Evaluation of Menstrual Cycle Characteristics in Indian Girls

Murugan A.[1], Anushiya Devi K.[2]
[1]Associate Professor in Zoology, S.T. Hindu College, Nagercoil, TN, India
[2]Associate Professor in Computer Science, S.T. Hindu College, Nagercoil, 629 002
([1]dr.a.murugan@gmail.com, [2]anukaiser@hotmail.com)

Abstract- Menstrual cycle is an intricate, intimate interaction between a bundle of chemical messengers. Menarche, a multifactorial event and the age of onset of menarche in girls in the recent period has pronounced shocking revelations among the parents in the global level. It is a known fact that early menarche and late menopause provoke breast cancer in women in later ages. The present study tries to analyze the differences of menstrual cycle in the subjects and their mothers and the role of some of the selected serum biomarkers to understand its normal biological process in college girls. Linear regression model confirms that subjects' menarche age is lower than their mothers'.

Keywords- *amenorrhea, biomarker, cancer antigen – 125, dysmenorrhea, menarche*

I. INTRODUCTION

Menstrual cycle is a rhythmic fashion of cyclical events that takes place in every 28 ± 3 days in the fertile age of a woman. Menses is a routine periodical monthly discharge of impure blood, mucous, shrouded epithelium and unfertilized ovum. It is the funeral of the unfertilized egg and an example of biological failure. For a successful normal menstrual cycle endocrine, ovarian and endometrial co-ordination is an essential one.

'Menstruation' and 'menses' are derived from Latin 'mensis' (month) which in turn relates to the Greek 'mene' (moon) and to the roots of the English words month and moon [1]. The first menses in a woman is termed as "menarche" [2], which is multifactorial in nature. Girls experience menarche at different ages. Reports say the mean menarche age is not uniform among girls [3-6]. It is known that the mean menarcheal ages of the mothers are higher than their daughters [7].

The average menstrual cycle takes 28 days, but the mean cycle length is not a static one [8]. Menstrual disorder is an irregular condition in a woman's menstrual cycle [9]. Studies indicate that menstrual disorders are common presentation by late adolescence and most of the girls experience some problems associated with menses [10], [11].

Premenstrual syndrome (PMS) is a collection of emotional symptoms, with or without physical symptoms related to women's menstrual cycle which affects millions of women [12]. The severe form of PMS is called as premenstrual dysphoric disorder (PMDD) [13], it is afflicting a sizeable number of menstruating women [14-16].

The prime roles of serotonin, a serum biomarker in emotional symptoms are well documented in many studies [17-20]. One previous report explained the association between magnesium deficiency and PMS [21]. A previous study explains the elimination of lead through menses [22] and the significance of CA - 125 as a biomarker for ovarian cancer is emphasized in another study [23].

The present study tries to focus on the variations if any in the menarche age of the college girls and their mothers, type of menstrual cycles, cycle related abnormalities and the behavior of certain serum biomarkers in menstrual phases.

II. MATERIALS AND METHODS

A. Study Area

The present study is on menstrual cycle characteristics in college girls in Nagercoil, the district headquarters of Kanyakumari, Tamil Nadu, the southern land mark of Indian sub - continent. This tiny district is owned by beautiful landscapes, three sides are bathed by the Sea and the northern side is fenced by Western Ghats. This number one literacy district in the State is with a land spread of 1684 Km2 and lies between 77°5' of the eastern longitudes and 8°03' of the northern latitudes [24].

B. Study Subjects

The study includes 10,000 respondents which constitute 5000 college girls of age 17-22 yrs and their 5000 mothers with different socio - economic, urban, semi - urban and rural backgrounds. The study has been conducted during the period 2011 - 12 and a standard questionnaire has been used for data collection and Ethics Committee's recommendations are strictly adhered during the survey.

Standard methods are used for the estimation of serotonin [25], magnesium [26], lead [27] and CA – 125 [28] in serum. Ordinary least square regression is used to check the linearity of the data [29]. Statistical analysis is made by SPSS statistical package [30].

III. RESULTS

The distribution of the respondents with respect to their menarche age includes 1735 (34.7%) subjects in 10-12 yrs age-group, 1610 (32.2%) in 13 yrs category and 1655 (33.1%) in 14-17 yrs of age, while the menarche age-wise distribution of their mothers in 10 - 12 yrs, 13 yrs and 14 – 19 yrs age - groups are 393 (7.86%), 793 (15.86%), 3814 (76.28%) respectively.

The study further shows that, out of 1735 pre-teen menarche mothers, 8.07% (140) mothers' menarche age is noticed between 10-12 yrs, 19.48% (338) mothers reached menarche at the age of 13 yrs and 72.45% (1257) mothers' menarche age is seen between 14-19 yrs. In 13 yrs age group menarche mothers, 5.84% (94) reached menarche at the age of 10-12 yrs, 13.6% (219) attained menarche at the age of 13 yrs and 80.56% (1297) mothers are seen in the menarche age - group 14-19 yrs. In 14-17 yrs menarche age – group mothers, out of 1655, 9.61% (i.e.) 159 reached menarche at the age of 10-12 yrs, 14.26% (236) in the age 13 yrs and the rest 76.13% (1260) mothers' menarche age is found in the age - group 14-19 yrs (Table 1). Ordinary least square regression model proves that the daughter's menarche age is greater than their mothers (Fig. 1).

Table 2 denotes the distribution of the subjects and their mothers based on their menarche ages. There are 1735 (34.7%) pre - teen and 3265 (65.3%) teenage menarche subjects and 393 (7.86%) pre - teen and 4607 (92.14%) teenage menarche mothers. It is also evident from the table that there is only 21.28% pre-teen menarche cases (2128 respondents, including 1735 subjects and 393 mothers) and a great majority (i.e.) 78.72% are detected as teenage menarche cases (7872 respondents, including 3265 subjects and 4607 mothers). It is evident from table 3 that, in 1735 (34.7%) pre-teen menarche subjects, their 7.32% (12) mothers reached menarche in their pre-teen period and 92.68% (i.e.) 1608 mothers attained menarche at the age of 13-19 yrs. But in 3265 (65.3%) teenage menarche subjects, their 266 (8.15%) mothers' menarche age is found as 10-12 and 2999 (91.85%) mothers' menarche age is observed as 13-19 yrs.

The type of menstrual cycles in the subjects and their mothers are shown in table 4 Out of 5000 subjects 323 (6.46%) are having irregular cycles and 4677 (93.54%) are with regular cycles, while in their mothers, 54 (1.08%) are having irregular and 4946 (98.92%) are with regular cycles.

The menstrual cycle abnormalities in the study subjects are given in table 5 It is quite obvious from the study that dysmenorrhea is noticed as a common problem (27.2%), followed by oligomenorrhea (1.64%), menorrhagia (1.42%), polymenorrhea (0.92%), hypermenorrhagia (0.78%), amenorrhea (0.32%) and spotting (0.14%).

Table 6 explains some of the important serum biomarkers during the menstrual cycle phases are measured to understand the normal biological process in college going girls. Irrespective of the menarche age enhanced levels of serotonin is found in preovulatory, ovulatory and luteal phase than the menstrual phase. An elevated level of serum Mg is noticed in proliferative phase when compared to the other phases of the preteen and teen menarche subjects. Lead, a health deteriorator is found low during menstrual phase with respect to other phases in pre-teen and teenage menarche girls. A high level of CA – 125, a biomarker for ovarian cancer is seen during the menstrual phase than the other phases of preteen and teenage menarche subjects. But, the values are found within the reference range.

IV. DISCUSSION

Menstruation is an integral, prime biological signal noticed as a biomarker event to confirm gestation in a woman's fertile age. It is the opening ceremony of the reproductive age and an eye opener discerning the reproductive health of women. This cyclical event decides the continuation of races in menstrual animals. The integration of hormonal, neural and endometrial factors decides the fate and type of menstrual cycles.

The age of both onset of puberty and menarche continues to decline in developing countries [31-33] and India is not an exception to this change. Reports say the mean menarcheal ages of the mothers are higher than their daughters [7], [34]. Ordinary least square regression is an easy and most powerful one to check the model assumption such as linearity, constant variance and the effect of outliers using simple graphical methods [29]. It proves that our subjects' menarche age (13.14 ± 1.18 yrs.) is lower than their mothers (14.48 ± 1.4 yrs.).

The length of a menstrual cycle is the number of days between the first days of menstrual bleeding of one cycle to the onset of menses of the next cycle [35], [36]. One study explained that the variability of menstrual cycle length is highest for women less than 25 yrs. of age [8]. The mean age of our study population is 18.89 ± 1.57 yrs. and 6.46% are having irregular cycles, while it is only 1.08% in their mothers (p =<0.01).

Menstrual disorders are the common presentation by late adolescence and some problems are associated with menstruation [11], [12]. Earlier studies reveal that there is a lot of difference in the prevalence of dysmenorrhea (i.e.) painful menstruation such as 90% [37] and 67.2% [38] in adolescent girls. It is around 27.24% in our subjects.

Abnormally heavy and prolonged uterine bleeding or menorrhagia is a common gynecological problem in adolescent girls [38-40]. It is seen around 1.42% in our subjects. Hyper menorrhagia, oligomenorrhea, polymenorrhea, amenorrhea and spotting are the other menstrual disorders observed in negligible levels.

The active role of serotonin [17-20] and magnesium deficiencies [21], [41] in mood disturbances are explained by previous studies. The menstrual phase specific low levels of occurrence of these biochemical reveal their roles in mood disorders in our subjects (p =<0.01).

Lead a health deteriorator, produces reproductive problems also. One study described the elimination of lead through menses [22] and it is true in our study too.

Detection of CA – 125, useful biomarker detection for ovarian cancer is very well discussed [28]. Studies reveal a

significant level of increase of CA - 125 in menstrual phase than the other phases of menstrual cycle [42-43]. A very narrow level of increase of CA - 125 is noticed in our pre-teen than the teenage menarche subjects, but it is within the range.

V. CONCLUSION

The present population based study is to try to identify and analyze the decline of age at menarche and menstrual cycle characteristics in college girls. Since, the age at menarche and menstrual cycle disorders are multifactorial in nature, large scale global studies are a must to solve the facts about these biomarker events in the reproductive age of women.

TABLE I. EXPLAINS THE MENARCHEAL AGE OF THE STUDY SUBJECTS' AND THEIR MOTHERS'. (N=10,000 RESPONDENTS; 5000 DAUGHTERS+5000 MOTHERS)

Subjects' menarche age (yrs.)	Mother's menarche age (yrs.)			Total subjects
	10-12	13	14 – 19	
10-12	140 (8.07)	338 (19.48)	1257 (72.45)	1735(34.7)
13	94 (5.84)	219 (13.6)	1297 (80.56)	1610 (32.2)
14-17	159 (9.61)	236 (14.26)	1260 (76.13)	1655 (33.1)
Total mothers	393 (7.86)	793 (15.86)	3814 (76.28)	5000 (100)

(Figures in parentheses are percentage values)
χ^2 test : subjects' menarche age Vs mothers' menarche age
p =< 0.01 highly significant

TABLE II. INDICATES THE DISTRIBUTION OF SUBJECTS' AND THEIR MOTHERS' WITH RESPOSECT TO THEIR MENARCHE AGE. (N=10,000 RESPONDENTS; 5000 DAUGHTERS + 5000 MOTHERS)

Menarche age (yrs.)	No. of subjects	No. of mothers	Total
Pre-teen (>13)	1735 (34.7)	393 (7.86)	2128 (21.28)
Teen (13-19)	3265 (65.3)	4607 (92.14)	7872 (78.72)
Total	5000 (100)	5000 (100)	10,000 (100)

(Figures in parentheses are percentage values)
χ^2 test : subjects' menarche age Vs mothers' menarche age
p =< 0.01 highly significant

TABLE III. DENOTES THE VARIATIONS IN MENARCHE AGE IN THE SUBJECTS' AND MOTHERS'. (N=10,000 RESPONDENTS; 5000 SUBJECTS + 5000 MOTHERS)

Subjects' menarche age(yrs)	Mothers' menarche age(yrs)		Total subjects
	Pre-teen	Teen	
Pre-teen	127 (7.32)	1608 (92.68)	1735 (34.7)
Teen	266 (8.15)	2999 (91.85)	3265 (65.3)
Total mothers	393 (7.86)	4607 (92.14)	5000 (100)

(Figures in parentheses are percentage values)
χ^2 test : subjects' menarche age Vs mothers' menarche age
p =<0.01 highly significant

TABLE IV. REVEALS THE TYPE OF MESNSTRUAL CYCLE IN THE STUDY SUBJECTS' AND THEIR MOTHERS' (N=10000 RESPNDENTS; 5000 SUBJECTS + 5000 MOTHERS)

Type of subjects' cycle	Mothers' cycle		Total subjects
	Irregular	Regular	
Irregular	4 (1.24)	319 (98.76)	323 (6.46)
Regular	50 (1.07)	4627 (98.93)	4677 (93.54)
Total mothers	54 (1.08)	4946 (98.92)	5000 (100)

(Figures in parentheses are percentage values)
χ^2 test : subjects'cycle Vs mothers'cycle
p =<0.01 highly significant

TABLE V. SHOWS THE MENSTRUAL CYCLE ABNORMALITIES IN THE STUDY POPULATION (N=5000 SUBJECTS)

Abnormalities	No. of subjects
Menorrhagia	71(1.42)
Hypermenorrhagia	39(0.78)
Dysmenorrhea	1362(27.2)
Oligomenorrhea	82(1.64)
Polymenorrhea	46(0.92)
Amenorrhea	16(0.32)
Spotting (irregular bleeding)	7(0.14)

(Figures in parentheses are percentage values)

TABLE VI. ILLUSTRATES SOME OF THE SERUM BIOMAKERS IN THE SUBJECTS(N=96 SUBJECTS; PRE-TEEN:9 SUBJECTS IN EACH PHASE; TEEN 15 SUBJECTS IN EACH PHASE) (VALUES ARE ± SD)

Biomarker / period (yrs)	Menstrual cycle phases (days)			
	a. Menstrual (2nd)	b.Preovulatory (7th)	c.Ovulatory (14th)	d. Luteal (25th)
1.Serotonin				
a.Pre – teen (10-12)	99.89 ±3.52	178.89 ±2.76	274.89 ±7.1	106.44 ±3.71
b.Teen (13 - 17)	104.93 ±3.17	181.87 ±3.07	274.8 ±6.18	106.4 ±3.48 [NS]
2.Magnesium				
a. Pre - teen	1.48 ±0.13	2.02 ±0.06	1.98 ±0.08	1.3 ±0.09
b. Teen	1.37 ± 0.16	2.01 ±0.04	1.98 ±0.11	1.31 ±0.09 [NS]
3.Lead				
a. Pre - teen	6.16 ±0.1	7.17 ±0.09	8.18 ±0.1	8.89 ±0.05
b. Teen	6.37 ±0.06	7.78 ±0.11	8.28 ±0.06	9.03 ±0.16
4. CA - 125				
a. Pre - teen	10.86 ±6.17	11.81 ±5.08 [NS]	8.07 ±3.53 [NS]	8.02 ±4.85 [NS]
b. Teen	8.39 ±5.13	9.71 ±5.16 [NS]	7.59 ±3.09 [NS]	6.56 ±3.36 [NS]

t values: a Vs b; a Vs c; a Vs d
P < 0.05 highly significant; P>0.05 not significant [(NS)]

$$y = x - 9E\text{-}14$$
$$R^2 = 1$$
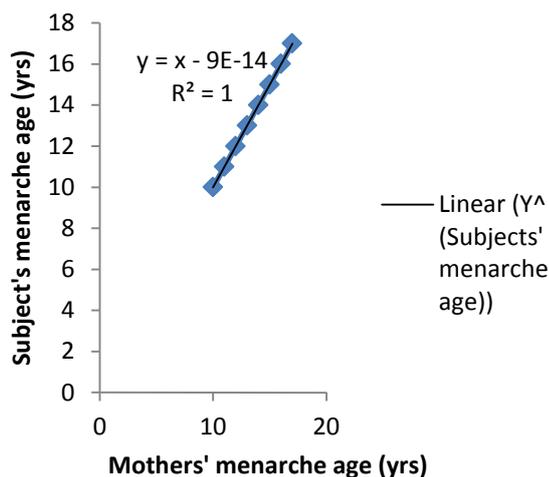
Figure 1. Illustrates the relationship between the menarche age of the subjects and their mothers

REFERENCES

[1]   Allen Kevin. In: The reluctant hypothesis: "A history of discourse surrounding the lunar phase method of regulating conception". Lacuna Press, 2007, PP. 239.

[2]   http: // en.wikipedia.org/wiki/menarche

[3]   S.C. Demir, T.O. Kadayifci, M.A. Vardar, et. al., "Dysfunctional uterine bleeding and other menstrual problems of secondary school students in Adana, Turkey", J. Pediatr. Adolesc. Gynecol, Vol 13(4), 2000, PP. 171-75.

[4]   V.V. Khadilkar, R.G. Stanhope and V. Khadilkar, "Secular trends in puberty", Indian Pediatrics, Vol 43, 2006, PP. 475-78.

[5]   A.Khanna A.Khanna, R.S. Goyal and R. Bhawsar, "Menstrual practices and reproductive problems: a study of adolescent girls in Rajasthan, J. Health Manage, Vol 7, 2005, PP. 91-107.

[6]   A. Dasgupta and M. Sarkar, "Menstrual hygiene: how hygienic is the adolescent girl?", Indian J. Com. Med, Vol 33 (2), 2008, PP. 77-80.

[7]   B.Ersoy, C. Balkan, T. Gunay and A. Egemen, "The factors affecting the relation between the menarcheal age of the mother and daughter", Child care Health Dev, Vol 31 (3), 2005, PP. 303-8.

[8]   L. Chiazze Jr, FT. Brayer, JJ. Macisco Jr, MP. Parker and BJ. Duffy, "The length and variability of the human menstrual cycle", JAMA, Vol 203(6); 1968, PP. 377-80.

[9]   http: // en.wikipedia.org/wiki/menstrual_disorder

[10] CK. Lee, PCY. Chen, KK Lee, and J. Kaur, "Menstruation among adolescent girls in Malaysia: a cross sectional school survey", Singapore Med. J, Vol 47 (10), 2006, PP. 874-79.

[11] L. French, "Dysmenorrhea", Am. Fam. Physi, Vol 71 (2), 2005, PP. 285-92.DM. Lori, MJ. Pamela, and HH. Melissa, "Premenstrual syndrome", Am. Fam. Physi, Vol 67 (8), 2003, PP. 1743-52.

[12] DM. Lori, MJ. Pamela, and HH. Melissa, "Premenstrual syndrome", Am. Fam. Physi, Vol 67 (8), 2003, PP. 1743-52.

[13] http: // patients.update.com/topic.asp? file = endocrin/10662

[14] U. Halbreich, J. Borenstein, T. Pearstein and LS. Kahn, "The prevalence, impairment, impact, and burden of premenstrual dysphoric disorder (PMS/ PMDD)", Psychoneuroendocrinology, Vol 28, 2003, PP. 1-23.

[15] L.S. Cohen, CN. Soares, MW. Otto, BH. Sweeney, RF. Liberman, and BL. Harlow, Prevalence and predictors of premenstrual dysphoric disorder (PMDD) in older premenopausal women. The Harvard study of moods and cycles", J. Affect. Disord, Vol 70 (2), 2002, PP. 125-32.

[16] A.Perkonigg, KA. Yonkers, H. Pfister, et. al., "Risk factors for premenstrual dysphoric disorder in a community sample of young women: the role of traumatic events and postraumatic stress disorder", J. Clin. Psych, Vol 65 (10), 2004, PP. 1314-22.

[17] K. Wyatt, PW. Dimmock, and PM. O'Brien, "Premenstrual syndrome. In: Barton, S (edn), Clinical Evidence, 4th issue, London, BMJ Publishing group", 1998, PP. 1121-33.

[18] B.Kessel, "Premenstrual syndrome: advances in diagnosis and treatment", Obstet. Gynecol. Clin. North Am, Vol 27, 2000, PP. 625-39.

[19] O. Eriksson, A. Wall, I. Marteinsdottir, H. Agren, P. Hartvig, G. Blomqvist, B. Langstrom, and T. Naessen, "Mood changes correlate to changes in brain serotonin ecursor trapping in women with premenstrual dysphoria", Psychiatry Res, Vol 146 (2), 2006, PP. 107-116.

[20] T. Pearlstein and M. Steiner, "Premenstrual dysphoric disorder: burden of illness and treatment update", J. Psychiatry and Neuroscience, Vol 33 (4), 2008, PP. 291- 301.

[21] GM. Tong, and RK. Rude, "Magnesium deficiency in critical illness", J. Intensive care Med, Vol 20 (1), 2005, PP. 3-17.

[22] YH. Yang, SH. Liou, CY. Yang, FC. Sung, CC. Wu and TN. Wu, "Increased blood lead concentration during menstruation in teen female students", The Sci. of Total Environ, Vol 382 (2-3), 2007, PP. 224-27.

[23] KS. Sub, Sw. Park, A. Castro, H. Patel, P. Blake, M. Liang and A. Goy, "Ovarian cancer biomarkers for molecular biosensors and translational medicine", Expt. Rev. Mol. Diagn, Vol 10 (8), 2010, PP. 1069-83.

[24] www.en.wikipedia.org/wiki/kanyakumari_district

[25] J. Laporta, TL. Peters, SR. Weaver, KE. Merriman and LL. Hernandez, "Feeding 5 – hydroxy - 1 - trptophan during the transition from pregnancy to lactation increases calcium mobilisation from bone in rats", Domest. Anim. Endocrinol, Vol 44 (4), 2013, PP. 176-84.

[26] UPS. Chauhan and BC. Ray Sarkar, "Use of calmagite for the determination of traces of magnesium in biological materials", Anal. Biochem, Vol 32 (1), 1969, PP. 70-80.

[27] RJ. Flanagan, RA. Taylor, ID. Watson and R. Whelpton, "In: Fundamentals of analytical toxicology. Analytical techniques for clinical chemistry: Methods and applications", John Wiley and sons Ltd, UK, 2007, PP. 840-56.

[28] www.labmed.ucsf.edu/labmanual/db/resource/Centaur_CA125.pdf

[29] GD. Hutcheson, "Ordinary least square regression. In: L. Moutinho and GDHutcheson, The SAGE dictionary of quantitative management research", 2011,PP. 224-28.

[30] www.tekisimizanaliz.com

[31] RM. Malina, ME. Pena Reyes, SK. Tan and BB. Little, "Secular change in age at menarche in rural Oaxaca, southern Mexico : 1968 - 2000", Ann.Hum.Biol, Vol 31(6), 2004, PP. 634-46.

[32] S. Rao, S. Joshi and A. Kanade, "Height velocity, body fat and menarcheal age of Indian girls", Indian Pediatr, Vol 35(7), 1998, PP. 619-28.

[33] KF. Huen, SS. Leung, JT. Lau, AY. Cheung, NK. Leung, and MC. Chiu, "Secular 1 trend in the sexual maturation of southern Chineese girls", Acta. Pediatr, Vol 86, 1997, PP.1121-24.

[34] FR. Tehrani, P. Mirmiran, S. Zahedi - Asl, K. Nakoda and F. Azizi, "Menarcheal age of mothers and daughters: Tehran Lipid and Glucose study", Eastern Mediter. Health J, Vol 16(4), 2010, PP. 391-95.

[35] AE. Treloar, RE. Boynton, BG. Behn, and BW. Brown", Variation of the human menstrual cycle through reproductive life, "Intl.J. Fertil, Vol 12 (1pt 2), 1967, PP. 77- 126.

[36] HB. Preser, "Temporal data relating to the human menstrual cycle". In: Biorhythms and human reproduction, M. Ferin et. al (editors), John Wiley and sons, NewYork, 1974, PP.145-60.

[37] JR. Klein and IF. Litt, "Epidemiology of adolescent dysmenorrhea Pediatrics, Vol 68, 1981, PP. 661-64.

[38] P. Sharma, C. Malhotra, DK. Taneja and R. Saha, "Problems related to menstruation amongst adolescent girls", Indian J. Pediatr, Vol 75 (2), 2008, PP. 125-29.

[39] A.Caufriez, "Menstrual disorders in adolescence: Pathophysiology and treatment", Horm. Res, Vol 36 (3-4), 1991, PP. 156-59.

[40] EA. Claessens and CA. Cowell, "Acute adolescent menorrhagia", Am. J. Obest. Gynecol, Vol 139, 1981, PP. 277-80.

[41] S. Johnson, "The multifacted and widespread pathology of magnesium deficiency", Med. Hypotheses, Vol 56 (2), 2001, PP. 163-70.

[42] P. Lehtovirta, D. Apter, and UH. Stenman, "Serum CA 125 levels during the menstrual cycle", Br. J. Obstet. Gynecol, Vol 97 (10), 1990, PP. 930-33.

[43] S. Grover, H. Koh, P. Weideman, and MA. Quinn, "The effect of menstrual cycle on serum CA 125 levels: a population study", Am. J. Obstet: Gynecol, Vol 167 (5), 1992, PP. 1379-81