Evaluating the four most important salivary pubertal sex steroids: testosterone best characterizes pubertal development

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Summary and Conclusion:

1. Among 4 pubertal male sex hormones in saliva dehydroepiandrosterone and testosterone can be recommended for characterization of puberty development
2. Testosterone seems to be best, addition of results of the other hormones do not markedly improve correlation between hormone levels and puberty development

Background: During pubertal development in healthy boys increased levels of different sex steroids occur which are responsible for sexual maturation and physical changes. Most of these hormones are detectable in saliva. However, relationships between pubertal sexual hormones in saliva and pubertal development stages have not been sufficiently studied.

Methods: The investigation included 165 normal boys (mean age 12.7 ± 2.8 years, mean body mass index 19.6 ± 4.2 kg/m^2). Pubic hair stages were stratified by Tanner and testicular volume by the Prader orchidometer. Four different sex steroids (testosterone, dehydroepiandrosterone /dehydroepiandrosterone-sulfate, androstenedione, 17-hydroxy-progesterone) were measured in saliva by immunoassay.

Results: The characterization of the investigated 165 boys is shown in table 1.Serum and saliva levels of all 4 pubertal sexual hormones significantly correlated with the pubertal stages und testicular volume, table 2. Among them, testosterone best correlated with the pubertal stages and testicular volume. The addition of the results of the remaining three hormones did not improve the correlation, table 3

Table 1 Pubic hair stages and testis volume of 165 normal boys

Boys, n	Pubic hair, stage	Testis volume, mL	Age, years	BMI, kg/m^2
72	PH1	2.5 (1.3)	10.7 (2.8)	17.4 (3.4)
19	PH2	4.6 (2.0)	13.2 (1.4)	20.7 (4.7)
20	PH3	8.2 (3.5)	13.8 (1.5)	20.7 (3.9)
25	PH4	12.2 (5.0)	13.8 (1.2)	19.7 (2.6)
29	PH5/6	17.0 (4.1)	15.2 (1.8)	23.2 (4.0)

Data are means (SD); n, number of boys; PH, pubic hair; BMI, body mass index

Table 2 Correlation of saliva and serum total steroid levels with pubic hair stages and testis volume in normal boys

Steroid	Pubic hair			Testis volume		
	n	r	p	n	r	p
17-OHP, serum	81	0.50	<0.001	81	0.52	<0.001
17-OHP, saliva	150	0.43	<0.001	149	0.42	<0.001
DHEAS, serum	81	0.50	<0.001	81	0.49	<0.001
DHEA, saliva	150	0.62	<0.001	151	0.58	<0.001
AE, serum	81	0.64	<0.001	81	0.63	<0.001
AE, saliva	150	0.45	<0.001	146	0.38	<0.001
TE, serum	81	0.71	<0.001	81	0.77	<0.001
TE, saliva	134	0.72	<0.001	143	0.74	<0.001

n, number of subjects; r, Spearman rho; 17-OHP, 17-hydroxyprogesterone; DHEA, dehydroepiandrosterone; DHEAS, DHEA-sulfate; AE, androstenedione; TE, testosterone

Table 3 Correlation between pubertal development and salivary steroids in normal boys

Variable	Model	Coefficients	Estimate	p-value	R^2
		Prepuberty to Puberty			
Testis volume	1	Intercept	0.0637	0.0000	0.4200
		DHEA	0.9990	0.4275	
		17OHP	1.0223	0.5290	
		AE	1.0068	0.3490	
		TE	1.0602	0.0000	
	2	Intercept	0.1029	0.0000	0.4100
		TE	1.0620	0.0000	
Pubic hair	1	Intercept	0.0436	0.0000	0.4400
		DHEA	1.0014	0.5490	
		17-OHP	1.0060	0.8630	
		AE	1.0107	0.2270	
		TE	1.0549	0.0000	
	2	Intercept	0.0986	0.0000	0.4100
		TE	1.0602	0.0000	
		Puberty to Postpuberty			
Testis volume	1	Intercept	0.0311	0.0000	0.2100
		DHEA	1.0020	0.2350	
		17-OHP	1.0325	0.2110	
		AE	1.0040	0.4510	
		TE	1.0098	0.1190	
	2	Intercept	0.1158	0.0000	0.1400
		TE	1.0148	0.015	
Pubic hair	1	Intercept	0.0311	0.0001	0.2000
		DHEA	1.0011	0.4797	
		17-OHP	1.0478	0.0665	
		AE	1.0068	0.0436	
		TE	1.0066	0.2677	
	2	Intercept	0.1532	0.0002	0.1000
		TE	1.0121	0.0058	

Binomial logistic regression was used for categorical variables and log estimates were transformed by exponentiation; 17-OHP, 17-hydroxyprogesterone; DHEA, dehydroepiandrosterone; AE, androstenedione; TE, testosterone

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