

Effect of Age at Menarche on The Risk of Occurrence of Cardiovascular Adversities Among A Tribal North Indian Population

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Abstract

Background: The beginning of menarche, an important phenomenon of a female's life and is associated with the development of various physiological and metabolic changes. Innumerable studies have shown a positive association of early menarche with development of cardio metabolic risk factors. WHO has also re-established that till 2015 the highest number of mortality and morbidity in India will be due to CVDs. The present study deals with understanding the association, if any, between the age at menarche and an increase in cardiovascular adversities among the Gaddis of Himachal Pradesh and further establishing that which group (early, normal or late menarche) is a better determinant of the same.

Methods: This study is cross sectional household based study, including 317 ever married Gaddi women aged 25-70 years from higher altitude Himachal Pradesh's two districts viz. Chamba and Kangra.. Data pertaining to demographic, reproductive, anthropometric, physiological and biochemical variables were collected from these women. They were further divided into three categories based on their age at menarche viz, early, normal and late and characterized for cardio-metabolic risk factors. Statistical analysis was done using SPSS version 16.0.

Results: The mean age at menarche of the present population was observed to be 15.23 years, which is towards the higher side of the normal range. Also the number of females falling under the late menarcheal group is higher and closer to 75%. BMI and abdominal obesity are found to be significantly increased in females with early menarche. The early menarcheal group also has a significantly higher percentage of hyperglycemic individuals. Both hypertensives and pre hypertensives are increased in the late menarcheal group wherein pre hypertensives are significantly increased. The mean values of other lipid parameters (TC, TG, LDL, VLDL, non HDL-C) tend to relatively decrease in both early and late menarcheal groups.

Conclusion: Age at menarche can be considered as the potential determinant of cardiovascular adversities for the present population, particularly for the determination of abdominal obesity and general obesity. An increased number of females falling under late menarcheal group having an elevated blood pressure in spite of having reduced SBP and DBP further indicates that late age at menarche has a protective effect for the prevention from blood pressure related adversities. This can be further used by policy makers for development of interventional strategies for prevention of cardiovascular risk.

Keywords: Menarche; Cardiovascular Adversities; Altitude; Lipoprotein

1. Introduction

The beginning of menarche (menstrual cycle), an important phenomenon of a female's life and is associated with the development of various physiological and metabolic changes. This phenomenon has an impact not only on the reproductive health but also on the general health status of women in the future. The difference in the time of attaining puberty has been attributed to the socioeconomic status of the populations with the females who belong to the low privileged group having a delayed menarche when compared to the privileged class [1]. It is also established that there is an effect of climate on the onset of menstruation. The hot climate aggravates the onset and cold climate and hypoxia delays the same [2]. Further a delay in age at menarche is also attributed to cold climate, higher altitude and tribal population. A secular trend of the decreasing menarcheal age is been observed in the western countries as well as in developing countries like India [3].

Age at Menarche has been reported to be associated with the development of vascular disease and various other health complications. Many studies have shown early menarche as the risk for dyslipidemia, hypertension, hyperglycemia [4]. Also certain other diseases are found to be associated with late age at menarche [5].

Studies have been conducted on the age at menarche of various ethnic groups, including Gaddis, of India residing on a higher altitude and also otherwise. The present study deals with understanding the association if any between the age at menarche and increase in cardiovascular adversities among the Gaddis of Himachal Pradesh and further establishing that which group (early, normal or late menarche) is a better determinant of the same.

2. Material & Methods

2.1 Subjects

This is a cross sectional household based study conducted on ever married females of Gaddi tribe which is an endogenous group, from year 2011-2013. A total of 317 women aged 25-70 years were selected. The women were enrolled from two districts of Himachal Pradesh, North India viz. Chamba and Kangra. (The altitude of the study area was 900m-3000m considered as higher altitude [6]). The study was approved by the ethical committee of Department of Anthropology, University of Delhi. Written informed consents were obtained from the participants prior to the participation in the study.

2.2 Collection of Data

Retrospective data of reproductive history and prospective data of tobacco use, marital status and family planning measures were obtained through the structured interview schedule. Anthropometric data such as height, weight, waist circumference along with blood pressure measurement were collected from all the subjects. Blood pressure was taken twice in the right arm in sitting position using standard sphygmomanometer and stethoscope, with a time gap of a minimum 10-15 minutes of first reading and second reading was used for the analysis to avoid false reading due to increased palpitations.

Overnight fasting 5 ml intravenous blood sample was taken from the participants to perform the lipid profiling. The serum lipids and fasting glucose were tested for at the Red cross lab, Chamba and Nurpur lab, Kangra, Himachal Pradesh.

MetS and its components were identified by NCEP ATPIII criteria [7]. Any three of the five major listed risk factors are:

- a) Waist circumference ≥ 88 cm in females
- b) High FBG ≥ 110 mg/dl
- c) High TG ≥ 150 mg/dl
- d) High BP ≥ 130 or ≥ 85 mmHg
- e) Low HDL < 50 mg/dl

Among the non-traditional risk factors, non-High Density Lipoprotein cholesterol (non-HDL-C), was calculated by subtracting HDL-C from total cholesterol [8] and Hypertriglyceridemic waist (HTGW) was derived as per the National Health and Nutrition Survey [9].

2.3 Statistical Analysis

The mean \pm SD and frequency of variables analysed with descriptive statistics. ANOVA test was employed to see the differences within mean levels of studied variables between different group of parity and gravidity. All these analysis were done using SPSS version 16.0.

3. Results

The mean age at menarche of the present tribal population was found to be 15.23 years.

Age at menarche	No of women	%
12	10	3
13	9	2.7
14	58	17.5
15	127	38.4
16	84	25.4
17	43	13

Table 1: Distribution of females on the basis of age at menarche

Distribution of women with respect to their age at menarche reveals that majority of the recruited subjects (approximately 75%) are found to be aged 14 years and above. (Table 1)

	Normal menarche (14-15.5 years)	Early menarche (9-13 years)	Late menarche (16-19 years)	P1 (Normal vs Early)	P2 (Normal vs late)	P3 (Early vs late)
	158 (54.48%)	18 (6.2%)	114 (39.31%)			
Present age	41.54	38.11	40.86	0.172	0.588	0.270
Literates (%)	61(40.13%)	12 (75%)	41 (38.31%)	0.007	0.769	0.006
Agriculture+other works(%)	29 (20.71%)	2 (14.28%)	13 (12.38%)	0.237	0.417	0.324
Smokers (%)	7(4.79%)	0	5 (4.71%)	0.342	0.977	0.347
Age at 1st conception	20.53	20.86	21.08	0.611	0.101	0.750
No. of pregnancies	3.79	3.5	3.75	0.461	0.680	0.587

Table 2: Baseline characteristics of population by menarche status

The three groups viz. early, late and normal menarche are not found to be differing significantly with respect to age at first conception, smoking, number of pregnancies and occupation. However women with early menarche are found to be significantly literate as compared to those with normal and late menarche. (Table 2)

	Normal menarche	Early menarche	Late menarche	P1 (Normal vs. early)	P2 (Normal vs. late)	P3 (early vs. late)
General obesity						
BMI	21.51±4.05	24.13±4.78	21.35±3.81	0.012	0.733	0.006
WC (≥80cm)	72.13±16.94	80.19±18.72	72.49±16.10	0.060	0.898	0.064
WHR (<0.8)	0.80±0.16	0.859±0.172	0.81±0.15	0.180	0.870	0.228
FBG	86.10± 15.512	85.06± 19.416	87.39±22.976	0.792	0.580	0.683
Dyslipidemia						
TC	173.47±28.52	172.17±23.129	172.65±23.33	0.852	0.801	0.935
TG	134.72±30.75	129.89±35.22	130.53±36.55	0.535	0.306	0.945
HDL	48.48±5.49	49.11±5.86	49.06±6.45	0.650	0.428	0.976
LDL	98.71±25.92	97.08±23.59	97.59±20.367	0.798	0.700	0.923
VLDL	26.95±6.15	25.98±7.045	26.14±7.318	0.534	0.327	0.929
SBP	123.96±13.06	124.11±8.554	123.13±12.26	0.962	0.598	0.745
DBP	82.59±9.49	83.56±6.119	81.33±7.303	0.674	0.238	0.222
Non HDL C	124.98± 28.529	123.06 ±24.785	123.59± 23.754	0.784	0.670	0.812

Table 3: Mean levels of Cardio metabolic risk factors

Abdominal obesity in the form of mean values of WC and WHR are found to be significantly high in women falling under the early menarcheal group whereas no such difference was observed between early and late age at menarche when traditional (TC, TG, HDL, LDL, VLDL, SBP, DBP) and non-traditional (non HDL C) risk factors were considered (Table 3).

	Normal menarche (14-15.5 years)	Early menarche (9-13 years)	Late menarche (16-19 years)	P1 (Normal vs Early)	P2 (Normal vs late)	P3 (Early vs late)
General obesity (BMI)						
Underweight	25 (15.8%)	1 (5.6%)	24 (21.21%)	0.59 ^a	0.30	0.10 ^c
Overweight	29 (18.4%)	1 (5.6%)	17 (15%)	0.48 ^b	0.67	0.61 ^d
Obese	29 (18.4%)	8 (44.4%)	21 (18.6%)	0.07	0.85	0.10
Abdominal obesity						
Waist	58 (36.7%)	10 (55.6%)	43 (38.1%)	0.120	0.821	0.160

circumference (≥80cm)						
WHR (<0.8)	96 (60.8%)	13 (72.2%)	74 (65.5%)	0.343	0.427	0.574
Htn	34 (21.5%)	6 (33.3%)	16 (36.36%)	0.118	0.308	0.042
Dyslipidemia						
Hyperglycemia	9 (5.69%)	4 (22.2%)	13 (11.4%)	0.011	0.08	0.369
Abn. TC	34 (21.5%)	3 (16.7%)	16 (14%)	0.632	0.116	0.768
Abn. TG	52 (32.9%)	4 (22.4%)	23 (20.2%)	0.356	0.020	0.702
Abn. HDL	79 (50%)	10 (55.6%)	53 (46.5%)	0.655	0.568	0.571
Abn. LDL	19 (12%)	2 (11.1%)	7 (6.1%)	0.910	0.103	0.437
Abn. VLDL	3 (1.89%)	1 (5.6%)	4 (3.5%)	0.324	0.408	0.672
Nontraditional risk factors						
Prehypertension	84 (53.2%)	10 (55.6%)	69 (61.1%)	0.264	0.588	0.372
Non HDL-C	55 (34.81%)	7 (38.88%)	41 (35.96%)	0.731	0.844	0.811
MetS	41 (25.9%)	6 (33.3%)	18 (15.8%)	0.604	0.04	0.095
HTGW	9(5.69%)	1(5.55%)	4 (3.50%)	0.981	0.404	0.672

Table 4: Distribution of abnormal cardio metabolic risk factors by menarche status

Note: ^{a b c d} Yates correction applied

Significantly higher number of individuals with hyperglycemia is found in early menarcheal group. Further individuals with abnormal TG levels were found to be relatively low among early menarcheal group and significantly low among late menarcheal groups when compared to women with normal menarche. However no such difference was observed between groups for general and abdominal obesity. Non HDL C, MetS and HTGW are higher in early menarche group though the difference is not statistically significant except for MetS whereas hypertensive and pre hypertensive are higher in women with late menarche as compared to normal menarche. (Table 4)

4. Discussion

The mean menarcheal age in Indian women varies from 12 years [10, 11] to 15.28 years [12]. Further, the tribal Indian women have their menarcheal ages ranging from 12.8 years [13] to 15 years [14]. The age at menarche (15.23 years) in the present population was found to be towards the higher side of the range for both general Indian females and tribal females. When taking into consideration higher altitude rural and tribal populations, the age at menarche ranges from 15.1 years [15] to 18.2 years [15]. This varied range can be attributed to different altitudes. As can be seen among migratory Rang Bhotias residing at altitude of 4000-12000 feet the age at menarche is 16.0 years, at similar altitude the Nepal Sherpas (highlanders) have age at menarche 18.2 years [16]. With the decrease in altitude the age at menarche seem to decrease, Rang bhotias (7000-9000 feet) have age at menarche 15.6 years and

Johari Bhotias (3000-5000 feet) have age at menarche 15.1 years [15]. Thus the age at menarche of the present population is in concordance with the range for those residing at higher altitude but towards the lower side of the range [16-21]. This is further indicative that the age at menarche varies not only with respect to the socio-economic conditions and nutritional patterns but is also affected by the changing altitudes. In the current study also the altitude is the major contributing factor towards increased age at menarche from normal Indian women and tribal women.

Further similar trend is also observed in the distribution, wherein an increased number of women (approx. 75%) with late age at menarche and very few with early menarche are seen. The delayed age at menarche can be attributed to their geographical location. Higher altitude populations face the adversities of their geographical location through the rough terrain which leads to both physical [23] and psychological stress [22], hypoxia [15,24], cold climate [25-27] and unfavorable dietary pattern [28]. Clegg [29] further emphasized that though the highland areas share similar low atmospheric pressure but different areas have varied intensities of rough terrains and climatic conditions which contribute to the individual behavior of a particular zone.

Gaddi women depend on the available plants and animals for diet, which has higher content of carbohydrates. A higher intake of carbohydrates delays the age at menarche [29, 30]. Growth and development including sexual maturity are conditions which require high energy intake. Growth arrest and delayed sexual maturity is observed in females if these high energy needs are not satisfied [31]. This may be a possible explanation for delayed maturity. Also physical activity is considered an important contributor to the delayed age at menarche. There are studies which indicate delay in the age of menarche because of higher physical activity, inconsistent eating behavior and imbalance in energy intake and output [32,34]. The girls at higher altitude perform a greater amount of work as compared to those who live in plains. This strenuous work could have led to the delay in the release of hormones responsible for sexual maturity [35]. Further Frisancho [36], reported slow growth and delayed development prior to maturity among Himalayan high altitude residents.

When major confounders were considered, early menarche was found to be having significantly increased literacy indicating that literacy is an important variable leading to awareness among the studied women and thus causing the early onset of menarche.

The present study deals with the cardiovascular risk factors like abnormal anthropometric variables, dyslipidemia, hypertension and metabolic syndrome. Some authors have suggested that the risk of cardiovascular diseases can be “programmed” in early life through the persistence of endocrine, physiological, and metabolic adaptations made in the face of under nutrition [37, 38]. The argument that inadequate diet in early life may result in increased sensitivity to lifestyle related risk factors is of some importance to the unfolding of cardiovascular disease epidemic in low income and middle income countries like India, where under nutrition and urbanization exists simultaneously [39]. Rosenberg et al. [50] has demonstrated that women with early age at menarche have greater risk for the development of CVDs than those with later age at menarche. Early menarche is found to increase waist circumference, blood pressure, diabetes, triglycerides and metabolic syndrome [40-43].

In the present population, women with abdominal obesity, general obesity are relatively higher in females with early menarche, though the difference is not statistically significant except for hyperglycemia, which is significantly higher in women with early menarche. This is in concordance with other studies [42-44] suggesting an impaired glucose homeostasis leads to its early occurrence with all the potential factors controlled. Also as the population is a majorly carbohydrate dependent population, hence the glucose metabolism pathway is more aggravated in the present population as compared to the lipid metabolism pathway. Studies indicate that in women higher energy expenditures leads to slightly higher WHR [45]. The later age at menarche is further found to significantly increase the risk for incidence of hypertension as is found in other studies as well [46].

Further, significantly reduced TG is observed in females with late menarche as compared to those with early and normal menarcheal women. Age at menarche has mild inverse effects on changes in TG levels [49]. A study on rat model by Siques et.al, [47] has shown that elevated TG level was associated with hypoxia at altitudes, but the reduced level in late menarcheal women in the present population can be attributed to their protective phenomenon from cardiovascular adversities at this altitude. Thus, it can be concluded that late age at menarche poses lower risk for dyslipidemia, probably through their imbalanced nutrition.

An interesting finding of the study is that an increased number of individuals are found to have hypertension and pre hypertension in late menarcheal women, wherein the increase is significant in hypertensives. Also mean levels of SBP and DBP are observed to be lowest in the females with late age at menarche indicating that later age at menarche is an adaptive strategy in the present population. Thus the populations in the late menarcheal group who are protected from dyslipidemia due to either under nutrition or any other speculated pathway, are also adaptive to the elevated blood pressure. This can be further substantiated by the fact that higher altitude individuals have a denser capillary network, which helps in increased oxygen delivery and perfusion [48], and hence increased blood pressure.

The increased literacy is a welcoming trend in the present population with an increase in the intake of good nutrition and thereby prevention from many lifestyle disorders. It is more importantly the niche of the population along with the state of epidemiological transitioning it is into, that plays a major role in the occurrence of a particular battery of risk factors. We need to further contextualize our observations and consider what public health benefits may stem out if this intervention of screening the general population on the basis of menarcheal age was translated into primary prevention of disease burden.

Limitation of the Study

Sample size of the studied population was very small because of the transhumant nature of the tribe and also funding constraint. Further studies need to be done on population of different ethnicities with a larger sample size at similar altitude, to validate the results.

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