

---

## CHANGES IN BODY MASS COMPOSITION OF 14-YEAR OLD FEMALE VOLLEYBALL PLAYERS OF VARIOUS RATES OF MATURATION

Agata PAŁKA

*Police Headquarters in Warsaw*

---

### **Keywords:**

- Somatic build,
- menarche,
- volleyball.

### **Abstract:**

The research has shown differences in body composition of early- and average-maturing girls. Knowledge of the menarche age and somatic features related to the rate of maturation allows to qualify players to play on certain tactical positions and should be used by coaches.

---

### **INTRODUCTION**

Volleyball is a team game where it is important both to work on techniques, tactics and to fulfil certain requirements in respect of the players' somatic build. Every technical element specific for this discipline is a typical action during the game that decides about the winning [6,16].

Somatic build of a female volleyball player should be characterized by higher than average body height, slim figure and a significant length of both upper and lower limbs [4,7]. Identification of the characteristic body build features that can contribute to success in sport and possible structural differences among athletes in various sport disciplines has been the subject of research for both researchers and trainers. In some group teams, also in the case of volleyball, the player's height is of great significance. Body height has a positive influence on all lengths of body segments that determine the athlete's achievements. In the case of sports like volleyball certain positions on the field may require specific features of the players' body build [11].

The time of menarche is another important criterion for the assessment of the rate of female player's maturation. This time is mainly genetically determined, however, it also depends on environmental factors. The age of menarche is more correlated with bone age than calendar age, so girls that begin to menstruate are girls whose bone age corresponds to 13-14 years. In general, girls menstruation does not occur when the bone age is less than 12.5 years.

Menarche falls on the calendar age of 10- 17 years [8,9,10,12,25].

Girls have their first menstruation when they have reached at least the third degree of the external sexual characteristics' development, i.e. stages M3 and M4 of the mammary glands development and after the so called pubertal jump [12].

Research carried out on team sports players has shown a correlation between late menarche, irregular menstruations, somatic build and intensive sports training. The menstrual cycle is controlled by the hypothalamic-pituitary-ovary system. This system's proper operation affects both the regular occurrence of menstruation and hormone levels. Late menarche is quite often in the case of girls practising sports, and after the menstruation has started, the cycles are irregular, which is caused by the hypothalamic -pituitary-ovary system dysfunction. Intensive sports training also causes stimulation of the hypothalamic-pituitary-adrenal axis, which leads to hypercortisolism and hyperandrogenaemia. Additionally, increased concentrations of androstenedione have been observed in the case of girls practising

sports. Androstenedione is a precursor of testosterone and estrone, and even a small increase in androgens concentration can result in menstrual cycle disorders. Hypoestrogenism may contribute to the occurrence of osteopenia, i.e. low bone mass, which in turn can lead to increased risk of fatigue fractures [20,21].

During puberty, each somatic feature exhibits intense growing, and changes in length and width characteristics take place in a specific order [13]. Maturation is also the time of a significant body weight gain. Checking of the body height and weight as well as information on the menarche age in sports training are very important [18].

### **PURPOSE OF THE STUDY**

The purpose of this thesis was to determine the changes in body build and composition in young female volleyball players in subsequent calendar age ranges depending on the menarche age.

### **MATERIAL AND METHODS**

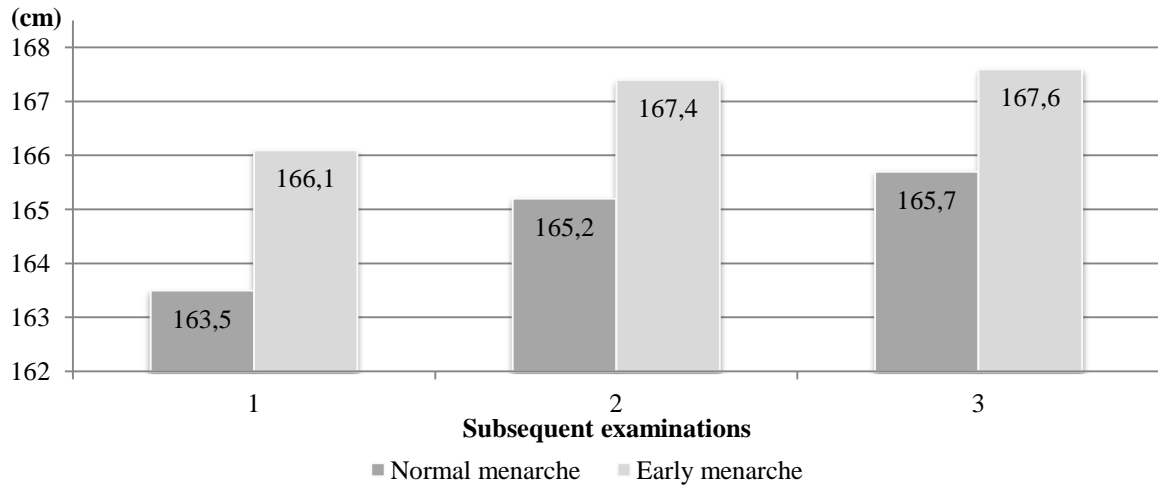
The research was carried out on 25 girls - players of MOSM Tychy Sports Club, attending a junior-high school class with extended curriculum in physical education focusing on volleyball.

The players were examined 3 times at intervals of six months. During the first examination, the girls' calendar age was  $14.32 \pm 0.23$  years, whereas the length of training was  $2.12 \pm 1.28$  years. The girls train 5 times a week, 1.5 hours daily.

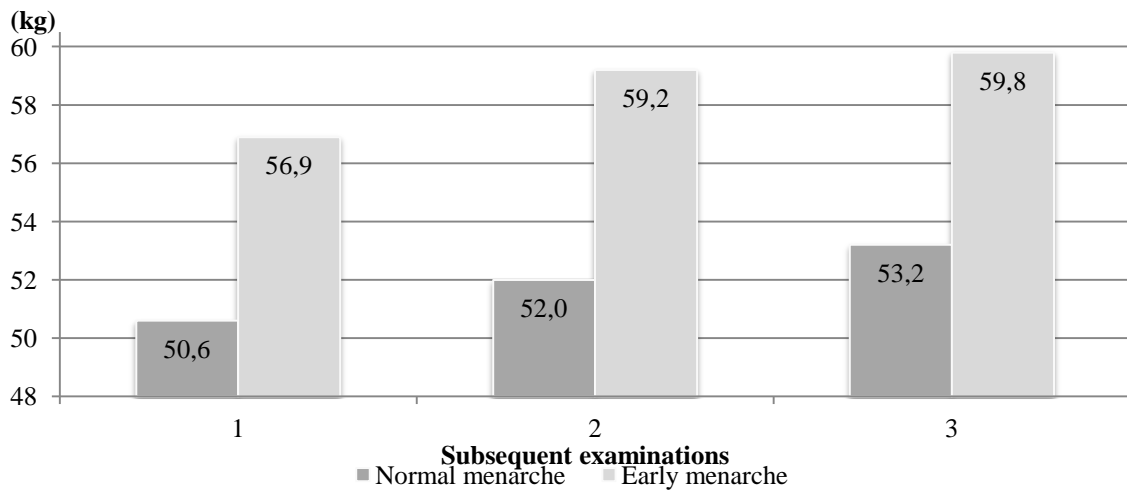
An antropometer was used to measure the girls' body height, whereas "Tanita" TBF-410 scale was used to determine the body weight, body mass index (BMI), fat content (FAT%) and fat-free mass (FFM kg). What is more, the test of difference significance was used for two medians of somatic variables in the group of players with early and normal menarches. The menarche age was determined using a retrospective method. The girls with their menarche before the age of twelve were considered to belong to the group with early menstruation. The classification into early- and averagely- menstruating girls was based on results of research carried out, among others, by Piechaczek et al. [1996], Rodziewicz-Gruhn [2002], Radochońska et al. [2006], Burdukiewicz [2009], and Wilczewski [2012]. Research of the aforementioned authors showed that the average age of menarche ranged from 12.60 to 13.16 years. Therefore, a scale has been adopted in this paper according to which early-menstruating girls are girls whose menarche occurred before the age of 12 years, whereas average-maturing girls are players who started menstruating after the age of 12 years [2,14,15,17,24].

### **RESULTS**

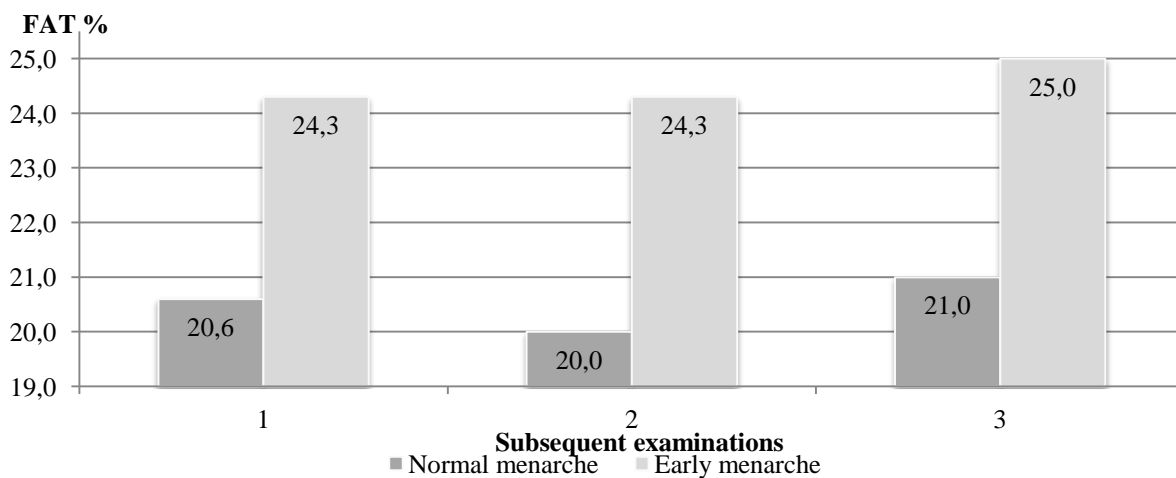
The examined group consisted of 17 players with early menarche ( $11.71 \pm 0.57$  years) and 8 players with menarche corresponding to the population standard ( $13.43 \pm 0.67$  years). Girls whose menstruation started earlier were characterized by greater height and body weight as well as body fat. In each of the three examinations body height of the players with early menarche was bigger compared with those with normal menarche (Fig. 1). In all the examinations body weight of the volleyball players with early menarche was greater than in the case of players with normal menarche (Fig. 2). Body fat in the case of female volleyball players with early menarche was also higher when compared with those with normal menarche (Fig. 3). The examinations showed that in female volleyball players with normal puberty the BIM was lower than in female players with early menarche (Fig. 4). Early menstruating volleyball players showed a significantly higher proportion of lean body mass compared with those with normal menarche (Fig. 5)



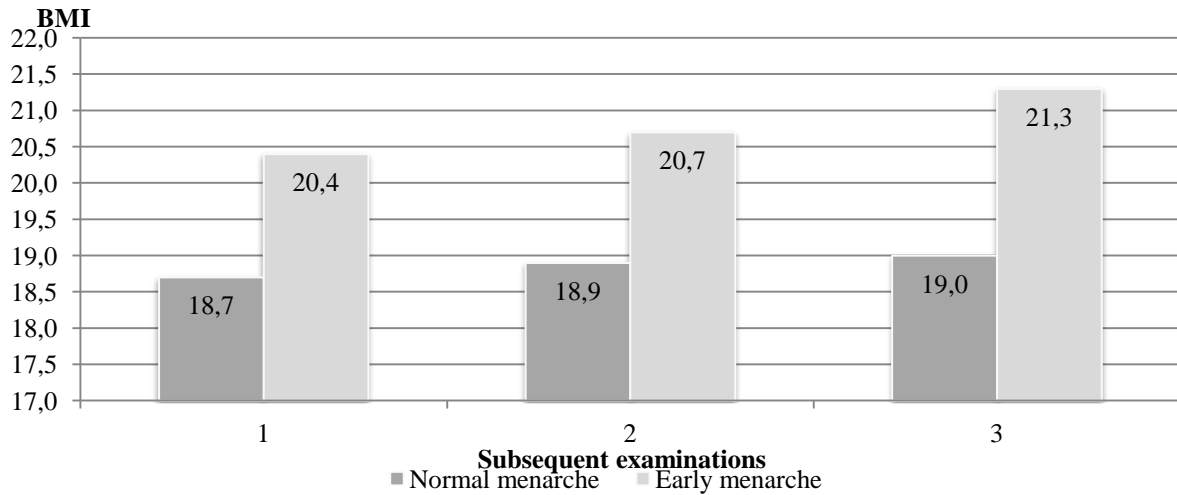
**Figure 1.** Changes in body height of female players with early menarche and those with normal menarche



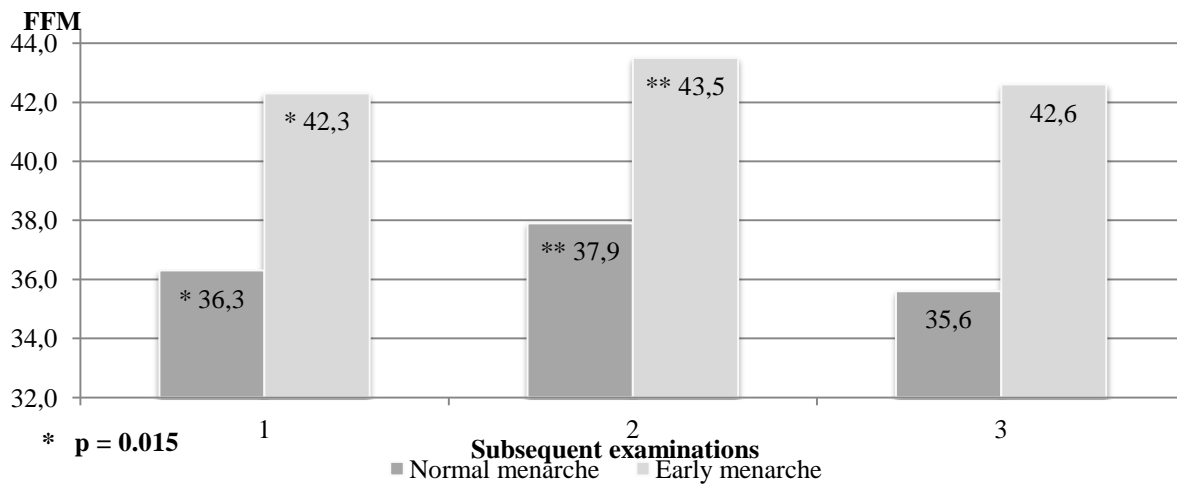
**Figure 2.** Changes in body weight of female players with early menarche and those with normal menarche



**Figure 2.** Changes in body fat of female players with early menarche and those with normal menarche



**Figure 4.** Changes in body mass index of female players with early menarche and those with normal menarche



**Figure 1.** Changes in the content of fat-free mass of female players with early menarche and those with normal menarche

Female players whose first menstrual cycle started early showed a significantly higher content of lean body mass when compared to the female players with normal menarche - in the first examination:  $p < 0.015$ , in the second examination:  $p < 0.030$ .

## DISCUSSION

Volleyball is a very specialized sport [5]. Volleyball's specific nature comprises a number of complex technical and tactical activities. A great deal and variety of actions as well as the cyclical nature of changes in the team's setting requires a high motor activity during every game [1]. The technical elements are non-standard exercises as they are carried out under various conditions and continuous body's response to external stimuli. In terms of movement structure, they are acyclic exercises [26]. Selection is related, among others, to determination what a player's maximum height and size will be [23]. Exact knowledge of body build of the female players who aspire to reach a high global level makes it possible to determine the body build model parameters, its components, and to determine the body build proportions and type [22]. Analysis of a female player's somatic build enables a coach to specify the player's suitability as the physiological characteristics affect the player's effectiveness during a match [5]. That is why during the training process it is of great

significance to systematically check the players' height and width characteristics as well as their body composition. The author's studies have shown that female players with normal menarche have lower height and body weight, lower content of FAT% and FFM, as well as lower BMI.

Additionally, specialization on the field is of great importance in volleyball. Development of volleyball tactics has resulted in the players specializing in a specific division of roles on the field. Effectiveness of specialized activities during a game also depends on somatic parameters [23]. The occurrence of menarche affects the change in body components and composition. That is why it is so important that during the training process the player informs the coach about this fact. Having specialist knowledge, the coach is able to use the information on the player's menarche age and the somatic predispositions related thereto in the training process while qualifying a given player for a certain tactical position, i.e.:

- female players with normal menarche - receiver, setter and libero;
- female players with early menarche - spiker and middle-blocker.

The setter and libero are usually the lowest players in the team. In contrast, spikers and middle blockers have the greatest length parameters and slimmest body structure, whereas receivers are characterized by slightly lower parameters than middle blockers and spikers. [3,19,22].

## CONCLUSIONS

1. Early- and average-maturing girls differ in body composition, and above all, the content of lean mass.
2. Knowledge of the menarche age and somatic features related to the rate of maturation allows to qualify players to play on certain tactical positions.

## REFERENCES

1. Bompą T, Zając A, Waśkiewicz Z, i in. *Przygotowanie sprawnościowe w zespołowych grach sportowych*. AWF Katowice 2013.
2. Burdukiewicz A., Andrzejewska J., Miałkowska J. i in. *Rozwój fizyczny dzieci i młodzieży wrocławskiej w wieku 7-18 lat*. Wydawnictwo AWF Wrocław 2009.
3. Ćwik. W. *Budowa somatyczna siatkarek pełniących różne funkcje na boisku*. Sport Wyczynowy; 1979; 2; 17-22.
4. Drozdowski Z. *Antropologia sportowa. Monografie, podręczniki, skrypty*. AWF Poznań 1984.
5. Duncan M.J, Woodfield L, Y al-Nakeeb. *Anthropometric and physiological characteristics of junior elite volleyball players*. Br J Sports Med 2006; 40: 649–651.
6. Forthomme B, Croisier JL, Ciccarone G, et al. *Factors correlated with volleyball spike velocity*. Am J Sport Med 2005; 33(10): 1513–1519.
7. Grządziel G, Ljach W. *Pilka siatkowa. Podstawy treningu. Zasoby ćwiczeń. Charakterystyka piłki siatkowej. Uwarunkowania rozwojowe i metodyczne szkolenia dzieci i młodzieży*. COS Warszawa 2000.
8. Jegier A, Nazar K, Dziak A. *Medycyna sportowa. Wybrane zagadnienia aktywności fizycznej osób w różnym wieku*. Wydawnictwo Lekarskie PZWL. Warszawa 2013.
9. Krawczyński M. *Rozwój dziecka. Pediatria Tom 1*. Górnicki B, Dębiec B, Baszczyński J [red]. Wydawnictwo lekarskie. Warszawa 1995.
10. Łaska-Mierzejewska T. *Antropologia w sporcie i wychowaniu fizycznym*. Centralny Ośrodek Sportu. Warszawa 1999.
11. Malousaris G, Bergles N, Barzouka K, et al. *Somatotype, size and body composition of competitive female volleyball players*. Journal of Science and Medicine in Sport; 2008; 11; 337 – 344.

12. Mięśowicz I. Auksologia. *Rozwój biologiczny człowieka i metody jego oceny od narodzin do dorosłości*. Warszawa 2001.
13. Pałowska - Szliagyi I. *Charakterystyka rozwoju somatycznego w okresie dojrzewania*. Postępy Nauk Medycznych; 6; 2006; 316-320.
14. Piechaczek H, Lewandowska J. *Wiek menarche i budowa ciała dziewcząt z warszawskich szkół sportowych*. Wychowanie fizyczne i sport; 1996; 1; 11-17.
15. Radochońska A, Dudzik S, Perenc L. *Zmiany sekularne wieku menarche u dziewcząt z Boguchwały i Krasnego w latach 1976/77, 1988/89 oraz 2003/04 na tle populacji dziewcząt rzeszowskich*. Prz. Med. Uniw. Rzesz.; 2006;1/4(1); 64-69.
16. Rodriguez-Ruiz D, Quiroga ME, Miralles JA, et al. Study of the technical and tactical variables determining set win or loss in top-level European men's volleyball. *J Quant Anal Sport*; 2011; 7; 1:1–13.
17. Rodziewicz-Gruhn J. Społeczno-ekonomiczne uwarunkowania wysokości, masy ciała i wieku I miesiączki dziewcząt miejskich i wiejskich w regionie częstochowskim. [W:] *Ontogeneza i promocja zdrowia w aspekcie medycyny, antropologii i wychowania fizycznego*. Malinowski A., Tatarczuk J., Asienkiewicz R. (red.). Wyd. Uniwersytetu Zielonogórskiego, Zielona Góra 2002; 158-162.
18. Rogol A, Clark P, Roemmich J. Growth and pubertal development in children and adolescents: effects of diet and physical activity. University Virginia Health Sciences Center Charlottesville. *Am J Clin Nutr*. 2000 Aug; 72; 2:521.
19. Saryczew H. *Zależność skuteczności działań u zawodników w grze w piłkę siatkową od warunków somatycznych*. Zeszyty Naukowe AWF Wrocław 1983; 32; 85 - 98.
20. Skalba P. *Endokrynologia ginekologiczna*. Wydawnictwa Lekarskie PZWL, Warszawa 1993.
21. Skrzypulec V, Lindert O, Morawiec M i in. *Zaburzenia miesiączkowania u sportsmenek*. Ginekol. Parkt. 2005; 5; 3.
22. Stefanicki E, Kosova A, Flora K. i in. *Budowa fizyczna młodych siatkarzy wysokiej klasy*. Sport Wyczynowy; 1994; 9-10; 33-39.
23. Szczepanik M, Klocek T, Spieszny M. *The level of the selected parameters of somatic build and explosive strenght indices with relations to tactical specialization of volleyball players- participations of Olympic Games In Athens W: Cepicka L.(red) Games*. Warsaw 2006.
24. Wilczewski A, Popławska H, Dmitriuk A i in. *Wiek menarche dziewcząt ze wschodniego regionu polski w aspekcie uwarunkowań środowiskowych*. Wilczewski A [red]. *Uwarunkowania rozwoju dzieci i młodzieży wiejskiej*. AWF Warszawa 2012; 340-351.
25. Wolański N. *Rozwój biologiczny człowieka*. Wydawnictwo naukowe PWN. Warszawa 2012; 493-512
26. Zatyrcz Z, Piasecki L. *Piłka siatkowa*. ZUPIW, Szczecin 2001.