

CHARACTERISTIC OF THE SEXUAL MATURITY OF ADOLESCENTS FROM THE REGION OF SOUTH-EAST RODOPI MOUNTAINS AT THE AGE OF 7 TO 17 YEARS

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Summary: The results showed that in boys the first sign of sexual maturity is the beginning of enlargement of testicles and penis (Re1 – 10years and 8months), and then followed by hair-growing on the pubic area (R1 – 11years and 4months), after that hair-growing on the body (T1 – 11years and 11months), the appearance of hairs at the axillary pit (Ah1 – 12years and 4months) and voice mutation (Mu1 – 13years and 2months). The beginning of breast glands swelling coincides in time with the first stage of facial hair-growing (13years and 3months). The Adam's apple has the latest development (Ad1 – 13years and 7months).

In girls, from the south-east Rhodopi Mountains, the puberty starts with the parallel development of mammary glands and hair-growing on the pubic area at the age of 9years and 7months. Then it is the axillary hair-growing (10years and 9months), followed by hair-growing on the body (11years and 8months), while the average age of menarche occurrence is 12years and 3months.

Key words: puberty, adolescents, menarche

Introduction

There are a lot of work studying the problems of growth and development of children and adolescents. Most of them studied the physical development of children [1, 5, 6]. In other analyze the processes of pubescence [2, 3, 4, 7, 8]. One of the most important periods in the postnatal ontogenesis in humans is the period of their sexual maturity /puberty/. The changes occurring in an adolescent organism in this period are of great importance to the whole further human's life. The somatic and sexual development in children and adolescents is an essential characteristic for their health condition and it reflects the total level of socio-economical and hygiene life conditions. This is a matter of particular importance, nowadays, when life conditions are changing rapidly.

Material and methods

The purpose of the present study is to characterize the processes of sexual maturity in 1481 children and adolescents from the south-east Rhodopi Mountains (Bulgaria) - girls 782, and 699 boys at the age of 7 to 17. Scopically, through the methods of Stefko-Ostrovskii (1929), there were recorded the most used in practice secondary sex-

ual signs, that pass in the different stages of development. We determined the periods of appearance of secondary sexual signs and the average age of menarche occurrences through the methods of non-linear, probity regression analysis.

Results

Analyzing our results, we found that the puberty start point in **boys** begins with the development of the **penis and scrotum (Re1)** (Table. 1), and it is also confirmed in the bibliographic data. The average age of the beginning of development of Re1 is 10 years and 8 months. We found the first signs of development of this characteristic in 17,20% of 9-year-old children (Table 1). After this age the frequency of Re1 occurrence gradually increases and reaches its maximum during the 13th year (88,88%), while after the 15th year we did not find children in this phase of development. The average age of appearance of the second phase of development of the penis and scrotum (R2) is 13 years and 10 months. For the first time R2 appears in 1,72% of the 12-year-old boys. At the age of 15 R2 reaches its maximum (83,6%) and after this age there is a decrease in the frequency of occurrence, and in 17-year-olds it is just about 1,92%. The average age of appearance of the last phase of the penis and scrotum development is 16 years and 0 month. The earliest phase was found in 2,46% of 14-year-old boys and they reach their maximum at the age of 17 – 98,07%.

Table 1. Development of the penis and scrotum - % of investigated children and adolescents

Age	N	Pe0	Pe1	Pe2	Pe3
7	52	100			
8	59	100			
9	93	82,79	17,20		
10	60	78,33	21,66		
11	68	48,52	51,47		
12	58	10,34	87,93	1,72	
13	63		88,88	11,11	
14	81		23,45	74,07	2,46
15	61		11,47	83,6	4,91
16	52			50,76	19,23
17	52			1,92	98,07

The average age of appearance of the first phase (Ru1) of development of the **pubis hair growing** is 11 years and 4 months (Table 2). The childish phase of development (Ru0) could be seen in all 7 and 8-year-old boys. With the next ages the percentage of children with R0 gradually decreases and after the 13th year we did not find children in this phase of development. The first cases of appearance of pubis hair growing (Ru1) in 2,15% of 9-year-old boys (Table 1). The biggest percentage of Ru1 can be seen in 11-year-old boys (47,61%), after this age it gradually decreases and it is 9,87% in 14-year-olds, and after this age we did not find children with first phase of pubis hair growing. The average age of appearance of the second phase (Ru2) of development of this characteristic is 12 years and 11 months. We found the first cases of Ru2 appearance at the age of 12 and they included 20,68% of the boys, it reaches its maximum in the

15th year (45,90%), but in 16-year-olds it is 0%. The third phase of development (Ru3) of pubis hair growing appears at about 14years and 4months and we found the first cases in 13-year-old boys (15,87%). The final phase of development of pubis hair growing (Ru4) appears at about 15years and 9months, and the highest frequency of occurrence is at the age of 17 - 94,23%.

Table 2. Development of the pubis hair growing - % of investigated children and adolescents

Age	N	Pu0	Pu1	Pu2	Pu3	Pu4
7	52	100				
8	59	100				
9	93	97,84	2,15			
10	60	76,66	23,33			
11	68	52,94	47,05			
12	58	43,10	36,20	20,68		
13	63	9,52	47,61	26,98	15,87	
14	81		9,87	32,09	54,32	3,70
15	61			45,90	32,78	21,31
16	52			15,38	25,00	59,61
17	52				5,76	94,23

Corporal hair growing is a characteristic that develops 7 months later than pubis hair growing (Table 3). The first phase (T1) appears at about 11years and 11months. The earliest phase was found in 11,82% of 9-year-old children. The age dynamics of this characteristic shows that the frequency of occurrence of T1 increases together with the age advancing and the maximum was found in 14-year-old boys – 88,52%.

Table 3. Development of the Corporal hair growing - % of investigated children and adolescents

Age	N	T0	T1	T2
7	52	100		
8	59	100		
9	93	88,11	11,82	
10	60	86,66	13,33	
11	68	64,70	35,29	
12	58	51,72	48,27	
13	63	15,87	82,53	1,58
14	81	12,34	86,41	1,23
15	61	14,75	60,65	24,59
16	52		59,61	40,38
17	52			100

Hair growing in the axilla develops about 5 months later than the initial development of corporal hair growing (Table 4). The first phase (Ah1) starts at about 12years and 4months, and there are some isolated cases of hair growing in the axilla yet in 9-year-old boys (6,54%). We found a parallel rise of the percentage together with the age, and it is the highest in 14-year-olds – 37,03%, after the 16th year it is 0%. The sec-

ond phase of the axillar hair growing (Ah2) has an average age of appearance at 14years and 5months, and in the group of 17-year-olds there are 5,76% with this phase of development. The last phase of development of this characteristic (Ah3) starts at about 15years and 7months.

Table 4. Development of the hair growing in the axilla - % of investigated children and adolescents

Age	N	Ax1	Ax2	Ax3
7	52			
8	59			
9	93	6,54		
10	60	8,33		
11	68	16,17		
12	58	41,37	5,17	
13	63	30,15	14,28	
14	81	37,03	37,03	8,64
15	61	32,78	45,9	18,03
16	52	15,38	25,00	59,61
17	52		5,76	94,23

Voice mutation (Table 5) (Mu1) in boys starts at 13years and 2months. The initial change of the voice can be met in 11-year-olds and it includes 1,66% of the children observed. The second phase of voice mutation (Mu2) starts at about 15years and 9months, and the earliest one was registered in 7,28% of 14-year-old boys.

Table 5. Development of the voice mutation - % of investigated children and adolescents

Age	N	Mu0	Mu1	Mu2
7	52	100		
8	59	100		
9	93	100		
10	60	100		
11	68	98,33	1,66	
12	58	60,34	39,65	
13	63	31,74	68,25	
14	81	27,16	65,55	7,28
15	61	21,31	70,49	8,19
16	52		55,76	44,23
17	52		5,76	94,23

The beginning of the **facial hair growing** comes a month later than voice mutation - (L1) (Table 6) 13years and 3months. The second phase of development of this characteristic (L2) has an average age of appearance at 16years and 1month, and the first cases were registered in the group of 14-year-olds (9,87%). The percentage of individuals with L2 among the 17-year-olds includes 84,31%.

Table 6. Development of the facial hair growing - % of investigated children and adolescents

Age	N	L0	L1	L2
7	52	100		
8	59	100		
9	93	100		
10	60	100		
11	68	100		
12	58	93,10	6,89	
13	63	49,20	50,79	
14	81	28,39	61,72	9,87
15	61	19,67	72,13	8,19
16	52		59,61	40,38
17	52		15,38	84,31

The beginning of the **puberty rise of the breast gland** (Gr1) (Table 7) coincides in time with the average age of facial hair growing – 13years and 3months.

Table 7. Development of the puberty rise of the breast gland - % of investigated children and adolescents

Age	N	Gr0	Gr1	Gr2
7	52	100		
8	59	100		
9	93	98,92	1,07	
10	60	98,33	1,66	
11	68	72,05	27,94	
12	58	58,62	41,37	
13	63	53,96	33,33	12,69
14	81	38,14	41,97	19,87
15	61	18,03	88,52	11,47
16	52		46,15	53,84
17	52		7,69	92,3

The development of the **Adam's apple** (Ad1) (Table 8) starts 4 months later than the puberty rise of the breast gland. The average age of beginning of the first phase (Ad1) of development of this characteristic is 13years and 7months, and the first cases of boys with Ad1 are in the group of 12-year-olds (13,79%). After the 15th year the cases with Ad1 get less, and in the 17-year-olds it is only 7,69%. The second phase (Ad2) of the Adam's apple development appears at the average age of 15years and 11months, and the first cases were registered yet in 14-year-old boys – 8,17%. Together with the age advancing the frequency of occurrence of boys at this phase of development also gets higher and it reaches 92,3% in 17-year-olds.

Table 8. Development of the Adam's apple - % of investigated children and adolescents

Age	N	Ad0	Ad1	Ad2
7	52	100		
8	59	100		
9	93	100		
10	60	100		
11	68	100		
12	58	86,20	13,79	
13	63	64,07	34,92	
14	81	28,39	62,72	8,17
15	61	19,67	72,13	9,10
16	52		57,69	42,3
17	52		7,69	92,3

It is known that in *girls* the puberty starts and finishes earlier than in boys. It was also proved by the analysis of our results.

The development of **mammary glands** (Ma) (Table 9) is one of the main characteristics of sexual development in girls. The average age of the first phase development – Ma1 is 9years and 7months. The first cases of appearance of Ma1 were registered yet in 8-year-old girls (10,52%). The highest percentage of girls with Ma1 can be seen in 11-year-olds (50%), and in 13-year-olds it is only 3,5%. The second phase of development of this characteristic – Ma2 appears on the average at 11years and 2months. After the 15th year they were not registered cases with a second phase of development of the breast gland. The third phase of mammary glands development – Ma3 appears on the average of 13years and 1month and the first cases were found in 11-year-old girls (2,7%). The highest frequency of occurrence of Ma3 is in girls at the age of 15 years – 73,17%. In the group of the 17-year-olds there are 1,47% with this phase of development. The average age of appearance of the last phase of development of this characteristic – Ma4 is 14years and 10months, and the first cases were recorded yet in 12-year-old girls (3,33%).

Table 9. Development of the mammary glands and pubis hair growing - % of investigated children and adolescents

Age	N	Ma0	Ma1	Ma2	Ma3	Ma4	Pu0	Pu1	Pu2	Pu3
7	51	100					100			
8	57	89,47	10,52				91,22	8,77		
9	76	65,38	34,21				69,73	30,26		
10	84	36,9	39,28	23,8			15,47	66,66	17,85	
11	74	16,21	50	31,08	2,7		12,16	66,21	21,62	
12	60	3,33	31,66	53,33	8,33	3,33	6,66	50	31,66	11,66
13	57		3,5	54,38	33,33	8,77		8,77	63,15	28,08
14	84			34,52	45,23	20,23			63,09	36,9
15	82			1,21	73,17	25,6			19,2	80,8
16	88				19,31	80,68			1,27	98,72
17	68				1,47	98,52				100

The average age of appearance of the first phase of **pubis hair growing** development (**Pu1**) (Table 9) is 9years and 7months, and the first cases were recorded yet in 8-year-old girls (8,77%). Ru1 is the most widely spread in 10- and 11-year-old children. The second phase of this characteristic development Pu2 appears on the average at 11years and 10months. The first cases were recorded in 10-year-old girls (17,85%), and after this age the percentage increases and it reaches its maximum in 13-14-year-olds and then it decreases and at the age of 17 there are no girls with a second phase of pubis hair growing. The final third phase (Pu3) of hair growing development starts on the average at 14years and 2months.

Table 10. Development of the axilla and corporal hair growing - % of investigated children

Age	N	Ax0	Ax1	Ax2	Ax3	T0	T1	T2
7	51	100				100		
8	57	100				100		
9	76	89,47	10,52			94,73	5,26	
10	84	57,14	28,47	14,28		72,61	27,38	
11	74	44,59	37,83	17,56		59,45	40,54	
12	60	33,33	36,66	25	5	38,33	60	1,66
13	57	3,5	28,07	47,36	19,29	19,29	73,68	7,01
14	84		1,19	77,38	21,48	11,9	54,76	33,33
15	82			12,19	87,8	3,65	48,78	47,56
16	88			10,18	89,82		10,2	89,77
17	68			4,41	95,58		1,47	98,52

Table 11. Presence or absence of menarche (%)

Age	N	“+”	“-”
7	51	0	100
8	57	0	100
9	76	0	100
10	84	0	100
11	74	14,86	85,13
12	60	28,33	71,66
13	57	82,45	17,54
14	84	91,66	8,33
15	82	100	0
16	88	100	0
17	68	100	0

The beginning of hair growing in the **axilla** (Ah1) (Table 10) appears on the average at 10years and 9months, and the first cases were recorded in 9-year-old girls (10,52%). The average age of appearance of the second phase of this characteristic development (Ah2) is 11years and 11months. Ah2 was registered for the first time in 10-year-old girls (14,28%), and after this age its frequency of occurrence increases and reaches its maximum in the 14th year (77,38%). The final third phase (Ah3) of the characteristic development starts on the average at 14years and 4months, and it was re-

corded for the first time in 12-year-old girls (5%). The average ages of beginning of the different phases of development of **corporal hair growing** (T) are (Table 10): for T1 – 11years and 8months; for T2 – 14years and 8months. 5,26% of the 9-year-old girls are in the first phase of corporal hair growing (table 3). The highest frequency of occurrence of T1 is in 13-year-olds (73,68%), and after this age the percentage gradually decreases and it is only 1,47% in 17-year-olds. At the second phase (T2) the first cases were registered in the group of 12-year-old girls (1,66%), and the highest percentage of children with this phase of development are 17-year-olds – 98,52%.

The average age of menarche appearance in the girls observed is 12years and 3months (Table 11).

From the detailed characteristic analysis done on the development of secondary sexual features in boys and girls and the average ages (Table 12, 13) of reaching the different puberty phases we can follow the dynamics of their development in boys and girls at the age from 7 to 17 years.

Table 12. Average age of the development of secondary sexual features of boys

Boys	Pubis hair growing	Hair growing in the axilla	Penis and scrotum	Puberty rise of the breast gland
Age (years, months)	Pu1 -11 and 4	Ax1 – 12 and 4	Pe1 – 10 and 8	Gr1–13 and 3
	Pu2 -12 et 11	Ax2 – 14 and 5	Pe2 – 13 and 10	Gr2–15 and 8
	Pu3-14y et 4	Ax3 – 15 and 7	Pe3 – 16	
	Pu4 -15y et 9			
	Voice mutation	The Adam's apple	Facial hair growing	Corporal hair growing
	Mu1–13 and 2	Ad1–13 and 7	L1 – 13 and 3	T1–11 and 11
	Mu2–15and 9	And2–15 and11	L2 – 16 and1	T2–16 and 3

Table 13. Average ages of the development of secondary sexual features of girls

Girls	Mammary glands	Pubis hair growing	Hair growing in the axilla	Corporal hair growing	The average age of menarche
Age (years, months)	Ma1 – 9 and 7	Pu1 – 9 and 7	Ax1 – 10 and 9	T1 – 11 and 8	12 and 3
	Ma2 – 11 and 2	Pu2 – 11 and 10	Ax2 – 11 and 11	T2 – 14 at 8	
	Ma3 – 13 and 1	Pu3 – 14 and 2	Ax3 – 14 and 4		
	Ma4 – 14 and 10				

Discussion

In Bulgaria, similar study of sexual maturation in children and adolescents was conducted in the Smolyan region by Mladenova, S., 2003. The study includes 817 girls and 777 boys. The results show that sexual maturation it begins with boys at the age or 11.25 years with the growth or pubic hair. With girls it begins with the development or the mammary glands (at age 9.85) and the growth of pubic hair (at age 9.87). The average age of the menarche is 12.77, i.e. about 3 years after the first puberty leap in the height growth, and it has decreased by 8 months for the last 15 years. The puberty of the Smolyan region is characterized by earlier start and shorter duration in comparison to that of boys.

The results of our study show that the first sign of sexual maturity in boys from the studied territorial region is the enlarging of testicles and penis (Pe1 – 10years and 8months), then it comes the pubis hair growing (Pu1 - 11g i 4m), and after that it is the start of corporal hair growing (T1 – 11years and 11months), the appearance of hair growing in the axilla (Ah1 – 12years and 4months), voice mutation (Mu1 – 13years and 2months), the beginning of breast glands swelling coincides in time with the first phase of facial hair growing (Gr = L – 13years and 3months) and the Adam's apple development is the latest (Ad1 – 13years and 7months).

In girls the puberty starts in parallel with the mammary glands development and the pubis hair growing which starts on the average at 9years and 7months, then the axillar hair growing comes (10years and 9months) and finally it is the corporal hair growing (11years and 8months). The average age of the first menstruation appearance is 12years and 3months.

Study on sexual development and sexual maturity in Bulgarian girls held Kondova, N. and Zl. Filcheva 2003. The average age of menarche onset in Sofia girls by the end of 20-th century is 12.4 years of age. The menses is of a men duration of 4.8 days and cyclic recurrence. The frequency rate of menarche is first recorder in girls from the city of Sofia is on the decline during the past century by an average of 0.25 (3 months) per decade the secular changes being at a much faster rate in the first half of the 20-th century.

With such a focus is the study of Rakić R., Božić-Krstić V., Pavlica T., 2004. They determined basic indicators of growth and development, i.e. height, body mass and the time of menarche appearance. The results have shown that menarche appear between 10 and 15 year. Most girls have menarche with 12 years (35,96 %) and with 14 year 99,12 % girls have menarche. The average age at which schoolgirls get first menarche is 12,34 +/-1,01 and medijana is 12,31 +/-0,01 year.

As a result of the data we can make the following conclusions:

On the basis of the average age of appearance of the puberty development phases we found that the duration of puberty period in girls from the South-east Rodopi mountains is 5 years and 7months, and in boys it is 5years and 11months. The sexual dimorphism with respect to the times of sexual maturity is probably due to the fact that girls get to a sexual and physical maturity which is characteristic for grown-up individuals in a shorter period of time, while boys reach this maturity much later.

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KARAKTERISTIKE POLNOG SAZREVANJA ADOLESCENATA IZ REGIONA JUGOISTOČNIH RODOPSKIH PLANINA U DOBU 7-17 GODINA

Izvod

Rezultati su pokazali da je kod dečaka prvi znak polnog sazrevanja početak uvećanja testisa i penisa (Pe1 – 10 godina i 8 meseci), a zatim je praćeno maljavošću pubične zone (P1 – 11 godina i 4 meseca), nakon toga maljavošću tela (T1 – 11 godina i 11 meseci), pojavom dlaka u pazušnoj jami (Ax1 – 12 godina i 4 meseca) i mutacijom glasa (Mu1 – 13 godina i 2 meseca). Početak uvećanja grudnih žlezda se vremenski poklapa sa prvim stepenom maljavosti lica (13 godina i 3 meseca). Adamova jabučica se najkasnije razvija (Ad1 – 13 godina i 7 meseci).

Kod devojčica, iz jugoistočnih Rodopskih Planina, pubertet počinje paralelnim razvojem mlečnih žlezda i maljavosti pubične zone sa 9 godina i 7 meseci. Zatim je pazušna maljavost (10 godina i 9 meseci), praćena maljavošću tela (11 godina i 8 meseci), dok je prosečna starost pojave menarhe 12 godina i 3 meseca.

Ključne reči: pubertet, adolescenti, menarha