

# Age at menarche and risk of abortion: Further evidence

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## Summary

**Objectives:** To study the relationship between the age of menarche and risk of abortion.

**Method:** Correspondence analysis and application of life table survival analysis were used to study the association between the age at menarche and the outcome of pregnancy on data collected from 329 women.

**Results:** Both analyses showed increased risk of abortion with increasing age of menarche. Risk of abortion associated with early age at menarche (9-11 years) was 1.2% and it increased to 66.7% when the menarche age was 15 years or above.

**Conclusion:** Early age at menarche is associated with lower risk of abortion.

**Key words:** Menarche; Abortion; Survival analysis.

## Introduction

The age of menarche “appearance of first menstruation” defines a particular stage of female maturation. It is an indicator of female physiological development and health and, a predictor of fecundity [1, 2].

Several studies have reported that the age of menarche may relate to the subsequent reproductive performance including risk for abortion with controversial results [2-5].

The objective of this study was to further investigate the association between age at menarche and the risk of abortion. We used correspondence analysis and life table survival analysis to investigate this association.

## Materials

The study was carried out at King Khaled University Hospital (KKUH), Riyadh, Saudi Arabia in the year 2001 by interviewing all adult females in the waiting area of the primary care clinic every morning for three months. Data was collected about their age, age at menarche and number of abortions.

## Statistical Method

The analysis was carried out only on the women who had had at least one abortion. The total pregnancies for each mother were computed by adding parity and abortions. Then, the risk of abortion by each mother was computed by dividing the number of abortions by total pregnancies. To investigate the association between age at menarche and risk of abortion, the abortion rates and age at menarche were arbitrarily grouped as shown in Table 1. Because of many small expected frequencies, we found it inappropriate to apply the chi-square test to the data in Table 1 to test for the statistical significance of the association. Instead, we used correspondence analysis to show the association between age at menarche and the risk of abortion. Program CA from the BMDP Statistical Package was used.

Quite briefly, correspondence analysis (CA) involves transforming data arranged in the form of a contingency table, as in Table 1, into a co-ordinate system that facilitates the drawing of a graph such that categories for row (x-axis) and column (y-axis) profiles are represented by points on the graph. The four quadrants formed by the intersection of the x-axis and the y-axis are used for guidance when interpreting the associations between row and column categories. Row and column categories appearing in the same quadrant indicate a positive association, and when they appear in opposite quadrants, it indicates a negative association. If the graph is presented on one axis, the association is judged by proximity of row and column categories. How well the information in the original contingency table is represented on the CA graph is judged by an index called “total inertia”, which takes on a maximum value of 100%. This value is usually printed at the bottom of the CA graph for two axes, or for one major axis. Ideally, good graphical representation requires that the graph represents at least 90% of total inertia.

We also perceived that the investigation of age at menarche in relation to the risk of abortion fits into the framework of life table survival analysis. Within the context of survival analysis, age at menarche may be treated as duration of follow-up, and the outcome of interest is having at least one abortion. Therefore, some women at the various ages of menarche had had at least one abortion, while others had had no abortion at that age. This kind of configuration appropriately leads to the application of the Kaplan-Meier survival analysis method. The life table survival analysis was conducted using program 1L from the BMDP Statistical Package and the results are presented in Table 2.

Table 1. — Distribution of 329 women by age at menarche and abortion rates experienced.

Age at menarche (years)	Abortion rates per 100 pregnancies					Total
	A ≤ 10	B 11-20	C 21-25	D 26-50	E 51-100	
9-10	0	4	1	1	3	9
11-12	7	21	19	36	16	99
13-14	8	46	22	59	41	176
15-18	2	11	5	17	10	45
Total	17	82	47	113	70	329

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Since age of menarche is fixed for each woman, we felt it inappropriate to use the cumulative hazard function to describe the abortion rates at the various ages of menarche. Instead, the hazard rates in column 7 (Table 2) give an indication of the risk of abortion in relation to age at menarche.

**Results**

A total of 989 women were interviewed with a mean age of 30.05 ( $\pm$  8.87). The mean age at menarche was 13.05 ( $\pm$  1.32), range 9-18 years. Only 329 women had had at least one abortion with an abortion rate of 33.26%.

When correspondence analysis (CA) was applied to the data in Table 1, the resultant CA (as shown in Figure 1) shows that in the group of 329 women who had at least one abortion, early age at menarche was associated with lower abortion rates and later age at menarche was associated with higher abortion rates. The low abortion rates in relation to early age at menarche are indicated in the third and fourth quadrants in Figure 1. In the fourth quadrant, women aged 9 to 10 at menarche experienced abortion rates between 11-20 abortions per 100 pregnancies. In the third quadrant, women aged 11-12 at menarche had abortion rates of  $\leq$  10 and 21 to 25 abortions per 100 pregnancies. In the first quadrant, it is indicated that

Table 2. — Results from life table survival analysis showing the risk of abortion in relation to age at menarche.

Age at menarche	Entered	Aborted	Proportion aborted	Proportion surviving	Cumulative proportion surviving at beginning of interval (S.E.)	Hazard (S.E.)
Col. (1)	Col. (2)	Col. (3)	Col. (4)	Col. (5)	Col. (6)	Col. (7)
9-<10	329	4	0.0122	0.9878	1.0000 (0.0000)	0.0122 (0.0061)
10-<11	325	5	0.0154	0.9846	0.9878 (0.0060)	0.0155 (0.0069)
11-<12	320	24	0.0750	0.9250	0.9726 (0.0090)	0.0779 (0.0159)
12-<13	296	75	0.2534	0.7466	0.8997 (0.0166)	0.2901 (0.0331)
13-<14	221	110	0.4977	0.5023	0.6717 (0.0259)	0.6627 (0.0596)
14-<15	111	66	0.5946	0.4054	0.3374 (0.0261)	0.8462 (0.0944)
15-18	45	45	1.0000	0.0000	0.1368 (0.0189)	0.6667 (0.0000)
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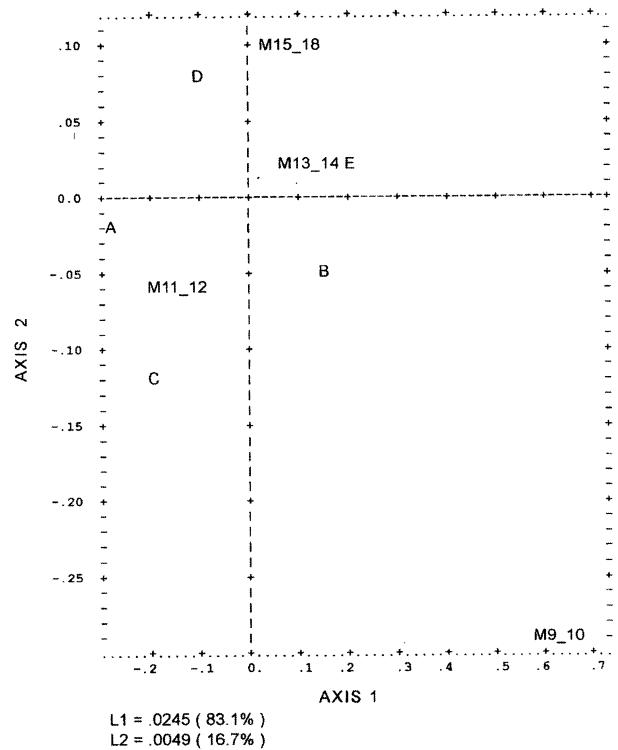


Figure 1. — Correspondence analysis graph showing association between age at menarche and risk of abortion (A =  $\leq$  10; B = 11-20; C = 21-25; D = 26-50; E = 51-100; M refers to menarche).

women aged 13 to 14 and 15 to 18 years at menarche experienced the highest abortion rates of above 50 abortions per 100 pregnancies. The result in the second quadrant indicates that some of the women aged 13 to 14 and 15 to 18 at menarche had abortion rates between 26 to 50 abortions per 100 pregnancies.

The results from the life table survival analysis are presented in Table 2. The risks of abortion at various ages of menarche are presented by the hazard rates in column 7. The results in Table 2 show that early age at menarche (9 to 11 years) was associated with low risk of abortion of 1.2%, 1.6% and 7.8%, respectively. The risk of abortion was 29% for women at 12 years of age at menarche. The risk of abortion was highest at 66.3% and 84.6% for women aged 13 and 14 years, respectively. For women aged 15 years at menarche, the risk of abortion was 66.7%.

**Discussion**

Age at menarche is directly influenced by genetic factors, nutritional status and other health factors. In addition, it is indirectly affected by socioeconomic variables which, in turn, affect nutritional status and health [2]. These factors also have a strong correlation to reproductive functions and pregnancy outcome as menarche is a biological and social indicator of readiness or impending readiness for sexual relations, marriage and pregnancy [2-6]. Therefore, several studies correlated the early age at

menarche with the risk of subsequent adverse reproductive events including abortion risk [7-9], while others found the relationship is controversial [2, 5, 10, 11].

Most of the previous studies have looked at early age at menarche as a leading cause of early age of intercourse, therefore, early age of pregnancy in adolescence which is subject to a lot of adverse events such as lack of social support, smoking and poor nutritional and socioeconomic situations.

Although the subject is not new, our study is the first unique analysis looking into the subject of age at menarche and risk of abortion using two different methods to investigate the topic (life table survival analysis and CA). The method of CA utilizes a graphical approach that displays the risks of abortion associated with various ages of menarche in one graph. The CA graph indicated that early age at menarche (9-12 years) was associated with lower risk of abortion, while older age (15-18 years) was associated with the highest risk of abortion. The same data was re-analyzed using the Kaplan-Meier method and life table survival analysis. To apply the method, we regarded age at menarche to be analogous to duration of follow-up and the outcome of interest was having at least one abortion for each age of menarche. Since age at menarche is fixed for each woman, it was inappropriate to report the risk of abortion in terms of the cumulative hazard function. Instead, we reported the hazard rates for the various intervals of age at menarche as the indicators of the risk of abortion. Results from this second approach indicated that the abortion rates tended to increase with age of menarche, with the rates being lowest for women in early age at menarche and rising for women in higher age at menarche (Tables 1, 2). Endocrinological studies, as well, suggest that early menarche is associated with hormonal differences that may persist for decades. For example, Vihko and Apter [12] found that early menarche was associated with more rapid onset of ovulatory cycles and females with early menarche had higher estradiol concentrations during the follicular phase of the menstrual cycle up to the age of 30 years [12]. In addition early age at menarche indicates a good nutritional status which is widely associated with improvement in socioeconomic factors [6] and subsequently affects the outcome of pregnancy.

On the other hand, this study was conducted in Saudi Arabia which has a culture that prohibits sexual activity prior to marriage and promotes early marriage. It also favors higher fertility, therefore, early menarche may provide a reproductive advantage in such setting.

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