CHAPTER II

REVIEW OF RELATED LITERATURE
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The present study is related to sports. The opinion of some of the authors in this regard must be considered and the relevant studies must be reviewed.

Livson et al.\(^1\) (1962) study on the accuracy of recalled age of menarche and observed that menarche, a discrete and notable event is easily recalled so that it has been employed in a number of cross sectional studies of growth in women as a retrospective index of maturation rate and also noted that women’s ability to recall menarche may be better.

Sarkar & RayChowdhury\(^2\) (1967) study on the secular trend of menarcheal age in the City Girls of Calcutta with 169 girls found that the age at menarche has been found to vary between 10 and 17 years in the case of urban girls and between 10 and 15 years in the case of rural women.

Malina et al.\(^3\) (1973) observed that a curbing of Physical activity may actually advance menarche among children who do

not participate in inter-scholastic sports and any athletic class meet
or when compared to studies of general population.

Daman et al.⁴ (1974) study on Age at menarche : Accuracy of
recall after thirty nine years with 143 females and found that the
coefficient of correlation between actual and recall ages was
significantly smaller and concluded that recalled age at menarche is
accurate enough for anthropological or epidemiological purposes
involving group comparison.

Erdelyi⁵ (1976) observed that athletes in sports that require
much physical effort and endurance have menstrual disorders more
often and concluded that heavy training and competitive sports
have no unfavourable effects on the onset of the menarche.

Malina et al.⁶ (1978) in their study on age at menarche and
selected menstrual characteristics in athletes at different competitive
levels and in different sports with 110 non-athletes, 59 high school
athletes, 53 college athletes, and 18 Olympic volleyball candidates were
determined through interview. The athletes attained menarche
significantly later than the non-athletes (p less than .001), and the

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4. ALBERT DAMAN and CARL JA BAJEMA, Age at menarche : Accuracy of recall
5. G. J. ERDELYI, Effects of Exercise on the Menstrual Cycle. Physician and Sports
   Medicine 4 (1976) : 79 – 81
6. R. MALINA, et al., Age at Menarche and selected Menstrual Characteristics in
   Athletes at different competitive levels and in different sports, Medicine & Science in
Olympic athletes attained menarche significantly later than the high school and college athletes (p less than .001).

Feicht et al.⁷ (1978) observed that a sample of women runners had a relatively late age at menarche and a high incidence of amenorrhea.

Malina et al.⁸ (1978) reported that high school and college athletes have a statistically significant later age at menarche than do non-athletes.

Sidhu and Grewal⁹ (1980) studied the effect of active participation in sports on age at menarche and reported that menarche appears significantly late in athletes than the non-athletes. According to them the strenuous activity delays the menarcheal age. The non-athlete girls attained menarche a significantly earlier age than the track and field athletes, who did not differ statistically in menarcheal age among them.

Sidhu et al.¹⁰ (1980) in course of their study on age of menarche in various categories of Indian sportswomen and collected data on the age of menarche of 264 Indian sportswomen,

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¹⁰ Ibid
and 108 girls forming the control group, all hailing from the Punjab, Haryana, Chandigarh and Delhi. Outstanding athletes and players of hockey, basketball and volleyball were included. The combined mean age at menarche for sportswomen is 15.21 years and for the control sample is 14.05 years. The difference in the two series is statistically significant. The mean age at menarche in hockey, basketball, volleyball and athletes is found to be 15.15, 15.40, 15.05 and 15.27 years respectively. The differences in these groups, however, are not found to be statistically significant.

Warren\textsuperscript{11} (1980) studied the effect of dancing on ballet dancers and showed that menarche was remarkably delayed and significant in young ballet dancers as compared to the age matched controls. Recent evidence proposes that the initiation of menses depends on the attainment of a critical body fat. Interest in fitness and endurance sports in women has raised the possibility that a large energy drain may also delay menarche.

Frisch et al.\textsuperscript{12} (1981) observed in their study that the menarcheal age of athletes and swimmers whose training began

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before menarche was significantly delayed and the intensive training directly increased the incidence of menstrual disturbances.

Baker\textsuperscript{13} (1981) study on Menstrual dysfunction and hormonal status in athletic women, and found that exercise associated menstrual dysfunction seems to occur more frequently in nulliparous athletes, in athletes with delayed menarche, and in athletes with low body fat.

Mathur & Toriola\textsuperscript{14} (1982) study on age at menarche in Nigerian Athletes with 418 national level women athletes and 512 women non-athletes and observed that the menarcheal age of athletes was higher than the non-athletes. It seems most probably that menarche is delayed and the influence of regular sports activities.

Vandenbroucke et al.\textsuperscript{15} (1982) study to assess the effects of intensive physical activity and thinness on menarche with 648 girls aged 10-14 were recorded and analysed. The girls were classified as thin or not thin on the basis of their body mass index, and whether or not they engaged in intensive sports activity was established. The presence of either thinness or intensive sports activity was associated with roughly a two-fold decrease in the proportion of girls who had reached menarche; the presence of both

\begin{itemize}
\item \textsuperscript{13} E R BAKER, Menstrual dysfunction and hormonal status in athletic women. \textit{Fertility \& Sterility} 36 : 6 (Dec 1981) : 691 - 696.
\item \textsuperscript{14} D. N. MATHUR & A. L. TORIOLA, Age at Menarche in Nigerian Athletes. \textit{British Journal of sports medicine} 16 : 4 (Dec 1982) : 250 - 252.
\end{itemize}
factors was associated with roughly a four-fold decrease. These results did not appear to depend on age. Thus intensive sports activity and thinness appear to have a synergistic effect in delaying menarche.

Hale\textsuperscript{16} (1983) observed in his investigation that with the increasing involvement of women in exercise programs, the physician is faced with more and more questions regarding the effect of exercise upon the reproductive system. Currently, it appears that pre-menarcheal training may have the effect of delaying the onset of menses in some girls. There is no evidence that it delays the other stage of puberty or that it causes any harmful development by this delay. In the post-menarcheal women, strenuous exercise can definitely alter her bleeding pattern. The usual result is oligomenorrhea progressing toward amenorrhea as the exercise increases. This is not a universal phenomenon, however other factors such as percentage of body fat, stress, diet, and energy drain also play a role. The menses will usually resume its pre-exercise pattern after a period of rest.

Bhalla et al.\textsuperscript{17} (1983) study on variations in the Age at Menarche due to physical exercise and Attitude with 64 sportswomen 50 women

\begin{itemize}
\item \textsuperscript{16} R.W HALE, Exercise, sports, and Menstrual dysfunction, \textit{Clinical Obstetrics & Gynecology} 26 :3 (1983) : 728 - 735.
\item \textsuperscript{17} S R Bhalla, A K Kapoor and I P Singh, Variations in Age at menarche due to Physical exercise and attitude. \textit{L. Morph. Anthrop} 73 : 3 (1983) : 323 – 332.
\end{itemize}
from high attitude and 300 women from plains and observed that the women from plain had the earliest menarche, while sportswomen though staying at the same attitude but differing in the extent of physical activities had it quite late and the females staying at high attitude had the highest age at menarche.

Ronkainen et al.\textsuperscript{18} (1984) study was undertaken in order to evaluate the onset of puberty and the presence of menstrual disorders in Finish sportswomen with different training programs — 53 long-distance runners, 39 skiers and their 93 controls, and 63 volleyball players with 64 controls were interviewed. All the sportswomen had trained intensively for several years and were in the top category of their sport in Finland. Menarche in all the sportswomen and also puberty in the volleyball players developed significantly later than in their controls. The runners and skiers (43\%) suffered significantly more often from menstrual irregularities than their controls (27\%), whereas volleyball players (19\%) did not differ from their controls (13\%) in this respect. Among runners and skiers, but not among volleyball players, pre-menarcheal start of sports activity had an aggravating effect on these endocrine disorders. Dysmenorrhea was found to occur more seldom in sportswomen than in the control subjects, and physical

exercise often alleviated menstrual distress. Because the runners and skiers trained as often and used as much time for their sport as the volleyball players, the more common occurrence of their menstrual disorders may be due to the nature of training and competition activity which is characterized by endurance physical exercise.

Wilson et al.\textsuperscript{19} (1984) study was undertaken to determine normal menstrual patterns in healthy girls in an independent high school and assess the effects of exercise (type and hours per day), age (chronological and gynecologic), calculated estimate of body fat, and place of residence (boarding and day students) on menstrual function. Three hundred twenty-seven girls (means age $15.5 + / -1.1$ years) answered a questionnaire on menstrual history; 306 (93.6\%) were post-menarcheal and 21 (6.4\%) pre-menarcheal. Calculated estimate of percent body fat was significantly lowered in pre-menarcheal than post-menarcheal girls (22.4\% versus 27.3\% $p$ less than 0.0001). Ninety three percent of adolescents reported flow lasting 4-7 days; 59.7\% dysmenorrhea; and 63\% premenstrual symptoms. There was no correlation between estimated body fat or hours per day of exercise and the regularity of menses, duration of

flow or dysmenorrhea. With the exception of gymnastics and
dancing, sports participation had little or no impact on menstrual
patterns. Follow up questionnaires and menstrual calendars were
obtained from 87 girls eight to fifteen months after the initial
questionnaires. All girls whose cycles had changed from regular
were boarding students, confirming previous anecdotal reports that
separation from home may be a significant stress for adolescents.

Stager et al.\textsuperscript{20} (1984) noted that a later age at menarche is
coincident with or related to some factors either permitting
continued athletic participation or allowing for enhanced
performance by girls with a later menarche.

Kovalcikova\textsuperscript{21} (1987) Study on menarche and menstrual Cycle of
top and active sportswomen with 605 girls divided according to their
physical load into (a) top sportswomen, (B) active sportswomen and (c)
women not engaged in sports and observed that (i) retarded age of
menarche in top and active sportswomen as compared with girls not
engaged in sports (ii) in the course of the menstrual cycle top and active
sportswomen had more complication than girls of the general
population.

\textsuperscript{20} J.M. STAGER, D. ROBERT SHAW and E. MIESCHEV, Menarche of Swimmers in
Relation to Age of onset Training and Athletic Performance, Medicine & Science in

\textsuperscript{21} J. KOVALCIKOVA, Menarche and the menstrual cycle of top and active
Salvi et al.\textsuperscript{22} (1988) study on exercise induced delayed menarche and amenorrhea with fifty sportswomen and controls and observed that the sportswomen who had started their training prior to menarche had their onset of menarche significantly delayed as compared to the sportswomen who commenced training post menarche and the control group.

Sodhi et al.\textsuperscript{23} (1988) investigated on the menstrual study of top ranking Indian sportswomen with 136 Indian top ranking sportswomen belonging to athletes, badminton, basketball, cycling, football, gymnastics, swimming, table tennis and volleyball and found that the menarcheal age of participants in athletes has been found to be highest and that in table tennis, the lowest.

Kovalcikova\textsuperscript{24} (1989) study on onset of menarche and the menstrual cycle in top level volleyball players with three groups of top level volleyball players and found that the age of menarche was later than in women not engaged in sports and in the general female population.


\textsuperscript{24} J. KOVALCIKOVA, Onset of menarche and the menstrual cycle in top level volleyball player, \textit{Ceskoslovenska Gynekologie} 54 : 10 (1989) : 748 - 754.
Mokha and Sidhu\textsuperscript{25} study on age of menarche in Indian female basketball and volleyball players at different competitive levels, with 98 volleyball and 75 basketball players belong to four different level of competitions—International, National, Intervarsity and District. It was observed that menarche is significantly delayed in players as compared with the controls. There is a continuous trend of increase in the age of menarche with the increasing levels of competition; menarche is more delayed in players playing at a higher level than those at the lower levels of competition.

Cavanaugh et al.\textsuperscript{26} (1989) observed that exercise and training alone does not result in delayed menarche and/or menstrual irregularities.

Stager et al.\textsuperscript{27} (1990) study on interpreting the relationship between age of menarche and prepubertal training with randomly selected 100 athletes that the later age of menarche in athletes may be a direct consequence of intense routine prepubertal physical activity.
Hata & Aoki\(^{28}\) (1990) study on Age at menarche and selected menstrual characteristics in young Japanese athletes with 204 non-athletes, 253 High School athletes, 386 college athletes, and 40 young top athletes of Japan and indicated three fundamental observations on the age at menarche of athlete: (a) Later attainment of menarche in athletes (b) association between the delayed menarche and more advanced competitive levels, (c) variance in age at menarche by sports in a given competitive level.

Kovalcikova\(^{29}\) (1991), Study on menarche and course of the menstrual cycle in sportswomen in youth training centers in Slovakia with 107 girls and found that an age above 12.5 years menarche was not recorded in high mountain skiers and swimmers. At a mean age above 13, menarche was recorded in tennis players, synchronized swimmers and gymnasts but not always in the whole group. The latest time of menarche was recorded in cross-country skiers.

Sharma and Shukla\(^{30}\) (1992) study with 85 sportswomen and concluded that menarche was significantly delayed in those sportswomen who embarked on physical training activities before


the onset of menstruation and there are also variations in the mean menarcheal age between participants in different sports specialties.

MerZenich et al. (1993) study on dietary fat and sports activity as determinants for age at menarche was conducted with 261 girls aged from 8 to 15 years to evaluate the role of nutrition, Physical activity and life-style factors for the age at menarche, a known breast cancer risk factor and found that the increased energy adjusted fat intake was associated with accelerated menarche (relative risk = 2.1; 95% confidence interval 1.1 – 4.0; lowest VS. Highest quartile), while increased sports activity was associated with a delay in menarche (relative risk = 0.3; 95% confidence interval 0.1 – 0.5; lowest VS. highest quartile.)

Rivera et al. (1993) investigation described maturation, menstrual and socio-demographic characteristics of 65 Puerto Rican women athletes that were interviewed during the XVI Central American and Caribbean Games (CACG), Mexico City in 1990. The results were compared with those of Puerto Rican women athletes (n=52) at the XV CACG, Santiago Dominican Republic, 1986. The Quantitative variables (age, age at initiation of training, years of training, age at menarche, birth order, and family


size) were not statistically different (t-independent, \( p > 0.05 \)). The observed frequencies for the qualitative variables (menstrual characteristics, degree of certainly in the recall of age of menarche, use of oral contraceptives, and marital status) were very similar. In conclusion: the women at the XVI CAC in Mexico demonstrated similar maturational, menstrual and socio-demographic characteristics to the those athletes evaluated far earlier in Santiago and based on their long history of training, both samples were representative of athletically mature athletes. The findings were very similar to those reported for Olympic athletes and such data expands the available information on Puerto Rican women athletes.

Boxter Jones et al.\(^3\) (1994) conducted the study on 255 female rhythmic gymnasts aged 11-23 years during the 13\(^{th}\) European Championship in Patras, Greece and found that the mean age of menarche was significantly delayed from that of their mothers and sisters (\( p=0.0008 \) and \( p=0.05 \), respectively) and was positively correlated to the intensity of training.

Faulkner et al.\(^4\) (2001) longitudinal study for girls active in sport compared with non-athletic girls indicate no effect of training


on the timing and progress of secondary sexual characteristics. The interval between ages at peak height velocity and menarche for girls active in sport and non-active girls also does not differ, and is similar to that of non-athletic girls. It was observed that the potential influence of training on the later mean age at menarche in female athletes and indicated that training for sport as the factor responsible for delayed menarcheal onset. Thus, given the many factors known to influence menarche, sport training is one of the causative factors for later menarche.

Boxter Jones et al.\textsuperscript{35} (2002) in their longitudinal study of the effects of intensive training during puberty and adolescence on age of menarche in 222 athletes and their mothers. All the sports studied (gymnastics, swimming and tennis) had latter mean ages of menarche (14.3, 13.3 and 13.2 respectively). A positive correlation was found between menarcheal age in mothers and daughters. Analysis of covariance, using maternal menarcheal age, socio-economic groups, duration of training and type of sport, confirmed that maternal menarcheal age and type of sport were having a significant influence on subject's age of menarche.