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Factors Associated With Early Menarche among Adolescents Girls: A Study from Nepal

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Abstract

Introduction: Menarche is the first periodical flow of blood from uterus in all healthy females. The main objective of the study was to explore the various factors associated with early menarche.

Methodology: A case control study was conducted among 260 adolescent's girls of Pokhara, Nepal. Girls who experienced menarche at the age ≤11 and ≥14 were selected as cases and controls respectively for this study. Results: Study showed that low birth weight girls were 9.44(3.022-29.517) times more likely to have early menarche (p=<0.001) compared to girls with normal birth weight. Girls who were physically inactive before menarche were 5.69(1.932-16.787) times more likely to develop early menarche (p=0.002) in comparison to girls who were physically active. Inadequate sleep before menarche were 8.07(2.628-24.830) times more likely to have early menarche (p=0.001). The girls whose mothers were using hormonal contraceptives were 5.80(1.722-19.568) times more likely to have early menarche (p=0.005). Similarly, the girls who had inadequate breastfeeding were 5.20(1.544-17.543) times more likely to develop early menarche (p=0.008). The girls whose mothers were exposed to chemicals during pregnancy were 3.91(1.159-13.234) times more likely to develop early menarche (p=0.028).

Conclusion: It was concluded that physical inactivity, inadequate sleep, absence of biological father, exposure to sexual materials, inadequate breastfeeding, use of hormonal contraceptives by mother, low birth weight, exposure to chemicals during pregnancy and mothers age at menarche were associated with early menarche. Furthermore, more research should be done to explore more on identified risk factors associated with early menarche.

Introduction

Adolescence is a transition period from childhood to adult life during which pubertal development and sexual maturation take place. The reproductive lifespan of a woman begins with the onset of menstruation i.e. menarche and it continues till the cessation of menstruation i.e. menopause [1]. Menarche indicates the specific stage of first periodical regular flow of blood from uterus in all healthy females. It is the most striking event in the process of female puberty, which in turn is a part of adolescence. Sequence of events takes place throughout puberty -thelarche, the development of breasts, followed by pubarche, the development of auxiliary and pubic hair, and then by menarche, the first menstrual period. The hypothalamus region of the brain secretes Gonadotropin-Releasing Hormone (GnRH) which starts the process of thelarche and menarche [2]. Its onset is preceded by a complex cascade of hormonal changes during puberty. Endocrine regulation of sexual maturation is susceptible to various factors from the very beginning of prenatal life. The menstrual flow consists of a combination of fresh and clotted blood with endometrial tissue. The initial flow of menarche is usually brighter than mature menstrual flow. It is often scanty in amount and may be very brief, even a single instance of "spotting [3]. Menarche, no doubt, is a biological event; however, its timing is influenced by a number of socio-economic and biological factors. The age at menarche is not fixed, and varies from population to population. It may also vary with races, size of the family and environmental factors [4,5].

Some of the aspects of family structure and function reported to be independently associated with earlier menarche are the increased incidence of childhood obesity, absence of father from the home from early childhood, high-conflict family relationship, low birth weight, experience of preeclampsia in the womb, exposure to smoking, inadequate breast-feeding, physical inactivity, exposure to DDT, Oral contraceptives and sexual exposure [6].

Problem of statement

Earlier than average age at menarche has been associated with certain adverse health effects in childhood and adolescent. These include eating disorders, depression, substance abuse, sexual exploits and teenage pregnancy. Early onset of menstruation in girls is also linked to increased risk of breast, ovarian and endometrial cancers, type 2 diabetes, metabolic syndrome, hypertension and

cardiovascular disease [5]. The younger girls are when they get their first periods, the greater their risk of breast cancer later in life. In fact, first menstruation (menarche) before age 12 raises breast cancer risk by 50% compared to menarche at age 16. One-year delay in menarche reduces the risk of breast cancer by 5%. Early puberty is associated with an increased exposure to and that early puberty expands the window of vulnerability for breast cancer development between first menstruation and first pregnancy [6]. An average age at menarche in Bangladesh was reported 15.8 years in 1976, 13.0 years in 1996 and 12 years in 2005 which was substantially lower than the previous estimate of 1976 [16]. The average age at menarche has been found declining in Gambian girls as the average age reported was 16 years in 1989, 15 years in 2000 and 14 years in 2008 [11].

The onset of menarche in three generations of Taiwanese females found it to be decreasing, on average, by one year per generation (15.16±1.75, 14.50±1.50, and 13.00±1.26 years, respectively) [17]. The median age decreased significantly from 13.66 years in 1955 to 13.15 years in 1997 and 13.05 years in 2009 among Dutch girls. Compared to Dutch girls there is a larger decrease in median age of menarche between 1997 and 2009 among Turkish girls which decreased from 12.80 to 12.50 years and among Moroccan girls from 12.90 to 12.60 years [20]. The mean age at menarche in Maharashtrian girls has lowered by about two years from 1962 to 1991, in three decades. The median menarcheal age as reported by national surveys of 1959-1961 in Hungary, has decreased at a rate of 2.6 months per decade [22].

The average age of first menarche has declined with every decade and raises a number of health issues. These include eating disorders, depression, substance abuse, sexual exploits and teenage pregnancy. Early onset of menstruation in girls is also linked to increased risk of breast, ovarian and endometrial cancers, type 2 diabetes, metabolic syndrome, hypertension and cardiovascular disease. The timing of menarche is an important determinant of population size and reproductive performance. The early onset of pubertal development is an important medical and social problem. From a physiological perspective and public health perspective, the age of menarche serves as an important clinical indicator of a girl's physical maturation, nutritional status, and reproductive health. From a social perspective, the onset of menses has traditionally served as a symbol of fertility, sexual readiness, and marriage ability, depending on the local cultural context. There is less documented evidence of factors of early menarche in Nepal and not adequate work has been done. The results of this study will set out to promote awareness on factors associated with the problem during menstruation among females.

Methodology

A case-control study was carried out among adolescent's girl of Secondary schools of Pokhara, Nepal from September to December 2016. The study was based on quantitative methods. Cases were taken as girls who experienced menarche at the age ≤11. Controls were girls who experienced menarche at the age ≥14.

The total sample size of 260 adolescent's girls (i.e.130 cases and 130 controls) were determined based on the previous studies as mean age from several countries like Nepal, Bangladesh China, Japan, Thailand, Hong Kong, India [1, 2, 16, 18, 19, 23]. The age limit for early and late menarche was determined. The average age at menarche was calculated i.e. 12.65. Similarly, a preliminary survey was conducted among 500 adolescent school girls and the mean age at menarche was found 12 years. Based on the above result 12 and 13 years was excluded as mean age at menarche on the basis of which the criteria for cases and controls were determined. Convenience sampling technique was carried out for the selection of the samples. Those girls who had menarche at ≤11 and ≥14 were included in the study as case and control respectively. Girls who had menarche at the age of 12/13 were excluded because it is the mean age at menarche for the study and the girls who currently don't stay with their mothers or who don't have mothers were also excluded from the study.

Face to face interview was done with both the participant and their mother. The semi structured questionnaire was used for data collection. Participants who were visited to their house were interviewed separately without any household member being present with the participant. The interview schedule included information on demographic characteristics, diet and physical activity, sexual exposure, family history, psychological stress, mother related characteristics and chemical exposure. Validity of the research instrument was maintained by consulting the supervisor, lecturers, and colleagues.

Ethical approval was taken from an ethical review board of INJE University and Nepal health research council and respective schools. Verbal consent was taken from each respondent and the confidentiality of the received information was maintained. Questionnaire was pretested among 40 girls (20 cases and 20 controls) and some modification was made. The questionnaire was prepared in simple and clear local language. Chi square test was used to find out the association between early menarche and the variables. Binary logistic regression was done to calculate unadjusted and adjusted odds ratio to identify factors of early menarche.

Results

The mean age of respondent in case group was 13.60 years and in control group was 15.47 years. The mean age at menarche of cases was10.82±0.5 and in controls were14.26±0.7.

Most of the cases (72.3%) were of Aryan followed by Mongolian (27.7%). In the control group 67.7% were of Aryan and 32.3% were of Mongolian. Likewise, majority of cases (93.1%) were from urban area compared to (65.4%) of controls. Majority of cases (73.8%) belong to nuclear family and majority of controls belong (72.3%) to nuclear family followed. Almost all of the cases (80.8%) and controls (81.5) had birth order less than or equal to 3 as shown in Table 1.

Cases and controls according to their dietary characteristics

Majority of cases (93.1%) and controls (83.1%) were non vegetarian followed by vegetarian (6.9%) of cases and (16.9%) of controls. Similarly, 91.5% of cases and 83.1% of controls used to drink milk on a regular basis whereas only 8.5% of cases and 16.9% of controls used to drink milk rarely.13.8% of cases and 20% of controls used to drink soft drinks very often whereas only 86.2% of cases and 20-80 % of controls used to drink rarely. Furthermore, 83.1% of cases and 67.7% of controls used to consume eggs very often whereas only 16.9% of cases and 32.3% of controls used to consume eggs rarely. Moreover, 97.7% of cases and 88.5% of controls used to consume junk food very often whereas only 2.3% of cases and 11.5% of controls used to consume junk food rarely.

Cases and controls according to their body size and birth weight

Greater proportion cases (56.9%) were found to be born low birth weight than the controls (18.5%). Comparatively greater proportions (20%) of cases were overweight as compared to (6.9%) controls.

Cases and controls according to physical activeness and sleeping hours

Majority of cases (58.5%) were not physically active in comparison with (23.1%) of controls. Similarly, the distribution of cases and controls according to the sleeping hours shows that, comparatively cases (60.8%) had inadequate sleep than (18.5%) of controls.

Cases and controls according to family history related characteristics

Study showed that 23.8% of mothers of cases and 7.7% of mothers of controls have a habit of drinking alcohol. Furthermore, 15.4% of cases mothers have a habit of smoking or chewing tobacco in comparison with 6.2% of controls mothers have a habit of smoking or chewing tobacco. Similarly, 20.8% of fathers of cases and 12.35 of fathers of controls have prevalence of any chronic disease. Likewise, both the mothers of cases (31.5%) and controls (25.4%) have almost equal percentage of prevalence of chronic disease (Table 2).

Cases and controls according to psychological stress

Among 130 cases and 130 controls, 8.5% of cases and 3.1% of controls had an experience of stressful unforgettable incident. Only

Table 1: Distribution of cases and controls based on Socio demographic characteristics.

Variables	Cases	Controls	Total
Age of the respondent			
10-14 years	85(65.4)	32(24.6)	117
15-19 years	45(34.6)	98(75.4)	143
Ethnicity			
Mongolian	36(27.7)	42(32.3)	78
Aryan	94(72.3)	88(67.7)	182
Residence before menarche			
Urban	121(93.1)	85(65.4)	206
Rural	9(6.9)	45(34.6)	54
Type of school			
Public	52(40)	59(45.4)	111
Private	78(60)	71(54.6)	149
Family type			
Nuclear	96(73.8)	94(72.3)	190
Joint	34(26.2)	36(27.7)	70
Birth order			
≤2	105(80.8)	106(81.5)	245
≥3	25(19.2)	24(18.5)	15

Note: Figures in the parenthesis indicate the percentage of respective frequencies.

Table 2: Cases and controls according to their Mother related characteristics.

Variables	Case	Control	Total
Mothers age at menarche			
≤12 years	67(51.5)	23(17.7)	90
≥13 years	63(48.5)	107(82.3)	170
Age at marriage			
>18 years	71(55)	84(65.6)	158
<18 years	58(45)	44(34.4)	102
Parity			
≥4	27(20.8)	33(25.4)	60
≤3	103(79.2)	97(74.6)	200
Use of hormonal contraceptives			
Yes	66(50.8)	11(8.5)	77
No	64(49.2)	119(91.5)	183
Workload during pregnancy			
Normal	71(54.6)	75(57.7)	146
Heavy	59(45.4)	55(42.3)	114
Stress during pregnancy			
Yes	59(45.4)	29(22.3)	88
No	71(54.6)	101(77.7)	172
Any medication during pregnancy			
Yes	6(4.6)	5(13.8)	11
No	124 (95.4)	125(96.2)	249
Anemia during pregnancy			
Yes	11(8.5	4(3.1)	15
No	119(91.5)	126(96.9)	245
TT vaccination			
Yes	102(78.5)	98(75.4)	220
No	28(21.5)	32(24.6)	60
Iron tablets compliance			
Yes	41(31.5)	69(53.1)	110
No	89(68.5)	61(46.9)	150
Pre-eclampsia			
Yes	35(26.9)	20(15.4)	55
No	95(73.1)	110 (84.6)	205
Eclampsia			
Yes	8(6.2)	9(6.9)	17
No	122 (93.8)	121(93.1)	243
Post-partum hemorrhage			
Yes	15(11.5)	11(8.5)	27
No	115 (88.85)	119(91.5)	233

Note: Figures in the parenthesis indicate the percentage of respective frequencies.

13.8% of cases and 8.5% of controls had gone through the death of their close family members. Similarly, 26.9% of the cases and 11.5% of controls had suffered family violence and debates. Most of the cases (82.3%) and controls (94.6%) with high proportion stay with their biological father.

Cases and controls according to sexual exposure

42.3% of cases and 16.2% of controls had an exposure to readable, visual and audible sexual materials before menarche. Similarly, about one fifth (21.5%) of cases and (9.2%) of control were in a relationship with a boyfriend before menarche. Moreover, 10.8% of the cases and 1.5% of the control were involved in indirect sexual activity.

Cases and controls according to breastfeeding

Our study shows that comparatively lesser cases (45.4%) had exclusive breastfeeding than control (72.3%). Almost fifty percent of the cases (50.8%) had breastfeeding for less than two years followed by more than 2 years (49.2%) whereas majority of controls (87.7%) had breastfeeding for more than 2 years followed by less than 2 years (12.3%).

Cases and controls according to their Mother related characteristics

The mothers of more than fifty percent of cases (51.5%) had their menarche at the age ≤ 12 whereas only (17.7%) of the mothers of controls had their menarche at the age ≤ 12.

Cases and controls according to chemical exposure

36.2% of cases were exposed to various chemicals during pregnancy and 16.9% of controls were exposed to various chemicals during pregnancy.

Bivariate Logistic Regression analysis of variables

The bivariate logistic regression analysis was done as a procedure of statistical analysis to identify the factors associated with early menarche. The variables with more categories were transformed into lesser categories to conduct bivariate logistic regression analysis. An odd ratio and p-value was calculated within 95% CI. Variables which had p value less than 0.05 and 0.001 were denoted by "*" "**" respectively (Table 3).

Table 3: Bivariate logistic regression for socio-demographic variables.

Variables	Cases	Controls	P-value	Unadjusted Odds ratio (95% CI)
Ethnicity			0.417	-
Mongolian	36(27.7)	42(32.3)		
Aryan	94(72.3)	88(67.7)		
Residence before			<0.001**	7.118(3.304-15.335)
Urban	121(93.)	85(65.4)		
Rural	9(6.9)	45(43.6)		
Family type			0.78	-
Joint	34(26.2)	36(27.7)		
Nuclear	96(73.8)	94(72.3)		
Birth order			0.874	-
≤2	105(80.)	106(81.5)		
≥3	25(19.2)	24(18.5)		

Note: *p<0.05, **p<0.001

Table 4: Bivariate logistic regression for dietary related variables.

Variables	Case	Control	P-value	Unadjusted Odds ratio (95% CI)
Vegetarian			0.013*	2.739(1.209 - 6.204)
Yes	121(93.1)	108(83.1)		
No	9(6.9)	22(16.9)		
Milk consumption				
Often	119(91.5)	108(83.1)	0.040*	2.204(1.021- 4.756)
Rarely/never	11(8.5)	22(16.9)		
Soft drinks consumption			0.186	-
Often	112(86.2)	104(80)		
Rarely/never	18(13.2)	26(20)		
Eggs consumption			0.004*	2.343(1.302- 4.217)
Often	108(83.1)	88(67.7)		
Rarely/never	22(16.9)	42(32.3)		
Junk food consumption				
Often	127(97.7)	115(88.5)	0.003*	5.522(1.558- 19.564)
Rarely/never	3(2.3)	15(11.5)		

Note: *p<0.05, **p<0.001

The above analysis showed that place of residence was statistically significant with age at menarche. Girls living in urban areas were 7.12 times more risk of having early menarche. Rest of the variables like ethnicity, family type and birth order were not significant with the age at menarche (Table 4).

Analysis showed that non-vegetarian girls were 2.74 times more risk of having early menarche than the vegetarian ones. Consumption of milk, eggs and junk food in a regular basis was also found statistically significant with early menarche i.e. cases with stated features are at 2.20, 2.34 and 5.52 times more risk than the control (Table 5).

Regarding the body size and birth weight related features, it is found that Low birth weight (p=<0.001) and being overweight (p=0.002), increases the risk of early menarche by 5.83 and 3.36 respectively.

Table 5: Bivariate logistic regression for body size and birth weight.

Variables	Case	Control	P-value	Unadjusted Odds ratio (95% CI)
Birth weight				
LBW	74(56.9)	24(18.5)	<0.001**	5.836(3.324-10.247)
Normal	56(43.1)	106(81.5)		
Body size			0.002*	3.361(1.507-7.496)
Overweight	26(20)	9(6.9)		
Normal	104(80)	121(93.1)		

Note: *p<0.05, **p<0.001

Table 6: Bivariate logistic regression for mother related variables.

Variables	Case	Control	P-value	Unadjusted Odds ratio (95%CI)
Mothers age at menarche				
≤12 years	67(51.5)	23(17.7)	<0.001**	4.948(2.807-8.720)
≥13 years	63(48.5)	107(82.3)		
Age at marriage				
>18 years	71(55)	84(65.6)	0.083	-
<18 years	58(45)	44(34.4)		-
Parity			0.377	
≥4	27(20.8)	33(25.4)		
≤3	103(79.2)	97(74.6)		
Use of hormonal contraceptives			<0.001**	11.156(5.502-22.622)
Yes	66(50.8)	11(8.5)		
No	64(49.2)	119(91.5)		
Workload			0.617	-
Normal	71(54.6)	75(57.7)		
Heavy	59(45.4)	55(42.3)		
Stress during pregnancy			<0.001**	2.894(1.689-4.958)
Yes	59(45.4)	29(22.3)		
No	71(54.6)	101(77.7)		
Medication during pregnancy			0.758	-
Yes	6(4.6)	5(13.8)		
No	124(95.4)	125(96.2)		
Anemia during pregnancy			0.063	-
Yes	11(8.5)	4(3.1)		
No	119(91.5)	126(96.9)		
TT vaccination			0.556	-
Yes	102(78.5)	98(75.4)		
No	28(21.5)	32(24.6)		
Iron tablets compliance			0.001*	2.455(1.481-4.071)
Yes	41(31.5)	69(53.1)		
No	89(68.5)	61(46.9)		
Pre-eclampsia				
Yes	35(26.9)	20(15.4)	0.023*	2.206(1.096-3.745)
No	95(73.1)	110(84.6)		
Eclampsia				
Yes	8(6.2)	9(6.9)	0.802	-
No	122(93.8)	121(93.1)		
Post-partum hemorrhage			0.408	-
Yes	15(11.5)	11(8.5)		
No	115(88.5)	119(91.5)		

Note: *p<0.05, **p<0.001

Table 7: Multiple logistic regression for selected respondent related exposure variables.

Variables	Cases	Controls	P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Place of residence			0.219	7.118(3.304-15.335)	-
Urban	121(93.1)	85(65.4)			
Rural	9(6.9)	45(43.6)			
Vegetarian			0.648	2.739(1.209-6.204)	-
Yes	9(6.9)	22(16.9)			
No	121(93.1)	108(83.1)			
Milk consumption			0.052	2.204(1.021-4.756)	-
Often	119(91.5)	108(83.1)			
Rarely	11(8.5)	22(16.9)			
Eggs consumption			0.61	2.343(1.302-4.217)	-
Often	108(83.1)	88(67.7)			
Rarely	22(16.9)	42(32.3)			
Junk food consumption					
Often	127(97.7)	115(88.5)	0.056	5.522(1.558-19.564)	-
Rarely	3(2.3)	15(11.5)			
Body size			0.422	3.361(1.507-7.496)	-
Overweight	26(20)	9(6.9)			
Normal	104(80)	121(93.1)			
Birth weight					
LBW	74(56.9)	24(18.5)	<0.001**	5.836(3.324-10.247)	9.444(3.022-29.517)
Normal	56(43.1)	106(81.5)			
Physically active					
Yes	54(41.5)	100(76.9)	0.002*	4.691(2.743-8.025)	5.694(1.932-16.787)
No	76(58.5)	30(23.1)			
Sleeping hours			0.001*	6.842(3.885-12.048)	8.077(2.628-24.830)
Inadequate	79(60.8)	24(18.5)			
Adequate	51(39.2)	106(81.5)			

Note: *p<0.05, **p<0.001

Analysis showed that not physically active (p=<0.001) and having inadequate hours of sleep (p=<0.001) increases the risk of early menarche by 4.69 and 6.84 times respectively. Alcohol consumption (p=<0.001) and smoking or tobacco consumption (p=0.016) by mother was highly significant with early menarche i.e. cases with stated feature were at 3.75 and 2.77 times more risk than the control.

Girls experiencing family debates, violence and conflicts (p=0.002) and not staying with biological father (p=0.002) increases the risk of early menarche by 2.82 and 3.77 times respectively. Rest of the variables like stressful unforgettable bitter incident in the family, unexpected death of any member in the family was not significant with early menarche.

Analysis showed that exposure to sexual material (readable, visual and audible), having boyfriend and having indirect sexual activity was found statistically significant with early menarche. Girls exposed to sexual materials (p=0.001), having boyfriend (p=0.006) and having indirect sexual activity (p=0.002) were 3.8 times, 2.7 times 7.7 times more risk of early menarche than those not having mentioned characteristics.

Breastfeeding is statistically significant with early menarche. Girls not having exclusive breastfeeding (p=<0.001) and inadequate breastfeeding (p=<0.001) were 3.14 and 7.34 times more risk of having early menarche. Regarding the chemical exposure, the daughters whose mothers were exposed to various chemicals during pregnancy were 2.780 times more likely to have early menarche (Table 6).

The above analysis showed that the girls whose mothers had earlier menarche (p=<0.001) were 4.948 more likely to have earlier menarche than the girls whose mother had later menarche. Preeclampsia, stress during pregnancy and mothers using hormonal contraceptives was statistically significant with early menarche i.e. 33 cases with stated features were 2.206, 2.894 11.156 times more risk than the controls.

Multiple logistic regression analysis for selected respondent related exposure variables

Variables from bivariate logistic regression analysis which have p

value less than 0.05 were selected for multivariate logistic regression analysis. Altogether twenty-five variables were used for multiple logistic regression analysis form bivariate logistic regression analysis (Table 7).

Low birth weight girls were 9.444(3.022-29.517 p= <0.001) times more likely to have early menarche than the girls who were born normal. Physical activity showed significant association with early menarche, girls who were physically inactive before menarche were 5.694(1.932-16.787, p=0.002) times more likely to develop early menarche. Girls who had inadequate sleep before menarche were 8.077(2.628-24.830, p=0.001) times more likely to have early menarche. Place of residence, vegetarian, milk, soft drinks, eggs, junk food consumption and body size were not statistically associated with early menarche (Table 8).

The girls who did not have their biological father before menarche showed significant association with early menarche, they were 10.00(1.195-83.660, p=0.034) more likely to have early menarche than the girls who were staying with their biological father. The girls who had exposure to readable, visual, audible sexual materials before menarche were 34.782(6.366-190.026, p=0.001) times more likely to have menarche earlier than the girls who were not exposed to those materials. Alcohol consumption, smoking, family debates, having boyfriend before menarche, indirect sexual activity and usual clothing was not statistically associated with early menarche (Table 9).

The girls whose mothers had earlier menarche were 10.782(3.381-34.389, p=<0.001) times more likely to develop early menarche than the girls whose mothers had later menarche. The girls whose mothers were using hormonal contraceptives were 5.805(1.722-19.568, p=0.005) times more likely to have earlier menarche. The girls who had breastfeeding less than two years 5.204(1.544-17.543, p=0.008) times more likely to have early menarche than the girls who were breastfed for more than 2 years. The girls whose mothers were exposed to chemicals during pregnancy were 3.917(1.159-13.234, p=0.028) times more likely to have early menarche

Identified factors associated with early menarche

Thus, physical inactivity (p=<0.001) with odds ratio 5.694(1.932-16.578), low birth weight (P=0.002) with odds ratio 9.444(3.022-29.517), inadequate sleep(excess or low)(P=0.001) with odds ratio 8.077(2.628-24.30), absence of biological father (P=0.034) with odds ratio 10.00(1.195-83.660), exposure to sexual materials (P=0.001) with odds ratio 34.782(6.36-190.026), inadequate breastfeeding (P=0.008) with odds ratio 5.204(1.544-17.543), mothers age at

Table 8: Multiple logistic regression for selected respondent related exposure variables.

Variables	Cases	Controls	P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Alcohol consumption				3.758(1.756-8.041)	-
Yes	31(23.8)	10(7.7)	0.298		
No	99(76.2)	120(92.3)			
Smoking and tobacco				2.773(1.174-6.549)	-
Yes	20(15.4)	8(6.2)	0.776		
No	110(84.6)	122(93.8)			
Family debates, violence				2.825(1.455-5.482)	-
Yes	35(26.9)	15(11.5)	0.37		
No	95(73.1)	115(88.5)			
Absence of biological father				3.777(1.559-9.150)	10.00(1.195-83.660)
Yes	23(17.7)	7 (5.4)	0.034*		
No	107(82.3)	123 (94.6)			
Exposure to sexual materials				3.806(2.126-6.815)	34.782(6.366-190.026)
Yes	55(42.3)	21(16.2)	0.001*		
No	75(57.7)	109(83.8)			
Boyfriend				2.699(1.306-5.581)	-
Yes	28(21.5)	12(9.2)	0.227		
No	102(78.5)	118(90.8)			
Indirect sexual activity					
Yes	14(10.8)	2(1.5)	0.7	7.724(1.719-34.712	-
No	116(89.2)	128(98.5)			
Type of Clothes				4.341(2.275-8.284)	-
Pants	115(88.5)	83(63.8)	0.053		
Kurtha	15(11.5)	47(36.2)			

Note: *p<0.05, **p<0.001

Table 9: Multiple logistic regression for selected respondent related exposure variables.

Variables	Cases	Controls	P-value	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Mothers age at menarche			<0.001**	4.948(2.807-8.720)	10.782(3.381-34.389)
≤12 years	67(51.5)	23(17.7)			
≥13 years	63(48.5)	107(82.3)			
Use of hormonal Contraceptives			0.005*	11.156(5.502-22.622)	5.805(1.722-19.568)
Yes	66(50.8)	11(8.5)			
No	64(49.2)	119(91.5)			
Stress during pregnancy			0.499	2.894(1.689-4.958)	-
Yes	59(45.4)	29(22.3)			
No	71(54.6)	101(77.7)			
Pre-eclampsia			0.243	2.206(1.096-3.745)	-
Yes	35(26.9)	20(15.4)			
No	95(73.1)	110(84.6)			
Duration of breastfeeding			0.008*	7.348(3.929-13.742)	5.204(1.544-17.543)
<2 years	66(50.8)	16(12.3)			
>2 years	64(49.2)	114(87.7)			
Exclusive Breastfeeding			0.562	3.142(1.875-5.267)	-
Yes	59(45.4)	94(72.3)			
No	71(54.6)	36(27.7)			
Iron tablets compliance			0.503	2.455(1.481-4.071)	-
Yes	41(31.5)	69(53.1)			
No	89(68.5)	61(46.9)			
Chemical exposure during pregnancy			0.028*	2.780(1.554-4.973)	3.917(1.159-13.234)
Yes	47(36.2)	22(16.9)			
No	83(63.8)	106(83.1)			

Note: *p<0.05, **p<0.001

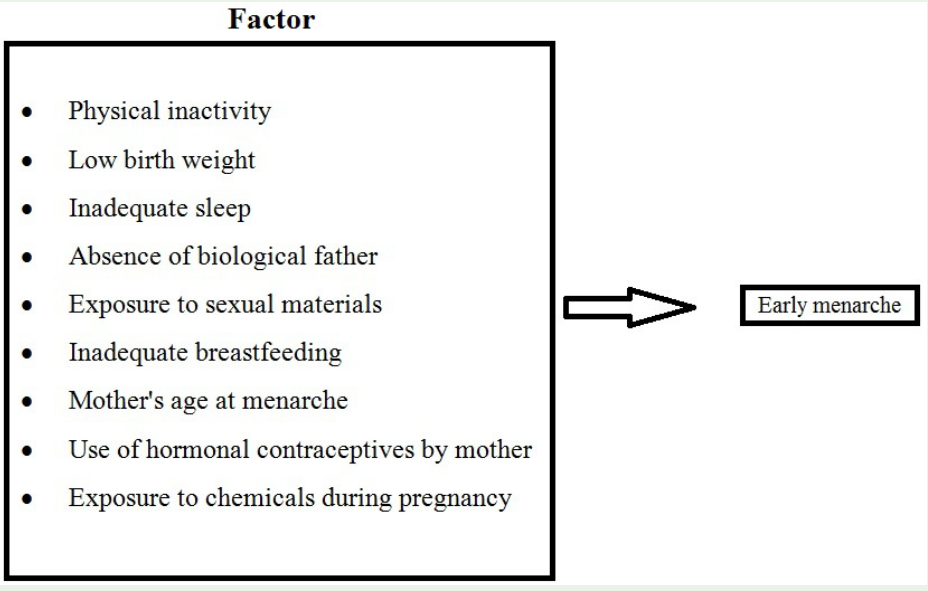

Figure 1: Identified risk factors of early menarche.

menarche (P=<0.001) with odds ratio 10.782(3.381-34.389), use of hormonal contraceptives (P=0.005) with odds ratio 5.805(1.722-19.568) and exposure to chemicals during pregnancy (P=0.028) with odds ratio3.917(1.159-13.234) are the identified risk factors of early menarche (Figure 1).

Discussion

The interest in the environmental factors that influence the onset of puberty has significantly increased. However, despite extensive studies, the mechanisms by which the environment influences the onset of menarche remain largely unclear. The results of this study show both associations and inverse associations between different factors that were considered determinants of early menarche. In the present study, place of residence showed significant association with early menarche that is staying in urban area had an odds ratio of 7.118(3.304-15.335) which was highly significant with p-value (<0.001). Similar findings were reported in a study done in Palpa and Rupandehi district Nepal, Punjab and South India [1,27,28] in which the urban girls had onset of menstruation earlier than the rural girls. This may be due to the climatic and ecological effects, or the difference in the socioeconomic status among them, the association between those could also be the subject of further study. Body image was highly associated with early menarche, a similar finding was reported in France [9] with odds ratio 2.3 (1.3-4.0) with p-value (0.004) and in a study among medina girls Ghana [8] the overweight girls had menarche earlier than the normal girls, similarly in a study in Poland higher BMI at the age of 14 years (OR=7.93; 95%CI 4.67-13.48) was significantly associated with early menarche [29]. Physical inactivity showed significant association with early menarche, a similar finding was reported in south Ethiopia [21] with odds ratio 0.1(0.04-0.19) with p-value (<0.005) and similar finding was reported in UK with (P=0.001) in which girls not doing exercises had significant association with early menarche [4]. There is still a controversy between the relationship between weight, and physical exercise. Studies have suggested that regular exercising girls may have low leptin levels and suppression of TSH, may disturb GnRH and can result in delayed menarche [41,42]. Similarly, girls who mature early tend to be more frequently obese as adults (oestrogens promoting deposition of fat in peripheral adipose tissue) on the other hand, childhood BMI is associated with an earlier menarche (due to oestrogen's production by peripheral adipose tissue) [43].

Birth weight was significantly associated with early menarche and similar findings was reported in Sweden [32] in which Small for-gestational-age girls had a menarcheal age that was approximately 5 months lower than that of normal girls (12.7 years vs. 13.1 years; p=0.032) and similar findings was reported in Poland [29]. Ghana [8] with (OR=2.54; 95% CI 1.22-5.28) and UK [4] Non Vegetarian diet, egg consumption and milk consumption in regular basis showed early onset of menarche and a similar finding was reported in Pokhara [1]. Previous studies have also reported that low menarche age was independently associated with high calorie consumption, high protein diet [21,34,36]. There should be proper study with proper classification on total energy intake and food consumption patterns to determine the actual influence of diet on menarche. Inadequate breastfeeding showed significant association with early menarche and a similar finding was reported in UK which showed the girls who were not breastfed were more likely to have menarche earlier [4]. The formula-feeding, as opposed to breastfed, had higher levels of body fat, which suggests one mechanism through which breastfeeding could delay menarche [46]. This may be due to the high protein containing formula feeding. Inadequate breastfeeding is also a risk factor for several diseases, so it is a matter of further study. In this study absence of biological father and family conflicts, psychological stress in childhood was statistically significant with early menarche. In accordance with the literature, living in a single parent family increased the likelihood of attaining early menarche [13,21,30]. The findings suggest that the physical and psychosocial stress caused by such environment induces metabolic changes that promote early menarche [44].

Exposure to materials promoting sexual activities, indirect sexual activity and being in relationship is statistically significant with early menarche in this study. A similar finding was reported in a study conducted in France [9] in which girls with sexual initiation (p=0.001) before menarche were 3.2 times more risk of early menarche. However, there is very few evidence regarding the relationship between menarche and sexual initiation and this study adds to evidence. It is a matter of concern as few studies have suggested that early maturing adolescents initiate health risk behaviors at an early age which appears to be at greater risk for negative consequences later in life and on health due to the inabilities to deal with consequences of such sexual activity [39,40]. Daughters of mothers with earlier menarche showed significant association with early menarche and a similar finding were reported in which daughters of mothers with earlier menarche were more likely to report early menarche [8,31,37]. It is however still unclear if this association reflects genetic influences or environmental influences. In the present study chemical exposure during pregnancy was associated with early menarche of the offspring. The findings from a study in china [33] show that the mean age at menarche was younger in the group exposed with high serum DDT. Similarly, the study from USA [45] also suggested the positive relationship between in utero exposure to DDE and menarche. Exposure to endocrine disruption chemicals during the intrauterine development may simultaneously increase the risk for higher body mass and early menarche [45]. However, the limitation of this study is lack of proper classification of chemical exposed. Exposure to preeclampsia during fetal life was associated with early menarche in the present study and similar finding was reported in UK which showed that menarche occurred earlier in women whose mother had pre-eclampsia or eclampsia with (p=0.001) [4]. Similarly, Menarche occurred slightly earlier in the preeclampsia (13.1 versus 13.3 years) group, but the difference was not statistically significant [38], whereas in contrary to this finding a study conducted on Sweden showed that exposure to preeclampsia had no association with age at menarche [26].

Conclusion

Our study assessed factors associated with early menarche and various risk factors. From multivariate logistic regression, nine factors were found significantly associated with early menarche which was physical inactivity, low birth weight, inadequate sleep, and absence of biological father, exposure to materials promoting sexual activity, inadequate breastfeeding, earlier mothers age at menarche, hormonal contraceptives and exposure to chemicals during pregnancy.

This study recommended that health education and promotion should be conducted on the consequences of early menarche.

Prevention and awareness should be conducted on the early onset of puberty and menarche. Encouragement for further studies to explore more on identified risk factors associated with early menarche is necessary. Mothers should be educated on the importance of exclusive breastfeeding. Schools should conduct regular physical activity classes and encourage sports activities. Further study in the identified risk factors can help pave the way for the menarche as a sensitive indicator of development of adolescent's girls.

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