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Differential Drift in Menarcheal Age in Blind and Sighted Girls

Kamalammal Pushkala[1], Purshottam Das Gupta[2]* and Ragunathan Geetha[3]

[1]*Former, Associate Professor, S. D. N. B. Vaishnav College for Women, Chennai, India*

[2]*Adjunct Professor, Manipal University, Manipal, Karnataka, India*

[3]*Principal and Head, Department of Statistics, S.D.N.B. Vaishnav College for Women, Chennai, India*

***Corresponding Author:** Purshottam Das Gupta, Adjunct Professor, Manipal University, Manipal, Karnataka, India.

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Abstract

Our survey data show that menarcheal age, both in sighted and blind girls has drifted towards younger years compared to 50 years back, however, in sighted girls it has gone further down compared to blind girls. In this paper we have explained the reasons, why it is so? For the comparison sake we were very careful to select sighted and blind girls from the same geographical region, socio-economical and education status and food habits. Taking into consideration, our earlier hypothesis, "blind women and breast cancer", here also we propose that only the photo regulatory system for hormonal axis is responsible for differential lowering of Menarcheal age in sighted and blind girls, since all other regulatory factors are same in both the groups.

Key words: *Delayed menarche in blind; Early Menarche; Influence of light; Mechanism of action*

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Introduction

Menarche is a signal when girls enter puberty, as a result primary and secondary sexual characters start developing and finally the reproductive phase starts. Accurate estimate on the age of menarche is very difficult since, sexual maturity is influenced by a wide variety of factors such as geographical connotations, socioeconomic status, diet, exercise, environment, religion, genetic and hereditary factors, ethnicity, psychological stress, migration and chronic illnesses with opinions both supporting and rejecting it (Rokade and Mane, 2009).

Danish people were the pioneers to calculate the age of menarche around mid-19th century (Freedman., *et al*. 2003). Age of menarche has been observed to reduce in many parts of the world during the early part of the 20th century at the rate of approximately four months per decade till it stabilized at around 13 years (Shawky and Milaat, 2000; Rokade and Mane, 2009; Pandey and Ashish Pradhan, 2017). Even the rate of reduction per decade has been calculated from few studies for example; English girls had menarche at an average rate of 4 months lower per decade (Tanner, 1973) and 2.6 months per decade in Hungary (Bodzsár, 1988). Some estimates suggest that the median age of menarche worldwide is 14, and there is a later onset of menarche in Asian populations compared to the West [1].

Recently, scientists suspect over exposure to artificial light at night could have a negative impact on the sexual maturity apparently due to the interference of normal maturation cycle in their lives in addition to other health hazards (Jafarey., *et al*. 1970; Jafarey., *et al*. 1971). This conclusion was drawn based on the fact that countries experiencing long winter nights, girls are now reaching sexual maturity months or years before than their grandmothers did.

The literature survey gives three views on menarcheal age in blind with evidence for the early age of menarche among the blind girls compared to sighted girls (Zacharias and Wurtman, 1964; Magee., *et al*. 1970; Umławska, 2000; Evans., *et al*. 2009 and Ibitoye., *et al*. 2017) or no impact of blindness on the age of menarche (Thomas and Pizzarello, 1967). Segos (1999) reported a delay regarding the age of menarche in blind girls. Subsequently, Griva., *et al*. (2006) observed in Greece blind women presented late age at menarche (median 13 years) as opposed to non blind individuals (mean age 12.58 years).

A decade later Kanmani and Ravisankar (2016) observed average age of menarche in blind was 13.43 years in a pilot study conducted in the selected 16 districts of Tamil Nadu during 2012-2013.They also reported a delayed menarche among the visually challenged subjects since, the number of subjects attained menarche above 13 years proves to be 83.65% than the subjects attained menarche below 12 years (12.6%).

In the present scenario there is a compelling reason to understand the factors influencing the lowering of menarcheal age worldwide to maintain the healthy human reproduction (Gupta and Pushkala, 2018) and avoid the deadly disease like cancer which takes away millions of human life. A relationship between timing of menarche and a diminished ovarian reserve was identified. Statistically significant impact of age at menarche on diminished functional ovarian reserve risk (DFOR) later in life among infertile women was observed.

It has been suggested that the occurrence of early menarche age <13 years may relate to follicular pool size and/or speed of follicle recruitment, which in turn is predictive of occurrence of DFOR later in life (Sadrzadeh., *et al*. 2003; Weghofer., *et al*. 2013). Earlier with blind menopausal women model, we provided strong evidence for the influence of light on the prevalence of hormonally regulated breast cancer (Gupta and Pushkala, 2012; Gupta., *et al*. 2010; Pushkala and Gupta (2009; 2011; 2013; 2016; 2016).

Aim of our study was to find the trend on the age of menarche in metropolitan cities since most of the previous reports were from rural areas in India. A controversy exists whether blind pre-pubertal girls with no light stimuli experience delayed or early puberty compared to sighted girls. This study was aimed to understand the influence of light on menarche with the evidence by comparing the age of menarche between visually challenged subjects and sighted subjects from the same socioeconomic background and geographical area. The probable mechanism on menarche operated in blind was also discussed in this paper.

Materials and Methods

Information on the age of menarche was collected by epidemiological survey from 598 sighted and 584 visually impaired subjects (age ranging from 9-60 years) from Chennai, metropolitan city situated on the north-east end of peninsular India, between 12° 9' and 13° 9' of the northern latitude and 80° 12' and 80° 19' of the southern longitude consisting of 178.20 Sq. kms included under the state of Tamil Nadu. The study was conducted in the year 2011-2014. A comparison on the age of menarche was also done between 126 sighted subjects from under privileged sector and 69 visually impaired girls were included from under privileged socioeconomic condition.

The subjects (blind and sighted) were then classified into 3 age groups as up to 20 years, 21-39 and 40-60 years to facilitate comparison of the age of menarche between blind and sighted subjects born in different years. The survey included subjects from schools, colleges, housewives and working women. IBM SPSS 18 version was used to analyze the data.

Results

A lowering trend of age of menarche was noticed at present in the metropolitan city of Chennai as suggested by earlier studies among sighted and blind subjects in our study compared to 50 years back. The results of our study showed that in sighted subjects within 50

years at least 14% showed very early and 71.6% showed early menarche (Table 1) but at the same time blind subjects showed 10.9% very early and 62.7% showed early menarche which was comparatively less than the sighted subjects. It was also observed that majority of the sighted subjects between the age 40-60 attained menarche (92.8%) only in their ideal age of above 13years. Surprisingly all the blind subjects had menarche only above 14 years in the age group 40 to 60years, which was suggested as healthy for reproduction.

Age Group	Survey from age Up to 20yrs		Survey from age 21-39 years		Survey from age 40-60 years	
Starting age of menarche	A (N = 357) B (N = 271)		A (N = 74) B (N = 160)		A(N = 153) (N = 167)	
	A (%)	B (%)	A (%)	B (%)	A (%)	B (%)
Up to Age 11 years	10.9	14	9.4	11.3	0	0
Between age 12-13 years	62.7	71.6	52.7	41.9	0	7.2
Age beyond 13 years	26.3	14.4	37.8	46.8	100	92.8

A (%) - Blind subjects; B (%) - Sighted subjects; N-Number of subjects

Table 1: *A comparison between lowering of Menarcheal age between sighted and blind subjects.*

In our study (Table 2) the percentage of blind subjects experiencing very early menarche at the age of 10 and 11 years was also less compared to sighted subjects among the age group up to 39 years unlike the age group 40 to 60 years. A trend of late menarche is distinct in our study among the blind subjects. Few blind subjects experienced menarche even above the age of 16-28 years

Age at menarche (Years)	Up to 20		21-39		40-60	
	A (%)	B (%)	A (%)	B (%)	A (%)	B (%)
9	0	0	2.7	1.3	0	0
10	0.6	3.0	0	1.9	0	0.0
11	10.4	11.1	6.8	8.1	0	0.0
12	30.3	32.5	25.7	22.5	0	3.6
13	32.5	39.1	27.0	19.4	0	3.6
14	17.6	10.7	12.2	24.4	0	65.3
15	5.6	3.3	6.8	16.3	22.9	19.2
16-28	3.1	0.4	18.9	6.3	77.1	8.4

A (%) Blind subjects; B (%) - Sighted subjects

Table 2: *Distribution of age over the years.*

The comparative analysis of the age of menarche, between girls from under privileged sector and visually impaired girls from similar socioeconomic condition showed (Table 4) that sighted girls had early menarche than blind subjects comparatively from the same socioeconomic background substantiating the influence of light on the age of menarche. Blind subjects across all age groups experienced menarche later than the sighted subjects in all age groups (Table 3).

Mean Menarcheal age (in years)	Blind	Sighted
Last 20 years	13	12.6
Last 40 year	14.5	13.6
Last 60 year	20.4	14.8

	Blind	Sighted
Mean Menarcheal age (in years) in the last 20 years	13	12.6
Mean Menarcheal age (in years) in the last 40 year	14.5	13.6
Mean Menarcheal age (in years) in the last 60 year	20.4	14.8

Table 3: *Average age of menarche in blind and sighted girls through ages.*

Menarche Groups	Sighted subjects in % (N =126)	Blind in % (N = 69)
Early menarche (9-11 years)	16.7	10.1
Ideal menarche(12-13years)	79.4	52.2
Late menarche(above 14years)	4.0	37.7

N- Number of subjects.

Meanarche groups	Government school (n = 126)		Blind (n = 69)	
	Number	Percent	Number	Percent
early menarche	21	16.7	7	10.1
ideal menarche	100	79.4	36	52.2
late menarche	5	4.0	26	37.7
Total	126	100.0	69	100.0

Table 4: *Showing the age distribution of menarche between sighted and blind from up to 20 years age group.*

Discussion

We observed lowering of the age of menarche among the subjects in the metropolitan city of Chennai similar to earlier reports from the rural area (Rajaratnam., *et al*. 2000; Parimalavalli and Sangeetha, 2011; Chitra., *et al*. 2014; Senthil Priya., *et al*. 2016; and Ravi., *et al*. 2016). The average Menarcheal age (in years) for blind subjects in the age groups up to 20 years, 21-39 years and above 40 years are 13,14.5 and 20.4 respectively while for sighted subjects it is 12.6,13.6 and 14.8 in their respective age groups. Hence this pilot comparative study gives an insight on the trend of age of menarche between present and 50 years back in India where an ideal age of menarche was prevailing both among sighted and blind since majority of them matured only after 13 years of age then.

In India at least 200,000 children have severe visual impairment or blindness and approximately 15,000 are in schools for the blind. Lack of pineal growth was noticed after infancy but not the growth of pituitary in a pre-pubertal girl (Schmidt., *et al*. 1995), though the mean melatonin concentration increased with advancing puberty due to an increase in the amplitude of secretary episodes (Penny, 1985). As early as 1964 Zacharias and Wurtman observed that the maturation of human Neuro-endocrine axis is influenced by environmental light. Artificial lighting system is also responsible for decreasing the age of menarche Jafarey., *et al*. (1971).

Environmental light plays an important role in regulating hormonal secretions of the pituitary-gonadal axis favourably controlling sexual and reproductive functions through a reduced secretion of melatonin from pineal gland, influencing pubescence, ovulation and a large number of daily rhythms (Jagota., *et al*. 1999). When circannual rhythm in LH, FSH, testosterone, PRL, and cortisol secretion was tracked for 4 years from 66 healthy females, aged 6–10, LH peak was observed in January, and PRL significant rhythm only in females with peak in March. Surprisingly, FSH and cortisol did not show an annual rhythm suggesting the sex influences the circannual hormonal rhythms from pre-puberty onwards (Bellastella., *et al*. 1983). Women living in Finland, a region with a strong seasonal contrast in

luminosity, showed increased melatonin and reduced gonadotropins during dark season, with consequent reduction of conception rates (Elden, 1971).

Light sensitive central clock gene and some independent clock genes in the peripheral tissues regulate the basal and rhythmic pituitary–gonadal hormone secretions. Light is able to induce the expression of some of these genes, thus playing an important role in increasing the hormonal secretions of two gonadotropins, luteinizing hormone (LH) and follicle stimulating hormone (FSH) mediated through effects on the suprachiasmatic nucleus (Kripke., *et al*. 2010).

A negative feed-back mechanism between melatonin and hormones of pituitary–gonadal axis is also anticipated because of the presence of gonadotropins and gonadal steroid receptors in human pinealocytes (Luboshitzki., *et al*. 1997) and melatonin receptors in human hypothalamus, pituitary, and in other tissues of gonadal tract (Shang-Mian., *et al*. 1995). The negative effect of melatonin on the sexual maturation is demonstrated in experimental animals by exogenous administration of melatonin or in animals kept in constant darkness where a delay in sexual maturation is observed (Aleandri., *et al*. 1996; Bellastella., *et al*. 2014; Reiter, 1998 and Silman., *et al*. 1997) since, hypothalamic pituitary gonadal axis has melatonin receptors.

In blind, increase of melatonin due to the absence of light resulting in the decrease of estradiol affects age of menarche. In born blind rats Jagota., *et al*. (1999) showed that melatonin is inversely proportional to estradiol which is playing a major role in reproductive maturation. Thus it is hypothesized that light is responsible for lowering of menarcheal age. Cumulative effect of increased exposure to light (natural and artificial) is responsible for lowering of menarcheal age at present compared to 50 years back.

Conclusion

A reducing trend on the age of menarche is observed in our study. Our results substantiates that light stimuli influence neuroendocrine-gonadal activity in humans, as in other mammals; and in blind pre-pubertal girls, impaired hormone secretion could be the cause for the delay of pubertal development. In primates "central inhibition" suppresses pulsatile GnRH release during the juvenile period and photoperiod could be the inducing factor for releasing the "central inhibition" in the absence of which delay in menarche could be anticipated in visually impaired girls.

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