

## Early Puberty and its Effect on Height in Young Saudi Females: A Cross-Sectional Study

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### Abstract

**Background:** Linear growth in females is influenced by many factors, one of them is puberty. Due to the worldwide downward trend in age of menarche, early puberty could be one of the causative factors of short stature.

**Objective:** The study was aimed at finding out the effect of early puberty on final height and to detect deviation from the target height in young females. The age group selected for the study, ranges from 6-14 years, living in Jeddah, Saudi Arabia.

**Methods:** This study was carried out in Jeddah for the complete month of July 2014. For the conduction of this study, a cross sectional study design was used. The total sample size was 586 young females selected from different areas in Jeddah. A manual height measuring tape and board was used to measure the height to the nearest value of 0.5 cm. Pubertal staging was done using the Tanner stage and the relevant data and information was gathered and assembled by the help of a questionnaire. For the analysis of data in this study, Multiple Linear Regression and Pearson's Correlation Coefficient were used.

**Results:** Mean of child's final height of 149.4 cm +/- 9.5, in comparison to the mean of their target height of 157.8 +/- 6.4, shows an 8.4 cm difference. Moreover, the correlation coefficient analysis showed a significant association between child's height in cm and age of menarche for child with ( $p$ -value = 0.001) and ( $r$ ) = 0.349. This indicates a positive relation between the two variables.

**Conclusion:** The menarcheal age and height are significantly related; the early onset of the signs of puberty or menarche is associated with a shorter height than the target height.

**Keywords:** Early puberty; Final height; Young females; Saudi Arabia

### Introduction

Height or stature is one of the most important standards in the assessment of child's growth pattern in pediatric clinics [1]. Linear growth in girls during childhood and adolescence time is influenced by many factors, one of them is puberty. Puberty is a natural process of human development; it is a period of hormonal changes that induces physical growth and sexual maturity [2]. The first and the foremost indications of puberty are the breast enlargement, which starts with the inception of puberty. The second is the onset of menstruation or menarche which occurs 1 or 1½ years after the initiation. Early onset of menarche lead to stunted growth and the height remains shortened than the targeted adult height [3].

Puberty is one of the main pivotal stages for the growth and development of an individual. During puberty many transitional phases take place, which consist of a succession of many biological processes. The developmental changes during puberty affect the final height of an adult. According to different studies the menarcheal age and the beginning of puberty can affect the final height of an adult [4].

Puberty in girls usually starts between the age group of 8 and 14. The onset of puberty could vary depending upon different factors including the genetic factors, family structure, environmental and socio economical factors, general health and BMI. These factors influence the initiation of puberty throughout the world. Menstruation or Menarcheal onset indicates the appearance of puberty in girls. The beginning of menarche is an event of significant importance since it marks the functional ability of pituitary management of the ovarian cycle. In current times, it has been concluded by several studies that the onset of menarche is starting at an earlier age in comparison to earlier times [5].

According to female physiology, after puberty there is an acceleration of endochondral ossification in bones, so girls tends to gain maximum 5-7 cm of height afterwards [6]. The average of their growth spurts last 24-36 months [7]. For the past years there have been some concerns regarding the early onset of puberty, that have been brought forward to the health providers and pediatric endocrinologist. An observable decline has been noted all across the globe regarding the age at which the puberty initiates in the female population. It has been noted that the new generation of girls are having their first signs

of puberty at an earlier age than before and this is one of the main causes of shorter heights in girls [2,8,9].

From the mid-19th century till now menarcheal age was reported to be dropping more and more leading to the puberty beginning at an earlier age [10]. This worldwide downward trend in the age of menarche could be one of the chief causative factors of short stature. There is little or no data available regarding the height and mean age of menarche in Saudi girls. No research works or studies have been carried out in Saudi Arabia to explore this phenomenon. Considering this, we carried out this study in order to establish and determine the effect of early puberty in young females on their final height. Their final heights were compared to their target heights, according to WHO height-for-age reference. It was also observed and noted that, how well they match with or diverges from their targeted heights [11].

## Material and Methods

### Data collection methods

A cross-sectional-questionnaire based study design was used to execute this study. Female subjects who had experienced either menarche or any signs of puberty were selected for the study. The selected age for the females, ranged from 6 to 14 years. In this study, data was collected using a questionnaire that comprised of questions related to demographic information and physical examination. The questionnaire focused on the age, menarcheal age, measuring height and pubertal staging.

Random participants were selected from the campaigns which were carried out at different shopping malls in Jeddah, Saudi Arabia. The campaigns were developed and maintained by some medical students. The questionnaires were distributed to the selected participants and were collected over the course of one month (July, 2014). Physical examination was also performed which was focused on measuring the female's height and determining their pubertal stage. Also, relevant data and information was collected, like exposure to Xenoestrogen products, adequate amount of nutrition, history of early puberty in the family and awareness. For the purpose of this research study, the segments involving the examination included a manual height measuring tape and board. These were used to measure the height to the closest value of 0.5 cm. Pubertal staging was done using Tanner stage and the menarcheal age was recorded by self or parental report.

There were some exclusion criteria as well for the conduction of this study. Those having diseases such as endocrine or hormone-related disorders, immunodeficiency, renal disturbances, neurological disorders, muscular disorders and respiratory illnesses were not allowed to participate in the study. Moreover, girls with insufficient data and information which was required to be filled in the questionnaire were also excluded from the study. Participants with incomplete questionnaires were also eliminated from the study group. All the participants were asked to sign an informed written consent to participate in the study. Since the participants were young girls, the consent of their parents was also taken. All the personal information, contact details and data was kept confidential. Only the researchers in the study had access to that data. The identity of the participants was also kept confidential. The information and data collected through questionnaire was only utilized for the study purpose and no one other than the researchers was allowed to access it.

## Statistical analysis

Statistical data analysis in this paper was done by finding the correlation coefficient and testing the significance of the relationship between each of the two variables. This was done by using Pearson's Correlation Coefficient method, after we assumed that the data followed normal distribution dependent on the large sample size (n=568). SPSS 16 was used for statistical purposes and results were considered significant with P-value (less than) 0.01 and sometimes P-value (less than) 0.05. We tested the relation between the child's height with other variables (target height and age of menarche) to check if there is any significant association between them. Pearson's Correlation Constant was also used to see the type of these relations and to check whether the relations were positive or negative. In our study we have defined an early breast development before the age of 8, early pubic hair appearance before age 9 and early menarche before age of 10.

## Results

The total number of participants were (n=586) and 91 of them reached their final height (had menarche). The mean age calculated was 10.6 +/- 2 years and mean age of menarche was 11.5 +/- 1.5 years. Furthermore, mean age of breast development was 9.1 +/- 1.6 m and the mean age of pubic hair growth is 9.8 +/- 1.6 (Table 1). The correlation coefficient analysis showed a significant association between child's height in cm and age of menarche with (p-value=0.0001) and (r)=0.418, which indicates a positive relation between the two variables.

Years	Min	Max	Mean	Std. Deviation
Age	6	17	10.65	2.053
Age of menarche	8	16	11.57	1.484
Age of 1st stage breast	6	15	9.11	1.561
Age of 1st stage pubic hair	6	15	9.79	1.566

**Table 1:** Mean and SD of age, age at menarche, age of 1st stage breast development and age of 1st stage pubic hair growth in the Participants (Jeddah, Saudi Arabia 2014).

One of the most initial signs of puberty in females is the development of breasts. Considering this, we tested it using the multiple linear regression as a depending variable. It showed a positive significant relation with the child's height (p-value=.000), target height (p-value=.002) and mother's height (p-value=.000). All were independent variables. This supports the previous analysis, and indicates that if the age of breast development increases, the child's height and target height will increase as well.

	N	Min	Max	Mean	Std. Deviation
Child height (cm)	91	116	167	149.35	9.46294
Target height (cm)	77	139	172	157.86	6.42920

**Table 2:** Mean and SD of children's height and Target height in the Participants (Jeddah, Saudi Arabia 2014).

The mean of child's final height in cm is 149.4 cm +/- 9.5 and the mean of target height in cm is 157.8 cm +/- 6.4. This shows a

difference of 8.4 cm in height, added to the target height. There is a significant difference with ( $p$ -value=0.009) and ( $r$ )=0.294 (Table 2). Moreover, the mean of mother's height in cm is 158.6 cm +/- 6.8, and the mean of child's final height in cm is 149.4 cm +/- 9.5. This shows 9.18 cm different between the two means. However, there is no significant relation between the child's final height in cm and mother's height ( $p$ -value=0.185) (Table 3).

	N	Min	Max	Mean	Std. Deviation
Age of menarche for mothers(years)	74	9	16	12.97	1.712
Mother height (cm)	77	135	178	158.58	6.848
Child height (cm)	91	116	167	149.35	9.46294

**Table 3:** Mean and SD of Age of menarche for the mothers, mother's height and children's height in the Participants (Jeddah, Saudi Arabia 2014).

## Discussion

Puberty is a dynamic stage of development [12]. It affects a child's growth and development in many ways. The greatest affect is on the child's growth pattern, especially linear growth. It is believed that, early puberty accelerates bone maturity and induces early closure of growth plates and eventually reduces the total adult height [13,14].

In this study, females who experienced early puberty or started their menstruation at an earlier age appeared to be shorter than their target height by 8.4 cm. This showed that a positive relationship exists between the age at which menarche starts and the height of a child. This finding of the study supports the result, which states, that a decline in the age of menarche causes decrease or decline in final height.

In Literature, alot earlier studies suggest the same results as that of our findings. A study conducted in 2002 on the effect of early puberty in the children also concluded the similar results, which stated that advanced puberty declines and halts the potential growth by approximately 5 cm in girls [15]. Moreover, a cohort study was carried out in 2005 by Onland-Moret et al. [16] to study the relation between the menarcheal age and adult height. They concluded that women with a late menarcheal onset age were taller in height as compared to the women who had an early menarcheal age. They concluded that a one year delay in the menarcheal age led to increase in height by at least 0.41 cm. They found these similar results in women across France, United Kingdom, Greece and Sweden.

In addition to the above studies, another research was conducted on early puberty and decreased final height in girls with less birth weight. The study stated that because of low weight at time of birth in girls, they had an earlier menarcheal onset and that in turn lead to decreased final height [17]. An Iranian study in 2008 investigated the relationship that exists between the age of menstruation and height, by carrying out a comparative study between university girls and intermediate school girls. It stated that girls with early menarche have a shorter adult height [18]. Furthermore, in 2010, another study conducted on Korean girls showed that females with early menarcheal age were taller in early adolescence. But in comparison to those girls who matured late, they had a shorter height in the early adulthood [19].

Similarly, more recent studies in 2013 concluded the same results as that of our study. One of these studies that were held in Seoul, South Korea concluded that a positive relation exists between height of a girl and the inception of early menarche. Another study carried out in China also stated the similar findings that the early starting of menarche is directly related to decline in height in girls. A Study performed in South Carolina illustrated that menarcheal start at an early age; growth spurt and early breast development all lead to short height in children [20-22].

In contrast to these results, a study conducted in 2011 on Thai girls showed different results than our finding. The researchers concluded that girls with early menarcheal beginning attained almost similar target height according to their genetic capability [17]. Furthermore, two studies in Iran that were published in 2012 and 2013, both declared that no significant relationship exists between the increase and decrease of height in relation to pubertal stage [23,24]. In 2014, a southern Thailand study said that earlier onset of puberty had no effect on final adult height of a girl [25]. In the same year an Indonesian study stated that the association between height and onset of menarche is very meager and considered non-significant [26].

There is a worldwide downward secular trend which shows that the inception of puberty affects the height in many countries [27]. But the previous conflict in studies has opened many new possibilities for research in this regard. Early puberty may not be the only causative factor for short stature but still studies suggest that it is one of the most important factors leading to reduced height in girls. More investigation in this field should be done especially in the earth equator and gulf regions.

## Conclusions

Puberty is one of the most crucial stages of development in a child's life. Puberty brings dynamic developmental changes in the appearance and growth of a child. The puberty is the transitional phase from adolescence to adulthood. Puberty have huge affect on the growth of a child, specifically the linear growth. It has been observed that onset of puberty increases the mass of body and bone maturation. Moreover, the growth plates shut off earlier because of puberty and in turn lead to declined height in adults. In the last few decades, rising concerns regarding early puberty and reduced adult height have been brought forward to the pediatricians. A new trend has also been observed all across the world, that the average age for the onset of puberty in the females has decreased.

It is noted that the girls are now depicting their first signs of puberty at an earlier age. This lead to early beginning of menarche and ultimately to reduced adult height and stature. From this study it can concluded that early puberty or menarche have a directly proportional relationship with decrease in height in children. The study proves that early puberty causes an 8.4 cm height deviation from the target height, and there is a positive relation between height and age of menarche. Careful and early assessments of females with early puberty should be one of the major priorities in pediatric clinic, because it allows for early intervention and can improve the final height. Furthermore, researchers should focus on the causes of early puberty since it has become an increased phenomenon in the population.

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