocial, and anatomical modifications leading to the appearance of secondary sexual

* Corresponding author. University Félix Houphouët-Boigny, Cote d'Ivoire.
E-mail addresses: edelaka@outlook.com, edelpap@gmail.com (E. Kacou Aka).

Publishing services by Elsevier on behalf of KeAi

https://doi.org/10.1016/j.gocm.2022.04.002
Received 21 December 2020; Received in revised form 4 July 2021; Accepted 12 April 2022
Available online 22 April 2022

characteristics.[6] This period is also marked by emotional immaturity associated with risky sexual behavior. Thus, in Côte d'Ivoire, one in four young girls (25.4%) aged 20–24 had given birth before the age of 18 in 2016 according to the fifth multiple indicator cluster survey (MICS 5 Côte d ' Ivory).[7] In this study, we aim to present the peculiarities over the course of pregnancy, childbirth, and the maternal-fetal prognosis of Ivorian adolescents to improve their obstetrical outcomes.

2. Methods

2.1. Study design

We performed an retrospective observational study of a historical cohort conducted over the course of three years from 1st January 2016 to 31rd December 2018. The study took place at the Obstetrics and Gynecology Service of University of Abidjan-Yopougon Hospital. This is a reference maternity hospital receiving patients from the northern zone of the city and its neighboring towns. This maternity hospital carries out more than 6000 deliveries per year.

2.2. Study population

The childbirth register formed the basis of our sampling from which we retained the following criteria:

Exposed group (adolescent): All adolescent girls aged 10 to 19 who gave birth in the maternity hospital of Yopougon after 28 weeks of amenorrhea (WA) (Professional consensus) different from the threshold set by the WHO (22 WA).

Unexposed group (young adult): This group constituted women aged between 20 and 24 who gave birth after 28 WA in the maternity hospital of the Yopougon University Hospital. They were selected at random. This selection was performed because involves less risk and young adults are the age group closest to adolescent girls, thereby limiting confounding biases such as sexual behavior. Finally, it constitutes the reference age group in most studies.[8] The inclusion of patients from the unexposed group was made according to the following criteria: The patient was between 20 and 24 years of age, gave birth on the same day as an adolescent patient without associated co-morbidity (hypertension, diabetes, HIV, sickle cell anemia, cancer, previous surgery), and gave birth with the same team of caregivers as the adolescent patient. Patients whose information was incomplete or unusable for various reasons were not retained in the study.

2.3. Variables studied

The comparative study considered the socio-demographic characteristics and previous surgical history of patients, as well as the gyneco-obstetric history for the following items: the method of admission, the reason for admission, the history of pregnancy, clinical examination upon admission to the delivery room, delivery (mode, type of delivery, bleeding), condition of the newborn (resuscitated or not) and maternal condition postpartum 2 h and24 h (exeat, transferred or hospitalized).

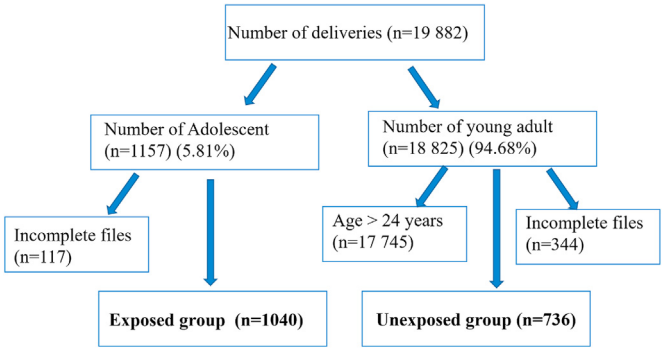

Fig. 1. Flow chart of patients.

2.4. Data collection and analysis

We identified patients who met our selection criteria in the admission register of the hospital. Subsequently, the partographs of these patients were consulted. The data appearing in said files were collected on a pre-established standardized survey form. Data analysis was performed using Stata version 20 software. Pearson's Chi[2] tests and Fisher's exact tests made it possible to compare the proportions of the different parameters studied in the two groups, then a multivariate analysis and a logistic regression with an alpha significance threshold set at 5% were performed.

3. Results

There were 19,882 deliveries during the study period, including 1157 (5.81%) of teenage mothers with 1040 complete records versus 736 records of the unexposed group of young adults (Fig. 1). Our study sample consisted of 1776 patients including 1040 adolescent girls (58.56%). Their average age was 17.45 years (SD = 1.39) and a minimum of 12 years. The risk of being transferred was 5.77 times higher in adolescent girls ($P < 0.001$). By comparing with young adult group, previous surgery ($P < 0.001$) and diabetes history ($P = 0.039$) and surgery was lower in adolescent girls. Previous pregnancies, parity, abortion, and caesarean section were lower in adolescent girls (P < 0.001) (Table 1).

Adolescent girls were consulted less (P < 0.001) and later (P < 0.001) compared to young adult women, and performed less prenatal workup (P < 0.001). The pelvis was considered clinically abnormal by our obstetricians (OR = 10.18; 4.69–22.10; P < 0.001) in adolescent girls (Table 2).

Notably, adolescent pregnancy increased the incidence of adverse pregnancy outcomes ($P < 0.001$). More specifically, adolescent pregnancy was associated with a 3.5-fold higher risk of developing hypertension and its complications in the postpartum period and 2.5-fold higher risk of contracting a postpartum infection. Maternal mortality was not significantly associated with adolescence (OR = 0.52; 0.22–1.19; $P = 0.089$) (Table 3).

The risk of premature birth, early neonatal death, and neonatal admission were 2.02 (1.56–2.63; $P < 0.0001$), 1.55 (1.14–2.13; $P = 0.0040$), and 1.73 (1.12–2.71; $P = 0.0097$) in adolescence and significantly different from those of young adults, respectively (Table 3).

Besides, adolescent girl in comparison to young adults were independently associated with a higher risk of being transferred (P < 0.001) realizing the first prenatal consultation after the first quarter (P < 0.001), achieving less than four prenatal consultations (P < 0.001), not realizing prenatal assessment (P = 0.037).

Multivariate analysis showed that adolescent pregnancy was associated with limited or narrowed pelvic bone (P < 0.001) and fetal prematurity (P = 0.016) (Table 4).

4. Discussion

4.1. Epidemiological and clinical features of adolescent subjects

The proportion of adolescent mothers in our study was 8.05%. These results seem to be underestimated at the national level because the data were collected at a referral center. Indeed, according to the MICS 5 Cote d'Ivoire survey, there were still six children per woman in rural versus three children per woman in urban areas. Also, one in four women aged 20–24 had given birth before the age of 18[7]. Teenage pregnancy rates are highly variable from country to country. Our numbers seem to be below the global average of 103 adolescent deliveries per 1000 deliveries according to an international study conducted by the WHO in 29 countries in Africa, Asia, Latin America, and the Middle East. This study involved

Table 1
Contingency table for adolescent girl group versus young adult group according to the mode of admission, previous surgical and obstetric history n(%).

	Adolescent n = 1040	Young-Adult n = 736	OR (95% CI)	*p* value
Mode of admission				
Transferred	373 (35.86)	65 (8.83)	5.77 (4.32–7.79)	<0.001
Evacuated	482 (46.34)	332 (45.10)	1.05 (0.86–1.28)	0.606
Voluntary	185 (17.78)	339 (46.05)	0.25 (0.20–0.32)	<0.001
Medical and surgical history				
Hypertension	26 (2.50)	9 (1.22)	0.59 (0.26–1.25)	0.144
Diabetes	0 (0)	3 (0.41)	0 (0–0.90)	0.039
Previous Surgery history	39 (3.75)	90 (12.22)	0.28 (0.18–0.42)	<0.001
Obstetric history				
Pregnancies (n)				
1	761 (73.17)	147 (19.97)	–	
2–3	268(25.77)	332 (45.10)	0.16 (0.13–0.21)	<0.001
>3	11 (1.05)	274 (37.22)	0.01 (0.01–0.02)	<0.001
Parity (n)				
0	904 (86.92)	244 (33.15)	–	
1	119 (11.44)	185 (25.14)	0.17 (0.13–0.23)	<0.001
>1	17 (1.63)	307 (41.71)	0.01 (0.01–0.02)	<0.001
Abortion	166 (15.96)	258 (35.05)	0.35 (0.28–0.44)	<0.001
Premature delivery	5 (0.48)	6 (0.81)	0.59 (0.14–2.32)	0.376
Previous caesarean section	36 (3.46)	79 (10.73)	0.29 (0.19–0.45)	<0.001

Table 2
Contingency table for the adolescent girl group versus young adult group according to the history of pregnancy and clinical examination n(%).

	Adolescent n = 1040	Youg-Adult n = 736	OR (95% CI)	*p* value
History of pregnancy				
Age of first prenatal consultation				
Trimester 1	130 (12.5)	312 (42.39)	–	–
Trimester 2	838 (80.57)	380 (51.63)	5.29 (4.17–6.71)	<0.001
Trimester 3	69 (6.63)	23 (3.12)	7.20 (4.30–12.04)	<0.001
Postterm pregnancy	3 (0.28)	21 (2.85)	0.34 (0.10–1.17)	0.087
Number of prenatal consultation ≥4	482 (46.34)	516 (70.10)	0.37 (0.30–0.45)	<0.001
Prenatal check-up	545 (52.40)	554 (75.27)	0.36 (0.29–0.45)	<0.001
Clinical Examination on admission				
Fever	26 (2.5)	9 (1.22)	2.07 (0.93–5.05)	0.056
Normal blood pressure	846 (81.34)	602 (81.79)	0.97 (0.75–1.25)	0.811
Excessive fundal height	173 (16.63)	200 (27.17)	0.53 (0.42–0.78)	<0.001
Fetal Heart Sound	898 (86.34)	655 (88.99)	0.78 (0.58–1.05)	0.097
Fetal Presentations				
Head position	970 (93.26)	66 (8.96)	1.59 (1.12–2.27)	0.006
Breech position	58 (5.57)	63 (8.55)	0.63 (0.43–0.93)	0.014
Transversal	12 (1.15)	13 (1.76)	0.65 (0.27–1.55)	0.280
Pelvic measurements				
Normal[(i)]	917 (88.17)	726 (98.64)	–	–
Limit[(ii)]	90 (8.65)	7 (0.95)	10.18 (4.69–22.10)	<0.001
Narrowed[(iii)]	33 (3.17)	3 (0.40)	8.71 (2.66–28.51)	<0.001
Genital mutilation	74 (7.11)	29 (3.94)	1.87 (1.18–3.01)	0.005

(i) manual Magnin Index (MI) ≥23 cm; (ii) MI<21–23 cm; (iii) MI<21 cm.
Note: MI = obstetric conjugate diameter (OCD) + median transverse diameter (MTD).

359 health facilities in the capital and two provinces selected at random from each participating country. Among these selected African countries, Angola led with 233 adolescent deliveries per 1000 deliveries, followed by Niger (148 per 1000), and the Democratic Republic of Congo (DRC; 144 per 1000).[8] Another study carried out in four African countries representing the different regions of sub-Saharan Africa (south, west, east, and central) between September 2009 and December 2013 showed high rates in Gabon (35.5%) and Mozambique (39.5%), but lower rates in Benin (10%) and Tanzania (13.5%).[9] This regional difference was primarily attributed to the socio-cultural and religious characteristics of the societies. Among these, the risk factors identified during teenage pregnancy were: a low level of education, an age of fewer than 15 years at first intercourse, absence of a partner, maternal history of pregnancy at adolescence, and lack of knowledge of and access to contraceptive methods.[9] These factors can negatively influence adolescent mother reproduction and should be taken into consideration by public health programs when developing strategies for preventing teen pregnancy.[9]

Regarding hypertension and its complications, this study observed a 3.5-fold higher risk in adolescents. The risk factors linked to the young age of the parturient have been widely demonstrated by numerous studies.[10] Santos et al.[11] observed a relationship between low birth weight and weight during pregnancy, body mass index during pregnancy, and weight gain during pregnancy. Unfortunately, these parameters were either missing or unusable in our database.

Our results from the univariate analysis showed that adolescent girls were more likely to have premature babies (OR: 2.02), and neonatal death (OR:1.55) In the multivariate analysis, the risk of prematurity is 1.86. The majority of authors unanimously agree that adolescent girls often give birth to premature and low birth weight infants.[9,12]

4.2. Maternal and infant mortality

According to Granja et al. approximately 22% of maternal deaths among teenage mothers were caused by pregnancy-induced hypertension, puerperal sepsis, and septic abortion, accounting for 75% of the total number of teenage mother deaths.[13] We recorded 12/1040 adolescent maternal deaths versus 16/736 during our work. Regarding maternal mortality, our study found that 60 maternal deaths per 100,000 live births to adolescents occurred during the study period, while it was 614/100,000 live births in 2016 for all of Côte d'Ivoire.[7] This contrast is likely due to selection bias. Maternal mortality was not significantly associated with adolescence on univariate analysis. In contrast, adolescence was significantly associated with maternal death during multivariate analysis with an OR of 1.55 (CI: 1.14–2.13; and $P = 0.0040$). The other independent factors associated with adolescence were prematurity (OR: 1.86) and high blood pressure (OR: 2.64). Also, there was no significant difference between adolescents and young adults (OR = 1.55) regarding the risk of neonatal death. Although this finding is similar in most studies, an association between young maternal age and perinatal mortality has not been proven.[12,14] However, we found twice as high of a risk of perinatal death in newborns of adolescent mothers in the DRC, results that can be compared to those found in Cameroon.[15]

Table 3
Contingency table of the adolescent girl group versus young adult group according to the mode of delivery, the consequences of childbirth, maternal deaths and the condition of the newborn n(%).

	Adolescent n = 1040	Youg-Adult n = 736	OR (95% CI)	*p* value
Vaginal delivery				
No	495 (47.59)	288 (39.13)	–	
Yes	545 (52.40)	448 (60.86)	0.71 (0.58–0.86)	0.000
Post partum period				
Normal	800 (76.92)	650 (88.31)	–	
Abnormal†	240 (23.07)	86 (11.68)	2.27 (1.72–3.00)	<0.001
Hypertension				
No	846 (81.34)	691 (93.88)	–	
Yes	194 (18.65)	45 (6.11)	3.52 (2.49–5.06)	<0.001
Post partum Infection‡				
No	1026 (98.84)	732 (99.45)	–	
Yes	14 (1.35)	4 (0.54)	2.50 (0.78–10.45)	0.096
Maternal Death	12 (1.15)	16 (2.17)	0.52 (0.22–1.19)	0.089
Newborn condition				
Low birth weight	305 (29.32)	176 (23.91)	1.32 (1.06–1.65)	0.011
Alive	932 (89.61)	672 (91.30)	–	–
Stillborn	86 (8.26)	54 (7.33)	1.15 (0.81–1.64)	0.444
Macerated fetus	22 (2.11)	10 (1.35)	1.59 (0.74–3.37)	0.230
Prematurity	253 (24.32)	101 (13.72)	2.02 (1.56–2.63)	<0.001
Malformation	2 (0.19)	14 (1.90)	0.10 (0.01–0.43)	0.000
Reanimation	279 (26.83)	356 (48.36)	0.39 (0.32–0.48)	<0.001
Neonatal death	146 (14.03)	70 (9.51)	1.55 (1.14–2.13)	0.004
Neonatal intensive care	78 (7.50)	33 (4.48)	1.73 (1.12–2.71)	0.009

† post partum infection and maternal death.
‡ Fever ≥38 °C and Hyperleukocytosis ≥15,000 elements per mm.^{3}.

4.3. Limitations

Given the retrospective nature of this study, it is subject to selection bias; especially in the choice of the control group. Thus, we carried out systematic recruitment of an age group *a priori* with fewer maternal-fetal risks. It is also necessary to note a few points which mar the external validity and applicability of our study. In this case, we refer to the representativeness of adolescent girls. We limited ourselves to the Yopougon University Hospital. The integration of other maternity hospitals in the city of Abidjan would have made it possible to improve the representativeness of the samples included in our study. The second limitation of our study in terms of external validity concerns the lack of integration of certain factors such as the socio-economic level of the parents of the adolescent and that of the partner. However, the large sample (1040) concentrated on a single-center spread over a fairly long study period (5 years) are elements that support the representativeness of our sample. In the methodology, we don't have many specific data to measure bleeding volume for example. Many of criteria diagnosis were clinic like anemia, hypertension and postpartum infection. Our study population was in emergency and no access to free care.

5. Conclusion

Adolescent childbirth remains associated with complications during pregnancy and delivery. Sensitization for prenatal care and the establishment of a prevention policy through the use of contraceptive methods will help to alleviate risks associated with adolescent pregnancy and childbirth and thus should be incorporated into healthcare programs.

Table 4
Multivariate analysis of factors associated with adolescent pregnancy.

	OR	95%CI	*p* value
Transferred	3.85	2.57–5.78	<0.001
Gravidity			
	–	–	–
Parity			
Nulliparous	–	–	–
Primiparous	0.42	0.23–0.76	0.004
Pauciparous & multiparous	0.07	0.03–0.18	<0.001
Abortion	1.01	0.58–1.75	0.964
Caesarean	0.69	0.35–1.37	0.295
Age of first prenatal consultation			
Trimester 1	–	–	–
Trimester 2	3.09	2.21–4.32	<0.001
Trimester 3	6.98	3.08–15.82	<0.001
Postterm pregnancy	0.31	0.07–1.32	0.115
Number of prenatal consultation ≥4	0.48	0.33–0.69	<0.001
Prenatal check-up	0.68	0.47–0.98	0.037
Pathology in pregnancy	1.52	0.52–4.42	0.446
Excessive fundal height	1.18	0.80–1.76	0.397
Fetal heart sound	1.16	0.67–2.00	0.594
Fetal cephalic presentation	1.47	0.86–2.51	0.153
Pelvic mearsurement			
Normal(i)	–	–	–
Limit(ii)	11.15	4.19–29.68	<0.001
Narrowed(iii)	27.37	4.23–176.89	0.001
Excision	1.09	0.56–2.12	0.789
Vaginal delivery	0.91	0.65–1.27	0.574
Postpartum abnormality	0.84	0.39–1.77	0.642
Hypertension	2.64	1.16–5.99	0.020
Infection	6.41	0.95–43.32	0.057
Birth weight (g)			
<2500	–	–	–
[2500–3800]	1.41	0.78–2.56	0.254
>3800	0.26	0.08–0.84	0.025
Prematurity	1.86	1.12–3.09	0.016
Malformation	0.13	0.02–0.76	0.024
Reanimation	0.29	0.21–0.41	<0.001
Perinatal death	0.90	0.45–1.79	0.771
Neonatal intensive care	1.84	0.87–3.90	0.108
Maternal death	0.27	0.08–0.93	0.038

(i) manual Magnin Index (MI) ≥23 cm; (ii) MI<21–23 cm; (iii) MI<21 cm.
Note: MI = obstetric conjugate diameter (OCD) + median transverse diameter (MTD).

Details of ethics approval

Because of retrospective study, ethics approval was exempt by University of Abidjan-Yopougon Hospital.

Consent for publication

The authors consent and approve this manuscript for publication.

Authors' contributions

EKA and AK designed the study, LO and PK collected the data collect, EKA, LO and PK analyzed the data, EKA and ATE were Responsible for methodology, EKA and MF has written the contents of this manuscript, and AH and MK were the supervisors of the manuscript.

Conflict of interest

The authors declare that they have no links of interest.

References

1. Okogbenin SA, Okpere EE. Age and reproductive outcome. *Clin Obstet*. 2004;3:398–400.
2. Treffers PE. Teenage pregnancy a worldwide problem. *Ned Tijdschr Geneeskd*. 2003;147(47):2320–2325. Nov 22.
3. Nour NM. Child marriage: a silent health and human rights issue. *Rev Obstet Gynecol*. 2009;2:51–56.
4. Chen CW, Tsai CY, Sung FC, et al. Adverse birth outcomes among pregnancies of teen mothers: age-specific analysis of national data in Taiwan. *Child Care Health Dev*. 2010;36:232–240.
5. *General Population and Housing Census*. 2014.
6. World Health Organization. *Adolescent Pregnancy (Issues in Adolescent Health and Development)*. Geneva: WHO; 2004.
7. National Institute of Statistics (INS) and United Nations. *Children's Fund (UNICEF). Côte d'Ivoire - Multiple Indicator Cluster Survey (MICS)*. 2016. Ref. CIV_2016_MICS_v01_M.
8. Ganchimeg T, Ota E, Morisaki N, et al. Pregnancy and childbirth outcomes among adolescent mothers: a World Health Organization multicountry study. *BJOG*. 2014;121(Suppl 1):40–48.
9. Mombo-Ngoma G, Mackanga JR, González R, et al. Young adolescent girls are at high risk for adverse pregnancy outcomes in sub-Saharan Africa: an observational multicountry study. *BMJ Open*. 2016;6(6).
10. Iacobelli S, Robillard PY, Gouyon JB, et al. Obstetric and neonatal outcomes of adolescent primiparous singleton pregnancies: a cohort study in the South of Reunion Island, Indian Ocean. *J Matern Fetal Neonatal Med*. 2012;25(12):2591–2596.
11. Santos M, Baião MR, Barros DC, et al. Pre-gestational nutritional status, maternal weight gain, prenatal care conditions and adverse perinatal disorders among adolescent puerperal women. *Rev Bras Epidemiol*. 2012;15(1):143–154.
12. Kongnyuy EJ, Nana PN, Fomulu N, et al. Adverse perinatal outcomes of adolescent pregnancies in Cameroon. *Matern Child Health J*. 2008;12(2):149–154.
13. Kakudji LP, Mukuku O, Mwembo TA, et al. Study of maternal and perinatal prognosis during childbirth in adolescents in Lubumbashi (DRC). *Pan Afr Med J*. 2017;26:182.
14. Faucher P, Dappe S, Madelenat P. Adolescent motherhood: obstetric analysis and review of the influence of cultural, socio-economic and psychological factors based on a retrospective study of 62 cases. *Gynecol Obstet Fertil*. 2002;30(12):945–952.
15. Markovitz BP, Cook R, Flick LH, et al. Socioeconomic factors and adolescent pregnancy outcomes: distinctions between neonatal and post-neonatal deaths? *BMC Publ Health*. 2005;5(79).