

Mobile Phone usage and Onset of Menarche: a Cross-sectional Study

Latha Ramalingam^{1*}, Akshaya Veeraragavan²

¹ Associate Professor, Department of Physiology, Shri Sathya Sai Medical college and Hospital, Ammapettai, Thiruporur, ²Third year MBBS student, Shri Sathya Sai Medical college and Hospital, Ammapettai, Thiruporur.

Abstract

Introduction: There has been a secular trend in the age of menarche of females at the rate of decrease of 1 month per decade since 1995. Hormonal imbalance, obesity, altered food habits, chemicals in cosmetics, and sedentary life have been the main causes. Mobile phone addiction in small children should also be considered for any association. **Aim:** The aim is to find out the trend of age of onset of menarche and its association with mobile phone usage in females of rural and urban areas in the past 5 years, since 2014. **Materials and methods:** The study was conducted among 378 females (196 rural and 182 urban) of age group 7-15 years in the rural and urban population. After obtaining written consent, a questionnaire was administered to know their current age, age of menarche and details about their mobile phone exposure. **Results and discussion:** The average age of menarche in urban and rural females was 11.95 ± 0.73 years and 12.47 ± 0.54 years respectively. 120 urban girls and 105 rural girls use cell phone, mainly for games (rural) and for calls in urban side, of which less than 1/3rd were only using hands-free devices. None of the urban or rural girls using cell phone were aware of the hazards of it. **Conclusion:** Direct exposure of radiation to brain may alter Hypothalamo-pituitary axis, which might affect Gonadotrophin secretion, leading to early menarche. Though this might be a theoretical correlation, mobile phone exposure should be considered for association with early menarche, as this has serious consequences on the physical, psychological and social health of the female.

Key words: Menarche, Mobile phone, Radiation

Corresponding Author

Dr. Latha Ramalingam, Associate Professor, Department of Physiology, Shri Sathya Sai Medical college and Hospital, Ammapettai, Thiruporur, Kanchipuram - 603108 Mobile. No: 9994652810
E- Mail id: lathura@gmail.com

Introduction

Onset of Menarche, the definitive marker of puberty, is an important event which establishes the capacity of procreation and regular menstrual cycles and is an indicator of healthy reproductive life of women. The mean age of menarche in Indian

women is declining at the rate of one month per decade since the year 1995¹.

There are differences in the age of menarche in urban and rural female population. Hormonal imbalance, obesity, altered food habits, chemicals in cosmetics, and sedentary lifestyle, which are

predominant in urban population do have impact on the onset of puberty. Factors like genetic influences, race, Body mass index, geographical location, socioeconomic conditions healthy nutrition, exercise, seasonality, and family size have been shown to have impact on the onset of menarche^{2,3}. Menstrual disorders like dysmenorrhea and Premenstrual syndrome were higher in rural than urban girls⁴. Girls with lower Body mass index, which is common in rural population attained menarche at a later age, as compared with girls with higher Body mass index⁵. There was significant difference in the age of menarche between low socioeconomic status and higher socioeconomic status groups⁶.

The most necessary modern invention of telecommunication which is the Mobile phone has become an integral part in every person's life. The electromagnetic radiations emitted from phones could be absorbed by soft tissues like brain and the nervous system of children are more vulnerable than adults⁷. Mobile phone addiction, especially by small children should also be considered for any association with the early age of menarche. Because of the socioeconomic status, usage and addiction to smart phones are higher in urban girls than rural girls. There are not many studies which link the cell phone radiation exposure and early onset of puberty in females. This study aims to link the extent of mobile phone usage and onset of age of menarche in rural and urban population with the hypothesis that radiation exposure may have an effect on the Hypothalamo-pituitary axis and Gonadotrophin secretions.

Materials and Methods

The study was conducted after obtaining clearance from Institutional ethics committee. Girls of age group 7 to 15 years who have attained menarche between 2015 and 2019 were randomly selected from rural and urban areas of Kanchipuram district of Tamilnadu. The participants were selected from schools in these areas. The nature of the study was

explained to all the girls and written informed consent was obtained from all the participants before the conduct of study. A total of 379 females were recruited for the study, of which 196 girls were from rural population and 183 girls were from urban population. The participant's height and weight were checked and noted. Body Mass Index (BMI) was calculated using Quetelet's index. Only the girls with normal BMI for Asian population (18.5 to 23 Kg/m²), as per WHO classification were included for the study⁸. Girls with history of regular physical exercise were excluded from the study.

The participant's current age, age of menarche and the year of attaining menarche were noted and entered in data excel sheet. Family history of precocious puberty was excluded. Mobile phone exposure questionnaire was administered to all the participants. The questionnaire was custom-made and standardized with a pilot study with 20 participants. The questionnaire covered the details of owning a personal mobile phone, hours of usage of mobile phone per day (questionnaire contained options of 1 to 3 or more hours), predominant time of using, purpose of using mobile phone, if any hands-free devices used during talking and awareness on the problems due to mobile phone usage. All the responses were transferred to a Microsoft excel sheet. The data obtained from rural and urban population was analyzed separately and compared between the groups. The data was analyzed using Microsoft excel and Statistical tests of significance with unpaired Students T test was done using SPSS software version 23. The trend of menarche across the past 5 years and its association with the mobile phone usage was analyzed and compared.

Results and discussion

The randomly selected population of females less than 15 years was 183 from urban areas and 196 from rural areas as shown in the figure 1.

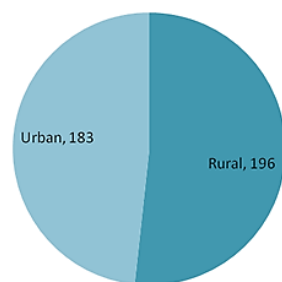


Figure1: Representation of Sample population of girls selected from Urban areas (n=183) and rural areas (n=196)

Age of menarche:

The age of onset of menarche was between 12 to 13 years in majority of urban as well as rural population. Table 1 shows the average age of menarche in Urban and rural population between 2014 and 2018.

Age of menarche	n	Mean \pm SD	Std. Error
Urban	183	11.95 \pm 0.730	0.054
Rural	196	12.47 \pm 0.540	0.039

Table 1: The table shows the average age of onset of menarche in all the girls of urban and rural areas in the past 5 years, since 2014.

The average BMI of urban girls was 21.85 ± 1.33 Kg/m² and in rural girls was 20.76 ± 1.65 Kg/m² with no significant difference between them. The average age of menarche was also significantly higher in rural population (12.47 ± 0.54 years) when compared with urban population (11.95 ± 0.73 years) with a P value < 0.001. But the number of females who attained menarche at 13 years and above was comparatively more in rural population (n=96) when compared with urban population (n=37), though there was no any statistically significant difference between the groups (Figure 2).

Mobile phone usage:

Also, we observed that the early age of onset starts in early 2015 in urban population, compared with the trend establishing in rural population in the recent 2017 and 2018. Out of the selected population of girls, 120 from urban and 105 from rural were using mobile phones as shown in the figure 3A, yet the number of hours of usage among them were comparatively higher on the urban side as shown in figure 3B, though there was no significant difference in them.

With regard to the time of exposure, Urban females were exposed to cell phones more during day time with a significant difference of $P=0.044$ when compared with the rural females as shown in figure 4A, though 47 girls from rural side were using mobile phones during night time which is comparatively a little higher than urban population (n=38), with no significant differences. Also the purpose of using mobile phones was predominantly for communication ($P<0.001$) and playing games in the urban population of girls, whereas in rural side, the usage was for predominantly for playing games in mobile phones (Figure 4B).

None of the girls in the rural or urban population were aware of any of the harmful effects of exposure to mobile phone radiations (Table 2).

Aware about the mobile phone risks	Urban	Rural
YES	0	0
NO	120	105

Table 2: Awareness about the mobile phone hazards in urban and rural girls. Almost no girls are aware of any risks associated with excessive mobile phone usage.

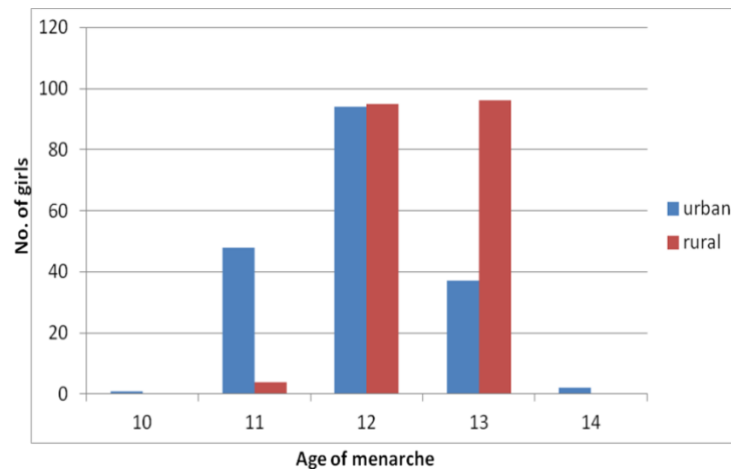


Figure 2: Represents the number of girls who attained menarche across ages 10 years to 14 years in urban and rural population

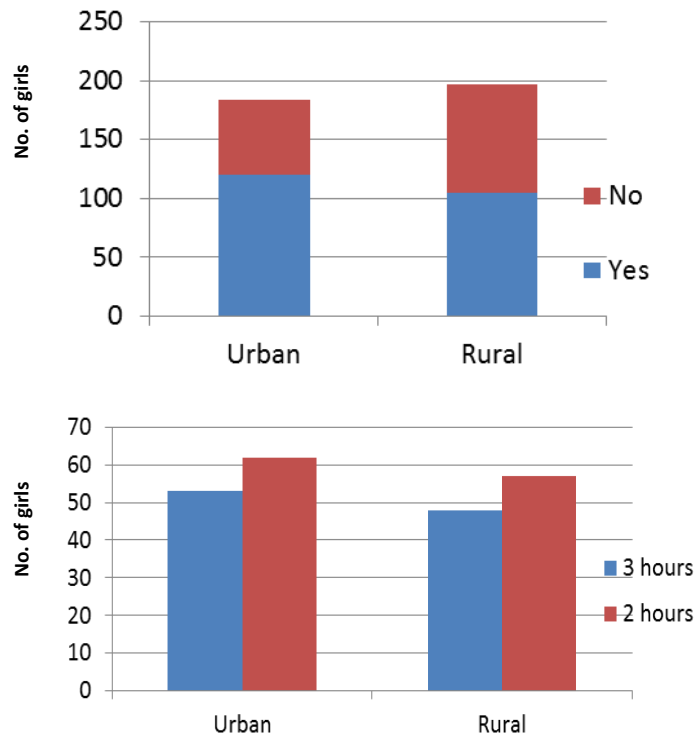


Figure 3:3A: Represents the total number of girls having mobile phone in rural and urban population. There was a significant difference ($p=0.009$) as the number of users was higher on the urban population. **3B:** shows the extent of mobile usage per day among the selected mobile phone users in the urban and rural population. Usage for 3 hours and above was almost similar for urban and rural population ($p=0.227$).

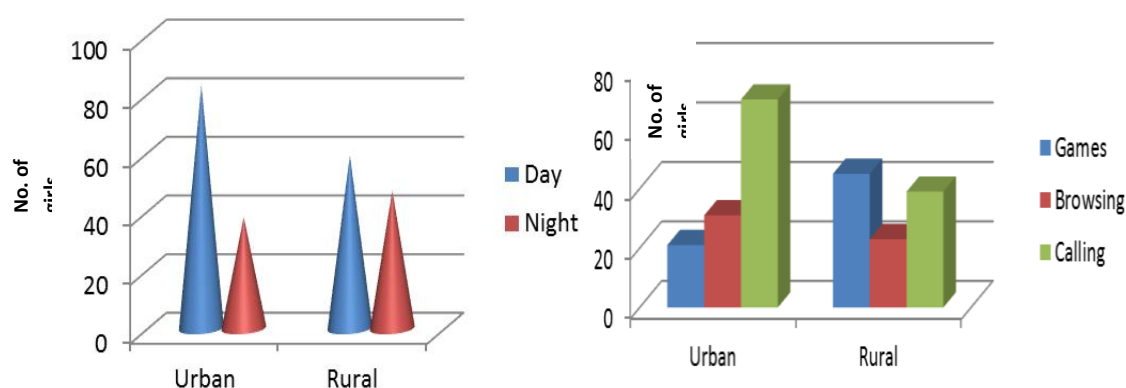


Figure 4:4A: Percentage of mobile phone users using during day time and night time in rural and urban population of girls. There was a significant difference ($p=0.044$) between the users in day time which was higher in urban population, but not in the night time users though the absolute value is higher in the rural population. **4B:** Predominant cause for using mobile phones in rural and urban population. Gaming was significantly higher ($p<0.001$) in the urban girls.

Out of the girls who were using phones for communication by calling, only 41 were using hands-free device during talking and none of the girls on the rural population use hands-free while talking as shown in the figure 5.

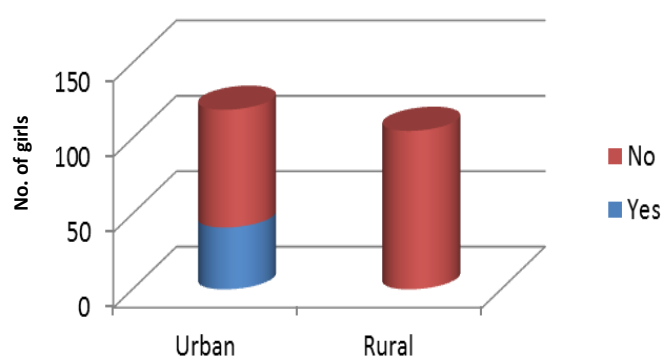


Figure 5: Number of girls who were using hands-free devices during mobile phone usage. Almost no girls from rural population were using such devices ($p<0.001$).

Discussion

The average age of menarche of urban girls of our study population in the past five years (2014 to 2018) was 11.95 years with a wider range of 10 to 14 years. A study conducted in urban area of South India showed mean age of menarche as 13.11 years with a wide variation between 10 to 17 years. The duration of blood flow during menstruation was also higher in early adolescent urban girls⁹. Another study reports average age of menarche in healthy school going girls of Northern India as 12.4 years

and also obese girls had earlier onset of menarche than non-obese girls¹⁰. In our study, since we started with the hypothesis that mobile phone radiations might have an impact on onset of menarche, Normal BMI girls were only chosen from rural and urban population so that the confounding effect of obesity on menarche is removed. The number of girls attaining menarche at an earlier age (10 and 11 years) was also higher on the urban areas.

The world is surrounded by Radiofrequency radiations all around to which our previous generations were not exposed to. Hence, the current generation, especially teenagers are facing the effects of harmful radiations especially due to excessive usage. In our study, the usage of mobile phones was excessive in urban females when compared with rural population. Low levels of income and digital literacy added with social and cultural norms were quoted as reasons behind less mobile usage in rural India as compared to Urban India¹¹. Less than 46% of Indian rural women own a mobile phone according to National Family Health Survey in the year 2015-16¹².

In our study, the usage of mobile phones by the young girls was mainly for the purpose of playing games and chatting. Some animal studies have demonstrated the effects of mobile phone radiations on the reproductive health of males and females. An animal study done on male rats by Tumkaya et al has demonstrated that low absorption rate from mobile phone radiations have no direct effect on the testicular histology¹³. However, microwaves from mobile phones have shown to decrease the number of follicles in ovaries of female rat pups¹⁴. Our study has reported minimum of 2 hours of uninterrupted usage of mobile phones per day by the young girls of rural and urban areas. Alteration of Oxidative stress parameters was observed in ovaries and uteri of rats exposed to radiofrequency radiations at the rate of 2 hours per day for 30 days¹⁵.

Bed time usage of mobile phones was comparatively higher in rural girls. Most of the previous studies were on the net amount of mobile phone usage and its impact on the other functions of the brain like memory, concentration etc. A study done by Jing et al has reported that positive affect and working memory was better in a group of population where they were restricted to use mobile phones 30 minutes before bed time¹⁶. Most of the urban girls and none of the rural girls were

using hands-free devices while communicating in cell phones, which imposes a direct effect of radiations to brain. Lennart Hardell has reported the brain was the main organ affected by Radiofrequency radiations emitted by handheld wireless phones¹⁷. Even use of hands-free kits, though lowers the exposure to the brain, but they may increase the risk of exposure to the other body parts, mainly the gonads¹⁸. None of the girls were aware of the real consequences and harmful effects involved with the exposure to the electromagnetic field radiations. The prevalence of infertility among urban population of Central India is 8.9%¹⁹. This is alarming as one in every ten women is infertile. In a study where rats were exposed to Electromagnetic field radiations, there was a significant decrease in the number of follicles in the ovaries²⁰. The exposure which seems to have an effect on alteration of onset of puberty, if continued can affect the reproductive years of the women.

Few of the limitations of the study were data on extent of signal coverage (2G/3G/4G) of the mobile phone used was not covered in the study as most of the young girls, especially in the rural areas were unaware of such terminologies. Similarly, the radiation exposure was not measured quantitatively as this study was mainly based on a Questionnaire.

Conclusion

Difference in the extent of exposure to radiofrequency radiations might be one of the causes of early onset of menarche in urban population. Though there are hardly any studies to say that the Radiofrequency radiations cause direct damage to the hypothalamo-pituitary axis, still the hypothesis for them to have an impact on the onset of menarche in young girls cannot be ruled out as we are in the era of radiofrequency emissions all around the world. Education on awareness and restrictions for mobile phone usage among younger generation deems necessary.



Acknowledgements: Nil

Conflict of interest: Nil

References

1. Pathak PK, Tripathi N, Subramanian SV. Secular trends in menarcheal age in India-evidence from the Indian human development survey. *PLoS One*. 2014;9(11):e111027. Published 2014 Nov 4. doi:10.1371/journal.pone.0111027
2. Karapanou, Olga, and Anastasios Papadimitriou. "Determinants of menarche." *Reproductive biology and endocrinology : RB&E* vol. 8 115. 30 Sep. 2010, doi:10.1186/1477-7827-8-115
3. Rees M. The age of menarche. *ORGYN*. 1995;(4):2-4.
4. Subhash B Thakre, Sushama S Thakre, Suresh Ughade and Amol D. Urban-rural Differences in Menstrual Problems and Practices of Girl Students in Nagpur, India. *Indian Pediatr* 2012;49: 733-736
5. Singh, Monika & Rajoura, OmPrakash & Honnakamble, Raghavendra Appasaheb. (2019). Menstrual patterns and problems in association with body mass index among adolescent school girls. *Journal of Family Medicine and Primary Care*. 8. 2855. 10.4103/jfmpc.jfmpc_474_19.
6. Tarannum F, Khalique N, Eram U. A community based study on age of menarche among adolescent girls in Aligarh. *Int J Community Med Public Health* 2018;5:395-400.
7. Naeem, Zahid. "Health risks associated with mobile phones use." *International journal of health sciences* vol. 8,4 (2014): V-VI.
8. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157-63.
9. Omidvar S, Amiri FN, Bakhtiari A, Begum K. A study on menstruation of Indian adolescent girls in an urban area of South India. *J Family Med Prim Care*. 2018;7(4):698-702. doi:10.4103/jfmpc.jfmpc_258_17
10. Rajesh Khadgawat, RK Marwaha, ^SNeena Mehan, ^{*}Vineet Surana, ^{*}Aashima Dabas, [#]V Sreenivas, ^{*}M Ashraf Gaine and ^{*}Nandita Gupta Age of Onset of Puberty in Apparently Healthy School Girls from Northern India. *Indian Pediatr* 2016;53: 383-387
11. Watkins, Jerry & Kitner, Kathi & Mehta, Dina. (2012). Mobile and smartphone use in urban and rural India. *Continuum-journal of Media & Cultural Studies - CONTINUUM-J MEDIA CULT STUD*. 26. 685-697. 10.1080/10304312.2012.706458.
12. International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.
13. Tumkaya, L., Kalkan, Y., Bas, O., & Yilmaz, A. (2016). Mobile phone radiation during pubertal development has no effect on testicular histology in rats. *Toxicology and Industrial Health*, 32(2), 328-336. <https://doi.org/10.1177/0748233713500820>
14. Gul, A., Çelebi, H. & Uğraş, S. The effects of microwave emitted by cellular phones on ovarian follicles in rats. *Arch Gynecol Obstet* 280, 729-733 (2009). <https://doi.org/10.1007/s00404-009-0972-9>
15. Alchalabi A.S.H., Rahim H., Aklilu E., Al-Sultan I.I., Aziz A.R., Malek M.F., Ronald S.H., Khan M.A. Histopathological changes associated with oxidative stress induced by electromagnetic waves in rats' ovarian and uterine tissues. (2016) *Asian Pacific Journal of Reproduction*, 5 (4), pp. 301-310.

16. He J-w, Tu Z-h, Xiao L, Su T, Tang Y-x (2020) Effect of restricting bedtime mobile phone use on sleep, arousal, mood, and working memory: A randomized pilot trial. PLoS ONE 15(2): e0228756. <https://doi.org/10.1371/journal.pone.0228756>
17. Hardell L. Effects of Mobile Phones on Children's and Adolescents' Health: A Commentary. Child Dev. 2018 Jan;89(1):137-140. doi: 10.1111/cdev.12831. Epub 2017 May 15.
18. Kuhn S, Cabot E, Christ A, Capstick M, Kuster N. Assessment of the radio-frequency electromagnetic fields induced in the human body from mobile phones used with hands-free kits. Phys Med Biol. 2009;54:5493–5508. doi: 10.1088/0031-9155/54/18/010.
19. Katole A, Saoji AV. Prevalence of primary infertility and its associated risk factors in urban population of central India: A community-based cross-sectional study. Indian J Community Med 2019;44:337-41
20. Bakacak M., Bostanci M.S., Attar R., Yildirim O.K., Yildirim G., Bakacak Z., Sayar H., Han A. The effects of electromagnetic fields on the number of ovarian primordial follicles: An experimental study. Kaohsiung Journal of Medical Sciences, 2015;31 (6) , pp. 287-292.

Title of the study: “A cross-sectional study on the age of onset of puberty in females among rural and urban areas of Kanchipuram district in the past 5 years”

Principal Investigator: Ms.Akshaya, 3rd MBBS, Shri Sathya Sai Medical College and Research Institute, Kanchipuram dt.

QUESTIONNAIRE:

Participant's ID: _____ Date: _____

Age: _____

Age of menarche: Year of attainment of menarche: _____

Regular exercise: Yes/No Ht (m) : Wt(Kg): BMI: _____

1. Do you use cell phone? Yes / No

2. Do you own the phone? Yes / No

3. How long have you been using cell phone? _____ months / years

4. How many in your house use cell phone? _____

5. How many hours per day are you using cell phone? 1. Day: 1 hr/ 2 hrs / 3 hrs/ > 3hrs

2. Night: 1 hr/ 2 hrs / 3 hrs/ >3 hrs

6. How much time you use cell phone with lights switched off during night? ____ min / hours

7. For what purpose you mostly use cell phone? Tick whichever is more appropriate.

Talking / Messaging / Playing games / Browsing/ Listening to songs

8. How long do you play games in your cell phone? _____ min / hours

9. Do you use hands free devices while talking in cell phone? If yes, how frequently?

A. Always B. Sometimes C. Never

10. Which ear you usually use while talking in cell phone? Right / Left

11. Are you aware of the amount of radiation emitted from your cell phone?

12. Are you aware of the health hazards associated with cell phone usage?

If Yes, List some. _____

